

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.
- B. Related Requirements:
 - 1. Section 321313 "Cement Concrete Pavement" for concrete pavement 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, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.
- 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. 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.
- E. Samples: For vapor retarders.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. 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. Curing compounds.
 - 7. Floor and slab treatments.
 - 8. Bonding agents.
 - 9. Adhesives.
 - 10. Vapor retarders.
 - 11. Semi-rigid joint filler.
 - 12. Joint-filler strips.
 - 13. Repair materials.
- C. Material Test Reports: For the following, from a qualified testing agency:
 - 1. Aggregates: Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- D. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.
- E. Field quality-control reports.

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.
- C. Testing Agency Qualifications: An independent agency, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

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

1.8 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When average 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.
- B. 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.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with the following unless modified by more stringent requirements in the Contract Documents:
 - 1. ACI 301, "Standard Specifications for Structural Concrete"
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials"
 - 3. ACI CP-1, "Technician Workbook for ACI Certification of Concrete Field Testing Technician – Grade 1."
 - 4. ACI 211.1, "Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete."
 - 5. ACI 304R, "Guide for Measuring, Mixing, Transporting and Placing Concrete."
 - 6. ACI 305R, "Hot Weather Concreting."
 - 7. ACI 306R, "Cold Weather Concreting."
 - 8. ACI 308, "Standard Practice for Curing Concrete."
 - 9. ACI 309, "Guide for Consolidation of Concrete."
 - 10. ACI 315, "Details and Detailing of Concrete Reinforcement."
 - 11. ACI 318, "Building Code Requirements for Structural Concrete and Commentary."
 - 12. ACI 544.3R, "Guide for Specifying, Proportioning, and Production of Fiber-reinforced Concrete."

2.2 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 - 1. Plywood, metal, or other approved panel materials.

- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- D. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- E. Form Ties: Factory-fabricated, removable or snap-off glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
 - 2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.
 - 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.3 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.

2.4 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, deformed unless specified otherwise, cut true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

2.5 CONCRETE MATERIALS

- A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- B. Cementitious Materials:
 - 1. Portland Cement: ASTM C 150/C 150M, Type I/II.
 - 2. Portland-Limestone Blended Hydraulic Cement: ASTM C 595/C 595M, Type IL(MS).
 - 3. Fly Ash: ASTM C 618, Class F.
 - 4. Slag Cement: ASTM C 989/C 989M, Grade 100 or 120.
 - 5. Blended Hydraulic Cement: ASTM C 595/C 595M, Type IS, portland blast-furnace slag cement.

6. Silica Fume: ASTM C 1240, amorphous silica.
- C. Normal-Weight Aggregates: ASTM C 33/C 33M, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.
 1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
- D. Air-Entraining Admixture: ASTM C 260/C 260M.
- E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
- F. Water: ASTM C 94/C 94M and potable.

2.6 FIBER REINFORCEMENT

- A. Synthetic Fiber Reinforcement: Synthetic macro-fiber reinforcing designed for use in concrete to replace welded wire reinforcement, complying with ASTM D7508 and ASTM C 1116/C 1116M, Type III, 1-1/2 inches long, self-fibrillating polyolefin.
 1. Manufacturers: Provide one of the following:
 - a. Sika Corporation, Fibermesh-650
 - b. GCP Applied Technologies (formerly Grace Construction Products), Strux 90/40
 - c. Master Builders (formerly BASF), MasterFiber MAC Matrix
 - d. Euclid Chemical Company, Tuf-Strand SF

2.7 VAPOR RETARDERS

- A. Sheet Vapor Retarder: ASTM E 1745, Class A, not less than 15 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.
- B. Vapor Retarder shall comply with the following qualities:
 1. Permeance of less than 0.1 Perms per ASTM F1249 or ASTM E 96
 2. Maintain permeance of less than 0.01 Perms after mandatory conditioning tests per ASTM E 154 Sections 8, 11, 12, and 13.
 3. Non-woven.
- C. 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. Reef Industries, Inc., Vaporguard.
 2. Stego Industries, LLC., Stego Wrap, 15 mils.

2.8 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation; Admixture Systems.
 - b. ChemMasters, Inc.
 - c. Euclid Chemical Company (The); an RPM company.
 - d. W. R. Meadows, Inc.
- F. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ChemMasters, Inc.
 - b. Euclid Chemical Company (The); an RPM company.
 - c. W. R. Meadows, Inc.

2.9 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- B. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- C. 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 IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- D. Reglets: Fabricate reglets of not less than 0.022-inch-thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

2.10 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Euclid Chemical Company (The); an RPM company; Euco Diamond Hard or a comparable product by one of the following:
 - a. W.R. Meadows, Inc.
 - 2. Locations: All areas indicated as CONC-4 on the Room Finish Schedules found within the Drawing Set.

2.11 REPAIR MATERIALS

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

2.12 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 - 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: 25 percent.
 2. Combined Fly Ash and Pozzolan: 25 percent.
 3. Slag Cement: 50 percent.
 4. Combined Fly Ash or Pozzolan and Slag Cement: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
 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, Slag Cement, 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, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
 2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a w/c ratio below 0.50.

2.13 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Footings, Foundation/Retaining Walls, and Piers: Normal-weight concrete.
1. Minimum Compressive Strength: 4500 psi at 28 days.
 2. ACI Exposure Class: F2, S1, W0, C2
 3. Maximum W/C Ratio: 0.45.
 4. Slump Limit: 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
 5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.
- B. Exterior Slabs-on-Grade and Frost Walls: Normal-weight concrete.
1. Minimum Compressive Strength: 5000 psi at 28 days.
 2. ACI Exposure Class: F3, S1, W0, C2
 3. Maximum W/C Ratio: 0.40.
 4. Minimum Cementitious Materials Content: 540 lb/cu. yd.
 5. Slump Limit: 5 inches, plus or minus 1 inch.
 6. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.
 7. Synthetic Fiber Reinforcement: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than a rate of 5.0 lb/cu. yd.
- C. Interior Slabs-on-Grade, Typical: Normal-weight concrete.
1. Minimum Compressive Strength: 4000 psi at 28 days.
 2. ACI Exposure Class: F0, S0, W0, C0
 3. Maximum W/C Ratio: 0.50.
 4. Minimum Cementitious Materials Content: 540 lb/cu. yd.

5. Slump Limit: 5 inches, plus or minus 1 inch.
6. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.
7. Synthetic Fiber Reinforcement: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than a rate of ~~53.0~~ 3.0 lb/cu. yd.

D. Interior Slabs-on-Grade, Maintenance Bay: Normal-weight concrete.

1. Minimum Compressive Strength: 5000 psi at 28 days.
2. ACI Exposure Class: F0, S0, W0, C2
3. Maximum W/C Ratio: 0.40.
4. Minimum Cementitious Materials Content: 540 lb/cu. yd.
5. Slump Limit: 5 inches, plus or minus 1 inch.
6. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.
7. Synthetic Fiber Reinforcement: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than a rate of 3.0 lb/cu. yd.

E. Interior Suspended Slabs: Normal-weight concrete.

1. Minimum Compressive Strength: 3500 psi at 28 days.
2. ACI Exposure Class: F0, S0, W0, C0
3. Maximum W/C Ratio: 0.50.
4. Minimum Cementitious Materials Content: 540 lb/cu. yd.
5. Slump Limit: 5 inches, plus or minus 1 inch.
6. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.
7. Synthetic Fiber Reinforcement: Uniformly disperse in concrete mixture at manufacturer's recommended rate based on specific project conditions, but not less than a rate of 4 lb/cu. yd.

2.14 FABRICATING REINFORCEMENT

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

2.15 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M, and furnish batch ticket information.
1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

- 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 B, 1/4 inch for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Install keyways, reglets, recesses, and the like, for easy removal.
 - 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEM INSTALLATION

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install dowels or anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.

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.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material are not 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-RETARDER INSTALLATION

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
1. Lap joints 6 inches and seal with manufacturer's recommended tape.
 2. Install under all concrete slabs-on grade.

3.5 STEEL REINFORCEMENT INSTALLATION

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

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. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-third of concrete thickness as follows:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint where indicated.

3.7 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.
- C. Before test sampling and placing concrete, water may be added at Project site, 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 is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
1. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.

2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301 and using procedures for consolidating concrete recommended by ACI 309R.
 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. Do not place concrete floors and slabs in a checkerboard sequence.
 2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 3. Maintain reinforcement in position on chairs during concrete placement.
 4. Screed slab surfaces with a straightedge and strike off to correct elevations.
 5. Level concrete, cut high areas, and fill low areas.
 6. Slope surfaces uniformly to drains where required.
 7. 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.
 8. Do not further disturb slab surfaces before starting finishing operations.

3.8 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
1. Apply float finish to surfaces to receive trowel finish and to be covered with fluid-applied or sheet waterproofing.
- 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, or another thin-film-finish coating system.
 2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:
 - a. Specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.
 3. Finish and measure surface, so gap at any point between concrete surface and an unlevelled, 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.
 - 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.

3.9 MISCELLANEOUS CONCRETE ITEM INSTALLATION

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Interior Equipment Bases and Foundations:
 - 1. Coordinate sizes and locations of concrete bases with actual equipment provided and structural typical details.
 - 2. Construct concrete bases to height indicated on the Mechanical and Electrical documents unless otherwise indicated and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated.
 - 3. Minimum Compressive Strength: 4000 psi at 28 days.
 - 4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 12-inch centers around the full perimeter of concrete base.
 - 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
 - 6. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 7. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.10 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 remainder of curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies does not interfere with bonding of floor covering used on Project.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.
4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.11 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 1. Defer joint filling until concrete has aged at least one month. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

3.12 CONCRETE SURFACE REPAIRS

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

- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar matches surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 - 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by 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.

3.13 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Inspections:
 - 1. Steel reinforcement placement.
 - 2. Headed bolts and studs.
 - 3. Verification of use of required design mixture.
 - 4. Concrete placement, including conveying and depositing.
 - 5. Curing procedures and maintenance of curing temperature.
 - 6. 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/C 172M 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.
 - 2. 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.
 - 3. Air Content: ASTM C 231/C 231M, 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.
 - 4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
 - 5. Compression Test Specimens: ASTM C 1077 and ASTM C 31/C 31M.
 - a. Cast and laboratory cure three sets of two 6 x 12 inch (six total cylinders) or three sets of three standard 4 x 8 inch (nine total cylinders) cylinder specimens for each class of concrete placed each day, not less than once per day, nor less than once for each 100 cubic yards of each concrete class placed in one day, nor less than once for each 5000 square feet of surface area for slabs and walls.
 - 6. Compressive-Strength Tests: ASTM C 1077 and ASTM C 39/C 39M; test one set of two 6 x 12 inch or one set of three 4 x 8 inch laboratory-cured specimens, based on specimen size used, one set of at 7 days and one set at 28 days. Remaining specimens shall be retained in reserve for later testing if required.
 - a. A compressive-strength test shall be the average compressive strength from a set of specimens obtained from same composite sample and tested at age indicated.
 - 7. 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.
 - 8. 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.
9. 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.
 10. 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.
 11. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

END OF SECTION 033000

SECTION 042000 - UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Concrete masonry units.
 - 2. Concrete masonry lintels.
 - 3. Mortar and grout.
 - 4. Steel reinforcing bars.
 - 5. Masonry-joint reinforcement.
 - 6. Ties and anchors.
 - 7. Embedded flashing.
 - 8. Miscellaneous masonry accessories.
- B. Products Installed but not Furnished under This Section:
 - 1. Steel lintels in unit masonry.
 - 2. Cavity wall insulation.
- C. Related Requirements:
 - 1. Section 072100 "Thermal Insulation" for cavity wall insulation.

1.3 DEFINITIONS

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For the following:
 - 1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
 - 2. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315.
 - 3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
- C. Samples for Initial Selection:

1. Weep holes/cavity vents.

D. Samples for Verification: For each type and color of the following:

1. Weep holes and cavity vents.
2. Accessories embedded in masonry.

1.5 INFORMATIONAL SUBMITTALS

A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.

1. Submittal is for information only. Receipt of list does not constitute approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.

B. Material Certificates: For each type and size of the following:

1. Masonry units.
 - a. Include data on material properties.
2. Integral water repellent used in CMUs.
3. Cementitious materials. Include name of manufacturer, brand name, and type.
4. Mortar admixtures.
5. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
6. Grout mixes. Include description of type and proportions of ingredients.
7. Reinforcing bars.
8. Joint reinforcement.
9. Anchors, ties, and metal accessories.

C. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91/C 91M for air content.
2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

D. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to TMS 602.

E. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.6 QUALITY ASSURANCE

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

1.7 MOCKUPS/ SAMPLE PANEL

- A. Sample Panel Mockup: Build Sample Panel to verify selections made under Sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 014000 "Quality Requirements" for mockups.
 - 1. Build Sample Panel for typical exterior wall in sizes and configurations as shown on the Drawings.
 - 2. Build Sample Panel facing South.
 - 3. Clean exposed faces of panels with masonry cleaner as indicated.
 - 4. Protect approved sample panel from the elements with weather-resistant membrane. Remove and dispose of Sample Panel prior to Substantial Completion.
 - 5. Approval of Sample Panel is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.
 - a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless Architect specifically approves such deviations in writing.

1.8 DELIVERY, STORAGE, AND HANDLING

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

1.9 FIELD CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 - 1. Extend cover a minimum of 48 inches down both sides of walls, and hold cover securely in place.

2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 48 inches down face next to unconstructed wythe, and hold cover in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 2. Protect sills, ledges, and projections from mortar droppings.
 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602.
 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.2 PERFORMANCE REQUIREMENTS

- A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.
 1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to TMS 602.

2.3 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602, except as modified by requirements in the Contract Documents.
- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.

2.4 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
 - 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
 - 2. Provide bullnose units for outside corners unless otherwise indicated.
- B. CMUs: ASTM C 90.
 - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2000 psi.
 - 2. Density Classification: Normal weight.
 - 3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
- C. Spilt-Face CMU:
 - 1. Provide products by York Building Products or equivalent. Basis-of-Design to be Standard Series, quick ship, sandstone.
- D. Ground-Face CMU:
 - 1. Provide products by York Building Products, Basis-of-Design to be Gemstone Standard Series, Mist.
- E. Insulated CMU:
 - 1. Provide products by York Building Products, Basis-of-Design to be Standard CMU with Hi-R Korfil inserts R-9.5 min, Gemstone Standard Series, Mist.

2.5 MASONRY LINTELS

- A. General: Provide lintels as indicated in contract documents.
- B. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.
- C. Precast Concrete Lintels: Provide as indicated on contract documents for opening sizes indicated.
- D. Steel Lintels: Provide as indicated on contract documents for opening sizes indicated.

2.6 REINFORCEMENT

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

2.7 TIES AND ANCHORS

- A. General: Ties and anchors shall extend at least 1-1/2 inches into veneer but with at least a 5/8-inch cover on outside face.
- B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
 - 1. Mill-Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M, with ASTM A 641/A 641M, Class 1 coating.
 - 2. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M, with ASTM A 153/A 153M, Class B-2 coating.
 - 3. Galvanized-Steel Sheet: ASTM A 653/A 653M, Commercial Steel, G60 zinc coating.
 - 4. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
- C. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
 - 1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.060-inch-thick steel sheet, galvanized after fabrication.
 - 2. Tie Section: Triangular-shaped wire tie made from 0.187-inch diameter, hot-dip galvanized steel wire.
- D. Adjustable Masonry-Veneer Anchors:
 - 1. General: Provide anchors that allow vertical adjustment but resist a 100-lbf load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of 1/16 inch.

2. Fabricate sheet metal anchor sections and other sheet metal parts from 0.0785-inch-thick steel sheet, galvanized after fabrication.
3. Fabricate wire ties from 0.187-inch- diameter, hot-dip galvanized-steel wire unless otherwise indicated.

2.8 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:

1. Stainless Steel: ASTM A 240/A 240M or ASTM A 666, Type 304, 0.016 inch thick.
2. Fabricate continuous flashings in sections 96 inches long minimum but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.
3. Fabricate through-wall metal flashing embedded in masonry from stainless steel.
 - 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) Hohmann & Barnard, Inc.
4. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.
5. Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
6. Fabricate metal expansion-joint strips from stainless steel to shapes indicated.
7. Solder metal items at corners.
 - a. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.

B. Application: Unless otherwise indicated, use the following:

1. Where flashing is indicated to receive counterflashing, use metal flashing.
2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing.
4. Where flashing is fully concealed, use metal flashing.

C. Solder and Sealants for Sheet Metal Flashings:

1. Solder for Stainless Steel: ASTM B 32, with acid flux of type recommended by stainless-steel sheet manufacturer.
2. Elastomeric Sealant: ASTM C 920, chemically curing silicone sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and remain watertight.

D. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

- E. Termination Bars for Flexible Flashing: Stainless-steel sheet 0.019 inch by 1-1/2 inches with a 3/8 inch sealant flange at top.

2.9 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene or urethane.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D 226/D 226M, Type I (No. 15 asphalt felt).
- D. Weep/Cavity Vent Products: Use one of the following unless otherwise indicated:
 - 1. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch less than depth of outer wythe; in color selected from manufacturer's standard.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) CavClear/Archovations, Inc.
 - 2) Mortar Net Solutions.
- E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CavClear/Archovations, Inc.
 - b. Mortar Net Solutions.
 - 2. Configuration: Provide one of the following:
 - a. Strips, full depth of cavity and 10 inches high, with dovetail-shaped notches 7 inches deep that prevent clogging with mortar droppings.

2.10 MASONRY CLEANERS

- A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
 - 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. Diedrich Technologies, Inc.; a Hohmann & Barnard company.
- b. EaCo Chem, Inc.
- c. PROSOCO, Inc.

2.11 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
 - 1. Do not use calcium chloride in mortar or grout.
 - 2. Use portland cement-lime mortar unless otherwise indicated.
 - 3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
 - 1. For masonry below grade or in contact with earth, use Type M.
 - 2. For reinforced masonry, use Type S.
 - 3. For interior nonload-bearing partitions (not shown on structural drawings), Type N may be used instead of Type S.
 - 4. For exterior masonry veneer above grade, use Type N.
- D. Grout for Unit Masonry: Comply with ASTM C 476.
 - 1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602 for dimensions of grout spaces and pour height.
 - 2. Proportion grout in accordance with ASTM C 476, paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
 - 3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 EXAMINATION

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

- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- B. Build chases and recesses to accommodate items specified in this and other Sections.
- C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.
- D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.

3.3 TOLERANCES

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

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Lay concealed masonry with all units in a wythe in running bond. Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- F. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.
- G. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
- H. Build any non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated, providing vertical deflection gap at top of partitions as indicated in the Drawing Set. Refer to drawings for top of wall bracing requirements.

3.5 MORTAR BEDDING AND JOINTING

A. Lay CMUs as follows:

1. Bed face shells in mortar and make head joints of depth equal to bed joints.
2. Bed webs in mortar in all courses of piers, columns, and pilasters.
3. Bed webs in mortar in grouted masonry, including starting course on footings.
4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.

5. Fully bed units and fill cells with mortar at anchors and ties as needed to fully embed anchors and ties in mortar.
- B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.
- E. Cut joints flush where indicated to receive waterproofing, cavity wall insulation, or air barriers unless otherwise indicated.

3.6 CAVITY WALLS

- A. Bond wythes of cavity walls together as follows:
 1. Masonry-Joint Reinforcement: Installed in horizontal mortar joints.
- B. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.
- C. Installing Cavity Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.
 1. Fill cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.

3.7 ANCHORED MASONRY VENEERS

- A. Anchor masonry veneers to wall framing and concrete and masonry backup with masonry-veneer anchors to comply with the following requirements:
 1. Fasten screw-attached anchors through sheathing to wall framing and to concrete and masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
 2. Embed tie sections, connector sections, and continuous wire in masonry joints.
 3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
 4. Space anchors as indicated, but not more than 18 inches o.c. vertically and 24 inches o.c. horizontally, with not less than one anchor for each 2 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 8 inches, around perimeter.

3.8 MASONRY-JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
 - 1. Space reinforcement not more than 16 inches o.c.
 - 2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
 - 3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. At intersections of exterior and bearing walls shown on structural drawings:
 - 1. Provide continuity at wall intersections by using prefabricated T-shaped units.
 - 2. Provide continuity at corners by using prefabricated L-shaped units.
- D. At any intersection of interior non-bearing walls (including to exterior and bearing walls):
 - 1. Provide continuity at wall intersections by using prefabricated T-shaped units or by means of Rigid Anchors intended for intersecting masonry walls spaced at 4-feet on center vertically.
 - 2. Provide continuity at corners by using prefabricated L-shaped units or by means of Rigid Anchors intended for intersecting masonry walls spaced at 4-feet on center vertically.

3.9 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

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

3.10 CONTROL AND EXPANSION JOINTS

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

C. Form expansion joints in brick as follows:

1. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Section 079200 "Joint Sealants."

3.11 LINTELS

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

3.12 FLASHING, WEEP HOLES, AND CAVITY VENTS

- A. General: Install embedded flashing and weep holes in masonry at lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install cavity vents at, ledges, and other obstructions to upward flow of air in cavities, and where indicated.
- B. Install flashing as follows unless otherwise indicated:
 1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape, as recommended by flashing manufacturer.
 2. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 8 inches, and through inner wythe to within 1/2 inch of the interior face of wall in exposed masonry. Where interior face of wall is to receive furring or framing, carry flashing completely through inner wythe and turn flashing up approximately 2 inches on interior face.
 3. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
 4. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.
- C. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.
- D. Install weep holes in exterior wythes and veneers in head joints of first course of masonry immediately above embedded flashing.
 1. Use specified weep/cavity vent products to form weep holes.
 2. Spaces weep holes 32 inches o.c. unless otherwise indicated.
- E. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.
- F. Install cavity vents in head joints in exterior wythes at spacing indicated. Use specified weep/cavity vent products to form cavity vents.

3.13 REINFORCED UNIT MASONRY INSTALLATION

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

3.14 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
- B. Inspections: Special inspections according to Level 2 Quality Assurance in TMS 602.
 - 1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
 - 2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
 - 3. Place grout only after inspectors have verified proportions of site-prepared grout.
- C. Testing Prior to Construction: One set of tests.
- D. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.
- E. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.

3.15 REPAIRING, POINTING, AND CLEANING

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

construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

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

3.16 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site. Retain "Waste Disposal as Fill Material" Paragraph below if clean masonry waste can be used as fill in footing trenches, etc. This diverts some material from waste stream, conserving landfill space and energy required to haul waste away.

END OF SECTION 042000

SECTION 047200 - CAST STONE MASONRY

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. Cast-stone, including the following:
 - a. Belt courses/ horizontal building banding.

- B. Related Sections:

- 1. Section 042000 "Unit Masonry" for installing cast-stone units in unit masonry.

- C. DEFINITIONS

- 1. Cast Stone: A refined architectural concrete building unit manufactured to simulate natural cut stone, used in Division 4 masonry applications, produced by the Dry Cast Method and meets ASTM 1364 requirements.
 - 2. Dry Cast Method: Manufactured from zero slump concrete.
 - 3. Vibrant Dry Tamp (VDT) casting method: Vibratory ramming of earth moist, zero-slump concrete against a rigid mold until it is densely compacted.
 - 4. Machine Casting Method: Manufactured from earth moist, zero-slump concrete compacted by machinery using vibration and pressure against a mold until it becomes densely consolidated.

1.3 ACTION SUBMITTALS

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

- 1. For cast-stone units, include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

- B. SUBMITTAL PROCEDURES

- 2. Samples: Submit pieces of the Cast Stone that are representative of the general range of finish and color proposed to be furnished for the project.
 - 3. Test Results: Submit manufacturer's test results of Cast Stone previously made by the manufacturer.
 - 4. Shop Drawings: Submit manufacturer's shop drawings including profiles, cross-sections, reinforcement, exposed faces, arrangement of joints (optional for standard or semi-

custom installations), anchoring methods, anchors (if required), annotation of stone types and their location. Include building elevations showing layout of units and locations of joints and anchors. For cast-stone units, include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

5. Warranty: Submit Cast Stone Institute Member Limited Warranty.
 6. Certification: Submit valid Cast Stone Institute Plant Certification and Product Data for each type of product.
- C. Samples for Initial Selection: For colored mortar.
- D. Samples for Verification:
1. For each color and texture of cast stone required, 10 inches square in size.
 2. For each trim shape required, 10 inches in length.
 3. For colored mortar, make Samples using same sand and mortar ingredients to be used on Project.
- E. Full-Size Samples: For each size of building veneer unit required.
1. Make available for Architect's review at Project site.
 2. Make Samples from materials to be used for units used on Project immediately before beginning production of units for Project.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer and testing agency.
1. Include copies of material test reports for completed projects, indicating compliance of cast stone with ASTM C 1364.
- B. Material Test Reports: For each mix required to produce cast stone, based on testing according to ASTM C 1364, including test for resistance to freezing and thawing.
1. Provide test reports based on testing within previous two years.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
1. Cast Stone shall be produced in a plant certified by the Cast Stone Institute.
 2. Manufacturer shall have sufficient plant facilities to produce shapes, quantities and size of Cast Stone required in accordance with the project schedule.
 3. Manufacturer shall submit a written list of projects similar in scope and at least ten (10) years of age, along with owner, architect, and contractor references.
- B. Standards: Comply with requirements of Cast Stone Institute Technical Manual and the project specifications. Where a conflict may occur, the contract documents shall prevail.
- C. Warranty Period: 10 years.

- D. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- E. Mockups: Furnish cast stone for installation in mockups specified in Section 042000 "Unit Masonry."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Coordinate delivery of cast stone with unit masonry work to avoid delaying the Work.
- B. Pack, handle, and ship cast-stone units in suitable packs or pallets.
 - 1. Lift with wide-belt slings; do not use wire rope or ropes that might cause staining. Move cast-stone units if required, using dollies with wood supports.
 - 2. Store cast-stone units on wood skids or pallets with nonstaining, waterproof covers, securely tied. Arrange to distribute weight evenly and to prevent damage to units. Ventilate under covers to prevent condensation.
- C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- D. Store mortar aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

1.7 PROJECT CONDITIONS

- A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Comply with cold-weather construction requirements in TMS 602/ACI 530.1/ASCE 6.
 - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until cast stone has dried, but no fewer than seven days after completing cleaning.
- B. Hot-Weather Requirements: Comply with hot-weather construction requirements in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Cast Stone: Obtain cast-stone units from single source from single manufacturer.
 - 1. Basis of Design Manufacturer: Sun Precast Co.
- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color, from one manufacturer for each cementitious component and from one source or producer for each aggregate.

2.2 ARCHITECTURAL CAST-STONE

A. General: Comply with ASTM C 1364.

1. Casting Method: Vibrant Dry Tamp; Machine Produced
2. Compressive Strength: ASTM C 1194: 6,500 psi minimum for products at 28 days.
3. Absorption: ASTM C 1195: 6 percent maximum by the cold water method, or 10% maximum by the boiling method for products at 28 days.
4. Freeze-thaw: ASTM C 1364: The CPWL shall be less than 5% after 300 cycles of freezing and thawing.
5. Linear Shrinkage, ASTM C 426: Shrinkage shall not exceed 0.065%.

2.3 CAST-STONE MATERIALS

- A. Portland Cement: ASTM C 150/C 150M, Type I or Type III, containing not more than 0.60 percent total alkali when tested according to ASTM C 114. Provide natural color or white cement as required to produce cast-stone color indicated.
- B. Coarse Aggregates: Granite, quartz, or limestone complying with ASTM C 33/C 33M; gradation and colors as needed to produce required cast-stone textures and colors.
- C. Fine Aggregates: Natural sand or crushed stone complying with ASTM C 33/C 33M, gradation and colors as needed to produce required cast-stone textures and colors.
- D. Pigments: ASTM C 979, inorganic iron oxides.
- E. Admixtures: ASTM C 494, Integral water repellants and other chemicals for which no ASTM standard exists. Previously established as suitable for use in concrete by proven field performance or through laboratory testing.
- F. Water: Potable.
- G. Reinforcing Bars: ASTM A 615/A 615M, galvanized or epoxy coated.
- H. All anchors, dowels and other anchoring devices and shims shall be standard building stone anchors commercially available in stainless steel Type 302 or 304.

2.4 CAST-STONE UNITS

- A. Cast-Stone Units: Comply with ASTM C 1364.
 1. Units shall be resistant to freezing and thawing as determined by laboratory testing according to ASTM C 666/C 666M, Procedure A, as modified by ASTM C 1364.
- B. Fabricate units with sharp arris and accurately reproduced details, with indicated texture on all exposed surfaces unless otherwise indicated.
 1. Slope exposed horizontal surfaces 1:12 to drain unless otherwise indicated.
 2. Provide raised fillets at backs of sills and at ends indicated to be built into jambs.
 3. Provide drips on projecting elements unless otherwise indicated.

- C. All surfaces intended to be exposed to view shall have a fine-grained texture similar to natural stone, with no air voids in excess of 1/32 in. and the density of such voids shall be less than 3 occurrences per any 1 in.² and not obvious under direct daylight illumination at a 5 ft. distance.
- D. Units shall exhibit a texture approximately equal to the approved sample when viewed under direct daylight illumination at a 10 ft. distance.
- E. ASTM D 2244 permissible variation in color between units of comparable age subjected to similar weathering exposure.
 - 1. Total color difference: Not greater than 6 units.
 - 2. Total hue difference: Not greater than 2 units.
- F. Minor chipping resulting from shipment and delivery shall not be grounds for rejection. Minor chips shall not be obvious under direct daylight illumination from a 20 ft. distance.
- G. The occurrence of crazing or efflorescence shall not constitute a cause for rejection.
- H. Remove cement film, if required, from exposed surfaces prior to packaging for shipment.
- I. Fabrication Tolerances:
 - 1. Variation in Cross Section: Do not vary from indicated dimensions by more than 1/8 inch.
 - 2. Variation in Length: Do not vary from indicated dimensions by more than 1/360 of the length of unit or 1/8 inch, whichever is greater, but in no case by more than 1/4 inch.
 - 3. Warp, Bow, and Twist: Not to exceed 1/360 of the length of unit or 1/8 inch, whichever is greater.
 - 4. Location of Grooves, False Joints, Holes, Anchorages, and Similar Features: Do not vary from indicated position by more than 1/8 inch on formed surfaces of units and 3/8 inch on unformed surfaces.
- J. Cure Units as Follows:
 - 1. Cure Cast Stone components with a direct fired vapor generator at a minimum temperature of 105 degrees F (41 degrees C) for a minimum of 6 hours within 12 hours of fabrication.
 - 2. Cure Cast Stone components in presence of carbon monoxide and carbon dioxide to promote carbonation at surface, to minimize efflorescence.
- K. Colors and Textures: Sandstone, smooth.
- L. Sizes: 24" long x 8" high x 4" thick (nominal) for belt course/ banding as indicated within the Drawing Set.

2.5 MORTAR MATERIALS

- A. Provide mortar materials that comply with Section 042000 "Unit Masonry."

2.6 ACCESSORIES

- A. Anchors: Type and size indicated, fabricated from Type 304 stainless steel complying with ASTM A 240/A 240M, ASTM A 276.

- B. Dowels: 1/2-inch- diameter round bars, fabricated from Type 304 stainless steel complying with ASTM A 240/A 240M, ASTM A 276.
- C. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cast-stone manufacturer and expressly approved by cleaner manufacturer for use on cast stone and adjacent masonry materials.

2.7 MORTAR MIXES

- A. Comply with requirements in Section 042000 "Unit Masonry" for mortar mixes.
- B. Do not use admixtures including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
 - 1. Do not use calcium chloride in mortar or grout.
 - 2. Use portland cement-lime mortar unless otherwise indicated.
- C. Comply with ASTM C 270, Proportion Specification.
 - 1. For setting mortar, use Type N.
 - 2. For pointing mortar, use Type N.
- D. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.
 - 1. Pigments shall not exceed 10 percent of portland cement by weight.
 - 2. Mix to match Architect's sample.
 - 3. Application: Use pigmented mortar for exposed mortar joints.
- E. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.
 - 1. Mix to match Architect's sample.
 - 2. Application: Use colored-aggregate mortar for exposed mortar joints.

2.8 SOURCE QUALITY CONTROL

- A. Engage a qualified independent testing agency to sample and test cast-stone units according to ASTM C 1364.
 - 1. Include one test for resistance to freezing and thawing.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, 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 SETTING CAST STONE IN MORTAR

- A. Install cast-stone units to comply with requirements in Section 042000 "Unit Masonry."
- B. Set cast stone as indicated on Drawings. Set units accurately in locations indicated, with edges and faces aligned according to established relationships and indicated tolerances.
 - 1. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure units in place.
 - 2. Coordinate installation of cast stone with installation of flashing specified in other Sections.
- C. Wet joint surfaces thoroughly before applying mortar or setting in mortar.
- D. Set units in full bed of mortar with full head joints unless otherwise indicated.
 - 1. Set units with joints 3/8 inch wide unless otherwise indicated.
 - 2. Build anchors and ties into mortar joints as units are set.
 - 3. Fill dowel holes and anchor slots completely with mortar.
 - 4. Build concealed flashing into mortar joints as units are set.
 - 5. Keep head joints in copings and between other units with exposed horizontal surfaces open to receive sealant.
 - 6. Keep joints at shelf angles open to receive sealant.
- E. Tool exposed joints slightly concave when thumbprint hard. Use a smooth plastic jointer larger than joint thickness.
- F. Provide sealant joints at head joints of copings and other horizontal surfaces; at expansion, control, and pressure-relieving joints; and at locations indicated.
 - 1. Keep joints free of mortar and other rigid materials.
 - 2. Build in compressible foam-plastic joint fillers where indicated.
 - 3. Form joint of width indicated, but not less than 3/8 inch.
 - 4. Prime cast-stone surfaces to receive sealant and install compressible backer rod in joints before applying sealant unless otherwise indicated.
 - 5. Prepare and apply sealant of type and at locations indicated to comply with applicable requirements in Section 079200 "Joint Sealants."

3.3 INSTALLATION TOLERANCES

- A. Variation from Plumb: Do not exceed 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
- B. Variation from Level: Do not exceed 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
- C. Variation in Joint Width: Do not vary joint thickness more than 1/8 inch in 36 inches or one-fourth of nominal joint width, whichever is less.

- D. Variation in Plane between Adjacent Surfaces (Lipping): Do not vary from flush alignment with adjacent units or adjacent surfaces indicated to be flush with units by more than 1/16 inch, except where variation is due to warpage of units within tolerances specified.

3.4 ADJUSTING AND CLEANING

- A. Remove and replace stained and otherwise damaged units and units not matching approved Samples. Cast stone may be repaired if methods and results are approved by Architect.
- B. Replace units in a manner that results in cast stone matching approved Samples, complying with other requirements, and showing no evidence of replacement.
- C. In-Progress Cleaning: Clean cast stone as work progresses.
 - 1. Remove mortar fins and smears before tooling joints.
 - 2. Remove excess sealant immediately, including spills, smears, and spatter.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed cast stone as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 2. Test cleaning methods on sample; leave one sample uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of cast stone.
 - 3. Protect adjacent surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 - 4. Wet surfaces with water before applying cleaners; remove cleaners promptly by rinsing thoroughly with clear water.
 - 5. Clean cast stone by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
 - 6. Clean cast stone with proprietary acidic cleaner applied according to manufacturer's written instructions.

3.5 INSPECTION AND ACCEPTANCE

- A. Inspect in accordance with the Cast Stone Institute Technical Bulletin #36

END OF SECTION 047200

SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Interior non-load bearing wall framing.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
 - 2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
- C. Delegated-Design Submittal: For cold-formed steel framing signed and sealed by the qualified professional engineer responsible for its preparation, licensed in the state of the project.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Welding certificates.
- C. Product Certificates: For each type of code-compliance certification for studs and tracks.
- D. Product Test Reports: For each listed product, for tests performed by a qualified testing agency.
 - 1. Steel sheet.
 - 2. Expansion anchors.
 - 3. Power-actuated anchors.
 - 4. Mechanical fasteners.
 - 5. Vertical deflection clips.
 - 6. Horizontal drift deflection clips
 - 7. Miscellaneous structural clips and accessories.

- E. Evaluation Reports: For nonstandard cold-formed steel framing post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- B. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.
- C. 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 or the Steel Stud Manufacturers Association.
- D. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- 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. ClarkDietrich Building Systems.
 - 2. MarinoWARE.
 - 3. The Steel Network, Inc.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel framing.
- B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.
 - 1. Minimum Design Loads: Weight of finish materials, equipment/fixtures and associated loads supported, and minimum 5 psf horizontal load in accordance with IBC 1607.15 or to meet minimum requirements noted below.
 - 2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
 - a. Interior Non-Load-Bearing Framing: Horizontal deflection of 1/240 of the unbraced wall height under a horizontal load of 5 lbf/sq. ft.

3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
 - a. Upward and downward movement of primary building structure of L/360 for floor framing and L/240 for roof framing.
- C. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing shall comply with AISI S100, AISI S200, and the following:
 1. Floor and Roof Systems: AISI S210.
 2. Wall Studs: AISI S211.
 3. Headers: AISI S212.
- D. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency acceptable to authorities having jurisdiction.

2.3 INTERIOR 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: 0.0329 inch (20 gauge).
 2. Minimum Flange Width: 1-3/8 inches.
 3. Section Properties: As required by design.
- 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: 0.0329 inch (20 gauge).
 2. Minimum Flange Width: 1-1/4 inches.
- C. Vertical Deflection Clips: Manufacturer's standard bypass or head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
- D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
 1. Minimum Base-Metal Thickness: 0.0329 inch (20 gauge).
 2. Minimum Flange Width: 1 inch plus the design gap.
- E. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.4 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation 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. Gusset plates.
 - 7. Stud kickers and knee braces.
 - 8. Joist hangers and end closures.
 - 9. Hole-reinforcing plates.
 - 10. Backer plates.

2.5 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. 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-ES AC01, ICC-ES AC193, ICC-ES AC58, or ICC-ES AC308 as appropriate for the substrate.
 - 1. Uses: Securing cold-formed steel framing to structure.
 - 2. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
 - 3. Material for Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 or Group 2 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.
- 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. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
 - 1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.
- E. Welding Electrodes: Comply with AWS standards.

2.6 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: ASTM A 780/A 780M or SSPC-Paint 20.

- B. Cement Grout: Portland cement, ASTM C 150/C 150M, 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: Factory-packaged, nonmetallic, noncorrosive, nonstaining grout, complying with ASTM C 1107/C 1107M, and with a fluid consistency and 30-minute working time.
- D. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.
- 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 as required.

2.7 FABRICATION

- A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
 - 1. Fabricate framing assemblies using jigs or templates.
 - 2. Cut framing members by sawing or shearing; do not torch cut.
 - 3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, with screws penetrating joined members by no fewer than three exposed screw threads.
 - 4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies by means that prevent damage or permanent distortion.
- C. Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable 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 steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, conditions, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

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

3.2 PREPARATION

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

3.3 INSTALLATION, GENERAL

- A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
 - 1. Cut framing members by sawing or shearing; do not torch cut.
 - 2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.
- D. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- E. Install temporary bracing and supports to secure framing and support loads equal 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.
- F. Install insulation, specified in Section 072100 "Thermal Insulation," in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- G. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

3.4 INTERIOR NON-LOAD-BEARING WALL INSTALLATION

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.
- B. Fasten both flanges of studs to bottom track unless otherwise indicated. Space studs as follows:
 - 1. Stud Spacing: As required by design with maximum spacing as indicated on Drawings.

- C. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support as indicated on Drawings or on Shop Drawings.
- E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.
 - 1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
 - 2. Strap 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.
 - 3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
 - 1. Install solid blocking at centers indicated on Shop Drawings.
- G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 ERECTION TOLERANCES

- A. Install cold-formed steel 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.

3.6 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. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.7 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780/A 780M and manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood products.
2. Dimension lumber framing.
3. Miscellaneous lumber.

B. Related Requirements:

1. Section 061600 "Sheathing"
2. Section 061753 "Shop-Fabricated Wood Trusses"

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 size or greater but less than 5 inches nominal size in least dimension.
- C. Exposed Framing:** Framing not concealed by other construction.
- D. Lumber grading agencies, and abbreviations used to reference them, include the following:**
1. NeLMA: Northeastern Lumber Manufacturers' Association.
 2. NLGA: National Lumber Grades Authority.
 3. SPIB: The Southern Pine Inspection Bureau.

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. 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. Material Certificates:

1. For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

B. Reports: For the following, from ICC-ES:

1. Wood-preservative-treated wood.

2. Power-driven fasteners.
3. Post-installed anchors.
4. Metal framing anchors.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products 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

- A. Lumber: Comply with DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 1. Factory mark each piece of lumber with grade stamp of grading agency.
 2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry wood products.
 3. Dress lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content:
 1. Boards: 19 percent.
 2. Dimension Lumber: 19 percent unless otherwise indicated.

2.2 DIMENSION LUMBER FRAMING

- A. Joists, Rafters, and Other Framing by Grade: No. 2 or better grade.
 1. Species:
 - a. Southern pine; SPIB.
 - b. Spruce-pine-fir; NLGA.

2.3 MISCELLANEOUS LUMBER

- A. Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 1. Blocking.
 2. Nailers.
 3. Cants.
 4. Furring.
 5. Grounds.

- B. Dimension Lumber Items: Construction or No. 2 grade lumber of any of the following species:
 - 1. Mixed southern pine or southern pine; SPIB.
 - 2. Spruce-pine-fir; NLGA.
- C. Roofing Nailers: Structural- or No. 2-grade lumber or better; kiln-dried Douglas fir, southern pine, or wood having similar decay-resistant properties.
- 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 furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.4 PLYWOOD BACKING PANELS

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

2.5 FASTENERS

- A. General: Fasteners are to be of size and type indicated and comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches into wood substrate.
 - 1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M or ASTM F2329.
- 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. 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.

2.6 METAL FRAMING ANCHORS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Simpson Strong-Tie Co., Inc.
- B. Allowable design loads, as published by manufacturer, shall meet or exceed those of products of manufacturers listed. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.

- C. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.
 - 1. Use for interior locations unless otherwise indicated.
- D. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A 653/A 653M; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 coating designation; and not less than 0.036 inch thick.
 - 1. Use for wood-preservative-treated lumber and where indicated.
- E. Stainless-Steel Sheet: ASTM A 666, Type 316.
 - 1. Use for exterior locations and where indicated.
- F. Rafter Tie-Downs (Hurricane or Seismic Ties): Bent strap tie for fastening rafters or roof trusses to top plates or wall studs below, refer to Structural drawings for type and size.
- G. Other metal framing fasteners: Refer to Structural drawings for type and size.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- C. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- D. Do not splice structural members between supports unless otherwise indicated.
- E. 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.
- F. 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.
- G. Comply with AWP A 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.

- H. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- I. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. Table 2304.10.1, "Fastening Schedule," in ICC's International Building Code (IBC).
 - 2. ICC-ES evaluation report for fastener.
- J. 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 INSTALLATION OF WOOD BLOCKING AND NAILERS

- 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 wood blocking to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.
- C. Attach wood roofing nailers securely to substrate to resist the designed outward and upward wind loads indicated on Drawings and in accordance with ANSI/SPRI ED-1, Tables A6 and A7.

END OF SECTION 061000

SECTION 061600 - SHEATHING

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. Wall and gable end sheathing.
 - 2. Roof sheathing.
- B. Related Requirements:
 - 1. Section 061000 "Rough Carpentry" for plywood backing panels.
 - 2. Section 072726 "Fluid-Applied Membrane Air Barriers" for water-resistive barrier applied over wall sheathing.

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-preserved treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies 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 plywood complies with requirements. Include physical properties of treated materials.
 - 3. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5516.
 - 4. For products receiving 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. Fire-retardant-treated plywood.

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 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 PERFORMANCE REQUIREMENTS

2.2 WOOD PANEL PRODUCTS

- A. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.
- B. Factory mark panels to indicate compliance with applicable standard.

2.3 WALL AND GABLE END SHEATHING

- A. Plywood Sheathing: Exposure 1 sheathing.
 - 1. Span Rating: Not less than 32/16.
 - 2. Nominal Thickness: Not less than 1/2 inch.
- B. ZIP Sheathing: 7/16" thickness. Taped all seams.

2.4 ROOF SHEATHING (FOR AREAS NOT ACCESSIBLE TO FOOT TRAFFIC)

- A. Plywood Sheathing: Exposure 1 sheathing.
 - 1. Span Rating: Not less than 40/20.
 - 2. Nominal Thickness: Not less than 5/8 inch.

2.5 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Screws for Fastening Sheathing to Wood Framing: ASTM C 1002.

2.6 MISCELLANEOUS MATERIALS

- A. Adhesives for Field Gluing Panels to Wood Framing: Formulation complying with APA AFG-01 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

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 in drawings and 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.
 - 3. Provide blocking at all unsupported panel edges.
 - 4. Refer to structural drawings for additional wall and roof sheathing fastening requirements.
- D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.
- E. Coordinate wall and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

- A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

- B. Fastening Methods: Fasten panels as indicated in structural drawing set and as indicated below:
 - 1. Wall and Roof Sheathing not accessible to foot traffic:
 - a. Nail to wood framing and blocking as indicated in drawings. Apply a continuous bead of glue to framing members at edges of wall sheathing panels.
 - b. Space panels 1/8 inch apart at edges and ends.

END OF SECTION 061600

SECTION 061753 - SHOP-FABRICATED WOOD TRUSSES

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. Wood roof trusses.
- B. Related Requirements:

1.3 DEFINITIONS

- A. Metal-Plate-Connected Wood Trusses: Planar structural units consisting of metal-plate-connected members fabricated from dimension lumber and cut and assembled before delivery to Project site.
- B. Metal-Plate Connected Wood Gable End Trusses: Planar structural units built in the shape and manner of the other metal-plate-connected wood trusses in a package designed to resist out-of-planed wind loading. Instead of a series of interlocking triangles, they have vertical pieces set at intervals of 16 in. or 24 in. for attaching sheathing and siding to resist out-of-plane wind loading and serving as exterior wall framing to match adjacent truss profiles.

1.4 ACTION SUBMITTALS

- A. Product Data: For metal-plate connectors, metal truss accessories, and fasteners.
 - 1. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to truss fabricator.
- B. Shop Drawings: Show fabrication and installation details for trusses.
 - 1. Show location, pitch, span, camber, configuration, and spacing for each type of truss required, including gable end trusses and additional trusses utilized for hip framing (corner girders, corner jack, and end trusses), as required.
 - 2. Indicate sizes, stress grades, and species of lumber.
 - 3. Indicate locations, sizes, and materials for permanent bracing required to prevent buckling of individual truss members due to design loads.
 - 4. Indicate type, size, material, finish, design values, orientation, and location of metal connector plates.
 - 5. Show splice details and bearing details.

- C. Delegated-Design Submittal: For metal-plate-connected wood trusses indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For metal connector-plate manufacturer, professional engineer, and fabricator.
- B. Material Certificates: For dimension lumber specified to comply with minimum specific gravity. Indicate species and grade selected for each use and specific gravity.
- C. Product Certificates: For metal-plate-connected wood trusses, signed by officer of truss-fabricating firm.
- D. Evaluation Reports: For the following, from ICC-ES:
 - 1. Metal-plate connectors.
 - 2. Metal truss accessories.

1.6 QUALITY ASSURANCE

- A. Metal Connector-Plate Manufacturer Qualifications: A manufacturer that is a member of TPI and that complies with quality-control procedures in TPI 1 for manufacture of connector plates.
 - 1. Manufacturer's responsibilities include providing professional engineering services needed to assume engineering responsibility.
 - 2. Manufacturer's Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
- B. Fabricator Qualifications: Shop that participates in a recognized quality-assurance program, complies with quality-control procedures in TPI 1, and involves third-party inspection by an independent testing and inspecting agency acceptable to Architect and authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Handle and store trusses to comply with recommendations in SBCA BCSI, "Building Component Safety Information: Guide to Good Practice for Handling, Installing, Restraining, & Bracing Metal Plate Connected Wood Trusses."
 - 1. Store trusses flat, off of ground, and adequately supported to prevent lateral bending.
 - 2. Protect trusses from weather by covering with waterproof sheeting, securely anchored.
 - 3. Provide for air circulation around stacks and under coverings.
- B. Inspect trusses showing discoloration, corrosion, or other evidence of deterioration. Discard and replace trusses that are damaged or defective.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design metal-plate-connected wood trusses.
- B. Structural Performance: Metal-plate-connected wood trusses shall be capable of withstanding design loads within limits and under conditions indicated. Comply with requirements in TPI 1 unless more stringent requirements are specified below.
 - 1. Design Loads: As indicated on drawings and in coordination with mechanical equipment supplier.
 - 2. Maximum Deflection under Design Loads:
 - a. Roof Trusses: Vertical deflection of 1/240 of truss span.
 - b. Gable End Trusses: Horizontal deflection of 1/600 of truss height.
 - 3. Where trusses support outrigger framing, as shown on structural drawings, top chord shall be dropped to accommodate cantilevered outriggers as shown on structural drawings.
- C. Comply with applicable requirements and recommendations of TPI 1, TPI DSB, and SBCA BCSI.
- D. Wood Structural Design Standard: Comply with applicable requirements in AF&PA's "National Design Specifications for Wood Construction" and its "Supplement."

2.2 DIMENSION LUMBER

- A. Lumber: DOC PS 20 and applicable rules of any rules-writing agency certified by the American Lumber Standard Committee (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. Provide dressed lumber, S4S.
 - 3. Provide dry lumber with 15 percent maximum moisture content at time of dressing.
- B. Minimum Chord Size for Roof Trusses: 2 by 6 inches nominal for top chords, 2 by 12 inches nominal for bottom chords of raised heel trusses.
- C. Permanent Bracing: Provide wood bracing that complies with requirements for miscellaneous lumber in Section 061000 "Rough Carpentry."

2.3 METAL CONNECTOR PLATES

- A. Fabricate connector plates to comply with TPI 1.
- B. Hot-Dip Galvanized-Steel Sheet: ASTM A653/A653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G60 coating designation; and not less than 0.036 inch thick.

1. Use for interior locations unless otherwise indicated.

2.4 FASTENERS

- A. Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 1. Provide fasteners for use with metal framing anchors that comply with written recommendations of metal framing manufacturer.
- B. Nails, Brads, and Staples: ASTM F1667.

2.5 METAL FRAMING ANCHORS AND ACCESSORIES

- A. Allowable design loads, as published by manufacturer, shall comply with or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.
- B. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, G60 coating designation.
- C. Truss Tie-Downs (Hurricane or Seismic Ties): Refer to drawings and install per manufacturer's instructions.

2.6 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: SSPC-Paint 20, with dry film containing a minimum of 92 percent zinc dust by weight.

2.7 FABRICATION

- A. Cut truss members to accurate lengths, angles, and sizes to produce close-fitting joints.
- B. Fabricate metal connector plates to sizes, configurations, thicknesses, and anchorage details required to withstand design loads for types of joint designs indicated.
 1. For gable end trusses supporting over-framed roof overhang (rakes), provide a drop-top configuration to permit over-framing installation.
- C. Assemble truss members in design configuration indicated; use jigs or other means to ensure uniformity and accuracy of assembly, with joints closely fitted to comply with tolerances in TPI 1. Position members to produce design camber indicated.
 1. Fabricate wood trusses within manufacturing tolerances in TPI 1.
- D. Connect truss members by metal connector plates located and securely embedded simultaneously in both sides of wood members by air or hydraulic press.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install wood trusses only after supporting construction is in place and is braced and secured.
- B. If trusses are delivered to Project site in more than one piece, assemble trusses before installing.
- C. Hoist trusses in place by lifting equipment suited to sizes and types of trusses required, exercising care not to damage truss members or joints by out-of-plane bending or other causes.
- D. Install and brace trusses according to TPI recommendations and as indicated.
- E. Install trusses plumb, square, and true to line and securely fasten to supporting construction.
- F. Space trusses 24 inches; adjust and align trusses in location before permanently fastening.
- G. Anchor trusses securely at bearing points; use metal truss tie-downs or floor truss hangers as applicable. Install fasteners through each fastener hole in metal framing anchors according to manufacturer's fastening schedules and written instructions.
- H. Install and fasten permanent bracing during truss erection and before construction loads are applied. Anchor ends of permanent bracing where terminating at walls or beams.
 - 1. Install bracing to comply with Section 061000 "Rough Carpentry."
- I. Install wood trusses within installation tolerances in TPI 1.
- J. Do not alter trusses in field. Do not cut, drill, notch, or remove truss members.
- K. Replace wood trusses that are damaged or do not comply with requirements.

3.2 REPAIRS AND PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect wood trusses from weather. If, despite protection, wood trusses become wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- C. Repair damaged galvanized coatings on exposed surfaces according to ASTM A780/A780M and manufacturer's written instructions.

END OF SECTION 061753

SECTION 071326 - SELF-ADHERING SHEET WATERPROOFING

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. Modified bituminous sheet waterproofing, fabric reinforced.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review waterproofing requirements including surface preparation, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs.
 - 2. Verify compatibility with proposed air barrier system. Ensure warranties of both systems will be maintained.

1.4 ACTION SUBMITTALS

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

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Field quality-control reports.
- C. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.
- B. Mockups: Build mockups to verify selections made under Sample submittals and to set quality standards for installation.
 - 1. Build for each typical waterproofing installation including accessories to demonstrate surface preparation, crack and joint treatments, inside and outside corner treatments, and protection.
 - a. Size: 100 sq. ft.
 - b. Description: Each type of wall installation.
 - 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.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended in writing by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.
 - 1. Do not apply waterproofing in snow, rain, fog, or mist.
- B. Maintain adequate ventilation during preparation and application of waterproofing materials.

1.8 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement waterproofing material for waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.
- B. Installer's Special Warranty: Specified form, signed by Installer, covering Work of this Section, for warranty period of two years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 MODIFIED BITUMINOUS SHEET WATERPROOFING

- A. Modified Bituminous Sheet: Minimum 60-mil nominal thickness, self-adhering sheet consisting of 56 mils of rubberized asphalt laminated on one side to a 4-mil- thick, polyethylene-film reinforcement, and with release liner on adhesive side.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide W.R. Meadows, Inc; Mel-Rol or a comparable product by one of the following:
 - a. Carlisle Coatings & Waterproofing Inc.
 - b. GCP Applied Technologies Inc.
 - 2. Physical Properties:
 - a. Tensile Strength, Membrane: 460 psi minimum; ASTM D 412, Die C, modified.
 - b. Ultimate Elongation: 971 percent minimum; ASTM D 412, Die C, modified.
 - c. Low-Temperature Flexibility: Pass at minus 20 deg F; ASTM D 1970/D 1970M.
 - d. Crack Cycling: Unaffected after 100 cycles of 1/8-inch movement; ASTM C 836.
 - e. Puncture Resistance: 48.2 lbf minimum; ASTM E 154.
 - f. Water Absorption: 0.1 percent weight-gain maximum after 48-hour immersion at 70 deg F; ASTM D 570.
 - g. Water Vapor Permeance: 0.036 perm maximum; ASTM E 96/E 96M, Water Method.
 - h. Hydrostatic-Head Resistance: 200 feet minimum; ASTM D 5385.
 - 3. Sheet Strips: Self-adhering, rubberized-asphalt strips of same material and thickness as sheet waterproofing.

2.3 AUXILIARY MATERIALS

- A. Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.
- B. Primer/ Surface Conditioner: Liquid waterborne primer recommended for substrate by sheet-waterproofing material manufacturer, Mel-Prime or equivalent.
- C. Substrate Patching Membrane: Low-viscosity, two-component, modified asphalt coating.
- D. Metal Termination Bars: Aluminum bars, approximately 1 by 1/8 inch, predrilled at 9-inch centers.

2.4 MOLDED-SHEET DRAINAGE PANELS

- A. Dimple-raised, molded polystyrene core with a non-woven geotextile fabric bonded to the dimples of the core and acceptable to waterproofing manufacturer and with a vertical flow rate through the core of 9 to 21 gpm per ft.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide W.R. Meadows, Inc; Mel-Drain 5035 or a comparable product by one of the following:
 - a. Carlisle Coatings & Waterproofing Inc.
 - b. GCP Applied Technologies Inc.

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 waterproofing.
 - 1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
 - 2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
 - 3. Verify that compacted subgrade is dry, smooth, sound, and ready to receive waterproofing sheet.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.
- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.
- E. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.
 - 1. Install sheet strips of width according to manufacturer's written instructions and center over treated construction and contraction joints and cracks exceeding a width of 1/16 inch.
- F. Bridge and cover isolation joints and expansion joints with overlapping sheet strips of widths according to manufacturer's written instructions.

1. Invert and loosely lay first sheet strip over center of joint. Firmly adhere second sheet strip to first and overlap to substrate.
- G. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D 6135.
1. Install membrane strips centered over vertical inside corners. Install 3/4-inch fillets of liquid membrane on horizontal inside corners and as follows:
 - a. At footing-to-wall intersections, extend liquid membrane in each direction from corner or install membrane strip centered over corner.
- H. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions according to ASTM D 6135.

3.3 MODIFIED BITUMINOUS SHEET-WATERPROOFING APPLICATION

- A. Install modified bituminous sheets according to waterproofing manufacturer's written instructions and per recommendations in ASTM D 6135.
- B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Reprime areas exposed for more than 24 hours.
- C. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align sheets and maintain uniform 2-1/2-inch- minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure watertight installation.
1. Make every effort to install waterproofing at temperatures above 40 deg F. If waterproofing can only be installed at temperatures below 40 deg F, install alternate products as recommended by the manufacturer, at no additional cost to the Owner. When ambient and substrate temperatures range between 25 and 40 deg F, install self-adhering, modified bituminous sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F.
- D. Seal edges of sheet-waterproofing terminations with mastic.
- E. Install sheet-waterproofing and auxiliary materials to tie into adjacent waterproofing.
- F. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending 6 inches beyond repaired areas in all directions.
- G. Immediately install additional molded-sheet drainage-panel over waterproofing membrane.

3.4 MOLDED-SHEET DRAINAGE-PANEL INSTALLATION

- A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate, according to manufacturer's written instructions. Use adhesive or another method that does not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner may engage a qualified testing agency to perform tests.
- B. Waterproofing will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.6 PROTECTION, REPAIR, AND CLEANING

- A. Do not permit foot or vehicular traffic on unprotected membrane.
- B. Protect waterproofing from damage and wear during remainder of construction period.
- C. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.
- D. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION 071326

SECTION 072100 - THERMAL INSULATION

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. Glass-fiber blanket insulation.
 - 2. Extruded polystyrene foam-plastic board.
 - 3. Spray Applied Cellulosic Insulation

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- B. Evaluation Reports: For foam-plastic insulation, from ICC-ES.

1.5 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 GLASS-FIBER BLANKET

- A. Glass-Fiber Blanket, Unfaced: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
 - 1. 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. Owens Corning, Pink Next Gen Fiberglas. Other thicknesses as indicated throughout the drawing set.

2.2 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD

- A. Extruded polystyrene boards in this article are also called "XPS boards." Roman numeral designators in ASTM C 578 are assigned in a fixed random sequence, and their numeric order does not reflect increasing strength or other characteristics.
- B. Extruded Polystyrene Board, Type IV: ASTM C 578, Type IV, 25-psi minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.
 - 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 provided they meet the required R-value without adding additional overall thickness:
 - a. DuPont. Styrofoam Cavitymate Ultra at all cavity wall installations.
 - 1) Above grade exterior walls: R-10, as indicated on drawings.
 - 2) Below grade foundation walls: R-15, as indicated on drawings.
 - 2. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

2.3 SPRAY-APPLIED CELLULOSIC INSULATION

- A. Self-Supported, Spray-Applied Cellulosic Insulation: ASTM C1149, Type I chemically treated for flame-resistance, processing, and handling characteristics.
 - 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 provided they meet the required R-value without adding additional overall thickness:
 - a. Henry Company (The). HFO Closed Cell Foam. Apply in locations noted to achieve R-Value as required.

2.4 INSULATION FASTENERS

- A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
 - 1. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - 2. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation.
- B. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick galvanized-steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches square or in diameter.
 - 1. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in the following locations:
 - a. Ceiling plenums.
 - b. Attic spaces.
- C. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.

2.5 ACCESSORIES

- A. Insulation for Miscellaneous Voids:
 - 1. Glass-Fiber Insulation: ASTM C 764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E 84.
 - 2. Spray Polyurethane Foam Insulation: ASTM C 1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
- B. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

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 SLAB INSULATION

- A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.
 - 1. If not otherwise indicated, extend insulation a minimum of 24 inches below exterior grade line.
- B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
 - 1. If not otherwise indicated, extend insulation a minimum of 24 inches in from exterior walls.

3.4 INSTALLATION OF FOUNDATION WALL INSULATION

- A. Butt panels together for tight fit.
- B. Anchor Installation: Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:
 - 1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application.
 - 2. Apply insulation standoffs to each spindle to create cavity width indicated on Drawings between concrete substrate and insulation.
 - 3. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation.
 - 4. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.
- C. Adhesive Installation: Install with adhesive or press into tacky waterproofing or dampproofing according to manufacturer's written instructions.

3.5 INSTALLATION OF CAVITY-WALL INSULATION

- A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches o.c. both ways on inside face and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.
 - 1. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 042000 "Unit Masonry."

3.6 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:
 - 1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft.
 - 2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

3.7 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 072100

SECTION 072726 - FLUID-APPLIED MEMBRANE AIR BARRIERS

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. Vapor-retarding, fluid-applied air barriers.

1.3 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.

1.4 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; dry film thickness; and tested physical and performance properties of products.

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

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Mockups: Build mockups to set quality standards for materials and execution.
 - 1. Build integrated mockups of exterior wall assembly, 150 sq. ft., incorporating backup wall construction, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.
 - a. Coordinate construction of mockups to permit inspection and testing of air barrier before external insulation and cladding are installed.
 - b. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.
 - 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.

1.7 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.

1.8 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 E 2357.

2.3 HIGH-BUILD AIR BARRIERS, VAPOR RETARDING

- A. High-Build, Vapor-Retarding Air Barrier: Synthetic polymer membrane with an installed dry film thickness, according to manufacturer's written instructions, of 35 mils or thicker over smooth, void-free substrates.

1. Synthetic Polymer Type:

- 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) W. R. Meadows, Inc., Air-Shield LM. Provide at all CMU backup walls and wall sheathing throughout the project.

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 E 2178.
- b. Vapor Permeance: Maximum 0.1 perm; ASTM E 96/E 96M, Desiccant Method.
- c. Ultimate Elongation: Minimum 500 percent; ASTM D 412, Die C.
- d. Adhesion to Substrate: Minimum 16 lbf/sq. in. when tested according to ASTM D 4541.
- e. 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 reinforcing fabric and 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.
- B. Primer: Liquid waterborne primer recommended for substrate by air-barrier material manufacturer.

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. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching material.
- E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- F. 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.
- G. Bridge movement joints and 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 ACCESSORIES INSTALLATION

- A. Install accessory 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.
 2. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier material on same day. Re-prime areas exposed for more than 24 hours.
- B. Connect and seal exterior wall air-barrier material continuously to concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
- C. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.

- D. 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.
- E. Wall Openings: Prime concealed perimeter frame surfaces of windows and doors. Apply transition strip so that a minimum of 3 inches of coverage is achieved over each substrate. Maintain 3 inches of full contact over firm bearing to perimeter frames, with not less than 1 inch of full contact.
- F. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air-barrier material with foam sealant.
- G. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.
- H. Seal top of through-wall flashings to air barrier with an additional 6-inch- wide, transition strip.
- I. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counter flashings or ending in reglets with termination mastic.
- J. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.

3.4 PRIMARY AIR-BARRIER MATERIAL INSTALLATION

- A. Apply air-barrier material to form a seal with strips and transition strips and to achieve a continuous air barrier according to air-barrier manufacturer's written instructions and details. Apply air-barrier material within manufacturer's recommended application temperature ranges.
 - 1. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
 - 2. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.
 - 3. Where multiple prime coats are needed to achieve required bond, allow adequate drying time between coats.
- B. High-Build Air Barriers: Apply continuous unbroken air-barrier material to substrates according to the following thickness. Apply air-barrier material in full contact around protrusions such as masonry ties.
 - 1. Vapor-Retarding, High-Build Air Barrier: Total dry film thickness as recommended in writing by manufacturer to comply with performance requirements, but not less than 35 mils, applied in one or more equal coats.
- C. Do not cover air barrier until it has been tested and inspected by testing agency.
- D. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.
- E. Air barrier to be installed at exterior face of interior wythe of cavity walls as well as behind all metal panel applications. Confirm compatibility of air barrier with metal panel manufacturer prior to installation.

3.5 FIELD QUALITY CONTROL

- A. Tests: As determined by testing agency from among the following tests:
 - 1. Air-Leakage-Location Testing: Air-barrier assemblies may be tested for evidence of air leakage.
 - 2. Adhesion Testing: Air-barrier assemblies may be tested for required adhesion to substrate according to ASTM D 4541.
- B. 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.
- C. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.
- D. Prepare test and inspection reports.

3.6 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.
- C. Remove masking materials after installation.

END OF SECTION 072726

SECTION 074113 - STANDING-SEAM METAL ROOF PANELS

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 standing-seam metal roof panels.
- B. Related Sections:
 - 1. Section 077253 "Snow Guards" for prefabricated devices designed to hold snow on the roof surface, allowing it to melt and drain off slowly.

1.3 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.
 - 11. Coordinate with the University's solar installer/ designer for details needed for roof-mounted solar panel installation.

1.4 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 Initial Selection: For each type of metal 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 Panels: 12 inches long by actual panel width. Include clips, fasteners, closures, and other metal panel accessories.
- 1.5 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For Installer.
 - B. Product Test Reports: For each product, for tests performed by a qualified testing agency.
 - C. Field quality-control reports.
 - D. Sample Warranties: For special warranties.
- 1.6 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For metal panels to include in maintenance manuals.
- 1.7 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.
- 1.8 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.

1.9 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.

1.10 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.

1.11 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 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 30 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: 20 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 E 1592:
 1. Wind Loads: As indicated on Drawings.
 2. Deflection Limits: For wind loads, no greater than 1/240 of the span.
- B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E 1680 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 E 1646 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 E 2140.
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.2 STANDING-SEAM METAL ROOF PANELS

- A. General: 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 in side 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 E 1637.
- B. Vertical-Rib, Seamed-Joint, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and intermediate stiffening ribs symmetrically spaced between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and mechanically seaming panels together.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide PAC-CLAD; 2" Tite-Loc Plus or a comparable product by one of the following:
 - a. PAC-CLAD; Petersen Aluminum Corporation; a Carlisle company.

2. Metallic-Coated Steel Sheet: Aluminum-zinc alloy-coated steel sheet complying with ASTM A 792, Class AZ50 to comply with ASTM A 755.
 - a. Nominal Thickness: .040 Aluminum.
 - b. Exterior Finish: 70% PVDF resin-based coating. AAMA 2605-13 and AAMA 620-02.
 - c. Color: As selected by Architect from manufacturer's full range of standard finishes.
3. Joint Type: Double folded (180 degree).
 - a. Verify standing seam fold will allow for solar panel installation clip prior to fabrication and as part of the shop drawing process.
4. Panel Coverage: 18 inches with stiffening ribs.
5. Panel Height: 2 3/8" inches with optional seam sealant included.

2.3 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 D 1970.
 2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D 1970.
- B. Synthetic Underlayment: PAC-CLAD HT or equivalent as approved by metal panel manufacturer.

2.4 MISCELLANEOUS MATERIALS

- A. 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 premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- B. 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.
- C. Gutters: Formed from same material as roof panels, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch- long sections, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports

spaced a maximum of 36 inches o.c., fabricated from same metal as gutters. Provide wire ball strainers of compatible metal at outlets. Finish gutters to match roof fascia and rake trim.

1. Gutters to be 5" 'Box' style at all locations.
- D. Downspouts: Formed from same material as roof panels. Fabricate in 10-foot- long sections, complete with formed elbows and offsets, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Finish downspouts to match gutters.
1. Downspouts to be 3" x 4".
- E. Metal Soffits: Formed from the same material as roof panels.
1. Pac Clad: PAC-750 soffit
 - a. Vented where noted on drawings.
 - b. Solid where noted on drawings.
 2. Provide required installation accessories as per manufacturer including J channel, fasteners, and sealants.
- F. Vinyl Soffits: Provide 3/8 inch, beaded, rigid PVC soffit.
1. Certainteed: Beaded Triple 2" Soffit
 - a. Color: selected from manufacturers full line of colors.
 - b. Finish: Smooth
 - c. Profile: Solid
 2. Provide required installation accessories, trims, fasteners, and sealants.
- G. Panel Fasteners: Self-tapping screws designed to withstand design loads.
- H. 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 C 920; 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 C 1311.

2.5 FABRICATION

- A. General: 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. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

- C. 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.
- D. 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 Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
 - 3. Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
 - 4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 - 5. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended 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.

2.6 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 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

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 subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.3 UNDERLAYMENT INSTALLATION

- A. Self-Adhering, High Temperature 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 roof area indicated below:
 - a. Apply over entire roof area as required by manufacturer.

3.4 METAL PANEL INSTALLATION

- A. General: 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. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use 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. Clipless Metal Panel Installation: Fasten metal panels to supports with screw fasteners at each lapped joint at location and spacing recommended by manufacturer.
- 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 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.
- 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 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).

- I. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 36 inches o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
- J. Downspouts: Join sections with telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.
 - 1. Connect downspouts to underground drainage system indicated.
- K. 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 074113

SECTION 074213.13 - FORMED METAL WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exposed-fastener, lap-seam metal wall panels.
2. Trim and accessories

1.2 PREINSTALLATION MEETINGS

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

1.3 ACTION SUBMITTALS

- A. Product Data:** Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

1. Exposed-fastener, lap-seam metal wall panels.
2. Trim and accessories

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.

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

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

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

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

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data:** For Installer.

- B. Product Test Reports:** For exposed-fastener, lap-seam metal wall panels for 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 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.

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 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 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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. 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 EXPOSED-FASTENER, LAP-SEAM METAL WALL PANELS

- A. Provide factory-formed metal panels designed to be field assembled by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps. Include accessories required for weathertight installation.
- B. Tapered-Rib-Profile, Exposed-Fastener Metal Wall Panels: Formed with raised, trapezoidal major ribs and a flat pan between major ribs.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide PAC-CLAD; M-36 Panel or a comparable product by one of the following:
 - a. 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: 0.040 inch.
 - b. Surface: Smooth finish.
 - c. Exterior Finish: Manufacturers standard Kynar 500 or Hylar 500 finish.
 - d. Color: As selected by Architect from manufacturer's full range.
 3. Major-Rib Spacing: 6 inches o.c.
 4. Panel Coverage: 36 inches.
 5. Panel Height: 0.75 inch.

2.3 MISCELLANEOUS MATERIALS

- A. 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 rakes, 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 premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- B. 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, 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 panels.
- C. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- D. 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.

2.4 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. 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 nonexpansion, 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. Finish shall be Kynar 500 or Hylar 5000 Fluorocarbon coating with a top side film thickness of 0.70 to 0.90 mil over a 0.25 to 0.3 mil prime coat to provide a total dry film thickness of 0.95 to 1.25 mil, to meet AAMA 621. Bottom side shall be coated with a primer with a dry film thickness of 0.25 mil. Finish shall conform to all tests for adhesions, flexibility and longevity as specified by Kynar 500 or Hylar 5000 finish supplier.

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 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 wall panel manufacturer.
 2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.
 - 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 subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

3.3 INSTALLATION OF METAL 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. Steel Panels: Use stainless steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
 - 2. 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.
 - 3. Copper Panels: Use copper, stainless steel, or hardware-bronze fasteners.
 - 4. Stainless Steel Panels: Use stainless steel fasteners.
- C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- D. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.
 - 1. Lap ribbed or fluted sheets one full rib. Apply panels and associated items true to line for neat and weathertight enclosure.
 - 2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
 - 3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.

4. Install screw fasteners with power tools having torque adjusted to compress washer tightly without damage to washer or panels. Install screws in predrilled holes.
 5. Flash and seal panels with weather closures at perimeter of all openings.
- E. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting and 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 wall panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.
- F. 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 achieve 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 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal wall panel installation, including accessories.
- B. Remove and replace metal wall 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.

3.5 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. After metal panel installation, clear weep holes and drainage channels of obstructions.
- C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074213.13

SECTION 077253 - SNOW GUARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rail-type, seam-mounted snow guards.

1.2 ACTION SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

1. Rail-type, seam-mounted snow guards.

B. Shop Drawings: Include roof plans showing layouts and attachment details of snow guards.

1. Include details of rail-type snow guards.

C. Samples:

1. Rail-Type Snow Guards: Bracket, 12-inch- long rail, and installation hardware.

- a. For units with factory-applied finishes, submit manufacturer's standard color selections or specified color.

D. Delegated Design Submittals: For snow guards, include analysis reports signed and sealed by the qualified professional engineer responsible for their preparation.

1. Include calculation of number and location of snow guards.

1.3 INFORMATIONAL SUBMITTALS

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

B. Product Test Reports: For each type of snow guard, for tests performed by a qualified testing agency, indicating load at failure of attachment to roof system identical to roof system used on this Project.

1.4 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit adhesive-mounted snow guards to be installed, and adhesive cured, according to adhesive manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design snow guards, including attachment to roofing material and roof deck, as applicable for attachment method, based on the following:
1. Roof snow load.
 2. Snow drifting
 3. Roof slope.
 4. Roof type.
 5. Roof dimensions.
 6. Roofing substrate type and thickness.
 7. Snow guard type.
 8. Snow guard fastening method and strength.
 9. Snow guard spacing.
 10. Coefficient of Friction Between Snow and Roof Surface: 0.
 11. Factor of Safety: 2.
- B. Performance Requirements: Provide snow guards that withstand exposure to weather and resist thermally induced movement without failure, rattling, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.
1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- C. Structural Performance: Snow guards to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
1. Snow Loads: As indicated on Drawings.

2.2 RAIL-TYPE SNOW GUARDS

- A. Rail-Type, Seam-Mounted Snow Guards:
1. Sno Gem, 2" Gem Series with MEC Bracket
 2. Description: Snow guard rails fabricated from metal pipes, bars, or extrusions, anchored to brackets and equipped with two rails.
 3. Brackets and Baseplate: ASTM B209 aluminum or ASTM A240, Type 304 stainless steel, powder coated.
 4. Bars: ASTM B221 aluminum or ASTM A240, Type 304 stainless steel, powder coated.
 - a. Profile: Round or square.
 5. Seam Clamps: ASTM B221 aluminum extrusion or ASTM B85 aluminum casting with stainless steel set screws incorporating round nonpenetrating point; designed for use with applicable roofing system to which clamp is attached. Provide proper material to prevent issues with dissimilar materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, snow guard attachment, and other conditions affecting performance of the Work.
 - 1. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean and prepare substrates for bonding snow guards.
- B. Prime substrates according to snow guard manufacturer's written instructions.

3.3 INSTALLATION

- A. Install snow guards according to manufacturer's written instructions.
 - 1. Space rows as indicated on approved Shop Drawings.
- B. Attachment for Asphalt Shingle Roofing:
 - 1. Rail-Type, Flat-Mounted, Snow Guards: Mounting plates bolted or screwed to the roof framing or roof deck.
- C. Attachment for Standing-Seam Metal Roofing:
 - 1. Do not use fasteners that will penetrate metal roofing or fastening methods that void metal roofing finish warranty.
 - 2. Rail-Type, Seam-Mounted Snow Guards:
 - a. Install brackets to vertical ribs in straight rows.
 - b. Secure with stainless steel set screws, incorporating round nonpenetrating point, on same side of standing seam.
 - c. Torque set screw in accordance with manufacturer's written instructions.
 - d. Install cross members to brackets.
 - e. Separate dissimilar materials.

END OF SECTION 077253

SECTION 079200 - JOINT SEALANTS

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. Silicone joint sealants.
 - 2. Urethane joint sealants.
 - 3. Mildew-resistant joint sealants.
 - 4. Butyl joint sealants.
 - 5. Latex joint sealants.

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. Joint-Sealant Schedule: Include the following information:
 - 1. Joint-sealant application, joint location, and designation.
 - 2. Joint-sealant manufacturer and product name.
 - 3. Joint-sealant formulation.
 - 4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Product Test Reports: For each kind of joint sealant, for tests performed by manufacturer and witnessed by a qualified testing agency.
- 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.

1.6 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.

1.7 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 selected by Architect from manufacturer's full range.

2.2 JOINT-SEALANT BACKING

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

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

3.4 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
1. Extent of Testing: Test completed and cured sealant joints as follows:
 - a. Perform five tests for each kind of sealant and joint substrate.
 2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
 - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 3. Inspect tested joints and report on the following:
 - a. Whether sealants filled joint cavities and are free of voids.
 - b. Whether sealant dimensions and configurations comply with specified requirements.
 - c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.
 4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
 5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
- B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 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.

3.6 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.

3.7 JOINT-SEALANT SCHEDULE

- A. Schedule is based on basis-of design products by the Sherwin Williams Company.
- B. Interior: Unpainted portions of plumbing fixture perimeters.
 - 1. SW Silicone Ultra Kitchen and Bath Sealant
- C. Interior: Perimeters of solid surface counters.
 - 1. SW Sher-Max Urethanized Elastomeric Sealant
- D. Interior: Perimeters of interior hollow metal door frames in gypsum board walls.
 - 1. SW MaxFlex Acrylic Urethane Elastomeric Sealant. Apply after wall and frame painting is complete.
- E. Interior: Joints in concrete slabs.
 - 1. SW Loxon S1 Smooth

END OF SECTION 079200

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes hollow-metal door and frame work.
- B. Related Requirements:
 - 1. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.

DEFINITIONS

- C. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or 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.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, core descriptions, and finishes.
- B. Shop Drawings: Include the following:
 - 1. Elevations of each door type.
 - 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
 - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 - 4. Locations of reinforcement and preparations for hardware.
 - 5. Details of each different wall opening condition.
 - 6. Details of anchorages, joints, field splices, and connections.
 - 7. Details of accessories.
 - 8. Details of moldings, removable stops, and glazing.
 - 9. Details of conduit and preparations for power, signal, and control systems.

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

1.5 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ceco Door; ASSA ABLOY.
 - 2. Curries Company; ASSA ABLOY.
 - 3. DE LA FONTAINE.
 - 4. Republic Doors and Frames.
 - 5. Steelcraft; an Allegion brand.
- B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.2 HOLLOW-METAL DOORS AND FRAMES

- A. Construct exterior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3 at all locations.
 - 1. Physical Performance: Level A according to SDI A250.4.
 - 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches.
 - c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A60 coating.
 - d. Edge Construction: Model 2, Seamless, with continuously welded edges.
 - e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.

- 1) Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 2.1 degrees F x h x square foot /Btu when tested according to ASTM C 1363 for all exterior doors.
3. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A60 coating.
 - b. Construction: Full web continuously welded.
4. 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. Type shall match wall construction type in which doors will be installed, as recommended by door manufacturer.
 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.

2.4 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
- C. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- E. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.
- F. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- G. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.5 FABRICATION

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Hollow-Metal Doors:
 - 1. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch, steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches apart. Spot weld to face sheets no more than 5 inches o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.
 - 2. Vertical Edges for Single-Acting Doors: Bevel edges 1/8 inch in 2 inches.
 - 3. Top Edge Closures: Close top edges of doors with inverted closures, except provide flush closures at exterior doors of same material as face sheets.
 - 4. Bottom Edge Closures: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets.
 - 5. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
- C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 - 1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 2. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
 - 3. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 16 inches from top and bottom of frame. Space anchors not more than 32 inches o.c., to match coursing, and as follows:
 - 1) Three anchors per jamb.
 - 4. 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.
- D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.
- E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
 - 1. Reinforce doors and frames to receive non-templated, mortised, and surface-mounted door hardware.
 - 2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.
- F. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
4. Provide loose stops and moldings on inside of hollow-metal work.
5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.6 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 SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.7 ACCESSORIES

- A. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

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

3.3 INSTALLATION

- A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.
- B. Hollow-Metal Frames: Install hollow-metal frames for doors, transoms, sidelites, borrowed lites, and other openings, of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - b. Install frames with removable stops located on secure side of opening.
 - c. Install door silencers in frames before grouting.
 - d. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - e. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - f. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.
 - 2. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
 - 3. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
 - 1. Non-Fire-Rated Steel Doors:
 - a. Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.
 - b. At Bottom of Door: 5/8 inch plus or minus 1/32 inch.
 - c. Between Door Face and Stop: 1/16 inch to 1/8 inch plus or minus 1/32 inch.

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow-metal work immediately after installation.

- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- E. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113

SECTION 083313 - COILING COUNTER DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Counter doors.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type and size of coiling counter 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.
 - 3. Include description of automatic closing device and testing and resetting instructions.
- 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.
- C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.
 - 1. Include similar Samples of accessories involving color selection.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For coiling counter doors 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 for both installation and maintenance of units required for this Project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS, GENERAL

- A. Source Limitations: Obtain coiling counter doors from single source from single manufacturer.

2.2 COUNTER DOOR ASSEMBLY

1. Basis-of-Design Product: Subject to compliance with requirements, provide Overhead Door Corporation; Model 650 counter door, or a comparable product by one of the following:
 - a. C.H.I. Overhead Doors, Inc.
 - b. Cornell.
 - c. McKeon Rolling Steel Door Company, Inc.
2. Wall Mounting Condition: Face-of-wall mounting.
3. Curtain: Interlocking slats, Type F-158 fabricated of 22 gauge galvanized steel. Endlocks attached to alternate slats to maintain curtain alignment and prevent lateral slat movement.
4. Finish: Slats and hood galvanized steel in accordance with ASTM A 653 with rust-inhibitive, roll coating process, including 0.2 mils thick baked-on prime paint, and 0.6 mils thick baked-on polyester (powder coated) top coat.
5. Powder coat: PowderGuard
 - a. PowderGuard Premium: Weather resistant polyester powder coat color as selected by the Architect from full range of available colors.
6. Bottom Bar: Steel tubular locking bottom bar with weatherstrip.
7. Guides: Extruded aluminum.
 - a. Finish: PowderGuard Zinc Finish for guides, bottom bar and head plate.
8. Brackets: Steel plate to support counterbalance, curtain and hood.
9. Counterbalance: Helical torsion spring type housed in a steel tube or pipe barrel.
10. Hood: Provided with intermediate support brackets as required.
11. Operation: Manual, push up
12. Locking: Slide bolt locks suitable for use with padlock.

2.3 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate coiling counter-door curtain of interlocking metal slats 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. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural steel sheet; complying with ASTM A 653, with G90 zinc coating; nominal sheet thickness (coated) of 0.028 inch; and as required.
 - 2. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84 or UL 723. Enclose insulation completely within slat faces.
 - 3. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face.
- 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.

2.4 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 A 653/A 653M.

2.5 LOCKING DEVICES

- A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.
- B. Chain Lock Keeper: Suitable for padlock.

2.6 CURTAIN ACCESSORIES

- A. Weatherseals: Equip door with weather-stripping gaskets fitted to entire perimeter of door for air-resistant installation unless otherwise indicated.
 - 1. At door head, use 1/8-inch- thick, replaceable, continuous-sheet baffle secured to inside of hood or field- installed on the header.
 - 2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch- thick seals of flexible vinyl, rubber, or neoprene.
- B. Astragal: Equip each door bottom bar with a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.

- C. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.

2.7 COUNTERBALANCING 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 or welded 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.
- 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.

2.8 MANUAL DOOR OPERATORS

- A. General: Equip door with manual door operator by door manufacturer.
- B. Push-up Door Operation: Design counterbalance mechanism so that required lift or pull for door operation does not exceed 25 lbf.

2.9 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" 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.

2.10 STEEL AND GALVANIZED-STEEL FINISHES

- A. Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

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

3.2 INSTALLATION

- A. Install coiling counter 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 coiling counter doors, hoods, controls, and operators at the mounting locations indicated for each door.

3.3 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Perform installation and startup checks according to manufacturer's written instructions.
 - 2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
 - 3. Test door closing when activated by detector or alarm-connected fire-release system. Reset door-closing mechanism after successful test.

3.4 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.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain coiling counter doors.

END OF SECTION 083313

SECTION 083323 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Insulated service doors

1.3 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.
 - 3. Include description of automatic closing device and testing and resetting instructions.
- 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 Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.
 - 1. Include similar Samples of accessories involving color selection.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For overhead coiling doors 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 for both installation and maintenance of units required for this Project.
- B. Regulatory Requirements: Comply with applicable provisions in ICC A117.1.

PART 2 - PRODUCTS

2.1 MANUFACTURERS, GENERAL

- A. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.
 - 1. Obtain operators and controls from overhead coiling door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.
 - 1. Design Wind Load: As indicated on Drawings.
 - 2. Testing: According to ASTM E 330.
 - 3. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.
 - 4. Operability under Wind Load: Design overhead coiling doors to remain operable under uniform pressure (velocity pressure) of 20 lbf/sq. ft. wind load, acting inward and outward.
- B. Seismic Performance: Overhead coiling doors shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. Component Importance Factor: 1.0.

2.3 DOOR ASSEMBLY

- A. Insulated Service Door: Overhead coiling door formed with curtain of interlocking metal slats.
 - 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. Overhead Door Corporation, Stormtite Insulated Heavy Duty Rolling Doors, Rolling Steel Service Doors 625.

- B. Operation Cycles: Door components and operators capable of operating for not less than 20,000 cycles. 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. Air Infiltration: Maximum rate of 1.0 cfm/sq. ft. at 15 and 25 mph when tested according to ASTM E 283.
- D. STC Rating: 21
- E. Curtain R-Value: Minimum 6.0 deg F x h x sq. ft./Btu
- F. Door Curtain Material: 24 gauge galvanized steel.
- G. Door Curtain Slats: Flat profile slats, type F-265.
- H. Bottom Bar: Primed steel with vinyl weatherseal.
- I. Curtain Jamb Guides: Three structural steel angles, powder coated.
- J. Hood: 24 gauge galvanized steel.
- K. Electric Door Operator:
 - 1. Usage Classification: Heavy duty, 25 or more cycles per hour and over 90 cycles per day.
 - 2. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use.
 - 3. Motor Exposure: Interior.
 - 4. Emergency Manual Operation: Push-up or Chain type.
 - 5. Obstruction-Detection Device: Automatic photoelectric sensor or electric sensor edge on bottom bar.
 - 6. Control Stations: Interior and exterior mounted.
- L. Curtain Accessories: Equip door with weatherseals, push/pull handles, and pull-down strap.
- M. Door Finish:
 - 1. Powder-Coated Finish:
 - a. PowderGuard Premium: Weather resistant polyester powder coat color as selected by the Architect from full range of available colors.

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. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural steel sheet; complying with ASTM A 653/A 653M, with G90 zinc coating; nominal sheet thickness (coated) of 0.028 inch; and as required.
2. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84 or UL 723. Enclose insulation completely within slat faces.
3. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face, with minimum steel thickness of 0.010 inch.

- 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.

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 A 653/A 653M.

2.7 CURTAIN ACCESSORIES

- A. Weatherseals for Exterior Doors: Equip each exterior door with weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant installation unless otherwise indicated.

1. At door head, use 1/8-inch- thick, replaceable, continuous-sheet baffle secured to inside of hood or field- installed on the header.
2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch- thick seals of flexible vinyl, rubber, or neoprene.

- B. Astragal for Interior Doors: Equip each door bottom bar with a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.

- C. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.

- D. Pull-Down Strap: Provide pull-down straps for doors more than 84 inches high.

2.8 COUNTERBALANCING 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 or welded 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.
- 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. Motors: Reversible-type motor for motor exposure indicated.
 - 1. Electrical Characteristics:
 - a. Phase: Single phase.
 - b. Volts: 115 V.
 - c. Hertz: 60.
 - 2. Motor Size: Minimum size as indicated. 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.
 - 3. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
 - 4. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.
- D. 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.
- E. Obstruction Detection Devices: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening.
 - 1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.

- a. Self-Monitoring Type: Designed to interface with door operator control circuit to detect damage to or disconnection of sensing device. When self-monitoring feature is activated, door closes only with sustained or constant pressure on close button.
- 2. Pneumatic Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device.
- F. 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.
 - 2. Exterior-Mounted Units: Provide with additional weatherproof enclosure.
- G. 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.
- H. 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.
- I. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.
- J. Audible and Visual Signals: Audible alarm and visual indicator lights in compliance with regulatory requirements for accessibility.

2.10 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" 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 STEEL AND GALVANIZED-STEEL FINISHES

- A. Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

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 regulatory requirements for accessibility.
- D. Power-Operated Doors: Install automatic garage doors openers according to UL 325.

3.3 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Perform installation and startup checks according to manufacturer's written instructions.
 - 2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

- A. Adjust moving parts to function smoothly so that doors operate easily.
 - 1. Adjust exterior doors and components to be weather-resistant.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust seals to provide tight fit around entire perimeter.

3.5 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 083323

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Interior gypsum board.
- B. Related Requirements:
 - 1. Section 054000 "Cold-Formed Metal Framing" for steel framing that supports gypsum board panels.

1.3 ACTION SUBMITTALS

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

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 C 840 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 E 119 by an independent testing agency.

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 C 1396.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation.
 - b. Georgia-Pacific Building Products.
 - c. National Gypsum Company.
- 2. Thickness: 5/8 inch.
- 3. Long Edges: Tapered.

- B. Gypsum Ceiling Board: ASTM C 1396.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation.
 - b. Georgia-Pacific Building Products.
 - c. National Gypsum Company.
- 2. Thickness: 1/2 inch, unless 5/8" required for fire-resistance rating as indicated in the Drawing Set.
- 3. Long Edges: Tapered.

- C. Abuse-Resistant Gypsum Board: ASTM C1396 gypsum board, tested according to ASTM C1629.

- 1. Core: 5/8 inch, Type X.
- 2. Surface Abrasion: ASTM C1629, meets or exceeds Level 1 requirements.
- 3. Indentation: ASTM C1629, meets or exceeds Level 1 requirements.
- 4. Soft-Body Impact: ASTM C1629, meets or exceeds Level 1 requirements.
- 5. Long Edges: Tapered.
- 6. Locations: See Drawing Set for locations.

- D. Mold-Resistant Gypsum Board: ASTM C 1396. With moisture- and mold-resistant core and paper surfaces.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation.
 - b. Georgia-Pacific Building Products.
 - c. National Gypsum Company.
 - 2. Core: 1/2 inch, regular type and 5/8 inch, Type X.
 - 3. Long Edges: Tapered.
 - 4. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
 - 5. Locations: All Toilet Rooms throughout the Project.

2.4 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
 - 1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
 - 2. Shapes:
 - a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. Expansion (control) joint.

2.5 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
 - 1. Interior Gypsum Board: Paper.
 - 2. Tile backing panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
 - 1. Prefilling: At open joints 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.
 - 3. Fill Coat: For second coat, use drying-type, all-purpose compound.
 - 4. Finish Coat: For third coat, use drying-type, all-purpose compound.

2.6 AUXILIARY MATERIALS

- A. Air/vapor Barrier
 - 1. Basis of Design: CertainTeed Membrain
 - 2. Performance Characteristics
 - a. Water Vapor Permeance: <1.0 perm (ASTM E96Desiccant Method)

- b. Water Vapor Permeance: >10 Perms (ASTM E96 Water Method)
 - c. Fungi Resistance (ASTM C1338): No Growth
- B. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- C. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- D. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
 - 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.

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 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. 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.
- G. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

3.3 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Type X: At all vertical applications not noted in paragraphs 3.3.A.3 and 3.3.A.4.
2. Ceiling Type: At all ceiling surfaces not noted in paragraphs 3.3.A.3 and 3.3.A.4.
3. Abuse-Resistant Type:
 - a. At other additional locations specifically called out in the Drawing Set.
4. Mold-Resistant Type: At all walls and ceilings of toilet room scheduled to receive gypsum board as well as mop sink area.
 - a. At other additional locations specifically called out in the Drawing Set.

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 walls, apply gypsum panels vertically (parallel to framing) or horizontally (perpendicular to framing) unless otherwise indicated or required by fire-resistance-rated assembly. Make determination based on minimizing end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - b. At 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; 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 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.
 - a. Adjust installation method as needed to meet established fire rating or STC rating requirements indicated within the Drawing Set.
3. Fastening Methods: Fasten base layers with screws; fasten face layers with adhesive and supplementary fasteners.
 - a. Adjust fastening method as needed to meet established fire rating or STC rating requirements indicated within the Drawing Set.

3.4 INSTALLING TRIM ACCESSORIES

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

3.5 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 and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
 - 1. Level 1: Ceiling plenum areas and concealed areas.
 - 2. Level 2: Panels that are substrate for tile.
 - 3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
 - 4. Level 5: Provide only at locations specifically designated within the Drawing Set.
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

3.6 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.

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

END OF SECTION 092900

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes acoustical panels and exposed suspension systems for interior ceilings.
- B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Initial Selection: For components with factory-applied finishes.
- C. 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 6-inch- long Samples of each type, finish, and color.

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 components covered by or adjacent to acoustical panels.
 - 8. Minimum Drawing Scale: 1/8 inch = 1 foot.
 - B. Qualification Data: For testing agency.
 - C. Product Test Reports: For each acoustical panel ceiling, for tests performed by a qualified testing agency.
 - D. Evaluation Reports: For each acoustical panel ceiling suspension system, from ICC-ES.
 - E. 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. Acoustical Ceiling Units: Full-size panels equal to 2 percent of quantity installed.
 - 2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.
- 1.7 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 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.
 - 1. Where pressurized plenums are present, operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

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 E 84; testing by a qualified testing agency. Identify products with appropriate markings from an applicable testing agency.

2.3 ACOUSTICAL PANELS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong Ceiling & Wall Solutions; or a comparable product by CertainTeed Corporation for acoustical products.
 - 1. Basis-of-Design product for ACT-1 to be Optima #3250, square tegular 15/16".
 - a. Size: 24" x 24" x 1"
 - b. Color: White.
- B. Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E 1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.
- C. Antimicrobial Treatment: Manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273, ASTM D 3274, or ASTM G 21 and evaluated according to ASTM D 3274 or ASTM G 21.

2.4 METAL SUSPENSION SYSTEM

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong Ceiling & Wall Solutions; or a comparable product by CertainTeed Corporation.
 - 1. Basis-of-Design product for acoustical panel products to be Prelude XL15/16" exposed tee.
 - a. Application: ACT-1
 - b. Color: White.
- B. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C 635 and designated by type, structural classification, and finish indicated.

2.5 ACCESSORIES

- A. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing according to ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
 - a. Type: Postinstalled expansion anchors.
 - b. Corrosion Protection: Carbon-steel components zinc plated according to ASTM B 633, Class SC 1 (mild) service condition.
 - c. Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Group 1 Alloy 304 or 316.
 - d. Corrosion Protection: Components fabricated from nickel-copper-alloy rods complying with ASTM B 164 for UNS No. N04400 alloy.
 2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E 1190, conducted by a qualified testing and inspecting agency.
- B. Wire Hangers, Braces, and Ties: Provide wires as follows:
1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641, Class 1 zinc coating, soft temper.
 2. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.106-inch- diameter wire.

2.6 METAL EDGE MOLDINGS AND TRIM

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong Ceiling & Wall Solutions; or a comparable product by CertainTeed Corporation.
- B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.
1. Edge moldings shall fit acoustical panel edge details and suspension systems indicated and match width and configuration of exposed runners unless otherwise indicated.
 2. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
 3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
- C. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's

designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements.

1. Baked-Enamel or Powder-Coat Finish: Minimum dry film thickness of 1.5 mils. Comply with ASTM C 635 and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
2. At exterior applications, provide molding and trim of material compatible with grid system and as recommended by grid manufacturer.
3. In all instances of ceiling products listed in this Section, provide all necessary end caps and trim for a complete installation.

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 to accommodate lighting layouts, 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 C 636 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. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 6. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 7. Do not attach hangers to steel deck tabs.
 8. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 9. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
 10. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
- 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. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
 2. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 3. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
 4. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.

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 FIELD QUALITY CONTROL

- A. Special Inspections: Owner may engage a qualified special inspector to perform the following special inspections:
 - 1. Periodic inspection during the installation of suspended ceiling grids according to ASCE/SEI 7.

3.6 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 095113

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Thermoplastic-rubber base.
 - 2. Rubber stair accessories.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, not less than 12 inches long.
- C. Samples for Initial Selection: For each type of product indicated.
- D. Product Schedule: For resilient base and accessory products.

1.4 MAINTENANCE MATERIAL SUBMITTALS

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

1.5 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Coordinate mockups in this Section with mockups specified in other Sections.
 - 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.

1.6 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 degrees F or more than 90 degrees F.

1.7 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 degrees F or more than 95 degrees 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 degrees F or more than 95 degrees F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 THERMOPLASTIC-RUBBER BASE

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Johnsonite; a Tarkett company.
- B. Product Standard: ASTM F 1861, Type TP (rubber, thermoplastic).
 - 1. Designations: RB-1, RB-2, and RB-3 as indicated on the Interior Finish Legend.
 - 2. Group: I (solid, homogeneous)
 - 3. Style and Location for profile:
 - a. Cove: Provide for RB-1 and RB-3.
 - b. Millwork profile – Reveal. Provide for RB-2, 4.25".
 - 4. Size and style: As indicated on the Interior Finish Legend.
- C. Lengths: Coils in manufacturer's standard length.
- D. Outside Corners: Job formed.
- E. Inside Corners: Job formed.
- F. Colors: To be selected from full range of Manufacturer's available colors or as indicated on the Interior Finish Legend.
- G. Locations: As listed within the Room Finish Schedules.

2.2 RUBBER STAIR ACCESSORIES

- A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
- B. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Johnsonite; a Tarkett company.
- C. Stair Treads with integrated risers: ASTM F 2169.
 - 1. Type: TS (rubber, vulcanized thermoset).
 - 2. Class: 2 (pattern; hammered).
 - 3. Group: 2 (with contrasting color for the visually impaired).
 - 4. Nosing Style: Integrated riser.
 - 5. Size: Lengths and depths to fit each stair tread and riser in one piece.
- D. Stringers: Height and length after cutting to fit risers and treads and to cover stair stringers, produced by same manufacturer as treads, and recommended by manufacturer for installation with treads.
 - 1. Thickness: 0.125 inch.
- E. Landing Tile: Produced by same manufacturer as treads and recommended by manufacturer for installation with treads.
- F. Locations: Provide rubber stair accessories in areas indicated.
- G. Colors and Patterns: To be selected from full range of Manufacturer's available colors.
- H. Transition Strips: Rubber. Tarkett CTA Series Wheeled Traffic Transitions of profile and width required based on installed material thicknesses, and of maximum lengths to minimize running joints. Provide at all locations of transitions between dissimilar height flooring materials. Color to be selected from Manufacturer's full range of available colors.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type 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 and with tops aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Job-Formed Corners:
 1. Inside Corners: Use straight pieces of maximum lengths possible
 - a. Miter corners to minimize open joints.

3.4 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Stair Accessories:

1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
2. Tightly adhere to substrates throughout length of each piece.
3. For treads installed as separate, equal-length units, install to produce a flush joint between units.

C. 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 096513

SECTION 096723 - RESINOUS FLOORING

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. Resinous flooring.
 - 2. Integral cove base accessories.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review manufacturer's written instructions for substrate preparation and environmental conditions affecting resinous flooring installation, specifically required cure times for new concrete.
 - 2. Review details of integral cove bases.
 - 3. Review manufacturer's written instructions for installing resinous flooring systems.
 - 4. Review protection measures for adjacent construction and installed flooring, floor drainage requirements, curbs, base details, and so forth.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's technical data, installation instructions, and recommendations for each resinous flooring component required.
- B. Samples: For each resinous floor system required and for each color and texture specified, 6 inches square in size, applied to a rigid backing by Installer for this Project.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Material Certificates: For each resinous flooring component.
- C. Material Test Reports: For each resinous flooring system, by a qualified testing agency.
- D. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

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

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
 - 1. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Simulate finished lighting conditions for Architect's review of mockups.
 - 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 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring installation.
- B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring installation.
- C. Close spaces to traffic during resinous flooring installation and for 24 hours after installation unless manufacturer recommends a longer period.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Flammability: Self-extinguishing in accordance with ASTM D635.

2.2 RESINOUS FLOORING

- A. Resinous Flooring System: Abrasion-, impact-, and chemical-resistant, aggregate-filled, resin-based monolithic floor surfacing designed to produce a seamless floor and integral cove base. Provide products by the following.
 - 1. Durex, DymaFlake
- B. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Obtain secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from manufacturer recommended in writing by manufacturer of primary materials.
- C. System Characteristics:
 - 1. Color, Pattern, and Texture: To be selected from Manufacturer's full range of available colors and textures.
- D. Waterproofing Membrane: Type recommended in writing by resinous flooring manufacturer for substrate and resinous flooring system indicated. Provide only if recommended by manufacturer.
- E. Reinforcing Membrane: Flexible resin formulation that is recommended in writing by resinous flooring manufacturer for substrate and resinous flooring system indicated and that inhibits substrate cracks from reflecting through resinous flooring. Provide only if recommended by manufacturer.
- F. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended in writing by manufacturer for installation indicated.

2.3 DYMAFLAKE SYSTEM

- A. Primer: Type recommended in writing by resinous flooring manufacturer for substrate and resinous flooring system indicated. Apply at manufacturer's recommended values.
 - 1. Number of Coats: One.
 - 2. Primer Thickness: System standard.
- B. Body Coats:
 - 1. Body Coat Thickness: System standard.
 - 2. Aggregates: Manufacturer's standard.
- C. Topcoats: Sealing or finish coats.
 - 1. Number of Coats: One.
 - 2. Topcoat Thickness: System standard.
 - 3. Finish: To be selected as part of submittal and sample review process.

2.4 COVE BASE

- A. Floor product to continue seamlessly up existing walls for one full course of CMU or CGFT. Provide a continuous horizontal stopping point throughout each room.

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 resinous flooring systems.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare and clean substrates in accordance with resinous flooring manufacturer's written instructions for substrate indicated to ensure adhesion.
- B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
 - 1. Roughen concrete substrates as follows:
 - a. Abrasive blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed abrasive within the apparatus, and recirculates the abrasive by vacuum pickup.
 - b. Comply with requirements in SSPC-SP 13/NACE No. 6, with a Concrete Surface Profile of 3 or greater in accordance with ICRI Technical Guideline No. 310.2R, unless manufacturer's written instructions are more stringent or moisture remediation requires a different profile.
 - 2. Repair damaged and deteriorated concrete in accordance with resinous flooring manufacturer's written instructions.
 - 3. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft., 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.
 - 4. Alkalinity and Adhesion Testing: Perform tests recommended in writing by resinous flooring manufacturer. Proceed with installation only after substrate alkalinity is not less than 6 or more than 8 pH unless otherwise recommended in writing by flooring manufacturer.
- C. Patching and Filling: Use patching and fill material to fill holes and depressions in substrates in accordance with manufacturer's written instructions.

1. Control Joint Treatment: Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring in accordance with manufacturer's written instructions.
- D. Resinous Materials: Mix components and prepare materials in accordance with resinous flooring manufacturer's written instructions.

3.3 INSTALLATION

- A. Apply components of resinous flooring system in accordance with manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness specified.
 1. Coordinate installation of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
 2. Cure resinous flooring components in accordance with manufacturer's written instructions. Prevent contamination during installation and curing processes.
 3. Expansion and Isolation Joint Treatment: At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.
- B. Primer: Apply primer over prepared substrate at spreading rate recommended in writing by manufacturer.
- C. Waterproofing Membrane: Apply waterproofing membrane over entire substrate surface, in thickness recommended in writing by manufacturer.
 1. Apply waterproofing membrane to cove base.
- D. Reinforcing Membrane: Apply reinforcing membrane to substrate cracks..
- E. Field-Formed Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring coats. Apply in accordance with manufacturer's written instructions and details, including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Round internal and external corners.
- F. Self-Leveling Body Coats: Apply self-leveling slurry body coats in thickness specified for flooring system.
 1. Aggregates: Broadcast aggregates at rate recommended in writing by manufacturer. After resin is cured, remove excess aggregates to provide surface texture indicated.
- G. Troweled or Screeded Body Coats: Apply troweled or screeded body coats in thickness specified for flooring system. Hand or power trowel and grout to fill voids. When body coats are cured, remove trowel marks and roughness using method recommended in writing by manufacturer.
- H. Grout Coat: Apply grout coat to fill voids in surface of final body coat.
- I. Topcoats: Apply topcoats in number indicated for flooring system specified, at spreading rates recommended in writing by manufacturer, and to produce wearing surface specified.

3.4 PROTECTION

- A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

END OF SECTION 096723

SECTION 096766 - RUBBER ATHLETIC FLOORING

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. Rubber Athletic Flooring
- B. Related Requirements:
 - 1. Section 096513 "Resilient Base and Accessories" for wall base and accessories.

1.3 PREINSTALLATION MEETINGS

- A. Pre-slab Conference: Conduct conference at Project site.
 - 1. Meet with Owner, Architect, testing and inspecting agency representative, flooring Installer, flooring system manufacturer's representative, slab installer, and installers whose work interfaces with flooring installation.
 - 2. Review methods and procedures related to concrete slab installation, including Rubber Athletic Flooring manufacturer's written instructions.
 - 3. Discuss deck and substrate conditions and finishes for compliance with requirements, including required flatness and use (and removal) of sealers and curing compounds. Make every effort to minimize use of curing compounds to minimize or eliminate the need for slab grinding or additional preparation prior to Rubber Athletic Flooring installation.
 - 4. Discuss required slab finish for acceptance of Rubber Athletic Flooring product. Adjust type of slab finish as recommended in writing by Rubber Athletic Flooring manufacturer to minimize or eliminate the need for slab grinding or additional preparation prior to Rubber Athletic Flooring installation.
 - 5. Discuss testing requirements, including manufacturer's written procedures to be followed.
 - 6. Record minutes from Pre-slab conference and distribute to all parties.
- B. Preinstallation Conference: Conduct conference at Project site.
 - 1. Meet with Owner, Architect, testing and inspecting agency representative, flooring Installer, flooring system manufacturer's representative, slab Installer, and installers whose work interfaces with flooring installation.
 - 2. Review methods and procedures related to flooring installation, including manufacturer's written instructions.
 - 3. Examine concrete substrate conditions for compliance with requirements, including flatness and use (and removal) of sealers and curing compounds. Review and agree upon any concrete repair procedures required prior to flooring installation.
 - 4. Review traffic and loading limitations of flooring during and after installation.

5. Review temporary protection requirements for flooring system during and after installation.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For flooring. Show installation details including layout, colors, and widths.
- C. Samples: For each color, gloss, and texture of floor required, 12 inches square, applied to a rigid backing.
- D. Samples for Initial Selection: Manufacturer's color charts showing colors and glosses available for flooring.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For Rubber Athletic Flooring to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An installer who is approved, trained, or certified by Rubber Athletic Flooring manufacturer.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Comply with flooring manufacturer's written instructions for substrate temperature, ambient temperature, humidity, ventilation, and other conditions affecting flooring application.
 1. Do not apply flooring until spaces are enclosed and weatherproof; wet-work in spaces is complete and dry; and overhead work, including installing mechanical systems, lighting, and athletic equipment, is complete.
 2. Maintain temperatures during installation within range recommended in writing by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive flooring 48 hours before installation, during installation, and 48 hours after installation unless longer period is recommended in writing by manufacturer.
 3. After installation period, maintain temperatures within range recommended in writing by manufacturer, but not less than 55 deg F or more than 95 deg F.
 4. Close spaces to traffic during flooring installation.

PART 2 - PRODUCTS

2.1 RUBBER ATHLETIC FLOORING

- A. Basis-of-Design Product: Subject to compliance with requirements, provide ECORE Fit Collection or a comparable product by the following:
 - 1. Mondo
 - 2. OsstSport USA
 - 3. PLAE
- B. Description: Rubber athletic flooring system applied directly to substrate.
- C. Sizes: 23 inch x 23 inch interlocking tiles.
- D. Thickness: 8 mm (RF-1).
- E. Finishes:
 - 1. Color: Architect to select from manufacturers full selection.
 - 2. Surface Texture: Manufacturer's standard slip-resistant surface texture.

2.2 ACCESSORIES

- A. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by flooring manufacturer.
- B. Adhesives: Manufacturers recommended two component polyurethane adhesive for application to substrate.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, 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 rubber products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Concrete Slabs: Verify that existing concrete slab meets the following requirements for a new concrete slab installation.

1. Moisture Testing: Perform tests so that each test area does not exceed 500 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 7 or more than 9 pH.
 - b. Relative Humidity Test: Using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum relative humidity level measurement no greater than the published Rubber Athletic Flooring limitations for the installed product. Under no instance shall Rubber Athletic Flooring be installed over concrete slabs with recorded rates greater than 85 percent relative humidity, unless accepted by the Rubber Athletic Flooring manufacturer in writing.
 - c. At the contractor's option, optional adhesives, approved in writing by the Rubber Athletic Flooring manufacturer, capable of allowing installation over slabs with increased relative humidity percentages may be used at no additional cost to the Owner, if approved, in writing, by the Owner and Rubber Athletic Flooring manufacturer.
 - d. Adjust building interior temperatures and dehumidification measures as recommended by Rubber Athletic Flooring manufacturer to reach required pH values, moisture-vapor-emissions rates, and relative humidity levels. Costs for increased heating or dehumidification measures shall not be passed on to the Owner, unless specifically agreed to as part of the Contract Documents.
 - e. Perform additional moisture tests recommended in writing by adhesive and Rubber Athletic Flooring manufacturers. Proceed with installation only after substrates pass testing.
- B. Remove substrate coatings and other substances that are incompatible with flooring system components and that contain soap, wax, oil, or silicone, using mechanical methods recommended in writing by manufacturer. Do not use solvents.
- C. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.
- D. Treat nonmoving substrate cracks and control joints to prevent cracks from telegraphing (reflecting) through flooring, according to manufacturer's written instructions.
- E. Move flooring installation materials into spaces where they will be installed at least 48 hours in advance of installation unless manufacturer recommends a longer period in writing.
 1. Do not install flooring until it is same temperature as space where it is to be installed.
- F. Sweep and vacuum clean substrates to be covered by flooring immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.
- G. Protect walls, floor openings, electrical openings, door frames, and other obstructions during installation.

3.3 FLOORING INSTALLATION, GENERAL

- A. Install flooring according to manufacturer's written instructions.

- B. Adhesive: Manufacturer's standard, two component polyurethane glue

3.4 PROTECTION

- A. Close spaces to traffic for 48 hours after flooring installation unless manufacturer recommends longer period in writing.
- B. Protect flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.
 - 1. Do not move heavy and sharp objects directly over flooring. Protect flooring with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

END OF SECTION 096766

SECTION 096815 - SYNTHETIC GRASS 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 synthetic grass surfacing.

1.3 PREINSTALLATION MEETINGS

- A. Pre-slab Conference: Conduct conference at Project site.
 - 1. Meet with Owner, Architect, testing and inspecting agency representative, flooring Installer, flooring system manufacturer's representative, slab installer, and installers whose work interfaces with flooring installation.
 - 2. Review methods and procedures related to concrete slab installation, including Synthetic Grass Surfacing manufacturer's written instructions.
 - 3. Discuss deck and substrate conditions and finishes for compliance with requirements, including required flatness and use (and removal) of sealers and curing compounds. Make every effort to minimize use of curing compounds to minimize or eliminate the need for slab grinding or additional preparation prior to Synthetic Grass Surfacing installation.
 - 4. Discuss required slab finish for acceptance of Synthetic Grass Surfacing product. Adjust type of slab finish as recommended in writing by Synthetic Grass Surfacing manufacturer to minimize or eliminate the need for slab grinding or additional preparation prior to Synthetic Grass Surfacing installation.
 - 5. Discuss testing requirements, including manufacturer's written procedures to be followed.
 - 6. Record minutes from Pre-slab conference and distribute to all parties.
- B. Preinstallation Conference: Conduct conference at Project site.
 - 1. Meet with Owner, Architect, testing and inspecting agency representative, flooring Installer, flooring system manufacturer's representative, slab Installer, and installers whose work interfaces with flooring installation.
 - 2. Review methods and procedures related to flooring installation, including manufacturer's written instructions.
 - 3. Examine concrete substrate conditions for compliance with requirements, including flatness and use (and removal) of sealers and curing compounds. Review and agree upon any concrete repair procedures required prior to flooring installation.
 - 4. Review traffic and loading limitations of flooring during and after installation.
 - 5. Review temporary protection requirements for flooring system during and after installation.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For synthetic grass surfacing.
 - 1. Include sections and details.
 - 2. Show locations of seams and method of seaming.
 - 3. Show layout of game lines. Indicate application method of each line and marking.
- C. Samples: For each type of synthetic grass surfacing indicated.
 - 1. Turf Fabric: 12 inches square.
 - 2. Game Line Turf Fabric: 12 inches long by actual width.
 - 3. Shock-Attenuation Pad: 12 inches square.
 - 4. Seam Sample: 24 inches square with seam centered in sample.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each synthetic grass surfacing assembly.
- C. Field quality-control reports.
- D. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For synthetic grass surfacing, including maintenance cleaning instructions, 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. Turf Fabric: Minimum of 300 sq. ft. for each type indicated.
 - 2. Seaming Tape and Adhesive: One roll of seaming tape and one gallon of adhesive.
 - 3. One new set of maintenance tools, of type recommended by synthetic grass surfacing manufacturer for installation.
 - 4. One sack of PivotCool infill for refresh by the Owner.

1.8 QUALITY ASSURANCE

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

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace synthetic grass surfacing that fails in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration and excessive wear.
 - b. Excessive loss of shock attenuation.
 - c. Seam separation, including game lines and markings.
 - 2. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Synthetic Grass Surfacing: Assembly tested according to the following methods, with additional test method conditions for each method according to ASTM F 1551.
 - 1. Shock Attenuation: 135 G(max) at time of installation according to ASTM F 355. Systems having published test results higher than 135 will not be acceptable on this Project.

2.2 SYNTHETIC GRASS SURFACING

- A. Synthetic Grass Surfacing: Complete surfacing system, consisting of synthetic yarns bound to water-permeable backing, suitable for multipurpose sport playing fields.
 - 1. Product: TenCate Pivot Performance, 100oz, 1.375" pile height
- B. Turf Fabric: Woven turf fabric with multicolored fiber and UV resistance.
- C. Backing: Manufacturer's standard woven or nonwoven polypropylene primary backing with urethane-coated secondary backing; provide perforations or drainage channels sufficient to meet permeability indicated.
- D. Infill: Manufacturer's standard low volume subsurface infill.
 - 1. Product: TenCate PivotCool
- E. Game Lines and Markings: Provide game lines and markers in widths and colors according to requirements indicated on Drawings.
 - 1. Application Method: Tufted in to the maximum extent practicable, with remaining lines inlaid. Painted lines will be entertained per manufacturer's recommendation for specific product being installed; however, tufted/ inlaid lines are the bidding requirement.
- F. Seaming Method: Sewn.

2.3 MATERIALS

- A. Seam Adhesive: One- or two-part urethane, recommended or approved by synthetic grass surfacing manufacturer, and suitable for ambient conditions at time of installation.
- B. Seam Tape: Synthetic grass manufacturer's recommended seam tape, minimum 12 inches wide for inlaid game lines.
- C. Seaming Cord: Seaming cord or thread, recommended by the synthetic grass surfacing manufacturer.
- D. Shock-Attenuation Pad: 20mm thick. TenCate MaxFlo+ or equivalent manufacturer to meet (G)max requirements. Shock-attenuation pad shall not exceed 20 mm in thickness.
- E. Game Line Paint: Permanent paint as recommended or approved by synthetic grass surfacing manufacturer. Factory installed.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Examine Synthetic Grass Surfacing for type, color, pattern, and potential defects.
- B. 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. Adjust concrete finish requirements as recommended by Synthetic Grass Surfacing manufacturer as part of the Pre-Slab Conference.
 - 1. Moisture Testing: Perform tests so that each test area does not exceed 500 sq. ft. over the entirety of the Synthetic Grass Surfacing installation area.
 - a. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 7 or more than 9 pH.
 - b. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 5 lb of water/ 1000 sq. ft. in 24 hours.
 - c. Relative Humidity Test: Using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum relative humidity level measurement no greater than the published Synthetic Grass Surfacing limitations for the installed product. Under no instance shall Synthetic Grass Surfacing be installed over concrete slabs with recorded rates greater than 85 percent relative

- humidity, unless accepted by the Synthetic Grass Surfacing manufacturer in writing.
 - d. At the contractor's option, optional adhesives, approved in writing by the Synthetic Grass Surfacing manufacturer, capable of allowing installation over slabs with increased relative humidity percentages may be used at no additional cost to the Owner, if approved, in writing, by the Owner and Synthetic Grass Surfacing manufacturer.
 - e. Adjust building interior temperatures and dehumidification measures as recommended by Synthetic Grass Surfacing manufacturer to reach required pH values, moisture-vapor-emissions rates, and relative humidity levels. Costs for increased heating or dehumidification measures shall not be passed on to the Owner, unless specifically agreed to as part of the Contract Documents.
 - f. Perform additional moisture tests recommended in writing by adhesive and Synthetic Grass Surfacing manufacturers. Proceed with installation only after substrates pass testing.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. 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.
- E. 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. No additional cost will be passed on to the Owner for removal of coatings or curing compounds.
- F. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

- A. Shock-Attenuation Pad Installation: Lay out pad and allow to relax a minimum of six hours prior to final fit and trim. Stagger head seams between adjacent rows. Fit seams snugly without stretching or forcing.
- B. Roll out turf fabric and allow to relax at least four hours prior to seaming.
- C. Provide seams flat and snug, with no gaps or fraying. Remove yarns that are trapped within seams. Attach turf fabric to perimeter restraint system as recommended by the manufacturer.
- D. Install inlaid game lines and markings by cutting through turf fabric and installing snugly fitting game line turf fabric. Provide seaming tape that extends minimum 6 inches beyond seam.
- E. Repair loose seams and bubbles formed due to expansion of turf fabric prior to installation of infill.
- F. The synthetic turf fabric shall be unfilled. No sand or SBR Rubber shall be allowed. A PivotCool ballast additive (oolitic aragonite) shall be incorporated at a rate of 2.5 lbs./square foot.
- G. Painted Game Lines: Apply lines and markings as recommended by the game line paint manufacturer.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner may engage a qualified testing agency to perform tests and inspections.
 - 1. Shock Attenuation: No greater than 120 G(max) at time of installation according to ASTM F 1936.

3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel in proper maintenance procedures for synthetic grass surfacing.

END OF SECTION 096815

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes surface preparation and the application of paint systems on interior substrates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Include Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
 - 2. Indicate VOC content.
- B. Samples for Initial Selection: For each type of topcoat product.
- C. 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.
- D. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint: 5 percent, but not less than 1 gallon of each material and color applied.

1.5 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.
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 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.

1.7 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. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
 1. The Sherwin-Williams Company.

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.

- B. Colors: As selected by Architect from manufacturer's full range.
 - 1. Assume 10 percent of surface area will be painted with deep tones.

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. Fiber-Cement Board: 12 percent.
 - 3. Masonry (Clay and CMUs): 12 percent.
 - 4. Wood: 15 percent.
 - 5. 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. 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.
- B. 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.
- C. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- D. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

E. Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Sand surfaces that will be exposed to view, and dust off.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

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. 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.

C. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed in occupied spaces:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - h. Other items as directed by Architect.
2. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 CLEANING AND PROTECTION

A. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

B. Protect work of other trades against damage. Correct damage to work of other trades by cleaning, repairing, and refinishing, and leave in an undamaged condition.

3.5 INTERIOR PAINTING SCHEDULE

- A. Gypsum board walls.
 - 1. First Coat (Primer): SW ProMar 200 Zero VOC Interior Latex Primer, B28W12600, 4 mils wet, 1.5 mils dry.
 - a. Omit primer at existing painted walls.
 - 2. Second Coat: SW ProMar 200 Zero VOC latex, Eg-Shel, B20-Series, 4 mils wet, 1.7 mils dry.
 - 3. Third Coat: SW ProMar 200 Zero VOC latex, Eg-Shel, B20-Series, 4 mils wet, 1.7 mils dry.
- B. Gypsum board ceilings:
 - 1. First Coat (Primer): SW ProMar 200 Zero VOC Interior Latex Primer, B28W12600, 4 mils wet, 1.5 mils dry.
 - a. Omit primer at existing painted ceilings.
 - 2. Second Coat: SW ProMar 200 Zero VOC latex, Flat, B30-Series, 4 mils wet, 1.6 mils dry.
 - 3. Third Coat: SW ProMar 200 Zero VOC latex, Flat, B30-Series, 4 mils wet, 1.6 mils dry.
- C. CMU wall surfaces throughout the building (not exposed to moisture).
 - 1. First Coat (Primer): SW Pro Industrial Heavy Duty Block Filler, B42W150
 - a. Omit primer at existing painted walls.
 - 2. Second coat: SW ProMar 200 HP Zero VOC acrylic Eg-Shel, B20-1900 series
 - 3. Third Coat: SW ProMar 200 HP Zero VOC acrylic Eg-Shel, B20-1900 series
- D. CMU Walls subject to moisture (toilet and shower rooms)
 - 1. First Coat (Primer): SW Loxon Concrete and Masonry Primer Sealer, LX02W50, 8 mils wet, 3.2 mils dry.
 - a. Omit primer at existing painted walls.
 - 2. Second Coat: SW Pro Industrial Waterbased Catalyzed Epoxy, B73-360, 5 mils wet, 2 mils dry.
 - 3. Third Coat: SW Pro Industrial Waterbased Catalyzed Epoxy, B73-360, 5 mils wet, 2 mils dry.
- E. Hollow metal door frames throughout the building.
 - 1. First Coat (Primer): SW Pro Industrial Pro-Cryl Universal Metal Primer, B66-1310 series, 5-10 mils wet, 1.8 to 3.6 mils dry.
 - a. Omit primer at existing painted doors and frames.
 - 2. Second Coat: SW Pro Industrial Waterbased Alkyd Urethane Semi-Gloss, B53-1150 series, 4-8 mils wet, 1.8-3.6 mils dry.
 - 3. Third Coat: SW Pro Industrial Waterbased Alkyd Urethane Semi-Gloss, B53-1150 series, 4-8 mils wet, 1.8-3.6 mils dry.
- F. Miscellaneous ferrous metal (structural steel and roof and floor decking) in areas scheduled to receive an exposed ceiling finish.
 - 1. First Coat (Primer): Pro Industrial Pro-Cryl Universal Metal Primer or Concrete Primer, depending on surface and as recommended by Sherwin Williams.

2. Second Coat: Pro Industrial Multi-Purpose Acrylic, B66-1560 series, Eg-Shel, 2.75 to 6 mils wet, 1.5 to 2.3 mils dry.
 3. Third Coat: Pro Industrial Multi-Purpose Acrylic, Eg-Shel, B66-1560 series, 2.75 to 6 mils wet, 1.5 to 2.3 mils dry.
- G. Exterior miscellaneous ferrous metal installations including railing, etc.
1. Primer: Macropoxy 646 Fast Cure Epoxy, B58-600 series.
 2. 1st Coat: Urethane Enamel, exterior, matching topcoat.
 3. 2nd Coat: Hi-Solids Polyurethane 250 Semi-Gloss, B65J-350 series or Gloss, B65J-300 series.
- H. Exterior lintels.
1. Primer: Macropoxy 920 Pre-Prime.
 2. 1st Coat: Macropoxy 646 Fast Cure Epoxy, B58-600 series.
 3. 2nd Coat: Hi-Solids Polyurethane 250 Semi-Gloss, B65J-350 series or Gloss, B65J-300 series.

END OF SECTION 099123

SECTION 101423 - ROOM-IDENTIFICATION SIGNAGE

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 room-identification signs that are directly attached to the building.

1.3 DEFINITIONS

- A. Accessible: In accordance with the accessibility standard.

1.4 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.

1.5 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. Variable Component Materials: Full-size Sample of each base material, character (letter, number, and graphic element) in each exposed color and finish not included in Samples above.
 3. Exposed Accessories: Full-size Sample of each accessory type.
 4. 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.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
- B. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

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

1.8 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. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.

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. 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. InPro Corporation (IPC).

- b. Mohawk Sign Systems.
- 2. Laminated-Sheet Sign: Photopolymer or Sandblasted polymer face sheet with raised graphics laminated to acrylic or phenolic backing sheet to produce composite sheet.
 - a. Composite-Sheet Thickness: Manufacturer's standard for size of sign.
 - b. Color(s): As selected by Architect from manufacturer's full range.
- 3. Sign-Panel Perimeter: Finish edges smooth.
 - a. Edge Condition: Square cut.
 - b. Corner Condition in Elevation: Rounded.
- 4. Mounting: Manufacturer's standard method for substrates indicated.
- 5. Text and Typeface: Accessible raised characters and Braille. Typeface as selected by Architect from manufacturer's full range. Finish raised characters to contrast with background color, and finish Braille to match background color.

2.3 SIGN MATERIALS

- A. Acrylic Sheet: ASTM D 4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).

2.4 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, rated for exterior installations, and complying with the following:
 - 1. Use concealed fasteners and anchors unless indicated to be exposed.
 - 2. For exterior exposure, furnish stainless-steel fasteners unless otherwise indicated.
 - 3. Exposed Metal-Fastener Components, General:
 - a. Fabricated from same basic metal and finish of fastened sign unless otherwise indicated.
 - b. Fastener Heads: Use flathead or oval countersunk screws and bolts with tamper-resistant slots unless otherwise indicated.
 - 4. Sign Mounting Fasteners:
 - a. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, and installed in predrilled holes.
- B. 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.

2.6 GENERAL FINISH REQUIREMENTS

- A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

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 debris.
- 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.
 - 2. Mounting to glass substrates: Provide blank backer plate on side of glass opposite scheduled signage. Blank plate to match size, material, color, and profile of scheduled signage.

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.

3.3 SIGNAGE QUANTITIES

- A. Provide base quantities as indicated on the Door Schedule
- B. Provide quantity of signs as indicated on the Door Schedule within the Drawing Set. Beyond those quantities, provide additional attic stock sign quantities as listed below.
 - 1. Signage type S-1: Provide (2) additional signs.
 - 2. Signage type S-2: Provide (4) additional signs, lettering to be confirmed
 - 3. Signage type S-4: Provide (2) additional signs.
 - 4. Signage type S-5 and S-6: Provide (1) additional sign each.

END OF SECTION 101423

SECTION 102113 - PLASTIC TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Solid-plastic toilet compartments configured as toilet enclosures.
- B. Related Requirements:
 - 1. Section 102800 "Toilet, Bath, and Laundry Accessories" for toilet tissue dispensers, grab bars, and similar accessories mounted on toilet compartments.

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 toilet compartments.
- B. Shop Drawings: For toilet compartments.
 - 1. Include plans, elevations, sections, details, and attachment details.
 - 2. Show locations of cutouts for compartment-mounted toilet accessories.
 - 3. Show locations of centerlines of toilet fixtures.
 - 4. Show locations of floor drains.
 - 5. Show ceiling grid, ceiling-mounted items, and overhead support or bracing locations.
- C. Samples for Initial Selection: For each type of toilet compartment material indicated.
 - 1. Include Samples of hardware and accessories involving material and color selection.
- D. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:
 - 1. Each type of material, color, and finish required for toilet compartments, prepared on 6-inch-square Samples of same thickness and material indicated for Work.
 - 2. Each type of hardware and accessory.
- E. Product Schedule: For toilet compartments, prepared by or under the supervision of supplier, detailing location and selected colors for toilet compartment material.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of toilet compartment.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For toilet compartments 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 and source.
 - 1. Door Hinges: Continuous hinges.
 - 2. Latch and Keeper: Six latches and keepers with associated fasteners.
 - 3. Door Bumper: Four bumpers with associated fasteners.
 - 4. Door Pull: Four door pulls with associated fasteners.
 - 5. Fasteners: Twenty fasteners of each size and type.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for toilet compartments designated as accessible.

2.2 SOLID-PLASTIC TOILET COMPARTMENTS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Scranton Products, Hiny Hiders.
- B. Toilet-Enclosure Style: Floor Mounted-Overhead Braced
- C. Door, Panel, Screen, and Pilaster Construction: Solid, high-density polyethylene (HDPE) panel material, not less than 1 inch thick, seamless, with eased edges, and with homogenous color and pattern throughout thickness of material.
 - 1. Integral Hinges: Configure doors and pilasters to receive integral continuous hinges.
 - 2. Style and Color: Orange Peel finish, color to be selected from manufacturers full range.
- D. Brackets (Fittings):

1. Full-Height (Continuous) Type: Manufacturer's standard design; extruded aluminum.

2.3 HARDWARE AND ACCESSORIES

- A. Hardware and Accessories: Manufacturer's standard operating hardware and accessories.
 1. Material: Clear-anodized aluminum.
 2. Hinges: Manufacturer's standard continuous, cam type that swings to a closed or partially open position, allowing emergency access by lifting door.
 3. Latch and Keeper: Manufacturer's standard surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
 4. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories. Provide one per compartment.
 5. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
 6. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.
- B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with anti-grip profile and in manufacturer's standard finish.
- C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless-steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel compatible with related materials.

2.4 MATERIALS

- A. Aluminum Castings: ASTM B 26.
- B. Aluminum Extrusions: ASTM B 221.
- C. Brass Castings: ASTM B 584.
- D. Brass Extrusions: ASTM B 455.
- E. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.
- F. Stainless-Steel Castings: ASTM A 743.

2.5 FABRICATION

- A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.

- B. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.
- C. Door Size and Swings: Unless otherwise indicated, provide 24-inch- wide, in-swinging doors for standard toilet compartments and 34-inch- wide, out-swinging doors with a minimum 32-inch-wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.
 - 1. Confirm location and adequacy of blocking and supports required for installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
 - 1. Maximum Clearances:
 - a. Pilasters and Panels: 1/2 inch.
 - b. Panels and Walls: 1 inch.
 - 2. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.
 - a. Locate bracket fasteners so holes for wall anchors occur in tile joints.
- A. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels and adjust, so tops of doors are parallel with overhead brace when doors are in closed position.

3.3 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 102113

SECTION 102600 - WALL PROTECTION

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. Wall panel protection

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For each type of wall and door protection showing locations and extent.
 - 1. Include plans, elevations, sections, and attachment details.
- C. Samples for Verification: For each type of exposed finish on the following products, prepared on Samples of size indicated below:
 - 1. Wall Panels – 3 inch x 3 inch sample chip

1.4 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each type of exposed plastic material.
- B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of wall protection product to include in maintenance manuals.
 - 1. Include recommended methods and frequency of maintenance for maintaining best condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to finishes and performance.

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. Mounting and Accessory Components: Amounts proportional to the quantities of extra materials. Package mounting and accessory components with each extra material.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store wall and door protection in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.
 - 1. Maintain room temperature within storage area at not less than 70 deg F during the period plastic materials are stored.
 - 2. Keep plastic materials out of direct sunlight.
 - 3. Store plastic wall- and door-protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F.
 - a. Store corner-guard covers in a vertical position.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of wall- and door-protection units that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including detachment of components from each other or from the substrates, delamination, and permanent deformation beyond normal use.
 - b. Deterioration of metals, metal finishes, plastics, and other materials beyond normal use.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain wall- and door-protection products of each type from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Surface Burning Characteristics: Comply with ASTM E84 or UL 723; 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.

2.3 WALL PANEL PROTECTION (WP-1)

A. Vinyl wall protection:

1. Basis-of-Design Product: Subject to compliance with requirements, provide products by the following.
 - a. Inpro, Palladium rigid sheet wall protection.
2. Thickness: 0.060 inch.
3. Height: As indicated on the Interior Finish Legend.
4. Color: As indicated on the Interior Finish Legend.
5. Trim and accessories: Provide corners, top caps, and divider bar trims and sealant for a complete system.
6. Locations: As indicated within the Drawing Set.

2.4 MATERIALS

- A. Plastic Materials: Chemical- and stain-resistant, high-impact-resistant plastic with integral color throughout; extruded and sheet material as required, thickness as indicated.
- B. Polycarbonate Plastic Sheet: ASTM D6098, S-PC01, Class 1 or Class 2, abrasion resistant; with a minimum impact-resistance rating of 15 ft.-lbf/in. of notch when tested according to ASTM D256, Test Method A.
- C. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.
- D. Adhesive: As recommended by protection product manufacturer.

2.5 FABRICATION

- A. Fabricate wall protection according to requirements indicated for design, performance, dimensions, and member sizes, including thicknesses of components.
- B. Factory Assembly: Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.
- C. Quality: Fabricate components with uniformly tight seams and joints and with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

2.6 FINISHES

- A. Protect 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 and wall areas, with Installer present, for compliance with requirements for installation tolerances, fire rating, and other conditions affecting performance of the Work.
- B. Examine walls to which wall protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
 - 1. For wall protection attached with adhesive, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Complete finishing operations, including painting, before installing wall and door protection.
- B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

- A. Installation Quality: Install wall and door protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
- B. Accessories: Provide splices, mounting hardware, anchors, trim, joint moldings, and other accessories required for a complete installation.
 - 1. Provide anchoring devices and suitable locations to withstand imposed loads.
 - 2. Adjust end and top caps as required to ensure tight seams.
- C. Abuse-Resistant Wall Covering: Install top and edge moldings, corners, and divider bars as required for a complete installation.

3.4 CLEANING

- A. Immediately after completion of installation, clean plastic covers and accessories using a standard ammonia-based household cleaning agent.
- B. Remove excess adhesive using methods and materials recommended by manufacturer.

END OF SECTION 102600

SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Public-use washroom accessories.
 - 2. Warm-air dryers.
 - 3. Childcare accessories.
 - 4. Underlavatory guards.

1.3 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.

1.4 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.

1.5 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

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

1.7 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 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.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

- A. Source Limitations: Obtain public-use washroom accessories from single source from single manufacturer. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the include but are not limited to Bobrick (basis-of-design).
- B. Grab Bar (TA-1B, TA-1D, TA-1E):
 - 1. Manufacturer: Bobrick: B-5806.99 Series
 - 2. Mounting: Flanges with concealed fasteners.
 - 3. Material: Satin stainless steel.
 - a. Finish: Peened
 - 4. Outside Diameter: 1-1/4 inches.
 - 5. Configuration and Length: As indicated on Drawings.
- C. Toilet Tissue (Roll) Dispenser (TA-2A): Provided by Owner
- D. Liquid-Soap Dispenser (TA-3A):
 - 1. Manufacturer: Bobrick B-2111.
 - 2. Description: Designed for dispensing all purpose hand soaps.
 - 3. Mounting: Vertically oriented, surface mounted.
 - 4. Capacity: 40 fluid ounces.

5. Materials: Satin stainless steel.
 6. Refill Indicator: Window type.
- E. Surface-Mounted Paper Towel Dispenser (TA-4A): Provided by Owner
- F. Mirror Unit (TA-5):
1. Manufacturer: Bobrick, B-165 Series.
 2. Frame: Stainless-steel channel.
 - a. Corners: Mitered and mechanically interlocked.
 3. Hangers: Produce rigid, tamper- and theft-resistant installation.
 4. Size: 24" x 36".
- G. Waste Receptacle (TA-6D):
1. Manufacturer: Bobrick, B-2400.
 2. Description: Unit for collecting waste.
 3. Mounting: Floor standing.
 4. Waste capacity: 33 gallons.
 5. Material and Finish: Satin stainless steel.
- H. Sanitary-Napkin Disposal Unit (TA-8A):
1. Manufacturers: Bobrick, B-254.
 2. Mounting: Surface mounted.
 3. Door or Cover: Self-closing with tumbler lockset.
 4. Receptacle: Plastic, removable.
 5. Material and Finish: Satin stainless steel.
- I. Robe Hook (TA-7A):
1. Manufacturers: Bobrick, B-7672.
 2. Mounting: Surface mounted.
 3. Material and Finish: Satin stainless steel.
- 2.3 WARM-AIR DRYERS
- A. Source Limitations: Obtain warm-air dryers from single source from single manufacturer. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the include but are not limited to Bobrick (basis-of-design).
- B. Warm-Air Dryer (TA-4D):
1. Manufacturers: Bobrick B-7128
 2. Description: Standard-speed, warm-air hand dryer.
 3. Mounting: Surface mounted.
 4. Operation: Electronic-sensor activated.
 - a. Operation Time: 12 seconds.
 5. Cover Material and Finish: To be selected from Manufacturer's full range.

6. Electrical Requirements: 115V, 15 Amp, 1,725 watts or 208-240V 6.8 – 7.8 Amp, 1,900 watts.

2.4 CHILDCARE ACCESSORIES

- A. Source Limitations: Obtain childcare accessories from single source from single manufacturer.
- B. Diaper-Changing Station (TA-11A):
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Koala Kare Products.
 2. Description: Horizontal unit that opens by folding down from stored position and with child-protection strap.
 - a. Engineered to support minimum of 250-lb static load when opened.
 3. Mounting: Surface mounted, with unit projecting not more than 4 inches from wall when closed.
 4. Operation: By pneumatic shock-absorbing mechanism.
 5. Material and Finish: HDPE. Color shall be selected from manufacturer's full range of available colors.
 6. Liner Dispenser: Built in.

2.5 UNDERLAVATORY GUARDS

- A. Underlavatory Guard:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Plumberex Specialty Products, Inc.
 - b. Truebro by IPS Corporation.
 2. Description: Insulating pipe covering for supply and drain piping assemblies that prevents direct contact with and burns from piping; allow service access without removing coverings.
 3. Material and Finish: Antimicrobial, molded plastic, white.
 4. Locations: Provide at lavatory in concessions.

2.6 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.
- B. Brass: ASTM B 19, flat products; ASTM B 16/B 16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.

- C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch minimum nominal thickness.
- D. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 hot-dip zinc coating.
- E. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- G. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
- H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.7 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F 446.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written instructions.

END OF SECTION 102800

SECTION 104416 - FIRE EXTINGUISHERS

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 portable, fire extinguishers and mounting brackets for fire extinguishers.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Schedule preinstallation conference with the local Fire Marshal to verify quantities, sizes, types, locations, and identification of fire extinguishers prior to ordering and installation. Invite Owner and Architect.

1.4 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.

1.5 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure of hydrostatic test according to NFPA 10.
 - b. Faulty operation of valves or release levers.
 - 2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 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.
 - 1. Provide fire extinguishers approved, listed, and labeled by FM Global.

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, provide products by one of the following:
 - a. Ansul by Johnson Controls Company.
 - b. Guardian Fire Equipment, Inc.
 - 2. Valves: Manufacturer's standard.
 - 3. Handles and Levers: Manufacturer's standard.
 - 4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.
- B. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 4-A:60-B:C, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container. See drawings for mounting types and locations. Provide at all locations indicated as 'FE'.

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.

END OF SECTION 104416

SECTION 105143 – WIRE MESH STORAGE LOCKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Welded wire mesh storage lockers.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.
 - a. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings:

1. Plans, elevations, sections, and attachment details.

C. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of wire mesh storage locker with factory-applied color finishes.

D. Delegated Design Submittals: For seismic restraint of wire mesh storage lockers, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Qualification Statements: For Installer.

C. Delegated design engineer qualifications.

1.4 QUALITY ASSURANCE

A. Delegated Design Engineer Qualifications: A professional engineer who is legally qualified to practice in state where Project is located and who is experienced in providing engineering services of the type indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wire mesh storage lockers with cardboard protectors on perimeters of panels and doors and with posts wrapped to provide protection during transit and Project-site storage. Use vented plastic.

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of construction contiguous with wire mesh storage lockers by field measurements and coordinate before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Regulations: Comply with applicable provisions in the DOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1 for wire mesh storage lockers designated as accessible.
- B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design seismic restraint of wire mesh storage lockers.
- C. Seismic Performance: Wire mesh storage lockers to withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.

2.2 WELDED WIRE MESH STORAGE LOCKERS

- 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. Wire Crafters Tenant Storage Locker Unit (Basis-of-Design).
- B. Source Limitations: Obtain plastic-laminate-faced cabinets from single manufacturer.
- C. Welded Wire Mesh: 10-gauge steel wire welded into 2-by-2-inch square mesh.
- D. Locker Configuration: Single tier.
- E. Unit Sizes:
 - 1. Width: As noted on drawings, both standard and custom sizes indicated.
 - 2. Depth: 60 inches.
 - 3. Height: 90 inches total.
- F. Wall Panels: Welded wire mesh welded to manufacturer's standard 1-1/4-by-1-1/4-by-1/8-inch steel angle framing.
 - 1. Horizontal Panel Stiffeners: Manufacturer's standard.
- G. Ceiling Panels: Fabricated from same mesh and framing as wall panels.
- H. Horizontal Dividers: Manufacturer's standard welded wire mesh divider.

1. Load Capacity: 250 lb, uniformly distributed.
- I. Doors: Fabricated from same mesh and framing as wall panels.
 1. Locking Device: Padlock hasp.
 2. Stiffener for Single-Tier Doors: 1/2-inch diameter steel rods or 3/4-by-1/4-inch steel flat bars, diagonal from center of door to corners.
 3. Hinges: Full-surface type, 2-1/2-by-2-1/2-inch steel, 1-1/2 pairs per single-tier door welded to door and jamb framing.
- J. Finish for Uncoated Ferrous Steel: Manufacturer's standard powder-coated finish unless otherwise indicated.
 1. Color: As selected by Architect from manufacturer's full range.

2.3 MATERIALS

- A. Steel Wire: ASTM A510/A510M.
- B. Steel Plates, Channels, Angles, and Bars: ASTM A36/A36M.
- C. Steel Sheet: Cold-rolled steel sheet, ASTM A1008/A1008M, Commercial Steel (CS), Type B.
- D. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B, with G60 zinc (galvanized) coating designation.
- E. Panel-to-Panel Fasteners: Manufacturer's standard steel bolts, nuts, and washers.
- F. Post-Installed Anchors: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.
 1. Material: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
- G. Power-Driven Fasteners: ICC-ES AC70.
- H. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer, complying with MPI#79.
 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- I. Zinc-Rich Primer: Compatible with topcoat, complying with SSPC-Paint 20 or SSPC-Paint 29.
- J. Galvanizing Repair Paint: High-zinc-dust-content paint for reglazing welds in steel, complying with SSPC-Paint 20.

2.4 FABRICATION

- A. General: Fabricate wire mesh storage lockers from components of sizes not less than those indicated. Use larger size components as recommended by wire mesh manufacturer. Furnish

bolts, hardware, and accessories required for complete installation with manufacturer's standard finishes.

1. Fabricate wire mesh storage lockers to be readily disassembled.
2. Welding: Weld corner joints of framing and grind smooth, leaving no evidence of joint.

B. Wire Mesh Storage Lockers: Fabricate initial storage locker with front and two sides. Fabricate additional storage lockers similarly, as add-on units designed to share one side with initial storage locker.

1. Fabricate wall panel and door framing with slotted holes for connecting adjacent panels.
2. Pre-hang doors in factory.

2.5 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.
- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean items of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- C. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- D. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's written instructions.
- E. Shop Priming: Apply shop primer to uncoated surfaces of wire mesh units unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
- F. Powder-Coat Finish: Complying with AAMA 2603.

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. Examine floors for suitable conditions where wire mesh storage lockers will be installed.
- C. Examine walls to which wire mesh storage lockers will be attached for properly located blocking, grounds, and other solid backing for attachment of support fasteners.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Anchor wire mesh storage lockers to floor with 3/8-inch- diameter expansion anchors at 12 inches o.c. through bottom panel framing. Shim panel framing as required to achieve level and plumb installation.
 - 1. Floor anchors may be set with power-actuated fasteners instead of post installed expansion anchors if indicated on Shop Drawings.
- B. Anchor wire mesh storage lockers to walls at 12 inches o.c. through back corner panel framing and as follows:
 - 1. For concrete and solid masonry anchorage, use expansion anchors.
 - 2. For hollow masonry anchorage, use toggle bolts.
- C. Attach adjacent wire mesh storage lockers to each other through side panel framing.
- D. Install divider panels as required.
- E. Install doors complete with door hardware.

3.3 ADJUSTING AND CLEANING

- A. Adjust doors to operate smoothly and easily without binding or warping. Adjust hardware to function smoothly. Confirm that hasps engage accurately and securely without forcing or binding.
- B. Remove and replace defective work, including doors and framing that are warped, bowed, or otherwise unacceptable.
- C. Touchup Painting:
 - 1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
- D. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 105143

SECTION 116833 – BAT AND HELMET STORAGE

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 WORK INCLUDED

- A. Provide all equipment and materials and do all work necessary to furnish and install the athletic equipment, as indicated on the drawings and as specified herein. Athletic equipment shall include, but not be limited to:

- 1. Bat/Helmet Storage Stand-Up Cubby Baseball/Softball Equipment and Accessories

1.3 REFERENCES

- A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

- 1. National Federation of State High School Associations (NFHS)
 - 2. American Sports Builders Association (ASBA)
 - 3. Manufacturers Data and Recommended Installation Requirements

1.4 SUBMITTALS

- A. Manufacturers Product Data
- B. Shop Drawings

1.5 QUALITY ASSURANCE

- A. Manufacturers warranties shall pass to the Owner and certification made that the product materials meet all applicable grade trademarks or conform to industry standards and inspection requirements.

1.6 PRODUCT DELIVERY AND STORAGE

- A. Materials delivered to the site shall be examined for damage or defects in shipping. Any defects shall be noted and reported to the Owners representative. Replacements, if necessary, shall be immediately re-ordered, so as to minimize any conflict with the construction schedule. Sound materials shall be stored above ground under protective cover or indoors so as to provide proper protection.

PART 2 – PRODUCTS

2.1 BAT/HELMET STORAGE AND ACCESSORIES

- A. Basis-of-Design: LG-BH-CUBBY Storage Stand-Up Bat/Helmet Cubby, Sportsfield Specialties, Inc. or approved equal.
 - 1. Pre-Assembled Bat, Helmet and Storage Cubby Units and Accessories:
 - a. Constructed of Exterior Grade A Plywood with Solid Ash Trim and Stainless Steel Assembly Hardware, Minimum of Three (3) Coats of Marine Grade Polyurethane
 - b. Bat and Helmet Cubby: 90"H x 60"W x 36"D with Sixteen (16) 14" x 11.375"
 - 2. Helmet and Eight (8) 14" x 8.5" Bat Cubbies
 - a. 2" x 4" Pressure Treated Base
 - b. Custom Sizes and/or Designs Available Upon Request

PART 3 – EXECUTION

3.1 INSTALLATION OF EQUIPMENT

- A. All equipment and accessories shall be installed as recommended per manufacturer's written instructions and as indicated on the drawings.

END OF SECTION 11 68 33

SECTION 116836 – POLYBOARD TEAM BENCHES

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 SECTION INCLUDES

- A. Provide all equipment and materials, and do all work necessary to furnish and install the athletic equipment, as indicated on the drawings and as specified herein. Athletic equipment shall include, but not be limited to:
 - 1. Team Benches.

1.3 REFERENCES

- A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.
 - 1. National Federation of State High School Associations (NFHS)
 - 2. American Sports Builders Association (ASBA)
 - 3. Manufacturers Data and Recommended Installation Requirements

1.4 SUBMITTALS

- A. Manufacturers Product Data
- B. Shop Drawings

1.5 QUALITY ASSURANCE

- A. Manufacturer's warranties shall pass to the Owner and certification made that the product materials meet all applicable grade trademarks or conform to industry standards and inspection requirements.

1.6 PRODUCT DELIVERY AND STORAGE

- A. Materials delivered to the site shall be examined for damage or defects in shipping. Any defects shall be noted and reported to the Owners representative. Replacements, if necessary, shall be immediately re-ordered, so as to minimize any conflict with the construction schedule. Sound materials shall be stored above ground under protective cover or indoors so as to provide proper protection.

PART 2 - PRODUCTS

2.1 TEAM BENCHES

- A. Basis-of-Design: Two Tier Polyboard Team Bench as manufactured by: Sportsfield Specialties Inc. www.sportsfieldspecialties.com
- B. Components:
 - 1. Frame: Fabricated with 1/8" Aluminum Formed Steel Frame and 2.0" x 2.0" x 1/8" Square Aluminum Tubing, Designed to Allow for Two Level Seating.
 - a. Overall Dimensions: As indicated.
 - b. Finish: Powder Coated: Color as selected by Architect from manufacturer's standard colors.
 - 2. Planking:
 - a. 2.0" x 4.0" and/or 2.0" x 6.0" Poly Board, Color as selected by Architect from manufacturer's standard colors.
 - 3. Accessories:
 - a. Stainless Steel Assembly Hardware

PART 3 - EXECUTION

3.1 INSTALLATION OF EQUIPMENT

- A. All athletic equipment shall be installed as recommended with manufacturer's written directions, and as indicated on the drawings.

END OF SECTION 11 68 36

SECTION 116837 – INDOOR VERTICALLY RETRACTABLE BATTING TUNNEL

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 WORK INCLUDED

- A. Provide all equipment and materials and do all work necessary to furnish and install the athletic equipment, as indicated on the drawings and as specified herein. Athletic equipment shall include, but not be limited to:

- 1. Indoor Vertically Retractable Batting Tunnel; Baseball

1.3 REFERENCES

- A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

- 1. National Federation of State High School Associations (NFHS)
 - 2. American Sports Builders Association (ASBA)
 - 3. Manufacturers Data and Recommended Installation Requirements

1.4 SUBMITTALS

- A. Manufacturers Product Data
- B. Shop Drawings

1.5 QUALITY ASSURANCE

- A. Manufacturers warranties shall pass to the Owner and certification made that the product materials meet all applicable grade trademarks or conform to industry standards and inspection requirements.

1.6 PRODUCT DELIVERY AND STORAGE

- A. Materials delivered to the site shall be examined for damage or defects in shipping. Any defects shall be noted and reported to the Owners representative. Replacements, if necessary, shall be immediately re-ordered, so as to minimize any conflict with the construction schedule. Sound materials shall be stored above ground under protective cover or indoors so as to provide proper protection.

PART 2 – PRODUCTS

2.1 INDOOR VERTICALLY RETRACTABLE BATTING TUNNEL; BASEBALL

A. Basis-of-Design: Sportsfield Specialties - BTIVRB – Indoor Vertically Retractable Batting Tunnel; Baseball.

1. Project Specific Supplementary Support Structure

a) Includes building connections, overhead supports, and 1.9 inch x 0.145 inch wall steel drive pipe assembly

b) Powder coated finish

2. LynRus CW3 Motorized Lift Winch

a) ¾ horsepower electric

b) 110/115V Single Phase, 11.5 FLA, 60HZ.

c) 1,000lb. vertical lift capacity.

d) 9.5ft/min pull speed.

e) Instant Reversing

f) Weight: 56lbs.

g) Includes 5' power cord with twist lock plug, toggle key switch and electrical box. Electrical by others.

3. Netting Support Frame

a) 1-3/4 inch x 1-3/4 inch, 14 gauge, square wall steel tubing

b) Bolted connections.

c) Color: Black

4. Batting Tunnel Net

a) Manufacturers standard #60 Black Nylon Net

b) 1-7/8 inch square mesh with rope bound perimeter.

c) (2) 4 foot x Full Height openings with curtain style exterior overlap flaps.

PART 3 – EXECUTION

3.1 INSTALLATION OF EQUIPMENT

A. All equipment and accessories shall be installed as recommended per manufacturer's written instructions and as indicated on the drawings. Installer should have a minimum of five (5) baseball/softball equipment installations or similar experience in the previous three (3) years.

END OF SECTION 11 68 33

SECTION 116839 – DUGOUT GUARDRAIL SYSTEM

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 WORK INCLUDED

- A. Provide all equipment and materials and do all work necessary to furnish and install the athletic equipment, as indicated on the drawings and as specified herein. Athletic equipment shall include, but not be limited to:
 - 1. Dugout Guardrail System with padding.

1.3 REFERENCES

- A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.
 - 1. National Federation of State High School Associations (NFHS)
 - 2. American Sports Builders Association (ASBA)
 - 3. Manufacturers Data and Recommended Installation Requirements

1.4 SUBMITTALS

- A. Manufacturers Product Data
- B. Shop Drawings

1.5 QUALITY ASSURANCE

- A. Manufacturers warranties shall pass to the Owner and certification made that the product materials meet all applicable grade trademarks or conform to industry standards and inspection requirements.

1.6 PRODUCT DELIVERY AND STORAGE

- A. Materials delivered to the site shall be examined for damage or defects in shipping. Any defects shall be noted and reported to the Owners representative. Replacements, if necessary, shall be immediately re-ordered, so as to minimize any conflict with the construction schedule. Sound materials shall be stored above ground under protective cover or indoors so as to provide proper protection.

PART 2 – PRODUCTS

2.1 GUARDRAIL SYSTEM

- A. Basis-of-Design: GRS72 72"H Guard Rail System and Accessories by Sportsfield Specialties, Inc. or approved equal.
- B. Features:
 - 1. Guard Rails: Modularized Steel Structure Consisting of Variable Length Modules with Top, Mid and Bottom Horizontal Rails, Equally Spaced Vertical Posts and Base Plates. Fabricated using Components with the Following Attributes:
 - a. 72"H (O.A.) 2" Square x 11ga (.120") Thick Wall Structural Steel Tube Posts with Factory Pre-Drilled 7" x 7" x 3/8" (.375") Steel Mounting Plates. Posts at Module Connections are Created by Two (2) Adjacent Tubes and Two (2) Half Size Base Plates
 - b. Four (4) 3/8" Diameter x 5"L Wedge Anchors per Base Plate Fasten Railing Modules to Concrete
 - c. 2" Square x 11ga (.120") Thick Wall Structural Steel Top Rail Running Across the Entire Module Length
 - d. 2" Square x 11ga (.120") Thick Wall Structural Steel Bottom and Mid Rails Between Posts
 - e. Fully Welded Modules with Factory Pre-Drilled Holes for Stainless Steel Bolt Module to Module Connection to Assist Installation
 - f. Super Durable Powder Coated Black Finish with Enhanced Resistance to UV and Fade
 - 2. Padding: Consisting of Squared Guard Rail Padding on Exposed Perimeter Edges, Flat Padding on Posts, Bottom Railing and Mid Railing
 - a. Three (3) – faced Squared Padding. 6"H Front and Rear Faces, 6-1/8"W Top Face. All Faces Consist of Vinyl Covering, Foam and Rigid Sheathing
 - b. 6"W Single Face Flat Padding Consisting of Vinyl Covering, Foam and Rigid Sheathing
 - c. Premium Outdoor Vinyl Encasement:
 - i. High UV Resistance
 - ii. Total Weight: 19 oz./yd² (ASTM D3776)
 - iii. Construction: 18 x 18, 1300 x 1300 Denier
 - iv. Grab Tensile: Warp 750 lb/2", Fill 655 lb/2". (ASTM D5034)
 - v. Tongue Tear: Warp 153 lb/in., Fill 135 lb/in (ASTM D2261)
 - vi. Adhesion: 38 lb/2" (ASTM D571)
 - vii. Cold Crack: -30° F (ASTM D2136)
 - viii. Rot, Mildew and Fungus Resistant: Yes
 - ix. Various Standard Colors Available
 - d. 1.25" Thick High Density Polyethylene Cross-Link Closed Cell Foam
 - i. Density: 1.7 pcf
 - ii. Tensile Strength: 20 psi
 - iii. Elongation: 95%
 - iv. Tear Resistance: 7 lb/in
 - v. Compression Strength:
 - 1. @ 25% psi: 4 psi
 - 2. @ 50% psi: 7 psi
 - vi. Compression Set: 29% of Original Thickness
 - vii. Thermal Stability: < 0.5% of Change @ 158°F for 22 hrs
 - viii. Thermal Conductivity: 0.20 btu/hr/inch ft/°F
 - ix. Working Temperature Range: -70 °F to 175 °F
 - x. Water Absorption: <0.06 lb/ft²/°F

- xi. Flammability: Pass (MVSS302)
- e. 3/4" AdvanTech® Water Resistant Composite Sheathing Panel, Stained and Sealed with Exterior Grade Finish
- f. Padding Attach to Modularized Steel Structure using 11ga (.120") Steel Brackets, Super Durable Powder Coated Black Finish. #10 316 Stainless Steel Round Head Wood Screws Fasten Brackets to Rigid Backing on Pads. #12 x 1-1/2"L Hex Head Self Drilling Screws with Sealing Washers used to Fasten Brackets to Railing
- 3. Ultra Cross® Knotless Dyneema® UHMWPE Netting:
 - a. Length, Height and Configuration as Required
 - b. Ultra Cross® Knotless Netting
 - c. Dyneema® Ultra-High Molecular Weight Polyethylene (UHMWPE) SK-75 Black Fiber Construction
 - d. 4 Ply, 1.2 mm (0.0472") Diameter Twine
 - e. 95% Open Mesh Area (See-Through Visibility)
 - f. 58,445 psi Minimum Breaking Strength
 - g. 30% Maximum Elongation at Break
 - h. 1-3/4" (44 mm) Square Mesh Size, 0.009 lbs. per Square Foot
 - i. 4-Strand, Braided, Continuous Monofilament Dyneema® Fiber
 - j. Urethane Black Bonded Finish
 - k. Strong Resistance to Ultraviolet (UV) Light Degradation
 - l. Excellent Resistance to Chemicals and Water Absorption
 - m. Attached to Rail Using 14"L Nylon Zip Ties with a 50 lb. Break Strength, UV Stabilized
- 4. Included Accessories:
 - a. Model Specific Hardware Kit and Installation Instructions
- 5. One (1) Year Limited Manufacturer's Product Warranty

PART 3 – EXECUTION

3.1 INSTALLATION OF EQUIPMENT

- A. All equipment and accessories shall be installed as recommended per manufacturer's written instructions and as indicated on the drawings.

END OF SECTION 11 68 39

SECTION 116843 – OUTDOOR SCOREBOARDS

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. This section includes the following:
 - 1. Single-sided LED multi-sport scoreboards
 - 2. Single-sided LED softball scoreboard
 - 3. Single-sided LED timing displays (Delay of Game)
- B. Related Sections:
 - 1. Division 26, "Electrical".

1.3 REFERENCES

- A. Standard for Electric Signs, UL 48
- B. Standard for CSA C22.2 #207
- C. Federal Communications Commission Regulation Part 15
- D. National Electric Code

1.4 SUBMITTALS

- A. Product data: Submit manufacturer's product illustrations, data and literature that fully describe the scoreboards and accessories proposed for installation.
- B. Shop drawings: Submit mechanical and electrical drawings.
- C. Maintenance data: Submit manufacturer's installation, operation, and maintenance manuals.
- D. Delegated-Design Submittals: For systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- E. Field measurements: Verify position and elevation of structure and its layout for scoreboard equipment. Verify dimensions by field measurements.
- F. Verify mounting structure can support the scoreboard's weight and windload in addition to the auxiliary equipment.
- G. Installation may proceed within acceptable weather conditions.

1.5 QUALITY ASSURANCE

- A. For outdoor use

- B. Source Limitations: Obtain each type of scoring or related equipment through one source from a single manufacturer.
- C. ETL listed to UL 48
- D. NEC compliant
- E. FCC compliant
- F. ETL listed to CSA 22.2 #207.
- G. Delegated-Design Engineer: A Professional Engineer licensed in Pennsylvania and who is experienced in providing engineering services of the kind indicated.

1.6 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design indicated systems including comprehensive engineering analysis by a qualified professional engineer; using performance requirements and design criteria indicated.
 - 1. Scoreboard structure and foundations
 - 2. Timer displays and foundations
- B. Structural Performance: Engineering design for scoreboard systems shall be based on withstanding minimum wind loading required by local building codes but no less than:
 - 1. Wind: $V_{ULT} = 115$ MPH

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Product delivered on site
- B. Scoreboard and equipment to be housed in a clean, dry environment

1.8 PROJECT CONDITIONS

- A. Environmental limitations: Do not install scoreboard equipment until mounting structure is secure and concrete has ample time to cure.

1.9 WARRANTY

- A. Provide 5 years of no cost parts exchange including standard shipping on electronics parts and radios due to manufacturing defects.
- B. Provide Daktronics Customer Care Level 3.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Daktronics, Inc., 201 Daktronics Drive, P.O. Box 5128, Brookings, SD 57006-5128 – No Substitutions.

2.2 DELEGATED DESIGN

- A. Delegated Design: Design scoreboard systems to include structural components and foundations, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated. Submit stamped engineering analysis for support structural supports and foundation design.

2.3 MULTI-SPORT SCOREBOARDS (MULTI-SPORT FIELDS 1 & 2)

- A. Daktronics FB-2018 single-sided football scoreboard (Model FB-2018-W-PV-F) with Team Name Message Centers (Model TNMC-10-@-12x45-21.17). Hard-wired installation.
- B. General information
 - 1. Main Display Dimensions: 8'-0" high, 18'-0" wide, 0'-8" deep
 - 2. Weight:
 - a. Main Display: 575 lbs.
 - b. Team Name Message Center (TNMC): 40lbs./display
 - 3. Power requirement:
 - a. Main Display: 635W
 - b. Team Name Message Center (TNMC): 80W/display
 - 4. Color: As selected by Architect from manufacturer's standard paint selections
- C. Construction
 - 1. Alcoa aluminum alloy 5052
 - 2. Scoreboard back, face, and perimeter: 0.063" thick
 - 3. Scoreboard top and bottom: 0.125" thick
- D. Digits
 - 1. LED color: White.
- E. Captions
 - 1. Color: As selected by Architect from manufacturer's standard paint selections
- F. Border Striping
 - 1. Vinyl striping applied around the scoreboard and ad panel faces
 - 2. Color: As selected by Architect from manufacturer's standard paint selections
- G. Accessories:
 - 1. Lacrosse/Field Hockey Captions Conversion Kit
 - 2. Soccer SOG, SOG, HALF and blank panel captions Conversion Kit
 - 3. 15" PanaView Time Outs Left Option (White LEDs)
 - 4. 12VDC Trumpet Horn w/ Power Supply
 - 5. I-Beam Mounting Hardware (for 2 I beams per display)
 - 6. Square Truss with Non-backlit Lettering and Screen Backing:
 - a. DA-1000-18
 - b. Dimensions: 2'H x 18' W x 3" D
 - 7. Outdoor Non-backlit ad panels:
 - a. Dimensions: 3'-0"H x 16'-0" W x 8" D

2.4 SOFTBALL SCOREBOARD (SOFTBALL FIELD 1)

- A. Daktronics BA-2017 single-sided Baseball/Softball scoreboard (Model BA-2017-R-PV-F). Hard-wired installation.
- B. General information

1. Main Display Dimensions: 6'-0" high, 14'-0" wide, 0'-8" deep
 2. Weight:
 - a. Main Display: 300 lbs.
 3. Power requirement:
 - a. Main Display: 300W
 4. Color: As selected by Architect from manufacturer's standard paint selections
- C. Construction
1. Alcoa aluminum alloy 5052
 2. Scoreboard back, face, and perimeter: 0.063" thick
 3. Scoreboard top and bottom: 0.125" thick
- D. Digits
1. LED color: Red
- E. Captions
1. Color: As selected by Architect from manufacturer's standard paint selections
- F. Border Striping
1. Vinyl striping applied around the scoreboard and ad panel faces
 2. Color: As selected by Architect from manufacturer's standard paint selections
- G. Accessories:
1. I-Beam Mounting Hardware (for 2 I beams)
 2. Outdoor Non-backlit ad panels:
 - a. Dimensions: 3'-0"H x 14'-0" W x 8" D

2.5 TIMING DISPLAY (DELAY OF GAME)

- A. Daktronics TI-2025 Outdoor PanaView Delay of Game Time (Model TI-2025-R-PV).
- B. General information
1. Dimensions: 2'-4" high, 3'-4" wide, 0'-8" deep
 2. Weight: 36 lbs.
 3. Power requirement: 150 W (red/amber digits)
 4. Color: semi-gloss black
- C. Construction
1. Alcoa aluminum alloy 5052
 2. Display back, face, and perimeter: 0.063" (1.60 mm) thick
- D. Digits
1. LED color: Red
 2. Clock digits: 24" high
- E. Horn
1. Vibrating horn mounted inside the scoreboard cabinet behind face
- F. Accessory Equipment
1. RC-200 Handheld Controllers
 2. Angle Clamp Mounting Hardware

2.6 SCORING CONSOLES

- A. Daktronics All Sport® 5010 controller

- B. Console includes:
 - 1. Aluminum enclosure to house electronics
 - 2. Sealed membrane water-resistant keyboard
 - 3. 32-character LCD to verify entries and recall information currently displayed
 - 4. Power cord that plugs into a standard grounded outlet; 6 watts max
- C. Accessory Equipment
 - 1. Hard carrying case
 - 2. Battery pack
 - 3. Hand-held switch for main clock start/stop and horn

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that mounting structures are ready to receive scoreboards and timing displays. Verify that placement of conduit and junction boxes are as specified and indicated in plans and shop drawings. Verify concrete has cured according to specifications.

3.2 INSTALLATION

- A. All power and control cables to scoreboards and displays will be routed in conduit. Power to the scoreboards/displays as well as raceways shown on electrical plans by the Electrical Contractor. Scoreboard control wiring including conduit will be the responsibility of the contractor assigned the scoreboard equipment.
- B. Install scoreboard to beams as indicated and in accordance with manufacturer's instructions and approved shop drawings. Verify units are plumb and level.

3.3 INSTALLATION—CONTROL CENTERS

- A. Provide boxes, cover plates and jacks in locations per plans.
- B. Test connect control unit to all jacks and check for proper operation of control unit, scoreboard and all features. Leave control unit in carrying case and other loose accessories with owner's designated representative.
- C. Verify earth ground does not exceed 15 ohms.

END OF SECTION 116843

SECTION 123216 - MANUFACTURED PLASTIC-LAMINATE-FACED CASEWORK

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 plastic-laminate-faced cabinets of stock design and miscellaneous plastic laminate at other locations as indicated.
- B. Related Requirements:
 - 1. Section 123661 "Solid Surfacing Countertops."

1.3 DEFINITIONS

- A. Definitions in the AWI's, AWMAC's, and WI's "Architectural Woodwork Standards" apply to the work of this Section.
- B. MDF: Medium-density fiberboard.
- C. Hardwood Plywood: A panel product composed of layers or plies of veneer, or of veneers in combination with lumber core, hardboard core, MDF core, or particleboard core, joined with adhesive, and faced both front and back with hardwood veneers.

1.4 COORDINATION

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

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Show fabrication details, including types and locations of hardware. Show installation details, including field joints and filler panels. Indicate manufacturer's catalog numbers for casework.
- C. Samples: For cabinet finishes.
- D. Samples for Initial Selection: For cabinet finishes.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Sample Warranty: For special warranty.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer for installation of units required for this Project.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver casework only after painting, utility roughing-in, and similar operations that could damage, soil, or deteriorate casework have been completed in installation areas. If casework must be stored in other than installation areas, store only in areas where environmental conditions meet requirements specified in "Project Conditions" Article.
- B. Keep finished surfaces covered with polyethylene film or other protective covering during handling and installation.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install casework until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Established Dimensions: Where casework is indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.
- C. Locate concealed framing, blocking, and reinforcements that support casework by field measurements before being enclosed, and indicate measurements on Shop Drawings.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of casework that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Delamination of components or other failures of glue bond.
 - b. Warping of components.
 - c. Failure of operating hardware.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- 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. Wilsonart (Basis-of-Design).
- B. Source Limitations: Obtain plastic-laminate-faced cabinets from single manufacturer.

2.2 CASEWORK, GENERAL

- A. Quality Standard: Unless otherwise indicated, comply with the AWI's, AWMAC's, and WI's "Architectural Woodwork Standards" for grades of casework indicated for construction, finishes, installation, and other requirements.
 - 1. Grade: Custom.
- B. Product Designations: Drawings indicate sizes, configurations, and finish materials of manufactured plastic-laminate-faced cabinets by referencing designated manufacturer's catalog numbers. Other manufacturers' casework of similar sizes and door and drawer configurations, of same finish materials, and complying with the Specifications may be considered. See Section 016000 "Product Requirements."

2.3 CASEWORK

- A. Design:
 - 1. Flush overlay.
- B. Exposed Materials:
 - 1. Plastic Laminate: Grade VGS.
 - a. Colors and Patterns: Refer to Interior Finish Legend on Drawing Sheet A-611A. Provide specified Wilsonart plastic laminate at all casework locations as indicated throughout the Drawing Set.
 - 2. Unless otherwise indicated, provide specified edge banding on all exposed edges.
- C. Semi exposed Materials:
 - 1. Plastic Laminate: Grade VGS unless otherwise indicated. Provide plastic laminate for semi exposed surfaces unless otherwise indicated.
 - a. Provide plastic laminate of same grade as exposed surfaces for interior faces of doors and drawer fronts and other locations where opposite side of component is exposed.
 - 2. Unless otherwise indicated, provide specified edge banding on all semi exposed edges.
- D. Concealed Materials:

1. Solid Wood: Any hardwood or softwood species, with no defects affecting strength or utility.
2. Plywood: Hardwood plywood.
3. Plastic Laminate: Grade BKL.
4. MDF.

2.4 MATERIALS

- A. Maximum Moisture Content for Lumber: 7 percent for hardwood and 12 percent for softwood.
- B. Hardwood Plywood: HPVA HP-1, particleboard core except where veneer core is indicated.
- C. Softwood Plywood: DOC PS 1.
- D. MDF: ANSI A208.2, Grade 130.
- E. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
 - a. Wilsonart
- F. Edge banding for Plastic Laminate: Plastic laminate matching adjacent surfaces.

2.5 FABRICATION

- A. Plastic-Laminate-Faced Cabinet Construction: As required by referenced quality standard, but not less than the following:
 1. Bottoms and Ends of Cabinets: 3/4-inch particleboard or MDF.
 2. Removable Front cover panels: 3/4-inch particleboard or MDF.
- B. Filler Strips: Provide as needed to close spaces between cabinets and walls, ceilings, and indicated equipment. Fabricate from same material and with same finish as cabinets.

2.6 CASEWORK HARDWARE AND ACCESSORIES

- A. Hardware, General: Unless otherwise indicated, provide manufacturer's standard satin-finish, commercial-quality, heavy-duty hardware.
 1. Removable Front Cover Panel: Manufacturers standard Z-Clip for ADA Accessible front panels.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 CASEWORK INSTALLATION

- A. Grade: Install cabinets to comply with same grade as item to be installed.
- B. Install casework level, plumb, and true; shim as required, using concealed shims. Where casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.
- C. Wall Cabinets: Hang cabinets straight, level, and plumb. Adjust fronts and bottoms within 1/16 inch of a single plane. Fasten to hanging strips, masonry, framing, wood blocking, or reinforcements in walls and partitions. Align similar adjoining doors to a tolerance of 1/16 inch.
- D. Fasten cabinets to adjacent cabinets and to masonry, framing, wood blocking, or reinforcements in walls and partitions to comply with the AWI's, AWMAC's, and WI's "Architectural Woodwork Standards."

3.3 CLEANING

- A. Repair or remove and replace defective work as directed on completion of installation.
- B. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

END OF SECTION 123216

SECTION 123616 - METAL COUNTERTOPS

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. Stainless-steel countertops.

1.3 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 wall-mounted shelves.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For metal fabrications.
 - 1. Include plans, sections, details, and attachments to other work. Detail fabrication and installation, including field joints.
 - 2. For countertops, indicate requirements for blocking or reinforcements in supporting construction.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products only after casework and supports on which they will be installed has been completed in installation areas.
- B. Keep finished surfaces of products covered with polyethylene film or other protective covering during handling and installation.

1.6 FIELD CONDITIONS

- A. Field Measurements: Where products 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.

- B. Established Dimensions: Where products are indicated to fit to other construction, establish dimensions for areas where products are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 STAINLESS-STEEL FABRICATIONS

- A. Countertops: Fabricate from 0.062-inch thick, stainless-steel sheet. Provide smooth, clean exposed tops and edges in uniform plane, free of defects.
 - 1. Joints: Fabricate countertops without field-made joints.
 - 2. Weld shop-made joints.
 - 3. Extend the top down to provide a 1-inch- thick edge with a 1/2-inch return flange.

2.2 MATERIALS

- A. Stainless-Steel Sheet: ASTM A240/A240M, Type 304.
- B. Sealant for Countertops: Manufacturer's standard sealant that complies with applicable requirements in Section 079200 "Joint Sealants" and the following:
 - 1. Mildew-Resistant Joint Sealant: Mildew resistant, single component, nonsag, neutral curing, silicone
 - 2. Color: Clear.

2.3 STAINLESS-STEEL FINISH

- A. Grind and polish surfaces to produce uniform, directional satin finish matching No. 4 finish, with no evidence of welds and free of cross scratches. Run grain with long dimension of each piece. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces clean.

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

3.2 INSTALLATION

- A. Install metal countertops level, plumb, and true; shim as required, using concealed shims.
- B. Field Jointing: Where possible, make field jointing in the same manner as shop jointing; use fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site

processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.

- C. Secure countertops to cabinets with Z- or L-type fasteners or equivalent; use two or more fasteners at each front, end, and back.
- D. Abut top and edge surfaces in one true plane, with internal supports placed to prevent deflection.
- E. Seal junctures of countertops, splashes, and walls with sealant for countertops.

3.3 CLEANING AND PROTECTION

- A. Repair or remove and replace defective work as directed on completion of installation.
- B. Clean finished surfaces. Remove and replace damaged products or touch up and refinish damaged areas to match original factory finish, as approved by Architect.
- C. Protection: Provide 6-mil plastic or other suitable water-resistant covering over countertop surfaces. Tape to underside of countertop at a minimum of 48 inches o.c. Remove protection at Substantial Completion.

END OF SECTION 123616

SECTION 123661 - SOLID SURFACING COUNTERTOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Solid surface material countertops.
 - 2. Solid surface material backsplashes.
 - 3. Solid surface material end splashes.
 - 4. Solid surface material apron fronts.

1.3 ACTION SUBMITTALS

- A. Product Data: For countertop materials and sinks.
- B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
 - 1. Show locations and details of joints.
 - 2. Show direction of directional pattern, if any.
- C. Samples for Initial Selection: For each type of material exposed to view.
- D. Samples for Verification: For the following products:
 - 1. Countertop material, 6 inches square.
 - 2. Vertical wall applications, 6 inches square.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For solid surface material countertops 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.

1.6 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.

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify dimensions of countertops by field measurements before countertop fabrication is complete.

1.8 COORDINATION

- A. Coordinate locations of utilities that will penetrate countertops 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. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Wilsonart
 - 2. Color: As indicated within the Drawing Set.
- B. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

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: Custom.
- B. Configuration:
 - 1. Front: Radius edge with apron, dimension as shown on drawings.
 - 2. Backsplash: Straight, slightly eased at corner.
 - 3. End Splash: Matching backsplash.
- C. Countertops: 1/2-inch- thick, solid surface material.
- D. Backsplashes: 1/2-inch- thick, solid surface material.

- E. Fabricate tops with shop-applied edges and backsplashes unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
 - 1. Install sink bowls in field.
- F. Joints: Fabricate countertops without joints.

2.3 INSTALLATION MATERIALS

- A. Adhesive: Product recommended by solid surface material manufacturer.
- B. Sealant: Comply with applicable requirements in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates to receive solid surface material countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install countertops level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.
- B. Fasten countertops by screwing through counter supports. Predrill holes for screws as recommended by manufacturer.
- C. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.
- D. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

END OF SECTION 123661

SECTION 126313 – STADIUM AND ARENA BENCH SEATING

PART 1 - PERFORMANCE CRITERIA

1.01 SCOPE OF WORK

- A. Provide outdoor permanent grandstands and press box as detailed in these performance specifications.
- B. Provide necessary engineering, material, freight, installation and supervision to provide grandstand seating systems in accordance with the following performance criteria.

1.02 PERFORMANCE CRITERIA

- A. The minimum acceptable standards of design are:
 - 1. Grandstand Designs to match layouts. Front Walkway, where shown to be 6'-2" deep. Overall length per plans. Grandstands are a Leg Truss or angle frame substructure designed for L/200.
 - 2. Decking System - Tread depth and riser heights to be per layouts
 - Fully closed interlock decking system
 - Riser of 13" and tread depth per row of 26" on all layouts
 - 3. Aisle layout is per plans. There shall be center aisle rails or end aisle rails per code.
 - 4. Handicap seating areas per plans and in accordance with local, state and national guidelines.
 - 5. Finishes to be "hot dipped" galvanized on the steel understructure, clear anodized on the seat boards. Riser boards to be Dur-Kyn painted finish from standards. Black painted aluminum aisle nosing strips at aisles and stairs risers. Perimeter steel railing risers to be hot dipped galvanized, horizontal pipe rails to be clear anodized and utilizes 6 ga. black vinyl chain link fencing with a 2" mesh pattern.
 - 6. Aluminum footboards added to the standard mill finish is an applied Premium traction coating system. Provide a premium traction finish that achieves a "high traction" rating as defined by the ANSI/NFSI B 101.1 standards with a minimum of .80 slip co-efficiency rating. The premium traction system must be verified, tested, and proven. Finishes must prevent any surface oxidation staining. Required on grandstand footboards, stairs, and ramps.
- B. Signage
 - 1. Properly label all handicap seating areas
- C. Press Box – Type II construction
 - 1. Press box to be constructed of steel framing.
 - 3. End viewing glass panels, per plans
 - 4. Full length rooftop filming platform. Entrance to the platform will be by interior wall ladder or ships ladder.
- D. An AISC certified steel fabricating plant is a requirement of this project for quality control and assurances. See Section Quality Assurance, C.
- E. Stairs and ramps per plans and in accordance with State and Local codes and guidelines.

1.03 QUALITY ASSURANCE

- A. Manufacturers Qualifications:
 - 1. Manufacturers must have a minimum of ten years of experience in the manufacturing of grandstands and press boxes under current company name.
 - 2. Manufacturer must provide five references of similar projects within the State of Pennsylvania. References shall include scope of work, contract amount, owner's name and phone numbers, contract completion date and actual completion date.
- B. Welders must be AWS certified; manufacturing capabilities in accordance with the governmental agencies having jurisdiction.
- C. Steel fabrication to be done in an AISC certified plant or in compliance with IBC Chapter 17. A third party AISC approved inspection agency must be hired to complete and properly document these inspections. The agency must disclose any possible conflicts of interest so that objectivity can be confirmed. Certified reports shall be submitted directly to the architect for confirmation. All associated costs shall be inclusive with the manufacturers bid.
- D. Installers Qualifications:
 - 1. Factory-trained and experienced in the installation of grandstands.
 - 2. Source Quality Control: Mill Test Certification.
 - 3. Single Source Responsibility: Obtain all of each distinct material required from a single manufacturer.
- E. Code Compliance: Provide aluminum bleachers to meet or exceed all State and Local applicable codes and in compliance with the International Building Code and the IBC/ICC National Code and CABO/ANSI A117.1 Barrier Free Sub code, Current Adopted Edition.

1.05 SUBMITTALS

- A. Product Data: Submit technical data for each distinct type of material, component and accessory indicated.
 - 1. Include information which specifically details physical properties and performance characteristics.
- B. Shop Drawings: Manufacturer to submit shop drawings with the bid. After award submittal drawings should be submitted with structural design calculations signed and sealed by a licensed Professional engineer (state of project location), and schedules for type, location, quantity and details of all aluminum components required for this project.
 - 1. Indicate on shop drawings that products are in compliance with the International Building Code and all other State and Local Codes and Regulations.
 - 2. Concrete designed per American Concrete Institute Guidelines
 - 3. Samples: Submit manufacturer's samples upon request.
- C. Certificate: Submit manufacturer's certification that materials furnished comply with requirements indicated and also in compliance with the IBC along with all other applicable Federal, State and local codes, and that materials meet or exceed test requirements indicated.

1.06 WARRANTY

- A. Submit a written warranty signed by the manufacturer, installer, and the contractor, guaranteeing to correct failures for a period of one (1) year after substantial completion, without reducing or otherwise limiting any other rights to correction which owner may have under the contract documents. Failures are defined to include faulty workmanship or faulty materials. Correction may include repair or replacement.

1.07 BUILDING CODES

- A. Comply with all applicable which includes but not limited to the following:
 - 1. International Building Code- Current Edition
 - 2. AISC Manual of Steel Construction, 9th Edition

3. Aluminum Association of America Guidelines
 4. International Building Code Guidelines for Accessibility, Current Edition
 5. American Concrete Institute
 6. COMcheck approval required for the Press box using the 2023 energy conservation code
- B. The bleacher shall be designed to support, in addition to its own weight, a uniformly distributed live load of not less than 100 pounds per square foot of gross horizontal projection of the bleacher. And 6 pounds per square foot of dead load on seats, footboards, risers and steel framing.
 - C. All seat and footboard members shall be designed to support not less than 120 pounds per linear foot. The bleacher shall be designed to resist, with or without live load, horizontal wind load appropriate for local conditions. It shall also be designed to resist, in addition to the live load, sway forces applied to the seats in a direction parallel to the length of the seat planks 24 pounds per linear foot; and, in a direction perpendicular, stresses in aluminum members and connections shall not exceed those specified for Building Type Structures by the Aluminum Association.
 - D. General: The structure shall be properly braced for wind and construction loads until all structural elements are secured. Lateral and longitudinal bays shall be cross-braced as required. Guardrails shall be of adequate size, location, and height to meet specified codes and designed to carry required loads. Exit stairs and intermediate aisle stairs shall be completely closed, in the direction of travel and shall have a maximum rise of 7" and a minimum tread of 11".
 - E. Code Compliance: Submittals shall be based upon specifications and drawings contained in the bid documents. Architect will not review any design or product changes prior to the bid date. Design changes to reduce overall aisle egress calculations or number of stair and ramp exits will not be allowed. All bidders must bid in accordance with these specifications.
 1. The Bleacher Contractor shall be responsible to meet the code interpretation provided in the bid documents and modify as required by state or local governmental review boards.
 2. Calculations that demonstrate code compliance with egress and exit of aisles, stairs, and ramps are a required submission with approved drawings.

PART – 2

2.01 PRODUCT MANUFACTURERS

- A. The basis of design is the Southern Bleacher Company, Graham, TX 800-433-0912
- B. Products specified herein have been selected because of their quality of construction, configuration, design, function, available finishes, components, accessories, dimensions, shape and style.
- C. Only the Architect/Owner reserves the right to accept or approve Bleacher manufacturers.

2.02 Leg Truss Designed Grandstand for Softball Field, Angle Frame design for multi purpose fields

- A. Product Description –
 1. The intent of the product design is to reduce and minimize the deflection of the aluminum deck. All individual deck members shall be fitted together longitudinally at all tread, front walk and cross walk locations. This design, in ambient conditions, allows for expansion and contraction without damage or deformation of the aluminum deck. All deck members shall be secured with two hold down clips at each structural member.
 2. Galvanized steel elevated permanent Leg Truss or angle frame style bleachers and grandstands
 3. Framing and spacing of all columns to follow the drawings. Crossbracing will be within every other bay starting with the end section.
 4. Front Walkway:

- a. Depth of the front walkway, per plans is to be 6'-2" from front fence to first row.
 - 1) Grandstand: Elevated per plans.
- 5. Entry stairs to be firmly anchored to uniformly poured concrete bases.
 - a. Stair rise: 7 inches (max) per Building Code with vertical aluminum closure.
 - b. Stair tread depth: 11 inches (min) per Building Code with contrasting extruded aluminum aisle nosing at leading edge of each tread.
 - c. Guardrails on Stair to be 42 inches above leading edge of step with two- line anodized aluminum rail and filled with 6-gauge black vinyl coated chain link fence (2" mesh).
 - d. Stairs to have offset handrail extensions on each side of stair. The handgrip portion of handrails shall not be less than 1 1/2 inches or more than 2 inches in cross-sectional dimension or the shape shall provide an equivalent gripping surface. The handgrip portion of handrails shall have a smooth surface with no sharp corner. The top of handrails and handrail extensions shall be placed not less than 34 inches or more than 38 inches above the nosing of treads and landings. Handrails shall be continuous the full length of the stairs and shall extend in the direction of the stair run not less than 12 inches beyond the bottom riser. Ends shall be returned or shall terminate in newel posts or safety terminals. Handrails shall be extruded anodized aluminum.
- 6. Aisles:
 - a. Aisles with seating on both sides to have 34-inch high handrail with intermediate rail at approximately 22 inches above tread. Aisles with seating on one side shall have 34-inch high handrail attached to guardrail system. Handrail shall be mounted to provide clearance from guardrail system in accordance with building code.
 - b. Pre-fabricated anodized aluminum handrails with continuous rounded ends are discontinuous to allow access to seating through a space 22 inches (min.) to 36 inches (max.).
 - 1) Handrails shall connect to decking / riser surface without penetration of the deck system. Any attachment which must have holes drilled through the decking or intermediate step members is not acceptable.
 - 2) If half steps are required, these steps shall be constructed of the same materials as the treads and risers of the grandstands. Ends shall be completely closed and attached with same mechanical fasteners as used for seat brackets. Extruded aluminum contrasting aisle nosing shall be mechanically fastened to the leading edge of each step.
- 7. Aluminum Decking System:
 - a. Bleachers: rise per and tread depth per plans.
 - b. Each seat 17 inches above its respective tread.
 - c. Decking Arrangement standard semi-closed configuration with closure angles. Aluminum footboards to be tongue and groove style - per section plans
 - d. The seats shall be 2 x 10 flat designed extruded aluminum alloy, 6063-T6 with clear anodized 204R1, AA-M10C22A31, Class II finish. Seats shall have serrations on top side to allow for safety of occupants.
 - e. The intent of the product design is to reduce deflection of aluminum deck and to minimize fluid drainage below spectator seating.
 - f. This design, in ambient conditions, allows for expansion and contraction without damage or deformation of the aluminum deck.
 - g. The nose extrusion at aisles shall allow for a 1" extruded aluminum contrasting nose piece to be flush mounted on the leading edge and shall capture the vertical riser plank in an extruded pocket. The heel extrusion shall have a .70" vertical lip at the rear of the plank to allow for placement of vertical riser plank.
 - hj. Entry stairs to be a minimum 2 x 11 mill finish aluminum with inset extrusion to accept contrasting nosing member.
 - i. Ramp planks to be interlocking to resist deflection of live loads.

- j. Open ends of planks to be covered with anodized aluminum end caps, securely fastened to the plank.
 - k. Joint sleeves: Dual joint sleeves to be inserted at each butt joint of each load bearing aluminum plank, and to penetrate 6 inches into each plank at the joint.
10. Guard railing: To be at all sides of bleacher, entry stairs, ramps portals and landings.
- a. Vertical rail risers to be galvanized steel angle 3" x 3" x 1/4 (50 ksi) for steel to steel connection and fastened with 3/8" galvanized hardware
 - b. Horizontal railing to be anodized aluminum with aluminum cast end plugs at ends of straight runs and/or elbows at corners.
 - c. All guards shall be secured to vertical rail members with hot dipped galvanized fasteners and clamps
 - d. Railings shall be placed at a minimum of 42" above walkways, entrances and adjacent seat boards.
 - e. The barrier material shall include 6 - gauge black vinyl coated chain link fencing, fastened in place with hot dipped galvanized tension bars and aluminum ties.
11. Ramps:
- a. Slope: 1 in 12.
 - b. Guardrails to be 42 inches above ramp with two-line anodized aluminum rail and in filled with 6- gauge black vinyl coated chain link fence (2" mesh) and 2 x 6 extruded aluminum toe board.
 - c. Handrail: Ramps to have handrail extensions. The handgrip portion of handrails shall not be less than 1 1/2 inches or more than 2 inches in cross-sectional dimension or the shape shall provide an equivalent gripping surface. The handgrip portion of handrails shall have a smooth surface with no sharp corners. The top of handrails and handrail extensions shall be placed not less than 34 inches or more than 38 inches above the ramp surface. Handrails shall be continuous the full length of the ramp and shall extend in the direction of the ramp not less than 12 inches beyond the end of the ramp. Ends shall be returned or shall terminate in newel posts or safety terminals. If returned, rail must be smooth with no external fittings.
 - d. Termination: Ramps shall end with smooth transition onto level concrete pad at benchmark elevation. Aluminum plate with end closures required.
12. Handicap provision:
- a. Quantity of wheelchair spaces: as shown on drawings and in full compliance with ADA Standards set forth in International Building Code Accessibility Regulations
 - b. Riser area adjacent to wheelchair spaces to have intermediate construction so 4-inch sphere cannot pass through opening.
 - c. Guardrail: Area directly behind handicap areas shall have two-line anodized aluminum rail attached to the riser members. These rails shall be pre-fabricated to match the appearance of the mid-aisle handrails. A toe rail shall be attached to the base of the rail.
- B. Substructures:
- 1. Structural shapes meet one of the following ASTM specifications: A36, A36/A572 grade 50, A572 grade 50, A529-50, or A500 grade B.
 - 2. Shop connections are seal welds.
 - 3. After fabrication, all steel is hot-dipped galvanized to ASTM-A-123 specifications. Painted and/or powder coated steel does not offer proper protection and is not an acceptable protective finish for this project
 - 4. All hardware shall be hot-dipped galvanized to ASTM A-123, mechanically galvanized or aluminum (aluminum applies to pop rivets, drive rivets, wire ties).
 - 5. A minimum of 3/8" galvanized connection hardware to be used on the substructure

C. Extruded Aluminum:

1. Seat Planks and Railing are extruded aluminum alloy, 6063-T6 with clear anodized 204R1, AA-M10C22A31, Class II finish.
 2. Riser planks are extruded aluminum alloy, 6063-T6 with Dur-Kyn painted finish, per location on plans. The visitor stand is clear anodized.
 3. Tread, stair and ramp planks are extruded aluminum alloy 6063-T6 mill finish
 4. Joint Sleeve Assembly to be inserted in flat plank to maintain true alignment in joining together two plank pieces. Extruded aluminum alloy, 6063-T, mill finish.
- D. Accessories:
1. Channel End Caps: Aluminum alloy 6063-T6, clear anodized 204R1, AA-M10C22A31, Class II. Mechanically fastened.
 2. Cast End Plugs: Aluminum 319 alloy, cast finish. (Required at termination ends of railing)
 3. Hardware:
 - a. Bolts, Nuts: Hot-dipped galvanized or mechanically galvanized.
 - b. Hold-down Clip Assembly: Aluminum alloy 6005A-T6, mill finish.
 - c. Structural Hardware: Equal to or greater than hot dipped galvanized ASTM-A307. No connections utilizing high strength bolts are classed as slip critical.
 - d. Aisle Nose and Stair Nose: Aluminum alloy, 6063-T6, slip-resistant black painted finish. Mechanically fastened.
 - e. Fabrication:
- E. Design Load:
1. Live Load: 100 psf gross horizontal projection.
 2. Lateral Sway Load: 24 plf seat plank.
 3. Perpendicular Sway Load: 10 plf seat plank.
 4. Live Load of Seat and Tread Planks: 120 plf.
 5. Handrails and Guardrail: Designed to resist a single concentrated load of 200# applied in any direction at any point along the top. Per the International Building Code.
 6. Wind load: Per State and Local Building Code.
 7. Liveload deflection of structural members shall be limited to L/200 of the span.
- F. All manufactured connections to be shop welded.
1. Manufactured by certified welders conforming to AWS Standards.

2.03 PRESS BOX WITH STEEL FRAME CONSTRUCTION

- A. Product Description: Steel Frame Construction with a flat front
- B. Press box Dimensions: (8) feet wide x (12) feet long, softball and (8) feet wide x (18) feet long multi purpose fields.
- C. Press box to be constructed with internal roof top access, either wall mounted or a ships ladder
- D. Special Inspections- third party inspection to be completed and documented at the fabrication facility in accordance with PA Regulations.
- E. Press Box Support Structure:
1. Structural shapes meet one of the following ASTM specifications: A36, A36/A572 grade 50, A572 grade 50, A529-50, or A500 grade B.
 2. Shop connections are seal welds.
 3. After fabrication, all steel is hot-dipped galvanized to ASTM-A-123 specifications.
- F. Press Box: All materials shall be new and shall comply with ASTM specifications.
1. Floor
 - a. Main support to be a galvanized steel floor frame sized to support structure and metal belly pan for support of insulation.

- b. Floor to be INTERLOCK Aluminum Decking System, extruded aluminum alloy 6063-T6. Attach Decking System to steel floor frame with mechanical fasteners at end of plank and at intermediate supports. Wood/plywood base decking has proven to deteriorate over time and is not an acceptable alternative.
- c. Insulation: Kraft faced fiberglass building insulation thickness in compliance with 2015 energy conservation code. Batt or roll as manufactured by Owens-Corning Fiberglass Corp., or equal.
- d. Wall Structure Steel Framing
 - 1) 4 inch x 4 inch x 11 gauge square tubing with maximum span of 14 feet on front wall and maximum span of 6 feet on back wall and 4 inch x 2 1/2 inch x 14 gauge steel "cees" with maximum spacing of 5 feet for all walls with siding. Spans greater than these require engineered calculations for design.
 - 2) Insulation: Kraft faced fiberglass building insulation R-11, 3 1/2 inches thick. Batt or roll as manufactured by Owens-Corning Fiberglass Corp., or equal. Insulation shall be in accordance with the 2023 International Energy Conservation code.
 - 3) Interior Finish
 - (a) 1/2 inch vinyl coated gypsum panels, Gold Bond vinyl-surfaced
 - (b) Cove Base: Vinyl 4 inches x.080 color to be medium gray.
 - 4) Exterior Finish
 - (a) 26 - gauge prefinished R-Panel paneling as manufactured by MBCI, Signature 200 color series, color to be determined. Vinyl clad siding is not an acceptable product.
 - (b) Wall panels are attached with #12 TEK screws - 6" O.C. at the top and bottom of the panels. Lap screws are placed at each end of the panels, at the intermediate supports, and at the mid-point between supports (TEK #14). All fasteners to be painted same color as exterior paneling.
- e. Roof Structure
 - 1) 4 inch x 4 inch x 11 gauge square tubing with maximum spacing of 6 feet on center and 4 inches x 2 1/2 inches x 14 gauge steel "cees" with maximum spacing of 2 feet on center.
 - 2) Roof: 1/8 inch four way steel plate roof, continuous welded seams coated with acrylic metal primer as manufactured by Coronado and 36 mils of acrylink roof coating as manufactured by Isothermal Protective Coatings, or equal. Plate is welded on both sides of rafters with 1-1/2 inch long 1/8 inch fillet welds on 12 inch centers. Plywood sheathing will not be accepted.
 - 3) Insulation: Kraft faced fiberglass building insulation, R-19 (minimum) 6 inches thick. Batt or roll as manufactured by Owens-Corning Fiberglass Corp., or equal.
 - 4) Cornice: 26 gauge steel prefinished- color to be determined.
 - 5) Ceiling: 24 inch x 24 inch x 5/8 inch acoustical ceiling tile architectural revealed edge style wind clips and other components as manufactured by USG, or equal.
- f. Exterior Doors
 - 1) Full flush steel construction with honeycomb core. 18 gauge skin sheets. Dimensions: 3 feet 0 inches x 6 feet 8 inches. Color: White.
 - 2) Steel door frame (16 gauge) complete with 1/2 inch threshold and weather-stripping.
 - 3) Exterior Hardware (Prior to completed fabrication check with the district to verify what core lock system they use): Yale 546F Exterior Trim, or equal. Handles shall be lever type that allows operation without tight grasping or twisting of the wrist. All exterior hardware must accommodate this.
 - 4) Interior Hardware: Yale 2100 Exit Device, or equal. Handle shall be panic bar that allows for opening without any grasping, twisting or turning.
 - 5) Interior Walls
 - (a) Framing to be steel galvanized studs (25 gauge) 1 1/4 inch x 3 5/8 inch at maximum 2 feet on center.
 - (b) Finishes to be consistent with all other interior finishes.

- (c) A 24" x 56" interior window in each wall.
- g. Windows
 - 1) Frame: Extruded aluminum single hung, horizontal sliding unit, thermal break.
 - 2) Sash: Tilt toward inside for easy cleaning.
 - 3) Glazing: Clear tempered panes.
 - 4) Dimensions of each unit: Dependent on compartment size. At interior wall locations or structural support locations the dimension between windows shall be no greater than 6 inches.
 - 5) Finish: Electrostatically applied acrylic enamel.
- h. Work Bench
 - 1) 18 inch deep clear anodized aluminum countertop with a radius front edge.
 - 2) Support using 4" x 2" x 14 ga. Steel "cee" on 4" x 4" x 11 ga. Sq. tubing welded to steel.
 - 3) Shelf brackets do not provide proper support and are not acceptable.
- i. Painting: Materials equal to. Coronado or equal.
 - 1) Surfaces: Exterior Door(s), Door Frame(s)
 - (a) Primer: Applied by Door Manufacturer.
 - (b) Finish: 2 coats acrylic latex semi-gloss enamel applied by press box manufacturer.
 - 2) Surfaces, Exterior Siding
 - (a) Primer: Applied by Siding Manufacturer.
 - (b) Finish: Applied by Siding Manufacturer.
 - (c) Touchup: If applicable
 - 3) Surfaces: Wall and Roof Structure
 - (a) Primer: Coronado DTM Industrial 180-11 acrylic metal primer applied after welding, or equal.
- j. Caulking: Sonneborn NP1 - Polyurethane sealant, All temperature, UV resistant, or equal. Silicone products are not acceptable.
- k. Electrical Work:
 - 1) Submittal drawing shall indicate devices and circuitry.
 - 2) Fixtures: Recessed Edgelit LED panel light fixture for use in grid ceiling systems.
 - 3) Wiring to be in nonmetallic Panduit, or equal. N.E.C. breaker box to be 100 amp service mounted on wall with 2 inch rigid conduit to be stubbed out at back wall of press box ready for service line to be connected.
 - 4) Service line to Press Box (By Electrical Contractor)
 - 5) Electrical outlet(s) installed per NEC shall be standard duty.
 - (a) All outlets shall be surface mounted on wall.
 - 6) Sound, Telephone, Clock, Field Communication: Empty double outlet boxes per N.E.C. with 3/4 inch conduit stubbed out bottom of Press Box. Electrical contractor is responsible for re-connecting all electric, telecommunications and audio visual wiring, conduit and equipment to the press box.
 - 7) Outlet boxes to be flush mounted into wall. Any wiring completed on-site will be responsibility of such contractor for inspections. Quantity per plans.
 - 8) Provide wall-mounted PTAC Air/Heat units per plans at the multi purpose fields and baseboard heat only at the softball field press box.
 - 10) Provide in each room an emergency combination exit/flood light with battery back-up. Also provide exterior emergency light with remote heads.
 - 11) Provide (2) wall mount exterior lights with photocell

PART 3 – EXECUTION

3.01 INSTALLATION

- A. All work performed by technicians experienced in bleacher seating. Project references may be required to verify the quality of finished projects.
- B. Installation with proven experience in the northeast region. Requirement for a minimum of (3) installer references in for this project of similar size and scope.
- C. Project is only to be installed as per approved shop drawings.

3.02 EXAMINATION

- A. Verify that foundation, floor slab, mechanical and electrical utilities, and placed anchors are in correct position

3.03 ERECTION

- A. Provide for erection and wind loads. Provide temporary bracing to maintain structure plumb and in alignment until completion of erection and installation of permanent bracing. Locate braced bays as indicated.
- B. Do not field cut or alter structural members without approval.

3.04 CLEAN-UP

- A. Clean up all debris caused by work of this section removed from site.
- B. Upon completion of the work and final inspections, bleacher manufacturer installer shall broom clean the stand removing all loose debris.

END OF SECTION 131250

SECTION 133419 - METAL BUILDING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural-steel framing.
2. Concrete over steel floor deck.
3. Metal roof panels.
4. Metal wall panels.
5. Metal soffit panels.
6. Thermal insulation.
7. Personnel doors and frames.
8. Accessories.

B. Related Requirements:

1. Section 077253 "Snow Guards" for prefabricated devices designed to hold snow on the roof surface.
2. Section 083323 "Overhead Coiling Doors" for coiling vehicular doors in metal building systems.
3. Section 087100 "Door Hardware" for hardware to be installed on metal building system doors.

1.2 DEFINITIONS

- A. Terminology Standard:** See MBMA's "Metal Building Systems Manual" for definitions of terms for metal building system construction not otherwise defined in this Section or in standards referenced by this Section.

1.3 COORDINATION

- A.** Coordinate sizes and locations of concrete foundations and casting of anchor-rod inserts into foundation walls and footings. Anchor rod installation, concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place Concrete."
- B.** Coordinate metal panel assemblies with rain drainage work, flashing, trim, and construction of supports and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.4 PREINSTALLATION MEETINGS

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

1. Review methods and procedures related to metal building systems 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.
- 2. Review methods and procedures related to metal roof panel assemblies including, but not limited to, the following:
 - a. Compliance with requirements for purlin and rafter conditions, including flatness and attachment to structural members.
 - b. Structural limitations of purlins and rafters during and after roofing.
 - c. Flashings, special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect metal roof panels.
 - d. Temporary protection requirements for metal roof panel assembly during and after installation.
 - e. Roof observation and repair after metal roof panel installation.
- 3. Review methods and procedures related to metal wall panel assemblies including, but not limited to, the following:
 - a. Compliance with requirements for support conditions, including alignment between and attachment to structural members.
 - b. Structural limitations of girts and columns during and after wall panel installation.
 - c. Flashings, special siding details, wall penetrations, openings, and condition of other construction that will affect metal wall panels.
 - d. Temporary protection requirements for metal wall panel assembly during and after installation.
 - e. Wall observation and repair after metal wall panel installation.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of metal building system component.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Metal roof panels.
 - b. Metal wall panels.
 - c. Metal soffit panels.
 - d. Thermal insulation and vapor-retarder facings.
 - e. Personnel doors and frames.
- B. Shop Drawings: Indicate components by others. Include full building plan, elevations, sections, details and the following:
 - 1. Anchor-Rod Plans: Submit anchor-rod plans and templates before foundation work begins. Include location, diameter, and minimum required projection of anchor rods required to attach metal building to foundation. Indicate column reactions at each location.
 - 2. Structural-Framing Drawings: Show complete fabrication of primary and secondary framing; include provisions for openings. Indicate welds and bolted connections, distinguishing between shop and field applications. Include transverse cross-sections.

- a. Show provisions for attaching mezzanines.
 - b. Show required steel floor deck and concrete for mezzanine.
 - c. Show stairs and railing framing.
 3. Metal Roof and Wall Panel Layout Drawings: Show layouts of panels including methods of support. Include details of edge conditions, joints, panel profiles, corners, anchorages, clip spacing, trim, flashings, closures, and special details. Distinguish between factory- and field-assembled work; show locations of exposed fasteners.
 - a. Show roof-mounted items including roof hatches, equipment supports, and pipe supports and penetrations.
 - b. Show wall-mounted items including personnel doors, vehicular doors, louvers, and lighting fixtures.
 4. Accessory Drawings: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches:
 - a. Flashing and trim.
 - b. Gutters.
 - c. Downspouts.
 - C. Samples for Initial Selection: For units with factory-applied finishes.
 - D. Samples for Verification: For the following products:
 1. Panels: Nominal 12 inches long by actual panel width. Include fasteners, closures, and other exposed panel accessories.
 2. Flashing and Trim: Nominal 12 inches long. Include fasteners and other exposed accessories.
 3. Vapor-Retarder Facings: Nominal 6-inch- square Samples.
 4. Accessories: Nominal 12-inch- long Samples for each type of accessory.
 - E. Door Schedule: For doors and frames. Use same designations indicated on Drawings. Include details of reinforcement.
 1. Door Hardware Schedule: Include details of fabrication and assembly of door hardware. Organize schedule into door hardware sets indicating complete designations of every item required for each door or opening.
 2. Keying Schedule: Detail Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations.
 - F. Delegated Design Submittals: For metal building systems.
 1. Include analysis data indicating compliance with performance requirements and design data signed and sealed by the qualified professional engineer responsible for their preparation.
- 1.6 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For erector and manufacturer.
 - B. Welding certificates.
 - C. Letter of Design Certification: Signed and sealed by a qualified professional engineer. Include the following:

1. Name and location of Project.
2. Order number.
3. Name of manufacturer.
4. Name of Contractor.
5. Building dimensions including width, length, height, and roof slope.
6. Indicate compliance with AISC standards for hot-rolled steel and AISI standards for cold-rolled steel, including edition dates of each standard.
7. Governing building code and year of edition.
8. Design Loads: Include dead load, roof live load, collateral loads, roof snow load, deflection, wind loads/speeds and exposure, seismic design category or effective peak velocity-related acceleration/peak acceleration, and auxiliary loads (cranes).
9. Load Combinations: Indicate that loads were applied acting simultaneously with concentrated loads, according to governing building code.
10. Building-Use Category: Indicate category of building use and its effect on load importance factors.

D. Erector Certificates: For qualified erector, from manufacturer.

E. Material Test Reports: For each of the following products:

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

F. Source quality-control reports.

G. Field quality-control reports.

H. Surveys: Show final elevations and locations of major members. Indicate discrepancies between actual installation and the Contract Documents. Have surveyor who performed surveys certify their accuracy.

I. Sample Warranties: For special warranties.

1.7 CLOSEOUT SUBMITTALS

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

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer.

1. Accreditation: Manufacturer's facility accredited according to IAS AC472, "Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems."
2. Engineering Responsibility: Preparation of comprehensive engineering analysis and Shop Drawings by a professional engineer who is legally qualified to practice in jurisdiction where Project is located.

B. Erector Qualifications: An experienced erector who specializes in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to manufacturer.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3, "Structural Welding Code - Sheet Steel."

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, sheets, panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, 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. Protect foam-plastic insulation as follows:
 1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
 2. Protect against ignition at all times. Do not deliver foam-plastic insulation materials to Project site before installation time.
 3. Complete installation and concealment of foam-plastic materials as rapidly as possible in each area of construction.

1.10 FIELD CONDITIONS

- A. Weather Limitations: Proceed with panel installation only when weather conditions permit metal panels to be installed according to manufacturers' written instructions and warranty requirements.

1.11 WARRANTY

- A. Special Warranty on Metal Panel Finishes: 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 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: 25 years for Silicone Polyester and 35 years from date of Substantial Completion.
- B. Special Weathertightness Warranty for Standing-Seam Metal Roof Panels: Manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that leak or otherwise fail to remain weathertight within specified warranty period.
 1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Nucor Building Systems
- B. Source Limitations: Obtain metal building system components, including primary and secondary framing and metal panel assemblies, from single source from single manufacturer.

2.2 SYSTEM DESCRIPTION

- A. Provide a complete, integrated set of mutually dependent components and assemblies that form a metal building system capable of withstanding structural and other loads, thermally induced movement, and exposure to weather without failure or infiltration of water into building interior.
- B. Primary-Frame Type:
 - 1. Rigid Clear Span: Solid-member, structural-framing system without interior columns.
- C. End-Wall Framing:
 - 1. Manufacturer's standard, for buildings not required to be expandable, consisting of load-bearing end-wall and corner columns and rafters.
- D. Mezzanine Framing:
 - 1. Interior loadbearing columns to support mezzanine framing and exterior and endwall columns sized appropriately to carry the mezzanine framing loads.
 - 2. Mezzanine framing, including all beams and girders supported from exterior and interior columns.
 - 3. Concrete over steel floor deck as required for mezzanine loadings and framing spacings.
 - 4. Provide stairs, any required stair posts, and railings for mezzanine.
 - a. Railings shall be a horizontal rod infill railing.
- E. Secondary-Frame Type: Manufacturer's standard purlins and joists and partially inset-framed girts.
- F. Bearing Height: 21 feet.
- G. Bay Spacing: As indicated on Drawings.
- H. Roof Slope: 6 inches per 12 inches.
- I. Roof System: Manufacturer's standard standing-seam, vertical-rib metal roof panels.
 - 1. Panels: Loc Seam-360 roof system by Nucor.
- J. Exterior Wall System: Manufacturer's standard recessed-fastener, A-Panel, metal wall panels.
 - 1. Panels: A-Panel system by Nucor.

2.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design metal building system.
- B. Structural Performance: Metal building systems to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to procedures in MBMA's "Metal Building Systems Manual."
 - 1. Design Loads:
 - a. Dead Loads: Self weight of all components plus 15 pounds-per-square foot collateral dead load allowance.
 - b. Live Loads: As indicated on Drawings.
 - c. Roof Snow Load: Per IBC and ASCE 7, including localized unbalanced, drift, and sliding snow, based on Criteria indicated on Drawings.
 - d. Wind Loads: Per IBC and ASCE 7, including localized components and cladding effects, based on Criteria indicated on Drawings.
 - e. Seismic Loads: Per IBC and ASCE 7 requirements for Seismic Design Category A
 - 2. Deflection and Drift Limits:
 - a. Design metal building system assemblies to withstand serviceability design loads without exceeding deflections and drift limits recommended in AISC Steel Design Guide No. 3 "Serviceability Design Considerations for Steel Buildings."
 - b. No greater than the following:
 - 1) Mezzanine Framing: Vertical deflection of 1/360 of the span for Live Load and 1/240 of the span for Dead + Live Load.
 - 2) Purlins and Rafters: Vertical deflection of 1/240 the span.
 - 3) Girts: Horizontal deflection of 1/120 of the span.
 - 4) Metal Roof Panels: Vertical deflection of 1/240 of the span or as required by supplier's cladding.
 - 5) Metal Wall Panels: Horizontal deflection of 1/180 of the span or as required by supplier's cladding.
 - 6) Design secondary-framing system to accommodate deflection of primary framing and construction tolerances, and to maintain clearances at openings.
 - 7) Lateral Drift: Maximum of 1/400 of the building height.
- C. Seismic Performance: Metal building system to withstand the effects of earthquake motions determined according to ASCE/SEI 7 as applicable for Seismic Design Category A
- 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: 120 deg F, ambient; 180 deg F, material surfaces.
- E. Fire Propagation Characteristics: Exterior wall assemblies containing foam plastics pass NFPA 285 fire test.
- F. Structural Performance for Metal Roof and Wall Panels: 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.
- G. Air Infiltration for Metal Roof Panels: 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.
- H. Air Infiltration for Metal Wall Panels: 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.
- I. Water Penetration for Metal Roof Panels: No water penetration when tested according to ASTM E1646 at the following test-pressure difference:
 1. Test-Pressure Difference: 6.24 lbf/sq. ft.
- J. Water Penetration for Metal Wall Panels: No water penetration when tested according to ASTM E331 at the following test-pressure difference:
 1. Test-Pressure Difference: 6.24 lbf/sq. ft.
- K. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
 1. Uplift Rating: UL 90.
- L. Thermal Performance for Opaque Elements: Provide the following maximum U-factors and minimum R-values when tested according to ASTM C1363 or ASTM C518:
 1. Roof:
 - a. U-Factor: .035.
 - b. R-Value: 30.
 2. Walls:
 - a. U-Factor: .052.
 - b. R-Value: 26.

2.4 STRUCTURAL-STEEL FRAMING

- A. Structural Steel: Comply with AISC 360, "Specification for Structural Steel Buildings."
- B. Bolted Connections: Comply with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
- C. Cold-Formed Steel: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" for design requirements and allowable stresses.
- D. Primary Framing: Manufacturer's standard primary-framing system, designed to withstand required loads and specified requirements. Primary framing includes transverse and lean-to frames; rafters, rake, and canopy beams; sidewall, intermediate, end-wall, and corner columns; and wind bracing.

1. General: Provide frames with attachment plates, bearing plates, and splice members. Factory drill for field-bolted assembly. Provide frame span and spacing indicated.
 - a. Slight variations in span and spacing may be acceptable if necessary to comply with manufacturer's standard, as approved by Architect.
 2. Rigid Clear-Span Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Interior columns are not permitted except where shown for mezzanine.
 3. Frame Configuration: Single gable
 4. Exterior Column: Tapered.
 5. Rafter: Tapered.
- E. End-Wall Framing: Manufacturer's standard primary end-wall framing fabricated for field-bolted assembly to comply with the following:
1. End-Wall, Corner, and Mezzanine Columns: I-shaped sections fabricated from structural-steel shapes; shop-welded, built-up steel plates; or C-shaped, cold-formed, structural-steel sheet.
 2. End-Wall Rafters: C-shaped, cold-formed, structural-steel sheet; or I-shaped sections fabricated from shop-welded, built-up steel plates or structural-steel shapes.
 3. Mezzanine Frames: I-shaped frame sections of structural-steel shapes. Interior columns are not permitted except where shown for mezzanine.
- F. Secondary Framing: Manufacturer's standard secondary framing, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other miscellaneous structural members. Unless otherwise indicated, fabricate framing from either cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet, prepainted with coil coating, to comply with the following:
1. Purlins:
 - a. C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; minimum 2-1/2-inch wide flanges.
 - b. Steel joists of depths:
 - 1) Depth: As needed to comply with system performance requirements.
 2. Girts: C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes. Form ends of Z-sections with stiffening lips angled 40 to 50 degrees from flange, with minimum 2-1/2-inch wide flanges.
 - a. Depth: As required to comply with system performance requirements.
 3. Eave Struts: Unequal-flange, C-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; to provide adequate backup for metal panels.
 4. Flange Bracing: Minimum 2-by-2-by-1/8-inch structural-steel angles or 1-inch diameter, cold-formed structural tubing to stiffen primary-frame flanges.
 5. Sag Bracing: Minimum 1-by-1-by-1/8-inch structural-steel angles.
 6. Base or Sill Angles: Manufacturer's standard base angle, minimum 3-by-2-inch, fabricated from zinc-coated (galvanized) steel sheet.
 7. Purlin and Girt Clips: Manufacturer's standard clips fabricated from steel sheet. Provide galvanized clips where clips are connected to galvanized framing members.
 8. Framing for Openings: Channel shapes; fabricated from cold-formed, structural-steel sheet or structural-steel shapes. Frame head and jamb of door openings and head, jamb, and sill of other openings.

9. Miscellaneous Structural Members: Manufacturer's standard sections fabricated from cold-formed, structural-steel sheet; built-up steel plates; or zinc-coated (galvanized) steel sheet; designed to withstand required loads.
- G. Bracing: Provide adjustable wind bracing using any method, or combination thereof, as follows:
1. Rods: ASTM A36/A36M; ASTM A572/A572M, Grade 50; or ASTM A529/A529M, Grade 50; minimum 1/2-inch diameter steel; threaded full length or threaded a minimum of 6 inches at each end.
 2. Angles: Fabricated from structural-steel shapes to match primary framing, of size required to withstand design loads.
 3. Rigid Portal Frames: Fabricated from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.
- H. Anchor Rods: Headed anchor rods as indicated in Anchor Rod Plan for attachment of metal building to foundation.
- I. Materials:
1. W-Shapes: ASTM A992/A992M; ASTM A572/A572M, Grade 50 or 55; or ASTM A529/A529M, Grade 50 or 55.
 2. Channels, Angles, M-Shapes, and S-Shapes: ASTM A36/A36M; ASTM A572/A572M, Grade 50 or 55; or ASTM A529/A529M, Grade 50 or 55.
 3. Plate and Bar: ASTM A36/A36M; ASTM A572/A572M, Grade 50 or 55; or ASTM A529/A529M, Grade 50 or 55.
 4. Steel Pipe: ASTM A53/A53M, Type E or S, Grade B.
 5. Cold-Formed Hollow Structural Sections: ASTM A500, Grade B or C, structural tubing.
 6. Structural-Steel Sheet: Hot-rolled, ASTM A1011/A1011M, Structural Steel (SS), Grades 30 through 55, or High-Strength Low-Alloy Steel (HSLAS) or High-Strength Low-Alloy Steel with Improved Formability (HSLAS-F), Grades 45 through 70; or cold-rolled, ASTM A1008/A1008M, Structural Steel (SS), Grades 25 through 80, or HSLAS, Grades 45 through 70.
 7. Metallic-Coated Steel Sheet: ASTM A653/A653M, SS, Grades 33 through 80, or HSLAS or HSLAS-F, Grades 50 through 80; with G60 coating designation; mill phosphatized.
 8. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A755/A755M.
 - a. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, SS, Grades 33 through 80, or HSLAS or HSLAS-F, Grades 50 through 80; with G90 coating designation.
 - b. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A792/A792M, SS, Grade 50 or 80; with Class AZ50 coating.
 9. 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: Plain.
 10. High-Strength Bolts, Nuts, and Washers, Grade A325: ASTM F3125/F3125M, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
 - a. Finish: Plain.
 11. High-Strength Bolts, Nuts, and Washers, Grade A490: ASTM F3125/F3125M, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.

12. Headed Anchor Rods: ASTM F1554, Grade 36.
 - a. Configuration: Straight.
 - b. Nuts: ASTM A563 hex or heavy-hex carbon steel, as required.
 - c. Plate Washers: ASTM A36/A36M carbon steel.
 - d. Washers: ASTM F436 hardened carbon steel.
 - e. Finish: Plain.
13. Threaded Rods: ASTM A36/A36M.
 - a. Nuts: ASTM A563 hex or heavy-hex carbon steel.
 - b. Washers: A36/A36M carbon steel.
 - c. Finish: Plain.

- J. Finish: Factory primed. Apply specified primer immediately after cleaning and pretreating.
 1. Clean and prepare in accordance with SSPC-SP2.
 2. Coat with manufacturer's standard primer. Apply primer to primary and secondary framing to a minimum dry film thickness of 1 mil.
 - a. Prime secondary framing formed from uncoated steel sheet to a minimum dry film thickness of 0.5 mil on each side.

2.5 METAL ROOF PANELS

- A. Standing-Seam, Vertical-Rib, Metal Roof Panels <Insert drawing designation>: Formed with vertical ribs at panel edges and minor striations between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels.
 1. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet 0.024-inch nominal uncoated steel thickness. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
 - a. Exterior Finish: Three-coat fluoropolymer or Siliconized polyester.
 - b. Color: As selected by Architect from manufacturer's full range.
 2. Clips: Manufacturers standard to accommodate thermal movement.
 3. Joint Type: Mechanically seamed 360 degree bend.
 4. Panel Coverage: 16 inches.
 5. Panel Height: 2 inches.
- B. Finishes:
 1. Exposed Coil-Coated Finish:
 - a. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - b. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a minimum dry film thickness of 0.2 mil for primer and 0.8 mil for topcoat.

2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

2.6 METAL WALL PANELS

- A. Semi-Concealed Fastener, A-Profile, Metal Wall Panels: Formed with vertical panel edges and two recessed valleys between panel edges; with flush joint between panels; with 1-inch wide flange for attaching interior finish; designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps.

1. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.024-inch nominal uncoated steel thickness. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
 - a. Exterior Finish: Siliconized polyester.
 - b. Color: As selected by Architect from manufacturer's full range.
2. Panel Coverage: 36 inches.
3. Panel Height: 1-5/16 inches.

B. Finishes:

1. Exposed Coil-Coated Finish:
 - a. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - b. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a minimum dry film thickness of 0.2 mil for primer and 0.8 mil for topcoat.
2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

2.7 METAL SOFFIT PANELS

- A. General: Provide factory-formed metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.
- B. Concealed-Fastener, Flush-Profile, Metal Soffit Panels: Formed with vertical panel edges and a single wide recess, centered between panel edges; with flush joint between panels; with 1-inch wide flange for attaching interior finish; designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps.
1. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.024-inch nominal uncoated steel thickness. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

- a. Exterior Finish: Fluoropolymer or Siliconized polyester.
 - b. Color: As selected by Architect from manufacturer's full range.
2. Panel Coverage: 16 inches.
3. Panel Height: 1 inch.

2.8 THERMAL INSULATION

- A. Basis of Design: Silvercote, LLC
 1. Roof System – Sag-N-Bag
 2. Wall System – Energy Saver Double Layer
- B. Faced Metal Building Insulation: ASTM C991, Type II, glass-fiber-blanket insulation; 0.5-lb/cu. ft. density; 2-inch wide, continuous, vapor-tight edge tabs; with a flame-spread index of 25 or less.
- C. Unfaced Metal Building Insulation: ASTM C991, Type I, or NAIMA 202, glass-fiber-blanket insulation; 0.5-lb/cu. ft. density; 2-inch wide, continuous, vapor-tight edge tabs; with a flame-spread index of 25 or less.
- D. Mineral-Fiber-Blanket Insulation: ASTM C665, type indicated below; consisting of fibers manufactured from glass, slag wool, or rock wool.
 1. Nonreflective Faced: Type II (blankets with nonreflective membrane covering), Category 1 (membrane is a vapor retarder), Class A (membrane-faced surface with a flame-spread index of 25 or less).
 2. Unfaced: Type I (blankets without membrane covering), passing ASTM E136 for combustion characteristics.
- E. Retainer Strips: For securing insulation between supports, 0.025-inch nominal-thickness, formed, metallic-coated steel or PVC retainer clips colored to match insulation facing.
- F. Vapor-Retarder Facing: ASTM C1136, with permeance not greater than 0.02 perm when tested according to ASTM E96/E96M, Desiccant Method.
 1. Basis of Design: Silvercote, LLC - GymGuard
 2. Composition:
 - a. White polypropylene film facing, fiberglass scrim reinforcement, and metallized-polyester film backing.
- G. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

2.9 PERSONNEL DOORS AND FRAMES

- A. Swinging Personnel Doors and Frames:
 1. Metal building system manufacturer's standard doors and frames; prepared and reinforced at strike and at hinges to receive factory- and field-applied hardware according to BHMA A156 Series.
 - a. Steel Doors: 1-3/4 inches thick; fabricated from metallic-coated steel face sheets, 0.036-inch nominal uncoated steel thickness, of seamless, hollow-metal

construction; with 0.060-inch nominal uncoated steel thickness, inverted metallic-coated steel channels welded to face sheets at top and bottom of door.

- 1) Design: Flush panel.
- 2) Core:

- a) Kraft honeycomb with U-factor rating of at least 0.47 Btu/sq. ft. x h x deg F.

- 3) Glazing Frames: Steel frames to receive factory-installed glass.
- 4) Glazing: Manufacturers standard glass.

b. Steel Frames: Fabricate 2-inch wide face frames from zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.060-inch nominal uncoated steel thickness.

- 1) Type: Factory welded.

c. Fabricate concealed stiffeners, reinforcement, edge channels, and moldings from either cold- or hot-rolled steel sheet.

d. Hardware:

- 1) Provide hardware for each door leaf, per 087100 "Door Hardware".

e. Anchors and Accessories: Manufacturer's standard units, galvanized according to ASTM A123/A123M.

f. Fabrication: Fabricate doors and frames to be rigid; neat in appearance; and free from defects, warp, or buckle. Provide continuous welds on exposed joints; grind, dress, and make welds smooth, flush, and invisible.

B. Materials:

1. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
2. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, CS, Type B; free of scale, pitting, or surface defects; pickled and oiled.
3. Metallic-Coated Steel Sheet: ASTM A653/A653M, CS, Type B; with G60 zinc (galvanized) or A60 zinc-iron-alloy (galvannealed) coating designation.

C. Finishes for Personnel Doors and Frames:

1. Factory-Applied Paint Finish: Manufacturer's standard, complying with SDI A250.3 for performance and acceptance criteria.
 - a. Color and Gloss: Match Architect's sample or As selected by Architect from manufacturer's full range.

2.10 ACCESSORIES

- A. General: Provide accessories as standard with metal building system manufacturer and as specified. Fabricate and finish accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes. Comply with indicated profiles and with dimensional and structural requirements.

1. Form exposed sheet metal accessories that are without excessive oil-canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
- B. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including copings, fasciae, corner units, ridge closures, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels unless otherwise indicated.
1. Closures: Provide closures at eaves and ridges, fabricated of same material as metal roof panels.
 2. Clips: Manufacturer's standard, designed to withstand negative-load requirements.
 3. Cleats: Manufacturer's standard, mechanically seamed cleats.
 4. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 5. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch thick, flexible closure strips; cut or premolded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
 6. Thermal Spacer Blocks: Where metal panels attach directly to purlins, provide thermal spacer blocks of thickness required to provide 1-inch standoff; fabricated from extruded polystyrene.
- C. Wall Panel Accessories: Provide components required for a complete metal wall panel assembly including copings, fasciae, mullions, sills, corner units, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal wall panels unless otherwise indicated.
1. Closures: Provide closures at eaves and rakes, fabricated of same material as metal wall panels.
 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch thick, flexible closure strips; cut or premolded to match metal wall panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- D. Flashing and Trim: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness, prepainted with coil coating; finished to match adjacent metal panels.
1. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers.
 2. Opening Trim: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.030-inch nominal uncoated steel thickness, prepainted with coil coating. Trim head and jamb of door openings, and head, jamb, and sill of other openings.
- E. Gutters: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness, prepainted with coil coating; finished to match roof fascia and rake trim. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch long sections, sized according to SMACNA's "Architectural Sheet Metal Manual."
1. Gutter Supports: Fabricated from same material and finish as gutters.
 2. Strainers: Bronze, copper, or aluminum wire ball type at outlets.

- F. Downspouts: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness, prepainted with coil coating; finished to match metal wall panels. Fabricate in minimum 10-foot long sections, complete with formed elbows and offsets.
 - 1. Mounting Straps: Fabricated from same material and finish as gutters.
- G. Pipe Flashing: Premolded, EPDM pipe collar with flexible aluminum ring bonded to base.
- H. Materials:
 - 1. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide fasteners with heads matching color of materials being fastened by means of plastic caps or factory-applied coating.
 - 2. Fasteners for Metal Roof Panels:
 - a. Self-drilling, Type 410 stainless steel or self-tapping, Type 304 stainless steel or zinc-alloy-steel hex washer head, with EPDM washer under heads of fasteners bearing on weather side of metal panels.
 - 3. Fasteners for Metal Wall Panels:
 - a. Self-drilling, Type 410 stainless steel or self-tapping, Type 304 stainless steel or zinc-alloy-steel hex washer head, with EPDM sealing washers bearing on weather side of metal panels.
 - 4. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.
 - 5. Blind Fasteners: High-strength aluminum or stainless steel rivets.
 - 6. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
 - 7. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.
 - 8. Metal Panel Sealants:
 - a. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene-compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape of manufacturer's standard size.
 - b. Joint Sealant: ASTM C920; one part elastomeric polyurethane or polysulfide; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended by metal building system manufacturer.

2.11 FABRICATION

- A. General: Design components and field connections required for erection to permit easy assembly.
 - 1. Mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.
 - 2. Fabricate structural framing to produce clean, smooth cuts and bends. Punch holes of proper size, shape, and location. Members to be free of cracks, tears, and ruptures.
- B. Tolerances: Comply with MBMA's "Metal Building Systems Manual" for fabrication and erection tolerances.

- C. Primary Framing: Shop fabricate framing components to indicated size and section, with baseplates, bearing plates, stiffeners, and other items required for erection welded into place. Cut, form, punch, drill, and weld framing for bolted field assembly.
 - 1. Make shop connections by welding or by using high-strength bolts.
 - 2. Join flanges to webs of built-up members by a continuous, submerged arc-welding process.
 - 3. Brace compression flange of primary framing with steel angles or cold-formed structural tubing between frame web and purlin web or girt web, so flange compressive strength is within allowable limits for any combination of loadings.
 - 4. Weld clips to frames for attaching secondary framing if applicable, or punch for bolts.
 - 5. Shop Priming: Prepare surfaces for shop priming according to SSPC-SP 2. Shop prime primary framing with specified primer after fabrication.
- D. Secondary Framing: Shop fabricate framing components to indicated size and section by roll forming or break forming, with baseplates, bearing plates, stiffeners, and other plates required for erection welded into place. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.
 - 1. Make shop connections by welding or by using non-high-strength bolts.
 - 2. Shop Priming: Prepare uncoated surfaces for shop priming according to SSPC-SP 2. Shop prime uncoated secondary framing with specified primer after fabrication.
- E. Metal Panels: Fabricate and finish metal panels at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.
 - 1. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of metal panel.

2.12 SOURCE QUALITY CONTROL

- A. Special Inspection: Owner will engage a qualified special inspector to perform source quality control inspections and to submit reports.
 - 1. Accredited Manufacturers: Special inspections will not be required if fabrication is performed by an IAS AC472-accredited manufacturer approved by authorities having jurisdiction to perform such Work without special inspection.
 - a. After fabrication, submit copy of certificate of compliance to authorities having jurisdiction, certifying that Work was performed according to Contract requirements.

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 metal building system manufacturer's tolerances.

1. Engage land surveyor to perform surveying.

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

3.2 PREPARATION

- A. Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition.
- B. Provide temporary shores, guys, braces, and other supports during erection to keep structural framing secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural framing, connections, and bracing are in place unless otherwise indicated.

3.3 ERECTION OF STRUCTURAL FRAMING

- A. Erect metal building system according to manufacturer's written instructions and drawings.
- B. Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer.
- C. Set structural framing accurately in locations and to elevations indicated, according to AISC specifications referenced in this Section. Maintain structural stability of frame during erection.
- D. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - 3. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- E. Align and adjust structural framing before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with framing. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure will be completed and in service.
- F. Primary Framing and End Walls: Erect framing level, plumb, rigid, secure, and true to line. Level baseplates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use grout to obtain uniform bearing and to maintain a level base-line elevation. Moist-cure grout for not less than seven days after placement.

1. Make field connections using high-strength bolts installed according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt type and joint type specified.
 - a. Joint Type: Snug tightened or pretensioned as required by manufacturer.
- G. Secondary Framing: Erect framing level, plumb, rigid, secure, and true to line. Field bolt secondary framing to clips attached to primary framing.
 1. Provide rake or gable purlins with tight-fitting closure channels and fasciae.
 2. Locate and space wall girts to suit openings such as doors.
 3. Provide supplemental framing at entire perimeter of openings, including doors, and other penetrations of roof and walls.
- H. Bracing: Install bracing in roof and sidewalls where indicated on erection drawings.
 1. Tighten rod and cable bracing to avoid sag.
 2. Locate interior end-bay bracing only where indicated.
- I. Framing for Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to structural framing.
- J. Erection Tolerances: Maintain erection tolerances of structural framing within AISC 303.

3.4 METAL PANEL INSTALLATION, GENERAL

- 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. Examination: Examine primary and secondary framing to verify that structural-panel support members and anchorages have been installed within alignment tolerances required by manufacturer.
 1. Examine roughing-in for components and systems penetrating metal panels, to verify actual locations of penetrations relative to seams before metal panel installation.
- D. General: Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 1. Field cut metal panels as required for doors, and other openings. Cut openings as small as possible, neatly to size required, and without damage to adjacent metal panel finishes.
 - a. Field cutting of metal panels by torch is not permitted unless approved in writing by manufacturer.
 2. Install metal panels perpendicular to structural supports unless otherwise indicated.

3. Flash and seal metal panels with weather closures at perimeter of openings and similar elements. Fasten with self-tapping screws.
 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 5. Locate metal panel splices over structural supports with end laps in alignment.
 6. Lap metal flashing over metal panels to allow moisture to run over and off the material.
- E. Lap-Seam Metal Panels: Install screw fasteners using power tools with controlled torque adjusted to compress EPDM washers tightly without damage to washers, screw threads, or metal panels. Install screws in predrilled holes.
1. Arrange and nest side-lap joints so prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full rib corrugation. Apply metal panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.
- F. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.
- G. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal panel assemblies. Provide types of gaskets, fillers, and sealants indicated; or, if not indicated, provide types recommended by metal panel manufacturer.
1. Seal metal panel end laps with double beads of tape or sealant the full width of panel. Seal side joints where recommended by metal panel manufacturer.
 2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

3.5 METAL ROOF PANEL INSTALLATION

- A. General: Provide metal roof panels of full length from eave to ridge unless otherwise indicated or restricted by shipping limitations.
1. Install ridge caps as metal roof panel work proceeds.
 2. Flash and seal metal roof panels with weather closures at eaves and rakes. Fasten with self-tapping screws.
- B. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint, at location and spacing and with fasteners recommended by manufacturer.
1. Install clips to supports with self-drilling or 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 that clip, metal roof panel, and factory-applied sealant are completely engaged.
 4. Rigidly fasten eave end of metal roof panels and allow ridge end free movement for thermal expansion and contraction. Predrill panels for fasteners.
 5. Provide metal closures at rake edges rake walls and each side of ridge caps.
- C. Metal Fascia Panels: Align bottom of metal panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws. Flash and seal metal panels with weather closures where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.

- D. Metal Roof Panel Installation Tolerances: Shim and align metal roof panels within installed tolerance of 1/4 inch in 20 feet on slope and location lines and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.6 METAL WALL PANEL INSTALLATION

- A. General: Install metal wall panels in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts, extending full height of building, unless otherwise indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Unless otherwise indicated, begin metal panel installation at corners with center of rib lined up with line of framing.
 - 2. Shim or otherwise plumb substrates receiving metal wall panels.
 - 3. When two rows of metal panels are required, lap panels 4 inches minimum.
 - 4. When building height requires two rows of metal panels at gable ends, align lap of gable panels over metal wall panels at eave height.
 - 5. Rigidly fasten base end of metal wall panels and allow eave end free movement for thermal expansion and contraction. Predrill panels.
 - 6. Flash and seal metal wall panels with weather closures at eaves and rakes, and at perimeter of all openings. Fasten with self-tapping screws.
 - 7. Install screw fasteners in predrilled holes.
 - 8. Install flashing and trim as metal wall panel work proceeds.
 - 9. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated on Drawings; if not indicated, as necessary for waterproofing.
 - 10. Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws.
 - 11. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.
- B. Metal Wall Panels: Install metal wall panels on exterior side of girts. Attach metal wall panels to supports with fasteners as recommended by manufacturer.
- C. Installation Tolerances: Shim and align metal wall panels within installed tolerance of 1/4 inch in 20 feet, noncumulative; level, plumb, and on location lines; and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.7 METAL SOFFIT PANEL INSTALLATION

- A. Provide metal soffit panels the full width of soffits. Install panels perpendicular to support framing.
- B. Flash and seal metal soffit panels with weather closures where panels meet walls and at perimeter of all openings.

3.8 THERMAL INSULATION INSTALLATION

- A. General: Install insulation concurrently with metal panel installation, in thickness indicated to cover entire surface, according to manufacturer's written instructions.
 - 1. Install factory-laminated, vapor-retarder-faced blankets straight and true in one-piece lengths, with both sets of facing tabs sealed, to provide a complete vapor retarder.
 - 2. Install blankets straight and true in one-piece lengths. Install vapor retarder over insulation, with both sets of facing tabs sealed, to provide a complete vapor retarder.

B. Blanket Roof Insulation: Comply with the following installation method:

1. Over-Purlin-with-Spacer-Block Installation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing. Install layer of filler insulation over first layer to fill space formed by metal roof panel standoffs. Hold in place by panels fastened to standoffs.
 - a. Thermal Spacer Blocks: Where metal roof panels attach directly to purlins, install thermal spacer blocks.

C. Blanket Wall Insulation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing. Hold in place by metal wall panels fastened to secondary framing.

1. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.
2. Sound-Absorption Insulation: Where sound-absorption requirement is indicated for metal liner panels, cover insulation with polyethylene film and provide inserts of wire mesh to form acoustical spacer grid.

3.9 DOOR AND FRAME INSTALLATION

- A. General: Install doors and frames plumb, rigid, properly aligned, and securely fastened in place according to manufacturers' written instructions. Coordinate installation with wall flashings and other components. Seal perimeter of each door frame with elastomeric sealant used for metal wall panels.
- B. Personnel Doors and Frames: Install doors and frames according to NAAMM-HMMA 840. Fit non-fire-rated doors accurately in their respective frames, with the following clearances:
1. Between Doors and Frames at Jambs and Head: 1/8 inch
 2. Between Edges of Pairs of Doors: 1/8 inch.
 3. At Door Sills with Threshold: 3/8 inch.
 4. At Door Sills without Threshold: 3/4 inch.
- C. Sliding Service Doors: Bolt support angles to opening head members through factory-punched holes. Bolt door tracks to support angles at maximum 24 inches o.c. Set doors and operating equipment with necessary hardware, jamb and head mold stops, continuous hood flashing, anchors, inserts, hangers, and equipment supports.

3.10 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
1. Install components required for a complete metal roof panel assembly, including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
 2. Install components for a complete metal wall panel assembly, including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
 3. Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying

rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by manufacturer.

- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
 - 1. Install exposed flashing and trim that is without excessive oil-canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
 - 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).
- C. Gutters: Join sections with riveted-and-soldered or lapped-and-sealed joints. Attach gutters to eave with gutter hangers spaced as required for gutter size, but not more than 36 inches o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
- D. Downspouts: Join sections with 1-1/2-inch telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.
 - 1. Tie downspouts to underground drainage system indicated.
- E. Circular Roof Ventilators: Set ventilators complete with necessary hardware, anchors, dampers, weather guards, rain caps, and equipment supports. Mount ventilators on flat level base. Install preformed filler strips at base to seal ventilator to metal roof panels.
- F. Continuous Roof Ventilators: Set ventilators complete with necessary hardware, anchors, dampers, weather guards, rain caps, and equipment supports. Join sections with splice plates and end-cap skirt assemblies where required to achieve indicated length. Install preformed filler strips at base to seal ventilator to metal roof panels.
- G. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to panel as recommended by manufacturer.

3.11 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform field quality control special inspections and to submit reports.
- B. Product will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.12 ADJUSTING

- A. Doors: After completing installation, test and adjust doors to operate easily, free of warp, twist, or distortion.

3.13 CLEANING AND PROTECTION

- A. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
- B. Touchup Painting:
 - 1. After erection, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted structural framing, bearing plates, and accessories.
 - a. Clean and prepare surfaces by SSPC-SP 2, "Hand Tool Cleaning," or by SSPC-SP 3, "Power Tool Cleaning."
 - b. Apply a compatible primer of same type as shop primer used on adjacent surfaces.
- C. Metal Panels: Remove temporary protective coverings and strippable films, if any, as metal panels are installed. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
 - 1. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.
- D. Doors and Frames: Immediately after installation, sand rusted or damaged areas of prime coat until smooth and apply touchup of compatible air-drying primer.
 - 1. Immediately before final inspection, remove protective wrappings from doors and frames.

END OF SECTION 133419

SECTION 220010 - PLUMBING GENERAL PROVISIONS

PART 1 - GENERAL

1.1 GENERAL

- A. The requirements of the General Conditions, the Supplementary General Conditions, and the applicable portions of Division 1 shall apply to this section of the specifications.

1.2 SCOPE

- A. Provide and install complete and operating plumbing systems in accordance with these specifications and accompanying contract drawings. This shall include all required labor, materials, equipment, and supervision.
- B. The work shall include but is not limited to the following systems, equipment, materials, and labor for a complete system including the following:
 - 1. New Plumbing Fixtures and Equipment
 - 2. Sanitary Waste, Vent, Storm and Domestic Water Piping
 - 3. Propane Tanks and Piping System

1.3 DEFINITION OF WORK RESPONSIBILITY

- A. All electrical control components including starters required for operation of plumbing equipment whether integral or remote shall be furnished and installed under this Contract. Control wiring, conduits and accessories for control devices shall be furnished and installed by the Contractor.
- B. Power wiring from panelboard or similar source through all equipment disconnects to motors or heating equipment shall be furnished and installed by the Electrical Contractor.
- C. Equipment disconnect switches, unless otherwise specified or supplied by the equipment supplier as an integral part of the equipment shall be furnished and installed by the Electrical Contractor.
- D. All electrical equipment, components, and wiring furnished and installed under this portion of the specifications shall conform to all requirements of the applicable portions of the electrical specifications.
- E. On new roofs, openings and base flashing shall be by the Contractor. Counter flashing shall be by the Contractor.
- F. All structural work needed for support of mechanical equipment or components shall be supplied by the contractor.
- G. All concrete pads necessary for the support of Plumbing equipment or components shall be supplied by the contractor.
- H. All access panels in finished walls or ceilings shall be supplied and installed by the respective Contractor.
- I. If any changes are required in the installation of mechanical or electrical services to any mechanical equipment accepted substitutes (non-Basis of Design), the respective Contractor shall be responsible for any additional costs incurred or coordination required.

1.4 RULES AND REGULATIONS

- A. All work shall be performed in accordance with the current adopted rules and regulations of the PA 2021 International Building, Plumbing, Gas, and Mechanical Codes, NFPA Codes and the utilities having jurisdiction, and all codes per local municipality.
- B. All work shall be performed in accordance with the rules and regulations of Pennsylvania Department of Labor and Industry, Federal Department of Labor (Occupational Safety and Health Administration), Department of Education and all codes and agencies having jurisdiction.
- C. All construction, design fabrication, tests, rating and installation shall comply with the rules and regulations of all local, state or national codes and agencies having jurisdiction over this project. Any costs involved in complying to these rules and regulations shall be included in original bid of this Contractor.
- D. This Contractor shall obtain and pay for all construction and installation permits, certificates and inspection fees relative to his work. He shall also prepare all specific plans as required by proper authorities before acceptance of the work. Costs incurred in the preparation of such plans shall be included in the Contractor's original bid.

1.5 DRAWINGS

- A. The accompanying drawings are a part of these specifications and are intended to show approximate and relative locations of services and equipment. They shall not be scaled to determine exact positions, locations and clearances.
- B. Due to the diagrammatic layout and small scale of the drawings, certain piping and duct rises, drops, offsets, valves, and related specialties are not shown. The Contractor shall provide all ductwork, piping, fittings, valves, and specialties required to insure a complete installation without additional cost to the Owner.
- C. All drawings and specifications pertaining to general construction, plumbing, electrical and other work shall be carefully examined. Where physical interferences with his work occur because of his failure to consult other trades, the Contractor shall rearrange his work at his own expense.

1.6 SUBMISSION OF SHOP DRAWINGS, EQUIPMENT, AND MATERIALS

- A. The Contractor shall submit, with a letter of transmittal to the Architect, the quantity of sets of shop drawings specified in Division 1 containing all capacities, performances, features, options, accessories and technical data of all materials and equipment listed herein. All submittals shall be made within 45 days after awarding of the contract.
- B. Refer to Division 1.
- C. All disapproved submittals shall be corrected as directed by the Architect and resubmitted in 6 sets until approved within 15 days after the original submittal was disapproved. No work involving any materials or equipment covered by shop drawings shall be started until the respective shop drawings are approved.
- D. None of the items listed under Section 1.2 shall be installed until final approval has been given by the Architect.
- E. Identify Project, Contractor, Subcontractor or supplier; pertinent drawing and detail number and specification section number, as appropriate on shop drawings.

- F. On shop drawings, apply Contractor's stamp, signed or initialed certifying that review, approval, verification of Products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the Work and Contractor Documents.
- G. On shop drawings, provide space for Contractor and Architect/Engineer review stamps.

1.7 VISIT TO THE SITE

- A. Prior to submission of his bid, the Contractor shall visit the site to acquaint himself with the existing conditions. Bids as submitted will be interpreted to include all costs and change made necessary by such conditions.

1.8 COORDINATION OF WORK

- A. Contractor shall coordinate his work with that of other trades. In case of interference or problems the Architect shall decide which work is to be relocated, regardless of which is installed first.

1.9 LOCATION OF EQUIPMENT

- A. All locations of plumbing equipment and pipe connections there to shall be verified by the Owner and Architect. The contractor shall verify locations sufficiently in advance of the installation to allow uninterrupted progress of the work of all trades.
- B. The Contractor shall prepare dimensioned arrangement drawings at a scale of (1/4" = 1'0"). Layouts represented by these drawings shall be coordinated with all other trades.
- C. This contractor shall obtain approval of all arrangement drawings before continuing his work.

1.10 MATERIALS AND EQUIPMENT

- A. All materials and equipment, unless otherwise specified, shall be new and of the best quality, approved for their specific application.
- B. This Contractor shall provide, when required by the Architect, labeled samples of materials to be used on the project. Samples shall be submitted for approval by the Architect prior to their installation.
- C. All materials and equipment installed by the Contractor shall be securely and rigidly supported from or attached to the building structure.

1.11 WORKMANSHIP

- A. All workmanship shall be done according to the best practices of the trade by qualified and competent tradesmen.

1.12 PROTECTION OF EQUIPMENT

- A. The Contractor shall protect all material and equipment from damage until final acceptance as installed. He shall close all openings during construction with temporary plugs and replace all damaged items with ones of exact sameness at his expense.

- B. He shall schedule material and systems for delivery in such a pattern that critical pieces of equipment may be stored within the building, protected from weather. Where materials are stored outside, they must be protected from the elements and damage.
- C. This Contractor shall be responsible for coordinating the procurement of specified materials and equipment being supplied by his sub-contractors and suppliers.

1.13 SCAFFOLDING AND HOISTING

- A. The Contractor shall furnish and erect all scaffolding, hoists, shoring, platforms, railings, ladders, and other devices required by local, state, and federal laws to install his systems and equipment. Scaffolding and all other equipment shall be removed at completion of the work.
- B. Contractor shall hoist or rig his own material and equipment into place or arrange for the rigging of it by others at his expense.

1.14 FOREMAN

- A. Contractor must provide a competent foreman, subject to approval of the Architect. The foreman shall be deemed the agent of the Contractor and must be on duty at the building during all working hours.
- B. Any instructions or notices given to the foreman shall have the same force as if given to the Contractor in person.

1.15 EXCAVATION AND BACKFILL

- A. The Contractor shall do all excavation and backfilling and all shoring, sheeting, pumping, and other work incidental to excavating as required for his installation.
- B. Backfill shall be made with clear earth; free from rocks, frozen earth, debris, or other foreign materials. Backfill shall be deposited in uniform layers of not over 8" thick and each layer shall be mechanically tamped before the next layer is applied.
- C. All excavated material remaining after the backfilling operation shall be removed from the site by this Contractor.
- D. Any settlement in trench backfill shall be brought to grade, and damage to pavement or slabs caused by such settlement shall be repaired at the Contractor's expense.
- E. All ditching, pumping, canvas covers, and other methods required to protect and keep all excavation and trenches free from water at all times during the construction period shall be furnished, installed, and maintained by the Contractor.
- F. If the trench bottom becomes muddy, all mud shall be removed and replaced by bankrun sand and gravel or other suitable material as approved by Architect and compacted to the density of the surrounding undisturbed soil. Bottom of trench shall be protected against frost or freezing. This Contractor shall provide adequate shoring to protect his and other workmen. Shoring shall be maintained until tests of lines is completed.
- G. Trenches that pass under paving or roads and have less than 2' of cover, shall have a load-relieving slab over the pipe. Trenches which pass under or within 18" of any wall foundation shall be backfilled with concrete mixes 1 part cement, 3 parts sand, and 5 parts coarse aggregate.

- H. All repair of macadam or concrete paving made necessary by work done under this contract shall be performed by the Contractor.
- I. All grading and seeding made necessary by work done under this contract shall be performed by the Contractor.

1.16 PAINTING

- A. All exposed piping, iron work, and equipment installed in the mechanical equipment rooms under this contract shall be painted 1 prime coat and 2 coats of best quality oil base paint of color as selected by the Architect.

1.17 CUTTING AND PATCHING

- A. This Contractor shall be responsible for all cutting and patching required for installation of work on this project. Cutting and patching methods shall conform to the requirements for new construction contained in other sections of this specification.
 - 1. Patching in surfaces that will remain visible when the project is finished shall be identical in appearance to the undisturbed surface.
 - 2. Patches in fire rated walls, ceilings and floors shall maintain the fire rating of these barriers by the use of approved materials including special fire rated sealing compounds or materials identical to the barrier materials. Refer to the Architectural Specifications for approved methods and materials.
 - 3. Any patching not deemed suitable by the Architect will be replaced by the Owner at the expense of the related Contractor.

1.18 WORK SEQUENCE

- A. Refer to Architectural Drawings and Specifications for Construction Requirements for this Project. Each Contractor shall plan and coordinate their work in accordance with those requirements.

1.19 CLEANING

- A. Upon completion of the installation, thoroughly purge all piping of all obstructions and scale and adequately flush all liquid carrying piping to assure a clean system.
- B. Wash all fixtures with soap and water, remove labels and protective covering and clean all grease and cutting from plates or polished piping and trim.
- C. Where damage to finish, furnishing or parts of the building results from pipe stoppage or from failure to clear and flush piping systems properly, the Contractor shall, at his own expense, employ qualified skilled labor to make repairs.

1.20 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. The Contractor shall prepare for the Owner 3 hard bound volumes, each containing all operating instructions and information necessary for the care and maintenance of the system. These volumes shall be complete in every respect and shall include detailed operating instructions for each piece of equipment and diagrams for control wiring and piping so arranged and detailed that the maintenance staff may trace the control in event of operational malfunctioning.
- B. The Contractor shall submit 1 of the hard-bound volumes to the Architect for approval prior to presenting same to Owner.

- C. Printed instructions covering the operation and maintenance of each item of equipment shall be posted at locations designated by the Architect.
- D. The Contractor shall provide Project Records Documents in accordance with requirements of Division 1.

1.21 CLEANING AND FINISHING

- A. After all tests have been made and the system proven satisfactory to the Architect, the Contractor shall go over the entire project, clean all equipment and material installed by him, and leave in a clean and working condition.

1.22 INSTRUCTION OF EMPLOYEES

- A. At the completion of the work this Contractor shall instruct the employees who shall have charge of the equipment in the care, adjustment, and operation of all parts of the system.
- B. At the time designated by the Architect, the equipment manufacturer's engineer shall instruct representatives of the Owner in the operation and maintenance of the equipment.

1.23 GUARANTEE

- A. All work done under these contracts shall be guaranteed by the respective contractors against defective materials and faulty workmanship for a period of 1 year from date of acceptance by the Owner.
- B. During such a period, and before the expiration of each such guarantee, contractor shall agree to make any and all repairs, adjustments, or replacements which may become necessary, owing to initial settlement or shrinkage, defective material, workmanship, or installation.
- C. He shall further agree to provide all labor and material which may be required and to restore to its original condition any adjacent work that he may disturb in making the necessary repairs, adjustments, or replacements in order to fulfill this guarantee.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install equipment to permit removal of components and parts which require periodic replacement or maintenance. Arrange pipes, ducts, and equipment to permit access to valves, gauges, starters, motors, doors and access panels.
- B. Provide access panels in equipment, ducts, etc. as required for inspection and maintenance.

3.2 PIPING INSTALLATION

- A. In general, piping shall be exposed in equipment rooms, and concealed in all finished rooms. Where piping is exposed, it shall be run so as to allow maximum headroom consistent with proper pitch. No piping or ductwork shall cross below the head of any window or door.
- B. Exposed piping, ducts, conduits, and/or appurtenances indicated on the inside of buildings, shall be installed parallel to the building lines. All piping shall be kept as close as possible to the ceilings and walls, and columns, to take up the minimum amount of space.
- C. All work shall be arranged and installed as high as possible to prevent obstruction of window areas, and to give adequate clearance and access for operation and maintenance.

3.3 SLEEVES

- A. Where pipes pass through concrete or masonry walls or concrete floors, they shall be protected through the full depth of the construction with galvanized sleeves; same to be at least one size larger than the pipe plus insulation.
- B. Where sleeves occur in concrete floors, the top of sleeve shall be flush with finished floor line, and the end shall be filed to a smooth round finish.
- C. This Contractor shall supply all pipe sleeves and shall inform general contractor of exact sleeve locations in time for their incorporation onto the concrete forms or masonry work.
- D. Any cutting and patching in masonry or concrete made necessary by failure to adequately coordinate shall be done by the contractor at the expense of the contractor.
- E. The space between pipes and sleeves shall be caulked airtight with a non-combustible inorganic material.

3.4 UNIONS

- A. Unions shall be provided at all connections to each piece of equipment and on both sides of all automatic valves, and devices which requires removal for maintenance. No unions are to be placed in a location which will be inaccessible after the completion of the project.
- B. Unions of copper tubing shall be 200 lbs. SWP brass ground joint.
- C. Unions for steel pipe shall be 250 lbs. SWP, malleable iron with brass to iron seat.

3.5 CLEARANCE

- A. All piping, including valves and fittings shall be installed to provide the following minimum clearances between the finish coverings, adjacent pipe and/or conduits: 2" between for piping services and 6" between piping services and electrical conduits.

3.6 SHOCK ABSORBERS

- A. Furnish and install absorbers where required for proper system operation.

3.7 ESCUTCHEON PLATES

- A. All piping passing through walls, ceilings, and floors shall be provided with escutcheon plates securely fastened in place. Where installed on piping in finished areas they shall be chrome plated.

3.8 ACCESS PANELS

- A. Removable panels shall be located so as to provide easy access to all concealed plumbing accessories that may require adjustments or maintenance, such as valves, water hammer arresters, traps, strainers, cleanouts or others.
- B. Access panels in finished wall or ceiling surfaces shall be furnished and installed by the Contractor.
- C. This Contractor shall pay for any work made necessary by his failure to inform other trades of access panel locations.

3.9 APPLICATIONS OF INSULATION AND COVERING

- A. No covering shall be installed by the Contractor until the piping and ducts have been approved by the Architect/ Engineer.

3.10 PIPING UNDER FLOORS

- A. Wherever piping, conduits and associated materials is run under a floor slab on grade, the work is to be installed after the sub-grade has been brought to the proper level. The work shall then be installed and backfilled, allowed to settle, and refilled before placing crushed stone fill.

3.11 INSERTS

- A. Except as noted, provide box type inserts for all hangers and supports intended to suspend piping or light weight equipment from new concrete construction. Fasten all inserts to the form work before concrete is poured. Inserts to be Grinnell Figure No. 282 or Figure No. 279 depending upon the maximum load to be carried.
- B. No toggle bolts, expansion screw anchors or similar imbedded hanger supports shall be used in new construction.

3.12 LUBRICATION

- A. The contractor shall provide all oil for the operation of all equipment until acceptance. The Contractor shall run in all bearings and, after they are run in, drain all oil from the bearings, flush out all bearings, and refill with new oil. The Contractor shall be held responsible for all damage to bearings while the equipment is being operated by him up to the date of acceptance of the equipment. The contractor shall be required to protect all bearings during installation and shall thoroughly grease steel shafts to prevent corrosion. All motors and other equipment shall be provided with covers as required for proper protection during construction.

3.13 JOINTS AND CONNECTIONS

- A. Screwed Connections - All joints made in screwed pipe shall be made with red lead or pipe compound applied to the threaded end of the pipe and not applied within the fitting. Threads shall be cut straight and true with sections reamed and cleaned before installation.

END OF SECTION 220010

SECTION 220100 - PLUMBING GENERAL EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Flexible Pipe Connectors
- B. Expansion Joints and Compensators
- C. Pipe Loops, Offsets, and Swing Joints
- D. Pressure Gauges and Pressure Gauge Taps
- E. Thermometers and Thermometer Wells
- F. Pipe and Equipment Hangers and Supports
- G. Equipment Bases and Supports
- H. Sleeves and Seals
- I. Flashing and Sealing Equipment and Pipe Stacks
- J. Nameplates
- K. Tags
- L. Stencils
- M. Pipe Markers
- N. Vibration Isolation
- O. Single Phase Electric Motors
- P. Three Phase Electric Motors

1.2 REFERENCES

- A. ASME - B40.1 - Gauges - Pressure Indicating Dial Type - Elastic Element.
- B. ASTM E1 - Specification for ASTM Thermometers.
- C. ASTM E77 - Verification and Calibration of Liquid-in-Glass Thermometers.
- D. ASTM F708 - Design and Installation of Rigid Pipe Hangers.
- E. MSS SP58 - Pipe Hangers and Supports - Materials, Design, and Manufacturer.
- F. MSS SP69 - Pipe Hangers and Supports - Selection and Application.

- G. MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
- H. NFPA 70 - National Electrical Code.
- I. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.3 PERFORMANCE REQUIREMENTS FOR PIPING EXPANSION COMPENSATION

- A. Provide structural work and equipment required to control expansion and contraction of piping. Verify that anchors, guides, and expansion joints provided, adequately protect system.
- B. Expansion Calculations:
 - 1. Installation Temperature: 50°F.
 - 2. Domestic Hot Water Heating: 140°F.
 - 3. Safety Factor: 30%

1.4 SUBMITTALS

- A. Submit in accordance with provisions of Section 220010.
- B. Product Data:
 - 1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
 - 2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.
 - 3. Gauges and Meters: Provide list which indicates use, operating range, total range and location for manufactured components.
 - 4. Supports and Anchors: Provide manufacturers catalog data including load capacity.
 - 5. Motors: Provide wiring diagrams with electrical characteristics and connection requirements.
 - 6. Plumbing Identification: Provide manufacturers catalog literature for each product required.
 - 7. Vibration Isolation: Provide schedule of vibration isolator type with location and load on each.
- C. Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each.

1.5 REGULATORY REQUIREMENTS

- A. Conform to applicable electrical code.
- B. All products shall be NSF approved and listed.
- C. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc., as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 FLEXIBLE PIPE CONNECTORS

- A. Copper Piping:
 - 1. Manufacturers:

- a. Flexonics Model 300
 - b. Mason Model BBF
 - c. Keflex Model KFCB
2. Inner Hose: Bronze
3. Exterior Sleeve: Braided bronze
4. Pressure Rating: 200 psig WOG and 250°F
5. Joint: As specified for pipe joints
6. Size: Use pipe sized units
7. Maximum offset: 3/4" on each side of installed center line

2.2 PRESSURE GAUGES

- A. Manufacturer: Winters Model PFQ711. No substitutions permitted.
- B. Gauge: ASME B40.1, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
 1. Case: Steel with brass bourdon tube.
 2. Size: 4-1/4"
 3. Mid-Scale Accuracy: 1%
 4. Scale: Both psi and kPa

2.3 PRESSURE GAUGE TAPPINGS

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

2.4 STEM TYPE THERMOMETERS

- A. Manufacturer: Weksler No substitutions permitted.
- B. Thermometer: ASTM E1, adjustable angle, solar digital, 3-1/2" stem.
- C. Catalog Number AADHFC

2.5 THERMOMETER SUPPORTS

- A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.
- B. Flange: 3" outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.6 TEST PLUGS

- A. Test Plug: 1/4" or 2" brass fitting and cap for receiving 1/8" outside diameter pressure or temperature probe with Nordel core for temperatures up to 350°F.
- B. Test Kit: Carrying case, internally padded and fitted containing one 2-1/2 diameter pressure gages, one gage adapters with 1/8" probes, two 1" dial thermometers.

2.7 PIPE HANGERS AND SUPPORTS

- A. Manufacturers:
 - 1. Grinnell
 - 2. Other acceptable manufacturers offering equivalent products.
 - a. or accepted substitute
- B. Plumbing Piping - DWV:
 - 1. Conform to ASTM F708, MSS SP58, MSS SP69, MSS SP89.
 - 2. Hangers for Pipe Sizes 1/2 to 1-1/2": Malleable iron adjustable swivel, split ring.
 - 3. Hangers for Pipe Sizes 2" and Over: Carbon steel, adjustable, clevis.
 - 4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - 5. Wall Support for Pipe Sizes to 3": Cast iron hook.
 - 6. Wall Support for Pipe Sizes 4" and Over: Welded steel bracket and wrought steel clamp.
 - 7. Vertical Support: Steel riser clamp.
 - 8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 - 9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- C. Plumbing Piping - Water:
 - 1. Conform to ASTM F708, MSS SP58, MSS SP69, MSS SP89.
 - 2. Hangers for Pipe Sizes 1/2 to 1-1/2": Malleable iron adjustable swivel, split ring.
 - 3. Hangers for Cold Pipe Sizes 2" and Over: Carbon steel, adjustable, clevis.
 - 4. Hangers for Hot Pipe Sizes 2 to 4": Carbon steel, adjustable, clevis.
 - 5. Hangers for Hot Pipe Sizes 6" and Over: Adjustable steel yoke, cast iron roll, double hanger.
 - 6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - 7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6" and Over: Steel channels with welded spacers and hanger rods, cast iron roll.
 - 8. Wall Support for Pipe Sizes to 3": Cast iron hook.
 - 9. Wall Support for Pipe Sizes 4" and Over: Welded steel bracket and wrought steel clamp.
 - 10. Wall Support for Hot Pipe Sizes 6" and Over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast-iron roll.
 - 11. Vertical Support: Steel riser clamp.
 - 12. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 - 13. Floor Support for Hot Pipe Sizes to 4": Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 - 14. Floor Support for Hot Pipe Sizes 6" and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
 - 15. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.8 PIPE HANGER ACCESSORIES

- A. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

2.9 INSERTS

- A. Manufacturers:
 - 1. Grinnell
 - 2. Other acceptable manufacturers offering equivalent products.
 - a. or accepted substitute

- B. Inserts: Malleable iron case of steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.10 FLASHING

- A. Metal Flashing: 26-ga galvanized steel.
- B. Metal Counterflashing: 22-ga galvanized steel.
- C. Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.
- D. Caps: Steel, 22-ga minimum; 16-ga at fire resistant elements.

2.11 SLEEVES AND SEALANTS

- A. Sleeves for Pipes Through Non-fire Rated Floors: 18-ga galvanized steel.
- B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18-ga galvanized steel.
- C. Firestopping Insulation: Glass fiber type, non-combustible.
- D. Sealant: Acrylic.
- E. Firestopping for non-plastic piping shall be 3M, Dow, Corning fire caulk/packing or accepted substitute.

2.12 TAGS

- A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2" diameter.
- B. Chart: Typewritten letter size list in anodized aluminum frame.

2.13 STENCILS

- A. Stencils: With clean cut symbols and letters of following size:
 - 1. 3/4 to 1-1/4" Outside Diameter of Insulation or Pipe: 8" long color field, 1/2" high letters.
 - 2. 1-1/2" to 2" Outside Diameter of Insulation or Pipe: 8" long color field, 3/4" high letters.
 - 3. 2-1/2" to 6" Outside Diameter of Insulation or Pipe: 12" long color field, 1-1/4" high letters.
 - 4. 8 to 10" Outside Diameter of Insulation or Pipe: 24" long color field, 2-1/2" high letters.
 - 5. Over 10" Outside Diameter of Insulation or Pipe: 32" long color field, 3-1/2" high letters.
 - 6. Ductwork and Equipment: 2-1/2" high letters.
- B. Stencil Paint: As specified in Section 09900, semi- gloss enamel, colors conforming to ASME A13.1.

2.14 PIPE MARKERS

- A. Color: Conform to ASME A13.1.

- B. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
- D. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6" wide by 4 mil thick, manufactured for direct burial service.

2.15 VIBRATION ISOLATORS

- A. Neoprene Pad Isolators:
 - 1. Rubber or neoprene waffle pads.
 - a. 30 durometer
 - b. Minimum 2" thick
 - c. Maximum loading 40 psi
 - d. Height of ribs shall not exceed 0.7 times width
 - 2. Configuration: Single layer
- B. Rubber Mount or Hanger: Molded rubber designed for 0.5" deflection with threaded insert.
- C. Glass Fiber Pads: Neoprene jacketed pre-compressed molded glass fiber.

2.16 MOTORS

- A. Manufacturers:
 - 1. Century
 - 2. Westinghouse
 - 3. Lincoln
 - 4. Baldor
 - 5. Or accepted substitute
- B. General Construction and Requirements:
 - 1. Motors Less than 250 Watts, for Intermittent Service: Equipment manufacturer's standard and need not conform to these specifications
 - 2. Electrical Service: Refer to Section 260180 for required electrical characteristics.
 - 3. Type:
 - a. Open drip-proof except where specifically noted otherwise.
 - b. Motors: Design for continuous operation in 40°C environment
 - c. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
 - d. Motors with frame sizes 254T and larger: Energy Efficient Type.
 - 4. Explosion-Proof Motors: UL approved and labeled for hazard classification, with over temperature protection.
 - 5. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.
 - 6. Wiring Terminations:
 - a. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
 - b. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

2.17 FIRE STOPPING

- A. Acceptable Manufacturers:
 - 1. EGS Nelson Firestop Product
 - 2. 3M
 - 3. Accepted Substitute
- B. Products:
 - 1. Nelson ES1399 Elastomeric Sealant: Water based acrylic latex, endothermic fire protective sealant. It is used for applications of through firestop penetrations and in construction joints. It is available in two grades, N/S (Non-Sag) for wall and overhead installations, and S/L (Self-Leveling) for floor installations.
 - 2. Nelson WRS+ Firestop Wrap Strips: To be used as a wraparound PVC type pipe. After the pipe is covered with the correct number of wraps the WRS+ is covered with a field cut and fabricated collar cover used in conjunction with CLK or FSP which provide a smoke seal.
 - 3. Nelson PCS Pipe Choke System Collars: To be used on PVC type pipes and conduits to produce an immediate smoke and fire seal. Each PCS is pre-filled with a highly intumescent pliable putty material. Collars are furnished in exact sizes from 1.5° to 4°. Collars are UL System Classified for through penetrations of drywall or concrete/masonry assemblies.
 - 4. Nelson LBS+ Firestop Latex Based Sealant: A one part "Latex-Water Based" intumescent caulk that is of a non-sag formulation for use in all applications, wall, floor, and overhead.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Piping Expansion Compensation:
 - 1. Install in accordance with manufacturer's instructions.
 - 2. Construct spool pieces to exact size of flexible connection for future insertion.
 - 3. Install flexible pipe connectors on pipes connected to equipment supported by vibration isolation. Provide line size flexible connectors.
 - 4. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.
 - 5. Rigidly anchor pipe to building structure where necessary. Provide pipe guides so movement is directed along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.
 - 6. Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where indicated.
- B. Gauges and Meters:
 - 1. Install positive displacement meters with isolating valves on inlet and outlet. Provide full line size valved bypass with globe valve for liquid service meters.
 - 2. Install pressure gauges with pulsation dampers. Provide needle valve to isolate each gauge. Extend nipples to allow clearance from insulation.
 - 3. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2" for installation of thermometer sockets. Ensure sockets allow clearance from insulation.
 - 4. Provide instruments with scale ranges selected according to service with largest appropriate scale.
 - 5. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45° off vertical.
 - 6. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.

7. Locate test plugs adjacent thermometers and thermometer sockets, pressure gages and pressure gauge taps and where indicated.
- C. Plumbing Identification:
1. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
 2. Install tags with corrosion resistant chain.
 3. Apply stencil painting in accordance with Section 09900.
 4. Install plastic pipe markers in accordance with manufacturer's instructions.
 5. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
 6. Install underground plastic pipe markers 6 to 8" below finished grade, directly above buried pipe.
 7. Identify control panels and major control components outside panels with plastic nameplates.
 8. Identify valves in main and branch piping with tags.
 9. Identify inline pumps with tags.
 10. Tag automatic controls, instruments, and relays. Key to control schematic.
 11. Identify piping, concealed or exposed, with plastic pipe markers. Use tags on piping 3/4" diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20' on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
 12. Provide Valve Identification Chart. Post framed chart in Mechanical Room.
- D. Vibration:
1. Install isolation for motor driven equipment.
 2. Bases:
 - a. Set steel bases for 1" clearance between housekeeping pad and base.
 - b. Set concrete inertia bases for 2" clearance between housekeeping pad and base.
 - c. Adjust equipment level.
 3. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.
 4. Connect wiring to isolated equipment with flexible hanging loop.
 5. All vibration isolation devices, including steel bases and pouring forms, shall be supplied by a single manufacturer.
 6. All piping located in Mechanical Room shall be isolated from the building structure by means of spring hangers.
 7. Flexible conduit shall be used for all electrical connections to isolated equipment. Flexible conduit shall be 50% longer than the actual distance between the rigid conduit and the equipment electrical connection locations.
 8. The schedule of isolators required shall be as follows: Pumps - inertia bases, 1" (minimum) deflection springs; piping - all piping in the mechanical rooms should have isolation hangers having the same deflection as those for the equipment in the rooms, or for 50' from the equipment, whichever is greater.
- E. Spring hangers for piping shall consist of clevis type hangers with spring hanger similar to Grinnell Fig. 247 or Fig. B-268 installed in threaded rod.
- F. Motors:
1. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
 2. Check line voltage and phase and ensure agreement with nameplate.
- G. Inserts:
1. Provide inserts for placement in concrete formwork.

2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4".
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

H. Pipe Hangers and Supports:

1. Support horizontal piping as scheduled.
2. Install hangers to provide minimum 1/2" space between finished covering and adjacent work.
3. Place hangers within 12" of each horizontal elbow.
4. Use hangers with 1-1/2" minimum vertical adjustment.
5. Support horizontal cast iron pipe adjacent to each hub, with 5' maximum spacing between hangers.
6. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
8. Support riser piping independently of connected horizontal piping.
9. Provide copper plated hangers and supports for copper piping.
10. Design hangers for pipe movement without disengagement of supported pipe.
11. Provide additional supports for heavy valves and specialties and provide sway bracing where needed.
12. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
13. Insulation protection saddles shall be installed at all pipe hangers and supports for insulated lines. Saddles shall be rolled with a radius to suit the insulation O.D. Saddles shall be #16-ga galvanized steel and shall be 8" long.

I. Equipment Bases and Supports:

1. Provide housekeeping pads of concrete, minimum 4" thick and extending 4" beyond supported equipment.
2. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.
3. Construct supports of steel members. Brace and fasten with flanges bolted to structure.
4. Provide rigid anchors for pipes after vibration isolation components are installed.
5. Shall be by the contractor installing the related equipment.

J. Flashing:

1. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
2. Flash vent and soil pipes projecting 3" minimum above finished roof surface with lead worked 1" minimum into hub, 8" minimum clear on sides with 24 x 24" sheet size. For pipes through outside walls, turn flanges back into wall and calk, metal counterflash, and seal.
3. Flash floor drains in floors with topping over finished areas with lead, 10" clear on sides with minimum 36 x 36" sheet size. Fasten flashing to drain clamp device.
4. Seal floor, shower and mop sink drains watertight to adjacent materials.
5. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control.
6. Provide curbs for mechanical roof installations 12" minimum high above roofing surface. Flash and counterflash with sheet metal; seal watertight. Attach counterflashing mechanical equipment and lap base flashing on roof curbs. Flatten and solder joints.
7. Adjust storm collars tight to pipe with bolts; calk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

K. Sleeves:

1. Set sleeves in position in formwork. Provide reinforcing around sleeves.

2. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
3. Extend sleeves through floors one inch above finished floor level. Caulk sleeves.
4. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with fire stopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
5. Install chrome plated steel escutcheons at finished surfaces.

3.2 MANUFACTURER'S FIELD SERVICES

- A. Prepare and start systems under provisions of Section 220010.

3.3 SCHEDULES

- A. Pressure Gauge Schedule:
 1. Location: Pumps, Water Heaters – Inlets and Outlets
- B. Stem Type Thermometer Schedule:
 1. Location: Water Heater, Thermostatic Mixing Valves – Inlets and Outlets
- C. Supports and Hangers

PIPE SIZE <u>Inches</u>	MAX. HANGER SPACING (FT)		HANGER ROD DIAMETER
	<u>Horizontal</u>	<u>Vertical</u>	<u>Inches</u>
1/2 to 1-1/4	6	10	3/8
1-1/4 to 2	10	10	3/8
2-1/2 to 3	10	10	1/2
4 to 5	10	10	5/8
6	10	10	3/4
8 to 12	10	10	7/8
14 and Over	10	10	1
PVC (All Sizes)	4		3/8
C.I. Bell and Spigot (or No-Hub) and at Joints	5	15	3/4

END OF SECTION 220100

SECTION 220250 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Piping Insulation
- B. Jackets and Accessories
- C. Equipment Insulation
- D. Covering
- E. Insulation Jackets

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM)
- B. National Fire Protection Association (NFPA)
- C. Underwriters Laboratories (UL)

1.3 SUBMITTALS

- A. Submit in accordance with provisions of Section 220010.
- B. Product Data: Provide product description, list of materials and thickness for each service, and locations.

1.4 QUALITY ASSURANCE

- A. Materials: Flame spread/smoke developed rating of 25/50 or less in accordance with ASTM E84, NFPA 255, UL 723.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Owens-Corning
- B. Johns Manville
- C. Certainteed
- D. Armstrong
- E. PPG

2.2 DOMESTIC WATER PIPING INSULATION

- A. All domestic water pipes, fittings, flanges and valves shall be insulated with heavy density fiberglass insulation similar to Owens/Corning Fiberglass 24ASJ/SSL pipe insulation or accepted substitute with all service jacket, self-sealing lap and UL listed. Insulation shall have flame spread rating of 25 or less when tested by ASTM E-84 method.
- B. Optional pipe insulation for cold water pipes only shall be Armaflex insulation (concealed areas only).

2.3 AC AND HP CONDENSATE DRAIN PIPING

- A. All interior AC and HP condensate drain pipes and fittings shall be insulated with nominal 1/2" wall thickness heavy density fiberglass insulation similar to Owens/Corning Fiberglass 24ASJ/SSL pipe insulation or accepted substitute with all service jacket, self-sealing lap and UL listed. Insulation shall have flame spread rating of 25 or less when tested by ASTM E-84 method.
- B. Optional pipe insulation shall be 1/2" thick Armaflex insulation (concealed areas only).

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions.
- B. On exposed piping, locate insulation and cover seams in least visible locations.
- C. Insulated pipes and equipment conveying fluids below ambient temperature:
 - 1. Provide vapor barrier jackets, factory applied, or field applied.
 - 2. Insulate fittings, joints, and valves with molded insulation of like material as adjacent pipe.
 - 3. PVC fitting covers shall be used. Double insulation inserts in PVC fittings.
 - 4. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations.
 - 5. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.
 - 6. Tape all joints and seal with mastic to maintain vapor barrier.
- D. For insulated pipes and equipment conveying fluids above ambient temperature:
 - 1. Provide standard jackets, with vapor barrier, factory applied, or field applied.
 - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe.
 - 3. PVC fitting covers shall be used.
- E. Do not insulate over nameplate or ASME stamps. Bevel and seal insulation around such.
- F. Install insulation for equipment requiring access for maintenance, repair, or cleaning, in such a manner that it can be easily removed and replaced without damage.

- G. Plumbing piping shall be insulated with thickness of insulation indicated below:
 - 1. CW Pipe – 0.5" thick
 - 2. Hot Water/HW Recirc – 1.5" thick
- H. Insulate all piping below ADA fixtures with insulation kits by TruBro or accepted substitute.

END OF SECTION 220250

SECTION 220410 - PLUMBING PIPING & SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pipe and Pipe Fittings
- B. Valves
- C. Sanitary Sewer Piping System
- D. Domestic Water Piping System
- E. Propane Piping System
- F. AC/HP Condensate Piping System
- G. Floor Drains
- H. Hose Bibbs
- I. Wall Hydrants
- J. Cleanouts
- K. Water Hammer Arresters
- L. Underground Propane Tanks

1.2 REFERENCES

- A. ANSI B31.1 - Power Piping.
- B. ASME - Boiler and Pressure Vessel Code.
- C. ASME B16.3 - Malleable Iron Threaded Fittings.
- D. ASME B16.18 - Cast Bronze Solder-Joint Pressure Fittings.
- E. ASME B16.22 - Wrought Copper and Bronze Solder-Joint Pressure Fittings
- F. ASME B16.23 - Cast Copper Alloy Solder-Joint Drainage Fittings - DWV.
- G. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.
- H. ASTM A47 - Ferritic Malleable Iron Castings.
- I. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
- J. ASTM A74 - Cast Iron Soil Pipe and Fittings.

- K. ASTM A120 - Pipe, Steel, Black and Hot-Dipped Zinc Coated (Galvanized), Welded and Seamless, for Ordinary Uses.
- L. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
- M. ASTM B32 - Solder Metal.
- N. ASTM B88 - Seamless Copper Water Tube.
- O. ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- P. ASTM D3033 - Type PSP Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- Q. ASTM D3034 - Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- R. ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
- S. AWWA C111- Rubber-Gasket Joints for Ductile Iron and Gray-Iron Pressure Pipe and Fittings.
- T. AWWA C651 - Disinfecting Water Mains.
- U. CISPI 301 - Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary Systems.
- V. NFPA 54 - National Fuel Gas Code.
- W. ICC 2015 – International Fuel Gas Code.

1.3 SUBMITTALS

- A. Submit in accordance with provisions of Section 220010.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves, specialties and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

PART 2 - PRODUCTS

2.1 SANITARY SEWER PIPING, BURIED

- A. Cast Iron Pipe: ASTM A74 service weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets.
- B. PVC Pipe: ASTM D2665:
 - 1. Fittings: PVC
 - 2. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.

2.2 SANITARY SEWER PIPING, ABOVE GRADE, DRAIN AND VENT

- A. Cast Iron Pipe: ASTM A74, service weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: ASTM C564, neoprene gasket system.

- B. Cast Iron Pipe: CISPI 301, hubless, service weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: Neoprene gaskets and stainless-steel clamp-and-shield assemblies.
- C. PVC Pipe: Schedule 40 ASTM D2665:
 - 1. Fittings: PVC
 - 2. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement

2.3 WATER PIPING, ABOVE GRADE

- A. Copper Tubing: ASTM B88, Type L, hard drawn.
 - 1. Fittings: ASME B16.18, cast bronze, or ASME B16.22, wrought copper and bronze.
 - 2. Joints: ASTM B32, solder, Grade 95TA. (No-Lead)

2.4 AC AND HP CONDENSATE PIPING

- A. Copper Tube: ASTM B88, Type L hard drawn.
 - 1. Fittings: ASME B16.23, cast bronze or ASME B16.29, wrought copper.
 - 2. Joints: ASTM B32, solder, Grade 95TA.
- B. PVC Pipe: ASTM D2665
 - 1. Fittings: PVC
 - 2. Joints: ASTM D2855, solvent weld.

2.5 PROPANE GAS PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53 or A120, Schedule 40 black.
 - 1. Fittings: ASME B16.3, malleable iron, or ASTM A234, forged steel welding type.
 - 2. Joints: NFPA 54, threaded or welded to ANSI B31.1 ASME Sec 1.

2.6 PROPANE GAS PIPING, BELOW GRADE

- A. Steel Pipe: ASTM A53 or A120, Schedule 40 black, seamless.
 - 1. Fittings: ASTM A234, forged steel welding type, with AWWA C105 polyethylene jacket or double layer, half lapped 10 mil (0.25 mm) polyethylene tape.
 - 2. Joints: NFPA 54, ANSI B31.1, ASME Sec 1, welded.
- B. Plastic Pipe: ASTM D2513 Polyethylene
 - 1. Fittings: ASTM A234, forged steel welding type, with AWWA C105 polyethylene jacket or double layer, half lapped 10 mil (0.25 mm) polyethylene tape.
 - 2. Joints: NFPA 54, ANSI B31.1, ASME Sec 1, welded.
- C. Underground piping shall be installed with at least 36" of cover. Piping through exterior walls shall be encased in protective pipe and vented per code.
- D. Pipe shall be and be installed in accordance with NFPA, International Gas Code and Gas Company.

2.7 BUTTERFLY VALVES

- A. Manufacturers:
 - 1. Over 1-1/2":
 - a. Nibco

- b. Crane
- c. Stockham

B. Iron body, bronze trim, rising stem, handwheel, single wedge, flanged ends.

2.8 BALL VALVES

A. Manufacturers:

- 1. Up to and Including 1-1/2":
 - a. Nibco
 - b. Crane
 - c. Stockham

B. Up to and including 1-1/2": Bronze 2-piece body, stainless steel ball, Teflon seats and stuffing box ring, full port, lever handle with balancing stops, solder or threaded ends.

2.9 SWING CHECK VALVES

A. Manufacturers:

- 1. Nibco
- 2. Crane
- 3. Stockham

B. Bronze swing disc, solder or screwed ends.

2.10 RELIEF VALVES

A. Manufacturers:

- 1. Watts
- 2. Bell & Gossett
- 3. Taco

B. Bronze body, Teflon seat, steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labeled, sized for specific application.

2.11 CLEANOUTS

A. Manufacturers:

- 1. Zurn
- 2. Wade
- 3. Smith
- 4. Watts

B. Exterior Surfaced Areas: Round heavy-duty dura-coated cast iron body with gas and watertight ABS tapered thread plug and round scoriated cover and frame, cast nickel bronze access frame and non-skid cover.

C. Interior Finished Floor: Dura-Coated cast iron, 2-piece body with double drainage flange, weep holes, and adjustable nickel-bronze strainer, round with scoriated cover, with gas and watertight ABS tapered thread plug. Use carpet marker type in carpeted areas.

D. Interior Finished Wall Areas: Line type with lacquered cast iron body and round epoxy coated gasketed cover, and round stainless-steel access cover secured with machine screw.

- E. Interior Unfinished Accessible Areas: Threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

2.12 FLOOR DRAIN (FD-1)

- A. Furnish and install floor drain model Z415 as manufactured by Zurn. Unit shall have durable cast iron body, nickel bronze adjustable strainer and inside caulk outlet. Contractor shall install with deep seal P-trap and Proset trap guard. Trap guard shall be compatible with floor drain and sized to match sanitary piping.

2.13 FLOOR DRAIN (FD-2)

- A. Furnish and install floor drain, Zurn Model Z-525. Unit shall be 10" diameter medium duty, with durable cast iron body with bottom outlet. It shall provide vertical adjustment and be equipped with anti-tilt slotted grate and seepage pan. Contractor shall install with deep seal trap. Provide ProSet Trap Guard Seal or approved equal.

2.14 FLOOR DRAIN (FD-3)

- A. Furnish and install floor drain, Sioux Chief Model 860 PVC Round Floor Sink with PVC Strainer. Floor drain top shall be 9" diameter PVC medium duty with durable PVC body, bottom outlet, and removable strainer. Contractor shall install with deep seal trap. Provide ProSet Trap Guard Seal or approved equal.

2.15 HOSE BIBB (HB-1)

- A. Hose Bibb shall be Zurn Z-1350 encased moderate climate wall hydrant for narrow wall installation. Complete with bronze body, all bronze interior parts, replaceable seat washer, screwdriver operated stop valve in supply, key operated control valve, and 3/4" solder inlet and 3/4" male hose connections standard. Stainless steel box and hinged cover with operating key lock and "WATER" stamped on cover. Shall be listed as NSF stamped.

2.16 HOSE BIBB (HB-2)

- A. Hose Bibb shall be Zurn Z-1341-BFP exposed, anti-siphon, for use in moderate climate. Install with Z1399-BFP external backflow preventor. Complete with bronze body, all bronze interior parts, replaceable seat washer, handle control valve, and 3/4" solder inlet and 3/4" male hose connections standard. Shall be listed as NSF stamped.

2.17 WALL HYDRANT (WH-1)

- A. Wall hydrant shall be Zurn #Z1320 encased, non-freeze, anti-siphon, automatic draining for flush installation type with 3/4" solder inlet, bronze casing, nickel-bronze face, brass operating parts, renewable nylon seat, vacuum breaker, and operating key lock. Comply with NSF 61, Section 9. Wall hydrant shall have 1/2 turn ceramic disc cartridge and stainless-steel box and hinged cover.

2.18 ICE MAKER CONNECTION BOX (IMB-1)

- A. Furnish and install Guy Gray Metal Ice Maker Box Model 2B with quarter turn valve, outlet, box, faceplate, and white powder coat finish.

2.19 WATER HAMMER ARRESTER

- A. Water hammer arresters shall be the Hydra-Rester as manufactured by Sioux Chief Manufacturing Company or equal. Arresters shall be of the piston type with a seamless, Type L copper chamber and have a permanent PSI air charge above a two O-ring piston. Units shall be certified and sized by PDI-WH201` and ASSE-1010 and carry an unconditional lifetime of the system warranty. Arresters shall be installed per manufacturers installation instructions.

2.20 TRAP PRIMERS

- A. Trap-Guard by Proset Systems may be used in lieu of mechanical trap primer if acceptable by local authorities. Trap-Guard shall be compatible with floor drain and sized to match sanitary pipe.

2.21 UNDERGROUND PROPANE TANK

- A. Furnish and install 1000 gallon underground propane tank. Tank shall be steel with sti-P₃ corrosion protection system, 250 psi rated, ASME stamped, UL 644 and shall include piping isolation, dielectric coating, riser tube excess flow valve (1.5 times max flow), and multi-valve (fill, gauge, pressure relief valve, supply).
- B. Tanks shall be installed per the requirements of the manufacturer, Code, and NFPA regulations including distance set-backs and L&I permitting. Install with manhole riser $\pm 6"$ above grade. Offset tank fittings as required to adjacent grass area outside of driveway area, provide ballast pad and hold down straps.
- C. Tanks shall include cathodic protection, (2) #17 magnesium anode bags per tank attached using 12 ga electrical lead attached to tank. Cathodic protection survey shall be conducted and recorded at time of install.

2.22 STEEL PRODUCTS

- A. All steel products shall be manufactured in the United States with US steel only. Paperwork will be required as proof of compliance.

2.23 ACCEPTED SUBSTITUTES

- A. The following are accepted substitutes providing they meet the specifications:
 - 1. Drains, Hydrants - Wade, Smith, Josam – US Steel material only.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that excavations are to required grade, dry, and not over-excavated.
- B. Ream pipe and tube ends. Remove burrs.
- C. Remove scale and dirt, on inside and outside, before assembly.
- D. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Route piping in orderly manner and maintain gradient.
- D. Install piping to conserve building space and not interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- G. Provide clearance for installation of insulation and access to valves and fittings.
- H. Provide access where valves and fittings are not exposed.
- I. Establish elevations of buried water piping outside the building to ensure not less than 3' of cover.
- J. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- K. Provide support for utility meters in accordance with requirements of utility companies.
- L. Install bell and spigot pipe with bell end upstream.
- M. Install valves with stems upright or horizontal, not inverted.
- N. Install unions downstream of valves and at equipment or apparatus connections.
- O. Install gate or ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- P. Install ball valves for throttling, bypass, or manual flow control services.
- Q. Provide flow controls in water recirculating systems where indicated.
- R. Horizontal drainage lines shall be laid to a uniform pitch of 1/4" per foot, if practical, but in no case less than 1/8" to the foot, except where otherwise specifically detailed on the drawings. Each length of pipe and each fitting shall be inspected for defects before installation. Any defective pipe or fitting damaged during or after installation shall be replaced. Each length of pipe shall be laid to bring the inverts to the required line and grade. No stretch of joints will be allowed. All pipe shall be installed to a true straight line. Piping shall be bedded on firm earth foundation of uniform density carefully shaped to fit the lower section of pipe. Each section of pipe shall have a full bearing along its entire length, except at joints where clearance shall be allowed for making up joints. Any length which shows settlement after laying or which is not in true alignment shall be taken up and reset. Under track or roads, the piping shall be run in a standard weight steel pipe sleeve.
- S. Slope water piping and arrange to drain at low points.
- T. Cleanouts shall be installed where indicated on the drawings and at all bends, angles, upper terminals, and not over 50' apart in any lineal run of piping. All cleanouts shall be accessible.
- U. All horizontal sanitary vent piping shall be sloped a minimum of 1/4" per ft.

- V. All underslab sanitary sewer piping shall be minimum 2" size.

3.3 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Prior to starting work, verify system is complete, flushed and clean.
- B. Ensure PH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
- C. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.
- D. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15% of outlets.
- E. Maintain disinfectant in system for 24 hours.
- F. If final disinfectant residual tests less than 25 mg/L, repeat treatment.
- G. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
- H. Take samples no sooner than 24 hours after flushing, from outlets and from water entry, and analyze in accordance with AWWA C651.
- I. Provide Owner with test locations and final report/certification.

3.4 OPERATING ADJUSTMENTS

- A. All flush valves shall be adjusted for quiet operation and to pass the required amount of water for the proper flushing action.

3.5 TEST OF WATER SUPPLYING SYSTEM

- A. At the completion of the work, the water supply system must be tested to do a hydrostatic pressure of 50 pounds over the working pressure but not less than 100 pounds to the square inch.
- B. Any water piping run in chases, in walls, or in any way concealed by structural work must be tested to above pressure and proven tight before the pipes are concealed.

3.6 TESTS OF PLUMBING AND DRAINAGE SYSTEMS

- A. The entire system of soil, waste, drain and vent piping must be tested with water or air, as hereinafter described and proved tight to the satisfaction of representatives of Architect/ Engineer before trenches are backfilled, or fixtures connected. Testing instruments must be furnished by the Plumbing Contractor.
- B. When water is used for testing, the drainage system below ground floor shall be filled with water to top of a vertical section of pipe 10' high (except for clay pipe) temporarily connected to the highest point on the lines to be tested. The water shall be allowed to stand for at least 60 minutes for inspection, after which if the lines prove tight, the water is to be drawn off, connection made with the sanitary sewer and trenches backfilled.

- C. All plumbing and drainage piping above the ground floor line must have the openings plugged where necessary and be filled with water to the level of the main roof or tops of vent pipes. The water shall be allowed to stand for at least 60 minutes for inspection, after which if the lines prove tight, the water is drawn off and the fixtures connected.
- D. When air is used for testing, a pressure of not less than 20" of mercury must be maintained without pressure loss for at least 15 minutes. A mercury column gauge must be used in making air tests.

END OF SECTION 220410

SECTION 220440 - PLUMBING FIXTURES & EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Water Closets
- B. Urinals
- C. Lavatories
- D. Sinks
- E. Mop Basins
- F. Drinking Fountains
- G. Water Coolers
- H. Water Heaters

1.2 REFERENCES

- A. ANSI/ARI 1010 - Drinking-Fountains and Self-Contained, Mechanically-Refrigerated Drinking-Water Coolers.

1.3 SUBMITTALS

- A. Submit in accordance with provisions of Section 220010.
- B. Product Data: Provide catalogue illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

PART 2 - PRODUCTS

2.1 WATER CLOSET (WC-1)

- A. Furnish and install American Standard Elongated Floor Mounted Madera Flushometer Toilet Model #3043.001, 1.6 gpf. Unit shall be vitreous china, floor mounted, with siphon jet action elongated bowl, 1-1/2" top spud, and bolt caps.
- B. Unit shall be supplied with Church #5321.112 open front seat and Sloan Regal 111-1.6 flush valve.
- C. Installation shall be ADA compliant.

2.2 WATER CLOSET (WC-2)

- A. Furnish and install American Standard Elongated Floor Mounted Madera Flowise Flushometer Toilet Model #2234.001, 1.6 gpf. Unit shall be vitreous china, floor mounted, with siphon jet action elongated bowl, 1-1/2" top spud, and bolt caps.
- B. Unit shall be supplied with Church #5321.112 (white) open front seat and Sloan Regal 111-1.6 flush valve.

2.3 URINAL (UR-1)

- A. Furnish and install wall mounted urinal. Unit shall be American Standard Washbrook Model #6501.010 with Sloan Regal Model #186-1.0 flushometer, flush valve and wall hanger. Mount at height as shown on Architectural drawings.
- B. Installation shall be ADA compliant.

2.4 URINAL (UR-2)

- A. Furnish and install wall mounted urinal. Unit shall be American Standard Washbrook Model #6501.010 with Sloan Regal Model #186-1.0 flushometer, flush valve and wall hanger.

2.5 LAVATORY (LV-1, LV-2)

- A. Furnish and install wall hung American Standard Aqualyn Drop-In Lavatory Model #0475.028. Unit shall be vitreous china oval sink with overflow.
- B. Faucet shall be Delta Model 501LF-HDF with 0.5-gpm vandal-proof aerator, back checks on supplies, strainer, ADA compliant, trim plate.
- C. Unit shall be supplied with grid drain strainer, McGuire #8872 adjustable P-trap, and #169 flexible supply pipes. Shall comply with NSF 61, Section 9.
- D. For lavatories being installed without instantaneous water heaters (EWH-2), provide and install with a Powers HydroGuard Series LM495 thermostatic mixing valve (or equal).

2.6 SINK (SK-1)

- A. Furnish and install Elkay stainless-steel Wall Hung Sink model ELVWO2219SACC with plug in sensor faucet, concealed wall hanger, etc. for a complete ADA system.
- B. Sink shall include drain with strainer and tailpiece. Unit shall be supplied with McGuire #169 flexible supply pipes and McGuire #8872 adjustable P-trap.
- C. Provide and install with a Powers HydroGuard Series LM495 thermostatic mixing valve (or equal).
- D. Provide and install with Trubro Shield to cover components below sink and meet ADA requirements.

2.7 MOP RECEPTOR (MB-1)

- A. Mop receptor shall be Model MSB-2424 as manufactured by Powers Fiat, Skokie, Illinois or equal. Color shall be No. T31 - White Drift. The drain body shall be factory installed stainless steel No. 302 with combination strainer and lint basket.
- B. Faucet shall be American Standard Heritage Service sink faucet with Aquaseal valves, renewable seats, 4 arm brass handles, 3/4" threaded hose and spout bucket hook top brace to wall, vacuum breaker, union inlets, adjustable 8" centers, 3/4" female thread, chrome finish.
- C. Furnish and install check valves on the hot and cold water lines serving the faucet.
- D. Contractor shall install drain with trap.
- E. Furnish and install with Model #832-AA hose and hose bracket, #889-CC mop hanger and #E-77-AA vinyl bumper guard.

2.8 DRINKING FOUNTAIN (DF-1)

- A. Furnish and install Elkay Wall Hung ezH2O® VR Mechanical Bottle Filling Station w/Bi-Level Integral Soft Sides® Fountain Filtered Non-Refrigerated in Stainless Steel finish Model LZLMSN-EDFPVM217DK. Unit shall be Barrier-Free.
- B. Unit shall be vandal resistant and include ambient water supply, WaterSentry® Lead + Microplastics NSF/ANSI Certified 3000 Gal 12 Month Filter, back access plate, laminar flow, mechanical activation. Furnished with vandal resistant bubbler. Mechanical Bottle Filler button with mechanical front bubbler button activation.
- C. Product shall be Wall Mounted (In-Wall Frame/Plate) and rated for Outdoor application serving 2 station(s).
- D. Install with traps and valved supplies.

2.9 WATER COOLER (EWC-1)

- A. Furnish and install wall hung bi-level Elkay Model LMABFTL8WSSK Barrier-Free Water Cooler(s) with ezH2O® Bottle Filling Station. Bubblers shall be mechanically activated and bottle filler shall be electronic. Unit shall be filtered, refrigerated, and supplied in stainless steel finish. Unit shall have capacity to cool at least 8 gph of water entering at 80°F and leaving at 50°F with room temperature of 90°F.
- B. Unit shall have built-in pressure regulator and solenoid valve controlled by a front push-button. Cooling tank shall be storage type with capacity of at least 2 pints and be vented, red brass with copper refrigerant coil bonded to exterior and hot tin-dipped after assembly. The refrigerant flow shall be controlled by a capillary tube. The temperature shall be controlled by an adjustable thermostat. Unit shall be furnished and installed with bottle filling station mounted integral to water cooler.
- C. The entire cooler shall be warranted for 5 years. Entire unit shall be "lead-free". Unit shall meet ADA requirements. Mount at height per Architectural drawings.
- D. Furnish and install with in wall carrier, cane apron, and WaterSentry® Lead + Microplastics NSF/ANSI Certified 3000 Gal 12 Month Filter.

2.10 WATER HEATER (PWH-1)

- A. Furnish and install HTP Model PHM-199-80 water heater or accepted substitute by Lochinvar, Rheem, Rianni, or Bradford White.
- B. Unit shall include the following:
 - 1. High Efficiency Heat Exchanger:
 - a. Copper Nickel primary with 800 H and Copper Nickel secondary tube construction
 - b. Gasketless heat exchanger design
 - 2. Combustion System:
 - a. Modulating burner with up to 5 to 1 turndown
 - b. High-grade Inconel premix burner
 - c. Spark ignition
 - d. Fires on LP Gas
 - e. Dual flame monitoring (Spark and Flame probe)
 - f. Flame stabilization monitoring – automatic adjustment of firing rate to stabilize flame signal
 - 3. Integrated Control System:
 - a. Digital operating control with LCD display 3-character for temperature and system monitor – LCD indicators for appliance faults (red light) and operation (green light)
 - b. System parameters password protected
 - c. Outdoor reset
 - d. 120-volt 5-amp electrical connection for condensate pump
 - e. 0-10-volt input for Building Management System
 - f. Dry contact for alarm output
 - g. Outdoor sensor input
 - h. Computer monitor cable allows user to monitor system parameters – fault history – graphical monitor of system operation
 - 4. Stainless-Steel Tank:
 - a. Tank construction of 316 L stainless-steel
 - b. System return tube with screen for built-in dirt and air separation
 - c. High Temperature Switch
 - d. 1" system return and supply connection for 55-gallon models
 - e. 1-1/2" system return and supply connection for 80 and 119-gallon models
 - f. Pressure relief port
 - g. Top and bottom sensor
 - h. Built-in low water cutoff probe
 - 5. Multi-Fit Models:
 - a. Additional top connections and shorter height increase installation flexibility
 - b. 1-1/2" system return and supply connections
 - 6. Additional Features:
 - a. Vents in Schedule 40 CPVC (ASTM F411) – Provide and install intake and exhaust per manufacturer. Shall meet UL 1738.
 - b. Vents up to 200 combined equivalent feet in 3" venting (up to 85 combined equivalent feet in 2" venting)
 - c. Built-in condensation system
 - d. Manual reset high limit
 - e. NSF Listed
 - f. Low NOx emissions – SCAQMD Certified
 - g. Lead Free Compliant, as required by the Safe Drinking Water Act, Section 1417
 - 7. Miscellaneous Equipment:
 - a. 3" PVC Concentric Vent Kit. Install through flashed roof curb or portal per manufacturer.
 - b. Condensate Neutralizer for the water heater.

2.11 WATER HEATER (EWH-2)

- A. Furnish and install tankless water heater. Unit shall be an Eemax Accumix II Model #AM007240T, 4.9 KW, 208/1 phase. 66 F rise @ 0.50 GPM. Unit shall have ABS-UL-94-V-0 rated cover. Unit shall have 0.3 gpm turn on. Unit shall allow mounting in any direction.
- B. Heater shall include ASSE 1070 approved integrated mixing valve to conform to UPC 407.3. Element shall be replaceable cartridge insert. Unit shall have replaceable filter in the inlet connector. Element shall be iron free, nickel chrome material.
- C. Tankless water heater shall utilize complex algorithm, actively managing power application to real time system demand. Integrated flow meter, along with inlet and outlet temperature sensors shall provide data which allows the unit to instantly adapt to variations in input parameters.
- D. Heater shall be fitted with 3/8" compression fittings to eliminate need for soldering. Maximum operating pressure shall be minimum 150 psi. Diagnostic features shall include error/fault display. Unit shall be Eemax or accepted substitute.

2.12 DOMESTIC WATER HEATER (EWH-3)

- A. Tank water heaters shall be A. O. Smith Model DEL-15 (208V/1PH – 4 KW) or accepted substitute. Heater(s) shall be listed by Underwriters' Laboratories. Models shall meet the standby loss requirements of the U.S. Department of energy and current edition of ASHRAE/IES 90.1.
- B. Heater(s) shall have 150 psi working pressure and be equipped with extruded high density anode rod. All internal surfaces of the heater(s) exposed to water shall be glasslined with an alkaline borosilicate composition that has been fused-to-steel by firing at a temperature range of 1400°F to 1600°F. Electric heating elements shall be medium watt density with zinc plated copper sheath. Each element shall be controlled by an individually mounted thermostat and high temperature cutoff switch. The outer jacket shall be of backed enamel finish and shall enclose the tank with foam insulation. Electrical junction box with heavy duty terminal block shall be provided. The drain valve shall be located in the front for ease of servicing. Heater tank shall have a three year limited warranty as outlined in the written warranty. Fully illustrated instruction manual to be included.
- C. Provide and install with shelf to mount unit.
- D. Provide and install with ASME relief valve piped to 6" AFF or mop basin.

2.13 DOMESTIC HOT WATER CIRCULATING PUMP (CP-1)

- A. Furnish and install domestic water circulating pumps. The pump shall be all bronze construction for domestic hot water service. The pump shall be of the horizontal, oil-lubricated type, specifically designed and guaranteed for quiet operation. Suitable for 125# working pressure.
- B. The pumps shall have a ground and polished steel shaft with integral thrust collar. The shaft shall be supported by two horizontal sleeve bearings designed to circulate oil. The pumps are to be equipped with a water-tight seal to prevent leakage. Mechanical seal faces to be carbon on ceramic. The motor shall be non-overloading at any point on pump curve.
- C. The motor shall be of the open, drip-proof sleeve-bearing quiet operating, rubber-mounted construction. Motors shall have built-in thermal overload protectors.

- D. Circulator Pump CP-1 shall be Bell & Gossett Model EcoCirc 20-18 series or approved equal by TACO or Armstrong. Pump shall have a capacity of 2.0 GPM at 10 feet of head and shall be 70 Watts, 120V/1Ø.
- E. The system shall be provided with a bronze balancing valve and bronze shutoff valves for flow adjustment and maintenance.

2.14 EXPANSION TANK (ET-1)

- A. Furnish and install an expansion tank Model ST-30V-C by Therm-X-Trol. Tank shall be diaphragm type specifically designed for potable water and shall be ASME stamped.

2.15 APPROVED EQUALS

- A. The following are approved equals providing they meet specifications:
 - 1. Water Closets, Lavatories - American Standard, Kohler, Zurn
 - 2. Faucets - Moen Commercial, American Standard, Speakman
 - 3. Flush Valves - Zurn
 - 4. Water Coolers - Elkay
 - 5. Seats - Beneke, Kohler, Eljer, American Standard
 - 6. Sinks - Kohler, Just

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.
- B. Verify that electric power is available and of the correct characteristics.

3.2 PREPARATION

- A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install each fixture with trap, easily removable for servicing and cleaning.
- C. Provide chrome plated rigid or flexible supplies to fixtures with stops, reducers, and escutcheons.
- D. Install components level and plumb.
- E. Install and secure fixtures in place.
- F. Seal fixtures to wall and floor surfaces with sealant as specified in Section 07900, color to match fixture.
- G. Solidly attach water closets to floor with lag screws.

3.4 INTERFACE WITH OTHER PRODUCTS

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

3.5 ADJUSTING

- A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.6 CLEANING

- A. At completion, clean plumbing fixtures and equipment.

3.7 PROTECTION OF FINISHED WORK

- A. Protect finished Work. Do not permit use of fixtures.

3.8 FIXTURE HEIGHTS

- A. Install fixtures to heights above finished floor as indicated on the Architectural Drawings.

END OF SECTION 220440 (Addendum No. 1)

SECTION 230010 - MECHANICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 GENERAL

- A. The requirements of the General Conditions, the Supplementary General Conditions, and the applicable portions of Division 1 shall apply to this section of the specifications.
- B. All references to Mechanical Contractor, HC or MC shall be same as reference to HVAC Contractor.

1.2 SCOPE

- A. Provide and install complete and operating heating, ventilating, air conditioning systems in accordance with these specifications and accompanying contract drawings. This shall include all required labor, materials, equipment, and supervision.
- B. The work shall include but is not limited to the following systems, equipment, materials, and labor for a complete system including the following:
 - 1. Split System Air Conditioners
 - 2. Propane Gas Furnaces
 - 3. Energy Recovery Units
 - 4. Electric Heaters
 - 5. Propane Infrared Heaters
 - 6. Ductwork Systems
 - 7. Diffusers, Registers & Grilles
 - 8. Exhaust Fans
 - 9. BAS Control System

1.3 DEFINITION OF WORK RESPONSIBILITY

- A. All electrical control components including starters required for operation of HVAC and plumbing equipment whether integral or remote shall be furnished and installed under this Contract. Control wiring, conduits and accessories for control devices shall be furnished and installed by the Contractor who provides the HVAC and plumbing equipment.
- B. Power wiring from panelboard or similar source through all equipment disconnects to motors or heating equipment shall be furnished and installed by the Electrical Contractor.
- C. Equipment disconnect switches, unless otherwise specified or supplied by the equipment supplier as an integral part of the equipment shall be furnished and installed by the Electrical Contractor.
- D. All electrical equipment, components, and wiring furnished and installed under this portion of the specifications shall conform to all requirements of the applicable portions of the electrical specifications.
- E. All base flashing, where required, shall be by others, with necessary counter-flashing by this contractor.
- F. All structural work needed for support of mechanical equipment or components shall be supplied by this contractor.

- G. All concrete pads necessary for the support of HVAC and plumbing equipment or components shall be supplied by the contractor who provides the HVAC and plumbing equipment.
- H. All access panels in finished walls or ceilings shall be supplied by this contractor for installation by the General Contractor.
- I. If any changes are required in the installation of mechanical, structural, or electrical services to any mechanical equipment accepted as approved equals, the Mechanical Contractor shall be responsible for any additional costs incurred or coordination required.

1.4 RULES AND REGULATIONS

- A. All work shall be performed in accordance with the rules and regulations of the Pennsylvania 2021 International Construction Code, local plumbing codes, the utilities having jurisdiction, the International Plumbing Code, International Building Code, the International Mechanical Code, the International Energy Conservation Code, and NFPA Codes.
- B. All work shall be performed in accordance with the rules and regulations of Pennsylvania Department of Labor and Industry, Federal Department of Labor (Occupational Safety and Health Administration), the Department of Education, and all codes and agencies having jurisdiction.
- C. All construction, design fabrication, tests, rating and installation shall comply with the rules and regulations of all local, state or national codes and agencies having jurisdiction over this project. Any costs involved in complying with these rules and regulations shall be included in original bid of this Contractor.
- D. This Contractor shall obtain and pay for all construction and installation permits, certificates, and inspection fees relative to his work. He shall also prepare all specific plans as required by proper authorities before acceptance of the work. Costs incurred in the preparation of such plans shall be included in the Contractor's original bid.

1.5 DRAWINGS

- A. The accompanying drawings are a part of these specifications and are intended to show approximate and relative locations of services and equipment. They shall not be scaled to determine exact positions, locations, and clearances.
- B. Due to the diagrammatic layout and small scale of the drawings, certain piping and duct rises, drops, offsets, valves, and related specialties are not shown. The Contractor shall provide all ductwork, piping, fittings, valves, and specialties required to insure a complete installation without additional cost to the Owner.
- C. All drawings and specifications pertaining to general construction, plumbing, HVAC, sprinkler, electrical and other work shall be carefully examined. Where physical interferences with his work occur because of his failure to consult other trades, this Contractor shall rearrange his work at his own expense.

1.6 SUBMISSION OF SHOP DRAWINGS, EQUIPMENT, AND MATERIALS

- A. The Contractor shall submit, with a letter of transmittal to the Architect, the quantity of sets of shop drawings specified in Division 1 containing all capacities, performances, features, options, accessories and technical data of all materials and equipment listed herein. All submittals shall be made within 45 days after awarding of the contract.

- B. Refer to Division 1.
- C. All disapproved submittals shall be corrected as directed by the Architect and resubmitted in six (6) sets until approved within 15 days after the original submittal was disapproved. No work involving any materials or equipment covered by shop drawings shall be started until the respective shop drawings are approved.
- D. None of the items listed under Section 1.2 shall be installed until final approval has been given by the Architect.
- E. Identify Project, Contractor, Subcontractor, or supplier; pertinent drawing and detail number and specification section number, as appropriate on shop drawings.
- F. On shop drawings, apply Contractor's stamp, signed or initialed certifying that review, approval, verification of Products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the Work and Contractor Documents.
- G. On shop drawings, provide space for Contractor and Architect/Engineer review stamps.

1.7 VISIT TO THE SITE

- A. Prior to submission of his bid, the Contractor shall visit the site to acquaint himself with the existing conditions. Bids as submitted will be interpreted to include all costs and change made necessary by such conditions.

1.8 COORDINATION OF WORK

- A. Contractor shall coordinate his work with that of other trades. In case of interference or problems the Architect shall decide which work is to be relocated, regardless of which is installed first.

1.9 LOCATION OF EQUIPMENT

- A. All locations of HVAC equipment and pipe connections there to shall be verified by the Owner and Architect. The contractor shall verify locations sufficiently in advance of the installation to allow uninterrupted progress of the work of all trades.
- B. When so directed by the Architect, the Contractor shall prepare dimensioned arrangement drawings at a scale of (1/4" = 1'0"). Layouts represented by these drawings shall be coordinated with all other trades.
- C. This contractor shall obtain approval of all arrangement drawings before continuing his work.

1.10 MATERIALS AND EQUIPMENT

- A. All materials and equipment, unless otherwise specified, shall be new and of the best quality, approved for their specific application.
- B. This Contractor shall provide, when required by the Architect, labeled samples of materials to be used on the project. Samples shall be submitted for approval by the Architect prior to their installation.
- C. All materials and equipment installed by the Contractor shall be securely and rigidly supported from or attached to the building structure.

1.11 WORKMANSHIP

- A. All workmanship shall be done according to the best practices of the trade by qualified and competent tradesmen.

1.12 PROTECTION OF EQUIPMENT

- A. The Contractor shall protect all material and equipment from damage until final acceptance as installed. He shall close all openings during construction with temporary plugs and replace all damaged items with ones of exact sameness at his expense.
- B. Contractor shall schedule material and systems for delivery in such a pattern that critical pieces of equipment may be stored within the building, protected from weather. Where materials are stored outside, they must be protected from the elements and damage, theft, and vandalism.
- C. This Contractor shall be responsible for coordinating the procurement of specified materials and equipment being supplied by his sub-contractors and suppliers.

1.13 SCAFFOLDING AND HOISTING

- A. The Contractor shall furnish and erect all scaffolding, hoists, shoring, platforms, railings, ladders, and other devices required by local, state, and federal laws to install his systems and equipment. Scaffolding and all other equipment shall be removed at completion of the work.
- B. Contractor shall hoist or rig his own material and equipment into place or arrange for the rigging of it by others at his expense.

1.14 FOREMAN

- A. Contractor must provide a competent foreman, subject to approval of the Architect. The foreman shall be deemed the agent of the Contractor and must be on duty at the building during all working hours.
- B. Any instructions or notices given to the foreman shall have the same force as if given to the Contractor in person.

1.15 EXCAVATION AND BACKFILL

- A. The Contractor shall do all excavation and backfilling and all shoring, sheeting, pumping, and other work incidental to excavating as required for his installation.
- B. Backfill shall be made with clear earth; free from rocks, frozen earth, debris, or other foreign materials. Backfill shall be deposited in uniform layers of not over 8" thick and each layer shall be mechanically tamped before the next layer is applied.
- C. All excavated material remaining after the backfilling operation shall be removed from the site by this Contractor.
- D. Any settlement in trench backfill shall be brought to grade, and damage to pavement or slabs caused by such settlement shall be repaired at the Contractor's expense.
- E. All ditching, pumping, canvas covers, and other methods required to protect and keep all excavation and trenches free from water at all times during the construction period shall be

furnished, installed, and maintained by the Contractor. If the trench bottom becomes muddy, all mud shall be removed and replaced by bankrun sand and gravel or other suitable material as approved by Architect and compacted to the density of the surrounding undisturbed soil. Bottom of trench shall be protected against frost or freezing. This Contractor shall provide adequate shoring to protect his and other workmen. Shoring shall be maintained until tests of lines is completed.

- F. Trenches that pass under paving or roads and have less than 2' of cover, shall have a load-relieving slab over the pipe. Trenches which pass under or within 18" of any wall foundation shall be backfilled with concrete mixes 1 part cement, 3 parts sand, and 5 parts coarse aggregate.
- G. All repair of macadam or concrete paving made necessary by work done under this contract shall be performed by the General Contractor at the expense of this Contractor. All such repairs shall match surrounding paving in materials and workmanship.
- H. All grading and seeding made necessary by work done under this contract shall be performed by the General Contractor at the expense of this Contractor. Work shall comply with the Architectural Section of the Specifications.

1.16 PAINTING

- A. All exposed piping, iron work, and equipment installed in the mechanical equipment rooms under this contract shall be painted (1) prime coat and (2) coats of best quality paint of color as selected by the Architect.
- B. Unless specifically noted, insulation and any galvanized piping in ceiling cavity area shall not be painted.
- C. All grilles, louvers, etc. unless otherwise indicated shall be either furnished in or painted in a color selected by the Architect. When requested by the Architect, the equipment shall be finished with a prime coat and then professionally painted in the field in a color selected by the Owner. The Mechanical Contractor shall assume responsibility for all costs involved.

1.17 CUTTING AND PATCHING

- A. This Contractor shall be responsible to meet the requirements for cutting and patching as described in Specification Section 012700 Cutting and Patching.
- B. Perform all cutting necessary to install Work. Cutting of structural members will not be permitted except by written permission of the Architect.
 - 1. The Mechanical Contractor shall do all required cutting and patching of existing construction necessary to install his work. The Mechanical Contractor, whose work necessitates the need for the cutting and patching through existing construction, i.e., a duct penetration through existing roof deck, shall be the responsible contractor to perform the cutting and patching, regardless if work of another prime contractor is shown in the required opening.
 - 2. Where openings are creating in existing walls for ductwork, the Mechanical Contractor shall be responsible for the cutting of the opening and installation of the associated lintel. Refer to the structural drawings for lintel size.
- C. The responsibilities for cutting and patching where roofing work is involved shall be as follows:
 - 1. All New Construction: The General Contractor shall provide openings in the new work for the proper engagement of the work of the Mechanical Contractor. Upon completion of the work by the Mechanical Contractor affecting roofing work, the General Contractor shall perform all required roofing work.

2. Existing Construction Where New Roofing is Involved: The Mechanical Contractor whose work necessitates the need for the cutting and patching of existing construction, i.e., a duct penetration through existing roof deck, shall be the responsible contractor to perform the cutting and patching, except for patching of the roofing assembly, i.e., insulation, roofing membrane, flashing, etc. The General Contractor shall support the edges of the new opening as shown on the structural drawings, i.e., new steel angle deck supports at the perimeter of the opening. The General Contractor shall also perform all required work of the new roofing assembly, i.e., insulation, roofing membrane, flashing, etc., as part of the new roofing work. In the event that the new roofing work is limited to new roof membrane and flashing only, where the existing insulation is specified to remain, the Mechanical Contractor performing the cutting, shall patch the insulation as required.
 3. Existing Construction Where Existing Roofing is to Remain: The Mechanical Contractor whose work necessitates the need for the cutting and patching of existing construction, i.e., a duct penetration through existing roof deck, shall be the responsible contractor to perform the cutting and patching, including patching of the existing roofing assembly, i.e., insulation, roofing membrane, flashing, etc. The General Contractor shall support the edges of the new opening as shown on the structural drawings, i.e., new steel angle deck supports at the perimeter of the opening.
- D. Patching and repair at own expense, all surfaces cut into or damaged as a result of Work.
1. The Mechanical Contractor shall patch and repair at their own expense, all existing surfaces cut into, or damaged as a result of their work using skilled mechanics of the proper trades, and to the satisfaction of the Architect.
 2. All cutting of new construction that is made necessary by ill-timed work or lack of coordination by the Mechanical Contractor, shall be patched and repaired by the Mechanical Contractor at his own expense, using skilled mechanics of the proper trades, and to the satisfaction of the Architect.
- 1.18 WORK SEQUENCE
- A. Refer to Architectural Drawings and Specifications for Phasing Requirements for this Project. This Contractor shall plan and coordinate his work in accordance with those requirements.
- 1.19 CLEANING
- A. Upon completion of the installation, thoroughly purge all piping of all obstructions and scale and adequately flush all liquid carrying piping to assure a clean system.
- B. Where damage to finish, furnishing or parts of the building results from pipe stoppage or from failure to clear and flush piping systems properly, the Contractor shall, at his own expense, employ qualified skilled labor to make repairs.
- 1.20 OPERATING AND MAINTENANCE INSTRUCTIONS
- A. The Contractor shall prepare for the Owner, 3 hard bound volumes, each containing all operating instructions and information necessary for the care and maintenance of the system. These volumes shall be complete in every respect and shall include detailed operating instructions for each piece of equipment and diagrams for control wiring and piping so arranged and detailed that the maintenance staff may trace the control in event of operational malfunctioning.
- B. The Contractor shall submit (1) of the hard-bound volumes to the Architect for approval prior to presenting same to Owner.

- C. Printed instructions covering the operation and maintenance of each item of equipment shall be posted at locations designated by the Architect.
- D. The Contractor shall provide Project Records Documents in accordance with requirements of Division 1.

1.21 CLEANING AND FINISHING

- A. After all tests have been made and the system proven satisfactory to the Architect, the Contractor shall go over the entire project, clean all equipment and material installed by him, and leave in a clean and working condition.

1.22 INSTRUCTIONS TO EMPLOYEES

- A. At the completion of the work this Contractor shall instruct the employees who shall have charge of the equipment in the care, adjustment, and operation of all parts of the system.
- B. At the time designated by the Architect, the equipment manufacturer's engineer shall instruct representatives of the Owner in the operation and maintenance of the equipment.

1.23 GUARANTEE

- A. As set forth in the General Conditions, the respective Contractor shall warrant in writing all work performed under this contract.
- B. All work done under these contracts shall be guaranteed by the respective contractors against defective materials and faulty workmanship for a period of one (1) year from date of acceptance by the Owner.
- C. During such a period, and before the expiration of each such guarantee, contractor shall agree to make any and all repairs, adjustments, or replacements which may become necessary, owing to initial settlement or shrinkage, defective material, workmanship, or installation.
- D. He shall further agree to provide all labor and material which may be required and to restore to its original condition any adjacent work that he may disturb in making the necessary repairs, adjustments, or replacements in order to fulfill this guarantee.

1.24 GENERAL NOTE

- A. The HVAC Contractor shall replace filters in all new HVAC units at the completion of the project.
- B. All mechanical equipment shall bear the label of an approved agency.
- C. All mechanical equipment shall be installed in accordance with the manufacturer's installation instructions which shall be available at job site.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install equipment to permit removal of components and parts which require periodic replacement or maintenance. Arrange pipes, ducts, and equipment to permit access to valves, gauges, starters, motors, doors, and access panels.
- B. Provide access panels in equipment, ducts, etc. as required for inspection and maintenance.

3.2 PIPING INSTALLATION

- A. In general, piping shall be exposed in equipment rooms, and concealed in all finished rooms. Where piping is exposed, it shall be run so as to allow maximum headroom consistent with proper pitch. No piping or ductwork shall cross below the head of any window or door.
- B. Exposed piping, ducts, conduits, and/or appurtenances indicated on the inside of buildings, shall be installed parallel to the building lines. All piping shall be kept as close as possible to the ceilings and walls, and columns, to take up the minimum amount of space.
- C. All work shall be arranged and installed as high as possible to prevent obstruction of window areas, and to give adequate clearance and access for operation and maintenance.

3.3 SLEEVES

- A. Where pipes pass through concrete or masonry walls or concrete floors, they shall be protected through the full depth of the construction with galvanized sleeves; same to be at least one size larger than the pipe plus insulation.
- B. Where sleeves occur in concrete floors, the top of sleeve shall be flush with finished floor line, and the end shall be filed to a smooth round finish.
- C. This Contractor shall supply all pipe sleeves and shall inform general contractor of exact sleeve locations in time for their incorporation onto the concrete forms or masonry work.
- D. Any cutting and patching in masonry or concrete made necessary by failure to adequately coordinate with the general contractor shall be done by the Masonry or Pre-Cast Contractor at the expense of this contractor.
- E. The space between pipes and sleeves shall be caulked air-tight with a non-combustible inorganic material.

3.4 UNIONS

- A. Unions shall be provided at all connections to each piece of equipment and on both sides of all automatic valves, and devices which requires removal for maintenance. No unions are to be placed in a location which will be inaccessible after the completion of the project.
- B. Unions of copper tubing shall be 200 lbs. SWP brass ground joint.

- C. Unions for steel pipe shall be 250 lbs. SWP, malleable iron with brass to iron seat.

3.5 CLEARANCE

- A. All piping, including valves and fittings shall be installed to provide the following minimum clearances between the finish coverings, adjacent pipe and/or conduits: 2" between for piping services and 6" between piping services and electrical conduits.

3.6 ESCUTCHEON PLATES

- A. All piping passing through walls, ceilings, and floors shall be provided with escutcheon plates securely fastened in place. Where installed on piping in finished areas they shall be chrome plated.

3.7 ACCESS PANELS

- A. Removable panels shall be located so as to provide easy access to all concealed plumbing accessories that may require adjustments or maintenance, such as valves, water hammer arresters, traps, strainers, cleanouts or others.
- B. Access panels in finished wall or ceiling surfaces shall be furnished by this Contractor for installation by the General Contractor.
- C. This Contractor shall pay for any work made necessary by his failure to inform other trades of access panel locations.

3.8 APPLICATIONS OF INSULATION AND COVERING

- A. No covering shall be installed by the Contractor until the piping and ducts have been approved by the Architect/ Engineer.

3.9 PIPING UNDER FLOORS

- A. Wherever piping, conduits and associated materials is run under a floor slab on grade, the work is to be installed after the sub-grade has been brought to the proper level. The work shall then be installed and backfilled, allowed to settle, and refilled before placing crushed stone fill.

3.10 INSERTS

- A. Except as noted, provide box type inserts for all hangers and supports intended to suspend piping or lightweight equipment from new concrete construction. Fasten all inserts to the formwork before concrete is poured. Inserts to be Grinnel Figure No. 282 or Figure No. 279 depending upon the maximum load to be carried.
- B. No toggle bolts, expansion screw anchors or similar imbedded hanger supports shall be used in new construction.

3.11 LUBRICATION

- A. The contractor shall provide all oil for the operation of all equipment until acceptance. The Contractor shall run in all bearings and, after they are run in, drain all oil from the bearings, flush out all bearings, and refill with new oil. The Contractor shall be held responsible for all damage to

bearings while equipment is being operated by him up to the date of acceptance of the equipment. The contractor shall be required to protect all bearings during installation and shall thoroughly grease steel shafts to prevent corrosion. All motors and other equipment shall be provided with covers as required for proper protection during construction.

3.12 JOINTS AND CONNECTIONS

- A. Screwed Connections - All joints made in screwed pipe shall be made with red lead or pipe compound applied to the threaded end of the pipe and not applied within the fitting. Threads shall be cut straight and true with sections reamed and cleaned before installation.

END OF SECTION 230010

SECTION 230100 - MECHANICAL GENERAL EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Flexible Pipe Connectors
- B. Pipe and Equipment Hangers and Supports
- C. Equipment Bases and Supports
- D. Sleeves and Seals
- E. Single Phase Electric Motors
- F. Three Phase Electric Motors
- G. Nameplates
- H. Tags
- I. Stencils
- J. Pipe Markers
- K. Vibration Isolation

1.2 REFERENCES

- A. ASME - B40.1 - Gauges - Pressure Indicating Dial Type - Elastic Element.
- B. ASTM E1 - Specification for ASTM Thermometers.
- C. ASTM E77 - Verification and Calibration of Liquid-in-Glass Thermometers.
- D. UL 393 - Indicating Pressure Gauges for Fire and Protection Services.
- E. ASTM F708 - Design and Installation of Rigid Pipe Hangers.
- F. MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
- G. MSS SP69 - Pipe Hangers and Supports - Selection and Application.
- H. MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
- I. NFPA 13 - Installation of Sprinkler Systems.
- J. NFPA 14 - Installation of Standpipe and Hose Systems
- K. NEMA MG 1 - Motors and Generators.

- L. NFPA 70 - National Electrical Code.
- M. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.3 SUBMITTALS

- A. Provide in accordance with provisions of Section 230010.
- B. Product Data:
 - 1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
 - 2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.
 - 3. Gauges and Meters: Provide list which indicates use, operating range, total range, and location for manufactured components.
 - 4. Supports and Anchors: Provide manufacturers catalog data including load capacity.
 - 5. Motors: Provide wiring diagrams with electrical characteristics and connection requirements.
 - 6. Mechanical Identification: Provide manufacturers catalog literature for each product required.
 - 7. Vibration Isolation: Provide schedule of vibration isolator type with location and load on each.
- C. Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each.

1.4 REGULATORY REQUIREMENTS

- A. Conform to applicable electrical code.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc., as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 FLEXIBLE PIPE CONNECTORS

- A. Steel Piping:
 - 1. Manufacturers:
 - a. Flexonics Model 400
 - b. Mason Model BSS
 - c. Keflex Model KFCS
 - 2. Inner Hose: Stainless Steel
 - 3. Exterior Sleeve: Single braided stainless steel
 - 4. Pressure Rating: 200 psig WOG and 250°F
 - 5. Joint: As specified for pipe joints
 - 6. Size: Use pipe sized units
 - 7. Maximum offset: 3/4" on each side of installed center line
- B. Copper Piping:
 - 1. Manufacturers:
 - a. Flexonics Model 300
 - b. Mason Model BBF
 - c. Keflex Model KFCB
 - 2. Inner Hose: Bronze

3. Exterior Sleeve: Braided bronze.
4. Pressure Rating: 200 psig WOG and 250°F
5. Joint: As specified for pipe joints
6. Size: Use pipe sized units
7. Maximum offset: 3/4" on each side of installed center line

2.2 TEST PLUGS

- A. Test Plug: 1/4" or 1/2" brass fitting and cap for receiving 1/8" outside diameter pressure or temperature probe with Nordel core for temperatures up to 350°F.
- B. Test Kit: Carrying case, internally padded and fitted containing one 2-1/2" diameter pressure gauges, one gauge adapters with 1/8" probes, two 1" dial thermometers.

2.3 PIPE HANGERS AND SUPPORTS

- A. Manufacturers:
 1. Grinnell (Basis of Design)
 2. Other acceptable manufacturers offering equivalent products.
 - a. or approved equal.
- B. HVAC Piping:
 1. Conform to ASTM F708, MSS SP58, MSS SP69, MSS SP89.
 2. Hangers for Pipe Sizes 1/2 to 12": Malleable iron adjustable swivel, split ring.
 3. Hangers for Cold Pipe Sizes 2" and Over: Carbon steel, adjustable, clevis.
 4. Hangers for Hot Pipe Sizes 2 to 4": Carbon steel, adjustable, clevis.
 5. Hangers for Hot Pipe Sizes 6" and Over: Adjustable steel yoke, cast iron roll, double hanger.
 6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6" and Over: Steel channels with welded spacers and hanger rods, cast iron roll.
 8. Wall Support for Pipe Sizes to 3": Cast iron hook.
 9. Wall Support for Pipe Sizes 4" and Over: Welded steel bracket and wrought steel clamp.
 10. Wall Support for Hot Pipe Sizes 6" and Over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast-iron roll.
 11. Vertical Support: Steel riser clamp.
 12. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 13. Floor Support for Hot Pipe Sizes to 4": Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 14. Floor Support for Hot Pipe Sizes 6" and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
 15. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.4 PIPE HANGER ACCESSORIES

- A. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

2.5 INSERTS

- A. Manufacturers:
 1. Grinnell
 2. Other acceptable manufacturers offering equivalent products.
 - a. or approved equal.

- B. Inserts: Malleable iron case of steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.6 FLASHING

- A. Metal Flashing: 26-ga galvanized steel.
- B. Metal Counterflashing: 22-ga galvanized steel.
- C. Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.
- D. Caps: Steel, 22-ga minimum; 16-ga at fire resistant elements.

2.7 EQUIPMENT CURBS

- A. Fabrication: Welded 18-ga galvanized steel shell and base, mitered 3" cant, 1-1/2" thick insulation, factory installed wood nailer.

2.8 SLEEVES

- A. Sleeves for Pipes Through Non-fire Rated Floors: 18-ga galvanized steel.
- B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18-ga galvanized steel.
- C. Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.
- D. Sleeves for Rectangular Ductwork: Galvanized steel.
- E. Firestopping Insulation: Glass fiber type, non-combustible.
- F. Sealant: Acrylic.
- G. Firestopping for non-plastic piping, ductwork shall be 3M, Dow, Corning fire caulk/packing or accepted substitute. Install steel angles around duct penetrations.

2.9 MOTORS

- A. Manufacturers:
 - 1. Century
 - 2. Westinghouse
 - 3. Lincoln
 - 4. Baldor
 - 5. Or approved equal
- B. General Construction and Requirements:
 - 1. Motors Less Than 250 Watts, for Intermittent Service: Equipment manufacturer's standard and need not conform to these specifications.
 - 2. Electrical Service:
 - a. Refer to Section 260180 for required electrical characteristics.
 - 3. Type:

- a. Open drip-proof except where specifically noted otherwise.
- b. Motors: Design for continuous operation in 40°C environment.
- c. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
- d. Motors with frame sizes 254T and larger: Energy Efficient Type.
4. Explosion-Proof Motors: UL approved and labeled for hazard classification, with over temperature protection.
5. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.
6. Wiring Terminations:
 - a. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
 - b. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.
7. Provide thermal overload protection for all motors per NEC.

2.10 TAGS

- A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 12"-diameter.
- B. Chart: Typewritten letter size list in anodized aluminum frame. Room numbers shall correspond to Owners room numbering system.

2.11 STENCILS

- A. Stencils: With clean cut symbols and letters of following size:
 1. 3/4 to 1-1/4" Outside Diameter of Insulation or Pipe: 8" long color field, 1/2" high letters.
 2. 1-1/2" to 2" Outside Diameter of Insulation or Pipe: 8" long color field, 3/4" high letters.
 3. 2-1/2" to 6" Outside Diameter of Insulation or Pipe: 12" long color field, 1-1/4" high letters.
 4. 8 to 10" Outside Diameter of Insulation or Pipe: 24" long color field, 2-1/2" high letters.
 5. Over 10" Outside Diameter of Insulation or Pipe: 32" long color field, 3-1/2" high letters.
 6. Ductwork and Equipment: 2-1/2" high letters.
- B. Stencil Paint: As specified in Section 09900, semi- gloss enamel, colors conforming to ASME A13.1.

2.12 PIPE MARKERS

- A. Color: Conform to ASME A13.1.
- B. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
- D. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6" wide by 4 mil thick, manufactured for direct burial service.

2.13 VIBRATION ISOLATORS

- A. Neoprene Pad Isolators:
 - 1. Rubber or neoprene waffle pads:
 - a. 30 durometer
 - b. Minimum 1/2" thick
 - c. Maximum loading 40 psi
 - d. Height of ribs shall not exceed 0.7 times width
 - 2. Configuration: Single layer
- B. Rubber Mount or Hanger: Molded rubber designed for 0.5" deflection with threaded insert.
- C. Glass Fiber Pads: Neoprene jacketed pre-compressed molded glass fiber.

2.14 ROOF PIPE PORTAL ASSEMBLY

- A. Provide roof pipe curb assembly as manufactured by Pate Co. Style PCA or accepted substitute.
- B. Pipe curb assembly shall be constructed of insulated galvanized steel curb with 2" wood nailer, plastic cover and graduated neoprene boots with stainless steel clamps.
- C. Provide pipe curb assembly for piping that penetrates roof membrane.

2.15 FIRE STOPPING

- A. Acceptable Manufacturer:
 - 1. EGS Nelson Firestop Product
 - 2. 3M
 - 3. Approved Equal
- B. Products:
 - 1. Nelson ES1399 Elastomeric Sealant: Water based acrylic latex, endothermic fire protective sealant. It is used for applications of through firestop penetrations and in construction joints. It is available in two grades, N/S (Non-Sag) for wall and overhead installations, and S/L (Self-Leveling) for floor installations.
 - 2. Nelson WRS+ Firestop Wrap Strips: to be used as a wrap around PVC type pipes. After the pipe is covered with the correct number of wraps the WRS+ is covered with a field cut and fabricated collar cover is used in conjunction with CLK or FSP which provide a smoke seal.
 - 3. Nelson PCS Pipe Choke System Collars: To be used on PVC type pipes and conduits to produce an immediate smoke and fire seal. Each PCS is pre-filled with a highly intumescent pliable putty material. Collars are furnished in exact sizes from 1.5" to 4". Collars are UL System Classified for through penetrations of drywall or concrete/masonry assemblies.
 - 4. Nelson LBS+ Firestop Latex Based Sealant: A one part "Latex-Water Based" Intumescent caulk that is of a non-sag formulation for use in all applications, wall, floor and overhead.

2.16 STARTERS

- A. All starters shall be Hand/Off/Auto Type.
- B. Starters for rooftop equipment (HRU's, EF's, etc.) shall be mounted at the unit on the roof and shall be NEMA rated, weatherproof for exterior installation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Piping Expansion Compensation:

1. Install in accordance with manufacturer's instructions.
2. Construct spool pieces to exact size of flexible connection for future insertion.
3. Install flexible pipe connectors on pipes connected to equipment supported by vibration isolation. Provide line size flexible connectors.
4. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.
5. Rigidly anchor pipe to building structure where necessary. Provide pipe guides so movement is directed along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.
6. Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where indicated.
7. Provide expansion loops as indicated on drawings.

B. Gauges and Meters:

1. Install positive displacement meters with isolating valves on inlet and outlet. Provide full line size valved bypass with globe valve for liquid service meters.
2. Install pressure gauges with pulsation dampers. Provide needle valve to isolate each gauge. Extend nipples to allow clearance from insulation.
3. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2" for installation of thermometer sockets. Ensure sockets allow clearance from insulation.
4. Install thermometers in air duct systems on flanges.
5. Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets. Where thermometers are provided on local panels, duct or pipe mounted thermometers are provided on local panels, duct or pipe mounted thermometers are not required.
6. Locate duct mounted thermometers minimum 10' downstream of mixing dampers, coils, or other devices causing air turbulence.
7. Coil and conceal excess capillary on remote element instruments.
8. Provide instruments with scale ranges selected according to service with largest appropriate scale.
9. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45° off vertical.
10. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.
11. Locate test plugs adjacent thermometers and thermometer sockets, pressure gauges and pressure gauge taps and where indicated.

C. Mechanical Identification:

1. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
2. Install tags with corrosion resistant chain.
3. Apply stencil painting in accordance with Section 09900.
4. Install plastic pipe markers in accordance with manufacturer's instructions.
5. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
6. Install underground plastic pipe markers 6 to 8" below finished grade, directly above buried pipe.

7. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with stencil painting. Small devices, such as in-line pumps, may be identified with tags.
8. Identify control panels and major control components outside panels with plastic nameplates.
9. Identify thermostats relating to terminal boxes or valves with nameplates.
10. Identify valves in main and branch piping with tags.
11. Identify air terminal units and radiator valves with numbered tags.
12. Tag automatic controls, instruments, and relays. Key to control schematic.
13. Identify piping, concealed or exposed, with plastic pipe markers. Use tags on piping 3/4" diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20' on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
14. Identify ductwork with stenciled painting. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.
15. Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.
16. Provide Valve Identification Chart. Post framed chart in Boiler Room.

D. Vibration:

1. Install isolation for motor driven equipment.
2. Bases:
 - a. Set steel bases for 1" clearance between housekeeping pad and base.
 - b. Set concrete inertia bases for 2" clearance between housekeeping pad and base.
 - c. Adjust equipment level.
3. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.
4. Connect wiring to isolated equipment with flexible hanging loop.
5. All vibration isolation devices, including steel bases and pouring forms, shall be supplied by a single manufacturer.
6. All piping located in Boiler Room, shall be isolated from the building structure by means of spring hangers.
7. For Air Handlers not located in the Mechanical Rooms, all piping 1" in diameter or greater shall be isolated with spring hangers having the same deflection, for the first three hangers, as those for the machine to which it is connected.
8. Bases for all end suction pumps shall be sized to include supports for the suction and discharge elbows.
9. Flexible conduit shall be used for all electrical connections to isolated equipment. Flexible conduit shall be 50% longer than the actual distance between the rigid conduit and the equipment electrical connection locations.
10. The schedule of isolators required shall be as follows: Pumps - inertia bases, 1" (minimum) deflection springs; Air handling units in mechanical rooms on grade - 1/2" deflection neoprene or fiberglass pads; Ceiling mounted air handling units - 1" deflection springs; piping - all piping in the mechanical rooms should have isolation hangers having the same deflection as those for the equipment in the rooms, or for 50' from the equipment, whichever is greater. For the ceiling mounted air handling units, any piping larger than 1" diameter should have the first three hangers of the same deflection as the equipment (1"). Provide spring hangers for piping in Boiler Room.
11. Spring hangers for piping shall consist of clevis type hangers with spring hanger similar to Grinnell Fig. 247 or Fig. B-268 installed in threaded rod.

E. Motors:

1. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
2. Check line voltage and phase and ensure agreement with nameplate.

F. Inserts:

1. Provide inserts for placement in concrete formwork.
2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4".
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

G. Pipe Hangers and Supports:

1. Support horizontal piping as scheduled.
2. Install hangers to provide minimum 1/2" space between finished covering and adjacent work.
3. Place hangers within 12" of each horizontal elbow.
4. Use hangers with 1-1/2" minimum vertical adjustment.
5. Support horizontal cast iron pipe adjacent to each hub, with 5' maximum spacing between hangers.
6. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
8. Support riser piping independently of connected horizontal piping.
9. Provide copper plated hangers and supports for copper piping.
10. Design hangers for pipe movement without disengagement of supported pipe.
11. Provide additional supports for heavy valves and specialties and provide sway bracing where needed.
12. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
13. Insulation protection saddles shall be installed at all pipe hangers and supports for insulated lines. Saddles shall be rolled with a radius to suit the insulation O.D. Saddles shall be #16-ga galvanized steel and shall be 8" long.

H. Equipment Bases and Supports:

1. Provide housekeeping pads of concrete, minimum 4" thick and extending 4" beyond supported equipment except pads in Boiler Room shall be 12" deep.
2. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.
3. Construct supports of steel members. Brace and fasten with flanges bolted to structure.
4. Provide rigid anchors for pipes after vibration isolation components are installed.

I. Flashing:

1. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
2. Flash vent and soil pipes projecting 3" minimum above finished roof surface with lead worked 1" minimum into hub, 8" minimum clear on sides with 24 x 24" sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counterflash, and seal.
3. Flash floor drains in floors with topping over finished areas with lead, 10" clear on sides with minimum 36 x 36" sheet size. Fasten flashing to drain clamp device.
4. Seal floor, shower and mop sink drains watertight to adjacent materials.
5. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control.
6. Provide curbs for mechanical roof installations 12" minimum high above roofing surface. Flash and counterflash with sheet metal; seal watertight. Attach counterflashing mechanical equipment and lap base flashing on roof curbs. Flatten and solder joints.
7. Adjust storm collars tight to pipe with bolts; calk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

J. Sleeves:

1. Set sleeves in position in formwork. Provide reinforcing around sleeves.

2. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
3. Extend sleeves through floors one inch above finished floor level. Caulk sleeves.
4. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with fire stopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
5. Install chrome plated steel escutcheons at finished surfaces.

3.2 MANUFACTURER'S FIELD SERVICES

- A. Prepare and start systems under provisions of Section 230010.

3.3 SCHEDULES

A. Supports and Hangers			
PIPE SIZE	MAX. HANGER SPACING		HANGER ROD DIAMETER
<u>Inches</u>	<u>Feet</u>		<u>Inches</u>
Up to 1	6		3/8
1-1/4 to 2	9		3/8
2-1/2 to 3	10		1/2
4 to 5	12		5/8
6	12		3/4
8 to 12	12		7/8
14 and Over	12		1
PVC (All Sizes)		4	3/8
C.I. Bell and Spigot (or No-Hub) and at Joints	5		3/4

3.4 APPLICATION

- A. Motors:
 1. Single phase motors for shaft mounted fans or blowers: Permanent split capacitor type.
 2. Single phase motors for fans, pumps, blowers, air compressors: Capacitor start type.
 3. Motors located in exterior locations: Totally enclosed type.
 4. Motors located in outdoors: Totally enclosed weatherproof epoxy-treated type.
 5. Motors located in outdoors: Totally enclosed weatherproof epoxy-sealed type.
 6. All Motors - All motors shall be high efficiency type.

END OF SECTION 230100

SECTION 230250 - INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Piping Insulation
- B. Jackets and Accessories
- C. Equipment Insulation
- D. Covering
- E. Ductwork Insulation
- F. Duct Liner
- G. Insulation Jackets

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM)
- B. National Fire Protection Association (NFPA)
- C. Underwriters Laboratories (UL)
- D. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
- E. ASHRAE Standard 90A-1980

1.3 SUBMITTALS

- A. Submit in accordance with provisions of Section 230010.
- B. Product Data: Provide product description, list of materials and thickness for each service, and locations.

1.4 QUALITY ASSURANCE

- A. Materials: Flame spread/smoke developed rating of 25/50 or less in accordance with ASTM E84, NFPA 255, UL 723.

PART 2 - PRODUCTS

2.1 INSULATION

- A. Manufacturers
 - 1. Owens-Corning
 - 2. Johns Manville
 - 3. Certainteed
 - 4. Armstrong
 - 5. PPG
 - 6. Knauf

2.2 DUCT INSULATION

- A. Provide and install acoustic and thermal lining in all supply air, fresh air, heat recovery unit air, transfer air, and return air ductwork as specified. Exhaust only ductwork does not need insulated unless specifically noted.
- B. Lining shall be fiberglass semi-rigid board type, or duct liner, 2.0 PCF density, with a thermal conductivity of approximately 0.16 BTU/Hr – sq ft - °F – inch and a minimum R-value of 6.3 or greater.
- C. Ductwork in attic areas shall be lined as specified and wrapped with an additional 2" duct wrap with all service jacket. The total minimum R-value shall be R-12.
- D. All insulation shall meet the code required flame and smoke ratings and shall be suitable for plenums.

2.1 REFRIGERANT PIPING

- A. All refrigeration lines shall be insulated in accordance with IECC Table C403.2.10 above with flexible elastomeric closed cell pipe insulation, Armaflex FR/Armaflex or approved equal having flame spread rating of 25 or less when tested by ASTM-84 method.
- B. All exposed FR/Armaflex insulation shall be finished with two coats of Armstrong Armaflex Finish or accepted substitute. Color to be selected by Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions.
- B. On exposed piping, locate insulation and cover seams in least visible locations.

- C. Insulated pipes and equipment conveying fluids below ambient temperature:
 - 1. Provide vapor barrier jackets, factory applied, or field applied.
 - 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe.
 - 3. PVC fitting covers shall be used.
 - 4. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations.
 - 5. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.
 - 6. Tape all joints and seal with mastic to maintain vapor barrier.
- D. For insulated pipes and equipment conveying fluids above ambient temperature:
 - 1. Provide standard jackets, with vapor barrier, factory applied, or field applied.
 - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe.
 - 3. PVC fitting covers shall be used.
- E. Do not insulate over nameplate or ASME stamps. Bevel and seal insulation around such.
- F. Install insulation for equipment requiring access for maintenance, repair, or cleaning, in such a manner that it can be easily removed and replaced without damage.
- G. External Duct Insulation Application:
 - 1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
 - 2. Secure insulation without vapor barrier with staples, tape, or wires.
 - 3. Install without sag on underside of ductwork. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift ductwork off trapeze hangers and insert spacers.
 - 4. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
 - 5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.
- H. Insulation including finishes and adhesive on the exterior surfaces of ducts and equipment shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less as determined by an independent testing laboratory in accordance with ASTM E84, NFPA 255-1972 as required by NFPA 90A. Smoke development rating for pipe insulation shall not exceed 50. Duct coverings shall not flame, glow, smolder or smoke when tested in accordance with ASTM C411.
- I. Linings in air ducts and equipment shall meet the Erosion Test Method described in Underwriter's Laboratories Publication No. 181. These linings, including coatings and adhesives and insulation on exterior surfaces of pipes and ducts in building spaces used as air supply plenums, shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less as determined by an independent testing laboratory in accordance with NFPA 255-1972, ASTM E84 as required by NFPA 90A. Linings shall not flame, glow, smolder or smoke when tested in accordance with ASTM C411.
- J. Duct Insulation:
 - 1. All insulation surfaces shall be coated with a compound to prevent erosion, flaking or peeling of liner material at air velocities of 3000 ft./minute.
 - 2. Insulation shall be applied using UL approved fire-retardant adhesive and mechanical fasteners. Adhesive shall be water-based Foster 85-17 or approved equal. Mechanical fasteners shall be Gripnail Corporation, or equal with self-locking washers, and shall be spaced not more than 6 inches apart on leading edges of liner.
 - 3. Top sheets of insulation in rectangular ducts shall lap the side sheets.
 - 4. All joints and seams in the lining shall be painted to a smooth surface with a fire-retardant insulation sealer, Foster 30-70 or equal as approved.
 - 5. Liner shall be anti-microbial.

6. Liner shall be impervious to dust and dirt.
- K. Refrigerant Pipe Insulation:
 1. Insulate per manufacturers recommendation.

END OF SECTION 230250

SECTION 230510 - HVAC PIPING & SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. High Efficiency Gas Furnace Condensation Drainage Piping
- B. Pipe and Pipe Fittings for:
 - 1. Refrigerant Piping

1.2 REFERENCES

- A. ASME - Boiler and Pressure Vessel Codes, SEC 9 - Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.
- B. ASME B16.3 - Malleable Iron Threaded Fittings Class 50 and 300.
- C. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
- D. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- E. ASME B31.9 - Building Services Piping.
- F. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
- G. ASTM A234 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
- H. ASTM B32 - Solder Metal.
- I. ASTM B88 - Seamless Copper Water Tube.
- J. ASTM F708 - Design and Installation of Rigid Pipe Hangers.
- K. AWS A5.8 - Brazing Filler Metal.
- L. AWS D1.1 - Structural Welding Code.
- M. MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacture.
- N. MSS SP69 - Pipe Hangers and Supports - Selection and Application.
- O. MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

1.3 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

- B. Use grooved mechanical couplings and fasteners in accessible locations.
- C. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.
- D. Use non-conducting dielectric connections whenever jointing dissimilar metals.
- E. Provide pipe hangers and supports in accordance with ASTM B31.9 unless indicated otherwise.
- F. Use gate, ball, or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- G. Use ball or butterfly valves for throttling, bypass, or manual flow control services.
- H. Use 3/4" ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment.

1.4 SUBMITTALS

- A. Submit in accordance with provisions of Section 230010.
- B. Product Data: Include data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalogue information. Indicate valve data and ratings.
- C. Welders Certificate: Include Welders Certification of Compliance with ASME SEC 9.

1.5 REGULATORY REQUIREMENTS

- A. Conform to ASME B31.9 code for installation of piping system.
- B. Welding Materials and Procedures: Conform to ASME SEC 9 and applicable state labor regulations.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

- A. Conform to ASME B31.9, ASTM F708, MSS SP89.

2.2 HIGH EFFICIENCY GAS FURNACE CONDENSATION PIPING

- A. PVC Pipe: ASTM D2665
 - 1. Fittings: PVC
 - 2. Joints: ASTM D2855, solvent weld.

2.3 REFRIGERANT PIPING

- A. Copper Tubing: ASTM B280, Type ACT hard drawn:
 - 1. Fitting: ASME B16.22, wrought copper.

2. Joints: Braze, AWS A5.8 BcuP silver/phosphorous copper alloy with melting range 1190 to 1480°F.

- B. Valves and associated specialties shall be suitable for refrigerant service.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
- E. After completion, fill, clean, and treat systems.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install heating water, chilled water piping to ASME B31.9.
- C. Route piping in orderly manner, parallel to building structure, and maintain gradient.
- D. Install piping to conserve building space, and not interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Sleeve pipe passing through partitions, walls, and floors.
- G. Slope piping and arrange to drain at low points.
- H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 230100.
- I. Pipe Hangers and Supports:
 1. Install in accordance with ASTM B31.9, ASTM F708 and MSS SP89.
 2. Support horizontal piping as scheduled.
 3. Install hangers to provide minimum 2" space between finished covering and adjacent work.
 4. Place hangers within 12" of each horizontal elbow.
 5. Use hangers with 12" minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 6. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
 7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- J. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

- K. Provide access where valves and fittings are not exposed.
- L. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
- M. Install valves with stems upright or horizontal, not inverted.
- N. Hydronic piping shall be tested with water at 150 psig and system shall not lose over 2 psig in two hours with no visible signs of leakage.
- O. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- P. Provide clearance for installation of insulation and access to valves and fittings.
- Q. Install bell and spigot pipe with bell end upstream.
- R. Install unions downstream of valves and at equipment or apparatus connections.
- S. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- T. Install ball valves for throttling, bypass, or manual flow control services.
- U. Provide flow controls in water recirculating systems where indicated. Size valves to meet flow quantities indicated.
- V. Refrigerant Piping:
 - 1. Arrange refrigerant piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40% in direction of flow.
 - 2. Flood piping system with nitrogen when brazing.
 - 3. Follow ASHRAE 15 procedures for charging and purging of systems and for disposal of refrigerant.
 - 4. Provide replaceable cartridge filter-driers, with isolation valves and valved bypass.
 - 5. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.
 - 6. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.
 - 7. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.
 - 8. Fully charge completed system with refrigerant after testing.
 - 9. Test refrigeration system in accordance with ASTM B31.5.

END OF SECTION 230510

SECTION 230835 - HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Propane Hot Air Furnaces
- B. Electric Heaters
- C. Ductless Split System AC and HP Units
- D. Propane Infrared Heaters

1.2 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code.

1.3 SUBMITTALS

- A. Submit shop drawings in accordance with provisions of Section 230010.

1.4 REGULATORY REQUIREMENTS

- A. Conform to ANSI/NFPA 70 code for internal wiring of factory wired equipment.

PART 2 - PRODUCTS

2.1 PROPANE GAS FURNACE

- A. Furnish and install Trane Propane Furnace Model S9X2 or accepted substitute by York/Johnson Controls, or Carrier.
- B. Furnace shall be condensing type with sealed venting and intake system, concentric vent system, filter rack, MERV-8 filters, propane conversion kits, etc. for complete system. Install concentric vent system through flashed roof curb or approved penetration kit.
- C. Provide with bottom or side return air connections shown on the drawings.
- D. Provide and install with inline condensate trap kit and neutralizer.
- E. Inlets and vents shall be Schedule 40 CPVC (ASTM F441) as approved and permitted by the unit manufacturer. System shall meet UL 1738.
- F. Provide with terminal strip controls. Coordinate all controls with Siemens Building Technologies.

2.2 PROPANE INFRARED HEATER

- A. Furnish and install Reznor Propane Infrared Heater Model VZ or acceptable substitute by Modine or Sterling.
- B. Unit shall be of size as listed on the drawing schedule.
- C. Provide and install with hangers, propane kits, burner cabinet, blower assembly, radiant tubes, aluminum reflectors, direct spark ignition, single stage gas valve, horizontal venting kit, combustion air inlet and vent outlet kits/terminals, hanger kits, control transformer, gas regulator, and control interface for Siemens BAS system.
- D. Mount and install per the manufacturer's requirements and maintain all required clearances.
- E. Provide with terminal strip controls. Coordinate all controls with Siemens Building Technologies.

2.3 ELECTRIC UNIT HEATERS

- A. Furnish and install as shown on the plans an electric unit heater of the size and capacity indicated. Unit shall be Model HUH by Berko or accepted substitute by Qmark or Marley.
- B. Unit shall include all standard equipment with attached ceiling bracket and self-contained or wall mounted thermostat as shown on the plans.
- C. Provide with terminal strip controls. Coordinate all controls with Siemens Building Technologies.

2.4 ELECTRIC WALL HEATER

- A. Electric wall heater shall be Berko Type CWH or accepted substitute by Qmark or Marley.
- B. Provide with a security tamperproof front cover.
- C. Heating elements shall be steel finned metal sheath elements.
- D. Fan motor shall be totally enclosed and permanently lubricated for long life and low maintenance.
- E. Heater shall contain automatic reset thermal overload protector to disconnect power in event of overheating due to accidental blockage.
- F. Heater shall contain built-in fan delay switch to energize fan motor only after elements are heated to prevent discharge of unheated air. When heat shuts off, switch shall de-energize fan motor only after residual heat has been dissipated.
- G. Heater shall contain built-in double-pole disconnect switch for added safety during maintenance.
- H. Electric wall heater shall be wall or recessed model as indicated.
- I. Units shall be furnished for connection to a wall mounted thermostat installed in a lock box.
- J. Provide with terminal strip controls. Coordinate all controls with Siemens Building Technologies.

2.5 MINI-SPLIT SYSTEM UNITS

- A. Manufacturer:
 - 1. Basis of Design: Trane/Mitsubishi
 - 2. Acceptable Substitutes:
 - a. Daikin
 - b. Fujitsu Airstage
- B. Furnish and install Mini-Split system air conditioning units as noted on the plans.
- C. Indoor units shall be wall hung (as shown on plans) and shall include thermostat and condensate pump. Condensate pump shall be supplied by the Mechanical Contractor. The discharge piping shall be by the Plumbing Contractor. The condensate pump shall be powered through the ductless split system.
- D. Outdoor units shall include all standard equipment and controls as well as a wall mounting bracket.
- E. Cooling only unit shall include low ambient control operation down to 0°F. Provide all necessary accessories required to achieve low ambient operation.
- F. Heating and cooling units shall be Heat Pumps with full low ambient heating as scheduled.
- G. Furnish with 5-year warranty for all components including compressors, control boards, etc.
- H. Provide each unit with one spare indoor and outdoor control boards as attic stock.
- I. Provide with BACnet interface for connection to Siemens BAS.
- J. Electrical Contractor wires to the outdoor unit and the Mechanical Contractor wires from the indoor unit to the outdoor unit.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Locate baseboard radiation on outside walls and run cover continuously wall-to-wall unless otherwise indicated. Center elements under windows. Install end caps where units butt against walls.
- C. Install convectors and cabinet heaters as indicated. Coordinate to assure correct recess size for recessed convectors.
- D. Locate unit ventilators as indicated, level and shim units, and anchor to structure. Coordinate exact location of wall louvers. Seal airtight around connection of unit vent/ falseback to wall louvers.
- E. Protect units with protective covers during balance of construction.

3.2 CLEANING

- A. After construction is completed, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.
- B. Touch-up marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.
- C. Install new filters.

END OF SECTION 230835

SECTION 230860 - VENTILATION EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Ceiling and Inline Exhaust Fans
- B. Wall Exhaust Fans
- C. Energy Recovery Ventilators

1.2 REFERENCES

- A. AMCA 99 - Standards Handbook.
- B. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.
- C. AMCA 261 - Directory of Products Licensed to Bear the AMCA Certified Ratings Seal.
- D. NFPA 70 - National Electrical Code.
- E. NFPA 96 - Installation of Equipment for the Removal of Smoke and Grease Vapors from Commercial Cooking Equipment.
- F. UL 705 - Power Ventilators.

1.3 SUBMITTALS

- A. Submit in accordance with provisions of Section 230010.
- B. Product Data: Provide data on fans and accessories including fan curves with specified operating point clearly plotted, sound power levels at rated capacity, and electrical characteristics and connection requirements.

PART 2 - PRODUCTS

2.1 CEILING AND INLINE EXHAUST FANS

- A. Manufacturers:
 - 1. Basis of Design: Greenheck
 - 2. Acceptable Substitutes: Penn Ventilator, Cook
- B. Furnish and install ceiling/inline exhaust fans. Units shall be direct drive models. Fans shall have acoustically insulated housing and shall have maximum sound level ratings as noted. Air deliveries shall be as indicated in the schedule and all fans shall bear the AMCA Certified Ratings Seal for air capacities only and the UL label. Manufacturer shall submit vibration amplitudes and magnetic motor hum levels in decibels. Units shall be equipped with integral backdraft dampers which shall be chatterproof. Fans shall have true centrifugal wheels with inlet perpendicular to or remote from

inlet grille. Ceiling model grilles shall be aerodynamic design of white eggcrate shape and provide 85% free open area. Terminal box shall be provided with cord, plug, and receptacle inside the housing, entire fan, motor, and wheel assembly shall be removable without disturbing the housing. Motors shall be suitably grounded and mounted on rubber-in-shear vibration isolators.

- C. Furnish Lek-Trol variable speed controller.

2.2 WALL PROPELLER FAN

- A. Furnish and install where shown on drawings, Greenheck Model SE steel commercial duty belt drive wall propeller fan or approved equal by Cook or Penn Ventilator.
- B. Fan shall include propellers, adjustable steel anchor angles, steel frame, wall sleeve, mesh screen, OSHA side guard, automatic damper, and weather hood.
- C. Mechanical Contractor shall secure fan with lag screws or anchor bolts and caulk on exterior anchor angles to prevent water entry.

2.3 ENERGY RECOVERY UNIT

- A. Energy Recovery Ventilators shall include a light-weight polymer enthalpy wheel with a permanently bonded silica gel desiccant coating. The wheel design shall consist of removable segments mounted in a stainless-steel rotor and insure laminar flow. Blowers shall be quiet running, forward curved type and enable independent balancing of exhaust and supply airflows by providing separate motors for exhaust and supply blowers with adjustable sheaves. All internal electrical components shall be prewired for single point power connection. Weatherproof disconnect and motor starters shall be supplied as standard components.
- B. Units shall be UL listed and bear the UL Label. Energy transfer ratings shall be in accordance with ASHRAE Standard 84. Ventilators shall bear the AMCA Certified Ratings Seals for air performance.
- C. Housing and internal components shall be constructed of heavy gauge galvanized steel. Housing shall be furnished with 1" rigid board fiberglass insulation with foil facing. All components shall be easily accessible through removable panels for both exhaust and supply compartments. Energy recovery wheel shall be mounted in a slide-out track for ease of inspection, removal and cleaning.
- D. All blower wheels shall be statically and dynamically balanced. Motors shall be permanently lubricated, heavy duty type, matched to the fan load, furnished at the specified voltage, phase and enclosure. Ground and polished steel fan shafts shall be mounted in permanently lubricated, sealed ball bearing pillow blocks. Bearings shall be selected for a minimum (L10) life in excess of 100,000 hours at maximum catalogued operating speeds. Drives shall be sized for a minimum of 150% of driven HP. Pulleys shall be of the fully machined cast type, keyed and securely attached to the wheel and motor shafts.
- E. Provide motorized outside air and exhaust air dampers in units.
- F. Provide MERV 8 filters.
- G. Ventilators shall be Model ERV Interior units as manufactured by Greenheck or accepted substitute by SEMCO or Cook. Provide with top ducted inlets and outlets.
- H. Provide enthalpy sensor with automatic winter override, frost control (timed exhaust), fan VFD's (modulating), stop/jog, wheel control (stop wheel-temp), rotation sensor, and double wall construction with 24-ga galvanized interior liner.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Secure roof exhausters with lag screws to roof curb.
- C. Extend ducts to roof exhausters into roof curb.
- D. Install flexible connections where indicated.
- E. Provide sheaves required for final air balance.
- F. Install backdraft dampers on inlet to roof exhausters.
- G. Provide backdraft dampers on outlet from cabinet and ceiling exhauster fans and as indicated.
- H. Do not operate fans for any purpose until ductwork is clean, filters in place, bearings lubricated, and fan has been test-run under observation.

END OF SECTION 230860

SECTION 230890 - DUCTWORK SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Metal Ductwork
- B. Fabric Ductwork
- C. Duct Cleaning
- D. Air Turning Devices/Extractors
- E. Backdraft Dampers
- F. Duct Access Doors
- G. Fire Dampers
- H. Flexible Duct Connections
- I. Volume Control Dampers
- J. Diffusers
- K. Registers/Grilles

1.2 REFERENCES

- A. ASTM A 90 - Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.
- B. ASTM A 525 - General Requirements for Steel Sheet, Zinc- Coated (Galvanized) by the Hot-Dip Process.
- C. ASTM A 527 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality.
- D. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
- E. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- F. NFPA 96 - Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment.
- G. SMACNA - HVAC Air Duct Leakage Test Manual.
- H. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- I. SMACNA - Fibrous Glass Duct Construction Standards.
- J. UL 181 - Factory-Made Air Ducts and Connectors.

- K. UL 33 - Heat Responsive Links for Fire-Protection Service.
- L. UL 555 - Fire Dampers and Ceiling Dampers.
- M. ASHRAE Handbook - Systems Volume, Chapter "Sound and Vibration Control".
- N. ASHRAE 70 - Method of Testing for Rating the Air Flow Performance of Outlets and Inlets.

1.3 SUBMITTALS

- A. Submit in accordance with provisions of Section 230010.
- B. Ductwork:
 - 1. Shop Drawings:
 - a. Indicate duct fittings, particulars such as gauges, sizes, welds, and configuration prior to start of work for kitchen hood exhaust systems.
 - b. The contractor shall submit for checking and approval, copies of his shop drawings of ductwork for the main trunk duct systems and must receive approval of the Architects before any fabrication upon this ductwork is begun.
 - 2. Product Data: Provide data for duct materials and duct connectors.
- C. Ductwork Accessories:
 - 1. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers, duct access doors, fire dampers, duct silencers, etc.
 - 2. Product Data: Provide for shop fabricated assemblies including volume control dampers, duct access doors, fire dampers, duct silencers, etc.
 - 3. Manufacturer's Installation Instructions: Indicate for fire dampers and combination fire and smoke dampers.
- D. Air Outlets and Inlets:
 - 1. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- B. Test and rate louver performance in accordance with AMCA 500.

1.5 REGULATORY REQUIREMENTS

- A. Construct ductwork to NFPA 90A and NFPA 96 standards.

PART 2 - PRODUCTS

2.1 DUCTWORK MATERIALS

- A. Galvanized Steel Ducts: ASTM A525 and ASTM A527 galvanized steel sheet, lock-forming quality, having G60 zinc coating of in conformance with ASTM A90.

- B. Aluminum Ducts: ASTM B209; aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061- T6 or of equivalent strength.
- C. Stainless Steel Ducts: ASTM A167, Type 304
- D. Insulated Flexible Ducts:
 - 1. Manufacturers:
 - a. Johns Manville Model Micro-Aire J/FLXSL.
 - b. Wiremold Model M-KH.
 - c. Automation Industries Flexible Tubing Div. Model Thermaflex.
 - 2. Flexible round ductwork shall consist of a vinyl coated spring steel helix bonded to a vinyl coated fiberglass liner wrapped with fiberglass wool insulation providing a thermal conductance of 0.23 Btu./hr./sq. ft./0°. Outer jacket shall be reinforced metalized mylar/neoprene laminate. Ducts shall be "Thermaflex" as manufactured by Automation Industries Flexible Tubing Division Type M-KH or type VTKC as manufactured by the Wiremold Company, suitable for an operating temperature from 0°F to 180°F and 2" wg. Clamps, connectors, and the installation shall be as recommended by the manufacturer. Ducts shall be listed by UL under their UL-181 standards as Class 1 air duct and comply with NFPA Standard No. 90A.

2.2 DUCTWORK FABRICATION

- A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- B. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Provide turning vanes in all elbows. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.
- C. Increase duct sizes gradually, not exceeding 15° divergence wherever possible; maximum 30° divergence upstream of equipment and 45° convergence downstream.
- D. Provide standard 45° lateral wye takeoffs unless otherwise indicated where 90° conical tee connections may be used.
- E. Size shall be as follows:
 - 1. Rectangular Duct

<u>Largest Duct Dimension Steel U.S. Standard Gauge</u>	
Up through 12"	26
13" through 30"	24
30" through 54"	22
55" through 84"	20
84" and above	18
 - 2. Round Duct (Exhaust System Only)

<u>Largest Dimension</u>	<u>Steel - U.S. Standard Gauge</u>
Up through 8"	26
9" through 22"	24
23" through 36"	22
37" through 50"	20
 - 3. Round Duct – Spiral – Spiral Lock Seam Type (except Double Wall)

<u>Duct Dimension</u>	<u>Steel US Standard Gauge</u>
Up through 14"	26
15" – 26"	24
27" – 36"	22

<u>Fitting Dimension</u>	<u>Steel US Standard Gauge</u>
Up through 14"	22
15" – 26"	22
27" – 50"	20

2.3 AIR TURNING DEVICES/EXTRACTORS

- A. Multi-blade device with blades aligned in short dimension; steel construction; with individually adjustable blades, mounting straps.

2.4 BACKDRAFT DAMPERS

- A. Gravity Backdraft Dampers, Size 18" x 18" (450 x 450 mm) or Smaller, Furnished with Air Moving Equipment: Air moving equipment manufacturer's standard construction.
- B. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: 16-ga thick galvanized steel, with blades of maximum 6" width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90° stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

2.5 DUCT ACCESS DOORS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.
- B. Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, install minimum 1" (25 mm) thick insulation with sheet metal cover.
 - 1. Less Than 12" Square: Secure with sash locks.
 - 2. Up to 18" Square: Provide two hinges and two sash locks.
 - 3. Up to 24 x 48": Three hinges and two compression latches with outside and inside handles.
 - 4. Larger Sizes: Provide an additional hinge.
- C. Access doors with sheet metal screw fasteners are not acceptable.

2.6 FABRIC DUCTWORK

- A. Furnish and install fabric ductwork system by DuctSox or accepted substitute that complies with all sections of this specification. Fabric Duct shall be Verona series with SkeleCore HIS system.
- B. Product must be Classified by Underwriter's Laboratories in accordance with the 25/50 flame spread / smoke developed requirements of NFPA 90-A and UL 2518.
- C. All product sections must be labeled with the logo and classification marking of Underwriter's Laboratories.
- D. Manufacturer must have documented design support information including duct sizing; vent, orifice, and/or nozzle location; vent, orifice, and/or nozzle sizing; length; and suspension. Parameters for design, including maximum air temperature, velocity, pressure and textile permeability, shall be considered and documented.
- E. Manufacturer must provide a 10 Year Product Warranty for products supplied for the fabric portion of this system as well as a Design and Performance Warranty.

- F. Protect textile air dispersion system and SkeleCore IHS components from damage during shipping, storage, and handling.
- G. SkeleCore IHS (Internal Hoop System): Air diffusers shall be constructed with internal retention system.
 - 1. System shall consist of an internal 360 degree hoop system, spaced 5' on centers.
 - 2. System shall be installed with a one row suspension system located 1.5" above top-dead-center of the textile system.
 - 3. System attachment to U-Track shall be made using Gliders spaced 12".
 - 4. U-Track suspension hardware to include 8' sections of aluminum track, aluminum splice connectors, track endcaps and vertical cable support kits – consisting of a length of cable with cable connectors. Radius aluminum track must be included for all horizontal/flat radius sections.
 - 5. U-Track suspension - Stainless steel cable
- H. Duct shall be Verona by DuctSox
 - 1. Textile Construction: Filament/filament twill polyester, fire retardant in accordance with UL 2518.
 - 2. Air Permeability: 2 (+2/-1) CFM/ft² per ASTM D737, Frazier
 - 3. Weight: 6.2 oz. /yd² per ASTM D3776
 - 4. Warranty: 10 years
- I. Textile Color - Custom color as selected by the Architect.
- J. Textile system to be constructed in modular lengths (zippered) with proper radial securing clips (inlets, endcaps, and mid-sections) and top access zippers for vertical cable safety attachment.
- K. Integrated air dispersion shall be specified and approved by manufacturer as follows:
 - 1. Linear Vents - Air dispersion accomplished by linear vent and permeable fabric. Linear vents must be sized in 1 CFM per linear foot increments (based on .5" SP), starting a 1 CFM through 90 CFM per linear foot. Linear vent is to consist of an array of open orifices rather than a mesh style vent to reduce maintenance requirements of mesh style vents. Linear vents should also be designed to minimize dusting on fabric surface.
 - 2. 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.
 - 3. Inlet connection includes zipper for easy removal / maintenance.
 - 4. Lengths to include required intermediate zippers as specified by manufacturer.
 - 5. 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.
 - 6. End cap includes zipper for easy maintenance.
 - 7. Each section of the textile shall include identification labels documenting order number, section diameter, section length, piece number, code certifications and other pertinent information.
- L. Textile air diffusers shall be designed from 0.25" water gage minimum to 3.1" maximum, with 0.5" as the standard.
- M. Textile air diffusers shall be limited to design temperatures between 0°F and 180°F.
- N. System overall design; diameter, length, airflow, operating static pressure and dispersion shall be designed or approved by the manufacturer.

- O. Install chosen suspension system in accordance with the requirements of the manufacturer. Instructions for installation shall be provided by the manufacturer with product.
- P. Clean air handling unit and ductwork prior to the DuctSox system unit-by-unit as it is installed. Clean external surfaces of foreign substance which may cause corrosive deterioration of facing.
- Q. 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.
- R. If DuctSox systems become soiled during installation, they should be removed and cleaned following the manufacturers standard terms of laundry.

2.7 FIRE DAMPERS

- A. Fabricate in accordance with NFPA 90A and UL 555, and as indicated for dynamic systems.
- B. Ceiling Dampers: Galvanized steel, 22-ga frame and 16- ga flap, two layers 0.125" ceramic fiber on top side, with locking clip.
- C. Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations and closure under air flow conditions. Configure with blades out of air stream. Similar to Ruskin for dynamic conditions.
- D. Fusible Links: UL 33, separate at 160°F with adjustable link straps for combination fire/balancing dampers.

2.8 FLEXIBLE DUCT CONNECTIONS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.
- B. Connector: Fabric crimped into metal edging strip.
- C. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz per sq yd.
 - 1. Net Fabric Width: Approximately 2" (50 mm) wide.
 - 2. Metal: 3" wide, 24-ga (0.6 mm thick) galvanized steel.

2.9 VOLUME CONTROL DAMPERS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.
- B. Single Blade (up to 12" high) – 16-ga blade on rod.
- C. Multi-Blade Damper (over 12" high): Fabricate of opposed blade pattern with maximum blade sizes 8"x72". Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
- D. End Bearings: Except in round ductwork 12" (300 mm) and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.

- E. Quadrants:
 - 1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
 - 2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
 - 3. Where rod lengths exceed 30" provide regulator at both ends.

2.10 RECTANGULAR CEILING DIFFUSERS

- A. Manufacturers:
 - 1. Tuttle & Bailey Model RC
 - 2. Metalaire Series 5000
 - 3. Titus TDV
 - 4. Price SMX/AMS
- B. Type: Square and rectangular, multi-louvered diffuser to discharge air in pattern as indicated on drawings.
- C. Frame: Surface mount type or lay-in grid type.
- D. Fabrication: Steel or aluminum with baked enamel off-white finish.
- E. Accessories: Radial opposed blade damper and multi-louvered equalizing grid with damper adjustable from diffuser face.

2.11 CEILING EXHAUST AND RETURN REGISTERS/GRILLES

- A. Manufacturers:
 - 1. Tuttle & Bailey Agitair Model A70D
 - 2. Acceptable equal by Titus, Metalaire, and Price provided specifications are met.
- B. Type: Streamlined blades, 3/4" minimum depth, 3/4" maximum spacing, with blades set at 45° horizontal face.
- C. Frame: 1-1/4" margin with countersunk screw mounting.
- D. Fabrication: Aluminum extrusions, with color to be selected by the Architect.
- E. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face where not individually connected to exhaust fans.

2.12 WALL EXHAUST AND RETURN REGISTERS/GRILLES

- A. Manufacturers:
 - 1. Tuttle & Bailey, T110
 - 2. Approved equal by Price, Titus, Metalaire
- B. Type: Streamlined blades, 3/4" minimum depth, 3/4" maximum spacing, with spring or other device to set blades, vertical face.
- C. Frame: 1-1/4" margin with countersunk screw mounting.
- D. Fabrication: 20 ga steel frames and 13 ga steel blades, color to be selected by Architect.

- E. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.

2.13 INSTALLATION

- A. Rectangular ductwork shall be galvanized unless otherwise noted.
- B. Install in accordance with manufacturer's instructions.
- C. Install and seal ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- D. Duct Sizes are inside clear dimensions. For lined ducts, maintain sizes inside lining.
- E. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- F. Use double nuts and lock washers on threaded rod supports.
- G. Connect terminal units to supply ducts with 1' maximum length of flexible duct. Do not use flexible duct to change direction.
- H. Connect diffusers to low pressure ducts with 8' maximum length of flexible duct held in place with strap or clamp. (Concealed areas only.)
- I. Connect flexible ducts to metal ducts with adhesive.
- J. Set plenum doors 6 to 12" above floor. Arrange door swings so that fan static pressure holds door in closed position.
- K. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- L. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- M. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- N. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide for cleaning kitchen exhaust ductwork in accordance with NFPA 96. Provide minimum 8"x8" size for hand access, 18"x18" size for shoulder access, and as indicated. Provide 4"x4" for balancing dampers only. Review locations prior to fabrication.
- O. Provide fire dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings, and hinges.
- P. Demonstrate re-setting of fire dampers to Owner's representative.
- Q. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment.

- R. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.
- S. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.
- T. Support duct silencers independent of ductwork.
- U. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.
- V. Install diffusers to ductwork with airtight connection.
- W. Paint ductwork visible behind air outlets and inlets matte black.

2.14 CLEANING

- A. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment which may be harmed by excessive dirt with temporary filters, or bypass during cleaning.

2.15 SHEET METAL WORK

- A. Provide air duct systems as shown on the drawings. Construction methods, unless otherwise specified, shall conform with the recommendations in the latest edition of the ASHRAE Guide. Unless otherwise noted, ductwork shall be galvanized steel.
- B. All ductwork seams and joints shall be caulked with white silicone caulking and taped before caulking compound cures. In lieu of caulk and tape, ductwork may be sealed with Benjamin Foster #30-02 duct seal or Cadoprene #725 installed per manufacturer's instructions.
- C. For use on ductwork 18" size and larger in any dimension, the system shall consist of angles, corners, PCV cleats, gaskets, and corner clips. Install the system in accordance with the manufacturer's instructions and installation manuals. Joints shall meet SMACNA Type "J" connection for Systems 35 and SMACNA Type "E" for System 25. Duct connection system shall be similar to "Ductmate" by Ductmate Industries, Inc.
- D. All branch connections shall be made in a manner that leaves no exposed liner edges.
- E. No pipe or conduit and no hangers for ceilings or piping shall pass through ducts unless it is impossible to avoid doing so, in which case, the approval of the Architect shall be obtained before proceeding with the work.
- F. Should vibrations occur in ductwork while the system is in operation, this contractor shall install such additional stiffening members as are necessary to overcome this vibration. All ductwork where vibration occurs shall be isolated at points of contact with the building by felt pads neatly and securely held in place. The ductwork at a manually or automatically operated damper shall be reinforced to properly support the damper and prevent vibration. Curved elbows shall have a centerline radius of not less than 1-1/2 times the width of the duct.
- G. All work shall be designed and fabricated to keep resistance losses to a minimum. Use gradual transformation and long radius elbows. Where sharp turns are necessary, the elbow or plenum shall be fabricated with vanes concentric with the inside and outside radii.

- H. Where indicated and where required for proper system air balancing, furnish and install opposed blade adjustable volume dampers as hereinafter specified.
- I. Volume dampers are to be key operated opposed blade type and are to be operable from the bottom.

2.16 HANGERS

- A. Ductwork shall be rigidly supported and secured in an approved manner to the structure, reinforced and braced to be free from vibration, rattle, and noise. Hangers shall be securely suspended from structure.
- B. Hanger schedule shall be as follows:
 - 1. Duct up to 20" wide: Galvanized band or strap iron not less than 12-ga not less than 1" wide - 8' centers.
 - 2. Ducts 21" to 36" wide: 1-1/2"x1-1/2"x1/8" angle iron and 3/8" threaded rod-8' centers.
 - 3. Ducts 36" wide: 1-1/2"x1-1/2"x3/16" angle iron and 1/2" threaded rod - 6' centers.

2.17 DUCT ACCESS DOORS AND FIRE DAMPERS

- A. Access doors shall be provided in ductwork and walls and ceilings where required for adjustment of manual dampers and fire dampers. Access doors in walls and/or ceilings shall be furnished by this contractor for installation by others. Access doors must meet fire rating requirements of associated wall or ceiling.
- B. Fire dampers shall in all cases be accessible with suitable means provided for replacing fusible links. Where no other means are available, access doors shall be provided in ductwork.

END OF SECTION 230890

SECTION 230900 - ATC SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes control equipment and installation for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-furnished controls.
- B. See "Sequences of Operation" for requirements that relate to this Section.
- C. The BAS control system shall be extension of the existing Siemens BAS and all controllers and software shall match existing or be latest version of existing.

1.2 DEFINITIONS

- A. DDC: Direct digital controls
- B. IP: Internet Protocol
- C. I/O: Input/Output
- D. LAN: Local area network.
- E. TCP: Transfer Control Protocol
- F. Scope Terminology
 - 1. Provide = Furnish equipment, engineer, program and install
 - 2. Furnish = Furnish equipment, engineer and program
 - 3. Mount = securely fasten to pipe
 - 4. Install = mount and wire
 - 5. Wire = wire only

1.3 SYSTEM DESCRIPTION

- A. The system shall be a direct extension of the existing Siemens Building Automation System on the Garden Spot High School campus.
- B. The Building Automation System (BAS) contractor shall furnish and install a networked system of HVAC controls. The contractor shall incorporate direct digital control (DDC) for HVAC equipment, building ventilation equipment, supplemental heating and cooling equipment, and terminal units.
- C. Provide networking to new DDC equipment using communication standards. The system shall not be limited to only standard protocols, but shall also be able to integrate to a wide variety of third-party devices and applications via drivers and gateways.

1.4 WORK INCLUDED

- A. The installation of the control system shall be performed under the direct supervision of the controls manufacturer with the shop drawings, flow diagrams, bill of materials, component designation, or identification number and sequence of operation all bearing the name of the manufacturer.
- B. Furnish a complete distributed direct digital control system in accordance with this specification section. This includes all system controllers, logic controllers, and all input/output devices. Items of work included are as follows:
 - 1. Provide a submittal that meets the requirements below for approval.
 - 2. Coordinate installation schedule with the Mechanical Contractor.
 - 3. Provide installation of all panels and devices unless otherwise stated.
 - 4. Provide power for panels and control devices.
 - 5. Provide all low voltage control wiring for the DDC system.
 - 6. Provide miscellaneous control wiring for HVAC and related systems regardless of voltage.
 - 7. Provide engineering and technician labor to program and commission software for each system and operator interface. Submit commissioning reports for approval.
 - 8. Participate in commissioning for all equipment that is integrated into the BAS.
 - 9. Provide testing, demonstration and training as specified below.

1.5 SUBMITTALS

- A. Provide submittals for fast track items that need to be approved and released to meet the schedule of the project. Provide submissions for the following items separately:
 - 1. Factory mounting and wiring diagrams and cut sheets.
 - 2. Sequence of operation.
 - 3. Thermostat locations.
- B. Provide a complete submittal with all controls system information for approval before construction starts. Include the following:
 - 1. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
 - 2. Wiring Diagrams: Power, signal, and control wiring.
 - 3. Details of control panel faces, including sizes, controls, instruments, and labeling.
 - 4. Schedule of dampers and actuators including size, leakage, and flow characteristics.
 - 5. If dampers are furnished by others, submit a damper actuator schedule coordinating actuator size with the damper schedule.
 - 6. Schedule of valves including leakage and flow characteristics.
 - 7. Written description of the Sequence of Operations.
 - 8. Network riser diagram showing wiring types, network protocols, locations of floor penetrations and number of control panels. Label control panels with network addresses. Show all routers, switches, hubs and repeaters.
 - 9. Point list for each system controller including both inputs and outputs (I/O), point numbers, controlled device associated with each I/O point, and location of I/O device.
 - 10. Starter and variable frequency drive wiring details of all automatically controlled motors.
- C. Product Data: Include manufacturer's technical literature for each control device indicated, labeled with setting or adjustable range of control. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated. Submit a write-up of the application software that will be used on the operator workstation including revision level, functionality and software applications required to meet the specifications.
- D. Submit a description of the application software that will be used on the operator workstation including revision level, functionality and software applications required to meet the specifications.

- E. Wiring Diagrams: Detail the wiring of the control devices and the panels. Show point-to-point wiring from field devices to the control panel. Show point-to-point wiring of hardwired interlocks. Show a ladder diagram or schematic of wiring internal to the panels, including numbered terminals. Clearly designate wiring that is done at a factory, at a panel shop or in the field.
- F. After the BAS system is approved for construction, submit sample operator workstation graphics for typical systems for approval. Print and submit the graphics that the operator will use to view the systems, change setpoints, modify parameters and issue manual commands. Programming shall not commence until typical graphics are approved.

1.6 QUALITY ASSURANCE

A. Codes

- 1. Perform all wiring in accordance with Division 26, NEC, local codes and Owner's requirements.
- 2. Current State and Local Building Codes.
- 3. 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.
- 4. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilation Systems."
- 5. All equipment shall be UL listed and approved and shall meet with all applicable NFPA standards, including UL 916 - PAZX Energy Management Systems,
- 6. Provide UL 864 – UUKL Smoke Control, where controllers and networks are used for that purpose. Provide written approvals and certifications after installation has been completed.
- 7. All electronic equipment shall conform to the requirements of FCC Regulation, Part 15, Governing Radio Frequency Electromagnetic Interference and be so labeled.
- 8. The manufacturer of the building automation system shall provide documentation supporting compliance with ISO-9002 (Model for Quality Assurance in Production, Installation, and Servicing) and ISO-140001 (The application of well-accepted business management principles to the environment). The intent of this specification requirement is to ensure that the products from the manufacturer are delivered through a Quality System and Framework that will assure consistency in the products delivered for this project.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to unit manufacturer.

1.8 COORDINATION

- A. Coordinate location of thermostats, humidistats, panels, and other exposed control components with plans and room details before installation.
- B. Coordinate power for control units and operator workstation with electrical contractor.
- C. Coordinate scheduling with the mechanical contractor and general contractor. Submit a schedule for approval based upon the installation schedule of the mechanical equipment.
- D. Products Furnished but Not Installed Under This Section
 - 1. Refrigerant Piping
 - a. Pressure and Temperature Sensor Wells and Sockets
 - 2. Sheetmetal accessories
 - a. Dampers
 - b. Airflow Stations

c. Terminal Unit Controls

1.9 WARRANTY

- A. Conform to the warranty requirement of the Contract Documents, General Requirements and this section or a minimum of 12 months.
- B. Warranty shall cover all costs for parts, labor, associated travel, and expenses for a period of one year from completion of system demonstration.
- C. Hardware and software personnel supporting this warranty agreement shall provide on-site or off-site service in a timely manner after failure notification to the vendor. The maximum acceptable response time to provide this service at the site shall be 24 hours.
- D. During normal building occupied hours, failure of items that are critical for system operation shall be provided within 4 hours of notification from the Owner's Representative.
- E. This warranty shall apply equally to both hardware and software.

PART 2 - PRODUCTS

2.1 ACCEPTABLE SYSTEMS

- A. Provide an extension to the existing Siemens BAS system as installed by Siemens Building Technologies industry branch office. Contact David Hebel at 717-254-9208.
- B. The vendors and products listed shall comply with these specifications. It shall not be assumed that standard products and methods will be acceptable without prior approval. Exceptions shall be noted during the bid process and documented in the submittal process.
- C. No Substitutions.

2.2 BUILDING CONTROLLERS (B-BC)

- A. Provide all necessary hardware for a complete operating system as required. The Building Controller shall be able to operate as a standalone panel and shall not be dependent upon any higher level computer or another controller for operation.
- B. Basis of design is Siemens PX Modular and Compact Controllers (PXC).
- C. This level of controller shall be used for the following types of systems:
 - 1. Chiller plant systems
 - 2. Heating plant systems
 - 3. Pumping systems
 - 4. VAV air handlers
 - 5. Air handlers over 15,000 cfm
 - 6. Systems with over 24 input/output points
- D. Computing power and memory minimum:
 - 1. A 32-bit, stand-alone, multi-tasking, multi-user, real-time 100MHz digital control microprocessor module.
 - 2. Inputs shall be 16-bit minimum analog-to-digital resolution
 - 3. Outputs shall be 10-bit minimum digital-to-analog resolution

4. Memory module (24 Megabyte, minimum) to accommodate all Primary Control Panel software requirements, including but not limited to, its own operating system and databases (see Controllers Software section), including control processes, energy management applications, alarm management applications, historical/trend data for points specified, maintenance support applications, custom processes, operator I/O, dial-up communications.
 5. Real time clock and battery
 6. Data collection/ Data Trend module sized for 10,000 data samples.
 7. Flash Memory Firmware: Each Building Level Control Panel shall support firmware upgrades without the need to replace hardware.
- E. Onboard or Modular hardware and connections:
1. Primary Network communication module, if needed for primary network communications.
 2. Secondary Network communication module, if needed for secondary network communications.
 3. RJ45 port 10/100Mbaud
 4. RS485 ports for subnetworks and point expansion
 5. Man to Machine Interface port (MMI)
 6. USB Port
- F. Input and Output Points Hardware
1. Input/output point modules as required including spare capacity.
 2. Monitoring of the status of all hand-off-auto switches.
 3. Monitoring of all industry standard types of analog and digital inputs and outputs, without the addition of equipment to the primary control panel.
 4. Local status indication for each digital input and output for constant, up-to-date verification of all point conditions without the need for an operator I/O device. Each primary control panel shall perform diagnostics on all inputs and outputs and a failure of any input or output shall be indicated both locally and at the operator workstation.
 5. Graduated intensity LEDs or analog indication of value for each analog output.
- G. Code compliance
1. Approvals and standards: UL916; CE; FCC
 2. Provide UL864-UUKL where called for in the sequences of operations.
- H. Accessories:
1. Appropriate NEMA rated metal enclosure.
 2. Power supplies as required for all associated modules, sensors, actuators, etc.
- I. Keypad.
1. Where called for in the sequence of operation, or on the plans, a local keypad and display shall be provided for each controller. The keypad shall be provided for interrogating and editing data. An optional system security password shall be available to prevent unauthorized use of the keypad and display.
- J. The operator shall have the ability to manually override automatic or centrally executed commands at the primary control panels via local, point discrete, on-board hand/off/auto operator override switches. If on board switches are not available, provide separate control panels with HOA switches. Mount panel adjacent to primary control panel. Provide hand/off/auto switch for each digital output, including spares.
- K. Each Building Level Control Panel shall continuously perform self-diagnostics on all hardware modules and network communications. The System Level Control Panel shall provide both local and remote annunciation of any detected component failures, low battery conditions or repeated failure to establish communication with any system.
- L. Panel setup, point definitions and sequencing diagrams shall be backed up on EEPROM memory.

- M. Power loss. In the event of the loss of power, there shall be an orderly shutdown of all Building Controllers to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 30 days.
- N. Building Level control panels shall provide at least two serial data communication ports for operation of operator I/O devices such as industry standard printers, operator terminals, modems and portable laptop operator's terminals. Primary control panels shall allow temporary use of portable devices without interrupting the normal communications, operation of permanently connected modems, printers or terminals.
- O. Building Level Controllers shall have the capability to serve as a gateway between Modbus subnetworks and the BAS. Provide software, drives and programming.
- P. Isolation shall be provided at all primary control panel terminations, as well as all field point terminations to suppress induced voltage transients consistent with IEEE Standards 587-1980.
- Q. Spare Capacity: Provide enough inputs and outputs to handle the equipment shown to be "future" on drawings and 10% more of each point type. Provide all hardware modules, software modules, processors, power supplies, communication controllers, etc. required to ensure adding a point to the spare point location only requires the addition of the appropriate sensor/actuator and field wiring/tubing.
- R. Environment.
 - 1. Controller hardware shall be suitable for the anticipated ambient conditions.
 - 2. Controllers used outdoors and/or in wet ambient conditions shall be mounted within waterproof enclosures and shall be rated for operation at 0°C to 49°C (32°F to 120°F).
 - 3. Controllers used in conditioned space shall be mounted in dust-proof enclosures and shall be rated for operation at 0°C to 49°C (32°F to 120°F).
- S. Immunity to power and noise.
 - 1. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage.
 - 2. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft).
 - 3. Isolation shall be provided at all primary network terminations, as well as all field point terminations to suppress induced voltage transients consistent with:
 - a. RF-Conducted Immunity (RFCI) per ENV 50141 (IEC 1000-4-6) at 3V.
 - b. Electro Static Discharge (ESD) Immunity per EN 61000-4-2 (IEC 1000-4-2) at 8 kV air discharge, 4 kV contact.
 - c. Electrical Fast Transient (EFT) per EN 61000-4-4 (IEC 1000-4-4) at 500V signal, 1 kV power.
 - d. Output Circuit Transients per UL 864 (2,400V, 10A, 1.2 Joule max).
 - 4. Isolation shall be provided at all Building Controller's AC input terminals to suppress induced voltage transients consistent with:
 - a. IEEE Standard 587 1980
 - b. UL 864 Supply Line Transients
 - c. Voltage Sags, Surge, and Dropout per EN 61000-4-11 (EN 1000-4-11)

2.3 APPLICATION SPECIFIC CONTROLLERS

- A. Each Application Level Control Panel shall operate as a stand-alone controller capable of performing its user selectable control routines independently of any other controller in the system. Each application specific controller shall be a microprocessor-based, multi-tasking, real-time digital control processor.

- B. Basis of design is Siemens TEC controller or PTEC for unique applications.
- C. Provide a Application Specific Control Panel for each of the following types of equipment (if applicable):
 - 1. Fan Coil Units
 - 2. Split Systems
 - 3. Electric Heaters
 - 4. Gas Fired Furnaces
 - 5. Exhaust Fans
 - 6. Energy Recovery Units
 - 7. Infrared Heaters
 - 8. Other terminal equipment
- D. Each Application Specific Controller shall, at a minimum, be provided with:
 - 1. Appropriate NEMA rated enclosure
 - 2. Floor Level network communications ability
 - 3. Power supplies as required for all associated modules, sensors, actuators, etc.
 - 4. Software as required for all sequences of operation, logic sequences and energy management routines.
 - 5. A portable operator terminal connection port
 - 6. Auxiliary enclosure for analog output transducers, isolation relays, etc. Auxiliary enclosure shall be part of primary enclosure or mounted adjacent primary enclosure
 - 7. Each controller measuring air volume shall include provisions for manual and automatic calibration of the differential pressure transducer in order to maintain stable control and insuring against drift over time
 - 8. Each controller measuring air volume shall include a differential pressure transducer
 - 9. Approvals and standards: UL916; CE; FCC
- E. Each Application Specific Controller shall continuously perform self-diagnostics on all hardware and secondary network communications. The Application Specific Controller shall provide both local and remote annunciation of any detected component failures, low battery conditions, or repeated failure to establish communication to the system.
- F. Provide each Application Specific Controller with sufficient memory to accommodate point databases, operating programs, local alarming and local trending. All databases and programs shall be stored in non-volatile EEPROM, EPROM and PROM. The controllers shall be able to return to full normal operation without user intervention after a power failure of unlimited duration. Provide uninterruptible power supplies (UPSs) of sufficient capacities for all terminal controllers that do not meet this protection requirement. Operating programs shall be field-selectable for specific applications. In addition, specific applications may be modified to meet the user's exact control strategy requirements, allowing for additional system flexibility. Controllers that require factory changes of all applications are not acceptable.
- G. The Application Specific Controller shall be powered from a 24 VAC source provided by this contractor and shall function normally under an operating range of 18 to 28 VAC (-25% to +17%), allowing for power source fluctuations and voltage drops. Install plenum data line and sensor cable in accordance with local code and NEC. The controllers shall also function normally under ambient conditions of 32 to 122 F (0 to 50 C) and 10% to 95%RH (non-condensing). Provide each controller with a suitable cover or enclosure to protect the intelligence board assembly.

2.4 CONTROL PANELS

- A. Controllers in mechanical rooms shall be mounted in NEMA 1 enclosures.
- B. Mount on walls at an approved location or provide a free standing rack.

- C. Panels shall be constructed of 16 gauge, furniture-quality steel, or extruded-aluminum alloy, totally enclosed, with hinged doors and keyed lock and with ANSI 61 gray polyester-powder painted finish, UL listed. Provide common keying for all panels.
- D. Provide power supplies for control voltage power.
- E. Dedicate 1 power supply to the DDC controller. Other devices shall be on a separate power supply, unless the power for the control device is derived from the controller terminations.
- F. Power supplies for controllers shall be a transformer with a fuse or circuit breaker. Power supplies for other devices can be plain transformers.
- G. All power supplies for 24V low voltage wiring shall be class 2 rated and less than 100VA. If low voltage devices require more amps, then provide multiple power supplies. If a single device requires more amps, then provide a dedicated power supply in a separate enclosure and run a separate, non-class 2 conduit to the device.
- H. Surge transient protection shall be incorporated in design of system to protect electrical components in all DDC Controllers and operator's workstations.
- I. All devices in a panel shall be permanently mounted, including network switches, modems, media converters, etc.
- J. Provide a pocket to hold documentation.

2.5 GENERAL SPECIFICATIONS FOR DEVICES

- A. Provide mounting hardware for all devices, including actuator linkages, wells, installation kits for insertion devices, wall boxes and fudge plates, brackets, etc.
- B. If a special tool is required to mount a device, provide that tool.

2.6 SENSORS

- A. Digital Display temperature sensor specifications – Wired:
 - 1. As called for in the sequences of operations or on the drawings, provide temperature sensors with digital displays.
 - 2. The sensing element for the space temperature sensor must be IC-based and provide the following.
 - a. Digitally communicating with the Application Specific Controller.
 - b. Mountable to and fully covering a 2 x 4 electrical junction box without the need for an adapter wall plate.
 - c. IC Element Accuracy: +/- 0.9°F
 - d. Operating Range: 55 to 95°F
 - e. Setpoint Adjustment Range: User limiting, selectable range between 55 and 95°F
 - f. Display of temperature setpoint with numerical temperature values
 - g. Display of temperature setpoint graphically, with a visual Hotter/Colder setpoint indication
 - h. Calibration: Single point, field adjustable at the space sensor to +/- 5°F
 - i. Installation: Up to 100 ft. from controller
 - j. Auxiliary Communications Port: included
 - k. Local OLED Temperature Display: included
 - l. Display of Temperature to one decimal place
 - m. Temperature Setpoint Adjustment: included

- n. Occupancy Override Function: included
 - 3. Auxiliary Communication Port. Each room temperature sensor shall include a terminal jack integral to the sensor assembly. The terminal jack shall be used to connect a portable operator's terminal to control and monitor all hardware and software points associated with the controller. RS-232 communications port shall allow the operator to query and modify operating parameters of the local room terminal unit from the portable operator's terminal.
 - 4. Provide the following options as they are called for in the sequences or on the drawings:
 - a. Setpoint Adjustment. The setpoint adjustment function shall allow for modification of the temperature by the building operators. Setpoint adjustment may be locked out, overridden, or limited as to time or temperature through software by an authorized operator at any central workstation, Building Controller, room sensor two-line display, or via the portable operator's terminal.
 - b. Override Switch. An override button shall initiate override of the night setback mode to normal (day) operation when activated by the occupant and enabled by building operators. The override shall be limited to two (2) hours (adjustable.) The override function may be locked out, overridden, or limited through software by an authorized operator at the operator interface, Building Controller, room sensor two-line display or via the portable operator's terminal.
 - c. Space Combination Temperature and Humidity Sensors. Each controller performing space temperature control shall be provided with a matching room temperature sensor, which also includes the ability to measure humidity for either monitoring or control purposes. The combination temperature and humidity sensors shall have the same appearance as the space temperature sensors. Humidity elements shall measure relative humidity with a +/- 2% accuracy over the range of 10 to 90% relative humidity. Humidity element shall be an IC (integrated circuit) sensing element. Humidity sensing elements shall be removable and field replaceable if needed.
- B. Temperature Sensors
- 1. All temperature sensors shall meet the following specifications:
 - a. Accuracy: Plus or minus 0.2 percent at calibration point.
 - b. Wire: Twisted, shielded-pair cable.
 - c. Vibration and corrosion resistant
 - 2. Space temperature sensors shall meet the following specifications:
 - a. 10k ohm type 2 thermistors
 - 3. Insertion Elements in Ducts shall meet the following specifications:
 - a. Single point 10k ohm thermister
 - b. Use where not affected by temperature stratification
 - c. The sensor shall reach more than 1/3 the distance from the duct wall
 - d. Junction box for wire splices
 - 4. Averaging Elements in Ducts shall meet the following specifications:
 - a. 72 inches (183 cm) long
 - b. Flexible
 - c. Use where prone to temperature stratification, in front of coils, or where ducts are larger than 9 sq. ft.
 - d. Junction box for wire splices
 - 5. Insertion Elements for Liquids shall meet the following specifications:
 - a. Platinum RTD with 4-20mA transmitter
 - b. Threaded mounting with matching well
 - c. Brass well with minimum insertion length of 2-1/2 inches for pipes up to 4" diameter
 - d. Brass well with insertion length of 6 inches for pipes up to 10" diameter
 - e. Junction box for wire splices
 - 6. Outside-Air Sensors Platinum RTD with 4-20mA transmitter:
 - a. Watertight enclosure, shielded from direct sunlight
 - b. Circulation fan

c. Watertight conduit fitting

- C. Humidity Sensors shall meet the following specifications:
1. Bulk polymer sensor element
 2. Accuracy: 2 percent full range with linear output
 3. Room Sensors: With locking cover matching room thermostats, span of 0 to 100 percent relative humidity
 4. Duct and Outside-Air Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity
- D. Air Static Pressure Transmitter shall meet the following specifications:
1. Non-directional sensor with suitable range for expected input, and temperature compensated.
 2. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
 3. Output: 4 to 20 mA.
 4. Building Static-Pressure Range: 0 to 0.25 inches wg.
 5. Duct Static-Pressure Range: 0 to 5 inches wg.
- E. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; proportional output 4 to 20 mA.
- F. Equipment operation sensors as follows:
1. Status Inputs for Fans: Differential-pressure switch with adjustable range of 0 to 5 inches wg.
 2. Status Inputs for Pumps: Differential-pressure switch piped across pump with adjustable pressure-differential range of 8 to 60 psig.
 3. Status Inputs for direct drive electric motors: Current-sensing relay with current transformers, adjustable and sized for 175 percent of rated motor current.
 4. Status inputs for belt drive electric motors: Current sensing transmitter with linear 4-20mA output
- G. Electronic Damper Position indication: Visual scale indicating percent of travel and 0 to 10 V dc, feedback signal.
- H. Air Differential Pressure Switches: Diaphragm type air differential pressure switches with die cast aluminum housing, adjustable setpoint, minimum 5 amp switch rating at 120VAC, SPDT switches, and the switch pressure range shall be suited for the application. Provide Dwyer or equal. These switches shall be utilized for filter status.
- I. All thermostats shall be mounted in a protective lock box.

2.7 ELECTRONIC ACTUATOR SPECIFICATION

- A. Electronic Damper Actuators
1. Actuator shall be direct coupled (over the shaft), enabling it to be mounted directly to the damper shaft without the need for connecting linkage. The actuator-to-shaft clamp shall use a "V" bolt and "V" shaped, toothed cradle to attach to the damper shaft for maximum holding strength. Single bolt or set screw type fasteners are not acceptable.
 2. Actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator. End switches to deactivate the actuator at the end of rotation or magnetic clutch are not acceptable.
 3. For power-failure/safety applications, a mechanical, spring return mechanism shall be used.
 4. Actuators with spring return mechanisms shall be capable of either clockwise or counterclockwise spring return operation by simply changing the mounting orientation.

5. Proportional actuators shall accept a 2-10VDC, 4-20mA signal, or be of the 2 point floating type and provide a 2-10VDC actuator position feedback signal.
6. All actuators shall have an external manual gear release (clutch) or manual crank to aid in installation and for allowing manual positioning when the actuator is not powered.
7. All actuators shall have an external direction of rotation switch to aid in installation and to allow proper control response.
8. Actuators shall be provided with a factory-mounted 3-foot electrical cable and conduit fitting to provide easy hook-up to an electrical junction box.
9. Actuators shall be listed under Underwriters Laboratories Standard 873 and Canadian Standards Association. They must be manufactured under ISO 9001.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. The project plans shall be thoroughly examined for control device and equipment locations. Any discrepancies, conflicts, or omissions shall be reported to the architect/engineer for resolution before rough-in work is started.
- B. The contractor shall inspect the site to verify that equipment may be installed as shown. Any discrepancies, conflicts, or omissions shall be reported to the engineer for resolution before rough-in work is started.
- C. The contractor shall examine the drawings and specifications for other parts of the work. If head room or space conditions appear inadequate—or if any discrepancies occur between the plans and the contractor's work and the plans and the work of others—the contractor shall report these discrepancies to the engineer and shall obtain written instructions for any changes necessary to accommodate the contractor's work with the work of others.

3.2 ELECTRICAL WIRING SCOPE

- A. This contractor shall be responsible for power that is not shown on the electrical drawings, to controls furnished by this contractor. If power circuits are shown on the electrical drawings, this contractor shall continue the power run to the control device. If power circuits are not shown, this contractor shall coordinate with the electrical contractor to provide breakers at distribution panels for power to controls. This contractor is then responsible for power from the distribution panel.
 1. Coordinate panel locations. If enclosures for panels are shown on the electrical drawings, furnish the enclosures according to the electrician's installation schedule.
- B. This contractor shall not be responsible for power to control panels and control devices that are furnished by others, unless it is part of the control interlock wiring.
- C. Refer to Coordination section for what devices this contractor is responsible to mount and which are turned over to others to mount.
- D. This contractor shall be responsible for wiring of any control device that is furnished as part of this section of specification.
- E. Wiring for controls furnished by others:
 1. Provide control wiring for HVAC controls furnished by others. Wiring may include, but not limited to, interlocks, standalone thermostats, safeties and remote control devices such as valves, sensors, etc.

- F. Interlock wiring shall be run in separate conduits from BAS associated wiring.
- G. Provide network wiring for equipment that is called to be integrated to the BAS.

3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. All low voltage control wiring shall be class 2. Control wiring that is not class 2 shall be run in separate conduits from class 2 wiring.
- B. Floor level network wiring between terminal units can be combined with thermostat and other low voltage wiring in the same conduit. All other network wiring shall be in dedicated conduits.
- C. Install raceways, boxes, and cabinets according to Division 26 Section "Raceways and Boxes."
- D. Install building wire and cable according to Division 26 Section "Conductors and Cables."
- E. Installation shall meet the following requirements:
 - 1. Conceal cable and conduit, except in mechanical rooms and areas where other conduit and piping are exposed.
 - 2. Install exposed cable in raceway or conduit.
 - 3. Install concealed cable using plenum rated cable.
 - 4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
 - 5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
 - 6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
 - 7. All wiring in lab areas shall be in conduit.
 - 8. All unsupported risers shall be rigid steel conduit. Supported risers shall be EMT.
- F. Rigid conduit shall be steel, hot dip galvanized, threaded with couplings, $\frac{3}{4}$ inch minimum size, manufactured in accordance with ANSI C-80-1. Electrical metallic tubing (EMT) with compression fittings or intermediate metallic conduit (IMC) may be used as conduit or raceway where permitted by the NEC.
- G. Concealed control conduit and wiring shall be provided in all spaces except in the Mechanical Equipment Rooms and in unfinished spaces. Install in parallel banks with all changes in directions made at 90 degree angles.
- H. Install conduit adjacent to machine to allow service and maintenance.
- I. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.
- J. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.
- K. Ground equipment.

3.4 COMMUNICATION WIRING

- A. All cabling shall be installed in a neat and workmanlike manner. Follow manufacturer's installation recommendations for all communication cabling.

- B. Do not install communication wiring in raceway and enclosures containing Class 1 wiring.
- C. Maximum pulling, tension, and bend radius for cable installation, as specified by the cable manufacturer, shall not be exceeded during installation.
- D. Contractor shall verify the integrity of the entire network following the cable installation. Use appropriate test measures for each particular cable.
- E. Cable bundling:
 - 1. RS485 cabling run open air in accessible areas can be bundled with other class 2 low voltage cabling.
 - 2. RS485 cabling run between terminal units in conduits above ceilings or under floors or in inaccessible areas can be bundled with other class 2 low voltage cabling.
 - 3. RS485 cabling run between floors shall be in a communication only conduit.
 - 4. RS485 conduit run long distances between utility rooms or between buildings shall be in a communication only conduit.
 - 5. Ethernet cabling shall be in a communication only conduit.
 - 6. Ethernet and RS485 can be run together.
 - 7. Fiber optics can be run with Ethernet and RS485 cabling as long as the conduit is bent to fiber optic standards and junction boxes are sized for fiber optic use.
- F. FLN Cabling
 - 1. FLN cabling shall be low capacitance, 20-24 gauge, twisted shielded pair.
 - 2. The shields shall be tied together at each device.
 - 3. The shield shall be grounded at one end only and capped at the other end.
- G. Ethernet Cabling
 - 1. Ethernet shall not be run with any Class 1 or low voltage Class 2 wiring.
 - 2. CAT6, unshielded twisted pair (UTP) cable shall be used for BAS Ethernet.
 - 3. Solid wire shall be used for long runs, between mechanical rooms and between floors. Stranded cable can be used for patch cables and between panels in the same mechanical room up to 50 feet away.
 - 4. When the BAS Ethernet connects to an Owner's network switch, document the port number on the BAS As-builts.
- H. When a cable enters or exits a building, a lightning arrestor must be installed between the lines and ground. The lightning arrestor shall be installed according to the manufacturer's instructions.
- I. All runs of communication wiring shall be unspliced length when that length is commercially available.
- J. All communication wiring shall be labeled to indicate origination and destination data.
- K. Grounding of coaxial cable shall be in accordance with NEC regulations article on "Communications Circuits, Cable, and Protector Grounding."

3.5 IDENTIFICATION

- A. Match the existing wiring and conduit identification methods.

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove malfunctioning units, replace with new units, and retest.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment, and retest.
 - 3. Calibration test controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
- B. Replace damaged or malfunctioning controls and equipment.
 - 1. Start, test, and adjust control systems.
 - 2. Demonstrate compliance with requirements, including calibration and testing, and control sequences.
 - 3. Adjust, calibrate, and fine tune circuits and equipment to achieve sequence of operation specified.

3.7 SYSTEM CHECKOUT AND STARTUP

- A. Inspect each termination in the MER control panels and devices to make sure all wires are connected according to the wiring diagrams and all termination are tight.
- B. After the controls devices and panels are installed and power is available to the controls, perform a static checkout of all the points, including the following:
 - 1. Inspect the setup and reading on each temperature sensor against a thermometer to verify its accuracy.
 - 2. Inspect the setup and reading on each humidity sensor against a hygrometer to verify its accuracy.
 - 3. Inspect the reading on each CO2 sensor using a calibration kit to verify the sensor range accuracy matches the DDC setup.
 - 4. Inspect the reading of each status switch to verify the DDC reads the open and close correctly.
 - 5. Command each relay to open and close to verify its operation.
 - 6. Command each 2-position damper actuator to open and close to verify operation.
 - 7. Command each 2-position valve to open and close to verify operation.
 - 8. Ramp each modulating actuator to 0%, 25%, 50%, 75% and 100% to verify its operation.
 - 9. Ramp each modulating output signal, such as a VFD speed, to verify its operation.
 - 10. Test each safety device with a real life simulation, for instance check freezestats with ice water, water detectors with water, etc.
- C. Document that each point was verified and operating correctly. Correct each failed point before proceeding to the dynamic startup.
- D. Verify that each DDC controller communicates on its respective network correctly.
- E. After all of the points are verified, and power is available to the mechanical system, coordinate a startup of each system with the mechanical contractor. Include the following tests:
 - 1. Start systems from DDC.
 - 2. Verify that each setpoint can be met by the system.
 - 3. Change setpoints and verify system response.
 - 4. Change sensor readings to verify system response.
 - 5. Test safety shutdowns.
 - 6. Verify time delays.

7. Verify mode changes.
 8. Adjust filter switches and current switches for proper reactions.
 9. Adjust proportional bands and integration times to stabilize control loops.
- F. Perform all program changes and debugging of the system for a fully operational system.
- G. Verify that all graphics at the operator workstations correspond to the systems as installed. Verify that the points on the screens appear and react properly. Verify that all adjustable setpoints and manual commands operate from the operator workstations.
- H. After the sequence of operation is verified, setup the trends that are listed in the sequence of operations for logging and archiving for the commissioning procedure.

3.8 SYSTEM COMMISSIONING, DEMONSTRATION AND TURNOVER

- A. The BAS Contractor shall prepare and submit for approval a complete acceptance test procedure including submittal data relevant to point index, functions, sequence, inter-locks, and associated parameters, and other pertinent information for the operating system. Prior to acceptance of the BAS by the Owner and Engineer, the BAS contractor shall completely test the BAS using the approved test procedure.
- B. After the BAS contractor has completed the tests and certified the BAS is 100% complete, the Engineer shall be requested, in writing, to approve the satisfactory operation of the system, sub-systems and accessories. The BAS contractor shall submit Maintenance and Operating manuals at this time for approval. An acceptance test in the presence of the Engineer and Owner's representative shall be performed. The Owner will then shake down the system for a fixed period of time (30 days).
- C. The BAS contractor shall fix punch list items within 30 days of acceptance.
- D. When the system performance is deemed satisfactory in whole or in part by these observers, the system parts will be accepted for beneficial use and placed under warranty.

3.9 PROJECT RECORD DOCUMENTS

- A. Project Record Documents: Submit three (3) copies of record (as-built) documents upon completion of installation. Submittal shall consist of:
1. Project Record Drawings. As-built versions of the submittal shop drawings provided as AutoCAD compatible files in electronic format and as 11 x 17 inch prints.
 2. Testing and Commissioning Reports and Checklists. Completed versions of reports, checklists, and trend logs used to meet requirements in the Control System Demonstration and Acceptance section of this specification.
 3. Operation and Maintenance (O & M) Manual.
 - a. Operator's Manual with procedures for operating control systems, logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing setpoints and variables.
 - b. Documentation of all programs created using custom programming language, including setpoints, tuning parameters, and object database.
 - c. Graphic files, programs, and database on electronic media.
 - d. List of recommended spare parts with part numbers and suppliers.
 - e. Licenses, guarantees, and warranty documents for equipment and systems.
- B. Provide updated versions of Operating manuals.

3.10 CONTROL OF EXHAUST FANS

- A. Control Type 1: These fans shall be controlled by means of tie-in with wall switch. Provide time delay so that fan operates for 5-60 minutes (selectable) after light switch is turned off.
- B. Control Type 2: These fans shall be controlled by means of wall mounted switches as indicated. Control wiring shall be by ATC Contractor as required.
- C. Points List:
 - 1. On/Off/Automatic
 - 2. Airflow
 - 3. Status
 - 4. Alarm

3.11 CONTROL OF GAS FURNACES

- A. General: The units shall be indexed to the occupied/unoccupied/warm-up positions from the DDC System. Duct smoke detectors (units with a flow of 2000 CFM or greater) mounted in discharge air duct shall, upon sensing alarm conditions completely shut down the unit supply fan and alarm the system.
- B. Warm-Up: The unit fan shall run continuously. The room thermostat shall stage the gas furnace as required to maintain room temperature.
- C. Occupied: The unit fan shall run continuously. A room thermostat shall, on a fall in space temperature, stage the gas furnace heat on to meet the temperature setting. The room thermostat shall, on a rise in space temperature, stage the gas furnace heat off.
- D. Unoccupied: The room thermostat shall cycle the fan to and stage the gas furnace heat to maintain the reduced night setting.
- E. Twinned Units: Where two units serve a single duct system, the gas furnaces shall be controlled as separate heating stages. The lead unit shall alternate weekly to allow for equalized furnace run time.
- F. Points List:
 - 1. On/Off/Automatic
 - 2. Discharge Air Temperature
 - 3. Return Air Temperature
 - 4. Gas Heat Stages
 - 5. Fan Status
 - 6. Air Smoke Detector (Normal/Alarm) – systems over 2000 CFM only
 - 7. Alarm

3.12 CONTROL OF HEAT RECOVERY UNIT

- A. Unit shall run continuously when the gas furnace is in occupied mode and shall de-energize when in the unoccupied or warm up modes. Associated dampers on the unit shall open when the units is energized and close when the unit is de-energized. Discharge air sensor in the supply duct shall shut down the unit on a temperature below 35°F (adjustable).
- B. HRU units shall operate in economizer mode when outside conditions allow.
- C. Points List:
 - 1. On/Off/Automatic

2. Discharge Air Temperature
3. Outdoor Air Inlet Temperature
4. Exhaust Air Discharge Temperature
5. Damper Positions
6. Supply Fan Status
7. Exhaust Fan Status
8. Wheel Status
9. Alarm

3.13 CONTROL OF ELECTRIC WALL WATER HEATERS AND UNIT HEATERS

- A. A temperature sensor shall energize the electric heat stages as required to maintain the desired room temperature setting. For wall heaters, the fan shall be cycled on a call for heat by thermostat.
- B. Thermostats shall be connected to DDC system.
- C. Points List:
 1. On/Off/Automatic
 2. Status
 3. Stages
 4. Alarm

3.14 CONTROL OF INFRARED GAS HEATERS

- A. A temperature sensor shall energize the gas heating section as required to maintain the desired room temperature setting.
- B. Thermostats shall be connected to DDC system.
- C. Points List:
 1. On/Off/Automatic
 2. Status
 3. Alarm

3.15 CONTROL OF DUCTLESS SPLIT SYSTEM UNITS (SS/CU)

- A. General: The units shall be controlled by wall mounted thermostats provided with the unit.
- B. Provide a room temperature sensor connected to the DDC system for monitoring purposes only.

3.16 CONTROL OF DOMESTIC HOT WATER RECIRCULATING PUMPS

- A. Pumps shall be controlled by a strap-on thermostat to maintain the desired hot water temperature in the return line. Pumps shall be tied into new DDC day-night system and shall be energized during the occupied cycle and de-energized during the unoccupied cycle.
- B. Points List:
 1. On/Off/Automatic
 2. Status
 3. Water Temperature
 4. Alarm

END OF SECTION 230900

SECTION 230990 - TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Testing, adjustment, and balancing of air systems.
- B. Testing, adjustment, and balancing of hydronic systems.
- C. Measurement of final operating condition of HVAC systems.

1.2 REFERENCES

- A. AABC - National Standards for Total System Balance.
- B. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.
- C. SMACNA - HVAC Systems Testing, Adjusting, and Balancing.

1.3 SUBMITTALS

- A. Submit in accordance with provisions of Section 230010.
- B. Submit name of adjusting and balancing agency for approval within 30 days after award of Contract.
- C. Field Reports: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
- D. Provide reports in binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include sets of reduced drawings with air outlets and equipment identified to correspond with data sheets and indicating thermostat locations.
- E. Test Reports: Indicate data on Standard AABC or NEBB Forms.

1.4 SEQUENCING

- A. Sequence work to commence after completion of systems and schedule completion of work before Substantial Completion of Project.

PART 2 - PRODUCTS – Not Used

PART 3 - EXECUTION

3.1 AGENCIES

- A. Tab Works
- B. Eastern Air Balance
- C. Flood & Sterling

3.2 EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
 - 1. Systems are started and operating in a safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - 5. Duct systems are clean of debris.
 - 6. Fans are rotating correctly.
 - 7. Fire and volume dampers are in place and open.
 - 8. Air coil fins are cleaned and combed.
 - 9. Access doors are closed, and duct end caps are in place.
 - 10. Air outlets are installed and connected.
 - 11. Duct system leakage is minimized.
- B. Submit field reports. Report defects and deficiencies noted during performance of services which prevent system balance as soon as observed.
- C. Beginning of work means acceptance of existing conditions.

3.3 PREPARATION

- A. Provide instruments required for testing, adjusting, and balancing operations.
- B. Provide additional balancing devices as required.

3.4 INSTALLATION TOLERANCES

- A. Air Handling Systems: Adjust to within $\pm 5\%$ of design for supply systems and $\pm 10\%$ of design for return and exhaust systems.

3.5 ADJUSTING

- A. Ensure recorded data represents actual measured or observed conditions.
- B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- E. Recheck points or areas as selected and witnessed by the Owner.

3.6 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities.
- B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross-sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
- F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50% loading of filters.
- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- K. Where modulating dampers are provided, take measurements and balance at extreme conditions.

END OF SECTION 230990

SECTION 260010 – ELECTRICAL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 GENERAL

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications, apply to all Division 26, 27 & 28 Specification Sections.

1.2 SCOPE OF PROJECT

- A. Provide a complete and operating electrical installation in accordance with these specifications and accompanying contract drawings. This includes all required labor, materials, apparatus, and supervision.

1.3 DESCRIPTIONS OF BASE BID AND ALTERNATE BID

- A. Refer to Section 012300.

1.4 UNIT PRICE ITEMS

- A. Refer to Section 012129 and 012200.

1.5 RULES AND REGULATIONS

- A. Perform in accordance with the rules and regulations of the National Electrical Code (NEC), International Building Code (IBC) and other Codes and Standards cited in this specification and the requirements of the utility companies serving the project site.
- B. Certificates of Approval in triplicate, for rough and finished wiring, from a Certified Inspection Service must be delivered to the Engineer before final payment can be authorized.
- C. Perform all work in accordance with the rules and regulations of the Pennsylvania Department of Labor and Industry, Federal Department of Labor (Occupational Safety and Health Administration) and any other national, state, or local authority having jurisdiction.
- D. Perform all Construction, design, fabrication, tests, rating, and installation in compliance with the regulations of all local, state, or national agencies having jurisdiction over the project. Pay all costs involved in work necessary to comply with these regulations.
- E. The Contractor assumes all responsibility and liability for any code violations, damage or injury which occurs as a result of a deviation from or a change to the requirements of these plans and specifications which has not been approved in writing by the Engineer.
- F. Consider the National Electrical Code, and the other codes and standards cited herein as providing the minimum construction standards for this project. Conform to all additional requirements and limitations contained in these plans and specifications as indicated.
- G. The intent of these drawings and specifications is to define the scope-of-work and standards of quality for the project. The Contractor is responsible for understanding and following the requirements of the codes and standards referenced by these documents. The Contractor shall

be responsible for costs associated with changes when a code enforcement official determines that work does not comply with referenced codes and standards.

1.6 DEFINITIONS

- A. General - Basic Contract definitions are included in the Conditions of the Contract.
- B. Indicated - The term indicated refers to graphic representations, notes, or schedules on the Drawings, or other Paragraphs or Schedules in the Specifications, and similar requirements in the Contract Documents. Terms such as shown, noted, scheduled, and specified are used to help the reader locate the reference. There is no limitation on location.
- C. Directed - Terms such as directed, requested, authorized, selected, approved, required, and permitted mean directed by the Architect, requested by the Architect, and similar phrases.
- D. Approved - The term approved, when used in conjunction with the Architect's action on the Contractor's submittals, applications, and requests, is limited to the Architect's duties and responsibilities as stated in the Conditions of the Contract.
- E. Regulation - The term regulation includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. Furnish - The term furnish means supply and deliver to the Project Site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. Install - The term install describes operations at the Project site including the actual unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. Provide - The term provide means to furnish and install, complete and ready for the intended use.
- I. Contractor - The Contractor or Electrical Contractor - The term means the Contractor responsible for all work under this Division.
- J. Installer - An installer is the Contractor, or another entity engaged by the Contractor, either as an employee, subcontractor, or contractor of lower tier, to perform a particular construction activity, including installation, erection, application, and similar operations. Installers are required to be experienced in the operations they are engaged to perform.
 - 1. The term experienced, when used with the term installer, means having a minimum of five previous projects similar in size and scope to this Project, being familiar with the special requirements indicated, and having complied with requirements of the authority having jurisdiction.
 - 2. Trades - Using terms such as carpentry is not intended to imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as carpenter. It also does not imply that requirements specified apply exclusively to tradespersons of the corresponding generic name.
 - 3. Assigning Specialists - Certain Sections of the Specifications require that specific construction activities be performed by specialists who are recognized experts in those operations. The specialists must be engaged for those activities, and their assignments are requirements over which the Contractor has no choice or option. However, the ultimate responsibility for fulfilling Contract requirements remains with the Contractor.
 - a. This requirement is not to be interpreted to conflict with enforcing building codes and similar regulations governing the Work. It is also not intended to interfere with local trade union jurisdictional settlements and similar conventions.

- K. Project Site is the space available to the Contractor for performing construction activities either exclusively or in conjunction with others performing other work as part of the Project. The extent of the Project site is shown on the drawings and may or may not be identical with the description of the land on which the Project is to be built.
- L. Testing Agencies - A testing agency is an independent entity engaged to perform specific inspections or tests, either at the Project Site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.
- M. AHJ – Authority(ies) Having Jurisdiction
- N. Abbreviations and Names - Trade association names and titles of general standards are frequently abbreviated. The following acronyms or abbreviations, as referenced in Contract Documents, are defined to mean the associated names.
1. AAHTO American Association of State Highway and Transportation Officials
 2. ACI American Concrete Institute
 3. AISC American Institute of Steel Construction
 4. AISI American Iron and Steel Institute
 5. ANSI American National Standards Institute
 6. ASTM American Society for Testing and Materials
 7. AWS American Welding Society
 8. CBM Certified Ballast Manufacturers Assoc.
 9. CRSI Concrete Reinforcing Steel Institute
 10. EIA Electronic Industries Assoc.
 11. ETL ETL Testing Laboratories Inc.
 12. FM Factory Mutual Research Organization
 13. ICEA Insulated Cable Engineers Association, Inc.
 14. IEC International Electrotechnical Commission
 15. IEEE Institute of Electrical and Electronic Engineers
 16. IESNA Illuminating Engineering Society of North America
 17. IMSA International Municipal Signal Association
 18. ISA Instrument Society of America
 19. LPI Lighting Protection Institute
 20. NEC National Electrical Code
 21. NECA National Electrical Contractors Assoc.
 22. NEMA National Electrical Manufacturers Assoc.
 23. NETA International Electrical Testing Assoc.
 24. NFPA National Fire Protection Assoc.
 25. UL Underwriters Laboratories, Inc.
- O. Federal Government Agencies - Names and titles of federal government standard- or Specification-producing agencies are often abbreviated. The following acronyms or abbreviations referenced in the Contract Documents indicate names of standard- or Specification-producing agencies of the federal government. Names and addresses are subject to change but are believed to be, but are not assured to be, accurate and up to date as of the date of the Contract Documents.
1. CFR Code of Federal Regulations
 2. EPA Environmental Protection Agency
 3. FAA Federal Aviation Administration (US Department of Transportation)
 4. FCC Federal Communications Commission
 5. FS Federal Specification (from GSA); Specifications Unit (WFSIS)
 6. MIL Military Standardization Documents (US Department of Defense)
 7. Naval Publications and Forms Center
 8. OSHA Occupational Safety and Health Administration (US Department of Labor)
 9. REA Rural Electrification Administration (US Department of Agriculture)

1.7 DRAWINGS

- A. The accompanying drawings are a part of the contract documents and are intended to show approximate and relative locations of services and equipment. Do not scale drawings to determine exact positions, locations, and clearances.
- B. Due to the diagrammatic layout and small scale of the drawings exact dimensions are not shown. Coordinate location and position of equipment with all other trades and the Engineer. Bring any discrepancies or interferences to the attention of the Architect and/or Engineer for clarification.
- C. All drawings and specifications pertaining to general construction, plumbing, HVAC, kitchen, electrical and other work shall be carefully examined. Where physical interferences with his work occur because of his failure to coordinate with other trade, this Contractor shall rearrange his work at his own expense.
- D. The following electrical abbreviations may or may not be used on this project:
 - A Amperes
 - AC Ceiling/Rooftop Air Conditioner
 - AF Amp Fuse
 - AFC Above Finished Ceiling
 - AFF Above Finished Floor
 - AFG Above Finished Grade
 - AH Air Handler
 - AHAP As High As Possible
 - AIC Asymmetric Interrupting Current
 - APMP Area Protection Monitor Panel
 - ARCH Architect
 - AT Amp Trip
 - ATS Automatic Transfer Switch
 - B Boiler
 - BD Bus Duct
 - BFC Below Finished Ceiling
 - BH Baseboard Heater
 - C Conduit
 - CH Cabinet Heater / Chiller
 - CHL Chiller
 - CP Circulating Pump
 - CT Cooling Tower
 - CU Condensing Unit
 - DB Direct Burial
 - DEH Dehumidifier
 - DH Duct Heater
 - DWG Drawing
 - DWGS Drawings
 - EC Electrical Contractor
 - ECB Enclosed Circuit Breaker
 - ECH Electric Cabinet Heater
 - EDH Electric Duct Heater
 - EL Elevation
 - ELEV Elevator
 - EM Emergency
 - EMT Electrical Metallic Tubing
 - ETR Existing To Remain
 - EWC Electric Water Cooler
 - EX Existing or Existing To Remain, U.O.N.
 - EXR Existing To Be Removed, U.O.N.

FA	Fire Alarm
FAAP	Fire Alarm Annunciator Panel
FACP	Fire Alarm Control Panel
FAEP	Fire Alarm Extender Panel
FC	Fan Coil
FD	Fire Damper
FPV	Fan Powered Variable Air Volume
FDS	Fused Disconnect Switch
FIN. FL.	Finished Floor
FIN.GR.	Finished Grade
FPC	Fire Protection Contractor
GALV	Galvanized
GC	General Trades Contractor
GEN	Generator
GND	Ground
GRC	Galvanized Rigid Steel Conduit
GRD	Ground
HH	Handhole
HP	Heat Pump
HRU	Heat Recovery Unit
HWH	Hot Water Heater
IDF	Intermediate Distribution Frame (Data) / Floor Distributor
IMC	Intermediate Steel Conduit
JB	Junction Box
KEC	Kitchen Equipment Contractor
KVA	Kilovolt Amperes
KW	Kilowatts
MC	Mechanical Contractor
MCB	Main Circuit Breaker
MDF	Main Distribution Frame (Data) / Building Distributor
MDP	Main Distribution Panel
MH	Manhole
MFS	Main Fused Switch
MLP	Main Lug Only
MTGB	Main Telecommunication Grounding Busbar
MTD	Mounted
MTS	Manual Transfer Switch
N	Neutral / Grounded Conductor
NATS	Non-automatic Transfer Switch
N/E	Normal-Emergency
NEC	NFPA 70 – National Electrical Code
NIC	Not In Contract
NFDS	Non-fused Disconnect Switch
NL	Nightlight
PB	Pull Box
PC	Plumbing Contractor
PH	Phase
PNL	Panelboard
PTAC	Packaged Through-the-wall Air Conditioner
RC	Rigging Contractor (Theatrical)
(REF)	Item Shown For Reference Purposes Only, Not Provided by EC, U.O.N.
REF.	Refrigerator
REFRIG	Refrigerator
RFG	Refrigerator
RTU	Roof Top Unit
SD	Smoke Damper

SF	Supply Fan
SWB	Switchboard
TBB	Telecommunication Backbone
TC	Telecommunication/Low Voltage/Systems Contractor
TGB	Telecommunication Ground Busbar
TVSS	Transient Voltage Surge Suppression
TYP	Typical
UH	Unit Heater
UG	Underground
U.O.N.	Unless Otherwise Noted
UON	Unless Otherwise Noted
UV	Unit Ventilator
V	Volts
VA	Variable Air Volume Box
VAV	Fan-powered Variable Air Volume Box
VS	Ventilating and Supply Unit
W	Wire
WC	Water Cooler
WG	Wire Guard
WH	Wall Heater
WP	Weatherproof / Weather Protected
XFMR	Transformer

1.8 SUBMITTAL OF SHOP DRAWINGS FOR REVIEW

- A. Submit shop drawings with a letter of transmittal to the Architect per requirements of the General Conditions and Architects instructions.
- B. Properly prepare submittals before transmitting to the designated reviewer.
 - 1. Prepare an individual submittal package for each related group of materials.
 - 2. Refer to individual 260000 Sections for materials to be submitted for review and approval.
 - 3. Collate all items to be submitted as required by Division 1 consisting of one copy of each item. Permanently bind together by staples or other means all pages in each set.
 - 4. Bind with each set a typed cover sheet showing the date, project name, project location, Engineer's name, Contractor's name, Specification Section, and an index of all items included.
 - 5. Provide space on the cover sheet for the approval stamps of the Subcontractor, Contractor, Engineer, and Architect. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of Products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the Work and Contract Documents.
 - 6. Clearly mark each page in the submittal set to show the manufacturer's name.
 - 7. When a page shows more than one item or catalog number, mark the item and catalog number which is proposed for use. Show all accessories, options and appurtenances which are required or which the Contractor desires to use.
 - 8. Improperly prepared submissions will be returned without action.
- C. All disapproved submittals shall be corrected as directed by the Architect/Engineer and resubmit the same quantity as originally submitted until approved. No work involving any materials or equipment covered by shop drawings shall be started until the respective shop drawings are approved.
- D. All items requiring shop drawing review shall not be installed until final approval has been given by the Architect/Engineer.

1.9 SUBSTITUTIONS

- A. All substitutions must be submitted in accordance with Division 1 requirements.
- B. Substitutions submitted not in accordance with Division 1 requirements will be returned without review.
- C. All costs involved in changes in the building, to the equipment, to the arrangement of equipment, or to the work performed or to be performed under other sections of the specifications, due to the substitution of equipment in lieu of that shown on the drawings or specified, shall be borne by the Contractor making such substitutions, and shall include, but not necessarily be limited to, costs or fees in connection with resubmission of drawings for approval, if required, by the Commonwealth of Pennsylvania, local authorities or insuring agencies having jurisdiction over the work.

1.10 SUBMITTALS FOR CLOSEOUT

- A. Record Drawings: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
 - 1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, Subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the mark-up before enclosing concealed installations.
 - 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Addendum Changes
 - b. Dimensional changes to Drawings.
 - c. Revisions to details shown on Drawings.
 - d. Depths of foundations below first floor.
 - e. Locations and depths of underground utilities.
 - f. Revisions to routing of cable tray and conduits.
 - g. Revisions to electrical circuitry.
 - h. Actual equipment locations.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Construction Change Directive.
 - k. Changes made following Architect's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
 - 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
 - 4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 - 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 - 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
 - 7. Provide one (1) hard copy and one (1) PDF electronic file on digital media acceptable to Architect/Engineer for Owner. Provide one (1) additional PDF electronic file for the Engineer.

- B. O&M Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
 - 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 - 2. File Names and Bookmarks: Enable bookmarking of individual documents based upon file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel upon opening file.
 - 3. Provide two (2) copies of the PDF electronic files on digital media acceptable to Architect/Engineer. One copy shall be for the Owner and the other shall be for the Engineer.
- C. O&M Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.
 - 1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2" x 11" paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders, if necessary, to provide essential information for proper operation or maintenance of equipment or system.
 - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL", Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
 - 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
 - 3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
 - 4. Supplementary Text: Prepared on 8-1/2" x 11" white bond paper.
 - 5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.
 - 6. Provide three (3) hard copies for Owner. Submit to Architect/Engineer for review and approval.
- D. The Contractor shall submit 3 copies of the final wiring certificates.
- E. The Contractor shall submit a copy of the Project Warranty

1.11 WARRANTY

- A. The Contractor shall submit the following guarantee:
 - 1. Written one (1) year full warranty guarantees shall be submitted for the entire electrical installation installed under this project (except lamps). The warranty shall begin at substantial completion of the project. If the manufacturer's warranty begins when the

equipment ships or is ordered, then the Contractor shall extend the warranty to cover the construction period plus the warranty specified under substantial completion. If the manufacturer's standard guarantee provides for a longer period, the longer period shall apply.

2. Where defects in the material, equipment and/or workmanship become evident within this guarantee period, the Contractor shall be responsible for providing new manufacturer approved material and equipment, and/or correcting the defective workmanship without any costs to the Owner.

1.12 INSPECTION

- A. Inspections of electrical work will be made by an agency hired by the Contractor.
- B. Contractor shall pay all inspection fees and submit 3 copies of final wiring certificates to Architect.

1.13 VISIT TO THE SITE

- A. Prior to submission of bid, the Contractor is required to visit the site to become acquainted with existing conditions. Bids as submitted will be interpreted to include all costs and changes made necessary by such conditions. Refer to the pre-bid meeting schedule in invitation to bid.

1.14 COORDINATION OF WORK

- A. Coordination and meetings: Coordinate the installation of all interior and exterior products and systems specified for this construction project including those specified under multiple prime contracts in accordance with Division 1.
- B. Coordination with Various Trades: Contractor shall coordinate space and installation requirements of all work, including underground utilities, which is indicated diagrammatically on drawings, with the project manager, respective contractors, and Utility Company's prior to starting any work. In case of interference or problems, the Architect shall decide which work is to be relocated, regardless of which work is installed first, at no additional cost. See Division 1 General Requirements.
- C. The Contractor shall prepare dimensioned arrangement drawings at a scale of (1/4" - 1") to be utilized by all contractors for coordination. Each contractor shall be required to, and responsible for, adding their respective work to those coordination drawings. Each contractor shall coordinate with all other trades to fit all equipment and materials in allocated space. Completed coordination drawings shall be submitted to Architect/Engineer for review.

1.15 UTILITY COMPANY CONTACTS & COORDINATION

- A. PPL Utilities
- B. Coordinate with each utility which serves the facility being constructed under this contract.
 1. Verify the utility company requirements indicated on Contract Drawings and in the Specifications and adjust as required.
 2. Notify the utility company of the date of completion of those portions of the work which are provided for utility company use.
 3. Make all other notifications requested by the utility.
 4. Provide equipment submittals as necessary for Utility review and approval.
- C. The Owner will pay all utility company service costs.

- D. Contractor to verify with the various Utility Company's exact location of their facilities and exact location for terminating the service conduits before starting any work and adjust as required.

1.16 LOCATION OF EQUIPMENT AND OUTLETS

- A. Request detailed and specific information regarding the locations of all equipment as the final location may differ from that indicated on the drawings.

1.17 MATERIAL QUALITY

- A. Use the best grade and quality items in commercial practice. Provide the manufacturer's name, address, and catalog number on a plate securely affixed in a convenient place. All electrical equipment or apparatus of any one system must be the product of one manufacturer, or equivalent products of a number of manufacturers, which are suitable for use in a unified system.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc., or other testing firms acceptable to the authority having jurisdiction.

1.18 WORKMANSHIP

- A. Execute all work utilizing qualified and competent employees in a manner consistent with good workmanship. Install all equipment in accordance with Engineer's approved shop drawings and manufacturer's recommendations.
- B. Firmly support and secure to the building construction all materials and equipment. Use only approved hardware and methods as described in these Specifications.

1.19 PROTECTION OF EQUIPMENT AND MATERIALS

- A. Responsibility for care and protection of electrical work rests with Contractor until it has been tested and accepted. Refer also to specific requirements in each section of this specification.

1.20 SCAFFOLDING AND HOISTING

- A. The Contractor shall furnish and erect all scaffolding, hoists, shoring, platforms, railings, ladders, and other devices required by local, state, and federal laws to install all systems and equipment. Scaffolding and all other equipment shall be removed at completion of the work.
- B. Contractor shall hoist or rig his own material and equipment into place or arrange for the rigging of it by others at his expense.

1.21 FOREMAN

- A. Contractor must provide a competent foreman, subject to approval of the Architect. The foreman shall be deemed the agent of the Contractor and must be on duty at the building during all working hours.
- B. Any instructions or notices given to the foreman shall have the same force as if given to the Contractor in person.

1.22 EXCAVATION AND BACKFILL

- A. The Electrical Contractor shall provide all excavation and backfilling and all shoring, sheeting, pumping, and other work incidental to excavating as required for the installation of electrical work. Refer to Division 31 & 32.
- B. All repair of macadam or concrete paving made necessary by work done under this contract shall be performed by the Electrical Contractor at the expense of this Contractor as required by the specifications. All such repairs shall match surrounding paving in materials and workmanship. Work shall comply with the appropriate sections of the General Specification.
- C. All grading and seeding made necessary by work done under this contract shall be performed by the Electrical Contractor as required by the specifications. Work shall comply with the appropriate sections of the General Specifications.
- D. All excavation is unclassified unless otherwise noted on the drawings or in Division 31 of the Specifications.
- E. Provide detectable warning tape above all underground services, properly identifying each type of service.

1.23 PAINTING

- A. All painting of electrical components and materials in finished area will be done under the general construction contract. If electrical components are installed after the area is painted or if no painting is scheduled by the General Contractor, the Electrical Contractor shall be responsible to paint the electrical components.
- B. Factory painted and galvanized finishes which are damaged before the Owner occupies the building shall be repaired with matching paint or cold galvanizing compound respectively. Touch-up of factory finishes shall be done by the Electrical Contractor.

1.24 CUTTING AND PATCHING

- A. This Contractor shall be responsible for all cutting and patching required for installation of work on this project. Cutting and patching methods shall conform to the requirements for new construction contained in other sections of this specification.
 - 1. Patching in surfaces that will remain visible when the project is finished shall be identical in appearance to the undisturbed surface.
 - 2. Patches in fire rated walls, ceilings and floors shall maintain the fire rating of these barriers by use of approved materials including special fire rated sealing compounds or materials identical to the barrier materials. Refer to the Architectural Specifications for approved methods and materials.
 - 3. Refer to Division 1 for additional requirements.

1.25 WORK SEQUENCE

- A. Refer to Architectural Drawings and Specifications for Phasing Requirements for this Project and the approved Contractors Phasing Schedule. This Contractor shall plan and coordinate his work in accordance with those requirements. Provide any and all temporary electrical lighting, power and system modifications to keep the occupied areas in service and maintained by the respective contractor.

1.26 CLEANING AND FINISHING

- A. After all tests have been made and the system proven satisfactory to the Architect, the Contractor shall go over the entire project, clean all equipment and material installed by him, and leave in a clean and working condition.

1.27 PERFORMANCE OF EQUIPMENT

- A. Provide materials, equipment, and appurtenances of any kind, shown on the drawings, hereinafter specified, or required for the completion of the work in accordance with the intent of these specifications, which are completely satisfactory and acceptable in operation, performance, and capacity. Approval, either written or verbal, of any drawings, descriptive data or samples of such material, equipment, and/or appurtenance does not relieve the Contractor of his responsibility to turn over the same to the Owner in perfect working order at the completion of the work.
- B. Replace any materials, equipment, or appurtenances, the operation, capacity, or performance of which does not comply with the drawings and/or specification requirements or which is damaged prior to acceptance by the Owner with proper and acceptable items in working order, satisfactory to the Engineer and Architect without additional cost to the Owner.

1.28 ACCESS

- A. Furnish and erect all scaffolding and ladders required in the installation of wiring, equipment, and fixtures.

1.29 ANCHOR BOLTS

- A. Provide and set in place, at the time of pouring of concrete foundations, all necessary anchor bolts as required for the equipment called for under these specifications. Provide anchor bolts of the hook type, of proper size and length to suit the equipment. The Contractor is responsible for proper emplacement of the bolts and must have representative present at the time foundations are poured.

1.30 INSERTS

- A. Where desired in cast in place concrete, provide and install inserts of an approved type. Where two or more parallel conduits are installed, continuous inserts may be used. Where required to distribute the load on the inserts, install a piece of reinforcing steel of sufficient length through the inserts.

1.31 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4" larger, in both directions, than supporting unit. Follow supported equipment manufacturer's anchorage recommendations and setting templates for anchor-bolt and tie locations, unless otherwise indicated. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 3.
- B. Provide minimum 4" high bases for all floor mounted equipment unless noted otherwise.

1.32 ACCESS PANELS

- A. Provide panels with fire ratings equal to the surface in which they are installed and be 12" x 12" or 4" larger than each dimension of the enclosed box, whichever is greater.

1.33 TESTING, ADJUSTING, AND BALANCING

- A. Make all connections at panels and switches; make all splices and taps. Install fuses in all fuse holders. Complete all circuits from power sources to loads at the time of final inspection.
- B. Upon completion of the work, test all parts of the electrical installation to ensure that it is free of unwanted grounds and other defects. Preliminary testing with continuity meters will be permitted but will not be accepted in obtaining final results. Make final tests with a megger.
- C. Check load balance and rearrange connections so that the KW demand on each of the phase conductors does not vary by more than 10%.
- D. Set all overload devices, including equipment furnished under other contracts, and adjust to suit the load conditions. Make selections in accordance with NEC requirements and manufacturer's instructions.
- E. Ensure that all covers, closures, doors, and plates are in place.
- F. Ensure that all trims and covers are adjusted to be parallel or perpendicular to building lines, tight against surrounding architectural finishes, and devices are set flush.
- G. Check devices and controls for proper mechanical and electrical operation and set to normal or appropriate positions at the time of contract closeout.

1.34 EXAMINATION OF CONTRACT DOCUMENTS

- A. Carefully examine the architectural, civil, structural, heat-ventilating - air conditioning, plumbing and sprinkler drawings. If any discrepancies occur between the drawings or between the drawings and the specifications, report such discrepancies to the Engineer and the Architect in writing in a Request For Information (RFI) form and obtain written instructions as to the manner in which to proceed. Make no departures from the contract drawings without prior written approval of the Architect/Engineer.
- B. Report any discrepancies prior to the submission of bid. In the event such discrepancies are not reported and claims for extra charges to the contract result, such claims will be allocated to and paid for by the Contractor, who, in the opinion of the Engineer and the Architect, is the responsible party.

1.35 EQUIPMENT WIRING - GENERAL

- A. Unless otherwise mentioned herein or shown on the drawings, provide power wiring to all equipment, associated controls, and appurtenances. Refer to Specifications Section 260180 for further information on equipment provided under the electrical and other contracts.

1.36 FOOD SERVICE EQUIPMENT

- A. All 15 and 20 ampere receptacles, in kitchens and other areas, for food service equipment shall be of the ground fault (GFCI) type or be fed by a ground fault (GFCI) type breaker. Unless otherwise noted, provide ground fault type receptacles.

1.37 TEMPORARY FACILITIES

- A. Provide temporary electric and lighting as required by Division 1.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 MOUNTING HEIGHTS AND LOCATION

- A. Outlets, controls, and system components shall be mounted at the heights listed below unless otherwise indicated. Heights shall be measured to the centerline of the box from the finished floor unless otherwise noted.
 - 1. Wall Switches: 42"
 - 2. Receptacle Outlet (General): 1'-6" unless indicated otherwise
 - 3. Receptacle Outlet (Mechanical, Storage, Electrical, Unfinished Rooms): 42"
 - 4. Telephone Outlet: 1'-6" unless indicated otherwise
 - 5. Data Outlet: 1'-6" unless indicated otherwise
 - 6. Wall Intercom Station: 46"
 - 7. Raise/Lower Switch: 42"
 - 8. Clock Outlet: 8'-0" when possible. Allow space below ceiling to service or replace. Above doors, center between door trim and ceiling.
 - 9. Bells, Buzzers, Chimes: 8'-0" when possible. Allow space below ceiling to service or replace. Above doors, center between door trim and ceiling.
 - 10. Fire Alarm Devices: Refer to Fire Alarm Section.
 - 11. Television Outlet: 1'-6" unless indicated otherwise.
 - 12. Microphone Inlet: 1'-6" unless indicated otherwise.
 - 13. Receptacles above counters or benches with full height or no backsplashes: 0'-8" above countertop.
 - 14. Range Outlet: Verify location and mounting height with Architect before roughing-in.
 - 15. Water Cooler Outlet: Verify location and mounting height with Plumbing Contractor before roughing-in.
- B. Equipment shall be mounted as follows:
 - 1. Safety Switches: 5'-0" to top of enclosure.
 - 2. Enclosed Circuit Breakers: 5'-0" to top of enclosure.
 - 3. Enclosed Motor Controllers: 5'-0" to top of enclosure.
 - 4. Enclosed Contactors: 5'-0" to top of enclosure.
 - 5. Time Controls: 5'-0" to top of enclosure.
 - 6. Combination Starters: 5'-6" – 6'-0" to top of enclosure.
 - 7. Panelboards: 6'-6" to top of enclosure.
- C. When specifically detailed in the Architectural or Electrical drawings, mounting heights are to be as indicated. Consult architectural plans and elevations for individual areas where device locations may conflict with other work.

- D. In general, coordinate all device locations with approved Casework Drawings, Architectural Elevation, and Drawings, Mechanical, Plumbing, approved Kitchen and Room Equipment Drawings and other applicable drawings.
- E. Locate outlets in commercial kitchens in accordance with approved Food Service Drawings or shop drawings.
- F. In lavatories or rooms with casework or fixed cabinets, coordinate mounting heights and locations in the field with architectural elevations and adjust as required to avoid conflicts with mirrors, back splashes, fixtures, and hardware items.
- G. Field verify the final rough-in location for the actual equipment to be connected.
- H. Lighting Fixtures: As scheduled or indicated.
- I. Throughout new installation, all raceways and boxes shall be installed so that they are concealed in new construction. Any exceptions shall be approved by Architect before installation.

3.2 CEILING TILE REMOVAL

- A. The Contractor shall remove and replace ceiling tile and grid work as required for the installation of electrical work. Damaged tile and grid shall be replaced by the Contractor and shall match the existing ceiling system.

3.3 LINTEL COORDINATION

- A. All electrical sleeves and lintels that need to penetrate NEW walls are to be provided by Electrical Contractor for their work as detailed on the Masonry Lintel Schedule on the Structural Drawings provided to the General Contractor and installed by the General Contractor during construction of walls. If Electrical Contractor does not coordinate prior to construction of walls with the General Contractor, the Contractor is responsible to cut, install, and patch walls for the installation of their sleeves, lintels, and work. Electrical Contractor is also responsible for their own cutting and patching of existing walls and installation of sleeves, lintels to allow for their work.

END OF SECTION 260010

SECTION 260060 – ELECTRICAL DEMOLITION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Electrical Demolition

1.2 RELATED WORK/DIVISIONS

- A. Division 2

1.3 SCOPE

- A. Refer to Drawings for Scope-of-Work

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Provide materials and equipment for patching and extending work approved by Architect/Engineer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that building conditions are as shown on Drawings. Report discrepancies to Architect/Engineer before disturbing existing installation.
- B. Verify that abandoned wiring and equipment serve only abandoned facilities.
- C. Demolition Drawings are based on casual field observation. Report discrepancies to Architect/Engineer before disturbing existing installation.
- D. Beginning of demolition means installer accepts existing conditions.

3.2 COORDINATION

- A. All electrical removals shall be coordinated with the removal and construction schedules of the other contractors working on this project so that the construction schedule may proceed without delays and interferences. Removals shall be complete before new work is started except portions of the removal which are designated for temporary use.
- B. Coordinate with the Mechanical and Plumbing Contractors for exact quantities and location of equipment to be disconnected and removed. The Electrical Contractor is responsible for removal of all electrical items serving mechanical equipment that is to be removed.

- C. Coordinate with the Mechanical and Plumbing Contractors for exact quantities and location of equipment to remain and/or to be relocated. Provide new disconnects, wire and conduits, same size as existing, and reconnect equipment as required.
- D. Maintain electrical service and emergency power system as required during phasing. Provide rework of systems as required.
- E. Removals of system specific equipment shall be performed by installer of such equipment so that a phased switchover of systems is facilitated.

3.3 PREPARATION

- A. Disconnect and remove electrical systems in walls, floors, and ceilings scheduled for removal.
- B. Coordinate utility service outages with Utility Company and Owner.
- C. Provide temporary wiring, supporting devices and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
- D. Maintain the following systems in service until new service is complete and ready for service. When system is to remain provide all rework required to maintain system operational. Systems shall only be disabled to make switchovers and connections. Provide temporary connections to maintain service in areas adjacent to work area. Obtain permission from Architect/Engineer at least 72 hours before partially or completely disabling systems, minimizing outage duration.
 - 1. Electrical Service
 - 2. Telephone Service
 - 3. CATV Service
 - 4. Fiber Service
 - 5. Fire Alarm System
 - 6. Telephone System
 - 7. Television System
 - 8. Computer Network System
 - 9. Security/Card Access Systems
 - 10. Sound Systems
 - 11. Program/Master Clock Systems
 - 12. Generator Systems

3.4 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Demolish and extend existing electrical work under provisions of Division 2 and Division 26.
- B. In areas where existing surfaces and structures are to remain, all electrical equipment and materials designated for removal shall be disassembled where possible and neatly cut where necessary to avoid damaging surfaces and structures. Where damage to existing surfaces and structures occurs, the contractor shall be responsible for repairs using proper materials as specified in other sections of this specification and as directed by the Architect/Engineer.
- C. Where items of equipment or materials are designated to be turned over to the Owner, such equipment and material shall be carefully removed and reassembled or packaged in order to avoid damage and loss of parts. The Contractor shall be responsible for repair of damage and replacement of lost parts.

- D. Demolished equipment and materials shall be removed from the work area by the end of each workday and more frequently when necessary to avoid congestion and hazardous conditions. Demolished equipment and materials shall be removed from the site at least once a week and more frequently when necessary to avoid congestion and hazardous conditions. Materials shall be carefully stacked or boxed as they are removed to avoid the safety hazards associated with cluttered work areas and unstable stacks and piles.
- E. All demolished materials and equipment not designated to be turned over to the Owner shall become the property of the Contractor. The contractor shall dispose of these materials and equipment in accordance with the applicable requirements of local, state, and federal authorities having jurisdiction.
- F. Removals shall be complete and shall include all attachments, brackets, hangers, cables, clamps, hardware, bolts, and screws. Cast in place and expanded anchors do not need to be removed where they are flush with the surface, but protruding studs shall be cut off flush.
- G. Where removals disrupt service to existing circuits and equipment which is to remain, the Contractor shall restore service to the remaining equipment and outlets using the construction methods and materials permitted or required by the appropriate sections of this specification.
- H. Remove, relocate, and extend existing installations as required to accommodate new construction.
- I. Remove abandoned wiring to source of supply.
- J. Remove exposed abandoned conduit, including abandoned conduit and cables above accessible ceiling finishes. Cut conduit to 1" below surface of walls and floors, and patch surfaces.
- K. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit and cables servicing them is abandoned and removed. Remove the backbox and patch/paint the wall to match the existing surfaces.
- L. Disconnect and remove abandoned panelboards and distribution equipment.
- M. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- N. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.
- O. Repair adjacent construction and finishes damaged during demolition and extension work.
- P. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.
- Q. Extend existing installations using materials and methods as specified.
- R. Remove any acoustical tile or ceiling material not removed by other trades, as required for the removal of existing and/or the installation of new electrical equipment. Contractor shall replace all ceiling tiles damaged by him that are to remain. New ceiling tiles shall match existing type. Verify type with Architect before installing.
- S. Repair fire and smoke rated partitions surrounding electrical work as specified. Refer to the Architectural Plans for locations of smoke and fire partitions.

- T. Remove abandoned telecommunications and low voltage cables from terminal to outlet. Remove abandoned outlets and terminal cabinets.
- U. Where demolition of electrical equipment damages existing surfaces that are to remain, restore those surfaces to the same condition as the adjacent surfaces. All patches and repairs shall be subject to review and approval by the Architect. When the Room Finish Schedule shows that a room will be painted under another contract, prime the wall and ceiling patches ready for finish painting. Where room finishes are not part of another contract, prime and paint wall and ceiling patches to match existing surfaces. Blank plates will not be acceptable for removed equipment including flush panelboards.

3.5 POLYCHLORINATED BIPHENYL MATERIAL

- A. Testing:
 - 1. The Contractor shall be responsible for the proper testing of all waste and expendable materials, including PCB fluid in accordance with local, state, federal regulations, ASTM D923 and D4059.
 - 2. All PCB fluids and PCB contained materials shall be transported by an approved hazardous materials company. Receipts and certificates of testing for each container of fluid and contaminated waste shall be provided to the Owner.
- B. Disposal:
 - 1. All ballasts containing PCB's and batteries shall be treated as hazardous waste and be disposed of as regulated by the Environmental protection Agency's Universal Waste Rule. Any state regulations more stringent shall take precedence.
 - 2. All fluorescent and HID lamps shall be treated as hazardous waste and be recycled as regulated by the Environmental Protection Agency's Universal Waste Rule. Any state regulations more stringent shall take precedence.
 - 3. All transformers containing PCB's shall be treated as hazardous waste and be recycled as regulated by the Environmental Protection Agency's Universal Waste Rule. Any state regulations more stringent shall take precedence.
- C. Guarantee: The Contractor shall guarantee that all hazardous materials have been removed from the Owner's property and disposed of properly and that the existing structure is free of contamination by any hazardous materials removed for this project.

3.6 SALVAGE

- A. The items indicated on the drawings shall be carefully removed, protected, and turned over to the Owner in the condition which existed before their removal. The Contractor shall transport the salvaged items with his own manpower to the Owner designated place located on site or re-install the items as shown on the drawings.

3.7 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment which remain or are to be reused.
- B. Reused Luminaires: Provide new lamps, ballasts, lenses and replace all broken electrical parts. Clean entire luminaire as recommended by manufacturer.
- C. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

3.8 INSTALLATION

- A. Install relocated materials and equipment under the provisions of Division 2.

END OF SECTION 260060

SECTION 260180 – EQUIPMENT WIRING SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Electrical Connections to Equipment Specified under other Sections

1.2 RELATED WORK/DIVISIONS

- A. Division 1 – GENERAL REQUIREMENTS
- B. Division 8 – OPENINGS
- C. Division 10 – SPECIALTIES
- D. Division 11 – EQUIPMENT
- E. Division 12 – FURNISHINGS
- F. Division 14 – CONVEYING EQUIPMENT
- G. Division 21 – FIRE PROTECTION
- H. Division 22 – PLUMBING
- I. Division 23 – MECHANICAL

1.3 REFERENCES

- A. ANSI/NFPA 70 – National Electrical Code
- B. NEMA WD 1 – General Purpose Wiring Devices
- C. NEMA WD 6 – Wiring Device Configurations

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc., or a testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

1.5 COORDINATION

- A. Coordinate work under provisions of Section 260010.
- B. Obtain and review shop drawings, product data, and manufacturer's instructions for equipment furnished under other sections.
- C. Verify voltage of equipment matches source before energizing power.

- D. Determine connection locations and requirements.
- E. Sequence rough-in of electrical connections to coordinate with installation schedule for equipment.
- F. Sequence electrical connections to coordinate with start-up schedule for equipment.

1.6 ELECTRICAL EQUIPMENT BY OTHERS

- A. Provide all power and control wiring for products furnished and installed under contracts for Divisions 2 through 14. Switches, pushbuttons, indicator lights and control panels are supplied as part of the equipment package unless otherwise noted on the drawings.
- B. Provide power wiring and disconnect means for kitchen equipment supplied by others. Unless noted otherwise, provide wiring between equipment and starter, and/or disconnect as required for a complete installation. Consult the Architectural, Food Service Equipment (Kitchen), and Electrical Drawings for electrical work to be performed. Provide all necessary wiring and make final connections to all kitchen equipment and to the Kitchen Hood's Fire Suppression System as required by the Food Service Contractor.
- C. Provide power wiring for equipment as provided under the Mechanical (Heating-Ventilating-Air Conditioning) and Plumbing Contracts. Complete all electrical power connections through the disconnect and starter to motor or load terminals. Control wiring and overload protection for this equipment is the responsibility of the Mechanical or Plumbing Contractors. Provide disconnect means for all mechanical and plumbing equipment as follows:
 - 1. Provide disconnect means for all 3-phase equipment. Mount switch adjacent to motor or load terminals.
 - 2. Provide thermal overload switches for all single-phase motors and single-phase equipment. Mount the switch adjacent to the motor or load terminals.
 - 3. Check three phase equipment for proper rotation. Change rotation as required.
- D. Site Sign (Unless otherwise noted on the Drawings):
 - 1. Provide 3#4 + 1#4 gnd in 2" conduit from nearest 120/208V panelboard to site sign and terminate on both ends.
 - 2. Provide fiber optic cable (or as required by sign manufacturer) in 1" conduit from junction box in nearest MDF/IDF closet to site sign and terminate as directed.
 - 3. Verify exact location of site sign with site drawings.
- E. Motorized Coiling Door:
 - 1. Provide fused disconnect switch and wire thru to coiling door.
 - 2. Coordinate size and voltage of disconnect switch with approved shop drawing.
 - 3. Provide all control/safety wiring in 3/4" conduit and install switches furnished with unit.
- F. Motorized Overhead Door:
 - 1. Provide local disconnect switch and wire thru to door.
 - 2. Coordinate size and voltage of disconnect switch with approved shop drawing.
 - 3. Provide all control/safety wiring in 3/4" conduit and install controls furnished with unit.

1.7 DIVISION 21, 22, and 23 POWER REQUIREMENTS

- A. Refer to Mechanical, Plumbing, and Fire Protection Schedules on Drawings and Division 21, 22, and 23 Specifications. For the power requirements which were the basis of design, confirm the actual power before ordering/installing, notify Architect/Engineer.

1.8 COORDINATION OF RESPONSIBILITIES

- A. Division of responsibility between Contractors shall be as indicated below.
- B. The respective contractor shall provide all items of material and equipment for the following:

		DIV 23	DIV 26
1.	ATC System		
	a. Furnish and install unit	X	
	b. All control wiring between panels and remote-control equipment	X	
	c. All low voltage wiring to control devices	X	
	d. 2 Category 6 cables to main panel from nearest IDF/MDF Room		X
	e. Transformers for control	X	
	f. N/E Power Wiring to Main Panel		X
	g. N/E Power to all other Panels	X	

		DIV 23	DIV 26
2.	Split System Air Conditioners (AC)		
	a. Furnish and install unit	X	
	b. Thermal Toggle Switch		X
	c. Power wiring thru starter and disconnect to terminals		X
	d. Control wiring	X	

		DIV 23	DIV 26
3.	Split System Condensing Unit (CU)		
	a. Furnish and install unit	X	
	b. Fused Disconnect Switch		X
	c. Power wiring thru starter and disconnect to terminals		X
	d. Control wiring	X	

		DIV 23	DIV 26
4.	Water Source Heat Pump (HP)		
	a. Furnish and install unit	X	
	b. Starter	X	
	c. Fused Disconnect Switch		X
	d. Power wiring thru disconnect and starter to terminals		X
	e. Control power transformer at starter	X	
	f. Smoke detector connect to building fire alarm system		X
	g. Control Wiring	X	

		DIV 23	DIV 26
5.	Electric Wall Heater (EWH)		
	a. Furnish and install unit	X	
	b. Local Disconnect Switch	X	
	c. Power wiring thru disconnect to unit		X
	d. Control wiring	X	

		DIV 23	DIV 26
6.	Electric Unit Heaters and Electric Cabinet Heaters (EUH) (ECH)		
	a. Furnish and install unit	X	
	b. Fused Disconnect Switch		X
	c. Power wiring thru disconnect to unit		X
	d. Control wiring	X	

		DIV 23	DIV 26
7.	Unit Heaters and Cabinet Heaters (UH) (CH)		
	a. Furnish and install unit	X	
	b. Local Disconnect Switch		X
	c. Power wiring thru disconnect to unit		X
	d. Control wiring	X	

		DIV 23	DIV 26
8.	Pump Packages (CP) (VFD)		
	a. Furnish and install unit	X	
	b. Starter/Disconnect Switch	X	
	c. Power wiring thru starter and disconnect to terminals		X
	d. Control wiring	X	
	e. Control power transformer at starter	X	

		DIV 23	DIV 26
9.	Domestic Hot Water Pumps, Sewage Ejector Pumps and Condensate Pumps (P-X)		
	a. Furnish and install unit	X	
	b. Thermal Toggle Switch/Fused Disconnect Switch		X
	c. Power wiring thru starter and disconnect to terminals		X
	d. Control wiring	X	

		DIV 23	DIV 26
10.	Exhaust Fans, Supply Fans and Propeller Fans (EF) (SF) (PF)		
	a. Furnish and install unit	X	
	b. Thermal Toggle Switch / Fused Disconnect Switch	X	
	c. Power wiring thru wall switch, disconnect switch, starter to unit		X
	d. Control wiring	X	

		DIV 23	DIV 26
11.	Heat Recovery Units (HRU)		
	a. Furnish and install unit	X	
	b. Starter	X	
	c. Fused disconnect switch fused per manufacturer/NEC		X
	d. Power wiring thru disconnect and starter to terminals		X
	e. Control wiring	X	
	f. Smoke detector connected to building fire alarm system		X
	g. Control power transformer at starter	X	

		DIV 23	DIV 26
12.	Blower Coil Air Handlers (AH)		
	a. Furnish and install unit	X	
	b. Starter	X	
	c. Fused Disconnect switch		X
	d. Power wiring thru disconnect and starter to terminals		X
	e. Control wiring	X	
	f. Smoke detector connected to building fire alarm system		X
	g. Control power transformer at starter	X	

		DIV 23	DIV 26
13.	Indoor Air Handlers (AH)		
	a. Furnish and install unit	X	
	b. Starter	X	
	c. Fused Disconnect switch		X
	d. Power wiring thru disconnect and starter to terminals		X
	e. Control wiring	X	
	f. Smoke detector connected to building fire alarm system		X
	g. Control power transformer at starter	X	

		DIV 23	DIV 26
14.	Boilers & Boiler Blend Pumps		
	a. Furnish and install unit	X	
	b. Starter/Controls	X	
	c. Fused disconnect switch fused per manufacturer/NEC		X
	d. Power wiring thru starter to terminals		X
	e. Control wiring	X	
	f. Emergency Boiler shutoff switches at exits	X	

		DIV 22	DIV 26
15.	Water Heaters		
	a. Furnish and install unit	X	
	b. Fused disconnect switch fused per manufacturer/NEC		X
	c. Power wiring thru disconnect to unit		X

		DIV 22	DIV 26
16.	Flush Valves		
	a. Furnish and install unit	X	
	b. 120-volt wiring to transformer for multiple valves		X
	c. Transformer(s)	X	
	d. Low voltage wiring to flush valves	X	

		DIV 22	DIV 26
17.	Lavatory Faucets		
	a. Furnish and install unit	X	
	b. GFI receptacle at unit		X
	c. Transformer(s)	X	
	d. Low voltage wiring to valves	X	

		DIV 23	DIV 26
18.	Paddle Fans		
	a. Furnish and install unit	X	
	b. Furnish Switch (Speed Controls)	X	
	c. Install Switch (Speed Controls)		X
	d. Provide power wiring thru switch (Speed Controls)		X

		DIV 23	DIV 26
19.	Duct Smoke Detectors		
	a. Furnish duct smoke detector base, sampling tube, and weatherproof enclosure (where applicable)		X
	b. Install duct smoke detector base, sampling tube, and weatherproof enclosure (where applicable)	X	
	c. Furnish and install duct smoke detector, fire alarm control relay for AHU shutdown, and remote test station (where applicable)		X
	d. Fire alarm wiring to/from Fire Alarm Control Panel and wiring from relay to AHU controller (for AHU shutdown)		X

- C. The respective contractor shall provide all items of material and equipment for the equipment listed in the matrix.
- D. Any material and equipment not listed in the matrix shall follow the following requirements:
1. Starter/Controls by Division 21/22/23.
 2. Fused disconnect switch by Division 26.
 3. Additional items required by Division 21/22/23.

1.9 ROUGHING-IN REQUIREMENTS

- A. The Contractor shall provide complete roughing-in requirements, including conduit, power, and control wiring, etc. for the following items furnished under Divisions 8, 10, 11, 12, and 14, unless otherwise indicated on the drawings.
1. Motorized Overhead Doors
 2. Motorized Coiling Door
 3. Door Hardware
 4. Kitchen Equipment

5. Hoods
 6. Scoreboards
 7. Gymnasium Equipment & Controls
 8. Site Signs
 9. Ranges
 10. Dryers
 11. Water Coolers
- B. The equipment supplier shall provide wiring (point to point) diagrams where the Electrical Contractor is to make final connections.
- C. Refer to approved shop drawings for roughing-in requirements.
- D. Provide power and interconnecting wiring to all equipment required by the Hardware Manufacturers. Doors shall operate as described in the notes of the Hardware Package.
- E. Contractor is responsible for damaged equipment if it has been connected without consulting the equipment suppliers point to point wiring diagrams.
- F. Throughout new installation, all raceways and boxes shall be installed so that they are concealed in new construction. Any exceptions shall be approved by Architect before installation.

PART 2 - PRODUCTS

2.1 CORDS AND PLUG SETS

- A. Refer to Section 260726

2.2 RACEWAY AND POWER CONDUCTORS

- A. Refer to Sections 260533 and 260519 as appropriate.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that equipment is ready for electrical connection, wiring, and energization.
- B. Verify that all motors rotate in the correct direction. Correct the connections for motors which do not.
- C. Verify that unit requirements match specified circuit sizes. Notify mechanical contractor and engineer of any discrepancies.

3.2 ELECTRICAL CONNECTIONS

- A. Provide electrical connections in accordance with equipment manufacturer's instructions.
- B. Provide conduit connections to equipment using liquidtight flexible metallic conduit. Use liquidtight flexible metallic conduit with watertight connectors in damp or wet locations.

- C. Provide wiring connections using wire and cable with insulation suitable for temperatures encountered in heat producing equipment.
- D. Provide receptacle outlet where connection with attachment plug as indicated or required. Provide cord and cap where field-supplied attachment plug as indicated or required.
- E. Provide suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- F. Install disconnect switches, controllers, control stations, and control devices as indicated or required.
- G. Modify equipment control wiring with terminal block jumpers as indicated or required.
- H. Provide interconnecting conduit and wiring between devices and equipment as indicated or required.
- I. Coolers and Freezers: Cut and seal conduit openings in freezer and cooler walls, floor, or ceilings. Install a conduit seal fitting 24" outside of the refrigerated space and wrap conduit with 1/2" preformed pipe insulation. Fill conduit seal with approved filler compound.
- J. Modify as required for the installation of lug adapters, crimp-on reducers, and hardware, as necessary, to terminate conductors on equipment.

END OF SECTION 260180

SECTION 260519 – ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Conductors and Cables
- B. Metal Clad Cable
- C. Wiring Connectors and Connections

1.2 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code.
- B. NETA - ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment (International Electrical Testing Association).

1.3 SUBMITTALS FOR REVIEW

- A. Submit a letter on company letterhead stating that all equipment is in compliance with the specifications.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years documented experience.

1.5 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc., or a testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

1.6 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Conductor sizes are based on copper. Substitution of aluminum for conductors specified as copper is not permitted.
- C. Conductor sizes are based upon 75°C insulation temperature ratings. When the contractor furnishes equipment that is listed for use with conductors having temperature ratings of less than 75°C, he shall furnish conductors sized in accordance with the 60°C column of NEC Tables 310-16 or 310-17 and the appropriate conduit size.

- D. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet Project Conditions. Include wire and cable lengths within 10' of length shown.
- E. Where wire and cable routing are not shown, and destination only is indicated, determine exact routing and lengths required.

1.7 WARRANTY

- A. Provide the warranty specified in Section 260010.

PART 2 - PRODUCTS

2.1 POWER CONDUCTORS

- A. Description: Single conductor insulated wire.
- B. Conductor: Copper, 98% conductivity minimum.
- C. Insulation Voltage Rating: 600 volts.
- D. Insulation: ANSI/NFPA 70; Type THHN/THWN or XHHW insulation for feeders and branch circuits.

2.2 METAL CLAD CABLE (See Wiring Methods, Paragraph 3.3 of this Section for Restrictions)

- A. Description: ANSI/NFPA 70, Type MC.
- B. Conductor: Copper
- C. Insulation Voltage Rating: 600 volts.
- D. Insulation Temperature Rating: 75°C.
- E. Insulation Material: Thermoplastic
- F. Armor Material: Steel or Aluminum
- G. Armor Design: Interlocked metal tape
- H. Jacket: None

2.3 POWER & CONTROL SIGNAL METAL CLAD CABLE (See Wiring Methods, Paragraph 3.3 of this Section for Restrictions)

- A. Description: ANSI/NFPA 70, Type THHN/THWN power and ground conductors along with a control conductor assembly composed of a 30 mil PVC jacket covering two 16 AWG CU Type TFN control conductors.
- B. Conductor: Copper
- C. Insulation Voltage Rating: 600 volts.

- D. Insulation Temperature Rating: 75°C.
- E. Insulation Material: Thermoplastic
- F. Armor Material: Steel or Aluminum
- G. Armor Design: Interlocked metal tape
- H. Jacket: None
- I. Usage: LED lighting with 0-10V dimming

2.4 WIRING CONNECTORS AND SPLICES

- A. UL-listed, factory-fabricated wiring connectors of size, ampacity rating, material and type and class for application and for service indicated.
- B. All wire connectors shall be manufactured in full compliance with UL 486A.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that interior of building has been protected from weather.
- B. Verify that mechanical work likely to damage wire and cable has been completed.

3.2 PREPARATION

- A. Completely and thoroughly swab raceway before installing wire.

3.3 WIRING METHODS

- A. Concealed Dry Interior Locations: Use only power conductors, type THHN/THWN or XHHW insulation, in raceway.
- B. Exposed Dry Interior Locations: Use only power conductor types THHN/THWN or XHHW insulation, in raceway.
- C. Above Accessible Ceilings:
 - 1. Home Runs: Use only power conductors, Type THHN/THWN or XHHW insulation, in raceway.
 - 2. In Corridors and for Circuits which extend to other rooms: Use only power conductors, type THHN/THWN or XHHW insulation in raceway.
 - 3. Branch Circuits which do not extend beyond the walls of the room: Use power conductors, type THHN/THWN or XHHW insulation in raceway or metal clad cable.
- D. Wet or Damp Interior Locations: Use only power conductors, type THHN/THWN or XHHW insulation, in raceway.
- E. Underground Installations: Use only power conductors, type XHHW in raceway.

- F. Exterior Locations: Use only power conductors, type THHN/THWN or XHHW insulation, in raceway.
- G. Wiring methods indicated on Drawings supersede the General Statements in this Section.
- H. MC Cable is specifically prohibited to penetrate walls to other spaces and prohibited above corridor ceilings other than short (10' or less) connections from raceway junction boxes to light fixtures and equipment.
- I. Throughout new installation, all raceways and boxes shall be installed so that they are concealed in new construction. Any exceptions shall be approved by Architect before installation.
- J. In renovation projects, MC Cable shall be used for existing fishable walls for new recessed devices and equipment. For larger than 30A circuits use flexible metal conduit (Greenfield) with the appropriate conductors.
- K. In underslab branch circuit raceways, there should be no less than one raceway extension installed from electrical device to an above accessible ceiling location terminated in a junction box per room. The intent of this requirement is to give future access to this raceway and circuits.

3.4 INSTALLATION

- A. Install products in accordance with manufacturers' instructions.
- B. Use solid conductor for feeders and branch circuits 10 AWG and smaller.
- C. Use stranded conductors for control circuits.
- D. Use conductor not smaller than 12 AWG for power and lighting circuits.
- E. Use conductor not smaller than 16 AWG for control circuits.
- F. Pull all conductors into raceway at same time.
- G. Use suitable wire pulling lubricant for all building wire.
- H. Protect exposed cable from damage.
- I. Support cables above accessible ceiling, using spring metal clips or metal or plastic cable ties to support cables from structure. Do not support cables from ceiling suspension system. Do not rest cable on ceiling panels.
- J. Modify as required for the installation of lug adapters, crimp on reducers and hardware, as necessary, to terminate conductors on equipment.
- K. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- L. Clean conductor surfaces before installing lugs and connectors.
- M. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

- N. Use split bolt connectors for copper conductor splices and taps No. 6 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150% of insulation rating of conductor.
- O. Use gutter taps for taps from parallel feeder cables.
- P. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
- Q. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
- R. Cover ends of spare conductors with electrical tape.
- S. Conductor Splices: Keep to minimum.
 - 1. Install splices and tapes that possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.
 - 2. Use splice and tap connectors that are compatible with conductor material.
- T. Voltage Drop: All feeders on the project have been sized to limit voltage drop to 2% or less. It shall be the Contractor's responsibility to size branch circuits as necessary, based on their actual lengths, to limit branch circuit voltage drop to 3% or less. This will limit the overall voltage drop at each outlet to the 5% maximum allowed by the National Electrical Code.

3.5 INTERFACE WITH OTHER PRODUCTS

- A. Identify wire and cable under provisions of Section 260553.
- B. Identify each conductor with its circuit number or other designation indicated on Drawings.

3.6 FIELD QUALITY CONTROL

- A. Perform field inspection and testing. Provide a written report of all test results to the Engineer.
- B. Inspect wire and cable for physical damage and proper connection. Replace all conductors and cables with damaged, insulation, sheaths, or jackets.
- C. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values.
- D. Verify continuity of each branch circuit conductor. Provide a written report of all test results to the Engineer.

END OF SECTION 260519

SECTION 260526 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Grounding Electrodes and Conductors
- B. Equipment Grounding Conductors
- C. Bonding

1.2 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code
- B. NPFA 99 - Health Care Facilities
- C. NETA-ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment (International Electrical Testing Association)

1.3 GROUNDING ELECTRODE SYSTEM

- A. Metal underground water pipe if present
- B. Metal frame of the building
- C. Rod electrode
- D. Reinforcing steel in foundation footing when being installed

1.4 PERFORMANCE REQUIREMENTS

- A. Grounding System Resistance: 5 ohms for equipment operation at 601 volts or higher, 25 ohms for equipment operating at 600 volts or less.

1.5 SUBMITTALS FOR REVIEW

- A. Submit a letter on Company letterhead stating that all equipment will be in compliance with the specifications.
- B. Test Report: Indicate overall resistance to ground.

1.6 SUBMITTALS FOR CLOSEOUT

- A. Submit under provisions of Section 260010.
- B. Accurately record actual locations of grounding electrodes.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum three years documented experience.

1.8 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Provide products listed and classified by Underwriters Laboratories, Inc., or a testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

1.9 WARRANTY

- A. Provide the warranty specified in Section 260010.

PART 2 - PRODUCTS

2.1 ROD ELECTRODE

- A. Material: Copper-clad steel.
- B. Diameter: 3/4"
- C. Length: 10'

2.2 MECHANICAL CONNECTORS

- A. Material: Bronze.

2.3 EXOTHERMIC CONNECTIONS

- A. Material: Copper alloy or copper

2.4 WIRE

- A. Material: Stranded copper.
- B. Foundation Electrodes: 4/0 AWG.
- C. Grounding Electrode Conductor: Size to meet NFPA 70 requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that final backfill and compaction has been completed before driving rod electrodes.

3.2 INSTALLATION

- A. Grounding counterpoise: Grounding counterpoise shall consist of three (3) ground rods spaced 8' minimum on center. Rods shall be installed with top of rod 12" below finished grade. Rods shall be interconnected with a #4/0 bare copper electrode with cadweld connections at each ground rod. Provide dedicated 2" conduit for #4/0 bare copper electrode conductor to switchgear ground bus. Locate grounding electrode in a grassy area as close to the building as possible.
- B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- C. Bonding Straps and Jumpers: install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.
- D. Metal Water Service Pipe: Provide insulated copper grounding conductor in 2" conduit from the electrical main service entrance equipment grounding bus to the main metal water service entrances to building. Connect ground bonding conductors to main metal water service pipes by grounding clamp connectors where a dielectric main water fitting is installed, connect ground bonding conductor to street side of fitting. Bond grounding conductor to conduit or sleeve at each end.
- E. Generator Grounding: Provide generator ground per manufacturer and National Electric Code.
- F. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.
- G. Bond each aboveground portion of gas piping system upstream from equipment shutoff valve.
- H. Install Products in accordance with manufacturer's instructions.
- I. Install rod electrodes at locations indicated. Install additional rod electrodes as required to achieve specified resistance to ground.
- J. Provide grounding electrode conductor and connect to reinforcing steel in foundation footing.
- K. Provide bonding to meet Regulatory Requirements.
- L. Provide a grounding bushing and equipment grounding conductor on the terminal end of metallic conduit systems where any of the following conditions occur:
 - 1. A conduit carrying circuit conductors protected by an overcurrent device rated 50 amps or larger is connected to a metallic enclosure by concentric knockouts or reducing washers.
 - 2. Concentric knockout rings or bridges are broken.
 - 3. The enclosure is non-metallic and does not have an integral grounding strap.
 - 4. Conduits stub up through floors and foundations into switchboards, transformers, and other equipment without a metallic wall at the point of entrance.
- M. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus or bushing or terminal.

3.3 CONNECTIONS

- A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
 - 2. Make connections with clean, bare metal at points of contact.
 - 3. Make aluminum-to-steel connections with stainless steel separators and mechanical clamps.
 - 4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
 - 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
- C. All underground bonding connections shall be exothermic-welded connections.
- D. Equipment Grounding Conductor Terminations: For #8 AWG and larger, use pressure-type grounding lugs. #10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
- E. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically non-continuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
- F. Tighten screws and bolts for grounding and bonding 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 and UL 486B.
- G. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
- H. Moisture Protection. If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connections and seal against moisture penetration of insulation and cable.
- I. Provide #8 ground wire in ¾" conduit and connect flammable storage cabinets and acid storage cabinets to building steel. Verify and adjust ground wire size to match manufacturers recommended wire size.
- J. Wire Rod Type Cable Tray (Section 260536): Provide #2 bare copper conductor, entire length of cable tray. Bond at 50' intervals.
- K. Identification: Provide tag on each ground conductor at bus to read as follows: "Caution – Ground Wire – Do not Remove". Provide I.D. marking of all conductors as per N.E.C.

3.4 FIELD QUALITY CONTROL

- A. Perform NETA-ATS testing and inspection of the grounding and bonding system.
- B. Inspect grounding and bonding system conductors and connections for tightness and proper installation.
- C. Use suitable test instrument to measure resistance to ground of system. Perform testing in accordance with test instrument manufacturer's recommendations using the fall- of-potential method. Provide a report of the results of the test of each grounding system. Where several grounding systems are tied together, test each system separately before making the interconnection.

END OF SECTION 260526

SECTION 260529 – HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Conduit and Equipment Supports
- B. Anchors and Fasteners
- C. Cable Supports

1.2 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code
- B. NECA - National Electrical Contractors Association

1.3 SUBMITTALS FOR REVIEW

- A. Submit a letter on Company letterhead stating that all equipment will be in compliance with the specifications.

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc., or a testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

1.5 WARRANTY

- A. Provide the warranty specified in Section 260010.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide supporting devices which comply with manufacturer's standard materials, design, and construction in accordance with published product information, and as required for complete installation; and as herein specified. Where more than one type of supporting device meets indicated requirements, selection is installer's option.

2.2 ANCHORS

- A. Provide anchors of types, sizes and materials indicated, with the following construction features:
 - 1. Toggle Bolts: Springhead; 3/16" x 4".
 - 2. Expansion sleeve anchors by Hilti or Phillips Redhead: 2"

2.3 SLEEVES AND SEALS

- A. Provide sleeves and seals, of types, sizes and materials indicated, with the following construction features:
 - 1. Wall and Floor Seals: Provide factory-assembled watertight wall and floor seals, of types and sizes indicated; suitable for sealing around conduit, pipe, or tubing passing through concrete floors and walls. Construct seals with steel sleeves, malleable iron body, neoprene sealing grommets and rings, metal pressure rings, pressure clamps, and cap screws.
 - 2. Fire-Rated Walls and Floors: At all locations where conduits or cables penetrate a fire-rated wall or floor, provide firestopping in accordance with Division 7.

2.4 U-CHANNEL STRUT SYSTEMS

- A. Provide U-Channel strut system for supporting equipment supplied under this contract, 12-ga hot-dip galvanized steel, or types and sizes indicated with standard green finish, and with the fittings which mate and match with U-Channel.
- B. Auxiliary Steel Supports: Provide all required auxiliary steel to install any equipment supplied under this contract. The design and gauge of steel used shall be as required by the manufacturer's specifications.

2.5 NON-CONTINUOUS CABLE SUPPORTS (J-HOOKS)

- A. Non-continuous cable supports shall provide a bearing surface of sufficient width to comply with required bend radii of high-performance cables.
- B. Non-continuous cable supports shall have flared edges to prevent damage while installing cables.
- C. Non-continuous cable supports 1-15/16" and larger shall have a cable retainer strap to provide containment of cables within the hanger.
- D. Non-continuous cable supports shall have an electro-galvanized finish and be rated for indoor use in non-corrosive environments.
- E. Non-continuous cable supports shall be UL listed, with manufacturer's name and part number stamped on.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Provide anchors, fasteners, and supports in accordance with NECA "Standard of Installation".
- C. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure as required. Do not use spring steel clips and clamps.
- D. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchor on concrete surfaces; sheet metal screws in sheet metal studs; and wood screws in wood construction.

- E. Do not fasten supports to piping, ductwork, mechanical equipment, and conduit.
- F. Do not use powder-actuated anchors.
- G. Obtain permission from Architect before drilling or cutting structural members.
- H. Fabricate supports from structural steel or steel channel, rigidly welded, or bolted to present neat appearance with adequate strength and rigidity. Use hexagon head bolts with spring lock washers under all nuts.
- I. Install surface-mounted cabinets, enclosures, and panelboards with minimum of four anchors.
- J. In wet and damp locations use steel channel supports to stand cabinets and panelboards 1" off wall.
- K. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.
- L. Square cut and deburr all structural steel, strut, threaded rods, and similar items.
- M. Prime and paint all ferrous metals which are not factory finished.
- N. Strut and Hardware Finishes:
 - 1. Indoor dry locations: painted or pre-galvanized.
 - 2. Outdoor and indoor wet locations: post-galvanized.
 - 3. Corrosive locations: PVC coated or fiber reinforced plastic.
 - 4. Pool Environment: aluminum or stainless steel.
- O. Coordinate with other mechanical, plumbing, sprinkler, and electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.
- P. Install hangers, supports, clamps and attachments to support piping properly from building structure. Arrange for grouping of parallel runs of horizontal conduits to be supported together on trapeze type hangers where possible. Install supports in compliance with NEC requirements.
- Q. Torque sleeve seal nuts, complying with manufacturer's recommended values. Ensure that sealing grommets expand to form watertight seal.
- R. Remove burrs from ends of pipe sleeves.
- S. Do not use bridle rings or tie-wraps to support cables. J-hooks are the only acceptable support method.

END OF SECTION 260529

SECTION 260533 – RACEWAYS AND BOXES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Metal Conduit
- B. Flexible Metal Conduit
- C. Liquidtight Flexible Metal Conduit
- D. Electrical Metallic Tubing
- E. Nonmetallic Conduit
- F. Fittings and Conduit Bodies
- G. Wireways
- H. Boxes
- I. Cabinets
- J. Enclosures

1.2 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code
- B. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated
- C. ANSI C80.3 - Electrical Metallic Tubing, Zinc Coated
- D. ANSI C80.6 – Intermediate Metal Conduit, Zinc Coated
- E. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies
- F. NECA “Standard of Installation”
- G. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
- H. NEMA TC 2 - Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80)
- I. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing
- J. NEMA TC 12 - Corrugated Polyvinyl Chloride Coilable Plastic Utilities Duct
- K. UL 94 - Vertical Flame Test

- L. NEMA FB 1 - Fittings and Supports for Conduit and Cable Assemblies
- M. NEMA OS 1 - Sheet-steel Outlet Boxes, Device Boxes, Covers, and Box Supports
- N. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes
- O. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)

1.3 DESIGN REQUIREMENTS

- A. Conduit Size: ANSI/NFPA 70.

1.4 QUALITY ASSURANCE

- A. Fire rated pathways shall bear the UL Classification marking.
- B. Pathways shall be tested in accordance with ASTM E814 (ANSI/UL1479)

1.5 SUBMITTALS FOR REVIEW

- A. Submit a letter on Company letterhead stating that all equipment will be in compliance with the specifications.

1.6 SUBMITTALS FOR CLOSEOUT

- A. Submit under provisions of Section 260010.
- B. Accurately record actual routing of conduits larger than 1" which are installed underground or under a slab on grade.

1.7 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc., or a testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle Products to site under provisions of Section 260010.
- B. Accept conduit on site. Inspect for damage.
- C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- D. Protect non-metallic conduit from sunlight.

1.9 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on Drawings.

- B. Verify routing and termination locations of conduit prior to rough-in.
- C. Conduit routing is shown on Drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

1.10 WARRANTY

- A. Provide the warranty specified in section 260010.

PART 2 - PRODUCTS

2.1 CONDUIT REQUIREMENTS

- A. Minimum Size: 3/4" unless otherwise specified.
- B. Where control devices are provided with 1/2" knockouts or hubs, 3/8" or 1/2" flexible conduit not exceeding 3' in length may be installed between the device and a junction box or conduit fitting.
- C. Underground Installations: Use galvanized rigid steel conduit or nonmetallic conduit as indicated.
 - 1. Minimum Size: 1"
- D. Outdoor Locations, Above Grade: Use galvanized rigid steel conduit or intermediate metal conduit.
- E. Outdoor Locations, Below Grade: Use nonmetallic conduit, concrete encased or stone-dust encased per details on drawings. All elbows shall be long radius steel.
- F. Wet and Damp Locations: Use galvanized rigid steel or intermediate metal conduit.
- G. Dry Locations:
 - 1. Concealed: Use galvanized rigid steel, intermediate metal conduit or electrical metallic tubing.
 - 2. Exposed: Use galvanized rigid steel, intermediate metal conduit or electrical metallic tubing.

2.2 METAL CONDUIT

- A. Galvanized Rigid Steel Conduit (GRC): ANSI C80.1.
- B. Intermediate Metal Conduit (IMC): Rigid steel.
- C. Fittings and Conduit Bodies: ANSI/NEMA FB 1; material to match conduit.

2.3 FLEXIBLE METAL CONDUIT

- A. Description: Interlocked steel construction.
- B. Fittings: ANSI/NEMA FB 1.

2.4 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

- A. Description: Interlocked steel construction with PVC jacket.

- B. Fittings: ANSI/NEMA FB 1.

2.5 ELECTRICAL METALLIC TUBING (EMT)

- A. Description: ANSI C80.3; galvanized tubing.
- B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel or malleable iron, compression type. Indenter type may be substituted for 3/4" size tubing installed in dry locations.

2.6 NONMETALLIC CONDUIT

- A. Description: NEMA TC 2; Schedule 40 PVC.
- B. Fittings and Conduit Bodies: NEMA TC 3.

2.7 WIREWAY

- A. Description:
 - 1. Indoor Use: General Purpose
 - 2. Where Indicated: Oil-tight and Dust-tight
 - 3. Outdoor Use: Rain-tight
- B. Knockouts: Manufacturer's Standard
- C. Size: Size and length as indicated or required for installation.
- D. Cover: Hinged or screw covers. Provide full gasketing on oil-tight wireways.
- E. Connector: Slip-in or flanged.
- F. Fittings: Lay-in type with removable top, bottom, and sides.
- G. Finish: Rust inhibiting primer coating with gray enamel finish or pre-galvanized.

2.8 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
 - 1. Luminaire and Equipment Supporting Boxes: Shape and size shall suit the type of fixture or canopy and be rated for weight of equipment supported; include 1/2" male fixture studs where required.
 - 2. Minimum Depth – 2-1/8"
 - 3. Concrete Ceiling Boxes: Concrete type.
 - 4. Provide 4" square boxes for fire alarm signaling devices and similar devices.
- B. Nonmetallic Outlet Boxes: NEMA OS 2.
- C. Cast Boxes: NEMA FB 1, Type FD, aluminum or cast ferrous alloy. Provide gasketed cover by box manufacturer. Provide boxes with threaded hubs.
- D. Use cast outlet boxes in exterior and wet locations.

2.9 PULL AND JUNCTION BOXES

- A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
 - 1. Cover: Furnish with machine screws.
- B. Surface Mounted Cast Metal Box: NEMA 250, Type 4; flat-flanged, surface mounted junction box:
 - 1. Material: Galvanized cast iron or Cast aluminum.
 - 2. Cover: Furnish with ground flange, neoprene gasket, and stainless-steel cover screws.

2.10 HINGED COVER ENCLOSURES

- A. Manufacturers:
 - 1. Square D
 - 2. Hoffman Engineering
 - 3. Hammond Manufacturing
- B. Construction: NEMA 250, galvanized steel.
- C. Covers: Continuous hinge, held closed by perimeter clamps operated by screws.
- D. Provide interior metal panel for mounting terminal blocks and electrical components finish with white enamel.
- E. Enclosure Finish: Manufacturer's standard enamel.
- F. Provide accessory feet for free standing enclosures.
- G. Enclosure:
 - 1. Interior Dry Locations: Type 1
 - 2. Interior Wet Locations: Type 4
 - 3. Exterior Locations: Type 3R
 - 4. Kitchen: Stainless Steel
 - 5. Dishwashing Rooms/Areas: Stainless Steel

2.11 CABINETS

- A. Manufacturers:
 - 1. Square D Company
 - 2. Hoffman Engineering
 - 3. Hennesy Enclosures
- B. Boxes: Galvanized Steel
- C. Box Size: As indicated or as required to house the indicated quantity of cables and connections plus 20% spare.
- D. Backboard: Provide 3/4" thick plywood backboard for mounting terminal blocks. Paint matte white.
- E. Fronts: Steel, flush or surface type as indicated with concealed trim clamps, concealed hinge, and flush lock keyed to match branch circuit panelboard. Finish with gray baked enamel.
- F. Knockouts: As required.

- G. Provide metal barriers to separate compartments containing control wiring operating at less than 50 volts from power wiring.
- H. Provide accessory feet for free standing equipment.
- I. Enclosure:
 - 1. Interior Dry Locations: Type 1
 - 2. Interior Wet Locations: Type 4
 - 3. Exterior Locations: Type 3R
 - 4. Kitchen: Stainless Steel
 - 5. Dishwashing Rooms/Areas: Stainless Steel

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify locations of floor boxes and outlets prior to rough-in.

3.2 CONDUIT INSTALLATION

- A. Install conduit in accordance with NECA "Standard of Installation" except paragraphs on "Mounting Height".
- B. Install nonmetallic conduit in accordance with manufacturer's instructions.
- C. Arrange supports to prevent misalignment during wiring installation.
- D. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- E. Group related conduits; support using conduit rack. Construct rack using steel channel; provide space on each for 25% additional conduits.
- F. Fasten conduit supports to building structure and surfaces under provisions of Section 260010.
- G. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports
- H. Do not attach conduit to suspended ceiling support wires.
- I. Arrange conduit to maintain headroom and present neat appearance.
- J. Route conduit parallel and perpendicular to walls.
- K. Route conduit installed above accessible ceilings parallel and perpendicular to walls.
- L. Route conduit in stone/gravel fill under slab from point-to-point.
- M. NO CONDUIT SHALL BE INSTALLED VERTICALLY OR HORIZONTALLY IN THE CAVITY SPACE BETWEEN THE BLOCK AND BRICK VENEER AREAS. Conduit penetrations through this cavity are to be installed directly into the back of the recessed flush mounted electrical outlet box/equipment back box. Conduit installations must be installed as required to minimize

interference with the insulation/vapor barrier installations. The conduits shall be installed horizontal, perpendicular through the cavity and located directly at the intended item.

- N. In new construction, unless specifically specified otherwise or approved in writing in advance by Architect, NO exposed conduit will be acceptable in finished spaces.
- O. In underslab branch circuit raceways, there should be no less than one raceway extension installed from electrical device to an above accessible ceiling location terminated in a junction box per room. The intent of this requirement is to give future access to this raceway and circuits.
- P. Provide raceways for all low voltage wiring in open structure ceiling spaces.
- Q. Maintain adequate clearance between conduit and piping.
- R. Maintain 12" clearance between conduit and surfaces with temperatures exceeding 104°F.
- S. Cut conduit square using saw or pipe-cutter; de-burr cut ends.
- T. Bring conduit to shoulder of fittings; fasten securely.
- U. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.
- V. Use conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.
- W. Install no more than equivalent of three 90° bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use factory elbows for bends in metal conduit larger than 2".
- X. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
- Y. Provide suitable fittings to accommodate expansion and deflection where conduit crosses control and expansion joints.
- Z. Provide suitable pull string in each empty conduit except sleeves and nipples.
- AA. Use suitable caps to protect installed conduit against entrance of dirt and moisture.
- BB. Ground and bond conduit and wireways under provisions of Section 260526.
- CC. Identify conduit under provisions of Section 260553.
- DD. Do not install conduits in the topping on precast floor and roof planks and tees.
- EE. Wireway Supports: provide steel channel supports as required or indicated. Mount directly on suitable walls and structural elements.
- FF. Close ends of wireway.
- GG. Throughout new installation, all raceways and boxes shall be installed so that they are concealed in new construction. Any exceptions shall be approved by Architect before installation.

3.3 BOX INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install boxes in accordance with NECA "Standard of Installation" except for mounting heights.
- C. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.
- D. Set wall mounted boxes at elevations to accommodate mounting heights indicated.
- E. Electrical boxes are shown on Drawings in approximate locations unless dimensioned. Adjust box location up to 10' if required to accommodate intended purpose.
- F. Orient boxes to accommodate wiring devices oriented as specified in Section 262726.
- G. Maintain headroom and present neat mechanical appearance.
- H. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- I. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6" from ceiling access panel or from removable recessed luminaire.
- J. All raceway/wiring and outlet box installations shall be installed as needed to meet the Architect's Ceiling, Wall, and Floor ratings. Review with Division 7 and Architect as needed to maintain the established and existing Ceiling, Wall, and Floor Ratings.
- K. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes and beside lavatory partitions, mirrors, lavatory fixtures and changes in architectural finishes.
- L. Locate outlet boxes to allow luminaries positioned as shown on reflected ceiling plan.
- M. Align adjacent wall mounted outlet boxes which are indicated to be mounted at the same height.
- N. Use flush mounting outlet box in finished areas.
- O. Install outlet boxes even with top and bottom of masonry course. Boxes shall be installed flush with no back to back outlet box installations between rooms/areas. Installations shall be coordinated with the GC/Masonry Contractor as needed. Any installation requiring an outlet box rough-in that does not line up with masonry course shall be reviewed with Architect/Engineer before installing.
- P. Outlet boxes shall not be installed back to back between rooms/areas. Provide a minimum of one stud opening space between outlet boxes installed on opposite sides of walls as needed to meet the acoustical and fire rating requirements. Where wall space is limited, and room layout or equipment requires outlet rough-ins to be installed at a closer dimension, review with Architect/Engineer before installing.
- Q. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- R. Use stamped steel bridges to fasten flush mounting outlet box between studs.
- S. Install flush mounting box without damaging wall insulation or reducing its effectiveness.

- T. Use adjustable steel channel fasteners for hung ceiling outlet box.
- U. Do not fasten boxes to ceiling support wires.
- V. Support boxes independently of conduit.
- W. Use gang box where more than one device is mounted together. Do not use sectional box.
- X. Use gang box with plaster ring for single device outlets.
- Y. Use cast outlet box in exterior locations and wet locations.
- Z. Large Pull Boxes: Use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.
- AA. Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner.
- BB. Install cabinet fronts plumb.
- CC. Do not drill or punch cabinets and enclosures except where devices or hardware which have the same NEMA type rating are being installed.
- DD. Mount waterproof enclosures using the holes or brackets furnished by the manufacturer only.
- EE. Provide enclosures for all control devices, pilot devices, timers, starters, contactors, adjustable frequency drives and programmable logic controller.
- FF. Provide cabinets where indicated or as required.
- GG. Throughout new installation, all raceways and boxes shall be installed so that they are concealed in new construction. Any exceptions shall be approved by Architect before installation.

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods under the provisions of Division 7.
- B. Route conduit through roof, wall, floor and ceiling openings and repair as specified in Section 260010.
- C. Low Voltage Wiring: Provide raceways for all wiring in all open structure ceiling spaces.
- D. Indoor Dry Type Transformers: Provide flexible conduits not exceeding 3' in length between the transformer enclosure and the end of all rigid conduits and non-flexible tubing. The flexible conduit shall be installed with a minimum 45° bend in its length.
- E. Motors: Provide flexible conduit not exceeding 4' in length between the motor junction box and the end of all rigid conduit and non-flexible tubing. Provide sufficient slack to permit the motor to be moved over the entire range of adjustment in the motor base and sub-base without stressing the flexible conduit or its connectors.
- F. Other Adjustable Devices: Provide flexible conduit at any device which has electrical connections and is adjusted for proper operation by sliding or rotating the mounting of the device. Provide

flexible conduit of sufficient length to permit the full range of adjustment allowed by the device mounting.

- G. Prewired Furniture: provide liquid-tight metal conduit not exceeding 4' in length between floor/wall box and furniture connection point for power and telecommunications.
- H. At HVAC equipment on trapeze hangers or vibration isolators, provide sufficient length of flexible conduit to accommodate the full range of normal motion without stressing the conduit or transmitting excessive mechanical forces to rigidly mounted conduit or building structures. Install the flexible conduit in such a manner that a 90° bend is included in the length of flexible conduit.
- I. Provide flexible conduits that are of sufficient length so they allow the full range of movement for adjustment and vibration without stressing the flexible conduit or connectors.
- J. Coordinate installation of outlet box for equipment connected under Section 260180.
- K. Throughout new installation, all raceways and boxes shall be installed so that they are concealed in new construction. Any exceptions shall be approved by Architect before installation.

3.5 INTERFACE WITH CONCRETE SLABS

- A. Conduits are not permitted in concrete slabs or elevated slabs for this project.
- B. Concrete Floors on Grade: Install conduits under concrete slabs in stone base.
- C. Concrete Elevated Floors: Install conduits below slab in ceiling plenum of floor below.
- D. Review all underslab conduit interface with Architect/Engineer before installation.

3.6 ADJUSTING

- A. Test, adjust, and balance as required.
- B. Adjust floor box flush with finish flooring material.
- C. Adjust flush-mounting outlets to make front flush with finished wall material.
- D. Install knockout closures in unused box openings.

3.7 CLEANING

- A. Clean interior of boxes to remove dust, debris, and other material.
- B. Clean exposed surfaces and restore finish.

END OF SECTION 260533

SECTION 260543 – UNDERGROUND DUCTS AND RACEWAYS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Conduit
- B. Duct
- C. Metallic Warning Tape
- D. Innerduct
- E. Access Structures:
 - 1. Handholes
 - 2. Transformer Vault

1.2 RELATED WORK/DIVISIONS

- A. Division 3
- B. Division 31

1.3 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code
- B. AASHTO H-20 - Standard Specification for Highway Bridges
- C. ANSI C80.1 - Rigid Steel Conduit, Zinc-Coated
- D. ANSI/ASTM A153 - Zinc Coating (Hot Dip) on Iron and Steel Hardware
- E. ANSI/ASTM A569 - Steel, Sheet and Strip, Carbon (0.15 Maximum Percent), Hot-Rolled, Commercial Quality
- F. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies
- G. ANSI/NFPA 70 - National Electrical Code
- H. ASTM A48 - Gray Iron Castings
- I. ASTM A123 - Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strips
- J. Bellcore TR-TSY 000356 - Optical Cable Duct Liner
- K. NEMA TC 2 - Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80)
- L. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing

- M. NEMA TC 6 - PVC and ABS Plastic Utilities Duct for Underground Installation
- N. NEMA TC 8 - Extra-Strength PVC Plastic Utilities Duct for Underground Installation
- O. NEMA TC 9 - Fittings for ABS and PVC Plastic Utilities Duct for Underground Installation
- P. NEMA TC 10 - PVC and ABS Plastic Communications Duct and Fittings for Underground Installation
- Q. NEMA TC 14 - Filament-Wound Reinforced Thermosetting Resin Conduit and Fittings
- R. PENNDOT 408: Pennsylvania Department of Transportation Form 408 Specification
- S. CMTI – Construction Materials Testing Institute

1.4 SUBMITTALS FOR REVIEW

- A. Submit under provisions of Section 260010.
- B. Shop Drawings: The following items shall be submitted for review and approval:
 - 1. Submittal booklet to include the following:
 - a. Reference to Specification Section.
 - b. A list of all equipment to be provided and installed.
 - c. Data sheets to indicate dimensions, capacities, reinforcement, size, location of openings and accessories.
 - d. Submit manufacturer's certificates on conduit and ducts.
 - e. Submit Utility Company approval letter for transformer foundation.
 - f. Submit Utility Company approval letter for manhole/handholes used in electrical duct system.
 - g. Submit metallic underground warning tape.

1.5 SUBMITTAL FOR CLOSEOUT

- A. Submit under provisions of Section 260010.
- B. Accurately record actual locations of exact routing of ductbank.
- C. Accurately record actual locations of each manhole, handhole, and transformer vault.
- D. Provide maintenance materials.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum three years documented experience.
- B. Manholes, handholes and transformer vault must meet Utility Company requirements.

1.7 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.

- B. Furnish products listed and classified by Underwriters Laboratories, Inc., or a testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle Products to site under provisions of Section 260010.
- B. Accept conduit on site. Inspect for damage.
- C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

1.9 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Verify routing and termination locations of duct bank prior to excavation for rough-in.
- C. Verify locations of access structures prior to excavating for installation.
- D. Duct bank routing is shown on Drawings in approximate locations unless dimensions are indicated. Route as required to complete duct system.
- E. Access structure's locations are shown on Drawings in approximate locations unless dimensions are indicated. Locate as required to complete ductbank system.

1.10 MAINTENANCE MATERIALS

- A. Provide 2 of each special tool required for maintenance.

1.11 WARRANTY

- A. Provide the warranty specified in Section 260010.

PART 2 - PRODUCTS

2.1 RIGID METAL CONDUIT

- A. Rigid Steel Conduit: ANSI C80.1.
- B. Fittings: ANSI/NEMA FB 1; steel.

2.2 PLASTIC CONDUIT

- A. Description: NEMA TC 2; Schedule 40 PVC.
- B. Fittings and Conduit Bodies: NEMA TC 3.

2.3 FABRIC MULTICELL INNERDUCT

- A. Manufacturers: MaxCell Group/TVC Communications, 600 Plum Creek Dr., Wadsworth, OH. 44281, 1-888-387-3828
- B. Materials: White Polyester and Nylon resin polymer
- C. Textile Innerduct: Detectable Outdoor Textile Innerduct: Micro 4-inch multi-cell polyester/nylon textile innerduct with (3) 1.5" inside diameter cells containing 1250lb polyester flat woven pull tape, and a solid copper, polyvinyl color coated conductor (19AWG minimum) for tracing and rated for a minimum of 6 amps and 600 volts. Conductor shall be placed in the sidewall edge fold of the textile sleeve.
- D. Textile Innerduct Fittings
 - 1. Conduit Plugs: Compression-type conduit plugs with locking nuts for sealing and securing one or more textile innerducts within a 4" inside diameter conduit, e.g.:
 - a. 4" plug with nine holes for cables in a 3 pack (9-cell) configuration
 - 2. Termination Bags: Inflation-type bags for sealing and securing around one or more textile innerducts and cables within 2" outside diameter or larger conduit.
- E. Pull Tape: Pull Tape: measuring and pulling tape constructed of synthetic fiber, printed with accurate sequential footage marks. Color-coded.
- F. Penetration Sealing Materials: Duct Water Seal: products suitable for closing underground and entrance conduit openings where innerduct or cable is installed, to prevent entry of gases, liquids, or rodents into the structure.

2.4 HANDHOLES

- A. Material: Glass Fiber reinforced polymer concrete. UL Listed.
- B. Construction: Modular sections. Bottom of box shall be open.
- C. Size: 18" x 18" x 18" unless otherwise indicated or required.
- D. Loading:
 - 1. Driveways, parking lots, and other paved areas subject to heavy vehicular traffic: AASHTO H-20.
 - 2. Provide Tier 22 for all other areas.
- E. Cover: Heavy duty gasketed, minimum coefficient of friction of 0.5.
- F. Logo: Provide cover marked to indicate usage, (Electric, Telecommunications or Site Lighting).
- G. Color: Green or to match surrounding surface. (Verify with Architect)
- H. Hardware: Stainless steel penta-head bolt. Provide two (2) penta-head sockets to Owner.

2.5 PRECAST CONCRETE TRANSFORMER VAULT

- A. Precast Concrete: Air-entrained, 3500 PSI (min) compression strength at 28 days.
- B. Size: 7'-0" x 7'-0" x 4'-6" precast transformer vault or as required by Utility Company. (Verify)

- C. Provide precast transformer vault top with 4'-0" x 2'-6" cable opening in front side.
- D. Provide tongue and groove construction seals top to base.
- E. Provide 2'-8" x 5'-6" conduit knockout area on all 4 sides of vault.

2.6 UNDERGROUND-LINE WARNING TAPE

- A. Tape:
 - 1. Recommended by manufacturer for method of installation and suitable to identify and locate underground electrical and 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 degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
- B. Color and Printing:
 - 1. Inscriptions for Red-Colored Tapes: ELECTRIC LINE HIGH VOLTAGE
 - 2. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE
- C. Type:
 - 1. Detectable, 3-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
 - 2. Overall Thickness: 5 mils
 - 3. Foil Core Thickness: 0.35 mils
 - 4. Weight: 28 lb/1000 sqft
 - 5. 3" Tensile according to ASTM D 882: 70 lbf, and 4600 psi

2.7 MATERIALS FOR ENCASEMENT

- A. Provide concrete for encasement of duct banks under the provisions of Division 3 with a minimum compressive strength of 2500 psi and a maximum slump of 4". Plasticizers to increase the slump to 6" may be added after the unmodified slump has been verified. Maximum aggregate size 3/8".
- B. Stonedust

2.8 FLOWABLE FILL

- A. Provide flowable fill containing, at a minimum, cementitious materials, and water. Cementitious materials shall be Portland cement, pozzolanic materials, or other self-cementing materials, or combinations thereof, at the contractor's option, and following approval by the Architect/Engineer. The flowable fill mix design may also contain, fine aggregate or filler, and/or chemical admixtures in any proportions such that the final product meets the strength, flow consistency and shrinkage requirements included in this specification, as approved by the Architect/Engineer.
- B. Portland Cement: ASTM C150, Type 1 or Type 2, meeting PADOT standards.
- C. Mixing Water: Fresh, clean, and potable, PADOT standards for use as mix-water for cast-in-place concrete.
- D. Air-Entraining Admixture: ASTM C260.

E. Chemical Admixtures: ASTM C494.

F. Aggregate: ASTM C33.

2.9 FLOWABLE FILL MIXTURE:

A. Mix design shall produce a consistency that will result in a flowable product at the time of placement which does not require manual means to move it into place.

B. Excavatable Flowable Fill:

1. Type 1 Portland Cement: 50-100 lbs/cy
2. Fly Ash: 250-600 lbs/cy
3. Air: 15-35%
4. Unit Weight, wet: 90-100 lbs/cf
5. Unit Weight, wet: 100- 125 lbs/cf
6. Water: Mix water as necessary to produce a consistency that will result in a flowable, self-leveling product at the time of placement.
7. 28 Day compressive strength: 150psi max

C. Non- Excavatable Flowable Fill:

1. Type 1 Portland Cement: 75-150 lbs/cy
2. Fly Ash: 150-600 lbs/cy
3. Air: 5-20%
4. Unit Weight, wet: 100- 125 lbs/cf
5. Water: Mix water as necessary to produce a consistency that will result in a flowable, self-leveling product at the time of placement.
6. 28 Day compressive strength: 150 psi minimum

D. Provide equipment as recommended by the Manufacturer and comply with manufacturer's recommendations for the addition of additives, whether at the production plant or prior to placement at the site.

2.10 REINFORCING FOR CONCRETE ENCASEMENT

A. #4 rods on all four corners of the envelope and #4 tie rods every 4' with necessary ties.

2.11 AGGREGATE

A. For bedding of precast structures: PENNDOT 408: Number 1B.

B. For Spill Containment: PENNDOT 408: Number 3.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify excavation under provisions of Division 31.

B. Verify that excavation, base material installation, and compaction is completed.

C. Verify transformer vault dimensions with transformer.

3.2 PREPARATION

- A. Excavate, install base material, and compact base material in accordance with manhole, handhole, and transformer vault manufacturer's instructions.

3.3 DUCT BANK INSTALLATION

- A. Provide concrete encasement for primary and secondary electric duct banks.
- B. Provide concrete encasement for telecommunications and site lighting ductbanks only under paved areas. Provide stonedust encasement for all non-paved areas unless otherwise noted.
- C. Install duct to locate top of ductbank at depths as indicated on drawings, NEC and as required by project conditions.
- D. Install duct with minimum slope of 4" per 100'. Slope duct away from building entrances.
- E. Cut duct square using saw or pipe cutter; de-burr cut ends.
- F. Insert duct to shoulder of fittings; fasten securely.
- G. Join nonmetallic duct using adhesive as recommended by manufacturer.
- H. Wipe nonmetallic duct dry and clean before joining. Apply full even coat of adhesive to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.
- I. Install no more than equivalent of three 90° bends between pull points.
- J. Provide suitable fittings to accommodate expansion and deflection where required.
- K. Terminate duct at manhole entries using end bell.
- L. Stagger duct joints vertically in concrete encasement 6" minimum.
- M. Use suitable separators and chairs installed not greater than 4' on centers for encased ductbanks.
- N. Securely anchor duct to prevent movement during concrete placement.
- O. Provide concrete under provisions of Division 3.
- P. Provide minimum 3" concrete cover at bottom, top, and sides of ductbank.
- Q. Connect to existing concrete encasement using dowels.
- R. Provide suitable pull string in each empty duct except sleeves and nipples.
- S. Swab duct. Use suitable caps to protect installed duct against entrance of dirt and moisture.
- T. Provide backfill for all trenches under provisions of Division 31.
- U. Interface installation of underground warning tape with backfilling specified in Division 31.
- V. Provide bends in duct bank as necessary to allow conduits to enter access structures perpendicular to the structure wall.

- W. A minimum separation of 12" shall be maintained between telecommunication ductbanks and electrical ductbanks.

3.4 UNDERGROUND-LINE WARNING TAPE INSTALLATION

- A. During backfilling of trenches install continuous underground-line warning tape directly above line at 6" to 8" below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16" overall.
- B. Provide number of tapes per trench as follows:
 - 1. Up to 18" wide: 1 tape in center of trench
 - 2. 18" to 36" wide: 2 tapes 18" apart
 - 3. 36" to 48" wide: 3 tapes 16" apart

3.5 FLOWABLE FILL INSTALLATION

- A. Place concrete via chute in flowable condition directly to cavity to be filled.
 - 1. To prevent segregation, drum should continuously agitate mix while on truck.
 - 2. Do not use vibrator to "pull" flowable fill
 - 3. Adjust mix as required to allow for pumping if delivery location requires.
- B. The flowable fill shall be left undisturbed until the material obtains sufficient strength. Sufficient strength for paving is achieved when the flowable fill can support the weight of foot traffic without apparent deformation.
- C. Protect exposed surfaces of flowable fill from premature drying, wash by rain or running water, wind, mechanical injury, and excessively hot or cold temperature.

3.6 FABRIC INNERDUCT INSTALLATION

- A. Provide textile innerduct in conduit using continuous un-spliced lengths of textile innerduct between manholes, handholes, pull boxes, and/or termination points as indicated on the drawings.
- B. Make a 2" incision, approximately 18" from the end of textile innerduct. Pull out and cut off approximately 2' of pull-tape. Thus, allowing the pull tape ends to retract back into the cells.
- C. Using approximately 6' of pull tape, tie a non-slip knot to the incision. Then, tie 3 to 6 half-hitch knots down to the end of textile innerduct. Apply black vinyl tape over all knots and the end of textile innerduct. Using a Bow Line knot tie a swivel to the end of 3' pull tape. For multi-pack installations one swivel is sufficient but stagger each textile innerduct.
- D. Using a Bow Line knot, attach the pull rope located in the rigid conduit to the other end of the swivel. Install textile innerduct – ensuring that no twist is introduced to the innerduct.
- E. Provide suitable textile innerduct slack in the manholes, handholes, pull boxes, and/or termination points and at turns to ensure there is no kinking or binding of the product.
- F. Provide conventional plastic cable ties through previously created incisions.
- G. Maintenance Hole and Hand Hole Installation:
 - 1. At locations where textile innerduct will be continuous through a manhole or hand hole, allow sufficient slack so that the innerduct may be secured to the side of the vault maintaining the minimum bend radius.

2. At maintenance holes serving as the junction location, pull the exposed end of the innerduct to the far end of the vault, install termination bag, and secure to the vault.

- H. Seal all conduit and textile innerduct entering structures at the first box or outlet to prevent entrance into the structure of gases, liquids, or rodents.

3.7 HANDHOLE INSTALLATION

- A. Install handholes in accordance with manufacturer's instructions.
- B. Install handholes plumb.
- C. Provide all excavation, backfill and crushed stone base as required to install handhole.

3.8 TRANSFORMER FOUNDATION INSTALLATION

- A. Install foundation no closer than 25'-0" to any building or as required by Utility Company. (Verify)
- B. Provide a minimum clearance around all four sides as follows:
 1. Front – 10'-0" minimum
 2. Back – 5'-0" minimum
 3. Sides – 5'-0" minimum
- C. Provide all excavation, backfill and crushed stone base required to install transformer vault.
- D. Final grade around transformer foundation shall be 3" to 6" below top of foundation surface and graded so that water drains away from the foundation.
- E. Provide ground ring and ground rods as required by Utility Company and N.E.C. requirements.
- F. Provide removable bollards on front and stationary bollards on sides and back. Spacing shall be as required to protect transformer or as required by the Utility Company.

3.9 HANDHOLE & TRANSFORMER VAULT WATERPROOFING

- A. Apply two coats 2-3 mils thickness (min) of a standard asphalt or epoxy waterproofing material in complete compliance with the manufacturer's recommendations.
- B. Fill all cracks and grooves.
- C. Verify coating is free from breaks and pinholes.
- D. The coating shall completely cover all exterior surfaces of the handhole or transformer foundation. Provide additional coating to patch all penetrations.

3.10 CABLE INSTALLATION

- A. Support all cables on rack arms.
- B. Route cables so that they do not block access to other conduits, ladders, pulling irons, sump pumps or working space.

3.11 UNDERGROUND DISTRIBUTION SYSTEM GROUNDING

- A. Grounding System: Ground pad-mounted equipment and non-current-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes.

END OF SECTION 260543

SECTION 260544 – SLEEVES & SLEEVE SEALS FOR ELECTRICAL RACEWAYS & CABLING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Sleeves
- B. Sleeve Seal Systems
- C. Grout
- D. Sealants
- E. Firestopping

1.2 REFERENCES

- A. ANSI/NFPA 70 – National Electric Code
- B. NFPA 101 – Life Safety Code
- C. Test Requirements: ASTM E 814, “Standard Method of Fire Tests of Through Penetration Fire Stops”
- D. Test Requirements: UL 1479, “Fire Tests of Through-Penetration Firestops”
- E. Underwriters Laboratories (UL) of Northbrook, IL publishes tested systems in their “FIRE RESISTANCE DIRECTORY” that is updated annually.
 - 1. UL Fire Resistance Directory:
 - a. Firestop Devices (XHJI)
 - b. Fire Resistance Ratings (BXRH)
 - c. Through-Penetration Firestop Systems (XHEZ)
 - d. Fill, Voids, or Cavity Material (XHHW)
 - e. Forming Materials (XHKU)
- F. International Firestop Council Guidelines for Evaluating Firestop Systems Engineering Judgments
- G. Inspection Requirements: ASTM E 2174, “Standard Practice for On-site Inspection of Installed Fire Stops.”
- H. ASTM E 84, “Standard Test Method for Surface Burning Characteristics of Building Materials.”

1.3 QUALITY ASSURANCE

- A. A manufacturer's direct representative (not distributor or agent) to be on-site during initial installation of firestop systems to train appropriate contractor personnel in proper selection and installation procedures. This will be done per manufacturer's written recommendations published in their literature and drawing details.

- B. Firestop System installation must meet requirements of ASTM E 814 or UL 1479 tested assemblies that provide a fire rating equal to that of construction being penetrated.
- C. Proposed firestop materials and methods shall conform to applicable governing codes having local jurisdiction.
- D. Firestop Systems do not reestablish the structural integrity of load bearing partitions/assemblies or support live loads and traffic. Installer shall consult the structural engineer prior to penetrating any load bearing assembly.
- E. For those firestop applications that exist for which no UL tested system is available through a manufacturer, a manufacturer's engineering judgment derived from similar UL system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineering judgment drawings must follow requirements set forth by the International Firestop Council.

1.4 SUBMITTALS FOR REVIEW

- A. Submit under provisions of Section 260010.
- B. Shop Drawings: The following items shall be submitted for review and approval:
 - 1. Submittal booklet to include the following:
 - a. Reference to Specification Section.
 - b. A list of all equipment to be provided and installed.
 - c. UL System drawings for each firestopping application.
 - d. Manufacturer's Certificates of Conformance for their products.
 - e. Manufacturer's specifications and technical data for each material including the composition and limitations, documentation of UL firestop systems to be used and manufacturer's installation instructions to comply with this Section.
 - f. Manufacturer's engineering judgment identification number and drawing details when no UL system is available for an application. Engineering judgment must include both project name and contractor's name who will install firestop system as described in drawing.

1.5 SUBMITTALS FOR CLOSEOUT

- A. Submit under provisions of Section 260010.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials undamaged in manufacturer's clearly labeled, unopened containers, identified with brand, type, and UL label where applicable.
- B. Coordinate delivery of materials with scheduled installation date to allow minimum storage time at jobsite.
- C. Store materials under cover and protect from weather and damage in compliance with manufacturer's requirements, including temperature limitations.
- D. Comply with recommended procedures, precautions or remedies described in material safety data sheets as applicable.
- E. Do not use damaged or expired materials.

1.7 PROJECT CONDITIONS

- A. Do not use materials that contain flammable solvents.
- B. Scheduling:
 - 1. Schedule installation of CAST IN PLACE firestop devices after completion of floor formwork, metal form deck, or composite deck but before placement of concrete.
 - 2. Schedule installation of other firestopping materials after completion of penetrating item installation but prior to covering or concealing of openings.
- C. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.
- D. Weather conditions: Do not proceed with installation of firestop materials when temperatures exceed the manufacturer's recommended limitations for installation printed on product label and product data sheet.
- E. During installation, provide masking and drop cloths to prevent firestopping materials from contaminating any adjacent surfaces.

1.8 WARRANTY

- A. Provide the warranty specified in Section 260010.

PART 2 - PRODUCTS

2.1 ROUND SLEEVES

- A. Wall Sleeves, Steel: Description: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends and integral waterstop.
- B. Wall Sleeves, Cast Iron: Description: Cast or fabricated "wall pipe", equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop.
- C. Pipe Sleeves, PVC: Description: ASTM D1785, Schedule 40.
- D. Molded Sleeves, PVC: Description: With nailing flange for attaching to wooden forms.
- E. Molded Sleeves, PE, or PP: Description: Removable, tapered cup-shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- F. Sheet Metal Sleeves, Galvanized Steel, Round: Description: Galvanized-steel sheet; thickness not less than 0.0239" round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

2.2 RECTANGULAR SLEEVES

- A. Sheet Metal Sleeves, Galvanized Steel, Rectangular:
 - 1. Description:
 - a. Material: Galvanized sheet steel.
 - b. Minimum Metal Thickness:
 - 1) For sleeve cross-section rectangle perimeter less than 50" and with no side larger than 16", thickness must be 0.052".

- 2) For sleeve cross-section rectangle perimeter not less than 50" or with one or more sides larger than 16", thickness must be 0.138".

2.3 SLEEVE SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable or between raceway and cable.
 1. Sealing Elements: EPDM or Nitrile (Buna N) rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 2. Pressure Plates: Carbon steel, Stainless steel.
 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, Stainless steel of length required to secure pressure plates to sealing elements.

2.4 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
 1. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
 2. Design Mix: 5000-psi, 28-day compressive strength.
 3. Packaging: Premixed and factory packaged.

2.5 POURABLE SEALANTS

- A. Description: Single-component, neutral-curing elastomeric sealants of grade indicated below.
 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

2.6 FOAM SEALANTS

- A. Description: Multicomponent, liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam. Foam expansion must not damage cables or crack penetrated structure.

2.7 FIRESTOPPING MANUFACTURERS

- A. Subject to compliance with through penetration firestop systems (XHEZ) listed in Volume II of the UL Fire Resistance Directory, provide products of the following manufacturers as identified below:
 1. Hilti Firestop Systems
 2. Specified Technologies Inc
 3. 3M Fire Protection Products
 4. Tremco, Inc
 5. Nelson Firestop Products
 6. USG Corporation

2.8 GENERAL FIRESTOPPING REQUIREMENTS

- A. Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.

- B. Provide components for each firestopping system that are needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.
- C. Penetrations in Fire Resistance Rated Walls: Provide firestopping with ratings determined in accordance with UL 1479 or ASTM E 814.
 - 1. F-Rating: Not less than the fire-resistance rating of the wall construction being penetrated.
- D. Penetrations in Horizontal Assemblies: Provide firestopping with ratings determined in accordance with UL 1479 or ASTM E 814.
 - 1. F-Rating: Minimum of 1-hour rating, but not less than the fire-resistance rating of the floor construction being penetrated.
 - 2. T-Rating: when penetrant is located outside of a wall cavity, minimum of 1-hour rating, but not less than the fire-resistance rating of the floor construction being penetrated.
 - 3. W-Rating: Class 1 rating in accordance with water leakage test per UL 1479.
- E. Penetrations in Smoke Barriers: Provide firestopping with ratings determined in accordance with UL 1479 or ASTM E 814.
 - 1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at both ambient and elevated temperatures.
- F. Mold Resistance: Provide penetration firestoppping with mold and mildew resistance rating of 0 as determined by ASTM G21.

2.9 GENERAL FIRESTOPPING REQUIREMENTS

- A. Provide firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Firestop systems shall be compatible with one another, with the substrates forming openings, and with penetrating items, if any.
- B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
 - 1. Fire-resistance-rated walls include fire walls, fire-barrier walls, smoke-barrier walls, and fire partitions.
 - 2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
 - 1. Horizontal assemblies include floors and floor/ceiling assemblies.
 - 2. F-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.
 - 3. T-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
- D. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg.
 - 1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at and no more than 50-cfm cumulative total for any 100 sq. ft. at both ambient and elevated temperatures.
- E. W-Rating: Provide penetration firestopping showing no evidence of water leakage when tested according to UL 1479.

- F. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- G. VOC Content: Penetration firestopping sealants and sealant primers shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1. Sealants: 250 g/L.
 - 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 - 3. Sealant Primers for Porous Substrates: 775 g/L.
- H. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.
 - 1. Permanent forming/damming/backing materials, including the following:
 - a. Slag-wool-fiber or rock-wool-fiber insulation.
 - b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
 - c. Fire-rated form board.
 - d. Fillers for sealants.
 - 2. Temporary forming materials.
 - 3. Substrate primers.
 - 4. Collars.
 - 5. Steel sleeves

2.10 FILL MATERIALS

- A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
- B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
- C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized-steel sheet.
- E. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.
- F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a non-shrinking, homogeneous mortar.
- H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

- I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.
- J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants; pourable (self-leveling) grade formulation for openings in floors and other horizontal surfaces, and non-sag formulation for openings in vertical and sloped surfaces, unless indicated firestopping limits use of non-sag grade for both opening conditions.

2.11 MIXING

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

2.12 IDENTIFICATION

- A. Through-Penetration Firestop Systems: Adhesive labels with preprinted, flexible, self-adhesive vinyl with legend over-laminated with a clear weather and commercial resistant coating.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Sleeves for Conduits Penetrating Above-Grade, Non-Fire-Rated, Concrete and Masonry-Unit Floors and Walls:
 - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall or floor, so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - b. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants".
 - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 3. Size pipe sleeves to provide 1/4" annular clear space between sleeve and raceway or cable, unless sleeve seal system is to be installed or seismic criteria require different clearance.
 - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
 - 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2" above finished floor level. Install sleeves during erection of floors.
- C. Sleeves for Conduits Penetrating Non-Fire-Rated Wall Assemblies:
 - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 2. Seal space outside of sleeves with approved joint compound for wall assemblies.
 - 3. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

- E. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel, cast-iron pipe sleeves and mechanical sleeve seal systems. Size sleeves to allow for 1" annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- F. Underground, Exterior-Wall and Floor Penetrations:
 - 1. Install steel, cast-iron pipe sleeves with integral waterstops. Size sleeves to allow for 1" annular clear space between raceway or cable and sleeve for installing sleeve seal system. Install sleeve during construction of floor or wall.
 - 2. Install steel pipe sleeves. Size sleeves to allow for 1" annular clear space between raceway or cable and sleeve for installing sleeve seal system. Grout sleeve into wall or floor opening.

3.2 INSTALLATION OF SLEEVES FOR FIRE-RATED ELECTRICAL PENETRATIONS

- A. The Contractor shall be responsible for providing permanent, UL approved firestopping systems for all penetrations through fire rated floor or fire rated wall assemblies. For areas that will require future access for the installation of additional cables, repair, or retrofit, the firestopping system shall consist of re-usable intumescent pillows or putty. All firestopping shall meet the requirements of ASTM E-814 and UL 1479.
- B. Regulatory Requirements: Install firestop materials in accordance with UL Fire Resistance Directory.
- C. Manufacturer's Instructions: Comply with manufacturer's instructions for installation of through-penetration joint materials.
 - 1. Seal all holes or voids made by penetrations to ensure an air and water-resistant seal.
 - 2. Consult with mechanical engineer, project manager, and damper manufacturer prior to installation of UL firestop systems that might hamper the performance of fire dampers as it pertains to duct work.
 - 3. Protect materials from damage on surfaces subjected to traffic.

3.3 INSTALLATION OF RECTANGULAR SLEEVES AND SLEEVE SEALS

- A. Install sleeves in existing walls without compromising structural integrity of walls. Do not cut structural elements without reinforcing the wall to maintain the designed weight bearing and wall stiffness.
- B. Install conduits and cable with no crossings within the sleeve.
- C. Fill opening around conduits and cables with expanding foam without leaving voids.
- D. Provide metal sheet covering at both wall surfaces and finish to match surrounding surfaces. Metal sheet must be same material as sleeve.

3.4 INSTALLATION OF SLEEVE SEAL SYSTEMS

- A. Install sleeve seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.5 SLEEVES

- A. Furnish to the General Contractor sleeves and locations where work of this contract must pass through new walls, floors, ceilings, roofs, and other construction. Extend each sleeve through the floor, wall or partition and cut flush with each surface unless otherwise required.
- B. For sleeves in bearing and masonry walls, floors, and partitions provide standard weight steel pipe finished with smooth edges. For other than masonry partitions, through suspended ceilings, and for concealed vertical piping, provide No. 22 U.S.G. galvanized iron, unless otherwise specified.
- C. Where conduits pass through the roof provide pre-molded synthetic rubber flashing boots or other approved means approved by the Roofing Contractor. Install as per Roofing Contractor.
- D. Provide any sleeve or opening not installed or made during construction under the requirements for cutting and patching.
- E. Provide sleeves as required in existing walls for renovation projects.

3.6 FIELD QUALITY CONTROL

- A. Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas.
- B. Keep areas of work accessible until inspection by applicable code authorities.
- C. Inspection of through-penetration firestopping shall be performed in accordance with ASTM E 2174, "Standard Practice for On-Site Inspection of Installed Fire Stops" or other recognized standard.
- D. Perform under this section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.

3.7 THROUGH-PENETRATION FIRESTOP SYSTEMS IDENTIFICATION

- A. Identify through-penetration firestop systems with adhesive labels.
- B. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems.
- C. Include the following information on labels:
 - 1. The words: "Warning - Through Penetration Firestop System-Do Not Disturb"
 - 2. Contractor's Name, address, and phone number.
 - 3. Through-Penetration firestop system designation of applicable testing and inspecting agency.
 - 4. Date of Installation.
 - 5. Through-Penetration firestop system manufacturer's name.
 - 6. Installer's Name.

3.8 CLEANING AND PROTECTION

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

END OF SECTION 260544

SECTION 260553 – IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Labels and Nameplates
- B. Color-Coding

1.2 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code

1.3 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc., or a testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

1.4 SUBMITTALS FOR REVIEW

- A. Submit a letter on Company letterhead stating that all equipment will be in compliance with the specifications.

1.5 WARRANTY

- A. Provide the warranty specified in Section 260010.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Thomas & Betts
- B. Ideal Industries, Inc.
- C. Lem Products, Inc.

2.2 RACEWAY AND CABLE LABELS

- A. Comply with applicable codes for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
 - 1. Color: Black letters on orange field.
 - 2. Legend: Indicates voltage and service.
- B. Adhesive Labels: Preprinted, flexible, self-adhesive vinyl with legend over-laminated with a clear weather and commercial resistant coating.

- C. Pre-tensioned, Wraparound Plastic Sleeves: Flexible, preprinted, color-coded, acrylic band sized to suit the diameter of the line it identifies and arranged to stay in place by pre-tensioned gripping action when placed in position.
- D. Colored Adhesive Tape: Self-adhesive vinyl tape not less than 3 mils thick by 3/4" to 2" wide.
- E. Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.
- F. Aluminum, Wraparound Market Bands: Bands cut from 0.014" thick aluminum sheet, with stamped or embossed legend, and fitted with slots or ears for permanently securing around wire or cable jacket or around groups of conductors.
- G. Plasticized Card-Stock Tags: Vinyl cloth with preprinted and field-printed legends. Orange background, unless otherwise indicated, with eyelet for fastener.
- H. Aluminum-Faced, Card-Stock Tags: Weather-resistant, 18-point minimum card stock faced on both sides with embossable aluminum sheet, 0.002" thick, laminated with moisture resistant acrylic adhesive, punched for fasteners, and preprinted with legends to suit each application.
- I. Brass or Aluminum Tags: 2 by 2 by 0.05" metal tags with stamped legend, punched for fastener.
- J. Telecommunication Cable Labels: Self-adhesive vinyl or vinyl-cloth wraparound tape markers, machine printed with alphanumeric cable designations.

2.3 NAMEPLATES AND SIGNS

- A. Engraved Plastic Nameplates and Signs: Engraving stock, melamine plastic laminate, minimum 1/16" thick for signs up to 20 sq. in. and 1/8" thick for larger sizes.
 - 1. Engraved legend with black letters on white face.
 - 2. Punched or drilled for mechanical fasteners.
 - 3. Provide outdoor rated plastic with UV Protection for outdoor or wet locations.
- B. Baked-Enamel Signs for Interior Use: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend and size required for the application. 1/4" grommets in corners for mounting.
- C. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32, stainless-steel machine screws with nuts and flat and lock washers.

2.4 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking, Type 6/6 nylon cable ties.
 - 1. Minimum Width: 3/16"
 - 2. Tensile Strength: 50 lb minimum.
 - 3. Temperature Range: Minus 40 to plus 185° F.

2.5 COLOR CODING OF SECONDARY CONDUCTORS

- A. Use the following colors for feeder and branch circuit phase conductors:
 - 1. 120/208 or 120/240 Volt Systems:
 - Black – A-Phase
 - Red – B-Phase
 - Blue – C-Phase

- White (Neutral)
- 2. 277/480 Volt Systems:
 - Brown – A Phase
 - Orange – B Phase
 - Yellow – C Phase
 - Gray (Neutral)
- 3. Factory apply color the entire length of conductors, except the following field-applied, color-coding methods may be used instead of factory-coded wire for sizes larger than No. 10 AWG:
 - a. Colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 3" from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Use 3/4" wide tape in colors specified. Adjust tape bands to avoid obscuring cable identification markings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Use Owner-furnished room numbers on all identifications. Room numbers on drawings are for reference only.
- B. Verify colors for color coding with Owner before proceeding and match existing color coding when applicable.
- C. Identification Materials and Devices: Install at locations for most convenient viewing without interference with operation and maintenance of equipment.
- D. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations with corresponding designations in the Contract Documents or with those required by codes and standards. Use consistent designations throughout Project.
- E. Sequence of Work: If identification is applied to surfaces that require finish, install identification after completing finish work.
- F. Self-Adhesive Identification Products: Clean surfaces before applying.
- G. Color Junction Boxes and Coverplates: Paint all boxes and covers above accessible ceilings colors as listed below:
 - 1. Fire Alarm System: Red
 - 2. Security System: Blue
 - 3. Normal/Emergency and Emergency Only Distribution Systems: Yellow
- H. Caution Labels for Indoor Boxes and Enclosures for Power and Lighting: Install pressure-sensitive self-adhesive labels identifying system voltage with black letters on orange background. Install on exterior of door or cover.
- I. Circuit Identification on Junction Boxes and Coverplates: Mark ID externally on junction box, coverplates and on the back of each coverplate for receptacles and switches.
 - 1. Boxes: Finished Areas – Inside, Permanent Marker
 - 2. Boxes: Non-Finished Areas – Outside, Permanent Marker
 - 3. ID Legend: Permanent, waterproof listing of panel and circuit number or equivalent. (IE Panel HA cct. 1, 3, 5)

- J. Paths of Underground Electrical Lines: During trench backfilling, for exterior underground power, control, signal, and communication lines, install continuous underground plastic line marker located directly above line at 6 to 8" below finished grade. Where width of multiple lines installed in a common trench or concrete envelope does not exceed 16" overall, use a single line marker. For trenches wider than 16" install parallel tapes at 2'-0" intervals across the width of the trench.
- K. Power-Circuit Identification: Metal tags or aluminum, wraparound marker bands for cables, feeders, and power circuits in vaults, pull and junction boxes, manholes and switchboard rooms.
 - 1. Legend: 1/4" steel letter and number stamping or embossing with legend corresponding to indicated circuit designations.
 - 2. Tag Fasteners: Nylon cable ties.
 - 3. Band Fasteners: Integral ears.
- L. Apply identification to conductors as follows:
 - 1. Conductors to be extended in the future: Indicate source and circuit numbers.
 - 2. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor's source and circuit number using permanent marking and using color-coding to identify circuits' voltage and phase.
 - 3. Multiple Control and Communication Circuits in the Same Enclosure: Identify each conductor by its system and circuit designation. Use a consistent system of tags, color-coding or cable marking tape.
- M. Apply warning, caution and instruction signs as follows:
 - 1. Warnings, Cautions, and Instructions: Install to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.
 - 2. Emergency Operation: Install engraved laminated signs with white legend on red background with minimum 3/8" high lettering for emergency instructions on power transfer, load shedding and other emergency operations.
- N. Equipment Identification Labels: Engraved plastic laminate. Install on each unit of equipment, including central or master unit of each system. This includes power, lighting, communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Unless otherwise indicated, provide a single line of text with 1/2" high lettering on 1-1/2" high label; where two lines of text are required, use labels 2" high. Use black letters on a white face. Apply labels for each unit of the following categories of equipment using punched or drilled mechanical fasteners.
 - 1. Transformers
 - 2. Switchboards (3/8" high letters)
 - 3. Panelboards
 - 4. Load Centers
 - 5. Enclosed Switches
 - 6. Enclosed Circuit Breakers
 - 7. Elevator Enclosed Switches
 - 8. Enclosed Contactors
 - 9. Enclosed Controllers
 - 10. Engine Generators (3/8" high letters)
 - 11. Fixed and Automatic Power Factor Equipment
 - 12. Transfer Switches (3/8" high letters)
 - 13. Area Protection Panels

END OF SECTION 260553

SECTION 260573 – OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes performing fault-current study, coordination study and overcurrent protective device setting by manufacturers representative.

1.2 SUBMITTALS FOR REVIEW

- A. Submit under provisions of Section 260010.
- B. Shop Drawings: The following items shall be submitted for review and approval:
 - 1. Submittal booklet to include the following:
 - a. Reference to Specification Section
 - b. A list of all computer software programs to be used for all studies
 - c. Coordination-Study input data
 - d. Coordination-Study Report
 - e. Fault Current-Study Report
 - f. Equipment Evaluation Report
 - g. Manufacturers Setting Report
 - h. Professional Engineers stamp/signature for the state the project is located.

1.3 SUBMITTALS FOR CLOSEOUT

- A. Submit under provisions of Section 260010.
- B. Manufacturers field service to notify Engineer in writing that all overcurrent protective device settings were correctly adjusted with Electrical Contractor to the values listed in the study results.

1.4 QUALIFICATIONS

- A. Software Qualifications: Software algorithms shall comply with requirements of industry standards and shall be as recommended by switchgear and panelboard manufacturer. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices. Manual calculations are not acceptable.
- B. Studies Specialist Qualifications: An organization experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices. Engineer to have at least 5 years of experience performing short circuit and coordination studies.
- C. Testing Agency Qualifications: Member of the International Electrical Testing Association.
- D. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association to supervise testing specified in this section.

PART 2 - PRODUCTS

2.1 UTILITY INFORMATION

- A. Refer to Section 260583.

2.2 STUDIES

- A. The contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E - Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D. This study shall also include short-circuit and protective device coordination studies.
- B. Study shall include a Professional Engineers stamp/signature for the state the project is located.

2.3 DATA

- A. Contractor shall furnish all data as required for the power system studies. The Engineer performing the short-circuit, protective device coordination and arc flash hazard analysis studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.
- B. Source combination may include present and future motors and generators.
- C. Load data utilized may include existing and proposed loads obtained from Contract Documents provided by Owner, or Contractor.
- D. If applicable, include fault contribution of existing motors in the study. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

2.4 SHORT CIRCUIT ANALYSIS

- A. Transformer design impedances shall be used when test impedances are not available.
- B. Provide the following:
 - 1. Calculation methods and assumptions
 - 2. Selected base per unit quantities
 - 3. One-line diagram of the system being evaluated that clearly identifies individual equipment buses, bus numbers used in the short-circuit analysis, cable and bus connections between the equipment, calculated maximum short-circuit current at each bus location and other information pertinent to the computer analysis
 - 4. The study shall include input circuit data including electric utility system characteristics, source impedance data, conductor lengths, number of conductors per phase, conductor impedance values, insulation types, transformer impedances and X/R ratios, motor contributions, and other circuit information as related to the short-circuit calculations.
 - 5. Tabulations of calculated quantities including short-circuit currents, X/R ratios, equipment short-circuit interrupting or withstand current ratings and notes regarding adequacy or inadequacy of the equipment rating.
 - 6. Results, conclusions, and recommendations. A comprehensive discussion section evaluating the adequacy or inadequacy of the equipment must be provided and include recommendations as appropriate for improvements to the system

7. The Contractor shall be responsible for supplying conductor information (lengths, types, number per phase, etc.) in a timely manner to allow the short-circuit analysis to be completed prior to final installation.
- C. For solidly grounded systems, provide a bolted line-to-ground fault current study for applicable buses as determined by the engineer performing the study.
- D. Protective Device Evaluation:
 1. Evaluate equipment and protective devices and compare to short circuit ratings.
 2. Adequacy of switchgear, motor control centers, and panelboard bus bars to withstand short-circuit stresses.
 3. The manufacturers study specialist shall notify Owner in writing, of any circuit protective devices improperly rated for the calculated available fault current.

2.5 PROTECTIVE DEVICE TIME-CURRENT COORDINATION ANALYSIS

- A. Protective device coordination time-current curves (TCC) shall be displayed on log-log scale graphs.
- B. Include on each TCC graph, a complete title with descriptive device names.
- C. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
- D. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
- E. Plot the following characteristics on the TCC graphs, where applicable:
 1. Electric utility's overcurrent protective device
 2. Medium voltage equipment overcurrent relays
 3. Medium and low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands
 4. Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands
 5. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves
 6. Medium voltage conductor damage curves
 7. Ground fault protective devices, as applicable
 8. Pertinent motor starting characteristics and motor damage points, where applicable
 9. Pertinent generator short circuit decrement curve and generator damage point
 10. The largest feeder circuit breaker in each motor control center and applicable panelboard
- F. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.
- G. Provide the following:
 1. A One-line diagram shall be provided which clearly identifies individual equipment buses, bus numbers, device identification numbers and the maximum available short-circuit current at each bus when known.
 2. A sufficient number of log-log plots shall be provided to indicate the degree of system protection and coordination by displaying the time-current characteristics of series connected overcurrent devices and other pertinent system parameters.
 3. Computer printouts shall accompany the log-log plots and will contain descriptions for each of the devices shown, settings of the adjustable devices, and device identification numbers to aid in locating the devices on the log-log plots and the system one-line diagram.

4. The study shall include a separate, tabular printout containing the recommended settings of all adjustable overcurrent protective devices, the equipment designation where the device is located, and the device number corresponding to the device on the system one-line diagram.
5. A discussion section which evaluates the degree of system protection and service continuity with overcurrent devices, along with recommendations as required for addressing system protection or device coordination deficiencies.

2.6 ARC FLASH HAZARD ANALYSIS

- A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA 70E, Annex D. The arc flash hazard analysis shall be performed in conjunction with the short-circuit analysis (Section 2.3) and the protective device time-current coordination analysis (Section 2.4)
- B. The flash protection boundary and the incident energy shall be calculated at significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway, and splitters) where work could be performed on energized parts.
- C. Circuits 240V or less fed by single transformer rated less than 125 kVA may be omitted from the computer model and will be assumed to have a hazard risk category 0 per NFPA 70E.
- D. Working distances shall be based on IEEE 1584. The calculated arc flash protection boundary shall be determined using those working distances.
- E. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.
- F. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location in a single table. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum. Conversely, the maximum calculation will assume a maximum contribution from the utility. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable as well as any stand-by generator applications.
 1. The Arc-Flash Hazard Analysis shall be performed utilizing mutually agreed upon facility operational conditions, and the final report shall describe, when applicable, how these conditions differ from worst-case bolted fault conditions.
- G. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors should be decremented as follows:
 1. Fault contribution from induction motors should not be considered beyond 5 cycles.
- H. For each piece of ANSI rated equipment with an enclosed main device, two calculations shall be made. A calculation shall be made for the main cubicle, sides, or rear; and shall be based on a device located upstream of the equipment to clear the arcing fault. A second calculation shall be made for the front cubicles and shall be based on the equipment's main device to clear the arcing fault. For all other non-ANSI rated equipment, only one calculation shall be required, and it shall be based on a device located upstream of the equipment to clear the arcing fault.

- I. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.
- J. Miss-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.
- K. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. A maximum clearing time of 2 seconds will be used based on IEEE 1584. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.
- L. Provide the following:
 - 1. Results of the Arc-Flash Hazard Analysis shall be submitted in tabular form, and shall include device or bus name, bolted fault and arcing fault current levels, flash protection boundary distances, working distances, personal-protective equipment classes and AFIE (Arc Flash Incident Energy) levels.
 - 2. The Arc-Flash Hazard Analysis shall report incident energy values based on recommended device settings for equipment within the scope of the study.
 - 3. The Arc-Flash Hazard Analysis may include recommendations to reduce AFIE levels and enhance worker safety.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance.
- B. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices not submitted for approval with coordination study may not be used in study.

3.2 OVERCURRENT PROTECTIVE DEVICE SETTING

- A. Manufacturer's Field Service: Engage a factory-authorized service representative, of electrical distribution equipment being set and adjusted, to assist in setting of adjustable overcurrent protective devices within equipment.
- B. Testing: Perform the following device setting and prepare reports:
 - 1. After installing overcurrent protective devices and during energizing process of electrical distribution system, perform the following:
 - a. Verify that overcurrent protective devices meet parameters used in studies.
 - b. Adjust devices to values listed in study results.

3.3 GROUND FAULT PROTECTIVE DEVICE SETTING/TESTING

- A. Manufacturer's Field Service: Engage a factory-authorized service representative, of electrical distribution equipment being set and adjusted, to assist in setting of ground-fault protective devices within equipment.
- B. Testing: perform the following device setting and prepare reports:

1. After installing ground-fault protective devices and during energizing process of electrical distribution system, perform the following:
 - a. Service ground-fault protective device setting in accordance with Article 230 of the NEC.
 - b. Service ground-fault protective device performance testing and written record in accordance with Article 230 of the NEC.
 - c. Other ground fault devices in accordance with the fault current study.

3.4 ARC FLASH LABELS

- A. Provide a 4" x 4" Brady thermal transfer type label of high adhesion polyester for each work location analyzed.
- B. The labels shall be designed according to the following standards:
 1. UL969 – Standard for Marking and Labeling Systems
 2. ANSI Z535.4 – Product Safety Signs and Labels
 3. NFPA 70 (National Electric Code) – Article 110.16
- C. The label shall include the following information:
 1. System Voltage
 2. Flash protection boundary
 3. Personal Protective Equipment category
 4. Arc Flash Incident energy value (cal/cm²)
 5. Limited, restricted, and prohibited Approach Boundaries
 6. Study report number and issue date
- D. Labels shall be printed by a thermal transfer type printer with no field markings.
- E. Arc flash labels shall be provided for equipment as identified in the study and the respective equipment access areas per the following:
 1. Floor Standing Equipment - Labels shall be provided on the front of each individual section. Equipment requiring rear and/or side access shall have labels provided on each individual section access area. Equipment line-ups containing sections with multiple incident energy and flash protection boundaries shall be labeled as identified in the Arc Flash Analysis table.
 2. Wall Mounted Equipment – Labels shall be provided on the front cover or a nearby adjacent surface, depending upon equipment configuration.
 3. General Use Safety labels shall be installed on equipment in coordination with the Arc Flash labels. The General Use Safety labels shall warn of general electrical hazards associated with shock, arc flash, and explosions, and instruct workers to turn off power prior to work.

END OF SECTION 260573

SECTION 260583 – UTILITY SERVICE ENTRANCE

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Arrangement with Utility Company for Permanent Electric Service
- B. Service Entrance as indicated on the Drawings
- C. Metering Equipment

1.2 COORDINATION

- A. The Contractor shall provide the following items in accordance with the serving electric utility company's requirements:
 - 1. Service Disconnecting Device
 - 2. Service Lug Compartments and Lugs
 - 3. Instrument Transformer Compartments or Enclosures
 - 4. Meter Sockets
 - 5. Service Trenches
 - 6. Transformer Foundations and Grounding
 - 7. Service Conduits and Ductbanks
 - 8. Service Conductors and Terminations
 - 9. Riser Conduits, Elbows, and Stand-offs
- B. Refer to Section 260010 of this specification, who is responsible for all service costs.
- C. Contractor to verify with the various Utility Company's exact location of their facilities and exact location for terminating the service conduits before starting any work and adjust as required.

1.3 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code

1.4 SYSTEM DESCRIPTION

- A. Utility Company: PPL Utilities
- B. System Characteristics: As indicated on the drawings.
- C. Service Entrance: As indicated on the drawings.

1.5 SUBMITTALS FOR REVIEW

- A. Submit under provisions of Section 260010.
- B. Shop Drawings: The following items shall be submitted for review and approval:
 - 1. Submittal Booklet to include the following:
 - a. Reference to Specification Section.
 - b. A list of all equipment to be provided and installed.

1.6 QUALITY ASSURANCE

- A. Perform work in accordance with Utility Company written requirements.
- B. Maintain one copy of each document on site.

1.7 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc., or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

1.8 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated.

PART 2 - PRODUCTS

2.1 UTILITY METERS

- A. Meters will be furnished by Utility Company.

2.2 UTILITY METER BASE

- A. Meter base will be provided by the Contractor.

2.3 METERING TRANSFORMER CABINET

- A. Manufacturers: Provided by Contractor per Utility Company approval list when applicable.

2.4 TRANSFORMER BASE

- A. Manufacturers: Provided by Contractor per Utility Company approval list.
- B. Description: Precast concrete transformer base with cable pit sized per Utility Company requirements.
- C. Installation: Provide installation of precast concrete transformer base as directed by the Utility Company.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify conditions under provisions of Section 260010.
- B. Verify that service equipment is ready to be connected and energized.

3.2 PREPARATION

- A. Make arrangement with Utility Company to obtain permanent electric service to the Project.
- B. Coordinate location of Utility Company's facilities to ensure proper access is available.

3.3 INSTALLATION

- A. Install service entrance conduits in concrete envelope from Utility Company's terminal pole to Utility Company's pad-mounted transformer to building service entrance equipment. Utility Company will connect primary service lateral conductors to primary service entrance conductors.
- B. PPL Utilities: The Utility Company will furnish and install, via the underground ducts the primary and secondary service entrance conductors and make final connections at the transformer and building service entrance equipment.

END OF SECTION 260583

SECTION 260620 – SCHEDULES FOR ELECTRICAL DISTRIBUTION EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the schedules for electrical distribution equipment.

1.2 SUBMITTALS FOR REVIEW

- A. Refer to the specific equipment section for submittals required.

1.3 EXTRA MATERIALS

- A. Refer to the specific equipment section for extra materials required.

1.4 MAINTENANCE MATERIALS

- A. Refer to the specific equipment section for maintenance materials required.

PART 2 - PRODUCTS

2.1 SCHEDULES FOR ELECTRICAL DISTRIBUTION EQUIPMENT

- A. Refer to Schedules attached to the following pages.

PART 3 - EXECUTION

3.1 STANDARD BRANCH CIRCUIT WIRE SIZING TABLE

A. Sizing Table:

STANDARD BRANCH CIRCUIT WIRE SIZING TABLE			
BREAKER TRIP RATING	1-POLE BREAKER	2-POLE BREAKER	3-POLE BREAKER
15-20A	2#12 + 1#12 GND IN 3/4" CONDUIT	3#12 + 1#12 GND IN 3/4" CONDUIT	4#12 + 1#12 GND IN 3/4" CONDUIT
25-30A	2#10 + 1#10 GND IN 3/4" CONDUIT	3#10 + 1#10 GND IN 3/4" CONDUIT	4#10 + 1#10 GND IN 3/4" CONDUIT
35-40A	2#8 + 1#10 GND IN 3/4" CONDUIT	3#8 + 1#10 GND IN 3/4" CONDUIT	4#8 + 1#10 GND IN 3/4" CONDUIT
45-50A	2#6 + 1#10 GND IN 3/4" CONDUIT	3#6 + 1#10 GND IN 3/4" CONDUIT	4#6 + 1#10 GND IN 1" CONDUIT
60-70A	2#4 + 1#8 GND IN 1" CONDUIT	3#4 + 1#8 GND IN 1-1/4" CONDUIT	4#4 + 1#8 GND IN 1-1/4" CONDUIT
80A	2#3 + 1#8 GND IN 1" CONDUIT	3#3 + 1#8 GND IN 1-1/4" CONDUIT	4#3 + 1#8 GND IN 1-1/4" CONDUIT
90A	N/A	3#2 + 1#8 GND IN 1-1/4" CONDUIT	4#2 + 1#8 GND IN 1-1/4" CONDUIT
100-110A	N/A	3#1 + 1#6 GND IN 1-1/2" CONDUIT	4#1 + 1#6 GND IN 1-1/2" CONDUIT

B. Table Notes:

1. Unless otherwise indicated, refer to this schedule for wire and conduit size for all circuits with identified breaker trip ratings.
2. Provide neutral conductor for 2 and 3 pole circuits as indicated above if the equipment requires a neutral.

DISTRIBUTION PANEL			Bus:	600A	Additional Notes	
			Main Type:	600A Main Breaker	100% Neutral with Ground Bus	
MDP			Features:	E	Customer Meter	
			Volts:	277/480V, 3PH, 4W	Service Entrance Rated	
			Space:	As Shown		
			AIC:	65,000		
			Mounting:	Surface		
CKT.	Breaker		Type	Description	KVA	Notes
	Amp	Pole				
1	60	3	T	TVSS H1	-	1,2
2	150	3	E	Panel LP1 (via T-LP1)	71.4	2,6
3	90	3	E	Panel LP2 (via T-LP2)	37.6	2,6
4	150	3	E	Panel LP3 (via T-LP3)	63.4	2,6
5	20	3	T	MP Field 1 - Musco Pole S1	11.1	3
6	20	3	T	MP Field 1 - Musco Pole S2	11.1	3
7	20	3	T	MP Field 1 - Musco Pole S3	11.1	3
9	20	3	T	MP Field 1 - Musco Pole S4	11.1	3
10	20	3	T	MP Field 2 - Musco Pole S6	11.1	3
11	20	3	T	MP Field 2 - Musco Pole S5	11.1	3
12	20	3	T	MP Field 2 - Musco Pole S3	11.1	3
13	20	3	T	MP Field 2 - Musco Pole S4	11.1	3
14	20	1	T	Pole Mounted Site Ltg - Circuit 1	1.3	3
15	20	1	T	Pole Mounted Site Ltg - Circuit 2	1.3	3
16	20	1	T	Flagpole Ltg	1.0	3
17	20	1	T	Spare		
18	20	3	T	Spare		
19	100	3	E	Spare		
20	225	3	E	Spare		
21	100	3		Prepared Space		
22	225	3		Prepared Space		
23	225	3		Prepared Space		
Total Connected Load KVA:					264.8	

PANEL			Bus:	300A Main Breaker	Additional Panel Notes										
LP1			Volts:	120/208V, 3PH, 4W		100% Neutral with Ground Bus									
			Poles:	42 + 42		Integral TVSS L3									
			AIC:	42,000											
			Mounting:	Surface		Fed From: Distribution Panel MDP via T-LP1									
Section 1 of 2															
CKT.	Breaker		Description	Notes	Load						Notes	Description	Breaker		CKT.
	Amp	Pole			A		B		C				Pole	Amp	
1	20	1	Ltg - Interior		1.4	0.5						Rec - Concessions Counter	1	20	2
3	20	1	Ltg - Exterior				0.2	0.5				Rec - Concessions Counter	1	20	4
5	20	1	Spare							0.5		Rec - Concessions Counter	1	20	6
7	20	1	BAS Panel		0.5	0.5						Rec - Concessions Counter	1	20	8
9	25	2	CU-1/AC-1				2.3	0.5				Rec - Concessions Counter	1	20	10
11									2.3	0.6		Dishwasher	1	20	12
13	20	2	EUH-3 - Concessions		1.5	0.2						Rec - Concessions	1	20	14
15							1.5	0.2				Rec - Concessions	1	20	16
17	20	2	EUH-2 - Storage						1.5	1.2	4	Rec - Freezer	1	20	18
19					1.5	1.0					4	Rec - Cooler	1	20	20
21	20	2	EUH-1 - Mechanical				1.5	0.9				Rec - Concessions, Exterior N	1	20	22
23									1.5	0.9		Rec - Restrooms	1	20	24
25	15	1	GF-1 - Mechanical		1.2	1.1						Rec - Storage, Exterior SW	1	20	26
27	15	3	HRU-1 - Mechanical				0.8	1.4				Rec - Mech, Elec, Exterior SE	1	20	28
29									0.8	0.7		Rec - Trainer	1	20	30
31					0.8	1.2						Hand Dryer - Women	1	20	32
33	20	2	EWB-1 - Restroom				1.5	1.2				Hand Dryer - Men	1	20	34
35									1.5	0.5	7	FACP	1	20	36
37	20	2	EWB-2 - Trainer		1.5	1.0						Access Control & Door Hardware Power	1	20	38
39							1.5	0.5				Athletic Lighting Control Cabinet	1	20	40
41	15	1	EF-2 - Concessions						0.2	1.0		Spare	1	20	42
					24.8		24.0		22.6		Total Connected Load KVA: 71.4 KVA				
					Phase Totals										

PANEL		Bus:	300A Main Breaker	Additional Panel Notes											
LP1		Volts:	120/208V, 3PH, 4W	100% Neutral with Ground Bus											
		Poles:	42 + 42	Integral TVSS L3											
		AIC:	42,000												
		Mounting:	Surface	Fed From: Distribution Panel MDP via T-LP1											
Section 2 of 2															
CKT.	Breaker		Description	Notes	Load						Notes	Description	Breaker		CKT.
	Amp	Pole			A		B		C				Pole	Amp	
43	15	1	Water Heater DWH-1 - Mechanical		0.5	1.0						Rec - AV/Data Rack	1	20	44
45	15	1	Circ Pump CP-1 - Mechanical				0.1	1.0				Rec - AV/Data Rack	1	20	46
47	20	1	Rec - Musco Pole #S4	3					0.4	1.0		Rec - AV/Data Rack	1	20	48
49	20	1	Rec - Musco Pole #S6	3	0.4	1.0						Rec - AV/Data Rack	1	20	50
51	20	1	Rec - JV Softball	3			0.4								52
53															54
55															56
57															58
59										4.0	2	MP Field #1 Pressbox Load Center LC1	2	100	60
61						4.0									62
63								4.0			2	MP Field #2 Pressbox Load Center LC2	2	100	64
65										4.0					66
67	25	2	Spare			4.0					2	Softball Pressbox Load Center LC3	2	100	68
69								4.0							70
71	15	1	Spare									Spare	2	20	72
73	20	1	Spare												74
75	20	1	Spare									Spare	2	100	76
77	20	1	Spare												78
79	20	1	Spare									Spare	3	15	80
81	20	1	Spare												82
83	20	1	Spare	4											84
					24.8		24.0		22.6		Total Connected Load KVA: 71.4 KVA				
					Phase Totals										

EASTERN LANCASTER COUNTY SCHOOL DISTRICT
GARDEN SPOT ATHLETICS CAMPUS

D E PROJECT #250540

PANEL			Bus:	175A Main Breaker		Additional Panel Notes									
LP2			Volts:	120/208V, 3PH, 4W		100% Neutral with Ground Bus									
			Poles:	54		Integral TVSS L3									
			AIC:	10,000											
			Mounting:	Surface		Fed From: Distribution Panel MDP via T-LP2									
CKT.	Breaker		Description	Notes	Load						Notes	Description	Breaker		CKT.
	Amp	Pole			A		B		C				Pole	Amp	
1	20	1	Ltg - Interior		0.9	0.5						Rec - Storage, Exterior N	1	20	2
3	20	1	Ltg - Exterior				0.2	0.4				Rec - Storage E	1	20	4
5	20	1	Spare							0.5		Rec - Storage, Exterior E	1	20	6
7	20	1	Overhead Door North		1.0	0.4						Rec - Storage S	1	20	8
9	20	1	Overhead Door Center				1.0	0.7				Rec - Mech, Storage, Exterior W	1	20	10
11	20	1	Overhead Door South						1.0	0.5		Rec - Storage, Exterior W	1	20	12
13	20	2	EWH-6 - Mechanical		1.5	0.7						Rec - Restrooms, Exterior S	1	20	14
15							1.5	0.5				Rec - Data Rack	1	20	16
17	20	2	EWH-5 - Interior Restroom						1.5	1.0		Access Control & Door Hardware Power	1	20	18
19					1.5	0.5					7	FACP	1	20	20
21	20	2	EWH-4 - Exterior Restroom West				1.5	2.0				Inst. Water Heater EWH-2 - Interior Restroom	2	25	22
23									1.5	2.0					24
25	20	2	EWH-3 - Exterior Restroom East		1.5	2.0						Inst. Water Heater EWH-2 - Exterior Restroom West	2	25	26
27							1.5	2.0							28
29	15	1	EF-7 - Storage						0.8	2.0		Inst. Water Heater EWH-2 - Exterior Restroom East	2	25	30
31	15	1	EF-6 - Mechanical		0.1	2.0									32
33	15	1	Infrared Heat - IR-1				0.2	1.0				Water Heater DWH-3 - Mechanical	2	15	34
35	15	1	Infrared Heat - IR-2						0.2	1.0					36
37	20	1	BAS Panel		0.5										38
39															40
41															42
43	15	1	Spare									Spare	2	15	44
45	20	1	Spare												46
47	20	1	Spare									Spare	2	20	48
49	20	1	Spare												50
51	20	1	Spare									Spare	2	25	52
53	20	1	Spare	4											54
					13.1		12.5		12.0		Total Connected Load KVA: 37.6 KVA				
					Phase Totals										

PANEL			Bus:	300A Main Breaker	Additional Panel Notes										
LP3			Volts:	120/208V, 3PH, 4W		100% Neutral with Ground Bus									
			Poles:	42 + 42		Integral TVSS L3									
			AIC:	10,000											
			Mounting:	Surface		Fed From: Distribution Panel MDP via T-LP3									
Section 1 of 2															
CKT.	Breaker		Description	Notes	Load						Notes	Description	Breaker		CKT.
	Amp	Pole			A		B		C				Pole	Amp	
1	20	1	Ltg - Ground Floor & Mezz		1.2	0.9						Rec - Lobby, Exterior NE	1	20	2
3	20	1	Ltg - Indoor Turf Field North				0.9	0.6			4	Rec - Water Cooler	1	20	4
5	20	1	Ltg - Indoor Turf Field Center						0.9	0.6	4	Rec - Water Cooler	1	20	6
7	20	1	Ltg - Indoor Turf Field South		0.9	0.7						Rec - Turf Field, Exterior W	1	20	8
9	20	1	Ltg - Exterior				0.4	0.7				Rec - Turf Field, Exterior N	1	20	10
11	20	1	Spare							0.5		Rec - Turf Field, Exterior N	1	20	12
13	20	1	Overhead Door - Turf Field West		1.0	0.4						Rec - Turf Field E	1	20	14
15	20	1	Overhead Door - Turf Field Center				1.0	0.5				Rec - Turf Field, Exterior S	1	20	16
17	20	1	Overhead Door - Turf Field East						1.0	0.5		Rec - Turf Field, Exterior S	1	20	18
19	20	1	Overhead Door - Athletics Storage Exterior		1.0	0.9						Rec - Athletics Storage	1	20	20
21	20	1	Overhead Door - Athletics Storage Interior				1.0	1.1				Rec - Athletics Storage, Storage	1	20	22
23	20	1	Motorized Batting Cage Hoist North						0.8	0.7		Rec - Office	1	20	24
25	20	1	Motorized Batting Cage Hoist South		0.8	0.7						Rec - Restrooms, Exterior E	1	20	26
27	20	1	Rec - Floorbox Mezz				0.2	0.2				Rec - Floorbox Mezz	1	20	28
29	20	1	Rec - Floorbox Mezz						0.2	0.2		Rec - Floorbox Mezz	1	20	30
31	20	1	Rec - Floorbox Mezz		0.2	0.2						Rec - Floorbox Mezz	1	20	32
33	20	1	Rec - Floorbox Mezz				0.2	0.2				Rec - Floorbox Mezz	1	20	34
35	20	1	Rec - Floorbox Mezz						0.2	0.2		Rec - Floorbox Mezz	1	20	36
37	20	1	Rec - Floorbox Mezz		0.2	0.2						Rec - Floorbox Mezz	1	20	38
39	20	1	Rec - Floorbox Mezz				0.2	0.2				Rec - Floorbox Mezz	1	20	40
41	20	1	Rec - Floorbox Mezz						0.2	0.2		Rec - Floorbox Mezz	1	20	42
					22.8		20.8		19.8		Total Connected Load KVA: 63.4 KVA				
					Phase Totals										

PANEL			Bus:	300A Main Breaker	Additional Panel Notes										
LP3			Volts:	120/208V, 3PH, 4W		100% Neutral with Ground Bus									
			Poles:	42 + 42		Integral TVSS L3									
			AIC:	10,000											
			Mounting:	Surface		Fed From: Distribution Panel MDP via T-LP3									
Section 2 of 2															
CKT.	Breaker		Description	Notes	Load						Notes	Description	Breaker		CKT.
	Amp	Pole			A		B		C				Pole	Amp	
43	20	1	Rec - Mezz		0.5	0.1						EF-10 - JC	1	15	44
45	20	1	Rec - Mezz				0.5	1.5				EWB-7 - Toilet Room	2	20	46
47	20	1	Rec - Mezz						0.7	1.5					48
49	20	1	Rec - Data Rack		0.5	1.5						EWB-8 - Toilet Room	2	20	50
51	20	1	FACP	7			0.5	1.5							52
53	20	1	Access Control & Door Hardware						1.0	1.5		EWB-9 - Exterior Toilet Room	2	20	54
55	15	2	CU-2/HP-1		1.2	1.5									56
57							1.2	1.5				EUH-4 - Athletics Storage	2	20	58
59	15	1	GF-2A						1.2	1.5					60
61	15	1	GF-2B		1.2	1.5						EUH-5 - Athletics Storage	2	20	62
63	15	1	GF-3A				1.2	1.5							64
65	15	1	GF-3B						1.2	1.0		Water Heater DWH-3 - JC	2	15	66
67	20	1	BAS Panel		0.5	1.0									68
69	15	1	Spare					2.0				Inst. Water Heater EWH-2 - Toilet Room	2	25	70
71	20	1	Spare							2.0					72
73	20	1	Spare			2.0						Inst. Water Heater EWH-2 - Toilet Room	2	25	74
75	20	1	Spare					2.0							76
77	15	2	Spare							2.0		Inst. Water Heater EWH-2 - Exterior Tilt Rm	2	25	78
79						2.0									80
81	20	2	Spare									Spare	2	25	82
83															84
					22.8		20.8		19.8		Total Connected Load KVA: 63.4 KVA				
					Phase Totals										

PANEL NOTES	
1	Provide conductors, overcurrent device and exact placement as recommended by the TVSS manufacturer.
2	Refer to Power Riser Diagram for wire and conduit sizes.
3	Refer to Site Plan for wire and conduit sizes.
4	Provide groundfault breaker for personal protection.
5	Provide groundfault breaker for equipment protection.
6	Provide a permanently fastened pad lockable breaker accessory for servicing.
7	Provide Space Age Electronics Model ELOCK-FA for breaker to lock in the ON position and identify breaker.
8	Provide a handle to lock in the on position.
9	Provide 2#10 + 1#10 gnd in 3/4" conduit for voltage drop.
10	Provide 2#8 + 1#8 gnd in 1" conduit for voltage drop.
11	Provide electronic trip breaker with Long Time, Short Time, and Instantaneous adjustments.
12	
13	

SWITCHBOARD/DISTRIBUTION PANEL BREAKER TYPES	
T	Thermal Magnetic
E	Electronic Trip with Long Time, Short Time, Instantaneous Setting Adjustments
ZSI	Zone-Selective Interlocking
EP	Energy/Power Trip Unit with Long Time, Short Time, Instantaneous Setting Adjustments, Zone Selective Interlock, Breaker Status Display & Modbus Wired Communications
GF	Ground Fault Protection
ST	Shunt Trip breaker accessory
HC	Permanently fastened pad lockable breaker accessory for servicing
AERS	Arc Energy Reduction Switch per NEC 240.87

SECTION 260650 – LUMINAIRE SCHEDULE

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the Luminaire Schedule.
- B. The luminaire manufacturers' catalog numbers scheduled hereinafter in the Luminaire Schedule may not include all the required accessories or hardware that is necessary for a complete installation. Provide all the required accessories or hardware that is necessary for a complete installation.
- C. Furnish luminaries with all associated appurtenances including, but not necessarily limited to, lamps, ballasts, drivers, reflectors, lenses and/or louvers, sockets, holders, suspension accessories, pendants, canopies, recessing boxes, plaster frames, and similar items completely wired, assembled, installed, and tested as specified and in the manner indicated.
- D. Every luminaire symbol shall have a luminaire number unless otherwise directed. In instances where a specific luminaire symbol has not been assigned a luminaire number, provide a complete luminaire of the type and wattage designated for a luminaire symbol of similar function and/or as directed by the Engineer.

1.2 LUMINAIRE SCHEDULE INTERPRETATION

- A. The first name luminaire manufacturer and catalog number is the Basis of Design for the intended usage. Additional luminaire manufacturers and catalog series of luminaries listed in the Luminaire Scheduled or added thru addenda are approved equals and may be subject to sample review, footcandle layout for rooms utilizing luminaire and/or a mock-up for Engineer review before final approval will be given.

1.3 MAINTENANCE MATERIALS

- A. Provide 2 of each special tool required for maintenance.

PART 2 - PRODUCTS

2.1 LUMINAIRE SCHEDULE

- A. Refer to Luminaire Schedule attached to the following pages.

PART 3 - EXECUTION – NOT USED

SECTION 260650 - LUMINAIRE SCHEDULE

Mark	Manufacturer	Catalog Number	Description	Volts	Lamps			Driver		Mtg.	Mtg. Height	Notes
					No.	Watts	Type/ Lumens	No.	Type			
OC1	SLG Lighting Barron Lighting ILP CGF	CSC-LS1-G1-FSK-XX ECX Series VCS Series CS10-S Series	LED Canopy Fixture	UNV	1	25	LED 4000	1	DLD	SC		6,13,14
OF1	Kirlin	LWR-09490-3500L-277-XX-50K-XX	LED Flagpole Spotlight	UNV	1	42.6	LED 3926	1	DLD	PM	See Notes	6,9
OP1	LSI NLS Lithonia McGraw-Edison Gardco	MRS-LED-18L-SIL-4-UNV-DIM-30- 70CRI-IMSBT2L-XX NV-1 Series RSX1 Series GLEON Series OPF-S Series	LED Single Head Pole Mount Site Light w/ Integral Motion Sensor – Type 4 Distribution	UNV	1	135	LED 17101	1	DLD	PM	25'-0"	6,10,13
OP2	LSI NLS Lithonia McGraw-Edison Gardco	(2) MRS-LED-18L-SIL-4-UNV-DIM-30- 70CRI-IMSBT2L-XX NV-1 Series RSX1 Series GLEON Series OPF-S Series	LED Dual Head Pole Mount Site Light w/ Integral Motion Sensor – (2) Type 4 Distribution @ 180-degrees	UNV	1	270	LED 34202	1	DLD	PM	25'-0"	6,10,13
OP3	LSI NLS Lithonia McGraw-Edison Gardco	MRS-LED-06L-SIL-3-UNV-DIM-30- 70CRI-IMSBT1L-XX NV Series RSX1 Series GLEON Series OPF-S Series	LED Single Head Pole Mount Site Light w/ Integral Motion Sensor - Type 3	UNV	1	39	LED 6016	1	DLD	PM	15'-0"	6,11,13
OP4	LSI NLS Lithonia McGraw-Edison Gardco	MRS-LED-06L-SIL-FT-UNV-DIM-30- 70CRI-IMSBT1L-XX NV-1 Series RSX1 Series GLEON Series OPF-S Series	LED Single Head Pole Mount Site Light w/ Integral Motion Sensor – Forward Throw Distribution	UNV	1	39	LED 5822	1	DLD	PM	15'-0"	6,11,18

Mark	Manufacturer	Catalog Number	Description	Volts	Lamps			Driver		Mtg.	Mtg. Height	Notes
					No.	Watts	Type/ Lumens	No.	Type			
OW1	Beacon Gardco McGraw-Edison Lithonia NLS	VPW-1-24L-10-3K7-4W-UNV-XX 121 Series ISC Series WST Series NV-W Series	Exterior LED Wall-Mount Fixture w/ Type 4 Distribution	UNV	1	10	LED 964	1	DLD	SW	See Notes	6,7,8, 13
OW2	Beacon Gardco McGraw-Edison Lithonia NLS	VPW-2-48L-35-3K7-4F-UNV-XX 121-16L-700-NW-G4-3-UNV-DD-XX ISC Series WST Series NV-W	Exterior LED Wall-Mount Fixture w/ Type 4 Distribution	UNV	1	35	LED 4536	1	DLD	SW	See Notes	6,7,8, 13
CH1	Oracle Lithonia Williams Metalux Day-Brite	4-OCL-LED-5000L-DIM10-MVOLT- 35K-85-OVCH ZL1D Series 76R Series SNLED Series FLP Series	4' LED Industrial	UNV	1	37	LED 5253	1	DLD	CH	8'-0" min	1,5
EM1	Lithonia Sure-Lites Compass Evenlite	ELM4L-UVOLT-LTP SELHP Series CU2 Series TEBL5 Series	LED Emergency Lighting Battery Pack w/ Remote Capacity	UNV	2	3.3	LED 320	-	-	SW	7'-0" AFF	
EM2	Lithonia Sure-Lites Compass Evenlite	ELA-T-SD-Q-L0309-M12 SRP Series CIR Series PI Series	LED Emergency Dual Remote Heads - Interior	9.6	2	1.5	LED 200	-	-	SW	7'-0" AFF	
EM3	Lithonia Sure-Lites Compass Evenlite	ELA-T-SD-QWP-L0309-M12 SRP Series COR Series PRW Series	LED Emergency Dual Remote Heads - Exterior	9.6	2	1.5	LED 200	-	-	SW	7'-0" AFF	
EX1	Lithonia Sure-Lites Compass Evenlite	LHQM-LED-R-SD LPXC Series CC Series TCXCOM Series	LED Combination Exit Sign and Emergency Lighting Unit w/ Remote Capacity Battery	UNV	-	-	LED	-	-	SW/SC		2,3

Mark	Manufacturer	Catalog Number	Description	Volts	Lamps			Driver		Mtg.	Mtg. Height	Notes
					No.	Watts	Type/ Lumens	No.	Type			
P1	ILP Columbia Lithonia Metalux Day-Brite	RB5L-26L-U-CCTS-PFL+Cx/5W+ RB5-AC10/SS+RB5L-WG CRN2 Series JEHL Series UHB Series HCY Series	LED High Bay (Indoor Turf Field)	UNV	1	167	LED 24154	1	DLD	AH	Varies	4,6,8
RC1	Williams Lithonia Oracle	BP-2-2-LS-8-C-DIM-UNV CPANL Series 22-FPL-BL-LED Series	2'x2' LED Edgelit Flat Panel	UNV	1	41	LED 4543	1	DLD	RC		12
RC1E	Williams Lithonia Oracle	BP-2-2-LS-8-C-DIM-UNV-EM/8W CPANL Series 22-FPL-BL-LED Series	2'x2' LED Edgelit Flat Panel w/ Emer Battery	UNV	1	41	LED 4543	1	DLD	RC		12
RC2	Williams Lithonia Oracle	BP-2-2-LS-8-C-DIM-UNV-DFK- 2424W CPANL Series 22-FPL-BL-LED Series	2'x2' LED Edgelit Flat Panel w/ Flange Trim Kit	UNV	1	41	LED 4543	1	DLD	RC		12
RC2E	Williams Lithonia Oracle	BP-2-2-LS-8-C-DIM-UNV-DFK- EM/8W-2424W CPANL Series 22-FPL-BL-LED Series	2'x2' LED Edgelit Flat Panel w/ Emer Battery & Flange Trim Kit	UNV	1	41	LED 4543	1	DLD	RC		12

Driver & Ballast Legend	
Symbol	Description
DLD	Dimming LED Driver, 0-10 volts.
LD	LED driver.
1LE	One lamp electronic
2LE	Two lamp electronic
3LE	Three lamp electronic
4LE	Four lamp electronic
FD	Fluorescent dimming as specified.
HID	Magnetic HID
DMX	DMX Dimming Driver

Mounting Legend			
Symbol	Description	Symbol	Description
RC	Recessed Ceiling	S	Suspended
RW	Recessed Wall	UC	Under Cabinet
SC	Surface Ceiling	PD	Per Detail on Drawings
SW	Surface Wall	PM	Pole Mounted
CH	Chain Hung	IG	Recessed In-Ground
AH	Aircraft Cable Hung	PT	Pole Top Mounted
P	Pendant	T	Track
WB	Wall Bracket	B	Bollard
SF	Surface Floor		

General Notes	
G1	Check descriptions against catalog numbers. Report any discrepancies prior to submitting a proposal for this work.
G2	Where the listed manufacturer of acceptable substitutes makes more than one grade of the fixture, provide the grade of fixture with equal or better construction, materials and performance as determined by the manufacturer.
G3	Engineer must approve all substitutes prior to bid.
G4	All Recessed 1x4, 2x2 and 2x4 fixtures shall have spring-loaded latches. Cam action (friction) latches are not acceptable.
G5	All drivers/ballasts shall be Universal 120-277 voltage. If universal driver is unavailable, furnish 277 volt type.
G6	Refer to Specifications Sections 265100 and 265600 for additional requirements.
G7	All approved equal pendant manufacturers will be required to submit footcandle layouts to verify they meet the basis of design.
G8	The luminaire schedule was developed with three or more equals to provide a competitive bidding climate. In certain circumstances, some luminaires are deemed proprietary due to local ordinance specifications or performance characteristics where alternate manufacturers cannot meet the requirements of the basis of design. In these cases where it is noted "No substitutions," the electrical distributors shall have the authority to require unit pricing from the manufacturer's representative in order to assemble the most competitive lump sum price for the luminaire package. Manufacturer representatives who fail to comply with this requirement risk changes to the luminaire schedule.

Luminaire Notes	
1	Provide stem/chain size as required.
2	Provide single or double faces as required.
3	Provide all additional mounting accessories for each application.
4	Provide aircraft cable length as required.
5	Provide continuous lengths as shown on the drawings.
6	Architect to select finish of luminaire. Provide color samples with submittals to Architect for review and selection.
7	Locations/Heights shown on Electrical Drawings are approximate. Coordinate exact mounting height and location with Architectural Elevations. Review with Architect before rough-in.
8	Review all field locations with Architect before rough-in.
9	Confirm recommended mounting height with manufacturer based on flag size provided by Owner. Confirm pole diameter at mounting height (tapered pole) with GC/Architect prior to ordering fixtures.
10	Provide 22' aluminum square pole with individual bolt covers. Provide pole base per Detail 8/E-401 on the Drawings to mount pole and luminaires.
11	Provide 12' aluminum square pole with individual bolt covers. Provide pole base per Detail 8/E-401 on the Drawings to mount pole and luminaires.
12	Set adjustable wattage to 40W output and color temperature to 3500K.
13	Basis of Design – Building and Parking Lot fixtures meet the township ordinance requirements. Approved equal manufacturers will be required to submit Approval Drawings to the Township and Engineer showing building and site layout, point by point calculation results and catalog cuts verifying photometric properties of luminaries. Final approval will only be given after these items are submitted.
14	Set adjustable wattage to 25W (4,000 lumen output) and color temperature to 3000K.

END OF SECTION 260650

SECTION 260800 – ELECTRICAL SYSTEMS COMMISSIONING

PART 1 - GENERAL

1.1 SUMMARY

- A. The purpose of this section is to specify the Division 26 responsibilities and participation in the commissioning process.
- B. Work under this contract shall conform to requirements of Division 1, General Requirements, Conditions of the Contract, and Supplementary Conditions. This specification covers commissioning of electrical systems which are part of this project.
- C. Commissioning work shall be a team effort to ensure that all electrical equipment and systems have been completely and properly installed, function together correctly to meet the design intent, and document system performance. Commissioning shall coordinate system documentation, equipment start-up, and verification and performance testing.
- D. The commissioning team shall be made up of representatives from the Owner, design professionals, major equipment suppliers, and electrical contractor. The lead person for each trade who will actually perform or supervise the work is to be designated as the representative to the commissioning team. Responsibility for various steps of the commissioning process shall be divided among the members of the commissioning team, as described in this section.
- E. The Commissioning Authority shall have responsibility for coordinating and directing each step of the commissioning process. The Authority shall be a true third party, not affiliated with any of the companies involved with the project design.
- F. Electrical system installation, start-up, testing, preparation of O&M manuals, and operator training shall be the responsibility of the Division 26 Electrical Contractor, with coordination, observation, verification and commissioning the responsibility of Commissioning Agent,
- G. The commissioning process does not relieve the Division 26 Electrical Contractor from the obligations to complete all portions of work in a satisfactory and fully operational manner.

1.2 QUALITY ASSURANCE

- A. Qualifications:
 - 1. The CTC (Certified Testing Company) performing the work of this section shall be qualified to test electrical equipment and is a NETA (National Electrical Testing Association)-certified testing agency. The CTC shall not be associated with the manufacturer of equipment or systems under test.
- B. Test Equipment:
 - 1. The Subcontractor shall provide all test equipment necessary to fulfill the checks and testing requirements. Test equipment shall have been calibrated within one (1) year of its use on the project.
 - 2. Refer to the Division 1 – Commissioning Requirements Section for additional requirements.

1.3 ROLES AND RESPONSIBILITIES

- A. Refer to Division 01, General Requirements, Conditions of the Contract, and Supplementary Conditions for the Commissioning Agent, Owner, Architect, and General Contractor roles and responsibilities.
- B. Electrical Contractor Responsibilities:
 - 1. Include cost to complete commissioning requirements for electrical systems in the contract price.
 - 2. Include requirements for submittal data, O&M data, and training in each purchase order or sub-contract written.
 - 3. Ensure cooperation and participation of specialty sub-contractors such as communications, data, etc.
 - 4. Ensure participation of major equipment manufacturers in appropriate training and testing activities.
 - 5. Attend Construction Phase coordination meetings scheduled by the Commissioning Agent.
 - 6. Conduct electrical system orientation and inspection when equipment is set.
 - 7. Respond to (in writing) and address items documented in the Contractor Commissioning Issues Log.
 - 8. Submit copies of all test results to the CxA.
 - 9. Complete Pre-Functional Checklists for all equipment.
 - a. Remedy any deficiencies identified in Pre-Functional Checklists and notify CxA in writing that deficiencies have been addressed.
 - 10. Assist the Commissioning Agent in all Pre-Functional Checklist verifications and Functional Performance Tests.
 - 11. Prepare preliminary schedule for electrical system orientation and inspections, O&M manual submission, training sessions, testing, equipment start up, and task completion for use by the Commissioning Agent. Update schedule as appropriate throughout the construction period.
 - 12. Attend initial training session.
 - 13. Conduct electrical system orientation and inspection at the equipment placement completion stage.
 - 14. Update drawings to the record condition to date, and review with the Commissioning Agent.
 - 15. Gather O&M data on all equipment and assemble in binders as required by the Commissioning Specification. Submit to Commissioning Agent for review prior to the completion of construction.
 - 16. Notify the Commissioning Agent a minimum of two weeks in advance, so that witnessing equipment and system start-up and testing can begin.
 - 17. Participate in, and schedule vendors and Contractors to participate in the training sessions as set up by the Commissioning Agent.
 - 18. Provide a complete set of as-built records to the Commissioning Agent.
- C. Equipment Suppliers and Miscellaneous Contractors Responsibilities:
 - 1. Include cost for commissioning requirements in the contract price.
 - 2. Provide submittals, and appropriate O&M manual sections.
 - 3. Attend initial commissioning coordination meeting scheduled by the Commissioning Agent.
 - 4. Participate in training sessions as scheduled by the Commissioning Agent.
 - 5. Demonstrate performance of equipment as applicable.

1.4 SCOPE OF WORK

- A. Commissioning work of Division 26 shall include, but not be limited to:
 - 1. Testing and start-up of the equipment.
 - 2. Completion of Functional Checklists.
 - 3. Cooperation with the Commissioning Agent.

4. Providing qualified personnel for participation in commissioning tests, including seasonal testing required after the initial testing.
 5. Providing equipment, materials, and labor as necessary to correct construction and/or equipment deficiencies found during the commissioning process.
 6. Providing operation and maintenance manuals, and as-built drawings to the Commissioning Agent for verification.
 7. Providing training and demonstrations for the systems specified in this Division.
- B. The work included in the commissioning process involves a complete and thorough evaluation of the operation and performance of all components, systems, and sub-systems. The following equipment and systems shall be evaluated:
1. Switchboards
 - a. Visual and Mechanical Inspection
 - 1) Verify engraved nameplate is installed with the proper identification.
 - 2) Verify engraved nameplate for each feeder overcurrent device showing name of load, each spare size and each available space size are installed with the proper identification.
 - 3) Verify mimic bus is installed to indicate all switchboard components.
 - 4) Inspect physical, electrical, and mechanical condition of switchboard and all components.
 - 5) Verify ground fault pickup and time-delay settings (if applicable) are setup per the coordination study.
 - 6) Verify that all circuit breakers are equipped with the correct rating plugs and current sensors.
 - 7) Verify all circuit breaker setting adjustments match the requirements of the coordination study.
 - 8) Verify customer metering is setup and connected to the data network.
 - b. Electrical Tests
 - 1) Access the meter information by the IP address to verify it is operational.
 - 2) Make ground fault pickup and time-delay setting adjustments (if applicable) in accordance with the coordination study.
 - 3) Make circuit breaker setting adjustments in accordance with the coordination study.
 2. Distribution Panelboards (600A and Above)
 - a. Visual and Mechanical Inspection
 - 1) Verify engraved nameplate is installed with the proper identification.
 - 2) Verify typed circuit directory for panelboard is showing the correct room name and/or number.
 - 3) Inspect physical, electrical, and mechanical condition of panelboard and all components.
 - 4) Verify ground fault pickup and time-delay settings (if applicable) are setup per the coordination study.
 - 5) Verify that all circuit breakers are equipped with the correct rating plugs and current sensors.
 - 6) Verify all circuit breaker setting adjustments match the requirements of the coordination study.
 - 7) Verify customer metering is setup and connected to the data network.
 - b. Electrical Tests
 - 1) Access the meter information by the IP address to verify it is operational.
 - 2) Make ground fault pickup and time-delay setting adjustments (if applicable) in accordance with the coordination study.
 - 3) Make circuit breaker setting adjustments in accordance with the coordination study.
 3. Lighting Control System (30% Sampling Rate)
 - a. Visual and Mechanical Inspection
 - 1) Verify lighting loads are circuited per the zones indicated on the drawings.

- 2) Verify controllers with the correct relay quantity are installed in the correct location.
- 3) Verify each occupancy sensor type is installed in the correct location.
- 4) Verify each wall switch type is installed in the correct location.
- 5) Verify each daylight sensor type is installed in the correct location.
- 6) Verify partition controls are installed in the correct location.
- 7) Verify exterior daylight sensors are installed in the correct location.
- 8) Verify all controllers/network bridges/border routers are connected to the network.
- 9) Verify segment manager is connected and can be access by the building management system.
- 10) Verify all emergency lighting control devices are installed in the correct location.
- b. Electrical Tests
 - 1) Test each controller relay is programmed to match the sequence of operation for normal and after hour modes.
 - 2) Test each occupancy sensor type is programmed to match the sequence of operation for normal and after hour modes.
 - 3) Test each wall switch type is programmed to match the sequence of operation for normal and after hour modes.
 - 4) Test each daylight sensor type is programmed to match the sequence of operation for normal and after hour modes.
 - 5) Test partition controls work with combined and separate rooms.
 - 6) Test exterior daylight sensors.
 - 7) Test connection to controllers/network bridges/border routers.
 - 8) Access the lighting control system by the IP address to verify it is operational.
 - 9) Test emergency lighting control devices.
4. Engine Generators & Transfer Switches
 - a. Visual and Mechanical Inspection
 - 1) Verify engraved nameplate are installed with the proper identification on the generators and transfer switches.
 - 2) Verify transfer switches are setup as required.
 - 3) Verify fuel source is connected or tank is full.
 - 4) Verify remote annunciator is connected and working.
 - 5) Verify battery charger, block heater and additional generator equipment is connected to the circuits indicated.
 - b. Electrical Tests
 - 1) Witness power failure simulation including operation of transfer switch, automatic starting cycle, and automatic shutdown and return to normal. Use the connected load for all tests.
 - 2) Witness full load test utilizing portable test bank for 2 hours.
 - 3) Witness test alarm and shutdown circuits by simulating conditions.
 - 4) Witness multiple generator starts.
 - 5) Verify all operational data and start-up minimum time interval.
 - 6) Verify all generator-running characteristics.
 - 7) Verify battery-charging system.
5. Electrical support for mechanical equipment listed in the Commissioning of HVAC Systems.

1.5 SUBMITTALS FOR REVIEW

- A. The Commissioning Agent shall review the relevant submittals and provide any comments to the Engineer for inclusion in their review comments.

- B. The Commissioning Agent will review the approved submittals and prepare the functional test procedures required for the equipment to be commissioned.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. The Electrical Contractors shall furnish all special tools and equipment required for testing during the commissioning process. A list of all tools and equipment to be used during commissioning shall be submitted to the Commissioning Agent for approval.

2.2 PROPRIETARY TEST EQUIPMENT

- A. Proprietary test equipment and software required by any equipment manufacturer for programming and/or start-up, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning process as needed. Proprietary test equipment (and software) shall become the property of the Owner upon completion of the commissioning process.

PART 3 - EXECUTION

3.1 TESTING PREPARATION

- A. Certify that electrical systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
- B. Certify that electrical instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.
- C. Certify that testing and adjusting procedures have been completed and that testing and adjusting reports have been submitted, discrepancies corrected, and corrective work approved.
- D. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
- E. Inspect and verify the position of each device and interlock identified on checklists.
- F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
- G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the Commissioning Agent.

3.2 TESTING VERIFICATION

- A. Prior to performance of testing Work, provide copies of reports, sample forms, checklists, and certificates to the Commissioning Agent.

- B. Notify the Commissioning Agent at least 10 days in advance of testing Work and provide access for the Commissioning Agent to witness testing Work.
- C. Provide technicians, instrumentation, and tools to verify testing of electrical systems at the direction of the Commissioning Agent.
 - 1. The Commissioning Agent will notify testing Contractor 10 days in advance of the date of field verification. Notice will not include data points to be verified.
 - 2. The testing Contractor shall use the same instruments (by model and serial number) that were used when original data were collected.
 - 3. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing and adjusting report.
 - 4. Remedy the deficiency and notify the Commissioning Agent so verification of failed portions can be performed.

3.3 GENERAL TESTING REQUIREMENTS

- A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the Commissioning Agent.
- B. Scope of electrical testing shall include all components, equipment, and systems as outlined in this section.
- C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response to input signals.
- D. Tests will be performed using design conditions whenever possible.
- E. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the Commissioning Agent and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
- F. The Commissioning Agent may direct that set points be altered when simulating conditions is not practical.
- G. The Commissioning Agent may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.
- H. If tests cannot be completed because of a deficiency outside the scope of the electrical system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.

3.4 REPORT

- A. Provide a written report of all outstanding electrical items that need to be corrected.

END OF SECTION 260800

SECTION 260923 – LIGHTING CONTROLS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Time Controls
- B. Photoelectric Relays

1.2 REFERENCES

- A. ANSI/NFPA 70 – National Electrical Code

1.3 SUBMITTALS FOR REVIEW

- A. Submit under provisions of Section 260010.
- B. Shop Drawings: The following items shall be submitted for review and approval:
 - 1. Submittal booklet to include the following:
 - a. Reference to Specification Section.
 - b. A list of all equipment to be provided and installed in the system.
 - c. Data sheets of all items to be provided with the specific item or model number highlighted.

1.4 SUBMITTALS FOR CLOSEOUT

- A. Submit under provisions of Section 260010.
- B. Record actual locations of dimmer outlets and circuiting arrangements in project record documents.
- C. Operation Data:
 - 1. Instructions for operating lighting control system.
 - 2. Instructions for operating system under unusual conditions when emergency life safety conditions exist.
 - 3. Operating limits which may result in hazardous or unsafe conditions, or in equipment damage.
 - 4. Document ratings of system and of each major component.
- D. Maintenance Data:
 - 1. Routine preventive maintenance schedule.
 - 2. Lists of special tools, maintenance materials, and replacement parts.
 - 3. Repair instructions for procedures to check, repair, and test equipment during typical malfunctions.
 - 4. Recommended cleaning methods, frequency, and materials.

1.5 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Supplier: Authorized or Franchised distributor of specified manufacturer with minimum three years documented experience.

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Products: Listed and classified by Underwriters Laboratories, Inc., or a testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation

1.8 WARRANTY

- A. Provide the warranty specified in Section 260010.

PART 2 - PRODUCTS

2.1 TIME CONTROLS

- A. Electric photo initiated
- B. Manufacturers:
 - 1. Intermatic ET8000CR Series
 - 2. Tork
 - 3. Paragon
- C. Scheduling Capability:
 - 1. The electronic time switch shall be a solid-state digital type capable of distributing setpoints on independent daily schedules throughout a 7-day time-period. The time switch shall provide for a 5-weekday programming, 2 weekend day programming or all 7-day programming to simplify program entry for typical 5/2-day load control. A copy feature shall be provided for duplicating full daily schedules where the 5/2-day scheduling is not applicable. The time and setpoints shall be programmable to the nearest minute with a minimum ON duration of 1 minute and a maximum of 6 days, 23 hours, and 59 minutes. The time switch shall have a digital LED readout and prompt LEDs for each function to further simplify program entry. Each load control shall include an ON/OFF pushbutton, an ENABLE/DISABLE switch, and an LED load status indicator. The time switch shall provide an operating temperature range of -40°F (-40°C) to 122°F (50°C).
 - 2. The time switch shall provide astronomic programming and momentary or interval programming for any or all circuits independently. Astronomic control shall automatically calculate "center of time zone" times for both sunrise and sunset and allow user-selectable offset of actual times. Pulse output shall be programmable for any duration of 1-127 seconds and interval output for up to 6 days, 23 hours, and 59 minutes. Interval output

shall also provide for user selectable override to turn load(s) on for a limited programmed time-period up to 6 days, 23 hours, and 59 minutes. See additional specifications to follow.

- D. Automatic Adjustment: The time switch shall provide full year control by providing automatic leap year and daylight-saving time adjustment. A user selectable override shall be provided for states not observing daylight saving time. The time switch shall also provide holiday or special day control requirements by providing up to 99 holiday schedules. Each of the holiday schedules shall be programmable for a single day or any duration as required. Each holiday schedule shall provide automatic no load activity and shall be independently programmable for a unique load schedule if required.
- E. Memory: A non-volatile memory shall maintain all program data for the life of the time switch without the need for battery backup. The time switch shall include a factory installed lithium battery backup which shall maintain clock time and calendar data for 8 years minimum. The single coil cell backup shall be user replaceable without removing the field wiring.
- F. Protection: The time switch logic control circuitry shall be isolated and shielded to prevent EMI and RFI interference, for reliable operation in electrically noisy environments. The power board circuitry shall provide protection for transients up to 6,000 volts. All control times shall be accurate to the minute and synchronized to the 50 to 60 Hz input. The time switch shall provide user-selectable 12-hour AM/PM or 24-hour clock formats.
- G. Enclosure: The time switch shall be enclosed in a lockable steel NEMA 1 enclosure. The time switch shall be powered by 120 or 60 Hz source.
- H. Contacts: Switch configuration to be SPDT for each circuit with a UL 916 Energy Management Equipment listed rating of:
 - 1. Normally Open Contacts: 470 VA pilot duty, 12-240 VAC
 - 2. Normally Closed Contacts: 276 VA pilot duty, 12-240 VAC
- I. Output Channels: As required plus 20% spare (8 min).
- J. Accessories: Provide relay for photo initiation of ON period on all channels.

2.2 PHOTOELECTRIC RELAYS

- A. Manufacturers:
 - 1. Intermatic
 - 2. Tork
 - 3. Paragon
 - 4. Allen-Bradley Co., Inc.
- B. Conform to UL 773A
- C. Type: Solid stage, with SPDT dry contacts rated to operate relay or contactor coils to which connected.
- D. Time delay prevents false operation.
- E. Outdoor Sealed Units: Weathertight housing, resistant to high temperatures and equipped with sun-glare shield and ice preventer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that surface is suitable for time controls and photo electric relay.

3.2 INSTALLATION

- A. Install time controls where indicated, in accordance with manufacturer's instructions.
- B. Install time controls plumb. Provide supports in accordance with Section 260190.
- C. Refer to Section 260010 for mounting heights.
- D. Mount photocell for time control on north face of the roof. Adjust sensitivity as directed by manufacturer.
- E. Connect photocell to time control with 3 #12 in 3/4" conduit unless otherwise directed by manufacturer.
- F. Provide engraved plastic nameplates under the provisions of Section 260195.

3.3 FIELD QUALITY CONTROL

- A. Perform inspection and testing.
- B. Verify settings of photoelectric devices with photometer calibrated to National Institute for Science and Technology (NIST) within the past 6 months.

3.4 MANUFACTURER'S FIELD SERVICES

- A. Prepare and start systems as required.

3.5 ADJUSTING

- A. Adjust installed work as required.

3.6 CLEANING

- A. Clean installed work as required.
- B. Clean electrical parts to remove conductive and harmful materials.
- C. Remove dirt and debris from enclosure.

3.7 DEMONSTRATION

- A. Provide systems demonstration as required.
- B. Demonstrate operation of time controls and photoelectric relay.

3.8 TRAINING

- A. Personnel Training: Provide and pay for the services of a factory-authorized service representative to demonstrate the system and train Owners personnel.
 - 1. Provide training for operating, testing, troubleshooting and general maintenance of the system.
 - 2. Provide a minimum of one, 1-hour session.
 - 3. Provide documentation of sessions to Architect/Engineer with signatures of at least 3 Owners Representatives present at demonstration.

END OF SECTION 260923

SECTION 260924 – OCCUPANCY SENSORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Occupancy Sensors

1.2 REFERENCE

- A. ANSI/NFPA 70 – National Electrical Code

1.3 SUBMITTALS FOR REVIEW

- A. Submit under provisions of Section 260010.
- B. Shop Drawings: The following items shall be submitted for review and approval:
 - 1. Submittal booklet to include the following:
 - a. Reference to Specification Section.
 - b. A list of all equipment to be provided and installed in the system.
 - c. Data sheets of all items to be provided with the specific item or model number highlighted.
 - d. Interconnection wiring diagrams.
 - e. Load restrictions for each device when used with electronic ballasts.
 - f. Overall lighting plan clearly marked by manufacturer showing proper product, location, and orientation of each sensor.

1.4 SUBMITTALS FOR CLOSEOUT

- A. Submit under provisions of Section 260010.
- B. Record actual locations of each occupancy sensor in project record documents.
- C. Operation Data:
 - 1. Instructions for operating lighting control system.
 - 2. Instructions for operating system under unusual conditions when emergency life safety conditions exist.
 - 3. Operating limits which may result in hazardous or unsafe conditions, or in equipment damage.
 - 4. Document ratings of system and of each major component.
- D. Maintenance Data:
 - 1. Routine preventive maintenance schedule.
 - 2. Lists of special tools, maintenance materials, and replacement parts.
 - 3. Repair instructions for procedures to check, repair, and test equipment during typical malfunctions.
 - 4. Recommended cleaning methods, frequency, and materials.

1.5 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Supplier: Authorized or Franchised distributor of specified manufacturer with minimum three years documented experience.

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Products: Listed and classified by Underwriters Laboratories, Inc., or a testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation

1.8 SYSTEM DESCRIPTION

- A. The objective of this section is to ensure the proper installation of the occupancy-sensor based lighting control system so that lighting is turned off automatically after reasonable time delay (minimum 15 minutes) when a room or area is vacated by the last person to occupy said room or area.
- B. The occupancy-sensor based lighting control shall accommodate all conditions of space utilization and all irregular work hours and habits.

1.9 SYSTEM OPERATION

- A. It shall be the contractor's responsibility to make all proper adjustments to assure Owner's satisfaction with the occupancy system.

1.10 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 - 1. Wall Switches: 1 for every 10 of each type installed. Furnish at least 1 of each type installed.
 - 2. Occupancy Sensors: 1 for every 20 of each type installed. Furnish at least 2 of each type installed.

1.11 WARRANTY

- A. Provide the warranty specified in Section 260010.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Wall switch sensors shall be capable of detection of occupancy at desktop level up to 300 square feet, and gross motion up to 1000 square feet.
- B. Wall switch sensors shall accommodate loads from 0 to 800 watts at 120 volts; 0 to 1200 watts at 277 volts and shall have 180° coverage capability.
- C. Wall switch products shall utilize Zero Crossing Circuitry which increases relay life, protects from the effects of inrush current, and increases sensor's longevity.
- D. Wall switch sensors shall have no leakage current to load, in manual or in Auto/Off mode for safety purposes and shall have voltage drop protection.
- E. Dual technology sensors shall be either corner mounted or ceiling mounted in such a way as to minimize coverage in unwanted areas.
- F. Dual technology shall consist of passive infrared and ultrasonic technologies for occupancy detection. Microphonics Equipment shall be acceptable equals.
- G. Ultrasonic sensors shall utilize Advanced Signal Processing to adjust the detection threshold dynamically to compensate for constantly changing levels of activity and airflow throughout controlled space.
- H. Ultrasonic operating frequency shall be crystal controlled at 40 kHz $\pm$ 0.002% tolerance to assure reliable performance and eliminate sensor crosstalk. Sensors using 32 kHz or multiple frequencies are not acceptable.
- I. All sensors shall be capable of operating normally with electronic ballasts, PL lamp systems and rated motor loads.
- J. Coverage of sensors shall remain constant after sensitivity control has been set. No automatic reduction shall occur in coverage due to the cycling of air conditioner or heating fans.
- K. All sensors shall have readily accessible, user adjustable settings for time delay and sensitivity. Settings shall be located on the sensor (not the control unit) and shall be recessed to limit tampering.
- L. In the event of failure, a bypass manual override shall be provided on each sensor. When bypass is utilized, lighting shall remain on constantly or control shall divert to a wall switch until sensor is replaced. This control shall be recessed to prevent tampering.
- M. All sensors shall provide an LED as a visual means of indication at all times to verify that motion is being detected during both testing and normal operation.
- N. All sensors shall have UL rated, 94V-0 plastic enclosures.

2.2 SINGLE BUTTON AUTOMATIC WALL SWITCH

- A. Manufacturers:
 - 1. Watt Stopper Model DW-100
 - 2. Sensor Switch Model WSX-PDT-XX

3. Leviton Model OSSMT-MDX
4. Lutron Model MSX102-XX

2.3 TWO BUTTON AUTOMATIC WALL SWITCH

- A. Manufacturers:
1. Watt Stopper Model DW-200
 2. Sensor Switch Model WSX-PDT-2P-XX
 3. Leviton Model OSSMD-MDX
 4. Lutron Model MSX202-XX

2.4 0-10V DIMMING WALL SWITCH OCCUPANCY SENSOR

- A. Manufacturers:
1. Watt Stopper Model DW-311-X
 2. Hubbell Model LHDMMTS-2-N-XX
 3. Sensor Switch Model WSX-PDT-D-XX

2.5 ULTRASONIC OCCUPANCY SENSOR with 120 or 277-VOLT RELAY POWER PACK

- A. Manufacturers:
1. Watt Stopper Model WT-1100
 2. Sensor Switch Model CM-PDT-9
 3. Leviton Model OSC10-U0W

- B. Usage: Gang Toilet Rooms

2.6 DUAL TECHNOLOGY SENSOR with 120 or 277-VOLT RELAY POWER PACK

- A. Manufacturers:
1. Watt Stopper Model DT-200
 2. Sensor Switch Model WV-PDT-16
 3. Leviton Model OSW12-M0W (for rooms under 1000 SF). Provide 2 sensors for rooms over 1000 SF.

- B. Usage: Classrooms, Large Conference Rooms, and other similar size rooms.

2.7 360° DUAL TECHNOLOGY SENSOR WITH 120 OR 277-VOLT RELAY POWER PACK

- A. Manufacturers:
1. Watt Stopper Model DT-300
 2. Sensor Switch Model CM-PDT-9
 3. Leviton Model OSC10-M0W

- B. Usage: Offices and small conference rooms.

2.8 CIRCUIT CONTROL HARDWARE - CU

- A. Control Units - For ease of mounting, installation and future service, control unit(s) shall be able to externally mount through a 1/2" knock-out on a standard electrical enclosure and be an integrated, self-contained unit consisting internally of an isolated load switching control relay and

a transformer to provide low-voltage power. Control unit shall provide power to a minimum of 2 sensors.

- B. Relay contacts shall have ratings of:
 - 1. 20A - 120 VAC Ballast
 - 2. 20A - 277 VAC Ballast
- C. Control wiring between sensors and controls units shall be Class II, 18-24 AWG, stranded UL Classified, PVC insulated or TEFLON jacketed cable suitable for use in plenums, where applicable.
- D. Minimum acceptable wire gauge from the circuit control hardware relays shall be #14 AWG.
- E. Provide power packs as required for all sensors. All power packs shall be universal voltage.

2.9 PROTECTIVE CAGES

- A. Manufacturers:
 - 1. Watt Stopper Model WC-1, WC-2, WC-3, or WC-4
 - 2. Sensor Switch Model WG1, WG2, WG3, or WG4
 - 3. Leviton Model OSWCG-W, OSWWG-W, OSWWG-POW, OSWCG-POW, OSFCG-W, or ODCCG
- B. Provide protective cages for all devices located in the Gymnasium and other areas shown on the Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. It shall be the contractor's responsibility to locate and aim sensors in the correct location required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas per the manufacturer's recommendations. Rooms shall have 90% to 100% coverage to completely cover the controlled area 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 the rooms which are to be provided with sensors. The contractor shall provide additional sensors if required to properly and completely cover the respective room.
- B. Time delays shall be set to a fixed interval of 15 minutes, minimum. In some cases, this may need to be increased, depending upon the use of the space.
- C. It is the contractor's responsibility to arrange a pre-installation meeting with manufacturer's factory authorized representative, at Owner's facility, to verify placement of sensors and installation criteria.
- D. Proper judgment must be exercised in executing the installation to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components. The Contractor shall also provide, at the Owner's facility, the training necessary to familiarize the Owner's personnel with the operation, use, adjustment and problem-solving diagnosis of the occupancy sensing devices and systems.
- E. Wiring Methods:

1. Wire Routing: Route wiring from each device up into accessible ceiling cavity within recessed metallic conduit. Stub all conduits into accessible ceiling cavity and provide bushing for each.
2. Cable Routing: Route wiring within accessible ceiling cavities. Install cable supports at 4' spacing maximum or in cable tray where applicable. No cabling is to lie on or attach to ceiling tile, ducts, pipes, conduits or ceiling suspension wires, rods, or structural members. Provide conduit stubs from devices and panels to the ceiling cavities.
3. Route all system wiring from system equipment within metallic conduit up into nearby ceiling cavity and connect to the wiring system indicated above. Provide bushings at conduit ends.
4. Provide raceways for all cabling in open structure spaces.

3.2 SETUP

- A. Provide dip switch setting for the following setup.
- B. Single button automatic wall switch:
 1. On – manual
 2. Off – sensor (15-minute delay)
- C. Two button automatic wall switch:
 1. On – manual
 2. Off – sensor (15-minute delay)
- D. 0-10V dimming wall switch occupancy sensor:
 1. On – manual
 2. Off – sensor (15-minute delay)
- E. Ultrasonic occupancy sensor:
 1. On – auto sensor
 2. Off – sensor (20-minute delay)
- F. Dual technology sensor:
 1. On – manual
 2. Off – sensor (20-minute delay)
- G. 360° dual technology sensor:
 1. On – manual
 2. Off – sensor (15-minute delay)

3.3 TRAINING

- A. Personnel Training: Provide and pay for the services of a factory-authorized service representative to demonstrate the system and train Owners personnel.
 1. Provide training for operating, testing, troubleshooting and general maintenance of the system.
 2. Provide a 1-hour session to demonstrate equipment.
 3. Provide documentation of sessions to Architect/Engineer with signatures of at least 3 Owners Representatives present at demonstration.

END OF SECTION 260924

SECTION 262200 – LOW VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Dry Type Energy Efficient Transformers

1.2 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code
- B. NEMA ST 20 - Dry Type Transformers for General Applications
- C. NETA-ATS - Acceptance Testing Specification for Electrical Power Distribution Equipment (International Electrical Testing Association)
- D. 2016 DOE Standards – Energy Efficient Transformers

1.3 SUBMITTALS FOR REVIEW

- A. Submit under provisions of Section 260010
- B. Shop Drawings: The following items shall be submitted for review and approval:
 - 1. Submittal booklet to include the following:
 - a. Reference to Specification Section.
 - b. A list of all equipment to be provided and installed.
 - c. Data sheets to indicate voltage, kva, test reports, impedance rating, tap configuration, dimensions, insulation, and rated temperature rise with specific items or model numbers highlighted.

1.4 SUBMITTALS FOR CLOSEOUT

- A. Submit under provisions of Section 260010.
- B. Record actual locations of transformers in project record documents.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum three years documented experience.

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by UL or a testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store, protect, and handle products to site.
- B. Deliver transformers individually wrapped for protection and mounted on shipping skids.
- C. Accept transformers on site. Inspect for damage.
- D. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- E. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

1.8 WARRANTY

- A. Provide the warranty specified in Section 260010.

PART 2 - PRODUCTS

2.1 ENERGY EFFICIENT TRANSFORMERS

- A. Manufacturers:
 - 1. Square D Company
 - 2. Siemens
- B. Description: NEMA ST 20, factory-assembled, air cooled dry type transformers, ratings as indicated on the drawings. Transformers using cooling fans to reduce size are not acceptable.
- C. Efficiency: Transformers shall be low loss type with minimum efficiencies per DOE Standard – Energy Efficient Transformers, when operated at 35% of full load capacity.
 - 1. Transformers shall meet the 2016 Energy Code Requirements.
- D. Insulation system and average winding temperature rise for rated KVA as follows:
 - 1. 1-15 KVA: Class 185 with 115°C rise.
 - 2. 16-500 KVA: Class 220 with 150°C rise.
 - 3. 500 KVA and Larger: Class 220 with 150° rise.
- E. Case temperature: Not to exceed 35°C rise above ambient at warmest point.
- F. Winding Taps:
 - 1. Transformers Less than 15 KVA: Two 5% below rated voltage, full capacity taps on primary winding.
 - 2. Transformers 25 KVA and larger shall have a minimum of 4 – 2-1.2% full capacity primary taps (2+2-).
 - 3. Transformers 15 KVA and Larger: NEMA ST 20.
- G. Sound Levels: NEMA ST 20.
- H. Basic Impulse Level: 10 KV.
- I. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

- J. Mounting:
 - 1. 1-15 kVA: Suitable for wall mounting.
 - 2. 16-75 kVA: Suitable for wall, floor, or trapeze mounting.
 - 3. Larger than 75 kVA: Suitable for floor or trapeze mounting.
- K. Coil Conductors: Continuous windings with terminations brazed or welded.
- L. Enclosure: NEMA ST 20; Type 1. For indoor use, Type 3R ventilated for outdoor use. Provide lifting eyes or brackets.
- M. Isolate core and coil from enclosure using vibration-absorbing mounts.
- N. Nameplate: Include transformer connection data.

2.2 IDENTIFICATION

- A. Transformer Engraved Plastic Nameplates: Engraving stock, melamine plastic laminate, minimum 1/16" thick for nameplates up to 20 sq.in. and 1/8" thick for larger sizes.
 - 1. Engraved legend shall be black letters on white face.
 - 2. Punched or drilled for mechanical fasteners.
- B. Fasteners for Nameplates: Self-tapping, stainless-steel screws, or #10/32 stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are suitable for installing transformer supports.

3.2 PREPARATION

- A. Provide 4" high concrete housekeeping pad for each floor mounted transformer.

3.3 INSTALLATION

- A. Install Products in accordance with manufacturer's instructions.
- B. Set transformer plumb and level.
- C. Use flexible conduit, under the provisions of Section 260533, for connections to transformer case. Make conduit connections to side panel of enclosure.
- D. Mount transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.
- E. Provide grounding and bonding in accordance with Section 260526.
- F. Mount wall mounted transformers using integral flanges or accessory brackets furnished by the manufacturer.
- G. Provide unit substation transformer mounting where shown as a switchgear lineup.

- H. Provide engraved plastic nameplates for each transformer with 1/2" high lettering. Label shall include the following:
 - 1. Transformer Name
 - 2. Phase
 - 3. Primary Voltage
 - 4. Secondary Voltage

3.4 FIELD QUALITY CONTROL

- A. Provide field inspection, testing, adjusting as required.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.2.
- D. Test insulation resistance in accordance with NETA-ATS specifications for dry type transformers.
- E. Provide production testing of each unit in accordance with NEMA ST20.

3.5 ADJUSTING

- A. Measure primary and secondary voltages and make appropriate tap adjustments.

END OF SECTION 262200

SECTION 262416 – PANELBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Distribution Panelboards
- B. Branch Circuit Panelboards
- C. Integral Equipment

1.2 REFERENCES

- A. ANSI/NFPA 70 – National Electrical Code
- B. NEMA PB 1 – Panelboards
- C. NEMA PB 1.1 – General Instructions for Safe Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less
- D. NEMA AB 1 – Molded Case Circuit Breakers and Molded Case Switches
- E. NEMA KS 1 – Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)
- F. UL 50 – Enclosures for Electrical Equipment
- G. UL 67 – Panelboards
- H. UL 98 – Enclosed and Dead-Front Switches
- I. UL 489 – Molded – Case Circuit Breakers and Circuit Breaker Enclosures
- J. UL 1449, Edition 4 – Standard for Surge Protective Devices
- K. Federal Specification W-P115C – Type 1, Class 1
- L. Federal Specification W-C-375B/Gen – Circuit Breakers, Molded Case, Branch Circuit, and Service
- M. Federal Specification W-C-37B – Molded Case Circuit Breakers
- N. ASTM – American Society of Testing Materials

1.3 SUBMITTALS FOR REVIEW

- A. Submit under provisions of Section 260010.
- B. Shop Drawings: The following items shall be submitted for review and approval:
 - 1. Submittal booklet to include the following:

- a. Reference to Specification Section.
- b. A list of all equipment to be provided and installed.
- c. Data sheets to indicate voltage, main bus ampacity, circuit breakers, short circuit rating with specific items or model numbers highlighted.

1.4 SUBMITTALS FOR CLOSEOUT

- A. Submit under provisions of Section 260010.
- B. Record actual locations of Products; indicate actual branch circuit arrangement.
- C. Submit record copy of all testing performed.
- D. Provide a copy of the approved Panel Schedules included in the O&M Manuals.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing of panelboards specified in this section with minimum three years documented experience.

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by UL or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and indicated.
- C. Provide UL service entrance equipment on all units used as service entrance equipment.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Inspect and report concealed damage to carrier within their required time-period.
- B. Handle carefully to avoid damage to panelboard internal components, enclosure, and finish.
- C. Store in a clean, dry environment. Maintain factory packaging and, if required, provide an additional heavy canvas or heavy plastic cover to protect enclosure(s) from dirt, water, construction debris and traffic.

1.8 MAINTENANCE MATERIALS

- A. Provide two keys for each panelboard installed.

1.9 WARRANTY

- A. Provide the warranty specified in Section 260010.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Square D Company
- B. Alternate manufacturers as listed below:
 - 1. Siemens
- C. Alternate manufacturers subject to compliance with the following requirements:
 - 1. The dimensions of the alternate manufacturer will fit in the proposed location and that all required clearances per NEC, Access and Maintenance are maintained.
 - a. The performance and operating characteristics meet or exceed the Basis of Design.
 - b. The alternate manufacturer shall include all features, accessories and additional equipment required for a complete installation.

2.2 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Ground Bus: Provide copper ground bus in enclosures and bond the bus to the enclosure.
- B. Neutral Bus: Provide copper insulated neutral bus in all enclosures where the feeder circuit contains a neutral conductor. Bond the neutral bus to the ground bus or enclosure when the enclosure contains the service main disconnect or the disconnect at a building which receives its power from a service in another building. Provide bus with current carrying capacity of 100% except where otherwise indicated.
- C. Service Equipment Label: UL labeled for use as service equipment for panelboards with main service disconnect switches.
- D. Ground Fault Systems: Provide ground fault systems and on-site testing per NEC Article 230 for panelboards with main service disconnect switch.
- E. Load Side Terminations: Provide lugs on circuit breakers of sufficient size to terminate conductors scheduled or indicated on plans.
- F. Use only Owner-assigned room names/numbers in final Panel Schedules.
- G. For recessed double panels, allow at least 4" between backboxes so that trim does not butt or overlap.
- H. Provide 2 – 100% neutral assemblies in all split bus panelboards.
- I. Provide "Hinged Trim" panelboard covers for all distribution and branch circuit panelboards. The entire trim shall be hinged to swing to one side of the box to access the panel gutter space.
- J. All Panelboards with greater than 42 poles shall have 2 panel backboxes. Single backboxes with more than 42 poles will be unacceptable.
- K. Provide manufacture start-up and training when required for the equipment provided.

2.3 PANELBOARD SHORT CIRCUIT RATING

- A. UL label indicating series-connected rating with integral or remote upstream devices. Include size and type of upstream device allowable, branch devices allowable, and UL series-connected short-circuit rating.

- B. Fully rated to interrupt symmetrical short-circuit current available at terminals.
- C. Manufacturers option unless noted otherwise on the Panel Schedules or Power Riser Diagram.

2.4 DISTRIBUTION PANELBOARDS (600A AND ABOVE)

- A. Panelboards: NEMA PB 1, circuit breaker type suitable for use as service entrance equipment.
- B. Interior:
 - 1. Panelboard Bus: Copper, (silver plated copper, or tin-plated copper) ratings as indicated.
 - a. Provide copper ground bus in each panelboard.
 - 2. Provide one (1) continuous bus bar per phase.
 - a. Each bus bar shall have sequentially phased branch circuit connectors suitable bolt-on branch circuit breakers.
 - b. The bussing shall be fully rated.
 - c. Panelboard bus current ratings shall be determined by heat-rise tests conducted in accordance with UL 67.
 - 3. Panelboards shall be suitable for use as Service Equipment when application requirements comply with UL 67 and NEC Articles 230-F and -G.
 - 4. All current-carrying parts shall be insulated from ground and phase-to-phase by high dielectric strength thermoplastic.
 - 5. A solidly bonded copper equipment ground bar shall be provided.
 - 6. Interior trim shall be of dead-front construction to shield user from energized parts. Dead-front trim shall have filler plates covering unused mounting spaces.
- C. Minimum Integrated Short Circuit Rating:
 - 1. Amperes Interrupting Current (AIC) Ratings: 120V, 208V, and 240V breaker – minimum AIC 10,000 amps unless otherwise noted on the Panel Schedules.
 - 2. Amperes Interrupting Current (AIC) Ratings: 277V and 480V breaker – minimum AIC 14,000 amps unless otherwise noted on the Panel Schedules.
- D. Main Circuit Breaker:
 - 1. Electronic trip molded case standard function 80% rated circuit breaker. Provide 100% when indicated on the Panel Schedules.
 - 2. All electronic circuit breakers shall have the following time/current response adjustments: Long Time Pickup, Long Time Delay, Short Time Pickup, Short Time Delay, and Instantaneous settings. Each adjustment shall have discrete settings (fully adjustable) and shall be independent of all other adjustments. Provide Ground Fault Pickup and Ground Fault Delay when indicated on the Panel Schedules.
 - 3. Circuit breaker trip system shall be a microprocessor-based true rms sensing designed with sensing accuracy through the 13th harmonic.
 - 4. Long Time Pickup indication to signal when loading approaches or exceeds the adjustable ampere rating of the circuit breaker shall be provided.
 - 5. Breaker handle and faceplate shall indicate rated ampacity. Standard construction circuit breakers shall be UL Listed for reverse connection without restrictive line or load markings.
 - 6. Circuit breaker escutcheon shall have international I/O markings, in addition to standard ON/OFF markings. Circuit breaker handle accessories shall provide provisions for locking handle in the ON or OFF position.
 - 7. Lugs shall be UL Listed to accept solid or stranded conductors.
 - 8. Breaker Accessories: Provide when indicated on the Panel Schedules.
 - a. Shunt Trip
 - b. Under Voltage Trip
 - c. Ground Fault Shunt Trip
 - d. Auxiliary Switch
 - e. Alarm Switch

- f. Mechanical Lug Kits
- g. Compression Lug Kits
- h. Handle Lock
- i. Zone Selective Interlocking

E. Branch Circuit Breakers:

- 1. General:
 - a. Circuit breakers shall be 80% rated unless otherwise indicated on the Panel Schedules.
 - b. Circuit breakers shall be UL Listed with amperage ratings, interrupting ratings, and number of poles as indicated on the associated panel schedules.
 - c. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with a common trip handle for each pole.
 - d. Provide circuit breakers UL listed as Type SWD for lighting circuits.
 - e. Provide circuit breakers UL listed as Type HACR for heating, air conditioning and refrigeration equipment branch circuits.
 - f. Circuit breakers shall have an overcenter toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have thermal and magnetic trip elements in each pole. Two- and three-pole circuit breakers shall have common tripping of all poles.
 - g. There shall be two forms of visible trip indication.
 - h. The exposed faceplates of all branch circuit breakers shall be flush with one another.
 - i. Lugs shall be UL Listed to accept solid or stranded conductors.
 - j. Breaker Accessories: Provide when indicated on the Panel Schedules.
 - 1) Shunt Trip
 - 2) Auxiliary Switch
 - 3) Alarm Switch
 - 4) Ground Fault – Personal Protection (6-mA trip)
 - 5) Ground Fault – Equipment Protection (30-mA trip)
 - 6) Handle lock
 - 7) Zone Selective Interlocking
- 2. Breaker Types:
 - a. Thermal Magnetic Circuit Breaker (TM):
 - 1) Molded case circuit breakers shall have integral thermal and instantaneous magnetic trip in each pole.
 - b. Electronic Trip Circuit Breaker with Long Time, Short Time, Instantaneous Setting Adjustments (E)
 - 1) All electronic circuit breakers shall have the following time/current response adjustments: Long Time Pickup, Long Time Delay, Short Time Pickup, Short Time Delay and Instantaneous settings. Each adjustment shall have discrete settings (fully adjustable).
 - 2) Circuit breaker trip system shall be a microprocessor-based true rms sensing designed with sensing accuracy through the 13th harmonic.
 - 3) Long time pickup indication to signal when loading approaches or exceeds the adjustable ampere rating of the circuit breaker shall be provided.
 - c. Electronic Trip Circuit Breakers with real time metering (EP)
 - 1) All electronic trip circuit breaker requirements.
 - 2) Current (phases, neutral, average, maximum)
 - 3) Voltage (phase-to-phase, phase-to-neutral, average, unbalance)
 - 4) Power (active kW, reactive kVAR, apparent kVA, power factor)
 - 5) Energy (active kWh, reactive kVAR, apparent kVA)
 - 6) Frequency
 - 7) Total harmonic distortion (current, voltage)

- 8) Metering accuracy shall be 1.5% current (above 600 amperes), 1.0% current (600 amperes and below), 0.5% voltage, and 2% energy. This accuracy shall be total system, including, but not limited to, CT and meter.
 - d. Mission Critical Circuit Breaker (M)
 - 1) All electronic trip circuit breaker requirements.
 - 2) Oversized frame size:
 - a) Minimum frame size of 400A for any breaker below 250A.
 - b) Minimum frame size of 600A for any braker between 300A-400A.
 - 3) Delivers high levels of selective coordination for overcurrent tripping with previously tested combinations of downstream breaker types.
 - 4) Breakers must be listed to coordinate with the provided downstream breaker types installed in the downstream panels.
 - e. Provide electronic trip type if not indicated on the Panel Schedules.
- F. Enclosure: NEMA PB 1:
- 1. Interior Locations: Type 1
 - a. Type 1 Boxes:
 - 1) Boxes shall be hot zinc dipped galvanized steel constructed in accordance with UL 50 requirements. Unpainted galvannealed steel is not acceptable.
 - 2) Boxes shall have removable blank end walls and interior mounting studs. Interior support bracket shall be provided for ease of interior installation.
 - b. Type 1 Cabinet Front:
 - 1) Front shall meet strength and rigidity requirements per UL 50 Standards. Front shall have ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.
 - 2) Trim front shall be hinged 1-piece with door or door in door. Mounting shall be flush, or surface as indicated.
 - 3) Trim front door shall have rounded corners and edges free of burrs.
 - 4) A clear plastic directory cardholder shall be mounted on the inside of the door.
 - 5) Locks shall be cylindrical tumbler type with larger enclosures requiring sliding vault locks with 3-point latching. All lock assemblies shall be keyed alike. One (1) key shall be provided with each lock.
 - 6) A clear plastic directory cardholder shall be mounted on the inside of door.
 - 2. Exterior Locations: Type 3R:
 - a. Type 3R Boxes:
 - 1) Enclosures shall be constructed in accordance with UL 50 requirements. Enclosures shall be painted with ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.
 - b. Type 3R Cabinet Front:
 - 1) All doors shall be gasketed and equipped with a tumbler type vault lock and two (2) additional quarter turn fasteners on enclosures 59" or more in height.
 - 2) All lock assemblies shall be keyed alike.
 - 3) One (1) key shall be provided with each lock.
 - 4) A clear plastic directory cardholder shall be mounted on the inside of door.
- G. Panel Skirts:
- 1. 3-Sided with open back:
 - a. Sheet metal to cover conduits above and/or below a standard panelboard box when the panelboard is located against a wall. Sheet metal shall be same gauge and finish as panelboard and equipped with mounting flanges.
 - 2. 4-Sided:
 - a. Sheet metal to cover conduits above and/or below a standard panelboard box when the panelboard is located at the center of the room/area. Sheet metal shall be same gauge and finish as panelboard and equipped with mounting flanges.

3. Provide when indicated on the Panel Schedules.

2.5 BRANCH CIRCUIT PANELBOARDS

- A. Lighting and Appliance Branch Circuit Panelboards: NEMA PB1, circuit breaker type.
- B. Interior:
 1. Panelboard Bus: Copper, ratings as indicated.
 - a. Provide copper ground bus in each panelboard.
 2. Provide one (1) continuous bus bar per phase.
 - a. Each bus bar shall have sequentially phased branch circuit connectors suitable for bolt-on branch circuit breakers.
 - b. The bussing shall be fully rated.
 - c. Panelboard bus current ratings shall be determined by heat-rise tests conducted in accordance with UL 67.
 3. Panelboards shall be suitable for use as Service Equipment when application requirements comply with UL 67 and NEC Articles 230-F and -G.
 4. All current-carrying parts shall be insulated from ground and phase-to-phase by high dielectric strength thermoplastic.
 5. A solidly bonded copper equipment ground bar shall be provided.
 6. Interior trim shall be of dead-front construction to shield user from energized parts. Dead-front trim shall have filler plates covering unused mounting spaces.
- C. Minimum Integrated Short Circuit Rating:
 1. Amperes Interrupting Current (AIC) Ratings: 120V, 208V, and 240V breaker – minimum AIC 10,000 amps unless otherwise noted on the Panel Schedules.
 2. Amperes Interrupting Current (AIC) Ratings: 277V and 480V breaker – minimum AIC 14,000 amps unless otherwise noted on the Panel Schedules.
- D. Main Circuit Breaker:
 1. Electronic trip molded case standard function 80% rated circuit breaker. Provide 100% when indicated on the Panel Schedules.
 2. All electronic circuit breakers shall have the following time/current response adjustments: Long Time Pickup, Long Time Delay, Short Time Pickup, Short Time Delay, and Instantaneous settings. Each adjustment shall have discrete settings (fully adjustable) and shall be independent of all other adjustments. Provide Ground Fault Pickup and Ground Fault Delay when indicated on the Panel Schedules.
 3. Circuit breaker trip system shall be a microprocessor-based true rms sensing designed with sensing accuracy through the 13th harmonic.
 4. Long Time Pickup indication to signal when loading approaches or exceeds the adjustable ampere rating of the circuit breaker shall be provided.
 5. Breaker handle and faceplate shall indicate rated ampacity. Standard construction circuit breakers shall be UL Listed for reverse connection without restrictive line or load markings.
 6. Circuit breaker escutcheon shall have international I/O markings, in addition to standard ON/OFF markings. Circuit breaker handle accessories shall provide provisions for locking handle in the ON or OFF position.
 7. Lugs shall be UL Listed to accept solid or stranded conductors.
 8. Breaker Accessories: Provide when indicated on the Panel Schedules.
 - a. Shunt Trip
 - b. Under Voltage Trip
 - c. Ground Fault Shunt Trip
 - d. Auxiliary Switch
 - e. Alarm Switch
 - f. Mechanical Lug Kits
 - g. Compression Lug Kits

- h. Handle Lock
- i. Zone Selective Interlocking

E. Branch Circuit Breakers:

1. Circuit breakers shall be 80% rated unless otherwise indicated on the Panel Schedules.
2. Circuit breakers shall be UL Listed with amperage ratings, interrupting ratings, and number of poles as indicated on the associated panel schedules.
3. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with a common trip handle for each pole.
4. Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole.
5. Provide circuit breakers UL listed as Type SWD for lighting circuits.
6. Provide circuit breakers UL listed as Type HACR for heating, air conditioning, and refrigeration equipment branch circuits.
7. Circuit breakers shall have an overcenter toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have thermal and magnetic trip elements in each pole. Two- and three-pole circuit breakers shall have common tripping of all poles.
8. There shall be two forms of visible trip indication.
9. The exposed faceplates of all branch circuit breakers shall be flush with one another.
10. Lugs shall be UL Listed to accept solid or stranded conductors.
11. Breaker Accessories: Provide when indicated on the Panel Schedules.
 - a. Shunt Trip
 - b. Auxiliary Switch
 - c. Alarm Switch
 - d. Ground Fault – Personal Protection (6-mA trip)
 - e. Ground Fault – Equipment Protection (30-mA trip)
 - f. Arc-Fault Circuit Interrupter
 - g. Handle lock

F. Enclosure: NEMA PB 1:

1. Interior Locations: Type 1:
 - a. Type 1 Boxes:
 - 1) Boxes shall be hot zinc dipped galvanized steel constructed in accordance with UL 50 requirements. Unpainted galvanized steel is not acceptable.
 - 2) Boxes shall have removable endwalls with knockouts located on one end. Boxes shall have welded interior mounting studs. Interior mounting brackets are not required.
 - b. Type 1 Cabinet Front:
 - 1) Front shall meet strength and rigidity requirements per UL 50 Standards. Front shall have ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.
 - 2) Front shall be hinged 1-piece with door. Mounting shall be flush, or surface as indicated.
 - 3) Panelboards shall have MONO-FLAT fronts with concealed door hinges and mounted with trim screws. Front shall not be removable with the door locked. Doors on front shall have rounded corners and edges shall be free of burrs.
 - 4) Front shall have cylindrical tumbler type lock with catch and spring-loaded stainless-steel door pull. All lock assemblies shall be keyed alike. One (1) key shall be provided with each lock.
 - 5) A clear plastic directory cardholder shall be mounted on the inside of door.
2. Stainless Steel Cabinet Front:
 - a. 304 stainless steel hinged 1-piece with door.
3. Exterior Locations: Type 3R:
 - a. Type 3R Boxes:

- 1) Enclosures shall be constructed in accordance with UL 50 requirements. Enclosures shall be painted with ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.
 - b. Type 3R Cabinet Front:
 - 1) All doors shall be gasketed and equipped with a tumbler type vault lock and two (2) additional quarter turn fasteners on enclosures 59" or more in height.
 - 2) All lock assemblies shall be keyed alike.
 - 3) One (1) key shall be provided with each lock.
 - 4) A clear plastic directory cardholder shall be mounted on the inside of door.
- G. Panel Skirts:
1. 3-Sided with open back:
 - a. Sheet metal to cover conduits above and/or below a standard panelboard box when the panelboard is located against a wall. Sheet metal shall be same gauge and finish as panelboard and equipped with mounting flanges.
 2. 4-Sided:
 - a. Sheet metal to cover conduits above and/or below a standard panelboard box when the panelboard is located at the center of the room/area. Sheet metal shall be same gauge and finish as panelboard and equipped with mounting flanges.
 3. Provide when indicated on the Panel Schedules.

2.6 ARC ENERGY REDUCTION SWITCH (AERS)

- A. Provide for 1200A and above panelboards.
- B. An ARC Energy Reduction Switch shall be made available mounted internally to the panelboard for breakers required per the National Electricals Code 240.87.
- C. Shall provide a Modbus TCP/IP connection to the breaker. Breaker data connection shall be available for connection to external monitoring software. Shall also provide a web page providing historical information, breaker status, breaker metering and maintenance data. Device shall be capable of sending breaker alarms via email and smart phone application.

2.7 CUSTOMER METERING

- A. Provide customer metering when indicated on the Panel Schedules or Power Riser Diagram.
1. Manufacturers:
 - a. Square D Company Model PM5560
 - b. Eaton Model PXE-1/PXM1K – ETHMULTI-NW Series
 - c. Siemens Model 9410E Series
 2. Digital Power Meter with 0.25% accuracy with the following features: A, V, kW, kVAR, kVA, PF, F kWh, kVARh, kVAh, KYZ, RS-485 Communications, Ethernet Communications THD, Demand, kWd kVARd, kVAd, date/time stamping, predicted power demand, onboard alarms, min/max readings, data log, and event log.
 - a. Onboard WEB pages to view real-time and logged information.
 - b. Connection point for Energy Management System.
 3. Circuit Monitor Installation:
 - a. Electronic Circuit Monitors shall be installed by the panelboard manufacturer for all circuits as indicated by the project drawings. Mount no lower than 48" and no higher than 72".
 - b. All control power, CT, PT, and communications wire shall be factory wired and harnessed within the panelboard.

- c. Where external circuit connections are required, terminal blocks shall be provided, and the manufacturer's drawings must clearly identify the interconnection requirements including wire type to be used.
- 4. Certification Description:
 - a. All equipment included as part of the power and trip history metering shall be UL listed.
 - 1) IEC 62053-23
 - 2) IEC 62052-11
- B. Provide necessary hardware to support monitoring of real-time operational data from trip units and customer meters in Panelboards.
 - 1. Hardware shall support protocol conversion from Modbus →BACNET/IP to support monitoring of data by customer BMS System.
 - 2. Hardware shall have the capability to monitor a minimum of 50 parameters from each installed trip unit via Modbus protocol and mapping these points to a common register map compatible with BACNET/IP protocol.
 - 3. Hardware shall have the capability to monitor a minimum of 20 Modbus devices concurrently.
 - 4. Hardware should be as manufactured by Sierra Montiro Protonode or approved equal.
- C. Provide Manufacturers Field Service to start-up, set-up, and train the Owner for all meters.

2.8 INTEGRATED SURGE SUPPRESSION DEVICE

- A. Provide integrated surge suppression device when indicated on the Panel Schedule or Power Riser Diagram.
- B. Integral Surge Suppressor:
 - 1. SPD shall be component recognized in accordance with UL 1449 Fourth Edition. SPD shall be installed by and shipped from the electrical distribution equipment manufacturer's factory.
 - 2. The surge protection devices shall be bus mounted. If a breaker is needed to feed the integrally mounted SPDs, provide the breaker and wiring required.
 - 3. SPD shall provide surge current diversion paths for all modes of protection; L-N, L-G, N-G in WYE Systems.
 - 4. SPD shall be constructed as a per phase or single system module design. Each mode including N-G shall be protected by internal overcurrent and thermal overtemperature controls.
 - 5. SPD shall be UL 1449 listed and labeled with 200kA Short Circuit Current Rating (SCCR).
 - 6. SPDs shall be equipped with the following diagnostics:
 - a. Visible indication of proper SPD connection and operation shall be provided. The indicator lights shall indicate which phase as well as which module is fully operable. The status of each SPD module shall be monitored on the front cover of the enclosure. A push-to-test button shall be provided to test each phase indicator. Push-to-test button shall activate a state change of dry contacts for testing purposes.
 - b. Audible alarm with on/off silence function and diagnostic test function (excluding branch).
 - c. Form C dry contacts
 - d. Surge Counter
 - 7. SPD shall be complimentary UL 1283 listed for EMI/RFI filtering with minimum attenuation of -50dB at 100kHz.
 - 8. SPD shall have a warranty for a period of 10 years, incorporating unlimited replacement of suppressor parts. Warranty shall be the responsibility of the electrical distribution equipment manufacturer and shall be supported by their respective field service division.

- C. Internal Type H1 Unit: Non-Critical Load Applications:
1. Voltage Rating: 480Y/277V, 3-phase, 4-wire
 2. Application: Distribution Panelboard
 3. Minimum Modes of Protection: Common or Normal: L-N, L-G, L-L & N-G
 4. Maximum UL 1449 Voltage Protection Ratings (VPRs) for L-N, L-G, and N-G Modes of Protection: 1200 volts
 5. I-nominal Rating: 20kA
 6. Minimum Acceptable Single Pulse Surge Current Capacity: 240,000 amps per phase
 7. The following Models are acceptable:
 - a. Square D Company Model TVS41MA24
 - b. Eaton Model SPD250480Y2A
 - c. Siemens Model TPS3E0525X2, TPS3E0125X002, TPS3E0225X2
- D. Internal Type H2 Unit: Non-Critical Load Applications:
1. Voltage Rating: 480Y/277V, 3-phase, 4-wire
 2. Application: Distribution or Branch Circuit Panelboard
 3. Minimum Modes of Protection: Common or Normal: L-N, L-G, L-L, & N-G
 4. Maximum UL 1449 Voltage Protection Ratings (VPR's) for L-N, L-G, & N-G Modes of Protection: 1200 volts
 5. I-Nominal Rating: 20kA
 6. Minimum Acceptable Single Pulse Surge Current Capacity: 160,000 amps per phase
 7. The following Models are acceptable:
 - a. Square D Company Model TVS41MA16
 - b. Eaton Model SPD160480Y2A
 - c. Siemens Model TPS3E0520X2, TPS3E0120X002, TPS3E0120X2
- E. Internal Type H3 Unit: Non-Critical Load Applications:
1. Voltage Rating: 480Y/277V, 3-phase, 4-wire
 2. Application: Distribution or Branch Circuit Panelboard
 3. Minimum Modes of Protection: Common or Normal: L-N, L-G, L-L & N-G
 4. Maximum UL 1449 Voltage Protection Ratings (VPRs) for L-N, L-G, and N-G Modes of Protection: 1200 volts
 5. I-nominal Rating: 20kA
 6. Minimum Acceptable Single Pulse Surge Current Capacity: 120,000 amps per phase
 7. The following Models are acceptable:
 - a. Square D Company Model TVS41MA12
 - b. Eaton Model SPD120480Y2A
 - c. Siemens Model TPS3E0515X2, TPS3E0115X002, TPS3E0115X2
- F. Internal Type L1 Unit: Non-Critical Load Applications:
1. Voltage Rating: 208Y/120V, 3-phase, 4-wire
 2. Application: Distribution Panelboard
 3. Minimum Modes of Protection: Common or Normal: L-N, L-G, N-G
 4. Maximum UL 1449 Voltage Protection Ratings (VPRs) for L-N, L-G, and N-G Modes of Protection: 700 volts.
 5. I-nominal Rating: 20kA
 6. Minimum Acceptable Single Pulse Surge Current Capacity: 240,000 amps per phase
 7. The following Models are acceptable:
 - a. Square D Company Model TVS21MA24
 - b. Eaton Model SPD250208Y2A
 - c. Siemens Model TPS3C0525X2, TPS3C0125X002, TPS3C0225X2
- G. Internal Type L2 Unit: Non-Critical Load Applications:
1. Voltage Rating: 208Y/120V, 3-phase, 4-wire
 2. Application: Distribution or Branch Circuit Panelboard
 3. Minimum Modes of Protection: Common or Normal: L-N, L-G, N-G

4. Maximum UL 1449 Voltage Protection Ratings (VPRs) for L-N, L-G, and N-G Modes of Protection: 700 volts.
 5. I-nominal Rating: 20kA
 6. Minimum acceptable single pulse surge current capacity: 160,000 amps per phase
 7. The following models are acceptable:
 - a. Square D Company Model TVS2IMA16
 - b. Eaton Model SPD160208Y2A
 - c. Siemens Model TPS3C0520X2, TPS3C0120X002, TPS3C0220X2
- H. Internal Type L3 Unit: Non-Critical Load Applications:
1. Voltage Rating: 208Y/120V, 3-phase, 4-wire
 2. Application: Distribution or Branch Circuit Panelboard
 3. Minimum Modes of Protection: Common or Normal: L-N, L-G, N-G
 4. Maximum UL 1449 Voltage Protection Ratings (VPRs) for L-N, L-G, and N-G Modes of Protection: 700 volts.
 5. I-nominal Rating: 20kA
 6. Minimum Acceptable Single Pulse Surge Current Capacity: 120,000 amps per phase
 7. The following models are acceptable:
 - a. Square D Company Model TVS2IMA12
 - b. Eaton Model SPD120208Y2A
 - c. Siemens Model TPS3C0515X2, TPS3C0115X002, TPS3C0215X2

2.9 IDENTIFICATION

- A. Panelboard engraved plastic nameplates: Engraving stock, melamine plastic laminate, minimum 1/16" thick for nameplates up to 20 sq. in. and 1/8" thick for larger sizes.
 1. Engraved legend shall be black letters on white face.
 2. Punched or drilled for mechanical fasteners.
- B. Fasteners for Nameplates: Self-tapping, stainless-steel screws or No. 10/32, stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install panelboards in accordance with NEMA PB 1.1, NEC Standards, Local Codes, and Manufacturer's Instructions.
- B. Install panelboards plumb.
- C. Install recessed panelboards flush with wall finishes.
- D. Provide supports in accordance with Section 260529.
- E. Mount panelboards 6'-6" to the top of enclosure.
- F. Provide breaker closures for unused spaces in panelboards.
- G. Provide typed circuit directory for each branch circuit panelboard.
 1. Revise directory to reflect circuiting changes required to balance phase loads.

2. Contractor to submit a copy of all panelboard directory schedules to the Owner, showing correct room name and/or number, for his approval. Contractor to make changes recommended by the Owner before final typed directories are installed in panelboards.
 - H. Provide engraved plastic nameplates for each panelboard with 1/2" high lettering. Label shall include the following:
 1. Panel Name
 2. Voltage, Phase, Wire
 3. Location of the panel, switchboard or disconnect device which feeds the panelboard.
 - I. Provide spare conduits out of each recessed panelboard to an accessible location above ceiling. Minimum spare conduits: 1 empty 1" per 4 poles of spare breakers and spaces. Identify each as SPARE.
 - J. Provide accessories which prevent circuit breaker handles from being manually moved from the ON position for the handles of all circuit breaker which feed emergency lighting circuits, public address and intercom systems and uninterruptable power supplies.
 - K. Ground and bond panelboard enclosure in accordance with Section 260526.
 - L. Provide category 6 cable in 3/4" conduit from each meter to nearest MDF/IDF and terminate on both ends unless otherwise noted.
 - M. Provide a dedicated 3-pole branch circuit breaker to feed TVSS unit (only when required by manufacturer). Circuit breaker size and wire size shall be per manufacturer recommendation. Connect leads to load side of the circuit breaker.
 - N. Where replacing existing panels and existing conductors are to be connected to new CB's, provide extensions of conductors as needed using same color and size of wire using a butt-splice.
 - O. Contractor shall trace all circuits listed as "Existing Circuits" and provide the correct description for the circuit. Existing Circuit will not be acceptable in the Final Panel Schedules.
 - P. Provide main lug only and main breaker lugs that are sized to terminate the conductors shown on the plans. Where lug sizes are not available to terminate the scheduled conductors the Electrical Contractor (EC) shall provide compression reducing pin terminals that are rated for the application. Where termination lug quantities are not available for the equipment the EC shall provide insulated termination lug sets with the quantity of conductors as needed to connect to the equipment. Conductor lengths shall be kept to a minimum and sized to meet the largest lug size and quantity available on the equipment. In no case shall the conductors be sized less than the amp rating of the circuit breaker feeding the equipment. All parallel sets of raceways, junction boxes and associated accessories shall be included.
- 3.2 FIELD QUALITY CONTROL
- A. Perform field inspection and testing.
 - B. Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections.
 - C. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads within 10% of each other. Maintain proper phasing for multi-wire branch circuits.

- D. Check tightness of bolted connections, and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written specifications.
- E. Test ground fault systems per NEC Article 230.
- F. Apply ANSI 61 (or other appropriate color paint) as needed.

3.3 PANEL SCHEDULES

- A. As indicated in the Specifications or Drawings.
- B. Schedules show separate wire and conduit sizes for each individual branch circuit. The Contractor may install more than one circuit in a conduit and eliminate unused conduits. The Contractor is responsible for resizing the conduits and providing derated conductors per the requirements of ANSI/NFPA 70 – National Electrical Code.

3.4 ADJUSTING

- A. Adjust all operating mechanisms for free mechanical movement per manufacturer's specifications.
- B. Tighten bolted bus connections in accordance with manufacturer's instructions.
- C. **Provide Coordination Study to achieve required settings for adjustment. Verify equipment can be adjusted to meet the study requirements before releasing for production.**
- D. **Provide Fault Current Study to achieve AIC ratings for panelboards. Verify equipment meets the requirements of the study before releasing for production.**
- E. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 10% of each other. Maintain proper phasing for multi-wire branch circuits.
- F. Adjust circuit breaker trip and time delay settings to values indicated in the Coordination Study.

3.5 CLEANING

- A. Upon completion of installation, inspect interior and exterior panelboards. Remove paint splatters and other spots, dirt, and debris from interior and exterior of panelboards.
- B. Touch up scratched or marred surfaces to match original finish.

3.6 SETUP/TRAINING

- A. Manufacturer's Setup: Provide and pay for the services of a factory-authorized service representative to start-up, set-up, and train the Owner for the equipment provided.

END OF SECTION 262416

SECTION 262726 – WIRING DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Wall Switches
- B. Wall Dimmers
- C. Receptacles
- D. Cord and Plug Sets
- E. Wall Plates

1.2 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code
- B. NECA - Standard of Installation
- C. NEMA WD 1 - General Requirements for Wiring Devices
- D. NEMA WD 6 - Wiring Device -- Dimensional Requirements
- E. UL486A & UL486B
- F. WC-596
- G. WC-896

1.3 SUBMITTALS FOR REVIEW

- A. Submit under provisions of Section 260010.
- B. Shop Drawings: The following items shall be submitted for review and approval:
 - 1. Submittal booklet to include the following:
 - a. Reference to Specification Section.
 - b. A list of all equipment to be provided and installed.
 - c. Data sheets to indicate voltage ratings, current rating, color and configuration with specific item and model numbers highlighted.

1.4 SUBMITTALS FOR CLOSEOUT

- A. Submit under provisions of Section 260010.
- B. Submit record copy of all testing performed.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Provide Products listed and classified by Underwriters Laboratories, Inc., or a testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.
- C. All devices shall meet Federal Spec WC-596 and WC-896.

1.7 COORDINATION

- A. Receptacles for General Contractor or Owner Furnished Equipment: Match plug configurations and ratings.
- B. Cord and Plug Sets: Match equipment requirements.
- C. Coordinate outlet box type and heights with Specification Sections 260010 and 260533.

1.8 EXTRA MATERIALS

- A. Furnish extra materials as described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 - 1. Wall Plates: 1 for every 100 of each style, size and finish installed. Furnish at least 2 of each style, size and finish installed.
 - 2. Switches: Furnish 5 of each style, size and finish installed. None required for Indicator Switches and Wall Dimmers.
 - 3. Receptacles: Furnish 10 of each style, size and finish installed. None required for Range and Dryer receptacles.

1.9 WARRANTY

- A. Provide the warranty specified in Section 260010.

PART 2 - PRODUCTS

2.1 WALL SWITCHES

- A. Single Pole Switch: 120/277V, 20A:
 - 1. Hubbell Model HBL1221X
 - 2. Leviton Model 1221-2X
 - 3. Pass & Seymour Model PS20AC1-X
 - 4. Provide 2-pole, 3-way and 4-way switches of the same series as required.
- B. Key Operated Switch, Single Pole: 120/277V, 20A:
 - 1. Hubbell Model HBL1221L
 - 2. Leviton Model 1221-2LX

3. Pass & Seymour Model PS20AC1-XL
 4. Provide 2-pole, 3-way and 4-way switches of the same series as required.
- C. Indicator Switch: 1P, 120/277V, 20A (Light on with load on):
1. Hubbell Model HBL1221PL
 2. Leviton Model 1221-PLI or 1221-7PX
 3. Pass & Seymour Model PS20AC1-XPL or PS20AC1-RPL7
 4. Provide 2-pole, 3-way and 4-way switches of the same series as required.
- D. Single Button Automatic Wall Switch: 120/277V, 20A:
1. Watt Stopper Model DW-100
 2. Sensor Switch Model WSX-PDT-XX
 3. Leviton Model OSSMT-MDX
 4. Lutron Model MSX102-XX
- E. Two Button Automatic Wall Switch: 120/277V, 20A:
1. Watt Stopper Model DW-200
 2. Sensor Switch Model WSX-PDT-2P-XX
 3. Leviton Model OSSMD-MDX
 4. Lutron Model MSX202-XX
- F. 0-10V Dimming Wall Switch Occupancy Sensor: 120/277V, 20A:
1. Watt Stopper Model DW-311-X
 2. Hubbell Model LHDMMTS-2-N-XX
 3. Sensor Switch Model WSX-PDT-D-XX
- G. Digital Time Switch: 120/277V, 20A:
1. Watt Stopper Model TS-400
 2. Sensor Switch Model PTS-60
- H. Color: Ivory unless directed otherwise by Architect.

2.2 WALL DIMMERS

- A. Single Pole, LED 0-10V, 120V-277V with slider and On-Off Switch:
1. Lutron Model DVSTV-XX
 2. Provide 3-way switches of the same series as required.
- B. Provide dimmers compatible with LED Drivers.
- C. Color: Ivory unless directed otherwise by Architect.

2.3 TAMPER-RESISTANT RECEPTACLES

- A. Tamper-Resistant Duplex Receptacle: 125V, 20A:
1. Hubbell Model HBL5362XTR
 2. Leviton Model 5362-SGX
 3. Pass & Seymour Model TR63-X
 4. Provide isolated ground and hospital grade type of the same series where indicated on the Drawings.
- B. Tamper-Resistant Half-Controlled Duplex Receptable for Plug Load Control: 125V, 20A:

1. Hubbell Model HBL5362C1XXTR
 2. Pass & Seymour Model TR5362CHX
- C. Tamper-Resistant/Weather-Resistant GFCI Receptacle: 125V, 20A:
1. Hubbell Model GFRTW20X
 2. Leviton Model GFWT2-X
 3. Pass & Seymour Model 2097TRWRX
 4. All GFI Receptacles shall meet the latest Standard 943 for Class A GFI Receptacles/UL 498 for receptacles.
 5. Provide isolated ground and hospital grade type of the same series where indicated on the Drawings.
 6. All GFI Receptacles shall be weather resistant.
- D. Tamper-Resistant Duplex Convenience Receptacle with USB Charger: 125V, 20A:
1. Hubbell Model USB20AC5PDX or USB20CPDX
 2. Pass & Seymour Model TR20USBAC6X or TR20USBCC6X
 3. Engineer's Choice on USB Type.
- E. Tamper-Resistant/Weather-Resistant GFCI Receptacle with USB Charger: 125V, 20A:
1. Hubbell Model GFUSBWR20ACX
 2. Pass & Seymour Model TR20USBAC6CDW.
 3. Engineer's choice on USB type.
 4. All GFI Receptacles shall meet the latest Standard 943 for Class A GFI Receptacles/UL 498 for receptacle.
 5. All GFCI Receptacles shall be weather-resistant.
- F. Tamper-Resistant Surge Suppressor Receptacle: 125V, 20A:
1. Hubbell Model SNAP5362XS
 2. Leviton Model T5380-X
 3. Pass & Seymour Model TR5362XSP
 4. Provide isolated ground and hospital grade type of the same series where indicated on the Drawings.
- G. Color: Ivory unless directed otherwise by Architect.

2.4 RECEPTACLES

- A. Range Receptacle (NEMA 14-50R):
1. Hubbell Model RR450F
 2. Leviton Model 279
 3. Pass & Seymour Model 3894
 4. Range receptacles shall be complete with matching cord/plug set and a stainless-steel cover plate. (Verify location and mounting heights with Architect before roughing-in.)
- B. Dryer Receptacles (NEMA 14-30R):
1. Hubbell Model RR430F
 2. Leviton Model 278
 3. Pass & Seymour Model 3864
 4. Dryer receptacles shall be complete with matching cord/plug set and a stainless-steel cover plate. (Verify location and mounting heights with Architect before roughing-in.)
- C. Color: Ivory unless directed otherwise by Architect.

2.5 CORDS

- A. Cord and Plug Sets:
 - 1. Description: Match voltage, current ratings, and number of conductors to requirements of equipment being connected.
 - a. Cord: Extra hard usage per NEC.
 - b. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.
- B. Pendant Cord/Connector Devices:
 - 1. Description: Matching, locking-type plug, and receptacle body connector, NEMA WD 6. Configurations as indicated or as required for equipment.
 - a. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
 - b. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.6 WALL PLATES

- A. Super Stainless-Steel Receptacle Cover Plate: Interior Finish Walls:
 - 1. Hubbell Model SS8/SS26
 - 2. Leviton Model 84003/84401-40
 - 3. Pass & Seymour Model SS8/SS26
- B. Super Stainless-Steel Switch Cover Plate: Interior Finish Walls:
 - 1. Hubbell Model SS1
 - 2. Leviton Model 84001
 - 3. Pass & Seymour Model SS1
- C. Metal Receptacle Cover Plate: Electrical Rooms, Mechanical Rooms and Boiler Rooms:
 - 1. Cooper Crouse-Hinds Model TP516
 - 2. Appleton Model 8365N
 - 3. Steel City Model RS12
- D. Metal Switch Cover Plate: Electrical Rooms, Mechanical Rooms, and Boiler Rooms:
 - 1. Cooper Crouse-Hinds Model TP512
 - 2. Appleton Model 8361
 - 3. Steel City Model RS-9
- E. Weatherproof While In Use Cover: All exterior building mounted receptacles unless otherwise noted.
 - 1. Hubbell Model WP26E
 - 2. Leviton Model 5977-CL
 - 3. Pass & Seymour Model WIUC10-XX
 - 4. Taymac Model MX3200
 - 5. Rating shall be maintained while in use.
 - 6. Provide horizontal cover if receptacle is mounted horizontally.
- F. Provide all additional combination cover plates of the same series required for the entire project. All devices in the project shall have a cover plate.
- G. Provide all devices, outlet boxes, junction boxes, etc with the appropriate type cover plate.

- H. Provide junior or jumbo size plates as required of the same series and type for all outlets installed in masonry walls.
- I. Wiring devices connected to Normal/Emergency power shall be red in color and pre-marked "Emergency" unless otherwise indicated on the Drawings or by the Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Coordinate all device rough-in heights and locations with all other trades and finished room schedules as applicable. Report any conflicts to Architect/Engineer before rough-in.
- B. Verify conditions prior to beginning work.
- C. Verify that outlet boxes are installed at proper height.
- D. Verify that wall openings are neatly cut and will be completely covered by wall plates.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean debris from outlet boxes.

3.3 INSTALLATION

- A. Install in accordance with NECA "Standard of Installation" except for mounting heights. Refer to Section 260010 for mounting heights.
- B. Device terminals may not be used to carry the continuity of the branch circuit. All branch circuit wiring must be spliced and tailed out to devices.
- C. Install devices and assemblies' plumb and level.
- D. Install single pole switches with OFF position down.
- E. Install ganged wall dimmers as recommended by manufacturer to achieve full rating specified.
- F. Install dedicated neutral conductors on-line and load side of dimmers.
- G. Install vertical receptacle installations with grounding pole opening up/on top.
- H. Install horizontal receptacle installations with the neutral pole opening side up/on top.
- I. Group adjacent switches and/or receptacles in single multi-gang wall plate. Provide internal box dividers as required by the NEC.
- J. Connect wiring device grounding terminal to metallic outlet box with a grounding wire conductor and the branch circuit equipment grounding conductor.
- K. Connect wiring devices by wrapping solid conductor around screw terminal. Connect solid and stranded wires by inserting in screw tension pressure plate connectors. Provide solid tails or

solderless connectors for stranded conductors where screw tension pressure plates are not available. Use of spring tension back wired terminals is unacceptable.

- L. Coordinate with trade responsible for painting to ensure final coat has been applied before installing wall plates.
- M. Provide all devices, outlet boxes, junction boxes, etc. with the appropriate type cover plate.
- N. Use junior or jumbo size plates for all outlets installed in masonry walls.
- O. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on devices installed in surface mounted boxes.
- P. When plastic wall plates are used throughout on a commercial project, provide super stainless-steel type wall plates in exposed commercial kitchen areas.
- Q. Provide panel/circuit information at each wiring device as specified in the identification specifications.
- R. When isolated wiring devices are used, connect the wiring device grounding terminals to a dedicated isolated grounding conductor. A separate equipment grounding conductor shall also be installed and used for metallic raceway and outlet box grounding. Install per NEC requirements.
- S. Provide a ground fault receptacle at each location indicated on the Drawing. Use of the feed-through feature is not permitted.
- T. Provide a surge protected receptacle at each location indicated on the Drawing. Use of the feed-through feature is not permitted.

3.4 CONNECTIONS

- A. Ground equipment in accordance with Section 260526.
- B. Wire all devices in accordance with Section 260519.
- C. 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 and UL-486B.

3.5 FIELD QUALITY CONTROL

- A. Provide field inspection, testing, adjusting, and balancing.
- B. Inspect each wiring device for defects.
- C. Operate each wall switch with circuit energized and verify proper operation.
- D. Verify that each receptacle device is energized.
- E. Perform the following field tests and inspections:
 - 1. After installing wiring devices and after electrical circuitry has been energized, test for proper polarity, ground continuity, and compliance with requirements.

2. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.

F. Remove malfunctioning units, replace with new units, and retest as specified above.

G. Check each TVSS receptacle indicating lights for normal indication.

3.6 ADJUSTING

A. Adjust installed work as required to meet field conditions.

B. Adjust devices and wall plates so they are flush and level.

3.7 CLEANING

A. Clean installed work as required.

B. Clean exposed surfaces to remove splatters and restore finish.

3.8 SETUP

- A. Provide dip switch setting for the following setup:
 1. Single Button Automatic wall switch:
 - a. On – Manual
 - b. Off – Sensor (15-minute delay)
 2. Two button automatic wall switch:
 - a. On – Manual
 - b. Off – Sensor (15-minute delay)
 3. 0-10V dimming wall switch occupancy sensor:
 - a. On – Manual
 - b. Off – Sensor (15-minute delay)

END OF SECTION 262726

SECTION 262813 – FUSES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Fuses
- B. Spare Fuse Cabinet

1.2 REFERENCES

- A. ANSI/NFPA 70 - National Electric Code
- B. NEMA FU 1 - Low Voltage Cartridge Fuses

1.3 SUBMITTALS FOR REVIEW

- A. Submit under provisions of Section 260010.
- B. Shop Drawings: The following items shall be submitted for review and approval:
 - 1. Submittal booklet to include the following:
 - a. Reference to Specification Section.
 - b. A list of all equipment to be provided and installed.
 - c. Data sheets to indicate electrical characteristics, time curves, fuse coordination on a 11"x17" time curve graph paper with specific item or model number highlighted.

1.4 SUBMITTALS FOR CLOSEOUT

- A. Submit under provisions of Section 260010.
- B. Record actual fuse sizes.

1.5 QUALIFICATIONS

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

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by UL or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and indicated.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 - 1. Fuses: Furnish 3 of each size and type installed.

1.8 WARRANTY

- A. Provide the warranty specified in Section 260010.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Cooper Bussman
- B. Littlefuse, Inc.
- C. Mersen

2.2 FUSE REQUIREMENTS

- A. Dimensions and Performance: NEMA FU 1, Class as specified or indicated.
- B. Voltage: Provide fuses with voltage rating suitable for circuit phase-to-phase voltage.
- C. All fuses in the power distribution system shall be by the same manufacturer.
- D. Main Service Switches Larger than 600 amperes: Current Limiting Class L (time delay).
- E. Motor Load Feeder Switches: Current Limiting Class RK1 (time delay).
- F. Motor Branch Circuits: Class RK5. (time delay).
- G. Parallel service and feeder cables - cable limiters.

2.3 SPARE FUSE CABINET

- A. Description: Wall-mounted sheet metal cabinet, suitably sized to store spare fuses and fuse pullers specified.
- B. Doors: Hinged, with hasp for Owner's padlock.
- C. Finish: Primed and painted medium gray.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install fuses in accordance with manufacturer's instructions.
- B. Install fuse with label oriented such that manufacturer, type, and size are easily read.
- C. Install spare fuse cabinet where directed by Owner.
- D. Provide an adhesive label inside each enclosure or compartment indicating the size and type of replacement fuse to be installed. Where multiple sizes or types of fuses are installed in a single enclosure placement or coding of labels shall clearly indicate the fuses to which the labels refer.

- E. Install cable limiters on both ends of each parallel cable in the designated set.

END OF SECTION 262813

SECTION 262816 – ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Fusible Switches
- B. Non-Fusible Switches
- C. Enclosed Circuit Breakers

1.2 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code
- B. NECA - Standard of Installation (Published by the National Electrical Contractors Association)
- C. NEMA FU1 - Low Voltage Cartridge Fuses
- D. NEMA KS 1 - Enclosed Switches
- E. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems (published by the International Electrical Testing Association).
- F. NEMA AB 1 Molded Case Circuit Breakers

1.3 SUBMITTALS FOR REVIEW

- A. Submit under provisions of Section 260010.
- B. Shop Drawings: The following items shall be submitted for review and approval:
 - 1. Submittal booklet to include the following:
 - a. Reference to Specification Section.
 - b. A list of all equipment to be provided and installed.
 - c. Data sheets to indicate type, switch ratings, dimensions and enclosure with the specific items or model numbers highlighted.

1.4 SUBMITTALS FOR CLOSEOUT

- A. Submit under provisions of Section 260010.
- B. Maintenance Data: Include spare parts data, recommended maintenance procedures and intervals.
- C. Submit record copy of all testing performed.

1.5 QUALITY ASSURANCE

- A. Manufacturer's Installation Instructions: Install in accordance with application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements.

Store, handle, protect, examine, prepare, install, and start the product in accordance with the manufacturer's instructions.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum three years documented experience.

1.7 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by UL or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage and are identified with labels describing contents.
 - 1. Fuses: Provide 3 of each size and type of fuse installed.

1.9 WARRANTY

- A. Provide the warranty specified in Section 260010.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Square D Company
- B. Eaton
- C. Siemens

2.2 ENCLOSED SWITCHES

- A. Fusible Switch Assemblies: NEMA KS 1, Type HD load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse clips: Designed to accommodate specified fuses.
- B. Non-fusible Switch Assemblies: NEMA KS 1, Type HD load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.

2.3 MOLDED CASE CIRCUIT BREAKERS

- A. Circuit Breaker: NEMA AB 1.
- B. Service Conditions:
 - 1. Temperature: 104°F

2. Altitude: 6000'

C. Interrupting Rating: As indicated on the drawings.

2.4 MOLDED CASE CIRCUIT BREAKERS - TRIP UNITS

A. Permanent (fixed) Trip Circuit Breaker: Provide circuit breakers with frame sizes 100 Amps and larger with permanent thermal and magnetic trip units in each pole.

B. Provide type HCAR circuit breakers for air conditioning and refrigeration branch circuits.

2.5 MOLDED CASE CIRCUIT BREAKERS - OPTIONS AND FEATURES

A. Provide accessories as scheduled, to NEMA AB 1.

B. Handle Lock: Include provisions for padlocking.

C. Load Side Terminations: Provide lugs on circuit breakers of sufficient size to terminate conductors scheduled or indicated on plans.

D. Provide grounding lug in each enclosure.

E. Provide Products suitable for use as service entrance equipment where so applied.

F. Minimum Integrated Short Circuit Rating: Adjusted per Fault-Current Study:

1. Amperes Interrupting Current (AIC) Ratings: 120V, 208V, and 240V breaker – minimum AIC 10,000 amps unless otherwise noted on the Drawings or Specifications.
2. Amperes Interrupting Current (AIC) Ratings: 277V and 480V breaker – minimum AIC 18,000 amps unless otherwise noted on the Drawings or Specifications.
3. The Contractor shall verify the AIC with the fault current study and adjust as required to comply with the study.

2.6 ENCLOSURE

A. Enclosures: NEMA KS 1.

1. Interior Dry Locations: Type 1
2. Interior Wet Locations: Type 4
3. Exterior Locations: Type 3R
4. Kitchen: Stainless Steel
5. Dishwashing Rooms/Areas: Stainless Steel

2.7 FUSES

A. Refer to Section 262813.

2.8 LOAD SIDE TERMINATIONS

A. Provide lugs on switches of sufficient size to terminate conductors scheduled or indicated on plans.

2.9 IDENTIFICATION

- A. Enclosed Switches and Circuit Breakers Engraved Plastic Nameplates: Engraving stock, melamine plastic laminate, minimum 1/16" thick for nameplates up to 20 sq. in. and 1/8" thick for larger sizes.
 - 1. Engraved legend shall be black letters on white face.
 - 2. Punched or drilled for mechanical fasteners.
- B. Fasteners for Nameplates: Self-tapping, stainless-steel screws, or #10/32 stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install disconnect switches where indicated and in accordance with NECA "Standard of Installation".
- B. Install fuses in fusible disconnect switches.
- C. Provide adhesive label on inside door of each switch indicating UL fuse class and size for replacement.
- D. Install enclosed circuit breakers where indicated, in accordance with manufacturer's instructions.
- E. Install enclosed circuit breakers plumb. Provide supports in accordance with Section 260529.
- F. Refer to Section 260010 for mounting heights.
- G. Provide engraved plastic nameplates for each enclosed switch and circuit breaker with 1/2" high lettering. Label shall include the following:
 - 1. Enclosed Switch or Circuit Breaker Name
 - 2. Voltage
 - 3. Size

3.2 FIELD QUALITY CONTROL

- A. Field inspection, testing, adjusting as required.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.5.
- D. Test and inspect each circuit breaker.
- E. Inspect and test each circuit breaker to NEMA AB 1.
- F. Inspect each circuit breaker visually.
- G. Perform several mechanical ON OFF operations on each circuit breaker.
- H. For record - verify circuit continuity on each pole in closed position.

3.3 ADJUSTING

- A. Adjust work as required.

END OF SECTION 262816

SECTION 262830 – ENCLOSED CONTACTORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Electrically held lighting contactors
- B. Mechanically and magnetically held lighting contactors

1.2 REFERENCES

- A. ANSI/NFPA 70 – National Electrical Code
- B. NEMA ICS 2 – Controllers, Contactors and Overload Relays.
- C. NEMA ICS 5 – Control Circuit and Pilot Devices.
- D. NEMA ICS 6 – Enclosures for Industrial Controls and Systems.
- E. UL 508, Industrial Control Equipment.

1.3 SUBMITTALS FOR REVIEW

- A. Submit under provisions of Section 260010.
- B. Shop Drawings: The following items shall be submitted for review and approval:
 - 1. Submittal booklet to include the following:
 - a. Reference to Specification Section.
 - b. A list of all equipment to be provided and installed.
 - c. Data sheets to indicate size, voltage ratings, current ratings, dimensions and enclosure with the specific item or model number highlighted.

1.4 SUBMITTALS FOR CLOSEOUT

- A. Submit under provisions of Section 260010.
- B. Maintenance Data: Include spare parts data, instructions for replacing and maintaining coil and contacts, recommended maintenance procedures and intervals.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.

- B. Provide Products listed and classified by Underwriters Laboratories, Inc., or a testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.7 WARRANTY

- A. Provide the warranty specified in Section 260010.

PART 2 - PRODUCTS

2.1 ELECTRICALLY HELD LIGHTING CONTACTORS

- A. Manufacturers:
 - 1. Square D Company
 - 2. Eaton
 - 3. Siemens
- B. Description: NEMA ICS 2 electrically held magnetic lighting contactor with continuously rated coils. Contactors shall be rated for all standard type ballast and tungsten lighting as well as general use and resistive heating loads.
- C. Contactor Ampere Rating: As scheduled or indicated.
- D. Poles: As scheduled or indicated.
- E. Power Contacts: To be totally enclosed in contactor housing and have double break operation.
- F. Coil operating voltage: 120 volts, 60Hz unless otherwise indicated.
- G. Wiring: Straight-through wiring with all terminals clearly marked.
- H. Enclosure: NEMA ICS 6, Type:
 - 1. Interior Dry Locations: Type 1
 - 2. Interior Wet Locations: Type 4
 - 3. Exterior Locations: Type 3R
 - 4. Kitchen: Stainless Steel
 - 5. Dishwashing Rooms/Areas: Stainless Steel
- I. Accessories: As indicated or required.
 - 1. Pilot Devices: NEMA ICS 5, cover-mounted type or flange-mounted 30mm type based upon enclosure selection. Contacts shall be rated NEMA B600 for cover-mounted devices and NEMA A600 for flange-mounted 30mm devices.
 - a. Pushbutton: On – Off
 - b. Selector Switch: Off/On
 - c. Indicating Light(s): Red On, and Green Off
 - 2. Control Power Transformers: As scheduled.
 - a. Provide fused primary and secondary and connect non-fused leg of secondary to enclosure.

2.2 MECHANICALLY AND MAGNETICALLY HELD LIGHTING CONTACTORS

- A. Manufacturers:
 - 1. Square D Company
 - 2. Eaton

3. Siemens

- B. Description: NEMA ICS 2 mechanically held lighting contactor which is electrically operated. Standard coil clearing contacts are to be provided so that the contactor coils shall be energized only during the instance of operation. Contactors shall be rated for all standard type ballast and tungsten lighting as well as general use and resistive heating loads.
- C. Contactor Ampere Rating: As scheduled or indicated.
- D. Poles: As scheduled or indicated.
- E. Power Contacts: To be totally enclosed in contactor housing and have double break operation.
- F. Coil operating voltage: 120 volts, 60Hz unless otherwise indicated.
- G. Enclosure: NEMA ICS 6, Type:
 - 1. Interior Dry Locations: Type 1
 - 2. Interior Wet Locations: Type 4
 - 3. Exterior Locations: Type 3R
 - 4. Kitchen: Stainless Steel
 - 5. Dishwashing Rooms/Areas: Stainless Steel
- H. Accessories: As indicated or required.
 - 1. Pilot Devices: NEMA ICS 5, cover-mounted type or flange-mounted 30mm type based upon enclosure selection. Contacts shall be rated NEMA B600 for cover-mounted devices and NEMA A600 for flange-mounted 30mm devices.
 - a. Pushbutton: On – Off
 - b. Selector Switch: Off/On
 - c. Indicating Light(s): Red On, and Green Off
 - 2. Control Power Transformers: as scheduled.
 - a. Provide fused primary and secondary and connect non-fused leg of secondary to enclosure.
 - 3. Control Modules:
 - a. 2 Wire Control
 - b. 3 Wire Control
 - c. On/Off Control

2.3 IDENTIFICATION

- A. Contactor engraved plastic nameplates: Engraving stock, melamine plastic laminate, minimum 1/16" thick for nameplates up to 20 sq. in. and 1/8" thick for larger sizes.
 - 1. Engraved legend shall be black letters on white face.
 - 2. Punched or drilled for mechanical fasteners.
- B. Fasteners for Nameplates: Self-tapping, stainless-steel screws or No. 10/32, stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install enclosed contactors where indicated, in accordance with manufacturer's instructions.

- B. Clean interiors of all enclosed electrical equipment to remove construction debris, dirt, and shipping materials.
- C. Repaint scratched or marred exterior surfaces to match original finish.
- D. Install enclosed contactors plumb. Provide supports in accordance with Section 260529.
- E. Refer to Section 260010 for mounting heights.
- F. Provide engraved plastic nameplates for each contactor. Label shall include the following:
 - 1. Contactor Name
 - 2. Voltage
 - 3. Coil Circuit

3.2 TESTING

- A. Perform factory and installation tests in accordance with applicable NEC, NEMA and UL requirements.

END OF SECTION 262830

SECTION 262900 – ELECTRIC CONTROLS, PUSHBUTTONS, RELAYS, AND EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Components for the following systems:
 - 1. Gas Valve Controls
 - 2. Power Controls

1.2 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code
- B. NEMA ICS 1 - General Standards for Industrial Control Systems
- C. NEMA ICS 2 - Standards for Industrial Control Devices, Controllers, and Assemblies
- D. NEMA ICS 6 - Enclosures for Industrial Controls and Systems
- E. NEMA ST 1 - Standard for Specialty Transformers (Except General Purpose Type.)

1.3 SUBMITTALS FOR REVIEW

- A. Submit under provisions of Section 260010.
- B. Shop Drawings: The following items shall be submitted for review and approval:
 - 1. Submittal booklet to include the following:
 - a. Reference to Specification Section.
 - b. A list of all equipment to be provided and installed.
 - c. Data sheets to indicate electrical characteristics and connection requirements with the specific item and model numbers highlighted.
 - d. Manufacturers' installation instructions.

1.4 SUBMITTALS FOR CLOSEOUT

- A. Submit under provisions of Section 260010.
- B. Operation Data: Include instructions for operating equipment.
- C. Maintenance Data: Include spare parts data, recommended maintenance procedures and intervals.

1.5 QUALIFICATIONS

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

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters laboratories, Inc. or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and indicated.

1.7 WARRANTY

- A. Provide the warranty specified in Section 260010.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Square D Company
- B. Eaton
- C. Siemens

2.2 CONTROL SWITCHES AND STATIONS

- A. Operators and Contact Blocks - Unless noted otherwise, operators for pilot duty control devices shall be heavy duty, oil tight NEMA 13, and shall be furnished with the quantity and types of contact blocks shown. All operators shall be 30.5 mm in diameter and suitable for cover mounting in a 1-7/32" diameter notch type cover hole and shall be held in place by the function nameplate or locking thrust washer in the event no nameplate is used. Pushbuttons and selector-switches shall have interchangeable inserts or caps in eight different colors for function color coding. Pushbutton inserts or caps and selector switch knobs shall be removable from the front of the control station without disturbing the wiring or mounting of the control units. Selector switches shall have removable knobs in eight different colors for function color coding. Contact blocks shall be single-pole, single-throw (SPST) or single-pole, double-throw (SPDT) and shall be suitable for mounting side by side and/or in tandem to the base of the operator. Terminals shall be pressure wire type with a self-lifting pressure clamp that will compensate for wire of different size ranging from #12 - #18 solid or stranded. Contacts shall be double break. Contact tips shall be silver. Standard contacts shall be nominally rated 10 amps continuous duty, inductive and shall be capable of making 60 amps and breaking 6 amps at 0-120 volts and making 7200 VA and breaking 720 VA at 120-600 volts. Special contacts including logic reed and overlapping contacts shall be available for mounting on the operator in combination with standard blocks.
 - 1. Provide NEMA 4 devices for exterior locations.
- B. Pilot Lights - Unless noted otherwise, pilot lights shall be heavy duty NEMA 13, transformer type with a round plastic lens. Pilot lights shall be standard full-sized units which mount in a 1-7/16" diameter hole. Terminals shall have a wire clamp plate suitable for holding two stranded wires, 18 AWG to 12 AWG.
 - 1. Provide NEMA 4 devices for exterior locations.

2.3 PUSH BUTTON OPERATORS: NEMA ICS 2

- A. Heavy duty type with red mushroom button, NEMA 1-B with stainless steel flush plate.

2.4 PUSH BUTTON OPERATORS WITH KEY RESET: NEMA ICS 2

- A. Heavy duty type with key reset switch, illuminated red mushroom button and stainless-steel flush plate.

2.5 SELECTOR SWITCH OPERATORS: NEMA ICS 2

- A. Two, three or four position rotary selector switches with contact blocks required.

2.6 START STOP PUSHBUTTON AND 120 VOLT AC or DC PILOT LIGHT STATIONS

- A. Heavy duty, momentary contact type with general purpose enclosure.

2.7 HAND OFF-AUTO SELECTOR SWITCH STATIONS

- A. Heavy-duty, maintained contact type with general purpose enclosure.

2.8 CONTROL POWER TRANSFORMERS

- A. Transformer: NEMA ST 1; machine tool transformer with isolated secondary winding.
- B. Power Rating: As indicated or required.
- C. Voltage Rating: As indicated or required.

2.9 TERMINAL BLOCKS

- A. Manufacturers:
 - 1. Square D Company
 - 2. Eaton
 - 3. Siemens
- B. Terminal Blocks: ANSI/NEMA ICS 4
- C. Power Terminals: Unit construction type with closed back and tubular pressure screw connectors, rated 600 volts.
- D. Signal and Control Terminals: Modular construction type, suitable for channel mounting, with tubular pressure screw connectors, rated 600 volts. Furnish blocks with a density of 3.4 blocks per inch or less.
- E. Provide ground bus terminal block, bonded to enclosure. Ground terminal blocks shall be plated bus bars pre-drilled to accept #16 through #6 conductors and provided with set screws or other manufactured assemblies meeting the requirements for panelboard ground bus assemblies.

2.10 CONDUCTORS

- A. Unless otherwise specified all power and control wiring shall be rated 600 volts, 98% conductivity copper, class B stranded, type THWN/MTW/AWM or MTW/AWM insulation.
- B. The following color code shall be observed for all single conductor control and power wiring used in the construction of control panels or for field wiring between panels and remote devices.

1. Red - all control wires originating from the fused side of the control transformer
2. White - all control wires connecting the common or neutral side of pilot lights, coils, horns, electronic controllers, etc. to the grounded side of the control transformer.
3. Green - all ground wires.
4. Yellow - all AC control wiring operating at a voltage higher than the secondary voltage of the control transformer.
5. Blue - all DC power and control wiring.
6. Black - All AC power wiring.

C. Minimum conductor sizes shall be as follows:

1. Control wiring unless otherwise noted - 14 AWG.
2. Power wiring unless otherwise noted - 12 AWG.

2.11 TERMINALS AND CONNECTIONS

- A. All incoming and outgoing control and power wiring shall be terminated on numbered terminal blocks.
- B. Terminal blocks shall be UL listed, rated 600V, have an ampacity not less than that of the fuses protecting the circuit connected to them but in no case less than 30A, have box lug with set screw construction, and be Square D 9080 GR6B or equal. Terminal blocks with a density greater than 3.4 terminals per linear inch will not be accepted.
- C. Terminal blocks shall be installed in the locations shown.
- D. Spare terminal blocks shall be furnished. Spare terminals shall equal 20% of the active terminals but not fewer than two or as otherwise indicated. When terminals are segregated in required groups in a panel, spare terminals shall be distributed among the groups.
- E. Provide multiple terminals and flat metal jumper straps when multiple wires have the same number. No more than 2 wires and 2 jumpers shall be permitted under 1 terminal block screw.
- F. Furnish ring type solderless connectors at all terminals on control components which do not have box lugs or clamp plates specifically designed for stranded wire.

2.12 ENCLOSURES

- A. Interior Dry Locations: Type 1
- B. Interior Wet Locations: Type 4
- C. Exterior Locations: Type 3R
- D. Kitchen: Stainless Steel
- E. Dishwashing Rooms/Areas: Stainless Steel

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install devices and equipment in accordance with manufacturer's instructions.

- B. Install relays in enclosures.
- C. Make electrical wiring interconnections as indicated.

END OF SECTION 262900

SECTION 262913 – ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Manual Motor Starters
- B. Magnetic Motor Starters
- C. Combination Magnetic Motor Starters

1.2 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code
- B. UL 198C - High-Interrupting Capacity Fuses; Current Limiting Type
- C. UL 198E - Class R Fuses
- D. NECA "Standard of Installation," published by National Electrical Contractors Association
- E. NEMA AB 1 - Molded Case Circuit Breakers
- F. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies
- G. NEMA ICS 6 - Enclosures for Industrial Controls and Systems
- H. NEMA KS 1 - Enclosed Switches

1.3 SUBMITTALS FOR REVIEW

- A. Submit under provisions of Section 260010.
- B. Shop Drawings: The following items shall be submitted for review and approval:
 - 1. Submittal booklet to include the following:
 - a. Reference to Specification Section.
 - b. A list of all equipment to be provided and installed.
 - c. Data sheets to indicate voltage, controller size, rating, size of switching, overcurrent protective device, short circuit ratings, dimensions and enclosure with the specific item or model number highlighted.

1.4 SUBMITTALS FOR CLOSEOUT

- A. Submit under the provisions of Section 260010.
- B. Maintenance Data: Include spare parts data and recommended maintenance procedures and intervals.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with NECA Standard of Installation except for mounting heights.
- B. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.7 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc., or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and indicated.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 - 1. Fuses: Furnish 3 of each size and type installed.

1.9 WARRANTY

- A. Provide the warranty specified in Section 260010.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Square D Company
- B. Siemens
- C. Allen Bradley

2.2 MANUAL CONTROLLERS

- A. Manual Motor Controller: NEMA ICS 2, AC general-purpose Class A manually operated, full-voltage controller with overload element, red pilot light, and toggle operator.
- B. Fractional Horsepower Manual Controller: NEMA ICS 2, AC general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, with thermal overload unit, red pilot light and toggle operator.
- C. Motor Starting Switch: NEMA ICS 2, AC general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, without thermal overload unit, with red pilot light and toggle operator.

2.3 AUTOMATIC CONTROLLERS

- A. Magnetic Motor Controllers: NEMA ICS 2, AC general-purpose Class A magnetic controller for induction motors rated in horsepower.
- B. Reversing Controllers: Include electrical interlock and integral time delay transition between FORWARD and REVERSE rotation.
- C. Two Speed Controllers: Include integral time delay transition between FAST and SLOW speeds.
- D. Coil operating voltage: 120 volts, 60 Hertz.
- E. Overload Relay: NEMA ICS; melting alloy.

2.4 PRODUCT OPTIONS AND FEATURES

- A. Auxiliary Contacts: NEMA ICS 2, one each normally open and closed field convertible contacts in addition to seal-in contact.
- B. Cover Mounted Pilot Devices: NEMA ICS 2, heavy duty oil-tight type 30.5mm round.
- C. Pilot Device Contacts: NEMA ICS 2, Form Z, rated A150.
- D. Pushbuttons: Recessed type.
- E. Indicating Lights: Transformer type.
- F. Selector Switches: Rotary type.
- G. Control Power Transformers: 120-volt secondary, NEMA IS2 recommended volt amperes minimum, in each motor starter. Provide fused primary and secondary, and bond unfused leg of secondary to enclosure.
- H. Load Side Terminations: Provide lugs on circuit breakers of sufficient size to terminate conductors scheduled or indicated on plans.
- I. Single Phasing Protection: (Three Phase Units)

2.5 COMBINATION UNITS

- A. Combination Controllers: Combine motor controllers with thermal magnetic circuit breaker or fusible switch disconnect in common enclosure.
- B. Thermal Magnetic Circuit Breakers: NEMA AB 1, with integral thermal and instantaneous magnetic trip in each pole.

2.6 ENCLOSURE

- A. Enclosure: NEMA ICS 6
 - 1. Interior Dry Locations: Type 1
 - 2. Interior Wet Locations: Type 4
 - 3. Exterior Locations: Type 3R
 - 4. Kitchen: Stainless Steel

- 5. Dishwashing Rooms/Areas: Stainless Steel

2.7 IDENTIFICATION

- A. Enclosed Controllers Engraved Plastic Nameplates: Engraving stock, melamine plastic laminate, minimum 1/16" thick for nameplates up to 20 sq. in. and 1/8" thick for larger sizes.
- B. Fasteners for Nameplates: Self-tapping, stainless-steel screws, or #10/32 stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install enclosed controllers where indicated, in accordance with manufacturer's instructions.
- B. Install enclosed controllers' plumb. Provide supports in accordance with Section 260529.
- C. Refer to Section 260010 for mounting heights.
- D. Install fuses in fusible switches.
- E. Provide engraved plastic nameplates for each contactor with 1/2" high lettering. Label shall include the following:
 - 1. Controller Name
 - 2. Circuit

3.2 FIELD QUALITY CONTROL

- A. Perform inspection and testing.
- B. Inspect and test each enclosed controller to NEMA ICS 2.

END OF SECTION 262913

SECTION 264313 – DISTRIBUTION SURGE PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 SCOPE

- A. Work under this section consists of furnishing all materials necessary for the execution and complete installation of surge protective devices.

1.2 REFERENCE STANDARDS

- A. Underwriters Laboratories, Inc. Standard No. 1449 (latest edition)
- B. IEEE Standard C62.45, C62.41 (latest edition)
- C. National Electrical Code Article 240-21 (Equipment complying with tap conductor rules) and Article 110-9 (Interrupting Capacity)
- D. Manufacturer shall be ISO 9001 Certified

1.3 SUBMITTALS FOR REVIEW

- A. Submit under provisions of Section 260010.
- B. Shop Drawings: The following items shall be submitted for review and approval:
 - 1. Submit booklet to include the following:
 - a. Reference to specification section.
 - b. A list of all equipment to be provided and installed.
 - c. Data sheets to indicate rating, dimensions and finishes with the specific item or model number highlighted.
 - d. Data sheet shall also include type of unit and the protected panels name or reference number (I.E. Type H2 – Panels CP1, CP2 & CP3)

1.4 SUBMITTALS FOR CLOSEOUT

- A. Submit under provisions of Section 260010.
- B. Record actual locations of equipment.
- C. Maintenance Data:
 - 1. Routing preventive maintenance schedule.
 - 2. Lists of special tools, maintenance materials, and replacement parts.
 - 3. Repair instructions for procedures to check, repair, and test equipment during typical malfunctions.
 - 4. Recommended cleaning methods, frequency, and materials.

1.5 WARRANTY

- A. Provide the warranty specified in Section 260010.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Units shall consist of parallel connections only. Series components are optional. All MOV's shall be individually fused to provide system redundancy.
- B. The surge protective device must be UL listed under the (UL 1449, Most Recent Edition), UL 1449, Third Edition Voltage protection rating, and short circuit current rating must be clearly stated.
- C. Metal Oxide Varistors (MOVs) are to be utilized as the primary suppression components.
 - 1. Suppression systems shall not employ any other technologies such as gas tubes, spark gap devices, selenium devices or filters.
- D. Enclosures:
 - 1. Units located in indoor environments shall be provided in heavy duty NEMA 1, or better rated enclosure.
 - 2. Units located in outdoor environments shall be provided in heavy duty NEMA 3R or better rated enclosure.
 - 3. Refer to the drawings to determine whether units are for indoor or outdoor applications.
 - 4. Refer to the drawings to determine whether units are for flush mount or surface mount installations.
 - 5. SDP units may be installed internal/integral to the gear.
- E. All units shall have active indicator lights, which shall extinguish when protection has failed.
- F. Units must be supplied as part of distribution equipment where UL listed as a complete assembly.
- G. Disconnect switch/overcurrent protection: See Part 3.1 for more information regarding this feature.
- H. 10-year unconditional warranty.

2.2 TYPE H1 UNIT – NON-CRITICAL, SERVICE ENTRANCE APPLICATIONS

- A. Voltage Rating: 480/277V, 3-phase, 4-wire.
- B. Application: Distribution Switchboard or Panelboard
- C. Minimum Modes of Protection: Common or Normal: L-N, L-G, L-L, & N-G
- D. Maximum UL 1449 Voltage Protection Ratings (VPRs) for L-N, L-G, and N-G Modes of Protection: 1200 volts.
- E. I-nominal Rating: 20kA
- F. Minimum Acceptable Single Pulse Surge Current Capacity: 240,000 amps per phase
- G. The following models are acceptable:
 - 1. Square D Company Model SSP04EMA24
 - 2. Eaton Model SPD250480Y2K
 - 3. Siemens Model TPS4E13250X2
 - 4. ASCO Model 460277YP25ACAE10

2.3 TYPE H2 UNIT – NON-CRITICAL LOAD APPLICATIONS

- A. Voltage Rating: 480/277V, 3-phase, 4-wire
- B. Application: Distribution Switchboard or Panelboard
- C. Minimum Modes of Protection: Common or Normal: L-N, L-G, L-L, & N-G
- D. Maximum UL 1449 Voltage Protection Ratings (VPR's) for L-N, L-G, & N-G Modes of Protection: 1200 volts.
- E. I-Nominal Rating: 20kA
- F. Minimum Acceptable Single Pulse Surge Current Capacity: 160,000 amps per phase
- G. The following Models are acceptable:
 - 1. Square D Company Model SSP04EMA16
 - 2. Eaton Model SPD160480Y2K
 - 3. Siemens TPS4E13200X2
 - 4. ASCO Model 430277YP20ACSJ20

2.4 TYPE H3 UNIT – NON-CRITICAL LOAD APPLICATIONS

- A. Voltage Rating: 480/277V, 3-phase, 4-wire.
- B. Application: Distribution Switchboard or Panelboard
- C. Minimum Modes of Protection: Common or Normal: L-N, L-G, L-L, & N-G.
- D. Maximum UL 1449 Voltage Protection Ratings (VPRs) for L-N, L-G, and N-G Modes of Protection: 1200 volts.
- E. I-nominal Rating: 20kA
- F. Minimum Acceptable Single Pulse Surge Current Capacity: 120,000 amps per phase
- G. The following models are acceptable:
 - 1. Square D Company Model SSP04EMA12
 - 2. Eaton Model SPD120480Y2K
 - 3. Siemens TPS4E13150X2
 - 4. ASCO Model 430277YP20ACSJ20

2.5 TYPE L1 UNIT – NON-CRITICAL SERVICE ENTRANCE APPLICATIONS

- A. Voltage Rating: 120/208V, 3-phase, 4-wire.
- B. Application: Distribution Switchboard or Panelboard
- C. Minimum Modes of Protection: Common or Normal: L-N, L-G, L-L, & N-G.
- D. Maximum UL 1449 Voltage Protection Ratings (VPRs) for L-N, L-G, and N-G Modes of Protection: 1200 volts.
- E. I-nominal Rating: 20kA

- F. Minimum Acceptable Single Pulse Surge Current Capacity: 240,000 amps per phase
- G. The following models are acceptable:
 - 1. Square D Company Model SSP02EMA24
 - 2. Eaton Model SPD250208Y2K
 - 3. Siemens Model TPS4C13250X2
 - 4. ASCO Model 460120YP25ACAE10

2.6 TYPE L2 UNIT – NON-CRITICAL LOAD APPLICATIONS

- A. Voltage Rating: 120/208V, 3-phase, 4-wire.
- B. Application: Distribution Switchboard or Panelboard
- C. Minimum Modes of Protection: Common or Normal: L-N, L-G, L-L, & N-G.
- D. Maximum UL 1449 Voltage Protection Ratings (VPRs) for L-N, L-G, and N-G Modes of Protection: 1200 volts.
- E. I-nominal Rating: 20kA
- F. Minimum Acceptable Single Pulse Surge Current Capacity: 160,000 amps per phase
- G. The following models are acceptable:
 - 1. Square D Company Model SSP02EMA16
 - 2. Eaton Model SPD160208Y2K
 - 3. Siemens Model TPS4C13200X2
 - 4. ASCO Model 430120YP20ACSJ20

2.7 TYPE L3 UNIT – NON-CRITICAL LOAD APPLICATIONS

- A. Voltage Rating: 120/208V, 3-phase, 4-wire.
- B. Application: Distribution or Branch Circuit Panelboard
- C. Minimum Modes of Protection: Common or Normal: L-N, L-G, L-L, & N-G.
- D. Maximum UL 1449 Voltage Protection Ratings (VPRs) for L-N, L-G, and N-G Modes of Protection: 1200 volts.
- E. I-nominal Rating: 20kA
- F. Minimum Acceptable Single Pulse Surge Current Capacity: 120,000 amps per phase
- G. The following models are acceptable:
 - 1. Square D Company Model SSP02EMA12
 - 2. Eaton Model SPD120208Y2K
 - 3. Siemens Model TPS4C13150X2
 - 4. ASCO Model 430120YP15ACSJ20

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The unit shall be installed in accordance with the manufacturer's printed instruction. All local and national codes and regulations must be observed.
- B. Units shall be installed of the same voltage rating as the intended protected equipment.
- C. Units shall be internally/integrally, surface, or flush mount to match the intended protected equipment.
- D. Installation of Units:
 - 1. Install separately enclosed units immediately adjacent to or within the protected panel with the shortest possible lead length without any unnecessary elbows, bends or turns. Where conduit is necessary to install lead connection conductors, leads shall be installed in conduit as required.
 - 2. Provide a dedicated 3-pole branch circuit breaker in all protected panels for connection. Circuit breaker size and wire size shall be per manufacturer recommendation. Connect leads to the load side of the circuit breaker.
 - 3. If space is not available in protected panel, provide a 3-pole disconnect switch between the protected panel and the SPD for connection. Fuse and wire size shall be per manufacturer recommendation. Connect leads from the disconnect switch to the main bus (or distribution bus), whichever allows for the shortest total lead length) of the protected panel.

3.2 LOCATIONS

- A. See the power riser drawings for all SPD unit locations and types.

END OF SECTION 264313

SECTION 265100 – INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Interior Luminaires and Accessories
- B. Exit Signs
- C. Luminaire Support Components

1.2 REFERENCES

- A. NEMA WD 6 - Wiring Devices-Dimensional Requirements
- B. NFPA 70 - National Electrical Code
- C. NFPA 101 - Life Safety Code
- D. ANSI/IESNA 500 - 1998 - Recommended Practice for Installing Interior Lighting Systems

1.3 SUBMITTALS FOR REVIEW

- A. Submit under provisions of Section 260010.
- B. Shop Drawings: The following items shall be submitted for review and approval:
 - 1. Submittal booklet to include the following:
 - a. Reference to Specification Section
 - b. A list of all luminaires arranged in order of designation.
 - c. Factory-issued luminaire data sheets to indicate features, finishes and dimensions with the specific items or model number highlighted. Photocopies with handwriting are not acceptable.
 - d. Factory-issued accessory sheets to indicate optional items added to the luminaires with the specific item or model number highlighted. Photocopies with handwriting are not acceptable.
 - e. Color samples for luminaires that require color selection.
 - f. Wiring diagrams for power, signals, and control wiring.
 - g. All warranties for luminaires.
 - 2. Provide the following items if requested by the Engineer:
 - a. Samples
 - b. Footcandle Layouts
 - c. Luminaire Mock-up proposed layout

1.4 SUBMITTALS FOR CLOSEOUT

- A. Submit under provisions of Section 260010.
- B. Submit a list of all luminaires installed in the system.

- C. Submit data sheets for all luminaires installed with manufacturers operation and maintenance instruction for each type.
- D. Submit replacement parts identification lists and tools required for all luminaire types.
- E. Submit a list of types of cleaners to be used on all luminaire types.
- F. Submit final As-Built shop drawings.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Conform to requirements of NFPA 101.

1.7 WORK INCLUDED

- A. Conformance: Luminaires shall be manufactured in strict accordance with the Contract Drawings and Specifications.
- B. Specifications and scale drawings are intended to convey the salient features, function, and character of the luminaires only, and do not undertake to illustrate or set forth every item or detail necessary for the work.
- C. Minor details not usually indicated on the drawings nor specified, but that are necessary for the proper execution and completion of the luminaires, shall be included, the same as if they were herein specified or indicated on the drawings.

1.8 COORDINATION

- A. Coordinate luminaires with the Room Finish Schedules for type of ceiling construction. The Electrical Contractor shall be responsible for ordering the proper luminaires and hardware required for installation in or on a specific ceiling.
- B. Coordinate luminaires with Mechanical and Plumbing Contractors and their respective equipment. Conflicts shall be brought to the attention of the Architect prior to installation of the luminaires and ceilings. Conflicts not brought to the Architect prior to installation of luminaires and ceilings shall be the Electrical Contractors responsibility for all costs associated with rework of luminaires, piping, ductwork, and ceiling grid.

1.9 QUALITY ASSURANCE

- A. Materials, equipment appurtenances as well as workmanship provided under this Section shall conform to the highest commercial standard as specified and as indicated on drawings.

1.10 MAINTENANCE MATERIALS

- A. Provide 2 of each special tool required for maintenance.

1.11 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective
 - 1. Glass and Plastic Lenses, Covers, and Other Optical Parts: Furnish 2 of each type and rating installed.
 - 2. Globes and Guards: Furnish 2 of each type and rating installed.

1.12 WARRANTY

- A. Provide the warranty specified in Section 260010.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- A. Refer to the Luminaire Schedule.

2.2 LUMINAIRES AND COMPONENTS (GENERAL)

- A. Metal Parts: Free of burrs, sharp corners, and edges.
- B. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- C. Doors, Frames, and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in operating position.
- D. Reflecting surfaces shall be minimum reflectance as follows:
 - 1. White – 85%
 - 2. Specular – 83%
 - 3. Diffusing Specular – 75%
 - 4. Laminated Silver Metalized Film – 90%
- E. Lenses, Diffusers, Covers and Globes:
 - 1. 100% virgin acrylic plastic, high resistance to yellowing and other changes due to aging, heat, and UV radiation.
 - a. Lens Thickness: At least 0.125" minimum
 - b. UV Stabilized
 - 2. Glass: Annealed crystal glass unless otherwise indicated.
- F. Luminaires subject to damage shall be equipped with approved heavy-duty metal guards.
- G. Luminaires exposed to weather shall be weatherproof, gasketed provided with aluminum boxes and trim of stainless steel, cast aluminum or other non-ferrous material.

- H. Furnish all necessary materials, accessories and any other equipment required for the complete and proper installation and operation of all lighting luminaires included in this contract.
- I. All lighting luminaires to be listed and labeled by UL or other testing agency acceptable to local code and authorities for installation in fireproof or non-fireproof construction, damp or wet locations as required.
- J. Provide luminaires with all associated appurtenances including, but not necessarily limited to, reflectors, lenses and/or louvers, sockets, holders, suspension accessories, pendants, canopies, lumessing boxes, plaster frames and similar items completely wired, assembled, installed, and tested as specified and in the manner indicated.
- K. All troffer-type lighting luminaires shall be designed to completely eliminate light leakage between the luminaire body and doorframe and shall be provided with positive acting, hinge and latch flush doorframes.
- L. Every luminaire symbol shall have a luminaire number unless otherwise directed. In instances where a specific luminaire symbol has not been assigned a luminaire number, provide a complete luminaire of the type and wattage designated for luminaire symbols of similar function and/or as directed by the Architect.
- M. All luminaires shall be UL listed or assembled from UL components.
- N. Provide lamps for all lighting luminaires furnished in the project. Contractor to verify that lamps installed in luminaires are of the type recommended by the manufacturer.

2.3 LED LUMINAIRES

- A. Die cast or extruded aluminum heat sinks for LED assemblies and drivers.
- B. Comply with LM79/LM80
- C. CCT: 4000K
- D. CRI: 70 or greater
- E. Operating Temperature: -30°C to +40°C
- F. Driver Power Factor: Greater than 0.9
- G. Driver THD: Less than 20%
- H. Provide light emitting diodes with individual injection molded acrylic optics.

2.4 EXIT SIGNS

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
 - 1. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.
 - 2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
 - a. Battery: Sealed, maintenance-free, nickel-cadmium type.

- b. Charger: Fully automatic, solid-stage type with sealed transfer relay.
 - c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80% of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 - f. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
 - g. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.
- C. Wireguards: Provide wireguards for all exit signs located in the Gymnasiums, Locker Rooms, Multi-Purpose Rooms, Electrical Rooms, Mechanical Rooms, Boiler Rooms, and all other areas indicated on the drawings.

2.5 FINISHES

- A. Manufacturer's standard color, unless otherwise indicated in Luminaire Schedule to be "custom color".

2.6 LUMINAIRE SUPPORT COMPONENTS

- A. Single-Stem Hangers: 1/2" steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- B. Twin-Stem Hangers: Two, 1/2" steel tubes with single canopy designed to mount a single luminaire. Finish same as luminaire.
- C. Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated, 12-ga.
- D. Rod Hangers: 3/16" minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire and line voltage and equipped with threaded attachment, cord, and locking-type plug.
- F. Aircraft Cable Support: Use cable, anchorages, and intermediate supports recommended by luminaire manufacturer.
- G. Safety Cables: Install manufacturer's standard safety cable on all luminaires in the Gymnasium.

2.7 EMERGENCY LIGHTING CONTROL DEVICES

- A. Emergency Lighting Control Unit – A UL 924 listed device that monitors a switched circuit providing normal lighting to an area. The unit provides normal ON/OFF control of emergency lighting along with the normal lighting. Upon normal power failure, the emergency lighting circuit will close, forcing the emergency lighting ON until normal power is restored. Features include:
- 1. 120/277 volts, 50/60 Hz, 20-amp ballast rating
 - 2. Push to test button

3. Auxiliary contact for remote test or fire alarm system interface
- B. Manufacturers:
 1. WattStopper Model: ELCU-100 or ELCU-200
 2. Bodine Model GTD20 or GTD20A
- C. Provide quantities/type as required by application.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Set all luminaires level, secure, plumb, and square with ceilings and walls according to manufacturer's written instructions or approved shop drawing.
- B. Install lamps in all luminaires. Contractor to verify that lamps installed in luminaires are of the type recommended by the manufacturer.
- C. Support for Luminaires in or on Grid-Type Suspended Ceilings:
 1. Troffer Type (i.e. 2x4, 1x4, 2x2):
 - a. Support Clips: Fasten to luminaires and to ceiling grid members at or near each luminaire corner with clips that are UL listed for the applications.
 - b. In addition to support clips, provide a minimum of (4) ceiling independently supported rods or wires for each luminaire. Locate at opposite corners of luminaire.
 - c. Provide additional supports as required by manufacturer.
 2. Luminaires of sizes less than ceiling grid (i.e. downlights, exit signs):
 - a. Install as indicated on electrical drawings and architectural reflected ceiling plans. Center luminaire in each panel or center luminaire in half of 2x4 panels to allow other half for use by other equipment. Coordinate final luminaire locations with other contractors.
 - b. Provide support of luminaires with at least two metal channels spanning and secured to ceiling tees with supports that are listed for the application.
 - c. In addition, provide at least one independently supported rod or wire from structure to a tab on the light luminaire. Wire or rod shall have breaking strength of the weight of the luminaire at a safety factor of 3.
 3. Install luminaires in strict conformance with the ceiling manufacturer's instruction.
- D. Suspended Luminaire Support: As follows:
 1. Pendants and Rods: Where longer than 48", brace to limit swinging.
 2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers.
 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
 4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.
- E. Support luminaires according to the luminaire manufacturer's requirements.
- F. Locate recessed ceiling luminaires as indicated on reflected ceiling plan.
- G. Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- H. Exposed Grid Ceilings: Support surface mounted luminaires on grid ceiling directly from building structure.

- I. Install recessed luminaires to permit removal from below.
- J. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- K. Install clips to secure recessed grid-supported luminaires in place.
- L. Install wall mounted luminaires, emergency lighting units and exit signs at height as indicated on Drawings or as directed by Architect.
- M. Install accessories furnished with each luminaire.
- N. Adjust aimable luminaires to provide required light intensities.
- O. Provide wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- P. When a dimming LED Driver is specified, provide 0-10V wiring between driver and control device.
- Q. When a DMX Driver is specified, provide DMX wiring between driver and control device.
- R. When a DMX Driver is specified, program each luminaire with a DMX address.
- S. Program a DMX address for each luminaire before installing luminaires. Coordinate addresses with Owner and Control Manufacturer.
- T. Bond products and metal accessories to branch circuit equipment grounding conductor.
- U. Luminaire Locations: Do not scale electrical drawings for exact location of the lighting luminaires. In general, the architectural reflected ceiling plans indicate the proper locations of lighting luminaires.
- V. Appurtenances: Install each luminaire properly and safely. Furnish and erect hangers, rods, mounting brackets, supports, frames, and other equipment required.
- W. Coordination: Furnish lighting luminaires complete with appurtenances required for the proper, safe, and distortion-free installation in the various surfaces in which they appear. Determine surface types from the Architectural drawings.
- X. Install lighting luminaires in strict conformance with the luminaire manufacturer's recommendations and instructions.
- Y. Rigidly align continuous rows of lighting luminaires for true in-line appearance.
- Z. Do not install luminaires and/or parts such as finishing plates, lenses, and trims for recessed luminaires until all plastering and painting that may mar luminaires finish has been completed.
- AA. Mechanical Rooms: Lighting luminaire locations in mechanical and electrical equipment rooms are approximate. Coordinate mounting height and location of lighting luminaires to clear mechanical, electrical, and plumbing equipment and to illuminate adequately meters, gauges, and equipment.
- BB. Concealment: Whenever a luminaire or its hanger canopy is applied to a surface mounted outlet box. Provide a finishing ring to conceal the outlet box.

- CC. Replace blemished, damaged, or unsatisfactory luminaires as directed.

3.2 CONNECTIONSs

- A. Ground Lighting Units: Tighten electrical connectors and terminals, including grounding connections, according to manufacturers published torque-tightening values. Where manufacturers torque values are not indicated, use those specified in L 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

- A. Inspect each installed luminaire for damage. Replaced damaged luminaires and components.
- B. Tests: Verify normal operation of each luminaire after luminaires have been installed and circuits have been energized with normal power source. Interrupt electrical energy to demonstrate proper operation of emergency lighting system.
- C. Replace or repair malfunctioning luminaires and components, then retest. Repeat procedure until all units operate properly.
- D. Report results of tests.
- E. Replace luminaires that show evidence of corrosion during project warranty period.

3.4 ADJUSTING AND CLEANING

- A. Clean luminaires after installation. Use methods and materials recommended by manufacturer.
- B. Adjust luminaires to provide required light intensities.

END OF SECTION 265100

SECTION 265600 – EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Exterior Luminaires and Accessories
- B. Poles

1.2 RELATED WORK/DIVISIONS

- A. Division 3

1.3 REFERENCES

- A. IES RP-8 - Recommended Practice for Roadway Lighting
- B. IES RP-20 - Lighting for Parking Facilities
- C. NFPA 70 - National Electrical Code

1.4 SUBMITTALS FOR REVIEW

- A. Submit under provisions of Section 260010.
- B. Shop Drawings: The following items shall be submitted for review and approval:
 - 1. Submittal booklet to include the following:
 - a. Reference to Specification Section.
 - b. A list of all luminaires arranged in order of luminaire designation.
 - c. Luminaire data sheets to indicate features, finishes, and dimensions with the specific items or model number highlighted.
 - d. Accessory sheets to indicate optional items added to the luminaires with the specific item or model number highlighted.
 - e. Color samples for luminaires that require color selection.
 - f. Wiring diagrams for power, signals, and control wiring.
 - g. Product certificates for each type of ballast for dimmer-controlled luminaires, signed by the product manufacturer.
 - h. All warranties for luminaires.

1.5 SUBMITTALS FOR CLOSEOUT

- A. Submit under provisions of Section 260010.
- B. Submit a list of all luminaires installed in the system.
- C. Submit data sheets for all luminaires and poles installed with manufacturers operation and maintenance instructions for each type.
- D. Submit replacement part identification lists and tools required for all luminaire and pole types.

- E. Submit a list of types of cleaners to be used on all luminaire types.
- F. Submit final As-Built shop drawings.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum 3 years' experience.

1.7 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Transport, handle, store, and protect products.

1.9 COORDINATION

- A. Coordinate site lighting installation with the paving, site grading and underground work by other contractors.
- B. Furnish bolt templates and pole mounting accessories to installer of pole foundations.

1.10 MAINTENANCE MATERIALS

- A. Provide 2 of each special tool required for maintenance.

1.11 EXTRA MATERIALS

- A. Furnish one gallon of touch-up paint.
- B. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 - 1. Glass and Plastic Lenses, Covers and Other Optical Parts: Furnish 1 of each type and rating installed
 - 2. Globes and Guards: Furnish 1 of each type and rating installed.

1.12 WARRANTY

- A. Provide the warranty specified in Section 260010.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Refer to the Luminaire Schedule

2.2 GENERAL REQUIREMENTS FOR LUMINAIRES

- A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.
- B. Lateral Light Distribution Patterns: Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
- C. Metal Parts: Free of burrs and sharp corners and edges.
- D. Sheet Metal Components: Corrosion-resistant aluminum unless otherwise indicated. Form and support to prevent warping and sagging.
- E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
- F. 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. Designed to disconnect ballast when door opens.
- G. Exposed Hardware Material: Stainless steel.
- H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.
- J. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
- K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- L. 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.
- M. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning", to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning, or SSPC-SP8 "Pickling".
 - 2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
- N. 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; 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 AAMA611.
 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 AAMA611.
- O. Every luminaire symbol shall have a luminaire number unless otherwise directed. In instances where a specific luminaire symbol has not been assigned a luminaire number, provide a complete luminaire of the type and wattage designated for a luminaire symbol of similar function and/or as directed by the Architect.
- P. All luminaires shall be UL listed or assembled from UL components.

2.3 LED LUMINAIRES

- A. Die cast or extruded aluminum heat sinks for LED assemblies and drivers.
- B. Comply with LM79/LM80
- C. CCT: 4000K
- D. CRI: 70 or greater
- E. Operating Temperature: -30°C to +40°C
- F. Driver Power Factor: Greater than 0.9
- G. Driver THD: Less than 20%
- H. Provide light emitting diodes with individual injection molded acrylic optics.

2.4 GENERAL REQUIREMENTS FOR POLES AND SUPPORT COMPONENTS

- A. Structural Characteristics: Comply with AASHTO LTS-4M.
- B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.
- C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
 1. Materials: 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.
 3. Anchor-Bolt Template: Plywood or steel.
- D. Handhole: Oval-shaped, with minimum clear opening of 2.5" x 5" with cover secured by stainless-steel captive screws.
- E. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Concrete, reinforcement, and formwork are specified in Division 3 Section "Cast-In-Place Concrete"

2.5 ALUMINUM POLES

- A. Poles: Seamless, extruded structural tube complying with ASTM B 429/B 429M, Alloy 6063-T6 with access handhole in pole wall.
- B. Poles: ASTM B209 (ASTM B209M), 5052-H34 marine sheet alloy with access handhole in pole wall.
 - 1. Shape: Refer to Luminaire Schedule.
 - 2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
- C. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.
- D. Grounding and Bonding Lugs: Welded 1/2" threaded lug, complying with requirements in Division 26 Section "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.
- E. Aluminum Finish: 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; 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.

2.6 POLE ACCESSORIES

- A. Base Covers: Manufacturers standard metal units, arranged to cover pole's mounting bolts and nuts. Provide 1 for every pole.

2.7 FINISHES

- A. Luminaires: Manufacturers standard color, unless otherwise indicated in the Luminaire Schedule to be "Custom Color".
- B. Poles: Manufacturers standard color, unless otherwise indicated in the Luminaire Schedule to be "Custom Color".
- C. Luminaire and pole assemblies finish shall always be identical.
- D. All accessories and mounting hardware shall match luminaire or pole finish.
- E. Foundation sealer shall be Drylock Extreme Water Proofer, or equivalent by Master Seal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide a pole for every pole mounted assembly.
- B. Provide concrete bases for all lighting poles in accordance with Division 3.
- C. Install poles plumb. Provide double nuts to adjust plumb. Grout around each base.
- D. Install lamps in each luminaire.
- E. Provide a ground rod in every concrete base.
- F. Bond luminaires, metal accessories and metal poles to branch circuit equipment grounding conductor and ground rod installed in concrete base.
- G. Provide sealing finish of concrete pole bases to hide form lines and air pockets.
- H. When a dimming LED Driver is specified, provide 0-10V wiring between driver and control device.

3.2 POLE INSTALLATION

- A. Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.
- B. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Division 3 Section "Cast-in-Place Concrete."
- C. Raise and set poles using web fabric slings (not chain or cable).

3.3 BOLLARD LUMINAIRE INSTALLATION

- A. Align units for optimum directional alignment of light distribution.
- B. Install on concrete base with top 2" above finished grade or surface at bollard location. Cast conduit into base, and shape base to match shape of bollard base. Finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Division 3 Section "Cast-in-Place Concrete".

3.4 INSTALLATION OF INDIVIDUAL GROUND-MOUNTING LUMINAIRES

- A. Install on concrete base with top 2" 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 Division 3 Section "Cast-in-Place Concrete".

3.5 GROUNDING

- A. Ground metal poles and support structures according to Section 260526.
 - 1. Install grounding electrode for each pole unless otherwise indicated.

2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

- B. Ground nonmetallic poles and support structures according to Section 260526.
 1. Install grounding electrode for each pole.
 2. Install grounding conductor and conductor protector.
 3. Ground metallic components of pole accessories and foundations.

3.6 CONNECTIONS

- A. Ground Lighting Units: Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.7 FIELD QUALITY CONTROL

- A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.
- B. Operate each luminaire after installation and connection. Inspect for improper connections and operation.
- C. Tests and Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source. Measure light intensities at night. Use photometers with calibration referenced to NIST Standards. Comply with the following IESNA testing guide(s):
 1. Check intensity and uniformity of illumination.
 2. Check excessively noisy ballasts.

3.8 ADJUSTING AND CLEANING

- A. Clean luminaires after installation. Use methods and materials recommended by manufacturer.
- B. Clean electrical parts to remove conductive and deleterious materials.
- C. Remove dirt and debris from enclosure.
- D. Clean photometric control surfaces as recommended by manufacturer.
- E. Clean finishes and touch up damage.
- F. Adjust aimable luminaires to provide required light intensities.

3.9 PROTECTION OF FINISHED WORK

- A. Protect installed work.

END OF SECTION 265600

SECTION 270500 – COMMON WORK REQUIRED FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Grounding and Bonding for Communications Systems
- B. Fire Rated Pathways for Communications Systems
- C. Hangers and Supports for Communications Systems
- D. Conduits and Backboxes for Communications Systems

1.2 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code

1.3 SUBMITTALS FOR REVIEW

- A. Submit under provisions of Section 260010.
- B. Shop Drawings: The following items shall be submitted for review and approval:
 - 1. Submittal booklet to include the following:
 - a. Reference to Specification Section
 - b. A list of all equipment to be provided and installed.

1.4 SUBMITTALS FOR CLOSEOUT

- A. Submit under provisions of Section 260010.
- B. As-Built Drawings: Provide a marked-up copy of original plans which reflect any changes or additions not shown on the plan.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Provide products listed and classified by Underwriters Laboratories, Inc., or a testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to project site in manufacturer's original, unopened cartons and containers, each bearing names of product and manufacturer.

- B. Store products in dry spaces protected from the weather. The storage temperature shall be 68°F to 122°F.

1.8 PLENUM WIRING

- A. This is an air "Plenum" project. Cabling installed in plenums or in areas above hung ceilings, used as a plenum, shall be plenum rated or installed in conduit.

1.9 WARRANTY

- A. Provide the warranty specified in Section 260010.

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

- A. Main Telecommunications Ground Bus:
 - 1. Material: 1/4" tinned copper busbar
 - 2. Size: 4"x12" min
 - 3. Mounting: Insulated stand-off
 - 4. Location: Service Entrance Telecommunications Backboard.
- B. Additional Telecommunications Ground Bus:
 - 1. Material: 1/4" tinned copper busbar
 - 2. Size: As required
 - 3. Mounting: Insulated stand-off
 - 4. Location: All MDF and IDF rooms in the project
- C. Ground Wires: Refer to Section 260519 for ground wires

2.2 FIRE RATED PATHWAYS FOR COMMUNICATIONS

- A. Manufacturers:
 - 1. Specified Technologies Inc.
 - a. EZ-PATH Fire Rated Pathway (single, double, and triple)
- B. Pathways:
 - 1. Cables passing through fire-rated floors or walls shall pass through fire-rated wiring devices which contain an intumescent insert material that adjusts automatically to cable additions or subtractions.
 - 2. The device shall have an F rating equal to the rating of the barrier in which the device is installed.
 - 3. Wiring devices shall be capable of allowing a 0 to 100% visual fill of cables.
 - 4. Wire devices shall be of a sufficient size to accommodate the quantity and size of electrical wires and data cables required.
 - 5. Wire devices to be provided with steel wall plates allowing for single or multiple devices to be ganged together.

2.3 FIRESTOPPING

- A. The Contractor shall be responsible for providing permanent, UL approved firestopping systems for all penetrations through fire rated floor or fire rated wall assemblies. For areas that will require

future access for the installation of additional cables, repair, or retrofit, the firestopping system shall consist of re-usable intumescent pillows or putty.

- B. Subject to compliance with project requirements, firestopping materials may be provided by one of the following manufacturers:
 - 1. Specified Technologies Inc., (STI) Somerville, NJ (800) 992-1180
 - 2. Tremco, Beechwood, OH (800) 321-7906
 - 3. 3M, St. Paul, MN (800) 328-1687
 - 4. Hilti, Tulsa, OK (800) 879-8000
- C. Submit the following for review and approval:
 - 1. Product data sheets
 - 2. UL System drawings for each firestopping application
 - 3. Manufacturer's Certificates of Conformance for their products

2.4 HANGERS AND SUPPORTS FOR COMMUNICATIONS

- A. Non-continuous cable supports (J-hooks):
 - 1. Non-continuous cable supports shall provide a bearing surface of sufficient width to comply with required bend radii of high-performance cables.
 - 2. Non-continuous cable supports shall have flared edges to prevent damage while installing cables.
 - 3. Non-continuous cable supports 1-15/16" and larger shall have a cable retainer strap to provide containment of cables within the hanger.
 - 4. Non-continuous cable supports shall have an electro-galvanized finish and be rated for indoor use in non-corrosive environments.
 - 5. Non-continuous cable supports shall be UL listed, with manufacturer's name and part number stamped on.
- B. Wire Rod Type Cable Tray:
 - 1. Refer to Section 260536 for wire rod type cable tray.

2.5 CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS

- A. Refer to Section 260533 for raceways and boxes.

2.6 FLAT PANEL MASONRY WALL BOXES

- A. The flat panel masonry wall box is a dedicated flat panel TV project box engineered for installation in 8" block walls. The all-metal box is designed to replace the front portion of one block and provides an attractive surface with the optional paintable cover with no visible jagged block edges. The box has two opposing 2-gang device boxes inside, providing space for power and low voltage devices, including most receivers.
- B. The box has available 1", 1.25", and 1.5" knockouts centered on the opening of the most common two-hole CMU blocks. This project wall box ships with a construction cover for the rough-out phase.
- C. Inside the box, two 2-gang compartments face the middle and accommodate standard electrical plates. These compartments are convertible to a single gang with the provided block-off plates; & are also removable for installing active brick receivers. The gang compartments are oversized to allow for extra service loops & cable storage and have a depth of 3.25" to allow for the largest active electronic wall plates.

- D. Provide FSR Inc model PWB-CMU8-B box with PWB-CMU8-WHT-C metal cover at wall mount tv locations installed in block walls.
 - 1. Hubbell model HRWB25WHT shall be an approved equal.

2.7 FLAT PANEL STUD WALL BOXES

- A. The wall box is the essential installation accessory for any flat panel display. It installs easily in the wall behind any display allowing your screen to sit flush against the wall. This unit provides a neat and secure environment for audio, video, control and power connections.
- B. The wall box is 11"W x 5.25"H x 3.57"D and installs easily between any two standard studs in the wall. Once populated the overall height is 7.39" behind the wall. Connections and cable entry can be on the top or the bottom depending on installation preference. Designed to mount along the bottom edge behind a flat panel display, the wall box provides a single point for all your connections.
- C. Provide FSR Inc model PWB-100 box with PWB-100-XXXI cover at wall mount tv locations installed in stud walls.
 - 1. Hubbell model NSAV62M shall be an approved equal.

2.8 OWNER FURNISHED EQUIPMENT FOR INSTALLATION

- A. Wireless Access Points.
- B. Wall Mounted Televisions and associated mounting brackets.
- C. Projectors and associated mounting brackets.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR COMMUNICATIONS INSTALLATION

- A. Verify locations and mounting heights with the communications equipment.
- B. Install Owner furnished equipment.

3.2 GROUNDING AND BONDING INSTALLATION

- A. Main Telecommunications Ground Bus: Connect to the following:
 - 1. CATV entrance ground lug with #6 copper – green insulation.
 - 2. Telephone entrance protector with #6 copper – green insulation.
 - 3. Bond to metal water pipe with #6 copper – green insulation. (Provide 1" conduit where run is over 3' away.)
 - 4. Bond to building roof steel with #6 copper – green insulation. (Provide 1" conduit where run is over 3' away.)
 - 5. Ground counterpoise with #3/0 copper – green insulation in 1-1/2" conduit.
 - 6. Main service entrance equipment ground bus with #3/0 copper – in 1-1/2" conduit.
 - 7. MDF rack ground bus with #3/0 copper – (Provide in 1-1/2" conduit when not in cable tray).
- B. MDF Rack Ground Bus shall connect to the following:
 - 1. Each IDF in the project with #1/0 copper – green insulation via cable tray and 1-1/4" conduit. Bond to cable tray near IDF and MDF Racks.
 - 2. Bond to rack with #6 copper – green insulation.

3. Building structural steel with #6 copper – green insulation.
- C. IDF Rack Ground Bus shall connect to the following:
 1. Additional IDF racks with #6 copper – green insulation. Lateral bonding between all IDF Racks.
 2. Bond to rack with #6 copper – green insulation.
 3. Building structural steel with #6 copper – green insulation.
- D. Wire Rod Type Cable Tray (Section 260536): Provide #2 bare copper conductor, entire length of cable tray. Bond at 50' intervals.
- E. Identification: Provide tag on each ground conductor at bus to read as follows: "Caution – Ground Wire – Do not Remove". Provide I.D. marking of all conductors as per N.E.C.
- F. Comply with Section 260526, 270500 and applicable details on plans.
- G. Provide connections to the main ground bus on all backboards, telephone line protectors, IDF Racks and MDF Racks in the project.
- H. Connect ground buses with cables per Specification Section 260526, 270500 and applicable details on plans.

3.3 FIRESTOPPING

- A. Penetrations in fire rated partitions shall be sealed to maintain the fire integrity of the assembly. Provide fire stopping meeting the same rating as the assembly being sealed.
- B. All firestopping shall meet the requirements of ASTM E-814 and UL 1479.
- C. Comply with all installation requirements of Division 7.

3.4 HANGERS AND SUPPORTS INSTALLATION

- A. Provide supports as required to support all communications cabling.
- B. Provide cable tray as required to support all communications cabling.
- C. Comply with all installation requirements of Sections 260529 and 260536.

3.5 CONDUITS AND BACKBOXES INSTALLATION

- A. Provide raceways and boxes as required for communications cabling.
- B. Comply with all installation requirements of Section 260533.
- C. Except for recessed outlet boxes in masonry walls or communication outlets provided in a shared outlet box with a wiring device (i.e., receptacle) using an internal outlet box partition, the minimum outlet box size consist of two or larger-gang box with a minimum depth of 2-3/4 inches, inclusive of any mud and/or tile ring depth, unless otherwise noted. Provide mud and/or tile ring with appropriate gang opening size as required. Communication outlet boxes installed recessed in masonry walls shall be a single or larger-gang outlet box with a minimum on 2-3/4 inches will be permitted unless otherwise noted.

- D. The minimum conduit size for communication conduit pathways and stub-outs shall be 1-inch.

3.6 SLEEVE INSTALLATION FOR COMMUNICATIONS PENETRATIONS

- A. Communications penetrations occur when pathways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2" above finished floor level.
- G. Size pipe sleeves to provide 1/4" annular clear space between sleeve and pathway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants".
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pathway and cable penetrations. Install sleeves and seal pathway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping".
- K. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1" annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1" annular clear space between pathway or cable and sleeve for installing mechanical sleeve seals.

3.7 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve

seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.8 COMMUNICATIONS SYSTEM WIRING METHODS

- A. Provide communication pathways as required in accordance with the following paragraphs. Where communication wiring is required by other specification sections, provide communications wiring in accordance with the following paragraphs.
1. Wire Routing: Route all device wiring from each device up into accessible ceiling cavity within metallic conduit in recessed or unfinished areas and within surface raceway for renovated non-fishable areas. Stub all conduits into accessible ceiling cavity and provide bushing for each.
 2. Cable Routing: Route cable for all device wiring within accessible ceiling cavities. Install cable supports at 4' spacing maximum or in cable tray where applicable. No cabling is to lie on or attach to ceiling tile, ducts, pipes, conduits or ceiling suspension wires, rods, or structural members. Provide conduit stubs from devices and panels to the ceiling cavities. Use cable tray for support when it is shown on the drawings.
 3. Route all system wiring from system equipment within metallic conduit up into nearby ceiling cavity and connect to the wiring system indicated in 1 and 2 above. Provide bushings at conduit ends.
 4. Provide raceways for all communications cabling in all open structure ceiling spaces.
 5. Refer to individual sections for methods specific to that system.

3.9 CEILING TILE REMOVAL

- A. The Contractor shall remove and replace ceiling tile and grid work as required for the installation of communications cabling. Damaged tile and grid shall be replaced by the Contractor and shall match the existing ceiling system.

END OF SECTION 270500

SECTION 271100 – COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Equipment Racks/Enclosures
- B. Wire Management
- C. Stand Off Brackets
- D. Labeling

1.2 REFERENCES

- A. NFPA 70 - National Electrical Code
- B. NEMA WD-6: Wiring Devices - Dimensional Requirements
- C. EIA 310-D: Cabinets, Racks, Panels, and Associated Equipment
- D. ANSI/ICEA S-80-576: Industry Color Codes

1.3 SUBMITTALS FOR REVIEW

- A. Submit under provisions of Section 260010.
- B. Shop Drawings: The following items shall be submitted for review and approval:
 - 1. Submittal booklet to include the following:
 - a. Reference to Specification Section
 - b. A list of all equipment to be provided and installed.
 - c. Data sheets to indicate dimensions, knockout sizes, material, fabrication details, finishes and accessories with specific item or model number highlighted.

1.4 SUBMITTALS FOR CLOSEOUT

- A. Submit under provisions of Section 260010.
- B. As-Built Drawings: Provide a marked-up copy of original plans which reflect any changes or additions not shown on the plan.
- C. Submit manuals indicating enclosures, accessories, and spare parts.
- D. Record actual locations of racks, equipment, and sizes of pathways.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

- B. Supplier: Authorized or Franchised distributor of specified manufacturer with minimum three years documented experience.
- C. Installer: Authorized or franchised installer of specified manufacturers with five years documented experience.

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Provide products listed and classified by Underwriters Laboratories, Inc., or a testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.7 COORDINATION

- A. Coordinate work of this section with telephone switch.
- B. Adjust arrangements and locations of equipment racks, cabinets, backboards, patch panels, and cross connects in IDF/MDF Rooms and consolidation points to accommodate and optimize arrangement and space requirements. Review revised layouts with Engineer before proceeding with work.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to project site in manufacturer's original, unopened cartons and containers, each bearing names of product and manufacturer.
- B. Store products in dry spaces protected from the weather. The storage temperature shall be 68°F to 122°F.

1.9 WARRANTY

- A. Provide the warranty specified in Section 260010.

PART 2 - PRODUCTS

2.1 FLOOR MOUNTED EQUIPMENT RACK – TWO POST RACK

- A. Manufacturers:
 - 1. Middle Atlantic Products
 - 2. Hubbell Premise Wiring
 - 3. Hoffman
 - 4. Great Lakes
- B. Basis of Design – Middle Atlantic Products
 - 1. Model: MK-19-45
 - 2. Type: 19" cable management rack
 - 3. Compliance: EIA/TIA 310D
 - 4. Overall Dimensions:
 - a. Height: 84.25"
 - b. Width: 24"
 - c. Depth: 24"

5. Useable Height: 45 rackspaces
 6. Construction: Fully welded
 7. Weight Capacity:
 - a. Evenly Distributed with Base Securely Fastened: 500 pounds.
 - b. Evenly Distributed with Base Securely Fastened and Top Braced to Structural Building Component: 800 pounds.
 8. Cable Management Rings: Steel, multi position, front mount, 20 places.
 9. 7" Obround Cable Pass-Through Openings:
 - a. Front: 8 cable holes with plugs
 - b. Each Side: 8 obrounds
 - c. Back: 12 obrounds
 10. Integrated Top Cable Trough: Front and rear
 11. Multiple Raised Cable Lacing Points: Cable management
 12. Cable Fastening Straps: Hook and loop
 13. Front Cable Feed-Through Hole Plugs: 8
 14. Rack Screws: 10-32 threads, 100
 15. Finish: Phosphate pretreated, black textured powder coat
- C. Power Outlet Strips:
1. Provide (2) AC power outlet strips with 12 NEMA 5-20R (20A) outlets and line cord vertically mounted in enclosure, Model PDT-1220C-NS with adapter bracket Model PB-5A.
- D. Provide the following accessories for **ALL** racks unless otherwise noted on the Drawings:
1. Horizontal lacer bars, Model LBP-1X
 2. Horizontal cable managers, Model HCM-X
 3. Cable ladder adapter, Model MK-LA
 4. Rackmount Cable Tray (one rackspace), Model HCT-1
 5. Rackmount Cable Tray (two rackspaces), Model HCT-2
 6. Vented center mount shelf, Model U2MS
 7. All equipment mounting hardware required.

2.2 WALL-MOUNT PIVOTING EQUIPMENT RACKS

- A. Manufacturers:
1. Middle Atlantic Products Model DWR-X-22 Series
 2. Atlas Soundolier
 3. Hoffman
 4. Great Lakes
- B. Basis of Design – Middle Atlantic Products
1. Model: DWR-35-22
 2. Type: 19" wall-mount rack.
 3. Compliance: EIA/TIA 310D.
 4. UL Listed: US
 5. Overall Dimensions:
 - a. Overall Width: 23.40"
 - b. Overall Height: 68.25"
 - c. Overall Depth: 22.3"
 6. Useable Dimensions:
 - a. Useable Racking Height: 61.25"
 - b. Useable Depth: 20", extends into backpan 3.5"
 7. Rackspaces: 35 space minimum
 8. Weight Capacity: 300 pounds
 9. Mounting: Tool-free "Quick-Mount" system for one-person mounting of center section to backpan at site

10. Center Section and Backpan:
 - a. 16-gauge steel
 - b. Finish: Black-textured powder coat
 11. Corner Braces: 1/8" thick
 12. Rackrail:
 - a. 11-gauge steel with tapped 10-32 mounting holes in universal EIA spacing
 - b. Finish: Black e-coat
 - c. Rackspaces: Marked
 13. Backpan: Raised mounting embosses to mount power products and other accessories
 14. Rack: Swing open for component cabling access
 - a. Center Section: Pivot for left or right opening
 15. Knockouts:
 - a. Center Section:
 - 1) Decora Knockouts: Top and bottom of face
 - 2) Fan Knockouts: Top and bottom, each accepts up to two 4-1/2" fans
 - b. Backpan:
 - 1) Electrical Knockouts: Top and bottom, 3/4", 1", 1-1/2", 2", and 3"
 - 2) BNC Knockouts: Top and bottom, 5/8" UHF/VHF antenna knockouts
 - 3) Laser Knockout: Backpan, 12-1/2" by 12" opening for through-wall cable pass-through
 - 4) UCP Knockouts: Locking side of backpan accepts 1 UCP panel
 16. Top, Bottom, and Sides: Vertical vent pattern, center section
 17. Lacing Points: Throughout interior to facilitate cable management
 18. Latch: Pad lockable
 19. Keylock: Standard 1/4 turn
 20. Grounding and Bonding Studs: 1/4-20 by 1" threaded, installed in center section and backpan
- C. Provide the following accessories for **ALL** racks unless otherwise noted on the Drawings:
1. Front Door: Reinforced 16-ga steel, vented, 64% open area, Model LVFD-XX
 - a. Hinges: Zinc die cast, can be installed while rack is fully loaded with equipment
 2. Rear Rail Kit: 11-ga steel, 10-32 threaded, pair, includes hardware, Model DWR-RR35
 3. Fan Kit: Two 4-1/2" exhaust fans, fan guards and vent blockers, Model DWR-FK22
 4. Zero-Clearance Latch: Allows close proximity mounting, Model DWRSR-ZL
 5. All equipment mounting hardware required
 6. Blank and vented panels to fill rack
- D. Power Outlet Strips:
1. Provide (1) AC power outlet strips with 9 NEMA 5-20R (20A) outlets and line cord mounted horizontally in enclosure, Model PD-920R.

2.3 WALL-MOUNT LOW-PROFILE EQUIPMENT RACKS

- A. Manufacturers:
1. Middle Atlantic Products Model VWM Series
 2. Atlas Soundolier
 3. Hoffman
 4. Great Lakes
- B. Basis of Design – Middle Atlantic Products
1. Model: VWM-4-5-36K-PW
 2. Type: Low-Profile vertical wall-mount rack.
 3. UL Listed: US
 4. Overall Dimensions:
 - a. Overall Width: 25"

- b. Overall Height: 36"
 - c. Overall Depth: 12"
 - 5. Rackspaces: 4 pivot RU; 5 fixed RU space minimum
 - 6. Weight Capacity: 150 pounds
 - 7. Finish: Putty or Black-textured powder coat
 - 8. Lacing Points: Throughout interior to facilitate cable management
 - 9. Latch: Pad lockable
 - 10. Keylock: Standard 1/4 turn
 - 11. Grounding and Bonding Studs: 1/4-20 by 1" threaded, installed in center section and backpan
- C. Provide the following accessories for **ALL** racks unless otherwise noted on the Drawings:
 - 1. Front Door: Solid with lever lock kit, Model LL-VWM-36SP
 - a. Reversible swing
 - 2. Rear Rail Kit
 - 3. Adjustable Mounting Bracket Kit, Model VWM-RR-4
 - 4. Pivoting/Rail Mount Bracket Kit, Model VWM-RR-PIV-4
 - 5. Fan Kit: One 4-1/2" exhaust fans, fan guards and vent blockers, Model QFAN
 - 6. Low Profile Vertical Power Strip: 6 outlet, 15A, Surge Protection, Model PDT-615C
 - 7. All equipment mounting hardware required
 - 8. Blank and vented panels to fill rack

2.4 HORIZONTAL WIRE MANAGEMENT

- A. Manufacturers:
 - 1. Hubbell Premise Wiring
 - 2. Middle Atlantic Products
 - 3. Hoffman
 - 4. Great Lakes
- B. Basis of Design – Hubbell Premise Wiring Horizontal Cable Managers
- C. Design Requirements:
 - 1. Horizontal cable management panel shall be all steel with black powdercoat finish.
 - 2. Horizontal cable management panel shall feature (5) cable management rings on front and back constructed of flat steel for maximum cable support.
 - 3. Horizontal cable management duct (Models HS14C or HS24C) shall feature hinged front steel covers.
 - 4. Black powder coating shall comply with all applicable ASTM standards for exposed metal, and resistance to flaking, cracking, or chipping.

2.5 WALL MOUNTED STAND-OFF BRACKETS

- A. Manufacturers:
 - 1. Middle Atlantic Products
 - 2. Hubbell Premise Wiring
 - 3. Hoffman
- B. Basis of Design: Middle Atlantic Products HPM Series Mounts.
- C. Heavy duty two vertical steel only spaced to mount 19" wide panels and chasses constructed to EIA-310-D dimensions with base plate and bracing.
 - 1. Universal keyhole mounting for left or right swing
 - 2. Mounting holes must provide options to mount directly to racks or walls

- D. Mounting Rails: 2 drilled and tapped to EIA-310-D dimensions.
 - 1. 10-32 rack screws included
- E. Mounting Space: Racks units as required plus 20% spare. Provide multiple brackets totaling the indicated number of units hinged for future termination without dismounting patch panel.
- F. Provide the following Accessories:
 - 1. Optional lid to protect equipment from dust, Model HPM-LID

2.6 IDENTIFICATION

- A. Engraved plastic nameplates: Engraving stock, melamine plastic laminate, minimum 1/16" thick for nameplates up to 20 sq. in. and 1/8" thick for larger sizes.
 - 1. Engraving legend shall be black letters on white face.
 - 2. Punched or drilled for mechanical fasteners.
- B. Fasteners for Nameplates: Self-tapping, stainless-steel screws or #10/32 stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine pathway elements intended for cable. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Provide horizontal and vertical cable management in all racks, on all backboards and any other location cabling is not routed in conduit or cable tray. Size cable management for 50% additional cables.
- B. Wiring within IDF/MDF and Enclosures: Provide adequate length of conductors. Train conductors to terminal points with no excess. Use lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
- C. Install a 1 rack unit blank filler plate between patch panels which contain more than 12 jacks.
- D. Provide blank filler plates as required to fill rack.
- E. Support raceways, cabinets, and all other equipment in accordance with manufacturer's instructions.
- F. Install backboards and cabinets plumb and attach securely to building wall at each corner and additional as necessary to obtain a firm mounting.
- G. Provide full assembly of all racks, equipment enclosures, cabinets and file servers with all accessories installed.
- H. Provide engraved plastic nameplates for each equipment rack and equipment enclosure with 1/2" high lettering. Label shall include the following:

1. Equipment Rack or Equipment Enclosure Name

3.3 GROUNDING

- A. Comply with Section 260526, 270500 and applicable details on plans.
- B. Provide connections to the main ground bus on all backboards, telephone line protectors, IDF Racks and MDF Racks in the project.
- C. Connect ground buses with cables per Specification Section 260526, 270500 and applicable details on plans.

END OF SECTION 271100

SECTION 271300 – COMMUNICATIONS BACKBONE CABLING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Fiber Optic Cables and Equipment

1.2 REFERENCES

- A. NFPA 70 - National Electrical Code
- B. ANSI/TIA-568-C.0, Generic Telecommunications Cabling for Customer Premises
- C. ANSI/TIA-568-C.1, Commercial Building Telecommunications Cabling Standard
- D. ANSI/TIA-568-C.2, Balanced Twisted-Pair Telecommunications Cabling and Components Standard
- E. ANSI/TIA-568-C.3, Optical Fiber Cabling Components Standard
- F. BISCO – Telecommunications Distribution Methods Manual (Current Edition)
- G. ANSI/TIA/EIA-607-C – Grounding and Protection of Telecommunication Cables and Equipment
- H. EIA/TIA-604-3: Fiber Optic Connector Internoteability Standard
- I. ANSI/ICEA S-80-576: Industry Color Codes
- J. UL 910/NFPA 262: Test method for fire and smoke characteristics of electrical and optical-fiber cables used in air handling spaces.
- K. UL 1666: Flame propagation height of electrical and optical-fiber cables installed vertically in shafts.

1.3 SYSTEM REQUIREMENT

- A. All cables specified are to be supplied in “Plenum-Rated” versions for this installation.
- B. Coordinate the features of materials and equipment so they form an integrated system. Match components and interconnections for optimum performance.

1.4 SUBMITTALS FOR REVIEW

- A. Submit under provisions of Section 260010.
- B. Shop Drawings: The following items shall be submitted for review and approval:
 - 1. Submittal booklet to include the following;
 - a. Reference to Specification Section
 - b. A list of all equipment to be provided and installed.
 - c. Data sheet to indicate each cable type including number of pairs, punch down block, outlet/connectors with the specific item or model number highlighted.

- d. Data sheets to indicate supply dimensions, ETL-verified electrical characteristics and parameters, upgrade/expansion data, and mounting methods for all hardware and materials with the specific item or model numbers highlighted.
- C. Submit manufacturer warranty certificate stating length of warranty, other accepted component manufacturers and overall testing/replacement responsibility.
- D. Submit product certificates signed by manufacturers of cables, connectors, and equipment certifying that products furnished comply with requirements and warranty is valid with equipment installed.
- E. Submit evidence that all qualifications have been met.
- F. Submit make/model numbers of testers to be used for all testing of cables.

1.5 SUBMITTALS FOR CLOSEOUT

- A. Submit under provisions of Section 260010.
- B. As-Built Drawings: Provide a marked-up copy of original plans which reflect any changes or additions not shown on the plan. Identify all cable and jack numbering as identified on site and in System Final Test Report. Indicate routing of all IDF to MDF cabling.
- C. Submit Test Report for each basic link from patch panel to jack/patch panel. Report to include test equipment type and calibration data, date, and operator.
- D. Submit electronic copy of final comprehensive schedules for project, in software and format selected by Owner.
- E. Record actual locations of outlets and sizes of pathways.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Supplier: Authorized or Franchised distributor of specified manufacturer with minimum three years documented experience.
- C. Installer: Authorized or franchised installer of specified manufacturers with five years documented experience.
- D. Installer must be able to identify and correct non-compliance in structured cabling systems. Provide the name of a fulltime RCDD employed by the installing company.
- E. Provide satisfactory evidence of a fully equipped service organization, capable of furnishing adequate inspection and service to the system, including standard replacement parts within 50 miles of the project site.
- F. Perform all terminations at device and headend locations using the hereby qualified installation firm.
- G. Supervise and approve all cable pulls in accordance with warranty requirements of the certifying company.

1.7 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Provide products listed and classified by Underwriters Laboratories, Inc., or a testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to project site in manufacturer's original, unopened cartons and containers, each bearing names of product and manufacturer.
- B. Store products in dry spaces protected from the weather. The storage temperature shall be 68°F to 122°F.

1.9 MAINTENANCE SERVICE

- A. Furnish service and maintenance of complete telecommunications backbone cabling system for one year from Date of Substantial Completion of project at no additional cost to Owner.

1.10 WARRANTY

- A. Provide the warranty specified in Section 260010.

PART 2 - PRODUCTS

2.1 FIBER OPTIC ENCLOSURES

- A. Manufacturers:
 - 1. Hubbell Premise Wiring
 - 2. The Siemon Company
 - 3. Systimax GigaSpeed Products
 - 4. Leviton
- B. Basis of Design – Hubbell Premise Wiring FCR Series Rack Mount Fiber Panels
- C. Design Requirements:
 - 1. Enclosure design shall be a modular, rack-mounted, powder coated formed cold rolled steel enclosure with a non-removable front cover, L shaped removable slide out cover panel, and slide-out inner tray.
 - 2. Each basic unit delivered shall consist of: (1) enclosure assembly, (2) installed mounting brackets, (4) #10-32 rack mounting screws, (1) splice tray stud, and an accessory kit containing hardware, cable management accessories, and label sheets.
 - 3. Material shall be as follows:
 - a. Enclosure, panels, and tray: 16-ga cold rolled steel (CRS)
 - b. Mounting brackets: 13-ga CRS
 - c. Front cover: smoke-tinted Lexan plastic
 - 4. Basic dimensions of the enclosures shall be approximately 17" wide by 17" deep.
 - 5. Enclosures shall be available in heights of 1.75" (1RU), 3.5" (2 RMU), 5.25" (3 RMU), and 7" (4 RMU) versions.
 - 6. Finish shall be black durable powder coat on all metal surfaces.
 - 7. Front door shall be smoke-tinted Lexan plastic, hinged at the bottom,
 - 8. Front door shall be secured in the closed position with magnetic closing operation.

9. One-piece top and rear cover shall be removable, without fasteners, to provide access to the connector field.
10. Enclosure shall be equipped with panel-mounting brackets assembled for 19" rack mounting, compliant to ANSI/EIA-310-D.
11. Panel mounting brackets shall be configurable to either 19" or 23" racks.
12. Enclosure chassis shall have two mounting bracket locations for either 5" or 7" center mount on the rack.
13. Rear of enclosure shall have knockouts, on each side, for backbone cable entry and internal routing.
14. Front of enclosure chassis shall have side cutouts for patch cord entry into and exit from the enclosure.
15. Inner tray shall slide out in the forward direction by releasing the lever-action quick-release latches. Tabs in the chassis shall engage with slots in the inner tray in the outward position to prevent tray from falling out.
16. Inner tray panel mounting posts shall accept modular adapter panels, in high- or low-density versions. Adapter panels shall be available in a range of adapter types for multimode and singlemode applications.
17. Inner tray shall have clips for cable ties, and holes to accept snap-in cable clips, front and rear, for complete cable management of patch cords and distribution cable strands.
18. Inner tray shall have rear cable tie-down features to accept various diameter backbone cables entering the enclosure.

- D. Provide fiber panel sized for adapter panels + 20% spare.

2.2 FIBER OPTIC ADAPTER PANELS

- A. Manufacturers:
1. Hubbell Premise Wiring
 2. The Siemon Company
 3. Systimax GigaSpeed Products
 4. Leviton
- B. Basis of Design – Hubbell Premise Wiring FSP Series Fiber Adapter Panels
- C. Design Requirements:
1. Fiber adapter panels shall be a modular, quick-fastening steel plate, powder coated to match the enclosure finish.
 2. Fiber adapter panels shall have pre-installed LC fiber adapters, available in low- or high-density multi-mode or single-mode applications.
 3. Each individually bagged unit delivered shall consist of: (1) fully assembled adapter panel, with push-pull fasteners pre-installed.
 4. Adapter panels shall be constructed of 16-ga cold rolled steel.
 5. Finish shall be black durable powder coat on all surfaces.
 6. Basic dimensions of the FSP panels shall be 5.10" length by 1.10" wide.
 7. Panels shall have two pre-installed, push-pull type quick-release fasteners for quick snap-in installation. Push-pull fasteners shall have an industry standard center distance of 4.65".
 8. Panels shall be suitable for mounting either vertically or horizontally.
 9. Panels shall be available in with LC adapters with precision ceramic alignment sleeves.
 10. All fiber adapters installed in FSP panels shall have dust caps installed.
 11. Panels shall be available in low-density and high-density adapter patterns.
- D. Fiber optic cable shall be terminated with LC OM4 50/125um Multimode or LC OS2 Singlemode connectors to fiber adapter panels mounted in Hubbell FCR series fiber optic enclosures with at least 50% spare capacity.

- E. Provide port quantities to match the fiber optic cables + 20% spare unless otherwise noted on the Drawings.

2.3 FIBER OPTIC CONNECTORS

- A. Manufacturers:
 - 1. Hubbell Premise Wiring
 - 2. The Siemon Company
 - 3. Systimax GigaSpeed Products
 - 4. Leviton
 - 5. Corning
- B. Basis of Design – Hubbell Splice-On Connectors to maintain the 25-year fiber warranty. PN#'s FCLCF900M50G6OK, FCLCF900SM6PK, FCSCF900M50G6PK, FCSCF900SM6PK.
- C. Fiber optic cable shall be terminated with LC OM3 50/125um Multimode (LC OM4 50/125 um Multimode as required by distance application parameters) or LC OS2 Singlemode connectors to fiber adapter panels mounted in Hubbell FCR series fiber optic enclosures with at least 50% spare capacity.
- D. Design Requirements:
 - 1. Connector basic design shall be a factory pre-polished LC optical fiber connector with a zirconium ceramic ferrule. Integral with the connector body is a wedge-activated fiber clamping mechanism to secure the inserted fiber into a mechanical splice with the factory installed cleaved fiber stub. Index-matching gel is supplied factory-injected into the cleaved fiber stub splice to optimize transmission performance. Connector attachment is achieved without tools, by inserting a field-cleaved optical fiber and then extracting the disposable clamp wedges from the connector body.
 - 2. Each basic connector unit delivered shall consist of: (1) connector body with disposable clamp wedge, (1) strain relief boot, and (1) plastic dust cap.
 - 3. LC multimode factory pre-polished connectors shall be 50-micron laser optimized pre-installed fiber.
 - 4. Connector termination method shall utilize an industry standard multi-layer strip tool and bare fiber cleave tool as the only field tools required.
 - 5. LC connectors shall have features to enable field verification using a Visual Fault Locator (VFL) during termination.
 - 6. Connector materials shall be designed with thermal stability to comply with environmental requirements of ANSI/TIA/EIA-568-C.3 and Telcordia GR-1081-CORE.
 - 7. Multimode and singlemode pre-polished fiber connector materials shall be as follows:
 - a. Ferrule: zirconium ceramic
 - b. LC inner body: thermally stable injection molded thermoplastic
 - c. Dust Cap: nylon or PVC
 - d. Strain relief boot: UL94-V0 molded PVC
 - 8. Pre-polished LC connectors shall require no field polishing.
 - 9. Pre-polished MM LC connector body shall be industry standard aqua for 50-micron multimode, laser optimized colors for specific applications, as designated below:
 - 10. Pre-polished MM LC connectors shall require no adhesives for termination.
 - 11. LC connector internal fiber clamping mechanism shall firmly secure both the inserted glass fiber and the 900-micron buffer layer of the inserted fiber for maximum strain relief.
 - 12. All standard mating and interface dimensions for LC connectors shall comply with ANSI/TIA/EIA-604-10 (FOCIS 10).
 - 13. Ferrule outside diameter for LC multimode connectors shall be 1.2467mm to 1.2497mm.
 - 14. Ferrule outside diameter for LC singlemode connectors shall be 1.2483mm to 1.2497mm.
 - 15. LC ferrule tip shall have a PC spherical radius of approximately 7.0 mm radius for multimode and singlemode versions.

16. Delivered connectors shall be individually bagged with the dust cap installed to protect from contamination.
17. Delivered connectors shall have the disposable clamp activation wedge element pre-installed onto the connector body.
18. Connector design and termination technique shall be independent of cable type or manufacturer and shall be compatible for either 900-micron buffer or 250-micron buffer distribution cables.
19. LC connector strain relief boot shall be a Telcordia style slotted design for maximum flexural strain relief.
20. Strain relief boot shall be black for multimode, and yellow for singlemode.
21. LC connectors shall be available individually bagged in packs of 12.
22. Pre-polished LC fiber connectors, when properly installed onto qualified cable, shall meet the 10 Gb/s Ethernet performance requirements of IEEE802.3.
23. Pre-polished LC fiber connectors, properly installed onto qualified cable, shall exceed the mechanical and environmental performance requirements of ANSI/TIA/EIA-568-C.3, Annex 'A'.
24. Pre-polished LC fiber connectors, properly installed onto qualified cable, shall exceed the mechanical and environmental performance requirements of Telcordia GR-1081-CORE.
25. Qualification test data shall be available from the manufacturer upon request.

2.4 SINGLE MODE FIBER OPTIC CABLES

- A. Manufacturers:
 1. Hubbell Premise Wiring
 2. The Siemon Company
 3. Systimax GigaSpeed Products
 4. Corning
 5. Belden
 6. Berk-Tek, Inc.
- B. Basis of Design – Hubbell Premise Wiring HFCD19 Series Indoor/Outdoor Fiber Optic Cable
- C. Optical Fiber Indoor/Outdoor Distribution Cable, Cable Requirements
 1. Optical Fiber Indoor/Outdoor Distribution Cable shall be constructed with 12 optical fibers unless otherwise noted on the Drawings, each coated with a 900-micron color-coded PVC tight buffer, surrounded by an aramid yarn strength member, and an armored outer jacket with the appropriate flame rating.
 2. Fiber cables shall be a non-metallic construction, OFNP (Plenum FT-6) flame rating.
 3. Cable markings shall repeat every meter, and shall have at minimum the following information:
 - a. Sequential length indicator marking (meters)
 - b. Lot number, traceable back to the fiber draw lot
 - c. Date of Manufacture
 - d. Fiber type: (Singlemode)
 - e. Cable rating (OFNR, OFNP, etc.)
 - f. Applicable Telcordia, TIA, IEC, and ICEA standard references and appropriate UL/CSA agency listings
 4. Cable jacket colors shall conform to the following industry standard conventions:
 - a. Yellow: Singlemode
 5. Buffer position color codes shall conform to standard ICEA and TIA-598 conventions as follows: 1-Blue, 2-Orange, 3-Green, 4-Brown, 5-Slate, 6-White, 7-Red, 9-Yellow, 10-Violet, 12-Aqua.
 6. Optical fiber in any cable construction shall be enhanced performance, bend-insensitive type.
 7. Singlemode cables shall perform at minimum to the attenuation, bandwidth, and distance application parameters in the table below.

Singlemode Fiber Gigabit and 10 Gigabit Ethernet Application Chart					
Application	Wavelength (nm)	Max Attenuation (dB/km)	Bandwidth (MHz•Km)	1 GbE Distance (m)	10 GbE Distance (m)
1000BASE-LX	1310	0.35	> 1000	5000	n/a
10GBASE-L	1310	0.35	> 1000	n/a	10,000
10GBASE-E	1550	0.25	> 1000	n/a	40,000
10GBASE-LX4	1310	0.35	> 1000	n/a	10,000

8. Optical fiber cables as supplied shall meet or exceed the applicable IEC 60793-1 qualification test requirements for optical, geometry, mechanical, and environmental parameters as specified, and tested in accordance with TIA/EIA-455.
9. For installed fiber cables, all fiber strands shall pass insertion loss and return loss in accordance with test methods ANSI/TIA/EIA-526-14 for multimode cables.
10. Installed fiber cables shall exceed all currently ratified bandwidth-distance- application performance parameters for IEEE 802.3ae (10 GbE) and for IEEE 802.3ba (40/100 GbE)
11. Plenum cables shall be rated UL NFPA-262/UL910/CSA FT-6

- D. Provide combination multimode/single mode cables when indicated.
- E. All fibers shall be terminated in Fiber Connectors with LC or SC connectors as required to match patch panels. Re-terminate existing fiber optic cables as required to make compatible with new patch bays.

2.5 SINGLE MODE FIBER OPTIC PATCH CORDS

- A. Manufacturers:
 1. Hubbell Premise Wiring
 2. The Siemon Company
 3. Systimax GigaSpeed Products
 4. Leviton
- B. Basis of Design – Hubbell Premise Wiring DFHPCLCL (SM) Series patch cords.
- C. Fiber optic cable shall be terminated with LC OS2 Singlemode connectors to fiber adapter panels mounted in Hubbell FCR series fiber optic enclosures with at least 50% spare capacity.
- D. Design Requirements
 1. LC duplex optical fiber patch cords shall be constructed with aramid-reinforced PVC loose-jacket duplex cable, with optical fibers having a 900-micron PVC buffer coating diameter.
 2. Single Mode OS2 core optical fiber within the patch cord cable shall be graded index type in accordance with ANSI/TIA/EIA-492AAAC, with the following specifications:
 - a. Core diameter: 9 ± 1.0 microns
 - b. Cladding diameter: 125 ± 2.0 microns
 - c. Core/cladding concentricity: less than 3.0 microns
 - d. Core non-circularity: 6% maximum
 - e. Proof test: 100 kpsi
 - f. Effective modal bandwidth: 2000 MHz•km
 - g. Coating diameter: 245 ± 15 microns
 - h. Buffer diameter: 900 microns nominal
 3. Connector terminations on each end of the fiber patch cord shall be heat-cured epoxy type with a machine polish, inspected 100% for polish quality and mated-pair insertion loss.

4. Epoxy volume within each connector shall be sufficient to properly surround and strain relieve the fiber and buffer layer at the buffer/fiber transition inside the connector body.
 5. Optical fiber patch cords shall be supplied in a sealed plastic bag with dust caps installed on each end, with insertion loss test results included.
 6. Optical fiber patch cords shall be available in standard lengths of 1, 2, 3, and 5 meters. Special lengths shall be available on a make-to-order basis.
 7. Optical fiber patch cords shall be manufactured with industry standard LC connector terminations on each end.
 8. Factory mounted connectors on each end of the patch cords shall comply with the applicable ANSI/TIA/EIA-604 Intermateability standard.
 9. Buffered fiber strands within the cable jacket shall be surrounded by aramid (Kevlar) material serving as a strength member.
 10. The aramid (Kevlar) strength member shall be mechanically secured at each connector to provide tensile strain relief of the optical fiber.
 11. Additional strain relief of the buffered fiber shall result from crimping the rear of the connector during termination.
 12. LC Duplex fiber patch cords shall be a zip-cord cable construction with jacket cross-section dimensions of 1.6 mm X 3.0 mm.
 13. Duplex fiber patch cords shall have reverse-pair polarity according to ANSI/TIA/EIA-568-C.3 and TIA/EIA-TSB-125.
 14. Cable jacket shall be marked with the cable manufacturer, UL Optical Fiber Non-Metallic Riser rating (Type OFNR) designation, lot number, and fiber core/cladding diameter designation.
 15. Fiber A-B polarity shall be clearly marked on each end of duplex patch cords.
 16. Optical fiber patch cord jacket color shall be yellow, specifically for Singlemode OS2 laser optimized multimode fiber cables.
 - a. Fiber patch cord connector materials shall be as follows:
 - b. Ferrules: zirconium ceramic
 - c. Housings: injection molded thermoplastic
 - d. Dust Cap: nylon or PVC
 - e. Strain relief boot: UL94-V0 molded PVC
 17. SingleMode OS2 laser optimized patch cords shall have a maximum mated-pair insertion loss of 0.60 dB per end, with a minimum return loss of -20 dB.
 18. Fiber patch cords shall exceed 10 Gigabit Ethernet performance requirements of IEEE 802.3 standard.
 19. Fiber patch cords shall exceed the mechanical reliability requirements for tensile, flex, twist and impact as specified in ANSI/TIA/EIA-568-C.3
 20. Fiber patch cords shall exceed the environmental reliability requirements for high/low temperature and humidity as specified in ANSI/TIA/EIA-568-C.3
- E. Provide one patch cable for every connected patch panel port. Provide length as required to terminate between fiber patch panels/outlets and equipment in a neat and workmanlike manner through cable management assemblies.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine pathway elements intended for cable. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install all cables in accordance with equipment manufacturer's instructions, and with recognized industry practices, to ensure the installation complies with requirements of the NEC, ANSI/TIA/EIA-568-C.1 Commercial Building Telecommunications Cabling Standard and BICSI'S "Telecommunication Distribution Methods Manual" (current edition).
- B. Install all cables only when the temperature is between 32°F to 122°F.
- C. Wiring Method: Wiring shall be installed in EMT conduit within walls and above inaccessible ceilings. Wiring shall be installed in cable tray where it is present. Wiring installed above accessible ceilings between ceiling mounted devices or conduit stub-ups and the cable tray shall be exposed and supported by J-hooks, spaced a maximum of 5'-0" on center, with minimum 1" flat bearing surface. Provide conduit sleeves, bushings and fireproofing through all wall penetrations. All wiring not in EMT conduit shall be kept a minimum of 6" away from all lighting fixtures, motors, and transformers. Cables cannot be ty-wrapped or stapled to ceiling or structural supports, conduit, or other items.
- D. Test each cable as detailed in specification. Include patch cord in test channel.
- E. Identify all cables with a neatly typed label as detailed in specification.
- F. Provide horizontal and vertical cable management in all racks, on all backboards and any other location cabling is not routed in conduit or cable tray. Size cable management for 50% additional cables.
- G. For buildings with floors in excess of two, provide a 2' diameter service loop (with 3 loops) in all between-floor fiber optic cables. Locate one service loop in ceiling cavities of each floor above the lowest floor for future changes/upgrades. Neatly cable tie service loop to structure or cable tray to prevent susceptibility to damage.
- H. Install cable without damaging conductors, shield, or jacket, do not use unjacketed pairs for jumpers.
- I. Do not bend cable in handling or in installing to smaller radii than minimums recommended by manufacturer.
- J. No splicing is permitted for fiber optic cables or telephone high pair count cables. Cables must be continuous between termination points. Make splices, taps and terminations only at indicated outlets, terminals, cross-connect and patch panels.
- K. Provide at least 10' of cable slack at MDF or IDF closet. This slack may be stored in the cable tray or a cable management device behind the MDF/IDF.
- L. Provide 2' diameter in service loops or use figure-8 or serpentine.
- M. Pull cables without exceeding cable manufacturers recommended pulling tensions.
 - 1. Pull cables simultaneously if more than one is being installed in the same raceway.
 - 2. Use pulling compound or lubricant if necessary. Use compounds that will not damage conductor or insulation.
 - 3. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage media or raceway.
- N. Install exposed cable parallel and perpendicular to surfaces or exposed structural members and follow surface contours where possible.

- O. Secure and support cable at intervals not exceeding 5'-0" and not more than 1'-0" from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
- P. Wiring within IDF/MDF and Enclosures: Provide adequate length of conductors. Train conductors to terminal points with no excess. Use lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
- Q. Separation of Wires: Comply with EIA/TIA-569 rules for separating unshielded copper telecommunications equipment cables from potential EMI sources, including electrical power lines and equipment.
- R. Install fiber optic cables leaving the building in innerduct inside conduit. Provide multiple innerducts in larger conduits.
- S. Support innerduct at manufacturers recommended intervals using manufacturer approved methods.

3.3 GROUNDING

- A. Comply with Section 260526 and applicable details on plans.
- B. Provide connections to the main ground bus on all backboards, telephone line protectors, IDF Racks and MDF Racks in the project. Connect to ground buses with cables per Specification Section 260526 and applicable details on plans.

3.4 FINAL TESTING AND INSPECTION

- A. Provide testing in accordance with ANSI/TIA/EIA-568-C.1.
- B. Cable Test: Provide prior to substantial completion, a Performance Evaluation Report, which will contain the following:
 - 1. Cable Test: List by cable number each Fiber Optic Cable in the project, which details:
 - a. Fiber Optic Cables:
 - 1) Cable ID Number
 - 2) Final measured attenuation in dB/Km
 - 3) List any discrepancies with the fiber installation (bad terminations, faulty labeling, etc.)
 - 2. Test Method: All fiber cabling to be tested as follows: Fiber Testing: Cable to be factory pre-tested on a reel basis for all fiber on this project. The attenuation in dB/Km to be recorded in Final Test Report. Contractor must test each fiber after installation using Power Meter. A dB Printout, end to end with connectors attached to be made and provided as part of the "Performance Evaluation Report". Traces must depict actual fiber loss (dB/Km), fiber length (ft.) and any fiber irregularities. Runs over 1,000' must be tested using an optical time domain refractometer (OTDR). Test horizontal cables when installed and terminated as follows:
 - a. Both Wavelengths
 - b. One Direction
 - c. Link Loss <8.5 dB, 200 meters
 - d. Test centralized cables from utility entrances (typically single mode) as follows:
 - 1) One Wavelength
 - 2) One Direction
 - 3) Link Loss <3.3 dB for 300 meters.
 - 3. System Performance Report: Provide a narrative detailing the system as a whole in regard to the quality of installation and any discrepancies affecting performance. This narrative to indicate a summary of the above Cable Test, as well as an accurate summary of specified

Category performance as well as capability of the cabling system to perform at specified Category bandwidth.

3.5 WARRANTY

- A. The installation shall be provided with a minimum 25-year warranty for strict compliance with the performance requirements of ANSI/TIA/EIA-568-C.1 to support and conform to ANSI/TIA/EIA-568-C.1 specifications covering any current or future application which supports transmission over a properly constructed horizontal cabling system premises network which meets the channel performance as described in ANSI/TIA/EIA-568-C.2.

END OF SECTION 271300

SECTION 271500 – COMMUNICATIONS HORIZONTAL CABLING – CATEGORY 6

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. UTP Cables and Equipment
- B. Modular Jacks, Modules and Faceplates
- C. Surface Mount Boxes
- D. Phone Plates
- E. Labeling

1.2 REFERENCES

- A. NFPA 70 - National Electrical Code
- B. ANSI/TIA-568-C.0, Generic Telecommunications Cabling for Customer Premises
- C. ANSI/TIA-568-C.1, Commercial Building Telecommunications Cabling Standard
- D. ANSI/TIA-568-C.2, Balanced Twisted-Pair Telecommunications Cabling and Components Standard
- E. BISCII – Telecommunications Distribution Methods Manual (Current Edition)
- F. NEMA WD-6: Wiring Devices - Dimensional Requirements
- G. ANSI/TIA/EIA-607-C – Grounding and Protection of Telecommunication Cables and Equipment
- H. ANSI/ICEA S-80-576: Industry Color Codes
- I. UL 910/NFPA 262: Test method for fire and smoke characteristics of electrical and optical-fiber cables used in air handling spaces.
- J. UL 1666: Flame propagation height of electrical and optical-fiber cables installed vertically in shafts.

1.3 SYSTEM REQUIREMENT

- A. All cables specified are to be supplied in “Plenum-Rated” versions for this installation.
- B. Coordinate the features of materials and equipment so they form an integrated system. Match components and interconnections for optimum performance.

1.4 SUBMITTALS FOR REVIEW

- A. Submit under provisions of Section 260010.
- B. Shop Drawings: The following items shall be submitted for review and approval:

1. Submittal booklet to include the following;
 - a. Reference to Specification Section
 - b. A list of all equipment to be provided and installed.
 - c. Data sheet to indicate each cable type including number of pairs, punch down block, outlet/connectors with the specific item or model number highlighted.
 - d. Data sheets to indicate supply dimensions, ETL-verified electrical characteristics and parameters, upgrade/expansion data, and mounting methods for all hardware and materials with the specific item or model numbers highlighted.
 - C. Submit manufacturer warranty certificate stating length of warranty, other accepted component manufacturers and overall testing/replacement responsibility.
 - D. Submit product certificates signed by manufacturers of cables, connectors, and equipment certifying that products furnished comply with requirements and warranty is valid with equipment installed.
 - E. Submit evidence that all qualifications have been met.
 - F. Submit make/model numbers of testers to be used for all testing of cables.
 - G. Labeling Scheme: Submit labeling scheme for cabling, outlets, and equipment for approval.
 1. Contractor to coordinate with Owner for final room designations utilized in applied labeling scheme. Labeling schemes applied without documented Owner coordination are subject to removal and re-application by Contractor.
 2. All labels are to be typed.
- 1.5 SUBMITTALS FOR CLOSEOUT
- A. Submit under provisions of Section 260010.
 - B. As-Built Drawings: Provide a marked-up copy of original plans which reflect any changes or additions not shown on the plan. Identify all cable and jack numbering as identified on site and in System Final Test Report. Indicate routing of all IDF to MDF cabling.
 - C. Submit Test Report for each basic link from patch panel to jack/patch panel. Report to include test equipment type and calibration data, date, and operator.
 - D. Submit electronic copy of final comprehensive schedules for project, in software and format selected by Owner.
 - E. Record actual locations of outlets and sizes of pathways.
- 1.6 QUALIFICATIONS
- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
 - B. Supplier: Authorized or Franchised distributor of specified manufacturer with minimum three years documented experience.
 - C. Installer: Authorized or franchised installer of specified manufacturers with five years documented experience.

- D. Provide two references of network installation, which exceeded 200 drops and were completed within the last 12 months.
- E. Installer must be able to identify and correct non-compliance in structured cabling systems. Provide the name of a fulltime RCDD employed by the installing company.
- F. Provide satisfactory evidence of a fully equipped service organization, capable of furnishing adequate inspection and service to the system, including standard replacement parts within 50 miles of the project site.
- G. Perform all terminations at device and headend locations using the hereby qualified installation firm.
- H. Supervise and approve all cable pulls in accordance with warranty requirements of the certifying company.

1.7 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Provide products listed and classified by Underwriters Laboratories, Inc., or a testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to project site in manufacturer's original, unopened cartons and containers, each bearing names of product and manufacturer.
- B. Store products in dry spaces protected from the weather. The storage temperature shall be 68°F to 122°F.

1.9 MAINTENANCE SERVICE

- A. Furnish service and maintenance of complete telecommunications horizontal cabling system for one year from Date of Substantial Completion of project at no additional cost to Owner.

1.10 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 - 1. UTP Patch Cables of sufficient length to replace any similar cable installed in the project: Furnish 10 for every 100 of each type installed but not less than 10 of each type.
 - 2. Connector Modules: Furnish 10 for every 100 of each type and rating installed but not less than 10 of each type.
 - 3. Wall Plates: Furnish 10 for every 100 of each type and rating installed but not less than 10 of each type.

1.11 WARRANTY

- A. Provide the warranty specified in Section 260010.

PART 2 - PRODUCTS

2.1 CATEGORY 6 UTP RACK MOUNT PATCH PANELS FOR DATA

- A. Manufacturers:
1. Hubbell Premise Wiring
 2. The Siemon Company – Z-Max Series
 3. Systimax GigaSpeed Products – XL Series
 4. Leviton – 69586 Series
- B. Basis of Design – Hubbell Premise Wiring HP624/HP648 Series category 6 patch panels
- C. Design Requirements:
1. Category 6 patch panels shall be standard 8-position, RJ-45 style, un-keyed, FCC and IEC 60603-7 compliant receptacle, in 24- and 48-port configurations. 96-Port will not be acceptable.
 2. Panel frames shall be black powder coated 14-ga steel with rolled edges top and bottom for proper stiffness.
 3. Panels shall accommodate a minimum of 24 ports for each rack mount unit (1 RMU = 1.75").
 4. Panels shall be designed for 4-pair, 100-ohm balanced unshielded twisted pair (UTP) cable.
 5. Panels shall terminate 26-22 AWG solid conductors, with maximum insulation diameter of 0.050".
 6. Panels shall have attached wiring instruction labels to permit either T568A or T568B wiring configurations.
 7. Panels shall have individual port identification numbers on the front and rear of the panel.
 8. Panels shall utilize 6-port adapter modules, each secured with one screw. Adapter module housings shall be UL 94 V-0 rated thermoplastic.
 9. Panel adapter modules shall be 110-style termination with lead free tin solder plated IDC contacts.
 10. Printed circuit boards shall be fully enclosed front and rear for physical protection.
 11. Panel contacts shall withstand a minimum of 2000 mating cycles with an FCC 8-position RJ-45 plug, without degradation of electrical or mechanical performance.
 12. Panel contacts shall be constructed of Beryllium copper for maximum spring force and durability.
 13. Panel receptacle contacts shall be arranged in-line on the PC board with pins in 1-2, 4-5, and 7-8 formed with a cross over feature to provide improved near end cross talk (NEXT).
 14. Contact plating shall be a minimum of 45 micro-inches of precious metal in the contact area over 50 micro-inch of nickel.
 15. Panel receptacle contact shall also make contact with secondary PCB to provide improved RF compensation while keeping contacts as sort as possible.
 16. IDC contacts shall be arranged in-line.
 17. Panels shall have the C6 designation, visible from the front when installed.
 18. Panels shall utilize a paired punch-down sequence to maximize electrical performance.
 19. Panel termination method shall follow the industry standard 110 IDC punch-down, using a standard 110 impact termination tool.
 20. Rear IDC contacts shall be Phosphor Bronze with 100 micro-inch lead free tin plating over nickel.
 21. HP6 series panel adapter ports shall accept optional hinged dust covers.
 22. HP6 series panel adapter ports shall accept snap-on icons for specific identification.
 23. Space above the adapter ports shall be available for additional labeling per ANSI/TIA/EIA-606-A.
 24. Category 6 panels shall be backward compatible with existing Category 3, 5, and 5e cabling systems for fit, form, and function.
 25. Panels shall accept a clip-on rear cable management support bar to provide cable strain relief.

26. Panels shall include integrated label holders with white designation labels and a clear cover for each 6-port adapter.
27. Panel adapters shall accept strain relieving stuffer caps, one cap per port.
28. Panels shall be manufactured in the USA.

D. Performance Requirements:

1. All transmission performance parameters shall be independently verified by a UL or ETL third party testing organization.
2. Category 6 panels shall meet or exceed Category 6 transmission requirements for connecting hardware, as specified in ANSI/TIA/EIA-568-C.2, Transmission Performance Specifications for 4-Pair 100-ohm Category 6 Cabling.
3. The manufacturer shall provide Category 6 component compliance certificates from third party testing organizations upon request.
4. Panels shall be UL LISTED 1863 and CSA certified.
5. Panels shall exceed IEEE 802.3bt DTE Power specification to 4 times the rated current limits with no degradation of performance or materials.
6. Panel contacts shall withstand a minimum of 2000 mating cycles with an FCC 8-position RJ-45 plug, without degradation of electrical or mechanical performance.
7. Panels shall be third party verified, error free Gigabit Ethernet performance to IEEE 802.3 standard.
8. Category 6 panels shall exceed 4 Gb/s data transmission capacity within the bandwidth of 1 – 250 MHz when configured in a 4-connector channel.
9. Category 6 panels shall meet or exceed the 4-connector channel performance requirements of Category 6, per the ANSI/TIA/EIA-568-C.2 standard.
10. The 4-connector channel test configuration shall utilize Category 6 patch panels, Category 6 jack, and Category 6 patch cords, from the same manufacturer, with qualified Category 6 cable.
11. The 4-connector channel performance margins in the table below shall be guaranteed. Conditions of requirement No. 10 above apply.
12. Category 6 panels shall meet the current draft 10 Gb/s performance requirements of IEEE 802.3 and TSB-155, for a maximum 55-meter channel length. Conditions of requirement No. 10 above apply.

Electrical Parameter (1 - 250MHz)	Guaranteed Margins to Category 6 / Class E Channel Specifications
Insertion Loss	3 %
NEXT	4 dB
PSNEXT	5 dB
ELFEXT	4 dB
PSELFEXT	5 dB
Return Loss	2 dB

- E. Provide patch panel port quantity as required for cables + 20% spare unless otherwise noted on the drawings.

2.2 CATEGORY 6 UTP CABLES FOR DATA

A. Manufacturers:

1. Hubbell Premise Wiring
2. The Siemon Company – 9C6P4-E3-(06)-RBA Series
3. Systemax GigaSpeed Products –2071E Series (700208093)
4. Berk-Tek, Inc. – 10032093 Series

- B. Basis of Design – Hubbell Premise Wiring HC6RPB Category 6 – 550MHz Plenum

C. Design requirements

1. Cable construction shall be four twisted pairs of 23 AWG insulated solid conductors, with a ripcord, surrounded by a tight outer jacket.
2. Cable shall be manufactured with an "X"-shaped pair-divider along the center to maintain separation of individual pairs.
3. Conductor diameters shall be $0.0224" \pm .0003"$ solid copper.
4. Conductor insulation diameter shall be $0.039" \pm .0005"$ fluoro copolymer.
5. Twist lay of each pair shall vary in a manner to optimize noise immunity and minimize crosstalk.
6. Outer jacket diameter shall be $0.235" \pm .008"$ low smoke PVC, with a nominal wall thickness of $0.015"$.
7. Ripcord shall be directly underneath the outer jacket.
8. Cable shall be marked: "HUBBELL NEXTSPEED CATEGORY 6 Mid-Grade – AAAAAA - PLENUM - 4PR 23AWG C(UL)US CMP E255553 – VERIFIED (UL) CAT6 ANSI/TIA 568-C.2 - Z/YY (XXXX) – R#".
 - a. Frequency of marking shall be every 2.0'.
 - b. 'Z' represents the month of manufacture.
 - c. 'YY' indicates the year of manufacture.
 - d. 'XXXX' indicates the job number.
 - e. 'NNNN' indicates the sequential footage markers.
9. UL, ETL, or CSA agency certification or verification markings shall be marked on the cable jacket according to the certifying agency's requirements.
10. Color coding of the pairs shall be as follows:
 - a. Pair 1: White/Blue; Blue
 - b. Pair 2: White/Orange; Orange
 - c. Pair 3: White/Green; Green
 - d. Pair 4: White/Brown; Brown
11. Cable shall be supplied in 1000' spools.

D. Performance Requirements:

1. All transmission performance parameters shall be independently verified by a UL or ETL third party testing organization.
2. Cable shall exceed Category 6 transmission requirements specified in ANSI/TIA/EIA-568-C.2-1 and shall be tested through 550 MHz.
3. Cable shall exceed the requirements of TIA/TSB-155: 10 Gb/s Ethernet Operation over 55 Meters Channel Length.
4. Worst-case cable performance shall be +8.0 dB headroom over current TIA/EIA and ISO standards limits for NEXT and PSNEXT loss, and ELFEXT and PSELFEXT loss.
5. Insertion loss shall be 3.0% lower than standard Hubbell Category 6 plenum and riser cables.
6. Worst case electrical performance characteristics shall be as follows:
 - a. Characteristic Impedance: 100 ± 15 ohms (1.0-100 MHz) 100 ± 20 ohms (101-250 MHz)
 - b. Maximum Conductor Resistance: 9.38 ohms /100 Meters @ 20°C
 - c. Maximum Resistance Unbalance: 3%
 - d. Maximum Mutual Capacitance: 5.6 nF/100 Meters @ 1 kHz
 - e. Maximum Capacitance Unbalance: 330 pF/100 Meters
 - f. Maximum Delay Skew: 35 ns/100 Meters
7. The manufacturer shall provide Category 6 component compliance certificates from third party testing organization upon request.
8. Cable shall be UL and c (UL) listed.
9. Cable shall exceed IEEE 802.3bt DTE Power specification to 4 times the rated current limits with no degradation of performance or materials.
10. Cable shall be third party verified, error free Gigabit Ethernet performance to IEEE 802.3 standard.

11. Cable shall meet or exceed the 4-connector channel performance requirements of Category 6, per the ANSI/TIA/EIA-568-C.2-1 standard.
12. The 4-connector channel test configuration shall utilize Category 6 jacks and patch panels, with Category 6 patch cords, from the same manufacturer, with qualified Category 6 cable.
13. The 4-connector channel performance margins in the table below shall be guaranteed provided the configuration satisfies requirement No. 12 above.

Electrical Parameter (1 - 250MHz)	Guaranteed Margins to Category 6 / Class E Channel Specifications
Insertion Loss	3 %
NEXT	4 dB
PSNEXT	5 dB
ACR-F	6 dB
PSACR-F	7 dB
Return Loss	4 dB

2.3 CATEGORY 6 INDOOR/OUTDOOR UTP CABLES

- A. Manufacturers:
 1. Hubbell Premise Wiring
 2. The Siemon Company
 3. Systemax GigaSpeed Products
 4. Berk-Tek, Inc.
- B. Basis of Design: Hubbell Premise Wiring C6I0SPBK
- C. Usage:
 1. Slab on grade conduit runs to floorboxes or outlet boxes.
 2. Exterior conduit to handholes or other locations.
- D. Design Requirements:
 1. Cable construction shall be four twisted pairs of 23-ga insulated solid copper conductors, cabled around a cross web separator, and surrounded by an overall jacket.
 2. Cable shall be gel free and use specialty jacket materials or barriers to protect against water ingress.
 3. Jacket color shall be black, and material shall be UV resistant.
- E. Performance Requirements:
 1. Cable shall meet or exceed Category 6 transmission requirements specified in TIA-568.2D (current revision), for all electrical characteristics.
 2. Cable shall meet or exceed permanent link and 4-connector channel performance requirements specified in ANSI/TIA 568 (current revision) standard.
 3. UL Listed Type CMP
 4. Cable shall be rated for an operating temperature range of -40°F to 167°F (-40°C to 75°C)

2.4 CATEGORY 6 UTP PATCH CABLES FOR DATA

- A. Manufacturers:
 1. Hubbell Premise Wiring
 2. The Siemon Company
 3. Systemax GigaSpeed Products
 4. Leviton

- B. Basis of Design – Hubbell Premise Wiring HCL6 Low OD Series category 6 patch cords
- C. Design Requirements:
1. Category 6 patch cords shall be constructed with a clear polycarbonate plug and boot having vertically staggered, trifurcated contacts, each having 50 micro-inches of gold plating.
 2. Plug dimensions and function shall comply with FCC 47, Part 68.5.
 3. Patch cords shall have a snag-less feature, integral to the strain relief boot on each end.
 4. Patch cords shall be constructed with category 6 patch cable, with 24 AWG 7/32 tinned copper stranded conductors, each insulated with polyethylene, and overall jacket with UL flame-retardant PVC.
 5. Patch cords shall be manufactured using a T568B wiring format and shall function suitably for either T568A or T568B wiring schemes.
 6. Patch cords shall be available in the following colors: black, blue, gray, yellow, orange, red, green, white, and purple. Custom lengths and colors shall be available with a delivery lead-time quotation.
 7. Standard patch cord lengths shall range from 3' to 20'.
 8. Category 6 patch cords shall be backward compatible with existing Category 3, 5, and 5e cabling systems for fit, form, and function.
- D. Performance Requirements:
1. All transmission performance parameters shall be independently verified by a UL or ETL third party testing organization.
 2. Category 6 patch cords shall be channel performance balanced with Hubbell category 6 jacks, patch panels, and punch-down blocks.
 3. Category 6 patch cords shall meet or exceed Category 6 component transmission requirements for connecting hardware, as specified in ANSI/TIA/EIA-568-C.2 standard.
 4. The manufacturer shall provide Category 6 component compliance certificates from third party testing organization upon request.
 5. Patch cords shall be cUL and UL LISTED 1863.
 6. Patch cords shall exceed IEEE 802.3bt DTE Power specification to 4 times the rated current limits with no degradation of performance or materials.
 7. Patch cords shall be third party verified, error-free Gigabit Ethernet performance to IEEE 802.3 standard.
 8. Jacks shall exceed 4 Gb/s data transmission capacity within the bandwidth of 1 – 250 MHz when configured in a 4-connector channel.
 9. Category 6 patch cords shall meet or exceed the 4-connector channel transmission performance requirements of Category 6, per ANSI/TIA/EIA-568-C.2 standard.
 10. The 4-connector channel test configuration shall utilize Category 6 patch panels, blocks, and jacks, with Category 6 patch cords, all from the same manufacturer, with qualified Category 6E cable.
 11. The 4-connector channel performance margins in the table below shall be guaranteed, provided the configuration satisfies requirement No. 10 above.
 12. Category 6 patch cords shall meet the current draft 10 Gb/s transmission performance requirements of TSB-155, provided the configuration satisfies requirement No. 9 above.

ELECTRICAL PARAMETER (1 – 250 MHz)	GUARANTEED MARGINS TO CATEGORY 6 / CLASS E CHANNEL SPECIFICATIONS
Insertion Loss	3 %
NEXT	4 dB
PSNEXT	5 dB
ACR-F	6 dB
PSACR-F	7 dB
Return Loss	4 dB

- E. Provide two patch cables for every connected patch panel ports. Provide length as required to terminate between fiber patch panels/outlets and equipment in a neat and workmanlike manner through cable management assemblies.

2.5 TELEPHONE CABLES

- A. Telephone Workstation Cable: Provide UTP patch cables to match those used for data.

2.6 CATEGORY 6 MODULAR JACKS

- A. Manufacturers:
 - 1. Hubbell Premise Wiring
 - 2. The Siemon Company – Z-Max Series
 - 3. Systimax GigaSpeed Products – X10 Series
 - 4. Leviton – 61110-RW6
- B. Basis of Design – Hubbell Premise Wiring HXJ6 or HJU6 (Cobra-Lock Style) Series category 6 jacks
- C. Design Requirements:
 - 1. Jacks shall be standard 8-position, RJ-45 style, un-keyed, FCC compliant.
 - 2. Jacks shall be designed for 4-pair, 100-ohm balanced unshielded twisted pair (UTP) cable.
 - 3. Each jack shall be single unit construction, with snap – fit to industry standard keystone opening (.760" x .580").
 - 4. Jack housings shall be high impact UL 94 V-0 rated thermoplastic.
 - 5. Jacks shall have a temperature rating of -10°C (14°F) to 70°C (158 °F).
 - 6. Jack housings shall fully encase and protect printed circuit boards and IDC fields.
 - 7. Modular jack contacts shall accept a minimum of 2000 mating cycles without degradation of electrical or mechanical performance.
 - 8. Jack contacts shall maintain a minimum deflection force of 100 grams while mated with an FCC-standard RJ-45 plug.
 - 9. Jack contacts shall be constructed of Beryllium copper for maximum spring force and durability.
 - 10. IDC contacts shall be Phosphor Bronze with 100 micro-inch tin lead 60/40 plating over nickel.
 - 11. Jacks shall terminate 26-22 AWG solid or stranded conductors.
 - 12. Jacks shall terminate insulated conductors with outside diameters up to .050".
 - 13. Jacks shall not require special cords, specialty tools or special installation requirements.
 - 14. Jacks shall be compatible with single conductor standard 110 impact termination tools.
 - 15. Jacks shall be compatible with a 4-pair single punch impact tool designed specifically for the purpose.
 - 16. Jacks shall include a translucent stuffer cap for wire retention and to permit visual inspection.
 - 17. Stuffer cap shall have retention snaps to assure conductor strain relief.
 - 18. Jacks shall accept FCC compliant 6 position plugs.
 - 19. Jacks shall accept optional hinged dust covers.
 - 20. Jacks shall be compatible with ANSI/TIA/EIA-606-A color code labeling.
 - 21. Jacks shall accept snap-on icons for specific identification.
 - 22. Jacks shall be available in various colors to meet specific customer applications.
 - 23. Jacks shall have attached wiring instruction labels to permit either T568A or T568B wiring configurations.
 - 24. Category 6 jacks shall be backward compatible with existing Category 3, 5, and 5e cabling systems for fit, form, and function.
- D. Performance Requirements:

1. All transmission performance parameters shall be independently verified by a UL or ETL third party testing organization.
2. Category 6 jacks shall exceed Category 6 transmission requirements for connecting hardware, as specified in ANSI/TIA/EIA-568-C.2, Transmission Performance Specifications for 4-Pair 100-ohm Category 6 Cabling.
3. Category 6 jacks shall exceed 10 Gb/s transmission requirements for connecting hardware, under the constraints of ANSI/TIA-TSB-155 (current draft).
4. The manufacturer shall provide Category 6 component compliance certificates from third party testing organization upon request.
5. Jacks shall be UL LISTED 1863 and CSA certified.
6. Jacks shall exceed IEEE 802.3bt DTE Power specification to 4 times the rated current limits with no degradation of performance or materials.
7. Jacks shall be third party verified, error free Gigabit Ethernet performance to IEEE 802.3 standard.
8. Jacks shall exceed 4 Gb/s data transmission capacity within the bandwidth of 1 – 250 MHz when configured in a 4-connector channel.
9. Jacks shall exceed the 4-connector channel performance requirements of Category 6, per the ANSI/TIA/EIA-568-C.2 standard.
10. Jacks shall exceed the 4-connector Category channel performance requirements for 10 Gb/s transmission over Category 6, according to TIA/TSB-155 (current draft).
11. The 4-connector channel test configuration shall utilize Category 6 patch panels and Category 6 patch cords, from the same manufacturer, with qualified Category 6E cable.
12. The 4-connector Category 6 channel performance margins in the table below shall be guaranteed, provided the configuration satisfies requirement No. 11 above.

Electrical Parameter (1 - 250MHz)	Guaranteed Margins to Category 6 / Class E Channel Specifications
Insertion Loss	3 %
NEXT	4 dB
PSNEXT	5 dB
ACR-F	6 dB
PSACR-F	7 dB
Return Loss	4 dB

2.7 STAINLESS STEEL FACE PLATES AND UNLOADED MODULES

- A. Manufacturers:
 1. Hubbell Premise Wiring
 2. The Siemon Company
 3. Systimax GigaSpeed Products
 4. Leviton
- B. Basis of Design – Hubbell Premise Wiring IMSS Series Modular Faceplates and Modules.
- C. Design Requirements:
 1. IMSS Series Faceplates:
 - a. Faceplates shall be constructed of Stainless Steel.
 - b. Faceplates shall be 2.75" W x 4.5" H for single gang and 4.5" X 4.5" for double gang.
 - c. Faceplates shall accept modules loaded with Hubbell HXJ-series series jacks and Hubbell Snap-Fit fiber optic, audio, and video connectors for multimedia applications.
 - d. Two #6-32 pan head Phillips/slotted mounting screws shall be included with each single gang faceplate.
 - e. Four #6-32 pan head Phillips/slotted mounting screws shall be included with each double gang faceplate.

- f. Faceplates shall be compatible with standard NEMA openings and boxes.
- g. Faceplates shall be compatible with raceway fittings, surface mount boxes, service fittings, service poles, flush mount boxes and drywall rings.
- 2. IMSS Series Modules:
 - a. Faceplate Modules shall be constructed of high impact, UL94 V-0 rated thermoplastic.
 - b. Modules shall be compatible with IMSS Series Faceplates, raceway, floor boxes, poke throughs, surface mount boxes, patch panels, furniture plates, and service poles.
 - c. Modules shall snap firmly into front of faceplate and position flush to outer plate surface for field installation in any of the specified mounting hardware devices and media configurations.
 - d. Single gang IMSS Series Faceplate shall accept (3) 1U modules
 - e. Double Gang IMSS Series Faceplate shall accept (6) 1U modules.
 - f. 1 Unit Modules shall be available for 1- and 2-Port Keystones, Blanks, and punched blanks to support the following connections per work area requirements.
 - 1) RJ-45 Category 6 jack per ANSI/TIA/EIA-568-C.2
 - 2) RJ-45 Category 6A jack per ANSI/TIA/EIA-568-C.2
 - 3) ST fiber optic connector per EIA/TIA-604-3
 - 4) SC fiber optic connector per EIA/TIA-604-3
 - 5) LC fiber optic connector per EIA/TIA-604-3
 - 6) S-Video Gold Jack
 - 7) RCA Gold Jack (color coded)
 - 8) BNC connector (straight mount)
 - 9) Gold F connector (straight mount)
 - 10) SVGA (female)
 - 11) 3.5 Mini Stereo Jack
 - 12) Gold Speaker Post
 - 13) HDMI connector
 - 14) USB connector
 - 15) Blank filler plate**

2.8 CATEGORY 6 PLENUM SURFACE MOUNT BOX 2-PORT

- A. Manufacturers:
 - 1. Hubbell Premise Wiring
 - 2. The Siemon Company
 - 3. Systimax GigaSpeed Products
 - 4. Leviton
- B. Basis of Design – Hubbell Premise Wiring HSB2EIP (Plenum Rated) with HXJ6 Series category 6 jacks
- C. Application – Wireless Access Points, IP cameras and other remote IP devices.
- D. Design Requirements:
 - 1. Box material shall be constructed from high impact thermoplastic; UL 94-V0.
 - 2. Box shall be suitable for use in other environmental air space in accordance with Section 300.22 of the National Electric Code.
 - 3. Box shall be tested for UL 2043.
 - 4. Box shall meet the requirements of UL 1863 modules and frames.
 - 5. Box shall be RoHS compliant.
- E. Performance Requirements:
 - 1. Box shall be suitable for air handling spaces.
 - 2. Box shall have a low-profile design.

3. Box shall accept Hubbell HJ and HXJ jacks and audio/video keystone connectors.
4. Box shall have easy cover latches to provide flexibility for simple moves, adds and changes.
5. Box shall have a secure, tamper resistant screw.

2.9 FIELD-TERMINATED PLUG, CATEGORY 6

- A. Manufacturers:
 1. Hubbell Premise Wiring
 2. The Siemon Company
 3. Systimax GigaSpeed Products
 4. Leviton
- B. Basis of Design – Hubbell Premise Wiring SP6 or SP690 (Right Angled) or Coupler Assembly SCP6Axyy (18", 3', 5', 7', 10')
- C. Application – Wireless Access Points, IP cameras and other remote IP devices.
- D. Design Requirements:
 1. The plug shall meet the following criteria:
 2. Meet or exceed all requirements for Category 6 as described in ANSI/TIA-568-C.2.
 3. Compliant with ANSI/TIA-1096-A.
 4. Accommodate T568A/B wiring schemes.
 5. Accommodate 26-22 AWG shielded or unshielded, solid or stranded conductors.
 6. Support Power over Ethernet (PoE) up to 100 watts.
 7. Connector body constructed of die-cast zinc
 8. Suitable for plenum areas.
 9. UL listed.

2.10 STAINLESS STEEL WALL-MOUNT PHONE PLATE

- A. Manufacturers:
 1. Hubbell Premise Wiring
 2. The Siemon Company
 3. Systimax GigaSpeed Products
 4. Leviton
- B. Basis of Design – Hubbell Premise Wiring SP10GR
- C. Listings:
 1. UL and cUL Listed 1863
 2. ANSI/TIA/EIA-568-C.2 Category 6 component
 3. ISO 11801/60603-7-41 Category 6 component
 4. Mechanical: Verified to TIA-568-C.2
 5. Mechanical TIA-568-C.2
 6. RoHS Compliant
- D. Design Requirements:
 1. Nose Contact: Beryllium copper with precious metal plating with nickel under-plating.
 2. IDC Contact: Phosphor bronze with 100 micro-inch tin lead 60/40 plating over nickel under plating.
 3. Jack Housing: High-impact thermoplastic (UL 94V-0)
 4. Stuffer Cap: Lexan® (UL 94 V-0)
- E. Performance Requirements:

1. Electrical:
 - a. Center balanced to Category 6 plug specifications
 - b. Positive PSACR beyond 300 MHz (channel)
 - c. 4+Gbs capacity within the bandwidth of 1-250MHz (channel)
 - d. Qualified to 150% of 802.3bt PoE Current Level
2. General Information:
 - a. Backward compatible to lower installed Categories
 - b. 100% factory tested
3. Mechanical:
 - a. Nose Contact Mating Cycles: 2000
 - b. IDC Contact Termination: 10x
 - c. Keystone Latching Force: 25 lbs.

2.11 CABLE LABELS

- A. Self-adhesive vinyl or vinyl-cloth wraparound tape markers, machine printed with alphanumeric cable designations.

2.12 OUTLET PLATE & PATCH PANEL LABELS

- A. Preprinted, flexible, self-adhesive vinyl with legend over-laminated with a clear weather and commercial resistant coating.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine pathway elements intended for cable. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install all cables in accordance with equipment manufacturer's instructions, and with recognized industry practices, to ensure the installation complies with requirements of the NEC, ANSI/TIA/EIA-568-C.1 Commercial Building Telecommunications Cabling Standard and BICSI'S "Telecommunication Distribution Methods Manual" (current edition).
- B. Install all cables only when the temperature is between 32°F to 122°F.
- C. Wiring Method: Wiring shall be installed in EMT conduit within walls and above inaccessible ceilings. Wiring shall be installed in cable tray where it is present. Wiring installed above accessible ceilings between ceiling mounted devices or conduit stub-ups and the cable tray shall be exposed and supported by J-hooks, spaced a maximum of 5'-0" on center, with minimum 1" flat bearing surface. Provide conduit sleeves, bushings and fireproofing through all wall penetrations. All wiring not in EMT conduit shall be kept a minimum of 6" away from all lighting fixtures, motors, and transformers. Cables cannot be ty-wrapped or stapled to ceiling or structural supports, conduit, or other items.
- D. Test each cable as detailed in specification. Include patch cord in test channel.
- E. Identify all cables with a neatly typed label as detailed in specification.

- F. Provide horizontal and vertical cable management in all racks, on all backboards and any other location cabling is not routed in conduit or cable tray. Size cable management for 50% additional cables.
- G. UTP Cable Length:
 - 1. Maximum installed length of each UTP cable between closet and workstation outlet is to be 90 meters (295'). Ensure lengths are within specification prior to installation. Contact Engineer for procedure in the event of excessive distances prior to installation.
 - 2. Minimum length shall be 15 meters (49'). Provide service loop as required to increase length on short runs.
- H. Install cable without damaging conductors, shield or jacket, do not use unjacketed pairs for jumpers.
- I. Do not bend cable in handling or in installing to smaller radii than minimums recommended by manufacturer.
- J. No splicing is permitted for UTP cables. Cables must be continuous between termination points. Make splices, taps and terminations only at indicated outlets, terminals, cross-connect and patch panels.
- K. Provide at least 10' of cable slack at MDF or IDF closet. This slack may be stored in the cable tray or a cable management device behind the MDF/IDF.
- L. Provide 2' diameter in service loops or use figure-8 or serpentine.
- M. Provide at least 1' of slack at each workstation outlet. This slack may be coiled within device box observing bend radius minimum or within accessible ceiling space using approved J-hook support.
- N. Remove jacket of cable and untwist individual UTP conductors the minimum amounts required to terminate on jacks and patch panels.
- O. Category 6 cable fill in conduit is 40% maximum as follows:
 - 1. 3/4" - 4 UTP Cables
 - 2. 1" - 6 UTP Cables
 - 3. 1-1/4" - 12 UTP Cables
 - 4. 1-1/2" - 16 UTP Cables
 - 5. 2" - 22 UTP Cables
 - 6. 2-1/2" - 36 UTP Cables
 - 7. 3" - 50 UTP Cables
 - 8. 3-1/2" - Not recommended
 - 9. 4" - Not recommended
 - 10. Provide larger conduits than recommended for cable fill if indicated on the Drawings.
- P. Pull cables without exceeding cable manufacturer's recommended pulling tensions.
 - 1. Pull cables simultaneously if more than one is being installed in the same raceway.
 - 2. Use pulling compound or lubricant if necessary. Use compounds that will not damage conductor or insulation.
 - 3. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage media or raceway.
- Q. Secure and support cable at intervals not exceeding 5'-0" and not more than 1'-0" from cabinets, boxes, fittings, outlets, racks, frames, and terminals.

- R. Wiring within IDF/MDF and Enclosures: Provide adequate length of conductors. Train conductors to terminal points with no excess. Use lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
- S. Separation of Wires: Comply with EIA/TIA-569 rules for separating unshielded copper telecommunications equipment cables from potential EMI sources, including electrical power lines and equipment.
- T. Support raceways, cabinets, and all other equipment in accordance with manufacturer's instructions.

3.3 LABELING

- A. System: Use a unique, 3 syllable alphanumeric designation for each cable, and label cable and jacks, connectors, and terminals to which it connects with the same designation. Use logical and systematic designations for facility's architectural arrangement.
 - 1. First syllable identifies and locates wiring closet or equipment room where cable originates.
 - 2. Second syllable identifies and locates cross-connect or patch-panel field in which cable terminates.
 - 3. Third syllable designates type of media (copper or fiber) and position occupied by cable pairs or fibers in the field.
 - 4. Example: A2-2-C46
- B. Workstation: Label cables within outlet boxes.
- C. Within Connector Fields, in IDF/MDF Rooms and Consolidation Points: Label each connector and each discrete unit of cable terminating and connecting hardware. Where similar jacks and plugs are used for both communication and data-processing equipment, use a different color for jacks and plugs of each service.
- D. Cables, General: Label each cable within 4" of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
- E. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 100 feet.
- F. Cable Schedule: Post in prominent location in each wiring closet and equipment room. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Provide electronic copy of final comprehensive schedules for project, in software and format selected by Owner.

3.4 GROUNDING

- A. Comply with Section 260526 and applicable details on plans.
- B. Provide connections to the main ground bus on all backboards, telephone line protectors, IDF Racks and MDF Racks in the project. Connect to ground buses with cables per Specification Section 260526 and applicable details on plans.

3.5 FINAL TESTING AND INSPECTION

- A. Provide testing in accordance with ANSI/TIA/EIA-568-C.1.

- B. Cable Test: Provide prior to substantial completion, a Performance Evaluation Report, which will contain the following:
1. Cable Test: List by cable number each UTP Cable in the project, which details:
 - a. UTP Cables:
 - 1) Cable ID Number
 - 2) List continuity, reversal, open, shorts and miswires
 - 3) Category performance
 - 4) List other discrepancies with the UTP installation (bad terminations, faulty labeling, etc).
 - 5) Tester printout for each cable.
 2. UTP Cable Testing: Test each cable pair of each cable after installation for Specified Category performance. Conduct test with a tester designed for testing above cable (with RJ-45 jacks installed) from each data outlet to associated patch cord through +0 panel jack (Channel). Provide printout for each test as part of the Performance Evaluation Report. Minimum performance categories for report are to be as follows:
 - a. Wire Map/Continuity
 - b. Length
 - c. Near End Crosstalk (pair to pair) NEXT
 - d. Near End Crosstalk (power sum) PSNEXT
 - e. Equal Level Far-End Crosstalk Loss (pair to pair) ELFEXT
 - f. Equal Level Far-End Crosstalk Loss (power sum) PSELFEXT
 - g. Return Loss
 - h. Attenuation
 - i. Propagation Delay
 - j. Delay Skew
 - k. PSACR (Powersum Attenuation – Crosstalk Ratio)
 3. System Performance Report: Provide a narrative detailing the system as a whole, in regard to the quality of installation and any discrepancies affecting performance. This narrative to indicate a summary of the above Cable Test, as well as an accurate summary of specified Category performance as well as capability of the cabling system to perform at specified Category bandwidth.

3.6 WARRANTY

- A. The installation shall be provided with a minimum 25-year warranty for strict compliance with the performance requirements of ANSI/TIA/EIA-568-C.1 to support and conform to ANSI/TIA/EIA-568-C.1 specifications covering any current or future application which supports transmission over a properly constructed horizontal cabling system premises network which meets the channel performance as described in ANSI/TIA/EIA-568-C.2.

END OF SECTION 271500

SECTION 271501 – COMMUNICATIONS HORIZONTAL CABLING – CATEGORY 6A

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. UTP Cables and Equipment
- B. Modular Jacks, Modules and Faceplates
- C. Surface Mount Boxes
- D. Phone Plates
- E. Labeling

1.2 REFERENCES

- A. NFPA 70 - National Electrical Code
- B. ANSI/TIA-568-C.0, Generic Telecommunications Cabling for Customer Premises
- C. ANSI/TIA-568-C.1, Commercial Building Telecommunications Cabling Standard
- D. ANSI/TIA-568-C.2, Balanced Twisted-Pair Telecommunications Cabling and Components Standard
- E. BISCI – Telecommunications Distribution Methods Manual (Current Edition)
- F. NEMA WD-6: Wiring Devices - Dimensional Requirements
- G. ANSI/TIA/EIA-607-C – Grounding and Protection of Telecommunication Cables and Equipment
- H. ANSI/ICEA S-80-576: Industry Color Codes
- I. UL 910/NFPA 262: Test method for fire and smoke characteristics of electrical and optical-fiber cables used in air handling spaces.
- J. UL 1666: Flame propagation height of electrical and optical-fiber cables installed vertically in shafts.

1.3 SYSTEM REQUIREMENT

- A. All cables specified are to be supplied in “Plenum-Rated” versions for this installation.
- B. Coordinate the features of materials and equipment so they form an integrated system. Match components and interconnections for optimum performance.

1.4 SUBMITTALS FOR REVIEW

- A. Submit under provisions of Section 260010.
- B. Shop Drawings: The following items shall be submitted for review and approval:

1. Submittal booklet to include the following;
 - a. Reference to Specification Section
 - b. A list of all equipment to be provided and installed.
 - c. Data sheet to indicate each cable type including number of pairs, punch down block, outlet/connectors with the specific item or model number highlighted.
 - d. Data sheets to indicate supply dimensions, ETL-verified electrical characteristics and parameters, upgrade/expansion data, and mounting methods for all hardware and materials with the specific item or model numbers highlighted.
 - C. Submit manufacturer warranty certificate stating length of warranty, other accepted component manufacturers and overall testing/replacement responsibility.
 - D. Submit product certificates signed by manufacturers of cables, connectors, and equipment certifying that products furnished comply with requirements and warranty is valid with equipment installed.
 - E. Submit evidence that all qualifications have been met.
 - F. Submit make/model numbers of testers to be used for all testing of cables.
 - G. Labeling Scheme: Submit labeling scheme for cabling, outlets, and equipment for approval.
 1. Contractor to coordinate with Owner for final room designations utilized in applied labeling scheme. Labeling schemes applied without documented Owner coordination are subject to removal and re-application by Contractor.
 2. All labels are to be typed.
- 1.5 SUBMITTALS FOR CLOSEOUT
- A. Submit under provisions of Section 260010.
 - B. As-Built Drawings: Provide a marked-up copy of original plans which reflect any changes or additions not shown on the plan. Identify all cable and jack numbering as identified on site and in System Final Test Report. Indicate routing of all IDF to MDF cabling.
 - C. Submit Test Report for each basic link from patch panel to jack/patch panel. Report to include test equipment type and calibration data, date, and operator.
 - D. Submit electronic copy of final comprehensive schedules for project, in software and format selected by Owner.
 - E. Record actual locations of outlets and sizes of pathways.
- 1.6 QUALIFICATIONS
- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
 - B. Supplier: Authorized or Franchised distributor of specified manufacturer with minimum three years documented experience.
 - C. Installer: Authorized or franchised installer of specified manufacturers with five years documented experience.

- D. Provide two references of network installation, which exceeded 200 drops and were completed within the last 12 months.
- E. Installer must be able to identify and correct non-compliance in structured cabling systems. Provide the name of a fulltime RCDD employed by the installing company.
- F. Provide satisfactory evidence of a fully equipped service organization, capable of furnishing adequate inspection and service to the system, including standard replacement parts within 50 miles of the project site.
- G. Perform all terminations at device and headend locations using the hereby qualified installation firm.
- H. Supervise and approve all cable pulls in accordance with warranty requirements of the certifying company.

1.7 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Provide products listed and classified by Underwriters Laboratories, Inc., or a testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to project site in manufacturer's original, unopened cartons and containers, each bearing names of product and manufacturer.
- B. Store products in dry spaces protected from the weather. The storage temperature shall be 68°F to 122°F.

1.9 MAINTENANCE SERVICE

- A. Furnish service and maintenance of complete telecommunications horizontal cabling system for one year from Date of Substantial Completion of project at no additional cost to Owner.

1.10 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 - 1. UTP Patch Cables of sufficient length to replace any similar cable installed in the project: Furnish 10 for every 100 of each type installed but not less than 10 of each type.
 - 2. Connector Modules: Furnish 10 for every 100 of each type and rating installed but not less than 10 of each type.
 - 3. Wall Plates: Furnish 10 for every 100 of each type and rating installed but not less than 10 of each type.

1.11 WARRANTY

- A. Provide the warranty specified in Section 260010.

PART 2 - PRODUCTS

2.1 CATEGORY 6A UTP RACK MOUNT PATCH PANELS FOR DATA

- A. Manufacturers:
 - 1. Hubbell Premise Wiring
 - 2. The Siemon Company – Z-Max Series
 - 3. Systimax GigaSpeed Products – XIOD Series
 - 4. Leviton – C1255-H48 w/ 6AUJK-R*6
- B. Basis of Design – Hubbell Premise Wiring HPJA24/HPJ6A48 Series category 6A Jack Panel Kits.
- C. Design Requirements:
 - 1. Category 6A patch panels shall be standard Jack Panel Kits, RJ-45 style, un-keyed, FCC and IEC 60603-7 compliant receptacle, in 24- and 48-port configurations. 96-Port will not be acceptable.
 - 2. Panel Kit frames shall be black powder coated 14-ga steel with rolled edges top and bottom for proper stiffness.
 - 3. Jack Panels shall accommodate a minimum of 24 ports for each rack mount unit (1 RMU = 1.75").
 - 4. Jack Panels shall be designed for 4-pair, 100-ohm balanced unshielded twisted pair (UTP) cable.
 - 5. Jack Panels shall terminate 26-22 AWG solid conductors, with maximum insulation diameter of 0.050".
 - 6. Jack Panels shall have attached wiring instruction labels to permit either T568A or T568B wiring configurations.
 - 7. Jack Panels shall have individual port identification numbers on the front and rear of the panel.
 - 8. Jack Panel contacts shall withstand a minimum of 2000 mating cycles with an FCC 8-position RJ-45 plug, without degradation of electrical or mechanical performance.
 - 9. Jack Panel contacts shall be constructed of Beryllium copper for maximum spring force and durability.
 - 10. Jack Panel Contact plating shall be a minimum of 45 micro-inches of precious metal in the contact area over 50 micro-inch of nickel.
 - 11. Rear Jack Panel contacts shall be Phosphor Bronze with 100 micro-inch lead free tin plating over nickel.
 - 12. HPJ6A series panel adapter ports shall accept optional hinged dust covers.
 - 13. HPJ6A series panel adapter ports shall accept snap-on icons for specific identification.
 - 14. Space above the adapter ports shall be available for additional labeling per ANSI/TIA/EIA-606-B.
 - 15. Category 6A panels shall be backward compatible with existing Category 3, 5, 5e, and 6 cabling systems for fit, form, and function.
 - 16. Panels shall accept a clip-on rear cable management support bar to provide cable strain relief.
 - 17. Panels shall include integrated label holders with white designation labels and a clear cover for each 6-port adapter.
 - 18. Panel adapters shall accept strain relieving stuffer caps, one cap per port.
 - 19. Panels shall be manufactured in the USA.
- D. Performance Requirements:
 - 1. All transmission performance parameters shall be independently verified by a UL or ETL third party testing organization.
 - 2. Category 6A panels shall meet or exceed Category 6A transmission requirements for connecting hardware, as specified in ANSI/TIA/EIA-568.2-D, Transmission Performance Specifications for 4-Pair 100-ohm Category 6A Cabling.

3. The manufacturer shall provide Category 6A component compliance certificates from third party testing organizations upon request.
4. Panels shall be UL LISTED 1863 and CSA certified.
5. Panels shall be tested to 150% of IEEE 802.3bt DTE Power specification to 4 times the rated current limits with no degradation of performance or materials.
6. The 4-connector channel test configuration shall utilize Category 6A patch panels, Category 6A jack, and Category 6A patch cords, from the same manufacturer, with qualified Category 6A cable.
7. The 4-connector channel performance margins in the table below shall be guaranteed. Conditions of requirement No. 6 above apply.

Electrical Parameter (1 - 500MHz)	Guaranteed Margins to Category 6A
Insertion Loss	3%
NEXT	4dB
PSNEXT	5dB
ACR	4dB
PSACR	5dB
Return Loss	4dB
ACRF	6dB
PSANEXT	4dB
PSAACRF	4dB

- E. Provide patch panel port quantity as required for cables + 20% spare unless otherwise noted on the drawings.

2.2 CATEGORY 6A UTP CABLES FOR DATA

- A. Manufacturers:
1. Hubbell Premise Wiring
 2. The Siemon Company – 9C6P4-A5-(XX)-ARIA Series
 3. Systemax GigaSpeed Products – X10 3291B Series
 4. Berk-Tek, Inc. – 11101842 SST Series
- B. Basis of Design – Hubbell Premise Wiring C6ASPDSxx Category 6A - Plenum
- C. Design requirements
1. Cable construction shall be four twisted pairs of 23 AWG insulated solid conductors, surrounded by an outer jacket.
 2. Cable shall be manufactured with an “X”-shaped pair-divider along the center to maintain separation of individual pairs.
 3. Cable shall have a non-conductive isolation wrap to suppress ANEXT.
 4. Conductor diameters shall be $0.022" \pm .0003"$ solid copper.
 5. Conductor insulation diameter shall be $0.042" \pm .0005"$ FEP.
 6. Outer jacket diameter shall be $0.260" \pm .008"$ low smoke PVC, with a nominal wall thickness of 0.016".
 7. Cable shall be marked: "HUBBELL PREMISE WIRING NEXTSPEED CATEGORY 6A UTP -- [P/N] -- 4PR 23AWG – C(UL)US CMP OR (UL) CMP-LP (0.6A) -- E255553-E --VERIFIED (UL) CAT 6A ANSI/TIA 568-C.2 AND ISO/IEC 11801 -- PATptnd.info/Hubbell/ -- ZZ/YY (DDJNN) -- *** FT"
 8. Frequency of marking shall be every 2.0'.
 - a. 'ZZ' represents the month of manufacture.
 - b. 'YY' indicates the year of manufacture.

- c. 'DDJNN' indicates the job number.
 - d. '***FT' indicates the sequential footage markers.
 9. UL, ETL, or CSA agency certification or verification markings shall be marked on the cable jacket according to the certifying agency's requirements.
 10. Color coding of the pairs shall be as follows:
 - a. Pair 1: White/Blue; Blue
 - b. Pair 2: White/Orange; Orange
 - c. Pair 3: White/Green; Green
 - d. Pair 4: White/Brown; Brown
 11. Cable shall be supplied in 1000' reel in box.
- D. Performance Requirements:
1. All transmission performance parameters shall be independently verified by a UL or ETL third party testing organization.
 2. Cable shall exceed Category 6A transmission requirements specified in ANSI/TIA/EIA-568-C.2-1 and shall be tested through 750 MHz.
 3. Worst-case cable performance shall be +7.0 dB headroom over current TIA/EIA standards limits for ANEXT loss.
 4. Cable shall be UL and c (UL) listed.
 5. Cable shall exceed IEEE 802.3bt DTE Power specification to 4 times the rated current limits with no degradation of performance or materials.
 6. Cable shall meet or exceed the 4-connector channel performance requirements of Category 6A, per the ANSI/TIA/EIA-568-C.2-1 standard.
 7. The 4-connector channel test configuration shall utilize Category 6A jacks and patch panels, with Category 6A patch cords, from the same manufacturer, with qualified Category 6A cable.
 8. The 4-connector channel performance margins in the table below shall be guaranteed provided the configuration satisfies requirement No. 7 above.

Electrical Parameter (1 - 500MHz)	Guaranteed Margins to Category 6A
Insertion Loss	3%
NEXT	4dB
PSNEXT	5dB
ACR	4dB
PSACR	5dB
Return Loss	4dB
ACRF	6dB
PSANEXT	4dB
PSAACRF	4dB

2.3 CATEGORY 6A UTP PATCH CABLES FOR DATA

- A. Manufacturers:
1. Hubbell Premise Wiring
 2. The Siemon Company
 3. Systimax GigaSpeed Products
 4. Leviton
- B. Basis of Design – Hubbell Premise Wiring HCL6A Low OD Series category 6A patch cords
- C. Design Requirements:
1. Category 6A patch cords shall be constructed with a clear polycarbonate plug and boot having vertically staggered, trifurcated contacts, each having 50 micro-inches of gold plating.

2. Plug dimensions and function shall comply with FCC 47, Part 68.5.
3. Patch cords shall have a snag-less feature, integral to the strain relief boot on each end.
4. Patch cords shall be constructed with category 6A patch cable, with 26 AWG 7/32 tinned copper stranded conductors, each insulated with polyethylene, and overall jacket with UL flame-retardant PVC.
5. Patch cords shall be manufactured using a T568B wiring format and shall function suitably for either T568A or T568B wiring schemes.
6. Patch cords shall be available in the following colors: black, blue, gray, yellow, orange, red, green, white, and purple. Custom lengths and colors shall be available with a delivery lead-time quotation.
7. Standard patch cord lengths shall range from 3' to 20'.
8. Category 6A patch cords shall be backward compatible with existing Category 3, 5, 5e, and 6 cabling systems for fit, form, and function.

D. Performance Requirements:

1. All transmission performance parameters shall be independently verified by a UL or ETL third party testing organization.
2. Category 6A patch cords shall be channel performance balanced with Hubbell category 6A jacks, patch panels, and punch-down blocks.
3. Category 6A patch cords shall meet or exceed Category 6A component transmission requirements for connecting hardware, as specified in ANSI/TIA/EIA-568-C.2 standard.
4. The manufacturer shall provide Category 6A component compliance certificates from third party testing organization upon request.
5. Patch cords shall be cUL and UL LISTED 1863.
6. Patch cords shall exceed IEEE 802.3bt DTE Power specification to 4 times the rated current limits with no degradation of performance or materials.
7. Category 6A patch cords shall meet or exceed the 4-connector channel transmission performance requirements of Category 6A, per ANSI/TIA/EIA-568-C.2 standard.
8. The 4-connector channel test configuration shall utilize Category 6A patch panels, blocks, and jacks, with Category 6A patch cords, all from the same manufacturer, with qualified Category 6A cable.
9. The 4-connector channel performance margins in the table below shall be guaranteed, provided the configuration satisfies requirement No. 8 above.

Electrical Parameter (1 - 500MHz)	Guaranteed Margins to Category 6A
Insertion Loss	3%
NEXT	4dB
PSNEXT	5dB
ACR	4dB
PSACR	5dB
Return Loss	4dB
ACRF	6dB
PSANEXT	4dB
PSAACRF	4dB

- E. Provide two patch cables for every connected patch panel ports. Provide length as required to terminate between fiber patch panels/outlets and equipment in a neat and workmanlike manner through cable management assemblies.

2.4 TELEPHONE CABLES

- A. Telephone Workstation Cable: Provide UTP patch cables to match those used for data.

2.5 CATEGORY 6A MODULAR JACKS

- A. Manufacturers:
 - 1. Hubbell Premise Wiring
 - 2. The Siemon Company – Z-Max Series
 - 3. Systimax GigaSpeed Products – X10 Series
 - 4. Leviton – 6AUJK-R*6
- B. Basis of Design – Hubbell Premise Wiring HJU6A Series category 6A Cobra Lock Tool-Less jacks
- C. Design Requirements:
 - 1. Category 6A jacks shall be a standard 8-position, RJ-45 style, un-keyed, IEC 60603-7-compliant receptacle.
 - 2. Jacks shall be designed for 4-pair, 100 ohm balanced unshielded twisted pair (UTP) cable.
 - 3. Each jack shall be single unit construction, to snap fit into keystone opening (.676" X .575").
 - 4. Jack housings shall be high impact UL 94 V-0 rated thermoplastic.
 - 5. Jacks shall have a temperature rating of -10 °C (14°F) to 70°C (158 °F).
 - 6. Jacks shall have attached wiring instruction labels to permit either T568A or T568B wiring configurations.
 - 7. Jacks shall have shielding properties to protect from electromagnetic interference and alien cross-talk (ANEXT).
 - 8. Jack housings shall fully encase and protect printed circuit boards and IDC contacts.
 - 9. Modular jack contacts shall accept a minimum of 750 mating cycles without degradation of electrical or mechanical performance.
 - 10. Jack contacts shall accept insertion of a FCC-Standard RJ-11 plug without degradation of electrical or mechanical performance with re-insertion of a FCC-Standard RJ-45 plug.
 - 11. Jack contacts shall be formed flat for increased surface contact with mated plugs.
 - 12. Jack receptacle contacts shall comply with Level A reliability requirements for connecting hardware as defined by IEC 60603-7 series of standards.
 - 13. Contact plating shall be a minimum of 45 micro-inches of precious metal plating in the contact area over 50 micro-inch of nickel.
 - 14. Jack termination shall only require a cable stripper and industry standard flush cutters.
 - 15. Jack termination method shall not utilize a 110 impact termination tool or any manufacturer specific tools.
 - 16. Jack termination completion shall be able to be performed by hand.
 - 17. Wire manager should be provided to organize and secure wire prior to termination completion.
 - 18. Jack termination shall lock in place with an audible snap and require a use of a small screwdriver to unlock.
 - 19. Jacks shall have the Category 6A designation, visible from the front when installed.
 - 20. IDC contacts shall be Phosphor Bronze with 100 micro-inch lead free tin plating over nickel.
 - 21. Jacks shall terminate 24-22 AWG solid conductors.
 - 22. Jacks shall terminate insulated conductors with outside diameters up to .050".
 - 23. Jacks shall be compatible with ANSI/TIA/EIA-606-A color code labeling.
 - 24. Jacks shall be available in various colors to meet specific customer applications.
 - 25. Jacks shall have attached wiring instruction labels to permit either T568A or T568B wiring configurations.
 - 26. Category 6A jacks shall be backward compatible with existing Category 3, 5, and 5e category 6 cabling systems for fit, form, and function.
 - 27. Jacks shall be manufactured in a Trade Agreements Act (TAA) Country
- D. Performance Requirements:
 - 1. All transmission performance parameters shall be independently verified by a UL or ETL third party testing organization.

2. Category 6A jacks shall meet or exceed Category 6A transmission requirements for connecting hardware, as specified in ANSI/TIA/EIA-568.2-D, Balanced Twisted-Pair Telecommunications Cabling and Components Standards.
3. The manufacturer shall provide Category 6A component compliance certificates from third party testing organization upon request.
4. Jacks shall be UL LISTED 1863 and CSA certified.
5. Panels shall be tested to 150% IEEE 802.3bt DTE Power specification with no degradation of performance or materials.
6. Category 6A jacks shall meet or exceed the 4-connector channel performance requirements of Category 6a, per the ANSI/TIA/EIA-568.2-D standard.
7. The 4-connector channel test configuration shall utilize Category 6A jack panels, Category 6A jack, and Category 6A patch cords, from the same manufacturer, with qualified Category 6A cable.

Electrical Parameter (1 - 500MHz)	Guaranteed Margins to Category 6A
Insertion Loss	3%
NEXT	4dB
PSNEXT	5dB
ACR	4dB
PSACR	5dB
Return Loss	4dB
ACRF	6dB
PSANEXT	4dB
PSAACRF	4dB

2.6 STAINLESS STEEL FACE PLATES AND UNLOADED MODULES

- A. Manufacturers:
 1. Hubbell Premise Wiring
 2. The Siemon Company
 3. Systimax GigaSpeed Products
 4. Leviton
- B. Basis of Design – Hubbell Premise Wiring IMSS Series Modular Faceplates and Modules.
- C. Design Requirements:
 1. IMSS Series Faceplates:
 - a. Faceplates shall be constructed of Stainless Steel.
 - b. Faceplates shall be 2.75" W x 4.5" H for single gang and 4.5" X 4.5" for double gang.
 - c. Faceplates shall accept modules loaded with Hubbell HXJ-series series jacks and Hubbell Snap-Fit fiber optic, audio, and video connectors for multimedia applications.
 - d. Two #6-32 pan head Phillips/slotted mounting screws shall be included with each single gang faceplate.
 - e. Four #6-32 pan head Phillips/slotted mounting screws shall be included with each double gang faceplate.
 - f. Faceplates shall be compatible with standard NEMA openings and boxes.
 - g. Faceplates shall be compatible with raceway fittings, surface mount boxes, service fittings, service poles, flush mount boxes and drywall rings.
 2. IMSS Series Modules:
 - a. Faceplate Modules shall be constructed of high impact, UL94 V-0 rated thermoplastic.
 - b. Modules shall be compatible with IMSS Series Faceplates, raceway, floor boxes, poke throughs, surface mount boxes, patch panels, furniture plates, and service poles.

- c. Modules shall snap firmly into front of faceplate and position flush to outer plate surface for field installation in any of the specified mounting hardware devices and media configurations.
- d. Single gang IMSS Series Faceplate shall accept (3) 1U modules
- e. Double Gang IMSS Series Faceplate shall accept (6) 1U modules.
- f. 1 Unit Modules shall be available for 1- and 2-Port Keystones, Blanks, and punched blanks to support the following connections per work area requirements.
 - 1) RJ-45 Category 6 jack per ANSI/TIA/EIA-568-C.2
 - 2) RJ-45 Category 6A jack per ANSI/TIA/EIA-568-C.2
 - 3) ST fiber optic connector per EIA/TIA-604-3
 - 4) SC fiber optic connector per EIA/TIA-604-3
 - 5) LC fiber optic connector per EIA/TIA-604-3
 - 6) S-Video Gold Jack
 - 7) RCA Gold Jack (color coded)
 - 8) BNC connector (straight mount)
 - 9) Gold F connector (straight mount)
 - 10) SVGA (female)
 - 11) 3.5 Mini Stereo Jack
 - 12) Gold Speaker Post
 - 13) HDMI connector
 - 14) USB connector
 - 15) Blank filler plate

2.7 CATEGORY 6A PLENUM SURFACE MOUNT BOX 2-PORT

- A. Manufacturers:
 - 1. Hubbell Premise Wiring
 - 2. The Siemon Company
 - 3. Systimax GigaSpeed Products
 - 4. Leviton
- B. Basis of Design – Hubbell Premise Wiring HSB2EIP (Plenum Rated) with HJ6A Series category 6A jacks
- C. Application – Wireless Access Points, IP cameras and other remote IP devices.
- D. Design Requirements:
 - 1. Box material shall be constructed from high impact thermoplastic; UL 94-V0.
 - 2. Box shall be suitable for use in other environmental air space in accordance with Section 300.22 of the National Electric Code.
 - 3. Box shall be tested for UL 2043.
 - 4. Box shall meet the requirements of UL 1863 modules and frames.
 - 5. Box shall be RoHS compliant.
- E. Performance Requirements:
 - 1. Box shall be suitable for air handling spaces.
 - 2. Box shall have a low-profile design.
 - 3. Box shall accept Hubbell HJ and HXJ jacks and audio/video keystone connectors.
 - 4. Box shall have easy cover latches to provide flexibility for simple moves, adds and changes.
 - 5. Box shall have a secure, tamper resistant screw.

2.8 FIELD-TERMINATED PLUG, CATEGORY 6A

- A. Manufacturers:
 - 1. Hubbell Premise Wiring
 - 2. The Siemon Company
 - 3. Systimax GigaSpeed Products
 - 4. Leviton
- B. Basis of Design – Hubbell Premise Wiring SP6A & SP6A90 (Right angled) or Coupler Assembly SCP6Axxxy (18", 3', 5', 7', 10')
- C. Application – Wireless Access Points, IP cameras and other remote IP devices.
- D. Design Requirements:
 - 1. The plug shall meet the following criteria:
 - 2. Meet or exceed all requirements for Category 6A as described in ANSI/TIA-568-C.2.
 - 3. Compliant with ANSI/TIA-1096-A.
 - 4. Accommodate T568A/B wiring schemes.
 - 5. Accommodate 26-22 AWG shielded or unshielded, solid or stranded conductors.
 - 6. Support Power over Ethernet (PoE) up to 100 watts.
 - 7. Connector body constructed of die-cast zinc
 - 8. Suitable for plenum areas.
 - 9. UL listed.

2.9 STAINLESS STEEL WALL-MOUNT PHONE PLATE

- A. Manufacturers:
 - 1. Hubbell Premise Wiring
 - 2. The Siemon Company
 - 3. Systimax GigaSpeed Products
 - 4. Leviton
- B. Basis of Design – Hubbell Premise Wiring SP10GR
- C. Listings:
 - 1. UL and cUL Listed 1863
 - 2. ANSI/TIA/EIA-568-C.2 Category 6 component
 - 3. ISO 11801/60603-7-41 Category 6 component
 - 4. Mechanical: Verified to TIA-568-C.2
 - 5. Mechanical TIA-568-C.2
 - 6. RoHS Compliant
- D. Design Requirements:
 - 1. Nose Contact: Beryllium copper with precious metal plating with nickel under-plating.
 - 2. IDC Contact: Phosphor bronze with 100 micro-inch tin lead 60/40 plating over nickel under plating.
 - 3. Jack Housing: High-impact thermoplastic (UL 94V-0)
 - 4. Stuffer Cap: Lexan® (UL 94 V-0)
- E. Performance Requirements:
 - 1. Electrical:
 - a. Center balanced to Category 6 plug specifications
 - b. Positive PSACR beyond 300 MHz (channel)
 - c. 4+Gbs capacity within the bandwidth of 1-250MHz (channel)
 - d. Qualified to 150% of 802.3bt PoE Current Level

2. General Information:
 - a. Backward compatible to lower installed Categories
 - b. 100% factory tested
3. Mechanical:
 - a. Nose Contact Mating Cycles: 2000
 - b. IDC Contact Termination: 10x
 - c. Keystone Latching Force: 25 lbs.

2.10 CABLE LABELS

- A. Self-adhesive vinyl or vinyl-cloth wraparound tape markers, machine printed with alphanumeric cable designations.

2.11 OUTLET PLATE & PATCH PANEL LABELS

- A. Preprinted, flexible, self-adhesive vinyl with legend over-laminated with a clear weather and commercial resistant coating.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine pathway elements intended for cable. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install all cables in accordance with equipment manufacturer's instructions, and with recognized industry practices, to ensure the installation complies with requirements of the NEC, ANSI/TIA/EIA-568-C.1 Commercial Building Telecommunications Cabling Standard and BICSI'S "Telecommunication Distribution Methods Manual" (current edition).
- B. Install all cables only when the temperature is between 32°F to 122°F.
- C. Wiring Method: Wiring shall be installed in EMT conduit within walls and above inaccessible ceilings. Wiring shall be installed in cable tray where it is present. Wiring installed above accessible ceilings between ceiling mounted devices or conduit stub-ups and the cable tray shall be exposed and supported by J-hooks, spaced a maximum of 5'-0" on center, with minimum 1" flat bearing surface. Provide conduit sleeves, bushings and fireproofing through all wall penetrations. All wiring not in EMT conduit shall be kept a minimum of 6" away from all lighting fixtures, motors, and transformers. Cables cannot be ty-wrapped or stapled to ceiling or structural supports, conduit, or other items.
- D. Test each cable as detailed in specification. Include patch cord in test channel.
- E. Identify all cables with a neatly typed label as detailed in specification.
- F. Provide horizontal and vertical cable management in all racks, on all backboards and any other location cabling is not routed in conduit or cable tray. Size cable management for 50% additional cables.

- G. UTP Cable Length:
 - 1. Maximum installed length of each UTP cable between closet and workstation outlet is to be 90 meters (295'). Ensure lengths are within specification prior to installation. Contact Engineer for procedure in the event of excessive distances prior to installation.
 - 2. Minimum length shall be 15 meters (49'). Provide service loop as required to increase length on short runs.
- H. Install cable without damaging conductors, shield or jacket, do not use unjacketed pairs for jumpers.
- I. Do not bend cable in handling or in installing to smaller radii than minimums recommended by manufacturer.
- J. No splicing is permitted for UTP cables. Cables must be continuous between termination points. Make splices, taps and terminations only at indicated outlets, terminals, cross-connect and patch panels.
- K. Provide at least 10' of cable slack at MDF or IDF closet. This slack may be stored in the cable tray or a cable management device behind the MDF/IDF.
- L. Provide 2' diameter in service loops or use figure-8 or serpentine.
- M. Provide at least 1' of slack at each workstation outlet. This slack may be coiled within device box observing bend radius minimum or within accessible ceiling space using approved J-hook support.
- N. Remove jacket of cable and untwist individual UTP conductors the minimum amounts required to terminate on jacks and patch panels.
- O. Category 6A cable fill in conduit is 40% maximum as follows:
 - 1. 3/4" - 3 UTP Cables
 - 2. 1" - 6 UTP Cables
 - 3. 1-1/4" - 10 UTP Cables
 - 4. 1-1/2" - 13 UTP Cables
 - 5. 2" - 22 UTP Cables
 - 6. 2-1/2" - 31 UTP Cables
 - 7. 3" - 49 UTP Cables
 - 8. 3-1/2" - Not recommended
 - 9. 4" - Not recommended
 - 10. Provide larger conduits than recommended for cable fill if indicated on the Drawings.
- P. Pull cables without exceeding cable manufacturer's recommended pulling tensions.
 - 1. Pull cables simultaneously if more than one is being installed in the same raceway.
 - 2. Use pulling compound or lubricant if necessary. Use compounds that will not damage conductor or insulation.
 - 3. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage media or raceway.
- Q. Secure and support cable at intervals not exceeding 5'-0" and not more than 1'-0" from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
- R. Wiring within IDF/MDF and Enclosures: Provide adequate length of conductors. Train conductors to terminal points with no excess. Use lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.

- S. Separation of Wires: Comply with EIA/TIA-569 rules for separating unshielded copper telecommunications equipment cables from potential EMI sources, including electrical power lines and equipment.
- T. Support raceways, cabinets, and all other equipment in accordance with manufacturer's instructions.

3.3 LABELING

- A. System: Use a unique, 3 syllable alphanumeric designation for each cable, and label cable and jacks, connectors, and terminals to which it connects with the same designation. Use logical and systematic designations for facility's architectural arrangement.
 - 1. First syllable identifies and locates wiring closet or equipment room where cable originates.
 - 2. Second syllable identifies and locates cross-connect or patch-panel field in which cable terminates.
 - 3. Third syllable designates type of media (copper or fiber) and position occupied by cable pairs or fibers in the field.
 - 4. Example: A2-2-C46
- B. Workstation: Label cables within outlet boxes.
- C. Within Connector Fields, in IDF/MDF Rooms and Consolidation Points: Label each connector and each discrete unit of cable terminating and connecting hardware. Where similar jacks and plugs are used for both communication and data-processing equipment, use a different color for jacks and plugs of each service.
- D. Cables, General: Label each cable within 4" of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
- E. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 100 feet.
- F. Cable Schedule: Post in prominent location in each wiring closet and equipment room. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Provide electronic copy of final comprehensive schedules for project, in software and format selected by Owner.

3.4 GROUNDING

- A. Comply with Section 260526 and applicable details on plans.
- B. Provide connections to the main ground bus on all backboards, telephone line protectors, IDF Racks and MDF Racks in the project. Connect to ground buses with cables per Specification Section 260526 and applicable details on plans.

3.5 FINAL TESTING AND INSPECTION

- A. Provide testing in accordance with ANSI/TIA/EIA-568-C.1.
- B. Cable Test: Provide prior to substantial completion, a Performance Evaluation Report, which will contain the following:
 - 1. Cable Test: List by cable number each UTP Cable in the project, which details:
 - a. UTP Cables:
 - 1) Cable ID Number

- 2) List continuity, reversal, open, shorts and miswires
 - 3) Category performance
 - 4) List other discrepancies with the UTP installation (bad terminations, faulty labeling, etc).
 - 5) Tester printout for each cable.
2. UTP Cable Testing: Test each cable pair of each cable after installation for Specified Category performance. Conduct test with a tester designed for testing above cable (with RJ-45 jacks installed) from each data outlet to associated patch cord through +0 panel jack (Channel). Provide printout for each test as part of the Performance Evaluation Report. Minimum performance categories for report are to be as follows:
 - a. Wire Map/Continuity
 - b. Length
 - c. Near End Crosstalk (pair to pair) NEXT
 - d. Near End Crosstalk (power sum) PSNEXT
 - e. Equal Level Far-End Crosstalk Loss (pair to pair) ELFEXT
 - f. Equal Level Far-End Crosstalk Loss (power sum) PSELFEXT
 - g. Return Loss
 - h. Attenuation
 - i. Propagation Delay
 - j. Delay Skew
 - k. PSACR (Powersum Attenuation – Crosstalk Ratio)
3. System Performance Report: Provide a narrative detailing the system as a whole, in regard to the quality of installation and any discrepancies affecting performance. This narrative to indicate a summary of the above Cable Test, as well as an accurate summary of specified Category performance as well as capability of the cabling system to perform at specified Category bandwidth.

3.6 WARRANTY

- A. The installation shall be provided with a minimum 25-year warranty for strict compliance with the performance requirements of ANSI/TIA/EIA-568-C.1 to support and conform to ANSI/TIA/EIA-568-C.1 specifications covering any current or future application which supports transmission over a properly constructed horizontal cabling system premises network which meets the channel performance as described in ANSI/TIA/EIA-568-C.2.

END OF SECTION 271501

SECTION 280500 – COMMON WORK REQUIRED FOR ELECTRONIC SAFETY & SECURITY

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Fire Rated Pathways
- B. Hangers and Supports
- C. Conduits and Backboxes

1.2 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code

1.3 SUBMITTALS FOR REVIEW

- A. Submit under provisions of Section 260010.
- B. Shop Drawings: The following items shall be submitted for review and approval:
 - 1. Submittal booklet to include the following:
 - a. Reference to Specification Section
 - b. A list of all equipment to be provided and installed.

1.4 SUBMITTALS FOR CLOSEOUT

- A. Submit under provisions of Section 260010.
- B. As-Built Drawings: Provide a marked-up copy of original plans which reflect any changes or additions not shown on the plan.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Provide products listed and classified by Underwriters Laboratories, Inc., or a testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to project site in manufacturer's original, unopened cartons and containers, each bearing names of product and manufacturer.

- B. Store products in dry spaces protected from the weather. The storage temperature shall be 68°F to 122°F.

1.8 PLENUM WIRING

- A. This is an air "Plenum" project. Cabling installed in plenums or in areas above hung ceilings, used as a plenum, shall be plenum rated or installed in conduit.

1.9 WARRANTY

- A. Provide the warranty specified in Section 260010.

1.10 OWNER FURNISHED EQUIPMENT FOR INSTALLATION

- A. Interior Cameras
- B. Exterior Cameras

PART 2 - PRODUCTS

2.1 FIRE RATED PATHWAYS

- A. Manufacturers:
 - 1. Specified Technologies Inc.
 - a. EZ-PATH Fire Rated Pathway (single, double, and triple)
- B. Pathways:
 - 1. Cables passing through fire-rated floors or walls shall pass through fire-rated wiring devices which contain an intumescent insert material that adjusts automatically to cable additions or subtractions.
 - 2. The device shall have an F rating equal to the rating of the barrier in which the device is installed.
 - 3. Wiring devices shall be capable of allowing a 0 to 100% visual fill of cables.
 - 4. Wire devices shall be of a sufficient size to accommodate the quantity and size of electrical wires and data cables required.
 - 5. Wire devices to be provided with steel wall plates allowing for single or multiple devices to be ganged together.

2.2 FIRESTOPPING

- A. The Contractor shall be responsible for providing permanent, UL approved firestopping systems for all penetrations through fire rated floor or fire rated wall assemblies. For areas that will require future access for the installation of additional cables, repair, or retrofit, the firestopping system shall consist of re-usable intumescent pillows or putty.
- B. Subject to compliance with project requirements, firestopping materials may be provided by one of the following manufacturers:
 - 1. Specified Technologies Inc., (STI) Somerville, NJ (800) 992-1180
 - 2. Tremco, Beechwood, OH (800) 321-7906
 - 3. 3M, St. Paul, MN (800) 328-1687
 - 4. Hilti, Tulsa, OK (800) 879-8000

- C. Submit the following for review and approval:
 - 1. Product data sheets
 - 2. UL System drawings for each firestopping application
 - 3. Manufacturer's Certificates of Conformance for their products

2.3 HANGERS AND SUPPORTS

- A. Non-continuous cable supports (J-hooks):
 - 1. Non-continuous cable supports shall provide a bearing surface of sufficient width to comply with required bend radii of high-performance cables.
 - 2. Non-continuous cable supports shall have flared edges to prevent damage while installing cables.
 - 3. Non-continuous cable supports 1-15/16" and larger shall have a cable retainer strap to provide containment of cables within the hanger.
 - 4. Non-continuous cable supports shall have an electro-galvanized finish and be rated for indoor use in non-corrosive environments.
 - 5. Non-continuous cable supports shall be UL listed, with manufacturer's name and part number stamped on.
- B. Wire Rod Type Cable Tray: Refer to Section 260536 for wire rod type cable tray.

2.4 CONDUITS AND BACKBOXES

- A. Refer to Section 260533 for raceways and boxes.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS

- A. Verify locations and mounting heights with the electronic safety & security equipment.
- B. Install Owner furnished equipment.

3.2 FIRESTOPPING

- A. Penetrations in fire rated partitions shall be sealed to maintain the fire integrity of the assembly. Provide fire stopping meeting the same rating as the assembly being sealed.
- B. All firestopping shall meet the requirements of ASTM E-814 and UL 1479.
- C. Comply with all installation requirements of Division 7.

3.3 HANGERS AND SUPPORTS INSTALLATION

- A. Provide supports as required to support all cabling.
- B. Provide cable tray as required to support all cabling.
- C. Comply with all installation requirements of Sections 260529 and 260536.

3.4 CONDUITS AND BACKBOXES INSTALLATION

- A. Provide raceways and boxes as required for cabling.
- B. Comply with all installation requirements of Section 260533.
- C. The minimum conduit size for conduit pathways and stub-outs shall be 3/4 inch.

3.5 SLEEVE INSTALLATION FOR PENETRATIONS

- A. Penetrations occur when pathways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2" above finished floor level.
- G. Size pipe sleeves to provide 1/4" annular clear space between sleeve and pathway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 7 Section "Joint Sealants".
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pathway and cable penetrations. Install sleeves and seal pathway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping".
- K. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1" annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1" annular clear space between pathway or cable and sleeve for installing mechanical sleeve seals.

3.6 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.7 SYSTEM WIRING METHODS

- A. Provide pathways as required in accordance with the following paragraphs. Where wiring is required by other specification sections, provide communications wiring in accordance with the following paragraphs.
 - 1. Wire Routing: Route all device wiring from each device up into accessible ceiling cavity within metallic conduit in recessed or unfinished areas and within surface raceway for renovated non-fishable areas. Stub all conduits into accessible ceiling cavity and provide bushing for each.
 - 2. Cable Routing: Route cable for all device wiring within accessible ceiling cavities. Install cable supports at 4' spacing maximum or in cable tray where applicable. No cabling is to lie on or attach to ceiling tile, ducts, pipes, conduits or ceiling suspension wires, rods, or structural members. Provide conduit stubs from devices and panels to the ceiling cavities. Use cable tray for support when it is shown on the drawings.
 - 3. Route all system wiring from system equipment within metallic conduit up into nearby ceiling cavity and connect to the wiring system indicated in 1 and 2 above. Provide bushings at conduit ends.
 - 4. Provide raceways for cabling in all open structure ceiling spaces.
 - 5. Refer to individual sections for methods specific to that system.

3.8 CEILING TILE REMOVAL

- A. The Contractor shall remove and replace ceiling tile and grid work as required for the installation of communications cabling. Damaged tile and grid shall be replaced by the Contractor and shall match the existing ceiling system.

END OF SECTION 280500

SECTION 282300 – VIDEO SURVEILLANCE SYSTEM CABLING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide cabling and install cameras for future cameras installed by the Owner.

PART 2 - PRODUCTS

2.1 CABLES

- A. Provide UTP cables as specified in Division 27 from Camera to network racks in IDF/MDF Rooms.
- B. UTP cables for cameras shall be a different color than the UTP data cables.

2.2 PATCH PANELS

- A. Provide UTP rack mounted patch panels as specified in Division 27. Camera patch panels shall be installed in the network racks in IDF/MDF Rooms.
- B. Provide patch cables as specified in Division 27. Provide lengths as needed.

2.3 POLE MOUNTED EQUIPMENT ENCLOSURE

- A. 18x16x10 polycarbonate weatherproof NEMA 3R enclosure, 120VAC mounting plate mechanical thermostat heat and 85°F turn on fan in dark gray.
- B. Provide L-Com Model NBPC181610-1HF-1 where indicated on Drawings.
 - 1. EC to adjust enclosure size as required so all equipment can mount inside.
- C. Provide pole mounting bracket as required for mounting on the site lighting pole.

2.4 EXTERIOR CAMERA ELECTRONICS

- A. Robust industrial, full gigabit ethernet switch.
 - 1. Provide one Cisco model IE-3200-8P2S-E in each enclosure.
- B. Din-Rail switch power supply.
 - 1. Provide one Cisco model PWR-IE240W-PCAC-L for each switch.
- C. Provide connectors and patch cables as required.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Category 6A installation shall meet all requirements of Division 27.

- B. Interior Cameras: Provide (1) Category 6A cable to nearest IDF/MDF with connections on each end. Refer to Detail on the Drawings.
- C. Exterior Cameras: Provide (1) Category 6A cable to nearest IDF/MDF with connections on each end. Refer to Detail on the Drawings.
- D. Provide 15' of extra cable at each camera locations for flexibility in installing cameras.
- E. Provide 1" conduit from each camera to nearest accessible corridor.
- F. Install cameras and mounting brackets furnished by the Owner.
- G. Pole Mounted Cameras: Provide (1) Category 6A indoor/outdoor cable from pole mounted equipment enclosure to camera with connectors required on each end.
- H. Equipment Enclosure Power: Provide power wiring in conduit as indicated on the drawings.

END OF SECTION 282300

SECTION 283111 – DIGITAL, ADDRESSABLE FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Fire Alarm Control Equipment
- B. Manual Initiating Devices
- C. Automatic Initiating Devices
- D. Notification Appliances
- E. Fire Alarm Interface Modules

1.2 RELATED WORK/DIVISIONS

- A. Division 1
- B. Division 8
- C. Division 23

1.3 REFERENCES

- A. Pennsylvania Construction Code Act (Title 34)
- B. International Building Code
- C. NFPA 70 - National Electric Code as adopted by IBC
- D. NFPA 72 – National Fire Alarm Code as adopted by IBC
- E. International Fire Code
- F. International Mechanical Code
- G. International Electrical Code
- H. NFPA 101 – Life Safety Code
- I. NFPA 1 – Fire Prevention Code

1.4 SYSTEM DESCRIPTION

- A. Voice Evacuation Addressable Fire Alarm System: Non-coded, addressable microprocessor-based fire alarm system with initiating devices, notification appliances, monitoring and control devices, and connection to an approved Supervising Station. The Notification Appliances on this project shall be Speakers and Speaker Strobes. The use of Horn and Horn Strobes will not be permitted on this project. It is the responsibility of the system integrator to furnish the appropriate

amount of signal extender and amplifier panels needed to support all notification appliances shown on the project drawings.

1.5 SUBMITTALS FOR REVIEW

- A. Submit under provisions of Section 260010.
- B. Shop Drawings: The following items shall be submitted for review and approval:
 - 1. Submittal booklet to include the following:
 - a. A list of all equipment to be provided and installed in the system
 - b. Data sheets of all items to be provided with the specific item or model number highlighted
 - c. Required support documentation indicating the authorized relationship of the system supplier and copies of certifications and listings that are required in the specifications.
 - d. Fire Alarm Cable
 - e. Matrix of operation of the system
 - f. Standby battery calculations
 - 2. Upon approval of the submittal material, provide system drawings, prepared in AutoCAD, to include the following:
 - a. All control equipment with interconnecting wiring
 - b. Field connections of all circuits connecting to the control equipment
 - c. Floor layouts with fire alarm system device locations shown
 - d. Addressable device numbers for each addressable device
 - e. Notification appliances circuited and numbered, with candela setting for visual units and output setting for audible units
 - f. Typical device connections for each type device used in the system
 - g. Basic riser diagram to include control equipment and all field circuits
 - h. Indicate temperature settings of thermal detectors.
- C. Local Code Authority Submission: It shall be the responsibility of the Approved Equipment Supplier to provide the required materials and submittal data, including drawings, to the Local Authority Having Jurisdiction (AHJ) for their review and approval if necessary. Any fees for the submission and approval process shall be the responsibility of the installing contractor.

1.6 SUBMITTALS FOR CLOSEOUT

- A. Submit under provisions of Section 260010.
- B. Record of Completion: The equipment supplier shall complete the Record of Completion as required in NFPA 72. Any deficiencies that are to be listed on the Record of Completion shall be reviewed with the Architect/Engineer on record for the project before the authority having jurisdiction is requested to sign the document. Upon approval, the original copy of the completed Record of Completion, signed by all required parties, shall be submitted through the Contractor to the Architect/Engineer and Building Owner.
- C. Drawings of the completed system reflecting any changes that were made from the original submission of drawings.
- D. Copy of the system program in printed form and on a USB thumb drive.
- E. Operating and Instruction Manuals of the entire system.
- F. Copy of the Testing and Maintenance Agreement for the first year of service.

- G. Copy of the Supervising Station Monitoring Agreement.
- H. Copy of the Certificate for Listing or Placarding the system.
- I. System Program: The equipment supplier shall provide a copy of the latest system program in printed form and on a USB thumb drive.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Equipment Supplier: Shall be a local Company or local Branch office that is authorized by contract to provide all the products and equipment to be installed in the fire alarm and detection system. Upon request, a current letter provided within the past 30 days, shall be provided to the Architect/Engineer of the Authorized relationship between the Manufacturer and the Equipment Supplier. In addition, the Equipment Supplier shall have the following minimum certifications and listings:
 - 1. A minimum of one individual who works full time with the local office of the Equipment Supplier supporting this project who is NICET Certified in Fire Alarm Systems at Level IV or higher. A copy of a current Certification Certificate shall be included in the Submittal Data required above.
 - 2. The Equipment Supplier shall be listed by Underwriters Laboratories, Inc. (U.L.) under category UJJS for Protective Signaling Systems or Factory Mutual Research Approved (FM) for Fire Alarm Service – Local Companies under Standard 3011. A copy of a current Listing or Approved Certificate shall be included in the Submittal Data required above.
- C. Installer: Company specializing in installing the products specified in this section with minimum 3 years documented experience. Certified by the state and/or local governments as fire alarm installer when required by law. In lieu of the installers being certified when required by local AHJ, the Equipment Supplier shall be responsible for certifying the installation.

1.8 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70, NFPA 72 and locally enforced codes.
- B. Furnish products listed and classified by UL, FM or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and indicated.
- C. Interconnecting equipment, initiation devices, notification appliance circuit extenders, and annunciating devices shall be UL listed to operate as a unit although manufacturers may differ.

1.9 MAINTENANCE SERVICE

- A. Inspection and Testing Agreement: As required for U.L. Certifying a Remote Supervising Station System, the Equipment Supplier shall furnish a full-service Testing and Maintenance Agreement to support the system during the first year of operation or for one year from Date of first beneficial use of the system. During this period, the Equipment Supplier shall provide the following at no additional cost to the Owner:
 - 1. Required Inspections and Testing
 - 2. Emergency Service during normal working hours
 - 3. Certifying the system for Remote Supervising Station service
 - 4. First Year monitoring service through a U.L. Listed Supervising Station or other Supervising Station approved by the local AHJ or Owner.

5. Repair or replacement of any required parts, provided they have not been abused or misused by abnormal conditions such as vandalism, fire, water damage, lightning damage or other abnormal conditions.
- B. Service Not Covered by Above
 1. Service or labor desired by the Owner outside normal working hours of Monday through Friday from 8:00 AM to 5:00 PM shall be charged at the Equipment Suppliers normal published rates.
 2. Repair or replacement parts required due to abuse or other abnormal use, upon Owner approval shall be charged by the Equipment Supplier at published prices.
- C. Service Agreement Renewal: The Equipment Supplier shall provide to the Owner at the time the system is turned over for first beneficial use, a Service Agreement Renewal proposal to cover the following:
 1. Two (2) additional years for an Inspection, Testing and Maintenance Agreement to meet the current codes in effect.
 2. The proposal shall include the cost for re-certificating (U.L.) or placarding (FM) the system for Remote Supervising Station Service.

1.10 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 1. Automatic Smoke Detector: Furnish 5 of each type and rating installed.
 2. Heat Detector: Furnish 5 of each type and rating installed.
 3. Manual Pull Station: Furnish 2 of each type and rating installed.
 4. Audible Indicating Devices: Furnish 2 of each type installed.
 5. Visual Indicating Devices: Furnish 2 of each type installed.
 6. Audible/Visual Devices: Furnish 5 of each type installed.
 7. Contact Interface Module: Furnish 1 of each type.
 8. Keys: Furnish 6 of each type.
 9. Handheld Detector Programmer: Furnish 1 of each type required.

1.11 WARRANTY

- A. Provide the warranty specified in Section 260010.

PART 2 - PRODUCTS AND OPERATIONS

2.1 MANUFACTURERS

- A. Provide a Fire Alarm and Automatic Detection System that is manufactured by a company that has a complete line of the products required for this project and has been successfully represented in this area for five years or more. Obtain fire alarm and automatic detection system components through one source from a single manufacturer who assumes responsibility for compatibility of system components. Following is a list of manufacturers that are known to meet these criteria. However, the specific equipment specifications and operations of the system to be provided for this project and the qualifications of the Authorized Representative (Equipment Supplier) of the manufacturer must meet or exceed the specifications to be considered for approval.
 1. Siemens Fire Safety – District Standard (NO SUBSTITUTIONS)

2.2 FIRE ALARM CONTROL PANEL

- A. Control Panel: Modular construction with flush or surface wall mounted enclosure as indicated on the Drawings.
- B. Power supply: Shall be an integral part of the control equipment and include primary and secondary power circuits. The secondary supply shall automatically supply power to the system upon loss of primary power. The secondary power shall be sized to meet the Remote Station requirements of 24-hours of system operation under maximum quiescent load, plus 15 minutes of full load operation under an alarm condition. Provide power supplies and batteries with a minimum of 20% spare capacity. These secondary power capacities shall apply to all remote controls, alarm extender panels, supervising station reporting units and other ancillary controls provided with the system. Provide dedicated 24-volt DC power supplies for all magnetic door (smoke door) hold-open devices.
- C. System Supervision: All initiating device circuits, notification appliance circuits, and ancillary circuits shall be supervised as class B circuits. All end-of-line device locations shall be clearly marked on the drawings.
- D. Initiating Device Circuits: Signaling line circuits shall be limited to a maximum of 50 devices without short-circuit protection. Circuits over 50 devices shall require circuit isolation modules to prevent short-circuits from affecting more than 50 devices. Each initiating device circuit shall be loaded to not more than 80% of its maximum number of addresses.
- E. Emergency Communication System shall be complete, electrically supervised evacuation system using one-way communication with microprocessor-based operating system having the following capabilities, features and capacities:
 - 1. Listed for emergency and non-emergency use.
 - 2. Listed for MNS from any control point to 'Request/Grant/Deny' and integrated with the system (no separate MNS panel).
 - 3. Ability to support up to two microphones per control panel for one-way paging, and up to 64 microphones in a voice network.
 - 4. Ability to provide manual voice control.
 - 5. Two channel message player supporting 300 messages (38 pre-recorded). The system supports MP3 and WAV files).
 - 6. Minimum of (1) simultaneous audio channel for each networked panel.
 - 7. Amplifiers shall be rated for 25V or 70.7V RMS, 50 watts. Voice amplification shall be supervised and backed up with like amplifiers. Back up shall be one or two per node.
 - 8. Ability to provide separate booster amplifier. Amplifiers shall be rated for 25V or 70.7V RMS, 100 watts.
 - 9. The system shall have the capability to support Peer-to-Peer or Master-Slave network and voice configurations.
 - 10. Multiple nodes shall provide peer-to-peer voice capability in order to eliminate a single point of failure.
 - 11. Audio shall be synchronized between nodes in order to take into account common areas.
 - 12. Speakers shall have the ability to play coded audio tones.
 - 13. The system shall provide status indicators and control switches for all the following functions:
 - a. Audible and visual notification alarm circuit zone control.
 - b. Speaker circuit zone control.
 - c. Status indicators for sprinkler system water flow and valve supervisory devices.
 - d. Any additional status or control functions as indicated on the drawings, including but not limited to emergency generator functions, fire pump functions, door unlocking, and security with bypass capabilities.
 - 14. The Voice Amplifier shall provide 25/70 V with a minimum of 50W amplifier. Up to four (4) amplifiers shall be capable of being are supported in a 3-to1 backup, or 1-to-1 backup

- schematic on a single intelligent voice-communication system: configured as one (1), two (2) or three (3) main amplifiers, and one (1) or two (2) optional backup amplifiers.
15. The Microphone Module shall be provided for live, non-pre-recorded voice communication on an intelligent voice communication panel. The microphone option module can serve either as a main microphone installed in the main-system enclosure, or as a remote microphone in a remote enclosure. Up to two (2) microphones are supported for each FACP.
 16. The Switch Option Module is a series of front-end, illuminated, and programmable pushbuttons primarily mounted in the middle inner door of each intelligent voice-communication FACP. Each switch- module has 24 group-switches, thus totaling 48 LEDs, and consists of up to 96 multi-color LED-status indicators. Each LED switch-group is assigned specific functionality during the configuration process. Furthermore, a pushbutton [for each affected zone] will illuminate to acknowledge the command has been received at the Voice System CPU Card. Additionally, if no microphone is used, up to eight (8) switch-option modules can be used in a given three-eight-unit (3HU) enclosure.
 17. The Booster Amplifier Option Module is a main board that allows for expansion of speaker zones for additional power to an intelligent voice communication system.
- F. Notification Appliance Circuits: Supervised notification modules, shall be installed as class B circuits with end-of-line device locations clearly marked on the drawings. Load signal circuits and modules to not more than 80% of rated capacity.
- G. Notification Appliance Circuit Supervision: All visual notification appliances throughout the facility shall be synchronized. All audible notification appliances throughout the facility shall be synchronized and operate on the temporal code 3 pattern. Visual and audible notification appliances shall be controlled independently allowing either to be silenced or operated manually at the control unit.
- H. Digital Communicator: The Multi-Point Digital Alarm Communicator shall be UL864 listed to provide point identification of alarm, supervisory, security and trouble events to a Central or Remote Receiving Station. The DACT shall support the following:
1. Ademco Contact ID or SIA protocol
 2. Ademco Contact ID selection shall provide the ability to transmit events for up to 999 individual zones
 3. SIA selection shall provide the ability to transmit events for up to 10,000 individual points
 4. Programming of accounts and phone numbers
 5. Cellular connectivity.
 6. Line fault monitoring.
 7. Automatic 24-hour test
 8. The DACT supports configurable alarm, alarm restoral, trouble, trouble restoral, supervisory, supervisory restoral, and reset events.
 9. The DACT supports Ademco Contact ID alarm event codes for general alarm, smoke detector alarm, waterflow alarm, duct alarm, and manual alarm events.
 10. Optionally, the DACT can be programmed to report events by event queue only.
- I. Commercial Cellular LTE Communicator: Provide Starlink SLETEVI-CFB-PS, Advanced LTE Dual Diversity Antenna for optimized performance or equal as follows:
1. 3 LED Indicators - Green, Signal Strength; Amber- Busy/ Activation; Red-Trouble
 2. Patented Signal Boost™ signal amplification circuit and high-gain performance antennae
 3. Operating Environment: 0 to 49°C (32-120°F), up to 93% humidity (non-condensing)
 4. 12V - 24V Universal FACP Support, auto-current sensing. Support all brands communicating in Contact ID and 4/2
 5. Locking Metal Enclosure with Hinged door & 2 key-slots for wall mounting (LED indicators, inside) • Dimensions: 9-5/8"x 11-3/4" x 3-3/8"D (HxWxD) • Weight: 8 lbs (max., power supply models)

6. Electrical Ratings for 120VAC, 60Hz • For Models with Power Supply: • Input Voltage: 120VAC Nominal • Input Current: 400mA maximum • Maximum Charging Current: 200mA
 7. The Communicators shall each be installed to meet the requirements of NFPA 72, 2013 for Secondary Power as required for Remote Station Supervising Station reporting. The system shall be programmed to report, as required in NFPA 72, 2013 for sole path reporting. The equipment supplier shall provide monitoring by a UL Listed supervising station and include the first-year monitoring fee as part of this contract. This contractor shall wire, connect, and test the operation of the communicators.
 8. Project shall include one years' annual monitoring of the Fire Alarm System. Monitoring shall be provided by a UL listed, approved Central Station. The Central Station shall be approved by the Professional Engineer and authority having jurisdiction and include required daily test reporting.
- J. Supervising Station Signal Transmitter: Provided as part of the system, shall be a Digital Alarm Communications Transmitter (DACT) that is capable of reporting the following signals to a U.L. Listed Supervising Station:
1. Alarm Conditions
 2. Trouble Conditions
 3. Supervisory Conditions
 4. Provide capability to provide additional signals as required by the AHJ.
 5. The DACT shall be installed to meet the requirements of NFPA 72 with 2 telephone line connections, and 24-hour standby power as required for Remote Station Supervising Station reporting. The system shall be programmed to report, as a minimum, every 24 hours to the Supervising Station and shall alternate telephone lines for reporting purposes. Unless otherwise directed by the Building Owner, the equipment supplier shall provide the connections to the supervising station and include the 1st year monitoring fee as part of this contract. The Building Owner shall be responsible making the 2 telephone lines available for connection to the DACT and provide a list of personnel to be contacted by the Supervising Station should the need arise. This contractor shall wire, connect, and test the operation of the DACT.
 6. If the system is certificated as a Central Station system, the battery standby may be reduced to 24 hours of standby power capacity.
 7. Project shall include one years annual monitoring of the Fire Alarm System. Monitoring shall be provided by a UL listed, approved Central Station. The Central Station shall be approved by the Professional Engineer and authority having jurisdiction and include required daily test reporting.
- K. Auxiliary Relays: Provide sufficient SPDT auxiliary relay contacts to provide accessory functions specified. The relay control wiring shall be electrically supervised by the Fire Alarm System to within three feet of the device or equipment to be controlled.
- L. The front panels of all Remote Annunciators shall include Operator controls for ALARM, TROUBLE and SUPERVISORY ACKNOWLEDGE/SILENCE, NOTIFICATION APPLIANCE SILENCING, NOTIFICATION APPLIANCE RESOUND, and SYSTEM RESET. These operations shall be protected in order that only personnel with equipment keys have access to these functions.
- M. Trouble Sequence of Operation: Any "TROUBLE" condition in the system shall cause the following system operations:
1. Indicate an alphanumeric message on the Main Control Unit and all Remote Annunciators of the specific trouble condition.
 2. Cause an audible trouble signal and "trouble" Lamp or LED to operate on the Main Control Unit and all Remote Annunciators. The audible trouble signal may be silenced, but the visual signal shall remain on until the trouble is corrected, and the system is reset.
 3. Cause a "trouble" signal to be transmitted to the Supervising Station.

- N. Alarm Sequence of Operation: Any "ALARM" condition in the system shall cause the following system operations:
1. Indicate an alphanumeric message on the Main Control Unit and all Remote Annunciators of the specific device that caused the "Alarm" condition
 2. Cause an "Alarm" Lamp or LED to operate on the Main Control Unit and all Remote Annunciators. The "Alarm" lamp or LED shall remain on until the device and system is reset.
 3. Cause all notification appliances in the facility to operate unless the specifications and/or drawings indicate zone or floor control of notification appliances.
 4. Cause an "Alarm" signal to be transmitted to the Supervising Station. The signal shall remain operated until the system is reset at the Main Control Unit or Remote Annunciators.
 5. Operate the following control functions if applicable:
 - a. Elevator recall to main floor and alternate floor as required by the AHJ
 - b. Allow all doors held open by door holders to close depending on the zone in alarm.
 - c. If a duct detector is in alarm, cause its respective air handling unit fan to shut down. The duct detector in alarm shall be programmed as a "supervisory" function per NFPA 90A, unless otherwise required to report as an alarm condition by the local AHJ.
 - d. Any security or access-controlled doors or gates shall be released as required by the local AHJ or Building Owner Representatives.
 - e. Output contact to lighting control panel input to enable selected lighting.
- O. Supervisory Sequence of Operation: Any "SUPERVISORY" condition in the system shall cause the following system operations:
1. Indicate an alphanumeric message on the Main Control Unit and all Remote Annunciators of the specific "Supervisory" condition.
 2. Cause an audible "Supervisory" signal and "Supervisory" Lamp or LED to operate on the Main Control Unit and all Remote Annunciators. The audible "Supervisory" signal may be silenced, but the visual signal shall remain on until the "Supervisory" condition is corrected. Upon correcting the "Supervisory" condition, the "Supervisory" signal shall resound and require acknowledgement. The system can then be reset.
 3. Cause a "Supervisory" signal to be transmitted to the Supervising Station upon activation and the back-to-normal condition.
 4. Supervisory conditions shall include, but not limited to, the following conditions as they apply to this project:
 - a. Sprinkler system valve tamper/shutoff and PIV switches
 - b. Sprinkler system fire pump signals (minimum of 3 signals)
 - c. Sprinkler system valve room – low temperature
 - d. Duct detectors, unless directed otherwise by the local AHJ.
 - e. Other conditions as listed in these specifications, shown on the drawings, or as directed by the local AHJ.
- P. Function Switches: Included on Main Control Panel shall be a minimum of 12 manual function switches or pushbuttons that can be programmed to include the items listed below and other functions required in these specifications, shown on the drawings or desired by the Building Owner:
1. System DRILL function
 2. Bypass Supervising Station Alarm Functions ONLY – Trouble and Supervisory conditions shall continue to report to the Supervising Station
 3. Bypass Audible Notification Appliances
 4. Bypass Visual Notification Appliances
 5. Bypass Door Holders
 6. Bypass all Smoke Detectors
 7. through 12 – programmed per the requirements of the specifications, drawings, local AHJ requirements or Building Owner

8. Operation of any of the above function switches shall cause a "trouble" condition on all Remote Annunciators and cause a report to the Supervising Station. The function switch operation shall be accessible through locked cabinet doors or other acceptable protection to limit access to authorized personnel only.
- Q. Control Equipment Display: All Remote Annunciators shall contain a minimum 80-character alphanumeric display for indicating all system alarm, supervisory, trouble and system functions. A minimum of 32 characters shall be capable of being custom programmed for displaying alarm, supervisory and trouble conditions.
- R. System Record Document Box: A System Record Documents Box shall be provided as follows:
1. The SRD shall be UL Listed and constructed of 18-ga cold rolled steel with a powder coat finish.
 2. The cover shall be permanently screed with 1" high lettering "SYSTEM RECORD DOCUMENTS" with white indelible ink.
 3. The access door shall be locked with a 3/4" barrel lock and there will be a 12" stainless steel piano hinge.
 4. The SRD will have a minimum of 8 gigabyte digital flash memory drive with a slide tab that allows user to select USB-C or Micro USB connector for uploading and downloading information.
 5. The enclosure will supply 4 mounting holes. Inside will accommodate standard 8-1/2" x 11" manuals and document records.
 6. A legend sheet will be attached to the door for system required documentation, key contacts, and system information.
 7. The enclosure shall also provide 2 key ring holders with a location to mount standard business cards for key contact personnel.
- S. Transient Voltage Surge Suppression and Breaker Locks/Labels: Provide on all 120 VAC equipment, control panels, power supplies, etc., the following Transient Voltage Surge Suppression (TVSS) protection, Breaker Locks and Circuit Labels:
1. Space Age Electronics, Inc., part number E120V-GT.
 2. The unit shall be ANSI/ UL listed to standard 1449, 4th edition and will be labeled clearly with indelible ink.
 3. Be attached via the 3/4" rigid coupling, or surface mounted via the 2 external mounting holes.
 4. The unit shall have thermal fuses to protect against fire in short circuit conditions and will have 18" long, 14-ga wires (3x) with a green ground wire.
 5. The enclosure will be a non-dielectric material UL94 QMFZ2/8 grade material providing UV protection.
 6. The unit shall provide visual indication (LED) that unit is protecting and functioning.
 7. The location of each branch circuit disconnecting means shall be permanently identified at the control unit.
 8. System circuit disconnecting means shall be permanently identified as to its purpose in accordance with the following: (1) "FIRE ALARM" for fire alarm systems (2) "EMERGENCY COMMUNICATIONS" for emergency communications systems (3) "FIRE ALARM/ECS" for combination fire alarm and emergency communications systems
 9. For fire alarm and/or signaling systems, the circuit disconnecting means shall have a red marking.
 10. The red marking shall not damage the overcurrent protective devices or obscure the manufacturer's markings.
 11. The circuit disconnecting means shall be accessible only to authorized personnel.
 12. Mechanical Protection. The branch circuit(s) and connections shall be protected against physical damage.
 13. Circuit Breaker Lock. Where a circuit breaker is the disconnecting means, a listed breaker locking device shall be installed.

2.3 MANUAL PULL STATIONS

- A. Description: Addressable single-action pull-lever type with integral addressable module, arranged to communicate manual station status (normal, alarm, or trouble) to the FACP. Fabricated of plastic and finished in red with molded raised-letter operating instructions of contrasting color. Station shall show a visual indication of alarm. UL 38 Listed.
- B. Station Reset: Key or wrench operated switch.
- C. Mounting: Semi-flush (where possible) or surface mounted. Provide manufacturer's standard backbox for surface locations that match the manual station.
- D. Weatherproof Pull Stations: Where indicated or required because the environmental conditions (including temperature and humidity) can become outside the listed ratings of a standard pull station, provide the following:
 - 1. Provide manual pull stations that are suitable for the environment in which they are installed.
 - 2. If a non-addressable device is required, locate an addressable interface module in an accessible location within the listed environmental conditions of the module and as close as possible to the device.
- E. Indoor Protective Shield: Factory fabricated clear plastic enclosure, hinged at the top to permit lifting for access to initiate an alarm.
 - 1. Provide where shown on the Drawings.

2.4 SPOT TYPE AUTOMATIC DETECTION

- A. Description: All devices shall be UL listed. Include features and meet requirements as follows:
 - 1. Detectors shall be documented as compatible with the control equipment to which they are connected. Detectors shall be listed for the application indicated (i.e. ceiling, wall, below access floor, etc.)
 - 2. The environmental conditions (including temperature and humidity) of each detector location shall be within the detectors listed ratings. If the detector will be exposed to environmental conditions outside of its listed ratings, provide a device that is suitable for the environment in which it is installed. If a non-addressable device is required, locate an addressable interface module in an accessible location within the listed environmental conditions of the module and as close as possible to the device.
 - 3. Detectors installed in air plenums shall be listed for the air velocities present.
 - 4. Spot type smoke and heat detectors shall fit into a base that is common for both types of detectors.
- B. Indoor Protective Shield: Factory fabricated wire guard to protect the automatic detector from physical damage. UL listed for use with the automatic detector.

2.5 SPOT TYPE SMOKE DETECTORS

- A. Description: Addressable photoelectric-thermal type with the capability to program the detector for specific hazard profiles. The detector shall be intelligent and be able to determine the difference between actual fire conditions and deceptive phenomena such as dust, steam, aerosols, and other non-fire conditions. The detector shall be immune to false alarms, capable of automatically adjusting sensitivity to match the environment, and provide alarm verification.
- B. Communications: The detector shall provide bi-directional communications with the FACP. The control panel shall be capable of analyzing the signal from the detector's analog value for

calibration, sensitivity, and address identification. The detector's sensitivity or application setting for specific hazard profiles shall be individually controlled by the FACP. If the detectors sensitivity becomes beyond an acceptable level for a predetermined duration, a trouble signal shall be initiated.

- C. Coverage Area: 900 square feet.
- D. In addition to the detection capabilities, the spot type smoke detectors shall include the following:
 - 1. Capability of programming the smoke detector for reporting alarms from smoke conditions only, abnormal thermal conditions only, or a combination of both.
 - 2. Capability of programming the smoke detector for alarm verification.
 - 3. Testing the smoke detector in the field before installation on a fixed or portable test unit for proper operation.
 - 4. An LED or multiple LED's that indicate a "normal" condition with one color LED and an "alarm" condition with a red blinking or steady LED.
 - 5. Capability of adding the following auxiliary functions:
 - a. Relay base assembly for controlling local functions. The relay shall be independently programmable from the smoke detector.
 - b. Remote LED operation for the smoke detector alarm condition.
 - c. Audible base assembly that is programmable to operate when the smoke detector is in alarm condition or from any other alarm condition in the system.

2.6 SPOT TYPE THERMAL DETECTORS

- A. General: Thermal detectors shall be provided that are appropriate for the area installed and are addressable and programmable. It shall be the responsibility of the Equipment Supplier to provide the lowest temperature setting and operating characteristics of all spot type thermal detectors to provide the earliest detection of abnormal heat without unwanted alarms. If the incorrect temperature setting is installed, during the first year of operation, the Contractor shall be responsible for replacing the unit with the correct temperature device. In all cases, each spot type thermal detector shall report as individual addressable points on the system.
- B. Addressable Combination Fixed Temperature/Rate-of-Rise Detectors: Addressable self-restoring combination Fixed Temperature and Rate-of-Rise. Fixed temperature element shall be rated for 135°F and 15° per minute rate-of-rise. Capability shall be provided to disable the rate-of-rise feature and allow the detector to perform just fixed temperature detection. Coverage area shall be 2500 square feet.
- C. Non-Addressable Devices:
 - 1. Install non-addressable devices only where the location exceeds the environmental ratings of the addressable devices. For each non-addressable device, provide an addressable interface module in an accessible location within the listed environmental conditions of the module and as close as possible to the device.
 - 2. Fixed Temperature/Rate of Rise Detectors: Fixed temperature element shall be rated for 135 or 200°F and 15° per minute rate-of-rise. Coverage area shall be 2500 square feet.
 - 3. Fixed Temperature Detectors: Fixed temperature element shall be rated for 135 or 200°F. Coverage area shall be 625 square feet.
 - 4. Rate Compensation/Fixed Temperature Detectors: Self restoring and rated either 135 or 200°F. Coverage area shall be 2500 square feet. Detectors shall be totally enclosed and weatherproof for installation in extremely dusty, wet, or humid locations.
 - 5. Other non-addressable thermal detectors may need to be provided for locations requiring higher temperature ratings.

2.7 DUCT MOUNTED SMOKE DETECTORS

- A. Description: Addressable, photoelectric type, with sampling tube of design and dimensions as recommended by the manufacturer for the specific duct size and installation conditions.
- B. Duct smoke detectors shall include the following:
 - 1. Duct mounted smoke detectors shall be provided with the same capabilities and functions as the spot type smoke detectors.
 - 2. Duct detector housing shall consist of a base which is common to the spot type automatic detection devices.
 - 3. The duct detector shall be rated for the air velocities, temperatures, and humidity expected during normal operation of the air handling system.
 - 4. The housing shall contain test ports for measuring airflow and testing.
 - 5. Auxiliary relay(s) shall be provided for the shutdown of the associated air handling unit(s). Locate this relay within 3' of the units control panel or starter.
- C. Remote Indicator: Provide remote indicators as required. All duct smoke detectors installed in concealed spaces shall be provided with a remote indicator consisting of alarm LED installed below the unit in order to facilitate locating the unit for testing and maintenance purposes. Coordinate remote indicator locations with Owner/Engineer before roughing-in.
- D. Weatherproof Enclosures: Where indicated or required provide enclosure complying with NEMA 250 requirements for Type 4X. Where subject to ambient temperatures below the rating of the duct smoke detector, provide insulation, strip heater, power supplies and thermostat.

2.8 MULTI-CRITERIA DETECTOR

- A. Description: Provide an addressable multi-criteria detector with CO sensor that shall support the use of an ambient Carbon Monoxide (CO) warning signal at the panel. This ambient CO level shall be user-configurable in parts per million (PPM) for the set threshold of the warning and event type generated by the warning. This event can be used to trigger system logic.
- B. The CO sensor may be programmed as part of the multi-criteria detector or may be an independent CO detector.
- C. Each CO detector shall be supplied with a local sounder base that is programmed to activate when CO is detected. This base shall be powered and supervised by the Fire Alarm System in accordance with NFPA 72 and shall be UL listed as a component of the Fire Alarm System and Detector. The sounder base shall be 520Hz if supplied in a sleeping room.

2.9 ADDRESSABLE INTERFACE MODULES

- A. Description: Addressable Interface Modules provide a means of interfacing for monitor or control of non-addressable devices to the fire alarm system. Fire alarm addressable module devices shown on the plans are not intended to indicate quantity, only that the fire alarm interface is required. Provide the quantities of module devices and interface wiring as required to meet NFPA 72 and other applicable code requirements.
- B. Addressable Monitor Modules: Provide means to monitor the status of a normally open or closed contact. Some functions that require addressable monitor modules include:
 - 1. Sprinkler System
 - 2. Kitchen Hood Systems Monitoring
 - 3. Ancillary Fire Protection Systems
 - 4. Knox Box

5. Non-Addressable Devices

- C. Addressable Control Module: Provide means to control equipment using a form C relay consisting of one normally open and one normally closed contact. Contact rating shall be as required for control function. Some functions that require addressable control modules include:
1. Smoke Door Holder Control
 2. Air-Handling Unit Control
 3. Smoke Control Functions
 4. Elevator Controls
 5. Security, Access-Controlled Doors and Gates
 6. Ancillary Fire Protection Systems
 7. Sound System Equipment
- D. Addressable interface modules shall include the following:
1. The interface modules shall be individually addressable and custom programmed for the items they monitor or control
 2. The interface module shall mount on a 4" square outlet box and be provided with a faceplate.
 3. Each module shall be provided with a label identifying the address and the control or monitor function.
 4. Modules shall include a status LED identifying normal condition, unit malfunctioning, and change of state.

2.10 NOTIFICATION APPLIANCES

- A. Description: UL listed speaker and visual units for fire alarm notification.
- B. Combination Units: UL listed speaker and visual units as required for application.
- C. Mounting: Wall mounted, or ceiling mounted. Semi-flush (where possible) or surface mounted. Provide manufacturer's standard back box for surface locations that match the notification appliance.
- D. Indoor Protective Shield: Factory fabricated wire guard or clear plastic enclosure to protect the notification appliance from physical damage. UL listed for use with the notification appliance.
- E. Weatherproof Notification Appliances: Where indicated or required because the environmental conditions (including temperature and humidity) can become outside the listed ratings of standard devices, provide weatherproof notification devices suitable for the environmental conditions in which it is installed.
- F. Color: White with red lettering unless directed otherwise by Architect.

2.11 AUDIBLE NOTIFICATION APPLIANCES (SPEAKERS)

- A. UL 1480 listed fire alarm speakers.
- B. Field Selectable Taps: 1/8, 1/4, 1/2, 1, and 2 Watts
- C. Field Selectable Taps for large spaces or spaces with high average ambient sound levels: 1/2, 1, 2, 4 and 8 Watts.
- D. Audible devices shall meet the requirements of voice intelligibility per NFPA 72.

- E. Audible device shall be 520HZ if installed in a sleeping room.

2.12 VISUAL NOTIFICATION APPLIANCES

- A. Xenon strobe lights with clear polycarbonate lens and the word "FIRE" is engraved in minimum 1" high letters. UL 1971 listed.
- B. Field Selectable Candela Settings:
 - 1. Wall: 15/30/75/110
 - 2. Ceiling: 15/30/75/95
- C. Field Selectable Candela Settings for large rooms and spaces:
 - 1. Wall: 135/185
 - 2. Ceiling: 115/177

2.13 KNOX BOX

- A. Provide a flush mounted Knox Box at locations where required by local AHJ, fire marshal, fire chief, etc. and meeting their key requirements. Surface mounted will be acceptable in existing walls. Connect to fire alarm system with a monitor module to provide a supervisory condition.

2.14 REMOTE ANNUNCIATOR

- A. LCD Annunciator:
 - 1. Provide a duplicate annunciator with all functions of the fire alarm control panel including Acknowledge, Silence, and Reset switches. Annunciator shall be capable of monitoring the entire system and full system control.
 - 2. Provide a supervised remote microphone with a push-to-talk microphone and operator interface panel. Remote microphone shall be included in the Remote Annunciator Enclosure.
 - 3. Provide at locations indicated on the drawings.

2.15 FIRE ALARM CABLE

- A. Manufacturers:
 - 1. Belden
 - 2. West Pen
 - 3. General
- B. Non-Power-Limited Circuits: Solid copper conductors with 600-V rated, 75°C, color-coded insulation. Wire type and sizes shall be as recommended by manufacturer.
- C. Power-Limited Circuits: NFPA 70, Types FPL, FPLR, or FPLP. Wire type and sizes shall be as recommended by manufacturer.
- D. All fire alarm cable shall be plenum rated.

2.16 SYSTEM RECORD DOCUMENTS BOX

- A. Space Age Electronics model SSU01690 (System Record Documents Cabinet - Black with your custom screened logo.)

- B. Box shall meet the requirements of NFPA 72 – 7.7.2.1, 7.7.2.4, 7.5.6.7, & 7.2.1.
- C. The SRD System Record Documents Box shall be UL Listed, constructed of 18-ga cold rolled steel and have a powder coat finish.
- D. Dimensions are 12" wide x 13" tall and 2-1/4" deep
- E. The cover shall be permanently screed with 1" high lettering "SYSTEM RECORD DOCUMENTS" with white indelible ink.
- F. The access door shall be locked with a 3/4" barrel lock and there will be a 12" stainless steel piano hinge.
- G. The SRD will have a minimum of 8 gigabyte digital flash memory drive with a slide tab that allows user to select USB-C or Micro USB connector for uploading and downloading information.
- H. The enclosure will supply 4 mounting holes. Inside will accommodate standard 8-1/2" x 11" manuals and document records.
- I. A legend sheet will be attached to the door for system required documentation, key contacts and system information.
- J. The enclosure shall also provide 2 key ring holders with a location to mount standard business cards for key contact personnel.
- K. Provide (1) for the project installed at a location coordinated with the Owner/Architect/Engineer

2.17 FIRE ALARM BREAKER LOCKOUT

- A. Space Age Electronics Model ELOCK-FA (Circuit Lockout Kit).
- B. NFPA 2016 Code Compliance:
 - 1. 10.6.5.2 Circuit Identification and Accessibility
 - 2. 10.6.5.2.1 The location of the branch circuit disconnecting means shall be permanently identified at the control unit
 - 3. 10.6.5.2.2 System circuit disconnecting means shall be permanently identified as to its purpose in accordance with the following:
 - a. (1) "FIRE ALARM" for fire alarm systems
 - b. (2) "EMERGENCY COMMUNICATIONS" for emergency communications systems
 - c. (3) "FIRE ALARM/ECS" for combination fire alarm and emergency communications systems.
 - 4. 10.6.5.2.3 For fire alarm and/or signaling systems, the circuit disconnecting means shall have a red marking.
 - 5. 10.6.5.2.4 The red marking shall not damage the overcurrent protective devices or obscure the manufacturer's markings.
 - 6. 10.6.5.2.5 The circuit disconnecting means shall be accessible only to authorized personnel.
 - 7. 10.6.5.3 Mechanical Protection. The branch circuit(s) and connections shall be protected against physical damage.
 - 8. 10.6.5.4 Circuit Breaker Lock. Where a circuit breaker is the disconnecting means, a listed breaker locking device shall be installed.
- C. Provide (1) for every circuit breaker feeding power to fire alarm panels.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Manufacturer's Installation Requirements: Install products in accordance with manufacturer's instructions and the minimum requirements of the latest edition of the National Electric Code (NEC), NFPA 72 and IBC.
- B. Mounting Heights: All devices shall be mounted at heights indicated below or as otherwise noted on the drawings:
 - 1. Pull stations: 42 to 44" above finished floor to operating handle or lever.
 - 2. Audible and Visual Notification Appliances: 80" to 96" above finished floor.
 - 3. Audible and Visual Notification Appliances-Special Circumstances:
 - a. Multipurpose Room: 96" above finished floor.
 - b. Library: 96" above finished floor but not less than 6" below ceilings and soffits.
- C. Minimum Wire Size: Use 16 AWG minimum size conductors for fire alarm detection and signal circuit conductors.
- D. Color Coded Wires: Provide fire alarm circuit conductors with insulation color coded or use colored tape at each conductor termination and in each junction box. Numbered wires may be substituted for color coded wires. Show numbers or color code on system wiring diagram.
- E. End-of-Line Devices: Mount end-of-line device in box with last device or separate box adjacent to last device in circuit. Indicate the exact location of the end-of-line device on the as-built drawings.
- F. Connections to Auxiliary Devices: Provide conduit and wiring connections to door release devices, door hardware packages, fire suppression system control panels, motorized smoke dampers and security systems.
- G. Trim Rings: Provide trim rings where flush mounted initiating and signaling devices do not completely cover the opening in the wall or ceiling surface.
- H. Telephone Lines: Provide two telephone lines directly to telephone terminal board for direct connections to outside lines for connection of the DACT by the contractor responsible for telecommunications.
- I. New Panel Power: Provide 1P.20A breaker in closest normal panel and connect to main fire alarm panel with 2 #12 + 1 #12 gnd in 3/4" conduit unless otherwise indicated.
- J. Additional panels added by manufacturer: Provide 1P.20A breaker in closest normal panel and connect to additional panel with 2 #10 + 1 #10 gnd in 3/4" conduit unless otherwise indicated.
- K. Provide fire alarm breaker lockout for all circuit breakers feeding fire alarm equipment.
- L. Provide system record document box at location coordinated with Owner/Architect/Engineer.
- M. Interconnection to Lighting Control System: There shall be an interconnection to the Lighting Control System. Provide fire alarm IM relay to initiate dry contact closure on Lighting Control System.
- N. Notification appliances shall meet all applicable codes. Notify the engineer of any problem areas before installation commences. The engineer will review all recommendations for the potential problem areas and advise in writing if additional items or changes are required. Any additional

devices required after this point of the project are to be provided at no additional cost to the project.

- O. Measure ambient sound levels once the building is occupied and adjusts audible device tap setting to meet all applicable codes. Tap settings shall be field adjusted to the lowest tap that meets code. Tap settings shall be indicated on the installation and record drawings.
- P. Locate strobe devices at locations indicated on the drawings. A device is only to be relocated if the device is in conflict with casework, equipment, etc. Do not center strobes on walls unless indicated to do so. Set field selectable strobe settings to meet applicable codes. Settings shall be indicated on the installation and record drawings.
- Q. Install automatic detection so it does not exceed the listed spacing and meets the requirements of NFPA 72. Do not locate automatic detection closer than 3' from HVAC grilles.
- R. Install the elevator smoke detectors, heat detectors, and control circuits per NFPA 72 and all applicable codes.
- S. The EC shall furnish the duct smoke detector bases, sampling tubes, and weatherproof enclosures (where applicable) to the MC for installation in/on the ductwork. The EC shall provide the duct smoke detector on the base, fire alarm control relay for AHU shutdown, remote test station (where applicable), and all wiring to/from Fire Alarm Control Panel, duct smoke detector, remote test station, fire alarm control relay, and AHU Controller (for AHU shutdown).

3.2 WIRING METHODS

- A. Wire Routing: Route all device wiring from each device up into ceiling cavity within metallic conduit in recessed or unfinished areas or within surface raceway for renovated non-fishable areas. Stub all conduits into ceiling cavity and provide protective bushing for each.
- B. Cable Routing: Route cable for all device wiring within accessible ceiling cavities. Install in bridle rings at 4' spacing maximum. No cabling is to lie on or attach to ceiling tile, ducts, pipes, conduits or ceiling suspension wires, rods, or structural members. Provide conduit stubs from devices and panels to the ceiling cavities.
- C. Route all fire alarm wiring from fire alarm panel within metallic conduit up into nearby ceiling cavity and connect to the wiring system indicated in A and B above. Provide bushings at conduit ends.
- D. Provide raceways for cabling in all open structure spaces.

3.3 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 260010.
- B. Acceptance Testing: A 100% Acceptance Test shall be conducted by the Approved Equipment Supplier to meet the requirements of NFPA 72 Chapter 7. The Record of Completion shall indicate the total number of items tested in the system.

3.4 AUTHORIZED EQUIPMENT SUPPLIER'S FIELD SERVICES

- A. Prepare and start systems under provisions of Section 260010.
- B. Include services of certified technician to supervise installation, adjustments, final connections, and system testing as required by local codes.

- C. Program the actual owner-assigned room names/numbers for alarm location indication on displays. System is not considered acceptable with architectural or manufacturer assigned numbers for spaces and devices. In addition, the Equipment Supplier shall reprogram the labels in the system at no charge during the first year of operation as desired by the Building Owner.

3.5 TRAINING

- A. Personnel Training: Provide and pay for the services of a factory-authorized service representative to demonstrate the system and train Owners personnel.
 - 1. Provide training for operating, testing, troubleshooting and general maintenance of the system.
 - 2. Provide a minimum of two, 2-hour sessions with at least 2 weeks advance notice and 2 weeks apart.
 - 3. Provide documentation of sessions to Architect/Engineer with signatures of at least 3 Owners Representatives present at demonstration.

3.6 SEQUENCE OF OPERATIONS

- A. Upon a duct mounted smoke detector alarm condition, the auxiliary relay provided with the smoke detector shall be wired by the electrical contractor to the mechanical equipment's starter and shut down its respective unit. An alarm or trouble signal shall be sent to the fire alarm control panel.
- B. Refer to Section 260180 for interface with elevator.

3.7 TOWNSHIP/FIRE MARSHAL DRAWINGS

- A. The Contractor shall provide CAD Drawings on 11" x 17" sheets showing all device locations with identification numbers attached. These drawings shall show all devices within the building. These drawings shall be turned over to the township representative/fire marshal for their approval.

END OF SECTION 283111

SECTION 31 10 00 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Protection of existing trees indicated to remain.
 - 2. Removal of trees and other vegetation indicated to be removed.
 - 3. Stripping and stockpiling of topsoil.
 - 4. Clearing and grubbing.
 - 5. Removing above and below-grade improvements.
 - 6. Layout of required site improvements.
 - 7. Protection of existing underground and overhead utilities, structures, and improvements to remain.
- B. Related Sections:
 - 1. Division 31, Section 31 20 00 "Earthwork".

1.3 SUBMITTALS

- A. Surveyor Qualifications.

1.4 QUALITY ASSURANCE

- A. Pre-Installation Conference: Conduct a meeting between the Prime/General Contractor, Sub-Contractors, Owner and the Design Professional to review the scope of work in this section, coordination with other work, special project conditions and quality standards. Notify all parties and schedule the meeting a minimum of two (2) weeks prior to the anticipated start of the work specified under this Section.

1.5 PROJECT CONDITIONS

- A. Site Information: Prior to beginning construction investigate existing underground utility locations, research available utility records, and dig test pits to the extent necessary to verify existing utility depths and locations and to verify that storm drainage and utility systems piping, excavation, filling and grading may be installed in compliance with original design and referenced standards. If the original design conflicts with the existing utilities, notify the Design Professional of such conflict immediately.
 - 1. Backfill and restore test pit locations in accordance with applicable Divisions 31 specification sections.
 - 2. Refer to and comply with Project Conditions of Section 31 20 00 Earthwork, and applicable Project Conditions of other sections of Divisions 31, 32 and 33.
- B. Burning is not permitted on site.

- C. Traffic: Conduct site-clearing operations to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close or obstruct streets, walks, or other occupied or used facilities without permission from the Owner and authorities having jurisdiction.
- D. Control dust caused by the work. Dampen surfaces as required. Comply with pollution control regulations of governing authorities.
- E. Protect existing improvements on site and adjacent to the site from damage caused by site work operations. Repair damages at no additional cost to the Owner.
- F. Protection of Existing Improvements: Provide protections necessary to prevent damage to existing improvements indicated to remain in place.
 - 1. Protect improvements on adjoining properties and on Owner's property.
 - 2. Restore damaged improvements to their original condition, as acceptable to property owners.
- G. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated or directed.

1.6 EXISTING UTILITY SERVICES

- A. Existing utilities and equipment: The existence and location of underground and other utilities indicated as existing are not guaranteed. Before beginning site work, investigate and verify the existence and location of public and private underground and overhead utilities and other construction.
 - 1. Prior to construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer and water service piping.
 - 2. Perform test pits at locations indicated and report utility conflicts prior to ordering structures and pipe materials.
- B. Prior to any excavation or filling activities, contact PA One-Call System (811) to notify utility companies to field verify underground utility locations within the contract limit work areas. Provide adequate means of protection of utilities and services designated to remain. Should damage occur, repair at no additional cost to Owner.
- C. Arrange for disconnecting, sealing, or capping all utilities and services designated to be removed before start of site work operations. Perform all work in accordance with the requirements of the applicable utility company or agency involved.
- D. When uncharted or incorrectly charted underground piping or other utilities and services are encountered during the site work operations, notify the Design Professional, the Owner, and the applicable utility company immediately to obtain procedure directions. Cooperate with the applicable utility company in maintaining active services in operation.
- E. Protect and maintain utility poles and services, curb boxes, valves and other services where required to maintain facilities and services in operation during construction work.
- F. Place markers to indicate the location of disconnected services. Identify service lines and capping locations on Project Record Documents.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

2.1 PREPARATION

- A. Examine the areas and conditions under which sitework is performed. Do not proceed with the work until unsatisfactory conditions are corrected.
- B. Consult the records and drawings of adjacent work and of existing services and utilities which may affect site work operations.
- C. Verify layout information shown on the drawings and existing benchmarks before proceeding to lay out the work. Locate and protect existing benchmarks and control points. Preserve permanent reference points during construction.
 - 1. Do not change or relocate benchmarks or control points without prior written approval from the Design Professional. Promptly report lost or destroyed reference points, or requirements to relocate reference points because of necessary changes in grades or locations.
 - 2. Promptly replace lost or destroyed project control points and provide data on new points to the Design Professional. Base replacements on the original survey control points.
- D. Establish and maintain a minimum of two (2) permanent benchmarks of the site, reference to data established by survey control points.
 - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.

2.2 PROTECTION OF EXISTING TREES AND VEGETATION

- A. General: Review all trees within contract limit line that may be saved with the Design Professional. Protect existing trees and other vegetation indicated to remain in place against unnecessary cutting, breaking or skinning of roots, skinning or bruising of bark, smothering of trees by stockpiling materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line.
- B. Equipment Operation and Storage: Do not permit heavy equipment, vehicular traffic, or stockpiles of any construction material (including soil) within the drip line of any tree to be retained. Do not fell trees to be removed into trees being retained. Do not use trees to be retained for cleaning off excavator buckets by slamming against them.
- C. Storage of Toxic Materials: Do not store toxic material closer than 100 feet to the drip line of any trees to be retained. Toxic materials include but are not limited to: paint, cement and concrete waste, acid, gypsum board, nails, wire, chemicals, fuels and lubricants.
- D. Fencing: Instruct all trades present on site to honor protective devices.
- E. Water trees and other vegetation to remain within limits of contract work as required maintaining their health during course of construction operations.

- F. Provide protection for roots over one and one-half inch (1 - ½") in diameter that are cut during construction operations. Coat cut faces with emulsified asphalt or other acceptable coating formulated to use on damaged plant tissues. Temporarily cover exposed roots with wet burlap to prevent roots from drying out; cover with earth as soon as possible.
- G. Replace trees and vegetation indicated to remain that are damaged by construction operations in a manner acceptable to the Design Professional. Employ a licensed arborist to repair damage to trees and shrubs.

2.3 RELOCATION OF EXISTING TREES

- A. Do not dig or re-plant trees between July 1st and August 31st.
- B. Verify proposed locations for trees to be transplanted.
- C. Excavate pits to receive trees prior to removal from existing locations. Provide excavations one and one-half (1 ½) times as wide as standard ball size for size of tree to be transplanted. The minimum ball size shall be eighty (80) inches diameter and minimum of three (3) feet deep.
- D. Carefully remove trees from existing locations by mechanical tree spade or manually ball and burlap for transplanting. Do not crack or break the ball.
- E. Set tree plumb in new planting pit flush with exiting grade. Adjust position of tree by handling the rootball only – do not push or pull trunk of tree. Backfill and water in accordance with Specification Section 32 93 00 Exterior Plants.
- F. If trees are moved in full leaf, spray with anti-desiccant prior to moving and again two (2) weeks after transplanting.
- G. Stake and guy trees in accordance with Section 32 93 00 Exterior Plants.

2.4 SITE CLEARING

- A. Preparation: Mark areas to be cleared and grubbed and items to be saved with stakes, flags, paint, or plastic colored ribbon for approval.
 - 1. Protect benchmarks, utilities, existing trees, shrubs, and other landscape features designed for preservation with temporary fencing or barricades satisfactory to the Design Professional.
- B. General: Remove trees, shrubs, grass, and other vegetation, improvements, or obstructions, as required, to permit installation of new construction. Remove similar items elsewhere on site or premises as specifically indicated. Removal includes digging out and off-site disposal of stumps and roots.
 - 1. Carefully and cleanly cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
- C. Clearing and Grubbing: Clear site of trees, shrubs, and other vegetation, except for those indicated to be left standing.
 - 1. Confine clearing to within the limits of the Owner's property.

2. Fell trees in a manner that will avoid damage to vegetation and other improvements which are to be retained.
 3. Completely remove stumps, roots, and other debris protruding through ground surface to a depth of eighteen inches (18") below finish grade.
 4. Use only hand methods for grubbing inside drip line of trees indicated to remain.
 5. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
 - a. Place fill material in horizontal layers not exceeding eight inches (8") loose depth, and thoroughly compact each layer to a density equal to adjacent original ground.
- D. Removal of Improvements: Remove existing above-grade and below-grade improvements as indicated to facilitate new construction.
1. Remove underground pipes where indicated and backfill excavation in accordance with Division 31, Section 31 20 00 Earthwork.
 2. Saw cut clean edges of concrete and asphalt to be removed. Remove paving and subbase to existing clean earth.

2.5 TOPSOIL STRIPPING

- A. Topsoil is defined as the top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is 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 more than 1 inch in diameter; and free of subsoil and weeds, roots, toxic materials, or other non-soil materials. Acceptable topsoil structure content consists of sand (50%-75%), silt (15%-50%), clay (10%-25%).
1. Verify depth of topsoil with core samples.
 2. Do not handle topsoil in a wet or frozen condition. If when squeezed by hand it forms a cohesive mass, as opposed to crumbling and loose, it is too wet.
 3. Strip topsoil to whatever depths encountered in a manner to prevent intermingling with underlying subsoil or other objectionable material.
 - a. Remove heavy growths of grass from areas before stripping.
 - b. Where existing trees are indicated to remain, leave existing topsoil in place within drip lines to prevent damage to root system.
 4. Stockpile topsoil in storage piles in areas indicated on the drawings or as directed by the Design Professional. Construct storage piles to provide complete free drainage of surface water. Cover storage piles to prevent wind erosion and saturation. Seed stockpiles with a temporary seed mix.

2.6 DISPOSAL OF WASTE MATERIALS

- A. Trees, logs, branches, brush, stumps, concrete, asphalt, and other debris resulting from clearing and grubbing operations are the property of the Contractor. Remove, recycle, or dispose of waste materials in a legal manner.
- B. Do not deposit or bury on the project site debris including asphalt or concrete resulting from the clearing and grubbing work.

END OF SECTION 31 10 00

SECTION 31 20 00 - EARTHWORK

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.
- B. Geotechnical Reports: These reports and attachments are provided as Owner's information for bidders' convenience and are intended to supplement rather than serve in lieu of Contractor's own investigations. The reports and attachments are not a warranty of existing conditions nor are they a part of the Contract Documents.
 - 1. *Geotechnical Engineering Report* prepared by Barry Isett & Associates, Inc., dated April 27, 2025.
 - 2. *Stormwater Infiltration Evaluation Report* prepared by Barry Isett & Associates, Inc., dated March 17, 2026.
 - 3. *Stormwater Infiltration Report* prepared by Barry Isett & Associates, Inc., dated November 24, 2020.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Field and Laboratory soil testing.
 - 2. General excavation and grading to bring the project site to the subgrade elevations indicated on the Contract Drawings.
 - 3. Supply and placement of required borrow materials from off-site source(s) or removal of excess or unacceptable excavated materials off the site.
 - 4. Preparing and grading subgrades.
 - 5. Base course for athletic fields, walks and pavements.
 - 6. Subsurface drainage backfill for walls and trenches.
 - 7. Excavating and backfilling for footings, underground utilities and appurtenant structures.
 - 8. Providing satisfactory backfill material, if necessary, by treatment of existing and/or removal of existing and importing of satisfactory materials.
 - 9. Final subgrading, (paralleling contract finish grades) together with placement of topsoil for lawns and planting.
 - 10. Amended soils for rain gardens.
 - 11. Geotextiles.
 - 12. River Stone.
- B. Related Sections:
 - 1. Divisions 22, 23 and 26 "Plumbing, Mechanical and Electrical Work" for backfill requirements relative to underground mechanical and electrical utilities.
 - 2. Division 31 Section 31 10 00 "Site Clearing" for site stripping, grubbing, topsoil removal, and protection, and tree protection.
 - 3. Division 32 Section 32 93 00 "Exterior Plants" for excavation, backfilling and tree installation.
 - 4. Division 32 Section 32 92 00 "Seeded Turf and Grasses" for finish grading, including preparing topsoil for lawns and planting.

5. Division 33 Section 33 11 16 "Site Water Utility Distribution Piping".
6. Division 33 Section 33 31 00 "Sanitary Utility Sewerage Piping and Structures".
7. Division 33 Section 33 41 00 "Storm Utility Drainage piping and Structures for pipe conveyance, drainage structures, trenching, underslab, and wall drainage.

1.3 UNIT PRICES

- A. Unit Prices: In accordance with Unit Price Schedule of the Contract: Total price for rock excavation, including removal of excavated rock from the site and backfill with approved materials.
- B. Refer to Paragraph 3.3 for Rock measurement criteria.

1.4 WORK NOT INCLUDED

- A. Excavation below the subgrade levels indicated on the contract drawings.

1.5 DEFINITIONS

- A. Excavation consists of the removal of soil and rock encountered to subgrade elevations indicated on drawings and the reuse or disposal of materials removed.
- B. Rock: As defined in paragraph 3.3 of this Section.
- C. Subgrade:
 1. The soil prepared and compacted to support a structure or a pavement system.
 2. The elevation of the bottom of a trench in which a sewer or pipeline is laid.
 3. The uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.
- D. Borrow: Soil material obtained off-site when sufficient approved soil material is not available from excavations.
- E. Aggregate Course: A layer of stone aggregate of specified thickness constructed on the subgrade to support a pavement system, providing drainage or to minimize frost action.
- F. Subbase Course: The layer placed between the subgrade and base course in a paving system, or the layer placed between the subgrade and surface course of a pavement or walk.
- G. Base Course: The layer placed between the subbase and surface pavement in a paving system.
- H. Drainage Fill: Course of washed granular material supporting slab-on-grade, or in other areas specified and placed to promote drainage or to cut off upward capillary flow of pore water.
- I. Unauthorized excavation consists of removing materials beyond indicated subgrade elevations or dimensions without direction by the Design Professional. Unauthorized excavation, as well as remedial work directed by the Design Professional, shall be at the Contractor's expense.
- J. Additional Excavation: Additional excavation consists of removal of materials beyond indicated subgrade or natural subgrade elevations or payment lines with specific direction by the Design Professional.

- K. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below ground surface.
- L. Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services within building lines.
- M. Test Pits: Excavation in specified locations to verify the horizontal and/or vertical location of existing utilities to verify that no conflict exists with the design.
- N. Stormwater Control Measure (SCM): For the purposes of these specifications, SCMs are defined as any proposed improvements, including preservation of natural features, that are related to storm water management facilities used for protection, infiltration, filtration, treatment, impoundment, or management of storm water runoff.
- O. Bioretention / Rain Garden Facilities (BR / RG Facilities): A shallow impoundment for storm water runoff designed to allow water treatment by surface infiltration.
- P. Infiltration Bed: A structural SCM created to infiltrate storm water into the subsoils. Infiltration Beds can be used with a number of different SCM's such as subsurface stone beds, Bioretention / Rain Garden facilities, and beneath porous asphalt.
- Q. Amended Soil (AS): A special soil mix placed over the subgrade that is designed for surface infiltration of storm water and associated plantings within a Bioretention / Rain Garden facility.

1.6 SUBMITTALS

- A. Material Certificates certifying that each material item meets specified requirements.
- B. Amended Soils mix design from supplier
 - 1. Submit a minimum of 3 months prior to installation to ensure approval of the design and for adequate order / delivery times.
 - 2. Amended Soils compost / sand / topsoil source verification letter(s)
 - 3. Amended Soils mix permeability test results: per USDA test method 34b, USDA Handbook #60)
 - 4. Mix design components and proportions based on each component's volume to entire volume of mix.
 - 5. Amended Soils Topsoil: source verification letter; test results: Ph, organic matter content, clay content.
 - 6. Amended Soils Compost: source verification letter, seal of approval from US Composting Council; test results: Ph, organic matter content, carbon to nitrogen ratio.
- C. Product data for the following:
 - 1. Geotextiles.
- D. Samples of the following:
 - 1. Twelve (12) by twelve (12) inch sample of geotextiles.
- E. Test Pit Data: Top and bottom elevations and horizontal location of underground utilities, specified to be located by a test pit.

F. Test Results.

1.7 QUALITY ASSURANCE

- A. Codes and Standards: Perform earthwork complying with applicable requirements of governing authorities having jurisdiction.
- B. Imported Topsoil Source: Before delivery of topsoil, furnish the Design Professional with written statement giving location of properties from which topsoil is to be obtained, names and addresses of owners, depth to be stripped, crops grown and herbicide applications during past two (2) years.
- C. Pre-Installation Conference: Conduct a meeting between the Prime/General Contractor, Sub-Contractors, Owner, Geotechnical Engineer and the Design Professional to review the scope of work in this section, coordination with other work, special project conditions and quality standards. Notify all parties and schedule the meeting a minimum of two (2) weeks prior to the anticipated start of the work specified under this Section.
 - 1. Review earthwork procedures and responsibilities including testing and inspection procedures and requirements.
 - 2. Record discussions and agreements and furnish a copy to each participant.
- D. Infiltration Bed subgrade testing: Prepare the subgrade and have the subgrade tested by a qualified geotechnical consultant prior to placement of stone or amended soils. Perform testing at the locations of original infiltration testing completed during the design phase as indicated on the plans. Perform testing in accordance with the methods required by the authority having jurisdiction. If the authority does not prescribe a method, utilize the same method used for testing during the design phase.

1.8 PROJECT CONDITIONS

- A. Site Information: Prior to beginning earthwork operations, investigate existing underground utility locations, research public and site utility records, and excavate test pits in areas indicated to verify existing utility depths and locations and to the extent necessary to verify that proposed improvements may be installed in compliance with original design and referenced standards. If the original design is in conflict with the existing utilities, immediately notify the Design Professional of such conflict.
- B. Review and confirm construction access route to all areas of construction with the owner prior to beginning earthwork operations.
- C. Existing Utilities:
 - 1. Locate existing underground utilities in all areas of work. If utilities are to remain in place, provide adequate means of support and protection during earthwork operations.
 - 2. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.
 - 3. Do not interrupt existing utilities serving facilities occupied and used by Owner or others, during occupied hours, except when permitted in writing by the Design Professional and then only after acceptable temporary utility services have been provided.
 - 4. Provide a minimum forty-eight (48) hours notice to the Design Professional and receive written notice to proceed before interrupting any utility.

- D. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.
- E. Blasting: The use of explosives is prohibited.
- F. Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights.
 - 1. Operate warning lights as recommended by authorities having jurisdiction.
- G. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.
 - 1. Perform excavation within dripline of large trees in accordance with Section 31 10 00.

PART 2 - PRODUCTS

2.1 SOIL & STONE MATERIALS

- A. General: Provide approved satisfactory non-contaminated borrow soil materials from off-site when sufficient approved soil materials are not available from excavations, at no additional cost to the Owner.
 - 1. Satisfactory Off-Site Borrow and Backfill Materials must meet the following criteria:
 - a. ASTM D 2487 Soil Classification Groups GW, GP, GM, SW, SP, and SM;
 - b. Relatively free of debris, waste, frozen materials, vegetation, organics, ash, and cinders.
 - c. Homogeneous.
 - d. Having a plasticity index of less than 10.
 - e. Free of rock or gravel larger than three inches in any dimension.
 - f. Containing less than 30 percent by weight smaller than the No. 200 sieve (fine particles).
 - g. Meeting the definition of clean fill according to PA DEP Management of Fill Policy, 258-2182-773.
 - h. Containing less than 0.5 percent sulfur.
 - i. Must be approved by the project geotechnical engineer prior to importation.
 - 2. Unsatisfactory Off-Site Borrow and Backfill Materials:
 - a. ASTM D 2487 Soil Classification Groups ML, MH, CH, OL, OH and PT.
- B. Satisfactory On-Site Borrow, Backfill and Fill Materials must meet the following criteria:
 - 1. Relatively free of debris, waste, frozen materials, vegetation, organics, ash, and cinders.
 - 2. Homogeneous.
 - 3. Having a plasticity index of less than 10.
 - 4. Free of rock or gravel larger than three inches in any dimension.
 - 5. Containing less than 30 percent by weight smaller than the No. 200 sieve (fine particles).

6. Meeting the definition of clean fill according to PA DEP Management of Fill Policy, 258-2182-773.
 7. Containing less than 0.5 percent sulfur.
- C. Product and source are required to be approved by PennDOT for the following: Specified Subbase Material, Engineered Fill, Bedding Material, Drainage Fill, Filtering Material, Pipe Bedding Material and Other Aggregate Stone Materials.
- D. Subbase Material: Crushed aggregate meeting the requirements of PennDOT 2A Coarse Aggregate, and produced from a Type A source stone, as specified in PennDOT Publication 408.
- E. Engineered Fill: Crushed aggregate meeting the requirements of PennDOT 2A Coarse Aggregate, and produced from a Type A source stone, as specified in PennDOT Publication 408.
- F. Drainage Fill: AASHTO No. 57 Coarse Aggregate meeting the requirements of PennDOT Publication 408 will be acceptable.
- G. Filter Material: Type A Concrete Sand meeting the requirements of PennDOT Publication 408.
- H. Pipe Bedding Material: AASHTO No. 8 Aggregate meeting the requirements of PennDOT Publication 408 and produced from a Type A source stone.
- I. Utility Trench Backfill Beneath Paving or Structures: Crushed aggregate meeting the requirements of PennDOT 2A Coarse Aggregate, and produced from a Type A source stone, as specified in PennDOT Publication 408.
- J. Impervious Fill: Clay and silty clays, fine grained sandy clays capable of compacting to a dense state under optimum moisture conditions to 3 percentage points above optimum moisture conditions, matching soil groups CL or CH, ML or SC of the Unified Soil Classification ASTM D2487.
- K. Topsoil: Uppermost layer of on-site soil which is fertile, friable and naturally loamy with organic matter contents ranging from 4-10%, by weight.
- L. Imported Topsoil:
1. Naturally occurring soil which is fertile, friable, naturally loamy and reasonably free of subsoil, clay lumps, brush, weeds, roots, stumps, stones larger than one inch (1") in any dimension, and other extraneous or toxic matter harmful to plant growth.
 2. The particle gradation of the topsoil shall be within the following range as a percentage of the total mix:
 - Sand (2.0 mm to 0.050 mm) up to 50 – 75%
 - Silt (0.050 mm to 0.005 mm) up to 15- 50%
 - Clay (0.002 mm and smaller) up to 10 – 25%
 3. Organic matter content by weight:
 - 4% minimum
 - 10% maximum
- M. River Stone: 3-5" diameter rounded, river gravels - Pocono Blend River stone or similar.

2.2 CONCRETE FLOW FILL MIX

- A. PennDOT Type A or B.

2.3 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: Class 2; AASHTO M 288.
 2. Survivability: As follows:
 - a. Grab Tensile Strength: 157 lbf; ASTM D4632.
 - b. Sewn Seam Strength: 142 lbf; ASTM D4632.
 - c. Tear Strength: 56 lbf; ASTM D4533.
 - d. Puncture Strength: 56 lbf; ASTM D4833.
 3. Apparent Opening Size: No. 70 sieve, maximum; ASTM D4751.
 4. Permittivity: 0.5 per second, minimum; ASTM D4491.
 5. UV Stability: 50 percent after 500 hours' exposure; ASTM D4355.

2.4 DETECTABLE WARNING TAPE

- A. Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils 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 deep; colored in accordance with authorities having jurisdiction.

2.5 AMENDED SOILS FOR BIORETENTION / RAIN GARDENS

- A. General material performance description: This specification describes permeable sandy soil material for use as the growing and infiltration layers (i.e. topsoil and amended soil) within bio-retention (BR) or rain garden (RG) facilities. The natural or existing in-place surface and subsoil materials are not feasible for use.
- B. Material Components: Uniformly pre-mix at the source / plant. On-site mixing of components is not acceptable. Percentages shown are measured by volume.
1. General material parameters:
 - a. Complete clean fill due diligence for all proposed soil and gravel materials.
 - b. All layers must be free of all unwanted debris and material and meet all requirements of the specification.
 - c. Provide an approximately 6 inch wide by 6-12 inch deep soil transition zone around the perimeter of the BR/RG facility. Mix of equal parts of the prepared ATS material and native topsoil/surface soil material to create this zone.
 - d. Do not apply fertilizer to Amended Soils.
 2. Mix proportions for Amended Soil by volume:
 - a. 50% Sand; ASTM C33; medium to coarse, washed silica concrete sand.
 - b. 25% Amended Soil Topsoil (AST); classified by USDA as Sandy Loam. The topsoil shall contain 7 to 10% max clay content. Native topsoil can be used when testing is performed by the contractor, and reviewed by the Design Professional, to determine the chemical and permeability characteristics, and if the test results indicate appropriate properties.
 - i. Soil fertility testing shall be completed by a certified testing laboratory.

- ii. pH range from 6-7.5
- iii. OM content 4-6% by wt.
- iv. EC <1.0 dS/m (note: dS/m = mS/cm = mmho/cm.)
- v. Phosphorus 15-60 mg/Kg
- vi. C/N ratio <20.
- c. 25% Leaf Compost
 - i. STA seal (US Composting Council seal of testing assurance)
 - ii. OMRI listed (organic materials review institute)
 - iii. Ph: 6-7.5
 - iv. Organic matter content: >40%
 - v. Carbon to nitrogen ratio: <20
 - vi. Soluble salt content: <10 (mmhos/cm)
 - vii. Stability indicator (respirometry): 1-2.5
 - viii. Maturity indicator (bioassay): emergence > 90; seedling vigor > 90
 - ix. Select pathogens / fecal coliform: "PASS"
 - x. Trace metals: "PASS"
 - xi. Material shall not contain animal manure.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prior to commencement of any excavation contact Pennsylvania One Call at 811 at least three days before beginning work. Notify the utility authority having jurisdiction and allow them the opportunity to be present to witness the excavation of test pits.
 - 1. Excavation adjacent to the utility shall be by hand. Soft-dig techniques such as air-spading or vacuum excavation may be permitted where allowed by the associated utility provider with their permission.
 - 2. Document elevations and horizontal locations and forward to the Design Professional.
 - 3. Upon completion, backfill and compact excavation to the satisfaction of the authority having jurisdiction.
- B. Protect subgrades and foundation soils against freezing temperatures. Provide protective insulating materials as necessary.
- C. Topsoil stripping is specified in Section 31 10 00 "Site Clearing and Construction Layout".
- D. Special precautions for construction of stormwater infiltration facilities associated with SCMs:
 - 1. Prior to heavy vehicle access to the jobsite and prior to any excavation, establish and cordon-off the perimeters of all Infiltration Bed areas such as Porous Asphalt areas, and BR / RG Facility areas. Construction traffic, parking and material / equipment storage and any other heavy load activities shall not be permitted in these areas. Depending on site conditions, exceptions may be made if special precautions are taken (for example preservation of natural soil cover for a minimum of 24-inches over the subgrade of the Infiltration Bed). Any such special precautions and construction access must be reviewed and approved prior to access in these areas by the Design Professional and agencies having jurisdiction.

2. Construct temporary or permanent diversion facilities around the perimeter of the Porous Pavement / BR / RG facilities to intercept and divert runoff and sediment both before and during construction.

3.2 DEWATERING

- A. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project Site and surrounding area.
- B. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.
 1. Direct drainage away from building sites.
 2. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrades and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations and building site, and to suppress groundwater levels to at least 2 feet below working subgrades.
 3. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey stormwater and water removed from excavations to catch basins or run-off areas. Do not use trench excavations as temporary drainage ditches.
 4. Pump or otherwise remove any standing water from Infiltration Bed subgrade areas after each storm event.

3.3 EXCAVATION

- A. Excavation is **Classified** and includes excavation to the natural subgrade elevations indicated or required for construction and shall be classified as earth and rock. Rock excavation will be paid for by adjusting the Contract Sum according to unit prices included in the Contract Documents.
 1. Earth: Earth Excavation includes excavation of pavements and other obstructions visible on surface; underground structures, utilities, and other items indicated to be demolished and removed; together with earth and other materials encountered that are not classified as rock or unauthorized excavation. Earth Excavation shall mean necessary removal of all necessary earth type materials including sand, gravel, silt, clay, quicksand, shale, loam, and all other earth type materials as they are encountered.
 2. Rock: Rock Excavation includes removal and disposal of both Bulk and Trench rock materials encountered that cannot be dislodged and excavated with modern, track-mounted, heavy-duty excavating equipment described in Paragraph 3.5.C and 3.5.D without drilling, blasting, ram hammering or ripping.
 3. Typical of materials classified as rock are boulders one (1) cubic yard or more in volume, solid rock, rock in ledges, and rock-hard cementitious aggregate deposits. Boulders smaller than one (1) cubic yard in volume shall be considered as earth excavation. Intermittent ripping performed to increase production and not necessary to permit excavation or material encountered will be classified as earth excavation.
 4. Do not perform rock excavation work until material to be excavated has been cross-sectioned and classified by Design Professional. Such excavation will be paid based on contract conditions relative to changes in work.
 5. Rock payment lines are limited to the following:

- a. Two feet outside of concrete work for which forms are required, except footings.
 - b. One (1) foot outside perimeter of footings and twenty-four (24) inches below bottom (unless shown to rest on rock).
 - c. In pipe trenches, six (6) inches below invert elevation of pipe and two (2) feet wider than inside diameter of pipe, but not less than three (3) feet minimum trench width.
 - d. Under slabs on grade, six inches below bottom of concrete slab.
 - e. Boulders which can be removed with specified equipment but extend beyond limits of responsibility and/or rock payment lines shall be considered within rock payment lines.
 6. When a question arises concerning the classification of material to be excavated, Design Professional shall be notified and their decision shall be final. No extra payment will be allowed unless a formal construction change directive or a change order is prepared and issued by the Design Professional.
 7. Contractor shall keep a running account of all rock excavation completed. A plan shall be kept noting location, quantity, type of excavation and date of removal for all rock excavation, and each quantity shall be initialed by Design Professional or his official field representative directly on this plan signifying agreement to its removal. When all excavation work is completed, this rock excavation report shall be submitted to the Design Professional to serve as a permanent record of rock excavation work completed.
- B. Earth Excavation Types: Earth Excavation includes bulk and trench earth excavation:
1. Bulk Earth Excavation: Bulk earth excavation includes excavation of subsoil required to accommodate building foundations, slabs-on-grade, paving, site structures, final site contours and other construction operations by one of the following methods.
 - a. Hand Excavation: Hand excavation is defined as digging soil by hand shoveling, including loosening with a pick and no more than a total lift of six (6) feet. Unit prices shall include labor, materials and platforms and shoring if required, and disposal.
 - b. Machine Excavation: Machine excavation is defined as excavation requiring power equipment and includes transportation, set-up/unrigging and disposal.
 2. Trench Earth Excavation: Earth excavation for trenches and pits includes removal and disposal of earth material not defined as rock excavation, required to accommodate footings and utilities. Trenches more than 10'-0" wide and pits more than of 30'-0" in either length or width are classified as bulk excavation.
 - a. Hand Excavation: Hand excavation is defined as digging soil by hand shoveling, including loosening with a pick and no more than a total lift of six (6) feet. Unit prices shall include labor, materials and platforms and shoring if required, and disposal.
 - b. Machine Excavation: Machine excavation is defined as excavation requiring power equipment and includes transportation, set-up/unrigging and disposal.
- C. Rock Excavation Types: Rock excavation includes bulk and trench rock excavation.
1. Bulk Rock Excavation: Bulk rock excavation includes removal and disposal of materials and obstructions, except boulders, which are encountered and cannot be removed with heavy-duty excavating equipment without ram hammering or ripping. Excavation equipment equal to Caterpillar Model No. 973 or equivalent track-mounted loader, rated at not less than 54,000 pounds operating weight, 210 HP rated power and developing minimum of 44,000-pound bucket breakout

force (measured in accordance with SAE J732). Excavation which can be accomplished with this equipment or equivalent shall be considered as Earth Excavation. Comply with any of the following methods for removal of rock. Method must be approved by the Design Professional prior to commencing removal:

- a. Ripping: Rock Excavation by Ripping Methods shall mean removal of rock type materials using tractors equipped with rock ripping mechanisms such as No. D-8 and No. D-9 Ripper Tractors by Caterpillar Company. Rock ripping methods shall be attempted for all bulk rock excavation and shallow (4'-0" $\pm$) trench rock excavation, as it is encountered at the site; unless waived by the Design Professional. Existing site rock which cannot be ripped with ripper tractors, and this fact is established after trial ripping, and or the Design Professional agrees that the rock cannot be ripped, shall be excavated by rock excavation methods employing ram hammering.
- b. Hand Method: Rock excavation by hand method shall mean removal of rock type materials by a worker using pneumatic or hydraulic vibrating chippers.
- c. Ram Hammer: Rock excavation by ram hammer method shall mean removal of rock type materials using boom mounted pneumatic, impact hammer equipment.
- d. Boulders: Boulder excavation shall mean removal of free-floating rock by excavation equipment at least equal to Caterpillar Model No. 973 track mounted loader or No. 320 track mounted excavator equipment. Boulders which cannot be removed with the above equipment shall be removed and compensated for by ripping, hand method or ram-hammer. Boulders encountered shall be set aside for measurement, then removed from the site, including those not qualified as rock. Large boulders shall be split into smaller units as required for disposal at no additional cost.

2. Trench Rock Excavation:

- a. Rock excavation for footings trenches and pits includes removal and disposal of materials and obstructions encountered that cannot be excavated with a 1.0 cubic yard (SAE heaped) capacity, Type T, 36 inch side bucket on a track-mounted power excavator, equivalent to Caterpillar Model No. 320, and rated at not less than 128 HP flywheel and 44,000-pound weight with a short stick.
- b. Trenches in excess of 10 feet in width and pits in excess of 30 feet in either length or width are classified as bulk rock excavation.

D. Excavation To Bedrock:

1. Where rock and/or bedrock is encountered at proposed subgrade elevations, over-excavate and replace with satisfactory fill material, regardless of the character of the rock/bedrock to the following depths:
 - a. Utility Trenches: 6 inches.
 - b. Natural Turf Athletic Fields: 24 inches
 - c. Synthetic Turf Athletic Fields: 18 inches
 - d. Lawn Areas: 18 inches
 - e. Building Footings: 12 inches, unless otherwise directed by the Structural Engineer.
 - f. Bioretention / Rain Gardens: 24-inches. Once excavated to subgrade probe using metal rod to determine bedrock depth. If bedrock is less than 24-inches below subgrade, rock must be over-excavated so that it is not less than 24-inches below subgrade elevation.

2. Backfill for Over-excavation:
 - a. For natural and artificial turf athletic fields and lawn areas: Satisfactory fill.
 - b. For building footings: Engineered fill.
 - c. Bioretention / rain gardens: Per geotechnical consultant guidelines depending on site conditions.

3.4 STABILITY OF EXCAVATIONS

- A. Comply with local, state and federal codes, ordinances, and requirements of authorities having jurisdiction to maintain stable excavations.
 1. Slope sides of excavations to comply with local codes and ordinances having jurisdiction. Shore and brace where sloping not feasible because of space restrictions or stability of material excavated, at no additional cost to Owner.
 2. Maintain sides and slopes of excavations in safe condition until completion of backfilling.
- B. Shoring and Bracing: Where shoring or bracing is required, provide materials for shoring and bracing, such as sheet piling, uprights, stringers and cross-braces, in good serviceable condition. Shoring systems must be designed by a Professional engineer registered in the jurisdiction of authority.
 1. Establish requirements for trench shoring and bracing to comply with all codes and authorities having jurisdiction.
 2. Maintain shoring and bracing in excavations, regardless of time period excavations remain open. Carry down shoring and bracing as excavation progresses.
 3. Provide permanent steel sheet piling or pressure-creosoted timber sheet piling wherever subsequent removal of sheet piling might permit lateral movement of soil under adjacent structures.

3.5 SINKHOLES

- A. Should sinkholes, open or mud-filled voids, or other peculiar subsurface conditions be encountered during grading or construction, immediately notify the Owner, Design Professional and Geotechnical Engineer. Take steps necessary to prevent surface runoff from entering the sinkhole until remediation measures have been determined.

3.6 EXCAVATION FOR STRUCTURES

- A. Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, and other construction and for inspection.
- B. Excavations for Footings and Foundations: Minimize disturbance to bottom of excavation. In soil subgrades, remove any material loosened by excavation; thoroughly compact underlying soil, and backfill to the specified subgrade elevation with engineered fill. Trim bottoms to required lines and grades to leave solid base to receive other work. Whether indicated or not, bottom of footings shall be a minimum of 3'-0" below finish grade. Adjust as required including excavation and backfill with Engineered Fill at no additional cost to Owner.
- C. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Structures: Conform to elevations and dimensions indicated within a tolerance of plus or minus 0.10

foot; plus a sufficient distance to permit placing and removal of concrete formwork, installation of services, and other construction and for inspection. Do not disturb bottom of excavations, intended for bearing surface.

3.7 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated cross sections, elevations, and grades. Unless noted otherwise, maintain subgrade with same slope and pitch as indicated for finish surface.

3.8 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated slopes, lines, depths, and invert elevations.
 - 1. Beyond building perimeter, excavate trenches for water lines to allow installation of top of pipe below frost line or to minimum depth indicated elsewhere herein or on the Contract Drawings.
- B. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to twelve inches (12") higher than top of pipe or conduit, unless otherwise indicated.
 - 1. Clearance: A minimum of twelve inches (12") each side of pipe or conduit, or as otherwise indicated.
- C. Trench Bottoms: Excavate and shape trench bottoms as required to place bedding material and 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 large stones and sharp objects to avoid point loading.
 - 1. Remove unstable, soft and unsatisfactory materials at or below the bottom of the trench upon which bedding material is to be laid.
 - 2. Where encountering rock or another unyielding bearing surface, carry trench excavation six inches (6") below outside surface of pipe to receive bedding course.
 - 3. Refer to article, "Utility Trench Backfill" for bedding and backfill requirements.

3.9 EXCAVATION FOR STORMWATER BIORETENTION / RAIN GARDENS AND INFILTRATION BEDS

- A. Protect subgrades from unnecessary compaction. Excavate using equipment which exerts a ground pressure no greater than 8 psi.
- B. Perform excavation as efficiently as possible to limit repetitive passes over the subgrade. Where feasible, excavation shall be performed outside the footprint of the facility.
- C. Subgrade Preparation:
 - 1. Excavate facility to required depth. Subgrade shall be uniform, level uncompacted subgrade free from rocks and debris. Level uncompacted subgrade shall be prepared for infiltration by scarifying or other suitable methods.
 - 2. Probe bottom on 30-foot grid with steel rod to ensure bedrock is at least 24-inches below subgrade level.
 - 3. A minimum thickness of 24 inches for subgrade soil (includes 6 inches of tilled-subgrade soil) is required to provide a minimum 24-inch vertical separation from

- bedrock and/or soil layer that consists of an excessive rock content layer (i.e. >75-80% by volume, unable to hand-probe).
4. If less than 24 inches of soil is identified below the stormwater facility, rock should be over-excavated, observed by a licensed professional, and replaced with satisfactory backfill material (e.g., on-site, native soils approved by the geotechnical engineer) so that at least 24 inches of attenuating soil base is provided across the entire bottom of the facility. The native soils should remain uncompacted. Backfilling shall take place in 12-inch lifts and shall be lightly compacted with a plate compactor until no movement is observed. If sinkholes are encountered, consult Design Professional to review repair options.

- D. Testing: Provide a minimum of two (2) infiltration tests for each prepared Infiltration Bed facility subgrade (eg. Porous Asphalt bed / BR / RG beds / subsurface Infiltration Beds).

3.10 APPROVAL OF SUBGRADE

- A. Notify Design Professional when excavations have reached required subgrade.
- B. Bioretention / Rain Garden / Infiltration Bed: Contact Design Professional and municipal engineer prior to completion of subgrade, to coordinate site visits to inspect and sign off on the subgrade.
- C. Proof-roll prepared subgrade surface to check for unstable areas and areas requiring additional compaction. Perform proof-rolling with a ten-ton minimum roller or loaded tandem-axle dump truck as directed and observed by the Design Professional.
 1. If soft, unstable soils are detected, notify Design Professional to determine how these conditions are to be corrected.
 2. Exceptions:
 - a. Do not proof roll wet or saturated subgrades,
 - b. Do not proof roll subgrades occurring within two to three feet of the water table.
 - c. Do not proof-roll subgrades intended for subsurface stormwater infiltration beds or rain gardens.
- D. Do not backfill trenches until tests and inspections have been made and the Design Professional has been informed in writing of the test results and authorizes proceeding with the backfill. Do not damage or displace pipe systems.
- E. Place and compact specified backfill material upon remaining bedrock that was over-excavated.
- F. When Design Professional determines that unforeseen unsatisfactory soil is present at and below subgrade, over-excavate and replace with compacted backfill or fill material as directed.
 1. Unforeseen additional excavation and replacement material will be paid according to the contract provisions for changes in work. No such payment will be made, however, if the subgrade material became saturated and soft as a result of the contractor's failure to properly protect the excavation or properly divert surface runoff away from excavations.

Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by the Design Professional at the contractor's expense.

- G. No stone aggregate base course or subbase course shall be placed until the subgrade of the entire section or portion of the project under preparation is approved for line, grade and stability.
- H. No topsoil is to be placed until the subgrade of an entire sub-area or portion of project under preparation is brought to an even plane and uniform depth consistent with the proposed finish grade as required by the drawings and reviewed by the Design Professional.

3.11 UNAUTHORIZED EXCAVATION

- A. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Design Professional. Unauthorized excavation, as well as remedial work directed by Design Professional, shall be at contractor's expense.
- B. Fill unauthorized excavation in rock under foundations or wall footings by extending indicated bottom elevation of concrete foundation or footing to excavation bottom, without altering required top elevation. Lean concrete fill may be used to bring subgrades to proper elevation when acceptable to the Design Professional. Fill unauthorized excavations in soil under foundations or wall footings with Engineered Fill.
 - 1. Elsewhere, backfill and compact unauthorized excavations as specified for authorized excavations of the same classification, unless otherwise directed by the Design Professional.
 - 2. Fill unauthorized excavations under other construction as directed by the Design Professional.
- C. Where indicated widths of utility trenches are exceeded, provide stronger pipe, or special installation procedures, as required by the Design Professional.

3.12 ADDITIONAL EXCAVATION:

- A. When excavation has reached required subgrade elevations, notify the Design Professional who will make an observation of conditions and render recommendations:
 - 1. If unsatisfactory or excessively fractured bearing materials are encountered at required subgrade elevations, carry excavations to the level decided by the Design Professional and replace excavated material as authorized by the Design Professional.
 - 2. Removal of unsatisfactory material and its replacement as authorized will be paid on basis of contract conditions relative to changes in work.

3.13 STORAGE OF SOIL MATERIAL

- A. Stockpile excavated materials satisfactory for use as backfill and fill soil materials, including satisfactory borrow materials.
 - 1. Stockpile soil materials without intermixing.
 - 2. Place, grade and shape stockpiles to drain surface water.
 - 3. Provide protection to prevent wind-blown dust, and accumulation of excessive moisture that may preclude use of material as intended for use on the project.
 - 4. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.
 - 5. Dispose of excess soil material and waste materials as specified herein.

B. Storage of Amended Soil Material

1. Prior to construction / use, stockpiled materials shall be protected from impacts/damage related to weather, excessive moisture, OM degradation, development of anaerobic conditions and any other chemical or physical impacts.

3.14 BACKFILL

- A. Prior to placing backfill contractor is to provide Owner's representative or Design Professional with the written anticipated Schedule of Backfill Operations a minimum of forty-eight (48) hours in advance. No backfill shall be placed without the Owner's representative or geo-technical testing agent at the site.
- B. Backfill excavations promptly, but not before completing the following:
1. Acceptance of construction below finish grade including, where applicable, damp-proofing, waterproofing, and perimeter insulation, pipe bedding and joints.
 2. Surveying locations of underground utilities for record documents.
 3. Testing, inspecting, and approval of underground utilities.
 4. Removal of all concrete formwork from excavation.
 5. Removal of trash and debris from excavation.
 6. Removal of temporary shoring and bracing, and sheeting.

3.15 UTILITY TRENCH BACKFILL

- A. Prior to placing backfill, provide Owner's representative or Design Professional with the written anticipated Schedule of Backfill Operations a minimum of forty-eight (48) hours in advance. Do not place bedding or backfill without the Owner's representative or geo-technical testing agent at the site.
- B. Bedding material: for pipes and conduit place bedding material upon prepared specified subgrade.
1. Carefully compact bedding material under pipe haunches to 70 percent relative density (ASTM D-4253 & D4254) and bring bedding to required thickness evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.
- C. Place and compact pipe bedding course on rock and other unyielding bearing surfaces and to fill unauthorized excavations. Shape pipe bedding material to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- D. Haunch Zone: Place and shape bedding material to support haunch zone of pipe circumference as detailed.
- E. Initial Backfill: Place and compact initial backfill to a height of twelve inches (12") over the utility pipe or conduit.
- F. Final Backfill:
1. Under paved areas, backfill above Initial Backfill in 4" layers with stone to subgrade. Compact each lift to 95 percent Modified Proctor.
 2. Under unpaved areas, backfill above Initial Backfill in 4" layers with satisfactory earth. Compacted each lift to 95 percent Modified Proctor.

- G. Backfill trenches with concrete where trench excavations pass within eighteen inches (18") of column or wall footing and which are carried below bottom of such footings, or which pass under wall footings. Place concrete to level of bottom of adjacent footing.
- H. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.
- I. Coordinate backfilling with utilities testing.
- J. Fill voids with approved backfill materials concurrently with the removal of shoring and bracing, and sheeting.
- K. Place backfill and fill materials in layers not more than four inches (4") in loose depth.
- L. Backfill narrow trenches of fifteen inches (15") and less in width that traverse roads, paved areas, running tracks, etc. with concrete flow-fill. Fill trench completely full with flowable fill under the entire pavement cross-section. Outside the limits of the paved area, taper flowable fill at forty-five degrees (45°) between pavement subgrade and the bottom of the trench.

3.16 FILL

- A. Prior to placing fill provide Owner's representative or Design Professional with the written anticipated Schedule of Backfill Operations a minimum of forty-eight (48) hours in advance. No fill shall be placed without the Owner's representative or geotechnical testing agent at the site.
- B. Preparation: Remove vegetation, topsoil, debris, wet and unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placing fills.
 - 1. Plow, strip, or break up sloped surfaces steeper than one (1) vertical to four (4) horizontal so fill material will bond with existing surface.
- C. When existing ground surface has a density less than that specified for pavements or structures, break up ground surface, pulverize, moisture-condition to optimum moisture content, and compact the top twelve (12) inches to required percentage of maximum density.
- D. Proofrolling: Proofroll the natural subgrade under all walls, pavements and concrete slabs, or other bearing surfaces, prior to placing subbase or compacted fill material. Also, proofroll all prior fill surfaces whose stability may be uncertain. Do not proof roll wet or saturated subgrades. Proof roll after clearing and grubbing and prior to fill placement in areas to receive fill, and after excavation to specified subgrade elevation in cut areas.
 - 1. If soft, unstable soils are detected, notify Design Professional to determine how these conditions are to be corrected.
- E. Place satisfactory on-site fill material in layers not more than eight inches (8") in loose depth for material compacted by medium to heavy (4-ton or larger) compaction equipment, and not more than four inches (4") in loose depth for material compacted by hand-operated tampers.
 - 1. Rock larger than three (3) inches in any dimension is prohibited within the top two (2) lifts (loose depth) of the subgrade.
 - 2. Below the top two (2) lifts, rock larger than six (6) inches in any dimension is prohibited.

3. Adjacent to structures, piping or conduit, place Satisfactory On-site Material evenly to required elevations. Take care to prevent wedging action of backfill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping or conduit to approximately same elevation in each lift.
- F. Materials encountered during site operations which are unsatisfactory for reuse or are too wet shall:
1. Be excavated and hauled off site to an approved spoils area,
 2. If satisfactory by USCS classification but too wet, be scarified and dried out until adequate moisture conditions, as defined by the geo-technical representative, is achieved,
 3. Be treated with amendments such as lime or cement products to achieve optimum conditions,
 4. Be replaced with approved satisfactory material.

3.17 ABANDONMENT OF PIPES AND STRUCTURES

- A. Abandoned Pipes:
1. Corrugated metal pipe (CMP) and terra cotta pipe twelve inches (12") and above shall be filled with flowable concrete fill. Pipes shall be completely sealed at points of connections and joints to prevent infiltration of water and entry by rodents or insects.
 2. Plastic pipe (PVC, PE) of any size shall be filled with flowable concrete fill.
 3. Concrete, ductile iron, steel or other rigid wall pipe twelve inches and above shall be closed at open ends as follows:
 - a. Provide sufficiently strong closures to withstand hydrostatic or earth pressure that may result after ends of abandoned utilities have been closed.
 - b. Close open ends of concrete or masonry utilities indicated to remain in place with not less than eight inch (8") thick brick masonry bulkheads.
 - c. Close open ends of ductile iron and steel piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Wood plugs are not acceptable. Pipes shall be completely sealed at points of connection and joints to prevent infiltration of water and entry by rodents or insects.
- B. Abandoned Structures: Remove structure and close open ends of the remaining piping, or remove top of structure down to not less than three feet (3') below final grade; punch or drill holes in bottom slab or base of side walls to allow drainage through structure, fill structure with AASHTO NO.8 stone to the top of structure remaining, and backfill the excavation with compacted earth fill.

3.18 MOISTURE CONTROL FOR STRUCTURAL FILL AND BACKFILL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill lift before compaction to within two percent (4%) of optimum moisture content as defined by ASTM ASTM 698.
1. Do not place backfill or fill material on surfaces that are muddy, soft, rutted, frozen, or otherwise suspect.
 2. Remove and replace or scarify and air-dry Satisfactory On-site Material that is too wet to compact to specified density.
 - a. Stockpile or spread and air dry removed wet satisfactory soil material.

3.19 MOISTURE CONTROL FOR AMENDED SOILS

- A. Handle amended soil materials only in a dry to slightly moist condition.

3.20 COMPACTION

- A. Place backfill and fill materials in lifts not more than eight inches (8") in loose depth for material compacted by heavy (10 ton or larger) compaction equipment, and not more than four inches (4") in loose depth for material compacted by hand-operated tampers.
- B. Before compaction, moisten or aerate each lift as necessary to provide moisture content indicated under Moisture Control.
- C. Control soil compaction during construction providing the minimum number of tests for each area indicated under Field Quality Control. The exposed subgrade should be proof rolled, tested and observed by the testing agency prior to fill placement.
- D. Percentage of Maximum Dry Density Requirements: Compact soil to not less than the following percentages of maximum dry density according to ASTM D698 (Standard Proctor):
 - 1. Subbase and base courses: Compact to not less than ninety-eight percent (98%).
 - 2. Under structures, building slabs, running tracks, steps, and heavy duty pavements: Compact the top twelve inches (12") below subgrade and each lift of backfill or fill material at ninety-eight percent (98%).
 - 3. Under walkways and pedestrian pavements: Compact the top twelve inches (12") below subgrade and each lift of backfill or fill material to at least ninety-eight percent (98%).
 - 4. Under lawn or landscaped areas: Compact the top twelve (12) inches below subgrade and each lift of backfill or fill material to ninety-two percent (92%).
 - 5. Utility trenches: Compact each layer of backfill material to ninety-five percent (95%).

3.21 AMENDED SOILS PLACEMENT

- A. Subgrade: Do not proofroll or compact subgrades of Bioretention areas / rain gardens / infiltration beds in any way.
- B. Amended soils: Do not compact amended soils with standard compaction equipment.
 - 1. Place amended soils in lifts not more than six inches (6") in loose depth.
 - 2. Roll or tamp gently into place using low pressure equipment such as a hand operated sod roller or tamping with excavator bucket pressed on rigid lay-down mats or plywood.
 - 2. When traversing on foot either the AS or TS materials during construction or during planting, or other activities, use lay-down mats placed across the TS/AS.

3.22 GRADING

- A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - 1. Provide a smooth transition between existing adjacent grades and new grades.
 - 2. Cut out soft spots, fill low spots, and trim high spots to conform to 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 elevations, within the following subgrade tolerances:
 - 1. Swales: Plus, or minus 1 inch. At stormwater inlets, grade swales with gradual approach and without abrupt sumps unless specifically indicated.
 - 2. Turf, landscape, or other unpaved Areas: Plus, or minus 1 inch.
 - 3. Patios, plaza and walks: Plus, or minus ½ inch.
 - 4. Driveways, roadways and other pavements: Plus, or minus ½ inch.
- C. Subgrade within Building Lines: Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of one-half inch (½ ") when tested with a ten-foot (10') straightedge.
- D. Subgrade of Athletic Fields: Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within the following tolerances when tested with a ten-foot (10') straightedge:
 - 1. Natural turf fields: Plus, or minus ½ inch.
 - 2. Synthetic turf fields: Plus, or minus ½ inch.
- E. Site Finish Grading: Slope grades to direct water away from buildings and to prevent ponding. Provide final grades within the following tolerances when tested with a ten-foot (10') straightedge:
 - 3. Swales: Plus, or minus 1 inch.
 - 4. Turf and landscape areas: Plus, or minus 1 inch.
- F. Athletic Field Grades: Provide final grades within the following tolerances when tested with a ten-foot (10') straightedge:
 - 5. Athletic fields: Plus, or minus ¼ inch.

3.23 SUBBASE AND BASE COURSES

- A. Under pavement, walks, steps, and ramps, place subbase or base course on approved subgrade. Place base course material over subbases of pavements where applicable.
 - 1. Under walks and pavements, use subbase or base material, or Satisfactory excavated or Borrow soil material or combination of both.
 - 2. Under steps and ramps, use subbase material.
 - 3. Under building slabs, use subbase material, unless specified otherwise.
 - 4. Under footings and foundations, use engineered fill.
 - 5. In excavations, use satisfactory excavated borrow material, except where otherwise specified.
 - 6. Under turf and landscaped areas, use satisfactory excavated or borrow soil material.
 - 7. Shape subbase and base to required crown elevations and cross-slope grades.
 - 8. When thickness of compacted subbase or base course is six inches (6") or less, place materials in a single layer.
 - 9. When thickness of compacted subbase or base course exceeds six inches (6"), place materials in equal layers, with no layer more than six inches (6") thick or less than three inches (3") thick when compacted.
 - 10. Proof-roll prepared subbase surface to check for unstable areas and areas requiring additional compaction.

- B. Pavement Shoulders: Place shoulders along edges of subbase and base course to prevent lateral movement. Construct shoulders at least twelve inches (12") wide of acceptable soil materials and compact simultaneously with each subbase and base layer.

3.24 SYNTHETIC TURF FIELD - STONE BASE COURSES

- A. Upon approved subgrade, place base course material.
 - 1. Proof-roll prepared subgrade surface to check for unstable areas and areas requiring additional compaction.
 - 2. Shape base courses to required grades, lines, and thicknesses.
 - 3. When thickness of compacted base course is six inches (6") or less, place materials in a single layer.
 - 4. When thickness of compacted base course exceeds six inches (6"), place materials in equal layers, with no layer more than six inches (6") thick or less than three inches (3") thick when compacted.
 - 5. Compact stone base to the extent that a stable base is achieved and in compliance with turf installer's requirements. Use extreme care to ensure that compaction does not create additional fines from too many passes of the roller.
- B. Tolerances: Grade base courses so that the finishing stone surface irregularities do not exceed ¼ inches (+/-) in ten feet. Inspect surfaces on a 10-foot grid pattern using a 10-foot straight edge or laser level.
- C. Correction of the Work: When testing agency reports that work does not meet specifications, remediate the work and retest until required results are obtained.

3.25 DRAINAGE FILL

- A. Under slabs-on-grade, place drainage fill course on prepared subgrade for support of building slabs.
 - 1. When the compacted thickness of drainage fill is six inches (6") or less, place materials in a single layer.
 - 2. When compacted thickness of drainage fill exceeds six inches (6") thick, place materials in equal layers, with no layer more than six inches (6") thick or less than three inches (3") thick when compacted. Maintain optimum moisture content for compacting material during placement operations.

3.26 TOPSOILING

- A. General: Stockpile On-site Topsoil for re-use. If quantity of stockpiled topsoil is insufficient, provide additional approved topsoil at no additional cost to the Owner. Obtain topsoil from local sources or from areas having similar soil characteristics to those found at site of work. Obtain topsoil from naturally well-drained sites where topsoil occurs in depth of not less than six inches (6"), do not obtain from bogs or marshes. This Article does not apply to Amended Soils – See Part 3 Amended Soils Placement.
- B. After the areas required to be topsoiled have been brought to subgrade, and immediately prior to placing the topsoil, loosen the subgrade, wherever excessively compacted by traffic or other causes, to a depth of 4" – 5" inches, to permit bonding of the topsoil to the subgrade.
 - 1. Scarify subgrade with a vibrating tine cultivator or similar equipment. Disc or roto-till subsoil to a loose, granular texture. The plane of the subgrade must

- parallel the proposed finish surface grade. Using the teeth of a backhoe, front end loader or other such equipment is unacceptable.
2. Prior to and following scarification, remove all stones, stumps, roots, brush, wire, grade stakes, or other objects larger than one inch (1") in thickness or diameter and legally dispose.
- C. Spread topsoil uniformly on all areas not covered by paving or other construction and evenly spread to the following depths:
 1. Turf and Landscape Areas: 6" minimum topsoil depth after settlement
 - D. Should excess topsoil remain after meeting the minimum thickness requirement, notify the Design Professional for recommendations. Spread topsoil in such a manner that seeding can proceed with little additional soil preparation or tillage.
 - E. Correct irregularities in the surface resulting from topsoiling or other operation in order to prevent the formation or depressions where water will stand. Do not place when subgrade is excessively wet, extremely dry, or in a condition otherwise detrimental to proper grading.
 - F. Remove all stones, stumps, roots, weeds, brush, wire, grade stakes, or other objects larger than one inch (1") in thickness or diameter.
 - G. Minimize excessive traffic over topsoil. Repair areas of topsoil rutted or compacted from traffic or erosion.

3.27 RIVER STONE BEDS

- A. Place river stone on geotextile fabric, where indicated, to a minimum depth of 6-inches.
- B. Lap seams of geotextile fabric a minimum of 12 inches.

3.28 FIELD QUALITY CONTROL

- A. Testing Agency Services: Owner shall engage a qualified Testing Agency to perform testing and inspections. Testing agency shall inspect and test each subgrade and each fill or backfill lift. Do not proceed until test results for previously completed work verify compliance with requirements. A plan showing the location of tests shall accompany the test results.
- B. Testing Agency shall provide weekly test reports to the Contractor, Design Professional and Owner. Any failing test shall be accompanied by new tests showing reworking of non-conforming work. Testing Agency shall test as follows:
 1. Perform field-in-place density tests according to ASTM D 1556 (sand cone method), ASTM D 2937 (drive cylinder method) or nuclear methods according to ASTM D-6938. For whichever method selected, testing of the full lift thickness shall be performed.
 2. Footing Subgrade: Perform Bearing Capacity test at all columns, corners and at 20 foot (20') maximum intervals for wall footings; test 3 feet (3') in depth from plan bottom of foundations or to refusal of testing equipment approved by the Geotechnical Engineer.
 3. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill lift, perform at least one (1) field in-place density test for every two thousand five hundred square feet (2500 SF) or less of paved area or building slab, but in no case fewer than three (3) tests, or greater frequency as directed.

4. Foundation Wall Backfill: In each compacted backfill lift, perform at least one (1) field in-place density test for each thirty feet (30') or less of wall length, but no fewer than two (2) tests along a wall face.
 5. Trench Backfill: In each compacted backfill lift, perform at least one (1) field in-place density test for each thirty feet (30') or less of trench, but no fewer than two (2) tests.
 6. Lawn Areas and Athletic Fields: In each compacted backfill lift, perform at least one (1) field in-place density test for each two thousand five hundred square feet (2500 SF), but no fewer than two (2) tests.
- C. When testing agency reports that subgrades, fills, or backfills are below specified density, scarify and moisten or aerate, or remove and replace soil to the required depth, re-compact and retest until required density is obtained. Provide additional compaction and testing at no additional cost to the Owner.

3.29 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from flooding, accumulation of water, freezing, erosion and traffic. Keep free of trash and debris.
- B. Repair and re-establish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or lose compaction due to subsequent construction operations or weather conditions.
1. Scarify or remove and replace material to depth directed by the Design Professional; reshape and re-compact at optimum moisture content to the required density prior to further construction.
- C. Settlement: Where settlement is measurable or observable at excavated areas during the Project correction Period, remove finished surfacing, backfill with additional approved material, compact, and reconstruct surfacing prior to further construction.
1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible as approved by and to the satisfaction of the Design Professional.

3.30 DISPOSAL OF SURPLUS SOIL AND WASTE MATERIALS

- A. Waste Material:
1. Remove unsatisfactory soil, trash, and debris, and legally dispose off the Owner's property.
- B. Surplus Satisfactory Soil and Topsoil:
1. Remove satisfactory soil and legally dispose of it off the owner's property.

END OF SECTION 31 20 00

SECTION 32 12 16 - ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Asphalt paving.
 - 2. Bumper blocks.
 - 3. Pavement reinforcement membrane.
- B. Related Sections:
 - 1. Division 31, Section 31 20 00 "Earthwork" for subgrade preparation.
 - 2. Division 32, Section 32 17 23 "Pavement Markings" for parking stall lines and pavement graphics on asphalt.

1.3 LIQUID ASPHALT ADJUSTMENT CLAUSE

- A. An escalation provision shall be added to the contract to adjust the cost of asphalt cement either up or down from a baseline index price based upon the quantity of asphalt cement required for the project. Bidders shall use the September 2026 Asphalt Cement Index Price for PennDOT Zone 1, District 8 as determined by the Pennsylvania Department of Transportation.
- B. Bidders must include on the Bid Form where noted, the quantity of asphalt cement included in their Bid.
- C. The cost of the work shall be adjusted by Change Order based upon the difference in asphalt index prices between the initial bid index price and the index price at the time of asphalt placement.

1.4 DEFINITIONS

- A. Superpave: Superior Performance Asphalt Pavement system.
- B. Superpave Nominal Maximum Aggregate Size (NMAS): One aggregate sieve size larger than the first sieve to retain more than 10% of the aggregate mix.
- C. Superpave Mixture Designation: This designation represents the aggregate gradation NMAS in which the particles fit together in the densest arrangement.
- D. Superpave Performance Grade Binder (PG): The asphalt cement used to bind together the aggregate in the asphalt mix; not to be confused with a pavement Binder Course. The PG numerical designations represent the anticipated climate where the material will be used. More specifically this range is the required average performance temperature range (Celsius) of the asphalt pavement (not air). These reflect the expected maximum and minimum pavement temperature over a 7-day period and also represent the temperatures at which the tests on the material are run.

- E. Reclaimed Asphalt Pavement (RAP): Existing pavement material that is removed and reprocessed to produce new aggregate for asphalt mix.

1.5 SUBMITTALS

- 1. Contractor Qualifications.
- 2. Manufacturer Qualifications.
- 3. Testing Agency Qualifications.
- 4. Material Certificates signed by material producer and Contractor, certifying that each material item meets specified requirements.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who has completed hot-mix asphalt paving similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance of not less than five (5) years.
 - 1. Qualifications shall include evidence and experience of skilled craftsmen or individuals who specialize in the handling, placement, assembling and finishing the materials and products required for asphalt paving installation.
- B. Manufacturer Qualifications: Engage a firm experienced in manufacturing hot-mix asphalt similar to that indicated for this Project and with a record of successful in-service performance of not less than five (5) years.
 - 1. Firm shall be a registered and approved paving mix manufacturer with authorities having jurisdiction or with the DOT of the state in which Project is located.
- C. Pre-Installation Conference: Conduct a meeting between the Prime/General Contractor, Sub-Contractors, Owner, Testing Agency and the Design Professional to review the scope of work in this section, coordination with other work, special project conditions and quality standards. Notify all parties and schedule the meeting a minimum of two (2) weeks prior to the anticipated start of the work specified under this Section.
 - 1. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
 - 2. Review condition of substrate and preparatory work performed by other trades.
 - 3. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.
 - 4. Review and finalize construction schedule for paving and related work. Verify availability of materials, paving Installer's personnel, and equipment required to execute the Work without delays.
 - 5. Review inspection and testing requirements, governing regulations, and proposed installation procedures.
 - 6. Review forecasted weather conditions and procedures for complying with unfavorable conditions.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:

1. Prime Coat: Minimum surface temperature of 60 deg F.
2. Tack Coat: Minimum surface temperature of 60 deg F.
3. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
4. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

1.8 CALENDAR LIMITATIONS

- A. No paving shall take place outside of the following dates without prior approval from the Design Professional:
 1. April 1st through October 31st.
- B. If weather conditions permit, submit a waiver request of calendar limitations no less than one week prior to proposed work.

1.9 TEMPORARY LINE PAINTING

- A. In the event the owner requires the use of a parking area before the asphalt wearing course is scheduled to be installed, temporary parking line painting shall be provided upon the binder surface to accommodate the Owner's request. Access and parking signage for the disabled shall be included with temporary line painting where applicable.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Use locally available materials and gradations that exhibit a satisfactory record of previous installations. Product and source are required to be currently approved by PennDOT. The use of blast furnace slag as outlined in PennDOT Form 408 is prohibited.
- B. Coarse Aggregate: Sound, angular crushed stone, crushed gravel, complying with ASTM D 692-20 and PennDOT Publication 408.
- C. Fine Aggregate: Sharp-edged natural sand or sand prepared from stone, gravel, or combinations thereof, complying with ASTM D 1073- and PennDOT Publication 408.
- D. Mineral Filler: Rock or slag dust, hydraulic cement, or other inert material complying with ASTM D 242-19 and PennDOT Publication 408.
- E. Asphalt Cement: ASTM D 3381-09 for viscosity-graded material: ASTM D 946 for penetration-graded material and PennDOT Publication 408.
- F. Tack Coat: Emulsified Asphalt; ASTM D 977 and PennDOT Publication 408.
- G. Asphalt Sealer (Hot-applied) for joint and crack repair: Asphalt Rubber Sealing Compound and Rubberized Joint Sealing Material per PennDOT Pub 408, Section 705.4.c & g.
- H. Asphalt Mix for Crack Repair: 4.75 mm wearing course per PennDOT Section 409.
- I. Precast Concrete Bumper Blocks: 3,500 psi concrete minimum. Provide chamfered corners and drainage slots on underside. Provide steel dowels or rebar pins to secure each block.

2.2 ASPHALT-AGGREGATE MIXTURE

- A. Provide plant-mixed, hot-laid asphalt-aggregate mixture complying with ASTM D 3515 and as indicated on the contract drawings.
- B. The asphalt mix shall be in accordance with PennDOT Publication 408. Mixes shall not contain more than 15% Reclaimed Asphalt Pavement (RAP).
 - 1. Superpave Asphalt Mixture.
- C. The asphalt mix design and material certificates shall be submitted for approval prior to mixing and delivery to the job site.

2.3 PAVEMENT REINFORCEMENT MEMBRANE

- A. Woven or non-woven geotextile specifically manufactured for reinforcing cracked asphalt pavement.
 - 1. Petromat by Propex, Inc.
 - 2. Mirafi MPV by Ten Cate Geosynthetics
 - 3. Paveprep by Crafcro, Inc.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

- A. General: Fine grade and remove loose material from compacted base surface immediately before applying herbicide treatment.
- B. Proof-roll prepared base surface to check for unstable areas and areas requiring additional compaction. Perform proof-rolling with a ten-ton minimum roller or loaded tandem-axle dump truck, as directed and observed by the Design Professional. Do not proofroll subgrades occurring within two to three feet of the water table.
- C. Notify Design Professional of unsatisfactory conditions. Do not begin paving work until deficient subbase areas have been corrected and are ready to receive paving.
- D. The contact area between existing and new pavements shall be saw cut full depth of wearing course and binder course so as to be smooth and straight prior to commencement of paving. The contact area of the surface layer shall be a minimum of eighteen (18) inches wider than the base or as indicated in the construction details. The horizontal distance between concrete curbing shall be sufficient to allow room for compaction equipment to be used on all layers.
- E. Tack Coat: Apply to newly constructed base courses, existing oxidized asphalt and milled asphalt.
 - 1. Distribute Rates:
 - a. New Hot-mix asphalt base : 0.03 to 0.05 gallons per square yard
 - b. Existing oxidized asphalt: 0.04 to 0.07 gallons per square yard
 - c. Existing milled asphalt: 0.05 to 0.08 gallons per square yard
- F. Asphalt Sealer: Apply to surfaces at joints of previously constructed asphalt or Portland cement concrete and at surfaces abutting or projecting into hot-mixed asphalt pavement.

1. Apply asphalt sealer to top surfaces of new hot-mixed asphalt abutting existing asphalt pavement. Apply uniform coat 6" wide centered over joint extending 3" parallel either side of joint, with neat edges.
2. Apply asphalt sealer to top surfaces of joints formed by hot-mixed asphalt paving and rims of manholes, catch basins, water valves, etc.
3. Apply uniform coat of sand or stone dust to exposed asphalt sealer upon completion.
4. Exercise care in application of asphalt sealer to avoid smearing or staining of adjoining concrete and other surface and appurtenances.

3.2 PREPARATION FOR ASPHALT OVERLAY

- A. Cold Milling: Remove existing asphalt pavement by cold milling to grades and cross sections indicated.
 1. Mill to a depth of 1-1/2 inches.
 2. Mill to a uniform finished surface free of excessive gouges, grooves, and ridges.
 3. Control rate of milling to prevent tearing of existing asphalt course.
 4. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.
 5. Broom sweep surface and dispose of millings in accordance with Section 31 10 00 Site Clearing.
 6. Repair or replace curbs, manholes and/or other existing improvements damaged during cold milling.
 7. Provide temporary asphalt around utilities and different pavement surface elevations for areas subject to traffic prior to resurfacing.
- B. Crack Repair: Seal cracks 1/8 inch to 1-inch wide with Asphalt Sealer. Fill cracks more than 1-inch wide with Asphalt Wearing Course FJ-1.
- C. Pavement Reinforcement: Install pavement reinforcement membrane in accordance with manufacturer's recommendations over sealed cracks of surfaces to receive asphalt overlay.
- D. Damaged areas of existing asphalt displaying settlement, severe cracking, deterioration and/or potholes shall be removed and restored in accordance with specifications for new asphalt pavement construction.

3.3 PLACING MIX

- A. General: Place hot-mixed asphalt mixture on prepared surface, spread, and strike off. Comply with PennDOT requirements for minimum temperature in spreading the mixture. Place areas inaccessible to equipment by hand. Place each course to required grade, cross-section, and compacted thickness.
- B. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes, unless otherwise indicated.
- C. Paving Placement: Place in strips in widest strip practical. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete base course for an entire section before placing surface course.
- D. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

- E. Correct irregularities in base course by placing leveling material or removing excess material forming high spots where required or where directed by the Design Professional. Prior to placing the wearing course, examine the binder course for depressions, high spots and unstable areas. Fill depressions with bituminous leveling material. The Design Professional reserves the right to order proof-rolling of binder course under his observation. Unstable areas shall be reconstructed including removal, replacement and compaction of unstable material as directed by the Design Professional.
- F. Immediately correct surface irregularities in finish course behind paver. Remove excess material forming high spots with shovel or lute. Fill depressions with hot-mix and smooth surface. Finish paving shall be free and even, and free of low spots or bumps. All areas must drain to established drainage points. No puddles will be permitted.
- G. Patching: Remove and replace paving areas mixed with foreign materials and defective areas. Cut out such areas and fill with fresh, hot-mixed asphalt. Compact by rolling to specified surface density and smoothness. The faces and surface edges of all patches adjacent to the existing pavement shall be sealed with hot applied asphalt joint sealer conforming to ASTM D 3405 within 5 working days. The cross-section of the patch shall be finished to match the existing cross-section of the roadway.

3.4 JOINTS

- A. Construct joints to ensure continuous bond between adjoining paving sections. Construct joints free of depressions with same texture and smoothness as other sections of hot-mix asphalt course.
 - 1. Clean contact surfaces and apply tack coat.
 - 2. Offset longitudinal joints in successive courses a minimum of 6 inches (150 mm).
 - 3. Offset transverse joints in successive courses a minimum of 24 inches (600 mm).
 - 4. Construct transverse joints by bulkhead method or sawed vertical face method.
 - 5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
 - 6. Compact asphalt at joints to a density within 2 percent of specified course density.
 - 7. If cold joints occur, provide appropriate heating apparatus to heat existing asphalt to provide continuous bond.

3.5 COMPACTION

- A. General: Follow PennDOT Pub 408 Section 409 compaction requirements. Begin rolling when mixture will bear roller weight without excessive displacement.
- B. Compact mixture with hot-hand tampers or vibrating plate compactors in areas inaccessible to rollers.
- C. Breakdown Rolling: Accomplish breakdown or initial rolling immediately following rolling of joints and outside edge. Check surface after breakdown rolling and repair displaced areas by loosening and filling, if required, with hot material.
- D. Second Rolling: Follow breakdown rolling as soon as possible, while mixture is hot. Continue second rolling until mixture has been evenly compacted to the following density:
 - 1. Average Density: 96 percent of reference laboratory density according to Superpave Gyratory Compactor test method, but not less than 94 percent or greater than 100 percent.

- E. Finish Rolling: Perform finish rolling while mixture is still warm enough for removal of roller marks.
- F. Patching: Remove and replace paving areas mixed with foreign materials and defective areas. Cut out such areas and fill with fresh, hot-mixed asphalt. Compact by rolling to specified surface density and smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.6 BUMPER BLOCKS

- A. General: Secure blocks to pavement with rebar dowels. Size length of pins to penetrate the subgrade as indicated.

3.7 FIELD QUALITY CONTROL

- A. Testing Agency Services: The Owner will engage a qualified testing agency to perform test and inspections.
- B. Thickness: In-place compacted thickness will be tested in accordance with ASTM D 3549. Pavement will not be acceptable if below the following tolerances:

<u>Mixture</u>	<u>Minimum Compacted Depth</u>
9.5 mm Wearing Course	1 1/2 inches
19 mm Binder Course	4 inches

- C. Surface Smoothness: Finished surface of each hot-mixed asphalt course will be tested for smoothness, using 10-foot straightedge applied parallel with and at right angles to centerline of paved area unless specified otherwise. Surfaces will not be acceptable if exceeding the following tolerances for smoothness:
 - 1. Base Course Surface: 1/4 inch.
 - 2. Wearing Course Surface: 3/16 inch
- D. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979/D 979M.
 - 1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041/D 2041M, and compacted according to job-mix specifications.
 - 2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726/D 2726M.
 - a. One core sample will be taken for every 500 sq. yd. or less of installed pavement, with no fewer than three cores taken.
 - b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726/D 2726M.

- E. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

END OF SECTION 32 12 16

SECTION 32 13 13 - 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. This Section includes the following:
 - 1. Concrete Curbs.
 - 2. Concrete Walkways.
 - 3. Reinforced Heavy Pavements.
 - 4. Detectable Warning Plates.
- B. Related Sections:
 - 1. Division 03, Section 03 30 00 "Cast-in-Place Concrete" for general applications of concrete.
 - 2. Division 31, Section 31 20 00 "Earthwork" for subgrade preparation, grading and subbase course.

1.3 SUBMITTALS

- A. Contractor's Qualifications.
- B. Product data and/or samples for proprietary materials and items, including reinforcement and forming accessories, admixtures, joint systems, curing compounds, and others as required in referenced sections.
- C. Design mixes for each class of concrete. Include revised mix proportions when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.
- D. Laboratory test reports for evaluation of concrete materials and mix design tests.

1.4 QUALITY ASSURANCE

- A. Concrete Standards: Comply with provisions of the following standards, except where more stringent requirements are indicated.
 - 1. All applicable ACI Publications.
 - 2. Concrete Reinforcing Steel Institute (CRSI) "Manual of Concrete Practice".
- B. Concrete Manufacturer Qualifications: Manufacturer of ready-mixed concrete products complying with ASTM C94 requirements for production facilities and equipment.
- C. Concrete Contractor's Qualifications: Firm regularly engaged in installing concrete pavement projects of similar size and scope as this project, with a minimum of seven (7) years experience. Provide a minimum of five (5) references of previous projects of like size and scope.

1. Include evidence and experience of skilled craftsmen or individuals who specialize in the handling, placement and finishing the materials and products required for concrete pavement installation.
- D. Provide a sample pour showing all details such as finish, texture/pattern, color, joints, etc., for pavements and curbs for approval by the Design Professional. Provide a minimum of 100 square feet of walks and 80 LF of curbing. Upon approval, preserve the samples as the minimal standard for the project. The samples may be poured as part of the finished work, however, re-work will include all affected adjacent improvements at no additional cost to the owner. Notify Design Professional in writing a minimum of two (2) weeks before making pours.
- E. Pre-Installation Conference: Conduct a meeting between the Prime/General Contractor, Sub-Contractors, Owner, Testing Agency and the Design Professional to review the scope of work in this section, coordination with other work, special project conditions and quality standards. Notify all parties and schedule the meeting a minimum of two (2) weeks prior to the anticipated start of the work specified under this Section.
 1. Review requirements for submittals, status of coordinating work, availability of materials.
 2. Review detailed requirements for preparing concrete design mixes and determining procedures for satisfactory concrete operations.
 3. Establish preliminary work progress schedule and procedures for materials inspection, testing, and certifications.
 4. Review methods of assuring quality control will conform to contract documents.
 5. Require representatives of each entity directly concerned with cast-in-place concrete to attend conference.
- F. Make all provisions necessary, prior to placing of concrete, to assure adequate time for proper placing, finishing and curing based on the existing conditions at the job site.

1.5 PROJECT CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
- B. Coordinate with requirements for "Temporary Facilities" specified in Division 01.
- C. Utilize flagmen, barricades, warning signs, and warning lights as required to protect concrete installations from damage and to assure the safety of vehicular and pedestrian traffic.

PART 2 - PRODUCTS

2.1 FORMS

- A. Steel or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects.
 1. Use flexible or curved forms for curves of one hundred feet (100') or less radius. Straight, non-flexible forms are not permitted for use in providing smooth, continuous curves.

- B. Form Release Agent: Provide commercial formulation form-release agent with a maximum of 350 mg/l volatile organic compounds (VOCs) that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars and Tie Bars: ASTM A615, Deformed steel bars, Grade 60.
- B. Welded Steel Wire Reinforcement: ASTM A1064 and AASHTO M 55.
 - 1. Provide flat sheets – not rolls.

2.3 JOINT MATERIALS

- A. Joint Filler
 - 1. Recycled Rubber Expansion Joint Material: ASTM D1751-97 & D1752.
 - a. JD Russell – Reflex
 - b. J&K Foam Fabricating – Rebonded Rubber
- B. Joint Sealer
 - 1. Applicable Standards: For Elastomeric Sealants: Federal Specification TT-S-00227E, Class A, Type II; ASTM C-920, Type S, Grade NS, Class 50, Use T, 7NT; ASTM C719; ASTM C 794.
 - a. Dynatrol II by Pecora Corporation
 - b. Sikaflex – 2c NS TG, NS/SL by Sika
 - c. Sonneborn NP-2, by Chemrex Inc.
 - 2. Color to match color of cured concrete.
- C. Backing Material
 - 1. Provide sealant backings of material and type that are non-staining; are compatible with join substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
 - 2. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg F (minus 32 deg C). Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and to otherwise contribute to optimum sealant performance.
- D. Expansion Joint Cap: Provide pre-formed plastic expansion joint cap, Sealtight snap-cap as manufactured by W.R. Meadows, or equivalent.

2.4 CONCRETE MATERIALS

- A. Portland Cement: ASTM C150, ACI 325.9R.
 - 1. Use one brand of cement and same ready-mix supplier throughout Project unless otherwise acceptable to the Design Professional.

- B. Normal-Weight Aggregates: ASTM C-33 and as follows. Provide aggregates from a single source. Product and source are also required to be currently approved by PennDOT.
 - 1. Fine Aggregates: Type A per PennDOT Publication 408, Section 703.1.
 - 2. Coarse Aggregates: Type A, AASHTO No. 57 per PennDOT Publication 408, Section 703.2 and per PennDOT Publication 408, Section 720.
 - 3. Do not use fine or coarse aggregates that contain substances that cause spalling.
 - 4. Coarse Aggregates for slip-form curb machines: maximum ½ inch.
- C. Water: Potable.

2.5 ADMIXTURES

- A. Provide concrete admixtures that contain not more than 0.1 percent by weight chloride ions.
- B. Air-entraining Admixture: ASTM C 260 and AASHTO M 154, certified by manufacturer to be compatible with other admixtures.
- C. Water-Reducing Admixture: ASTM C494, Type A and AASHTO M 194, Type A.
- D. High-Range Water-Reducing Admixture: ASTM C494, Type F or G and AASHTO M 194, Type F or Type G.
- E. Water-Reducing and Accelerating Admixture: ASTM C494, Type E and AASHTO M 194, Type E.
- F. Water-Reducing and Retarding Admixture: ASTM C494, Type D and AASHTO M 194, Type D.

2.6 CONCRETE MIX

- A. Prepare design mixes for each type and strength of normal-weight concrete by either laboratory trial batch or field experience methods as specified in applicable ACI 211.1, ASTM C 94 and AASHTO-M157. For the trial batch method, use a qualified independent testing agency for preparing and reporting proposed mix designs.
 - 1. Do not use the Owner's field quality-control testing agency as the independent testing agency.
 - 2. Limit use of fly ash to a maximum of twenty percent (20%) of cement content by weight.
 - 3. Limit use of slag cement to a maximum of thirty-five percent (35%) of cement content by weight.
- B. Proportion mixes to provide normal-weight concrete with the following minimum properties:
 - 1. Compressive Strength (28-Day): 4000 psi for exposed concrete.
 - 2. Maximum Water-Cement Ratio at Point of Placement: 0.45.
 - 3. Slump Limit at Point of Placement:
 - a. Five inches (5") for concrete containing normal water reducer.
 - b. Eight inches (8") for concrete containing high-range water reducer (superplasticizer).

- C. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content as follows with a tolerance of plus or minus one and one-half percent (1- ½ %): ASTM C-260.

- 1. Air Content: Six and one-half percent (6.5%) for one inch (1") maximum aggregate.

2.7 CONCRETE MIXING

- A. Ready-Mixed Concrete: ASTM C 94 and AASHTO M 157.

- 1. When air temperature is between eighty-five- and ninety-degrees Fahrenheit (85° - 90° F.), reduce mixing and delivery time from one and one-half (1- ½) hours to seventy-five (75) minutes; when air temperature is above ninety degrees Fahrenheit (90° F.), reduce mixing and delivery time to sixty (60) minutes.

2.8 CONCRETE EVAPORATION RETARDANT

- A. Water-based evaporation retardant: ACI 302.

- 1. Aquafilm by Conspec Marketing and Manufacturing Co., Inc.
 - 2. Evapre by W.R. Meadows of PA, Inc.
 - 3. Eucobar by Euclid Chemical Company.

2.9 CONCRETE CURING MATERIALS

- A. Water-Based Membrane-Forming Curing Compound: ASTM C 309, Type 1, Classes A & B; ASTM C 1315; ACI 308; and AASHTO M 148, Type I, Classes A & B.

- 1. Kure-N-Seal WB by Sonneborn Building Products/Chemrex, Inc.
 - 2. Vocomp 25 by W.R. Meadows of PA, Inc.
 - 3. Cure & Seal WB by Conspec Marketing and Manufacturing Co.

2.10 MISCELLANEOUS MATERIALS

- A. Concrete bonding agent: ASTM C-1059, Type 1 or 2.

- 1. Strong Bond by Conspec Marketing and Manufacturing Co., Inc.
 - 2. Intralok by W.R. Meadows of PA, Inc.
 - 3. Liquid Adhesive Bond by Euclid Chemical Company

- B. Epoxy Adhesive: ASTM C 881 and AASHTO M 235, two-component material suitable for dry or damp surfaces. Provide material type, grade, class and color to suit requirements.

2.11 DETECTABLE WARNING PLATES

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

- 1. East Jordan Iron Works
 - 2. Neenah Foundry

- B. Cast Iron plates with truncated domes that comply with ADA Accessibility Guidelines.

- C. Finish:

- 1. Powder coated: Provide Architect's color selection from manufacturer's standard range.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

- A. Proof-roll prepared subbase surface to check for unstable areas and verify need for additional compaction to meet requirements specified in 31 20 00, Earthwork. Do not begin placing concrete until such conditions have been corrected and are ready to receive the concrete.
- B. Remove loose material from compacted subbase surface immediately before placing concrete.

3.2 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for paving to required lines, grades, and elevations. Install forms to allow continuous progress of work and so that forms can remain in place at least twenty-four (24) hours after concrete placement.
- B. Check completed formwork and screeds for grade and alignment to following tolerances:
 - 1. Top of Forms: Not more than one-eighth inch (1/8") in ten feet (10').
 - 2. Vertical Face on Longitudinal Axis: Not more than three-sixteenth inch (3/16") in ten feet (10').
- C. Clean forms after each use and coat with form release agent as required ensuring separation from concrete without damage.

3.3 PLACING REINFORCEMENT

- A. General: Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars" for 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 of reinforcement.
- D. Install welded wire reinforcement sheets 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. 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 two inch (2") overlap to adjacent mats.

3.4 JOINTS

- A. General: Construct control, construction, and expansion joints true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to the centerline, unless indicated otherwise.
 - 1. Provide control joints in the patterns indicated.

2. When joining existing paving, place transverse joints to align with previously placed joint, unless indicated otherwise.
- B. Contraction Joints: Provide weakened-plane control joints as follows:
1. Tooled Joints: Form control joints in fresh concrete by grooving and finishing each edge of joint with a $\frac{1}{4}$ inch radius groover.
 2. Saw cut Joints: For concrete curb, cut contraction joints into fresh concrete within six to eight (6-8) hours of placement. Saw cut $\frac{1}{8}$ " inch wide and one inch deep at ten-foot (10') intervals. Saw cut joints are not permitted in concrete sidewalks and other flat work.
- C. Construction Joints: Set construction joints at side and end terminations of concrete and at locations where concrete operations are stopped for more than one-half ($\frac{1}{2}$) hour, unless concrete terminates at expansion joints.
1. Continue new pour from score line location or isolation joint. Remove excess from previous pour that extends between designated joint lines.
 2. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened and existing concrete surfaces.
- D. Expansion Joints: Form expansion joints of pre-formed joint filler strips abutting concrete curbs, catch basins, manholes, inlets, structure, utility poles, foundation walls, columns and where indicated.
1. Locate expansion joints at maximum intervals of 50 feet in curb, and at 20 feet in flatwork unless indicated otherwise. Provide isolated expansion joints in slabs-on-grade at points of contact between slab and vertical surfaces such as utility poles, foundation walls, columns, and as indicated.
 2. Furnish joint fillers in one-piece lengths for full width, being placed wherever possible, where more than one length is required, and lace or clip joint filler sections together.
 3. Extend joint fillers to full depth of joint, not less than $\frac{1}{2}$ inch or more than $\frac{3}{4}$ inch below finished surface where joint sealant is indicated.
 4. Protect top edge of joint filler during concrete placement with an expansion joint cap. Remove cap after concrete has been placed on both sides of joint, providing not less than $\frac{1}{2}$ inch or more than $\frac{3}{4}$ inch below finished surface. Clean joints of all foreign debris, particles, etc. with compressed air or similar method.
 5. At non-supported edges of pavement, provide a temporary form to support full, uniform depth of sealant.
- E. Joint Sealants:
1. Employ only proven installation techniques which will ensure that sealants are deposited in uniform, continuous ribbons without gaps or air pockets, with complete "wetting" of joint bond surfaces equally on opposite sides. Except as otherwise indicated, fill sealant rabbet to a slightly concave surface, slightly below adjoining surfaces. Where horizontal joints are between a horizontal surface and vertical surfaces, fill joint to form a slight cove, so that joint will not trap moisture and dirt.
 2. Cure sealants and caulking compounds in compliance with manufacturer's instructions and recommendations, to obtain high early body strength, internal cohesive strength and surface durability. Cure and protect sealants, concrete, etc. from damage during construction activities, so that they will be without deterioration or damage (other than normal wear and weathering) at time of

substantial completion. Replace or restore sealants which are damaged or deteriorated during construction period.

3.5 CONCRETE PLACEMENT

- A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.
- B. Remove snow, ice, or frost from subbase surface and reinforcing before placing concrete. Do not place concrete on surfaces that are frozen.
- C. Moisten subbase to provide a uniform dampened condition at the time concrete is placed. Do not place concrete around manholes or other structures until they are at the required finish elevation and alignment.
- D. Comply with requirements of AASHTO M 157, ACI 325.9R for measuring, mixing, transporting, and placing concrete.
- E. 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.
 - 1. When concrete placing is interrupted for more than one-half ($\frac{1}{2}$) hour, place a construction joint.
 - 2. Support expansion joint filler with temporary rigid backerboard on the opposite side from the pour, capable of maintaining straight joint lines, in proper alignment with adjacent joint lines of the slab.
- F. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- G. Use equipment and procedures to consolidate concrete complying with AASHTO M 157, ACI 325.9R.
 - 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 consolidation. Consolidate with care to prevent dislocating reinforcing, dowels, and joint devices.
- H. Screed paved surfaces with a straightedge and strike off. Use bull floats or darbies to form a smooth surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces prior to beginning finishing operations.
- I. Slip-form Curbs: When automatic machine placement is used for curbs, submit revised mix design and laboratory test results that meet or exceed requirements. Submit revised mix design. Design revised mix in accordance with ACI 211.1 and 211.2, specifically for slip-form curb machines while producing a curb which holds its shape, grade, strength and finish as required. Maximum size of coarse aggregates for slip-form curb machines is one-half ($\frac{1}{2}$) inch. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified for formed concrete. If results are not acceptable, remove and replace with formed concrete.
- J. Cold-Weather Placement: Comply with provisions of ACI 306R, and AASHTO M 157, and as follows: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.
- K. Hot-Weather Placement: Comply with provisions of ACI 305R and AASHTO M 157, when hot weather conditions exist.
 1. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedding in concrete.
 2. Fog spray forms, reinforcing steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.6 CONCRETE FINISHING

- A. Begin floating when bleed water sheen has disappeared and the 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.
- B. Finish surfaces to true planes within a tolerance of one-eighth inch (1/8") in ten feet (10') as determined by a ten foot (10') long straightedge placed anywhere on the surface in any direction. Cut down high spots and fill low spots. Re-float surface immediately to a uniform granular texture.
 1. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across concrete surface perpendicular to line of traffic to provide a uniform fine line texture finish.
- C. Final Tooling: Tool edges of paving, curbs, and joints formed in fresh concrete with a one-fourth inch (1/4") radius jointing tool. Repeat tooling of edges and joints after applying surface finishes. Eliminate tool marks on concrete surfaces.

3.7 PAVEMENT TOLERANCES

- A. Comply with tolerances of ACI 117 and as follows:
 1. Elevation: 1/2 inch.
 2. Thickness: Plus 3/8 inch (9 mm), minus 1/4 inch.
 3. Surface: Gap below 10-foot- (3-m-) long, unleveled straightedge not to exceed 1/4 inch.
 4. Joint Spacing: 3 inches.
 5. Contraction Joint Depth: Plus, 1/4 inch, no minus.
 6. Joint Width: Plus, 1/8 inch, no minus.

3.8 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with the recommendations of ACI 306R for cold weather protection and ACI 305R for hot weather protection during curing. Be prepared to protect freshly placed concrete from rain.
- B. Evaporation Control: In hot, dry, and windy weather, protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control material. Apply according to manufacturer's instructions after screeding and bull floating, but before floating.

- C. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- D. Curing Methods: Cure concrete using one of the following methods or a combination thereof:
 - 1. 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 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.
 - 2. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's directions. Recoat areas subjected to heavy rainfall within three (3) hours after initial application. Maintain continuity of coating and repair damage during curing period.
- E. Protect freshly placed concrete from accidental traffic and from deliberate damage such as initials and graffiti.

3.9 FIELD QUALITY CONTROL TESTING

- A. Testing Agency Services: Owner shall employ a qualified testing agency to sample materials, perform tests, and submit test reports during concrete placement as follows:
 - 1. Sampling and testing Fresh Concrete: ASTM C172, except modified for slump to comply with ASTM C94.
 - a. Slump: ASTM C143; one test at a point of placement for each compressive-strength test but no less than one test for each day's pour of each type of concrete. Additional tests will be required when concrete consistency changes.
 - b. Air Content: ASTM C231, pressure method; one test for each compressive-strength test but no less than one test for each day's pour of each type of air-entrained concrete.
 - c. Concrete Temperature: ASTM C1064; one test hourly when air temperature is 40 deg F (4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each set of compressive-strength specimens.
 - d. Compression Test Specimens: ASTM C31; one set for four standard cylinders for each compressive-strength test, unless directed otherwise. Mold and store cylinders for laboratory-cured test specimens except when field-cured test specimens are required.
 - e. Compressive-Strength Tests: ASTM C39; one set for each day's pour of each concrete class exceeding 5 cu. Yd. But less than 25 cu. Yd., plus one set for additional 50 cu. yd. Test one specimen at 7 days, test two specimens at 28 days, and retain one specimen in reserve for later testing if required.
 - 2. When frequency of testing provides fewer than five strength tests for a given class of concrete, conduct testing from at least five randomly selected batches or from each batch if fewer than five are used.
- B. Provide test reports to Design Professional and concrete manufacturer within 24 hours of testing. No more than two (2) testing representatives of the testing agency shall be assigned to conduct sampling and testing on the project. Provide the following information on reports:
 - 1. Project identification name and number

2. Date of concrete placement
 3. Name of concrete testing agency
 4. Concrete type and class
 5. Location of sample
 6. Design compressive strength at 28 days
 7. Concrete mix proportions and materials
 8. Compressive breaking strength
 9. Type of break for both 7-day and 28-day tests
- C. Non-destructive Testing: Impact hammer, sonoscope, or other non-destructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.
- D. Additional Tests: Perform additional tests of the concrete when test results indicate slump, air entrainment, concrete strengths, or other requirements have not been met, as directed by Design Professional. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed.

3.10 REPAIRS AND PROTECTION

- A. Remove and replace concrete paving that is broken, damaged, or defective, or does not meet the requirements of this Section.
- B. Drill test cores where directed by the Design Professional when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to paving with epoxy adhesive.
- C. Protect concrete from damage. Exclude traffic from paving for at least twenty-eight (28) 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 concrete paving just prior to final inspection.

END OF SECTION 32 13 13

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. This Section includes the following:
 - 1. Painted markings applied to asphalt pavement.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include technical data and tested physical and performance properties.
- B. Product and for each color and texture specified; on rigid backing, 8 inches square.

1.4 FIELD CONDITIONS

- A. Environmental Limitations: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg for alkyd materials not exceeding 95 deg F. 50 deg F for water-based materials, and not exceeding 95 deg F. Do not apply paint if precipitation is imminent.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Aexcel Inc.
 - 2. Benjamin Moore & Co.
 - 3. Color Wheel Paints & Coatings.
 - 4. Columbia Paint & Coatings.
 - 5. Conco Paints.
 - 6. Coronado Paint; Division of INSL-X Products Corporation.
 - 7. Diamond Vogel Paints.
 - 8. Dunn-Edwards Corporation.
 - 9. Ennis Traffic Safety Solutions, Inc.
 - 10. Frazee Paint.

11. General Paint.
12. Kwal Paint.
13. M.A.B. Paints.
14. McCormick Paints.
15. Miller Paint.
16. Parker Paint Mfg. Co. Inc.
17. PPG Industries.
18. Pratt & Lambert.
19. Rodda Paint Co.
20. Rohm and Haas Company; a subsidiary of The Dow Chemical Company.
21. Scott Paint Company.
22. Sherwin-Williams Company (The).

2.2 PAVEMENT MARKING PAINT

- A. Pavement-Marking Paint: Alkyd-resin type, lead and chromate free, ready mixed, complying with AASHTO M 248, Type N; colors complying with FS TT-P-1952.
 1. Color: As indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that pavement is dry and in suitable condition to begin pavement marking according to manufacturer's written instructions.
- B. Proceed with pavement marking only after unsatisfactory conditions have been corrected.

3.2 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Design Professional.
- B. Allow paving to age for a minimum of 30 days before starting pavement marking.
- C. Sweep and clean surface to eliminate loose material and dust.
- D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.
 1. Apply graphic symbols, numbering, and lettering with paint-resistant, die-cut stencils, firmly secured to pavement. Mask an extended area beyond edges of each stencil to prevent paint application beyond the stencil. Apply paint so that it cannot run beneath the stencil.
 - a. Apply parking spaces numbers in accordance with the owner's numbering and color scheme.

3.3 PROTECTING AND CLEANING

- A. Protect pavement markings from damage and wear during remainder of construction period.
- B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 321723

SECTION 32 18 00 - ATHLETIC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Softball Infield Mix
 - 2. Softball Clay
 - 3. Softball Warning Track Mix
 - 4. Foul Poles
 - 5. Homeplates, Pitcher's rubber, and Bases
 - 6. Soccer Goals
 - 7. Football Goals
 - 8. Football Goal Padding
 - 9. Multi-Sport Netting
 - 10. Tension Netting
 - 11. Fence Top Guard
 - 12. Outdoor Batting Cages
 - 13. Shot put
 - 14. Wall Padding
 - 15. Manhole Access Frame and Cover
- B. Related Sections:
 - 1. Division 31, Section 31 20 00 "Earthwork" for excavation, subgrade preparation, and geotextiles.
 - 2. Division 32, Section 32 31 13 "Chainlink Fences and Gates" for fences integral to ball control netting systems.
 - 3. Division 31

1.3 REFERENCES

- A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.
 - 1. National Federation of State High School Associations (NFHS)
 - 2. American Sports Builders Association (ASBA)

1.4 SUBMITTALS

- A. Qualification Data.
- B. Product Data: Submit manufacturer's technical product data and installation instruction for the materials and products.
- B. Shop Drawings: Plans, sections, elevations, details showing all components, layouts and relationship to other work. Provide sealed drawings by a registered professional engineer where indicated.

- C. Delegated-Design Submittals: For systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in the manufacture of products of types, materials and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.
- B. Delegated-Design Engineer: A Professional Engineer licensed in Pennsylvania and who is experienced in providing engineering services of the kind indicated.
- C. Comply with standards specified.
- C. Pre-Installation Conference: Conduct a meeting between the Prime/General Contractor, Sub-Contractors, the Owner and the Design Professional to review the scope of work in this section, coordination with other work, special project conditions and quality standards. Notify all parties and schedule the meeting a minimum of two (2) weeks prior to the anticipated start of the work specified under this Section.\

1.5 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design indicated systems including comprehensive engineering analysis by a qualified professional engineer; using performance requirements and design criteria indicated.
 - 1. Foul poles and foundations
 - 2. Football goals and foundations
 - 3. Outdoor batting cages
 - 4. Ball control netting systems and foundations
- B. Structural Performance: Engineering design for ball control netting systems and sports equipment shall be based on withstanding minimum wind loading required by local building codes but no less than:
 - 1. Wind: $V_{ULT} = 115$ MPH

1.6 ALLOWABLE TOLERANCES

- A. Erect manufactured accessories with vertical members plumb to within one-fourth inch ($\frac{1}{4}$ ") per ten feet (10'). Erect horizontal members level to within one-fourth inch ($\frac{1}{4}$ ") per ten feet (10').

1.7 MAINTENANCE DATA AND OPERATING INSTRUCTIONS

- A. Supply manufacturer's maintenance and operating instructions for equipment. Instructions shall include complete contact information for the manufacturers.

1.8 FACTORY AND FIELD FINISHES

- A. Inspect all items that are furnished in factory finishes for abrasions resulting from shipping and handling. Touch up minor abrasions with matching finish materials provided by manufacturer using techniques approved by the manufacturer. Provide field finishes in accordance with manufacturer's recommendations.

1.9 STORAGE OF MATERIALS AND EQUIPMENT

- A. Store materials and equipment off the ground to protect against weather, damage due to construction activity and vandalism. Repair or replace damaged equipment at no additional cost to the Owner.

1.10 PROJECT CONDITIONS

- A. Become familiar with the project area as it relates to the placement of proposed equipment and other site improvements.
- B. Report any conflicts between proposed location of equipment and other site improvements including underground utility systems.

PART 2 - PRODUCTS

2.1 SOFTBALL INFIELD MIX

- A. Infield mix for skinned areas by one of the following:
 - 1. Diamond-Tex, Martin Limestone
 - 2. Dymatex, NEP Sand and Gravel
 - 3. Martin Infield Mix, Martin Stone Quarries

2.2 SOFTBALL CLAY

- A. Turface Moundmaster Blocks or approved equal.
- B. Product Description: Unfired clay bricks for homeplate areas. 100% Virgin Clay. Color: Red.

2.3 SOFTBALL WARNING TRACK MIX

- A. Quarry screenings/Limestone dust.

2.4 FOUL POLES

- A. Sportsfield Specialties Model FPW415, Ground Sleeve Foul Pole with Wing.
- B. Description:
 - 1. 15' Height above grade
 - 2. 4" O.D. x 0.125" wall aluminum
 - 3. 7' Height mesh wing
 - 4. Finish: powder coat (yellow)

2.5 HOME PLATE, PITCHER'S RUBBER, AND BASES

- A. Acceptable Manufacturer's: Subject to compliance with requirements provide products by one of the following:
 - 1. Hollywood/Schutt
 - 2. Champion Products
 - 3. Rawlings

- B. Home Plate: A five (5) sided slab of whitened rubber or other suitable material. One edge is 17" long, two are 8.5" long and two are 12" long.
- B. Pitcher's rubber: A rectangular slab of whitened rubber or other suitable material 24" x 6".
- C. Bases: 15" x 15" x 3" molded rubber with honeycomb design with 1-1/2" ground anchors and rubber plugs.

2.6 SOCCER GOALS

- A. Goal: Sportsfield Specialties Model SG824S, Square Post Soccer Goal.
- B. Wheel Kit: Sportsfield Specialties Model SGWKL Levered Soccer Goal External Wheel Kit.
- C. Safety Tie-down Kit: Sportsfield Specialties Model SG2SCC Stand Alone Soccer Goal Safety System with Cable Clamp with Infill Retainer System for Synthetic Turf Application.

2.7 FOOTBALL GOALS

- A. Sportsfield Specialties Model GP820HS, Football Goal Post with Ground Sleeve and GPAFit Access Frame Kit for synthetic turf.
- B. Features:
 - 1. 8' offset
 - 2. 20' Uprights
 - 3. Finish: powder coat (yellow)
- C. Delegated Design: Design football goal and foundations, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated. Submit stamped engineering analysis for support pole and foundation design.

2.8 FOOTBALL GOAL PADDING

- A. Sportsfield Specialties Model GPPRDG Football Goal Post Pad with Digital Graphics.
- B. Features:
 - 1. 18 oz. outdoor vinyl. Color to match existing football stadium pad covers.
 - 2. High Impact polyurethane foam
 - 3. Hook and loop vertical closure
 - 4. 7" I.D. and 18" O.D.
 - 5. Custom digitally printed text to match existing football stadium graphics.

2.9 10' HT. MULTI-SPORT NETTING SYSTEM

- A. Sportsfield Specialties Model BSS210 Ball Safety Netting System, Ground Sleeve Inserted.
- B. Features:
 - 1. Nominal height above grade: 10'

2. Poles: 2.375" O.D. (2" Sched. 80) aluminum pipe
3. Pole Finish: powder coat. Black.
4. Netting: 1-3/4" square mesh polyester, #36 black nylon
5. Cables: Vinyl-coated wire rope
6. Hardware: Galvanized steel.
7. Ground sleeves: 24" x 2.625" O.D. aluminum tube
8. Removable installation: Provide ground sleeve caps.

- C. Delegated Design: Design netting system and foundations, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated. Submit stamped engineering analysis for support pole and foundation design

2.10 20' AND 40' HT. MULTI-SPORT NETTING SYSTEM

- A. Sportsfield Specialties Model TNPP36 Custom Pole-to-Pole Tension Netting System

- B. Features:

1. Nominal height above grade: 20' and 40' as indicated.
2. Poles: Steel pipe as sized by delegated-design engineer.
3. Footings: Cast in place concrete - Permanent embedment.
4. Pole Finish: powder coat. Black.
5. Netting: 1-3/4" square mesh polyester, #36 black nylon.
6. Cables: Vinyl-coated wire rope.
7. Hardware: Galvanized steel.

- C. Delegated Design: Design netting system and foundations, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated. Submit stamped engineering analysis for support pole and foundation design.

1. Integration with site fencing: Provide a custom design which integrates netting system poles and netting with vinyl-clad chainlink fence.
2. Integrate pole bases with site curb around synthetic turf field.

2.11 40' HT. TIEBACK TENSION NETTING SYSTEM (SOFTBALL FIELD #1)

- A. Sportsfield Specialties Tieback Tension Netting System. Provide a custom protective sports netting system including support poles, footings, galvanized steel cable, and netting.

- B. Features:

1. Nominal height above grade: 40'
2. Poles: Steel pipe as sized by delegated-design engineer.
3. Footings: Cast in place concrete - Permanent embedment.
4. Pole Finish: powder coat. Black.
5. Netting: 1-3/4" square mesh polyester, #36 black nylon.
6. Cables: Vinyl-coated wire rope.
7. Hardware: Galvanized steel.

- C. Delegated Design: Design netting system and foundations, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated. Submit stamped engineering analysis for support poles and foundation design.

2.12 40' HT. TENSION NETTING SYSTEM (SOFTBALL FIELD #2)

- A. Sportsfield Specialties Tension Netting System with Integrated Wall Pad Backstop. Provide a custom protective sports netting system including support poles, footings, galvanized steel cable, netting, and padded backstop wall.
- B. Features:
 - 1. Nominal height above grade: 40'
 - 2. Poles: Steel pipe as sized by delegated-design engineer.
 - 3. Footings: Cast in place concrete - Permanent embedment.
 - 4. Pole Finish: powder coat. Black.
 - 5. Netting: 1-3/4" square mesh polyester, #36 black nylon.
 - 6. Cables: Vinyl-coated wire rope.
 - 7. Hardware: Galvanized steel.
 - 8. Backstop panel: 1/2" MDO weather-resistant composite sheathing panel.
 - 9. Padding: BaseZone Wall pad;
 - a. 1/2" MDO weather-resistant composite sheathing panel.
 - b. 3" high-density HDPU foam.
 - c.
 - d. 19 oz. premium outdoor vinyl, UV resistant. Provide Architect's color selection from manufacturer's standard range.
 - e. Z-clip mounting.
 - 10. Backstop panel and padding support structure: 2.5" Sq. x 11 Gage steel support structure.
 - 11. Backstop nominal height above grade: 4'-0".
- C. Delegated Design: Design netting system and foundations, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated. Submit stamped engineering analysis for support poles and foundation design.

2.13 FENCE TOP GUARD

- A. Manufacturers: Subject to compliance with requirements provide products by one of the following:
 - 1. Sportsfield Specialties
 - 2. On Deck Sports
 - 3. BSN Sports
- B. Features:
 - 1. Exterior-grade UV-resistant polyethylene fence guard.
 - 2. Rectangular or circular profile.
 - 3. Color: Yellow.

2.14 OUTDOOR BATTING CAGES

- A. Sportsfield Specialties Model BTTSD Double Tension Softball Batting Tunnel.
- B. Features:
 - 1. Double tunnel type
 - 2. 55' net length; #36 nylon square mesh netting.
 - 3. Ground sleeve style installation.
- C. Surface: Stone Dust.

- D. Delegated Design: Design netting cage system and foundations, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated. Submit stamped engineering analysis for support poles and foundation design.

2.15 SHOTPUT

- A. Shotput Event:
 - 1. Throwing circle pad:
 - a. Throwing Circle: Sportsfield Specialties Model TRSPHAW Shot Put Reinforced Throw Ring.
 - b. Toeboard: Sportsfield Specialties Model SPTBCARHS – High School Shot Put Toe Board, Recessed Concrete Pad Installation
 - c. Slab: 4000 psi concrete.
 - d. Floor Drain: Zurn Model FD220 Adjustable Floor drain or approved equal.
 - 2. Implement landing area:
 - a. Timber Edging: 6"x6" #2 grade or better, pressure-treated southern yellow pine (UC4A: ground-contact treatment).
 - b. Steel pins: Deformed plain steel rebar, ASTM Grade 60.
 - c. Landing surface: Stone dust.

2.16 WALL PADDING

- A. Sportsfield Specialties BaseZone Field Wall Padding.
- B. Features:
 - 1. Attachment style:
 - a. Z-clip style for retaining wall attachment.
 - 2. Applications:
 - a. Site walls.
 - 3. Vinyl Covering:
 - a. UV, water and mildew resistant vinyl, 18 oz. per square yard.
 - b. Vinyl Color – Provide Architect's selection from manufacturer's standard range.
 - 4. Filler Foam: 3" high-density HDPU foam.
 - 5. Backing: ¾ inch exterior grade composite sheathing panel or marine grade plywood.
- B. Submittals:
 - 1. Shop drawings: Submit full color, scale renderings for approval.
 - 2. Samples: 12" x 12" samples of full padding cross section.
 - 3. Color charts: provide manufacturer's standard color chart or swatches.

2.17 MANHOLE ACCESS FRAME AND COVER

- A. Frame and Cover Kt: Sportsfield Specialties Model MHAFIT40 Manhole Access Frame for Synthetic Turf.
- B. Nailer lumber: Pressure-treated southern yellow pine (UC4A: ground-contact treatment).
- C. Footings: 4000 psi concrete.

PART 3 – EXECUTION

3.1 INFIELD SKINNED AREAS

- A. Establish subgrade of infield skinned area to specified tolerances parallel to finish grade. Stake out area in accordance with the layout and grades shown on the drawings with additional intermediate grade control stakes as required providing an accurate surface. Maintain stakes until final approval of infield area is obtained. The final subgrade shall be a clean compacted level plane free of stones or debris one (1) inch or greater in size, depressions or mounds and ready to receive the surface mixture.
- B. Apply a non-selective herbicide to prevent weed growth.
- C. Spread infield mix evenly on the skinned area subgrade and compacted to form the finished playing surface to thickness indicated by wetting and rolling. Screed surface off and work to accurate planes in accordance with finished grades.
- D. Conduct maintenance operations, including weed or grass removal, sweeping, sprinkling and rolling until the skinned area is thoroughly worked to an accurate consolidated surface. After proper wetting, roll the mix with a one-ton roller. Provide a level and uniformly sloped finish upon completion.
- E. Monumentation: If no anchors are provided with bases, set $\frac{3}{4}$ inch by two foot steel rebar at home plate and base locations. Survey pin locations accurately and drive flush with finished grade.

3.2 CLAY INFILL

- A. Install at locations indicated in accordance with manufacturer's instructions.
- B. Ensure surface of clay inserts are placed and finished at proper finish grade with surrounding grade.

3.3 WARNING TRACK MIX

- A. Apply non-selective herbicide to prepared subgrade prior to placing warning track mix. Upon prepared subgrade, place and compact warning track mix to depth indicated.
- B. Place and compact warning track mix to thickness indicated. Compact mix to 95% density (standard proctor test).
- C. Provide clean uniform edges. Fine grade warning track to be flush with outfield surface.

3.4 FOUL POLES

- A. Install foul poles in concrete footings at locations and distance from home plate indicated and in accordance with manufacturer's instructions.
- B. Ensure foul poles are erected plumb within indicated tolerances.

3.5 HOME PLATE, PITCHER'S PLATE AND BASES

- A. Install bases, home plates and pitcher's plates at the softball diamonds in locations indicated in accordance with manufacturer's recommendations and NFHS Standards.

3.6 SOCCER GOALS

- A. Assemble soccer goals and in accordance with manufacturer's instructions and place at locations indicated.
- B. Provide wheel kits and safety tie-down systems for each goal.
- C. Coordinate with turf installer for the provision of turf on safety tie-down covers.
- D. Instruct the Owner on the operation of the wheeled goal kits and safety tie-downs.

3.7 FOOTBALL GOALS

- A. Install football goal in concrete footing at locations indicated and in accordance with manufacturer's instructions.
- B. Ensure goal is accurately positioned in vertical and horizontal alignment.
- C. Provide one goal pad per goal post.

3.8 BALL CONTROL NETTING

- A. Install all ball control systems according to manufacturer's written instructions and as indicated on the approved shop drawings.
- B. Coordinate ball control netting system installation with fencing installer.

3.9 FENCE TOP GUARD

- A. Install fence guard on top of chainlink fence using manufacturer's recommended fasteners.
 - 1. Softball outfield fences.

3.10 OUTDOOR BATTING TUNNELS

- A. Install batting tunnels in accordance with manufacturer's guidelines and approved shop drawings.
- B. Provide compacted stone dust surfaces as indicated under all cages.

3.11 SHOTPUT EVENT

- A. Shot put pad
 - 1. Install throwing ring in cast in place concrete pad in accordance with manufacturer's guidelines.
 - 2. Provide a floor drain in depressed portion of the pad to allow drainage to stone base.
- B. Shot put landing sector:
 - 1. Install timber edging in accordance with details. Ease edges of exposed timbers to reduce splintering.
 - 2. Place stone dust on geotextile fabric to depth indicated.

3.12 WALL PADDING

- A. Install padding according to manufacturer's instructions and approved shop drawings using manufacturer's provided hardware.
 - 1. Use z-clips for mounting on masonry and concrete walls.

3.13 MANHOLE ACCESS FRAME AND COVER

- A. Install frame and cover as recommended per manufacturer's written instructions and as indicated on the drawings.
- B. Install frame and cover where utilities structures occur in synthetic turf playing surface.
- C. Provide concrete footing for access frame per manufacturer's written instructions.
- D. Provide turf nailer around edge of prefabricated frame.
- E. Secure synthetic turf to cover and provide infill flush to surrounding synthetic turf.

END OF SECTION 32 18 00

SECTION 32 18 13 – SYNTHETIC TURF ATHLETIC FIELD

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 DESCRIPTION OF WORK

- A. This Section includes the following:
 - 1. Synthetic turf surface with infill.
 - 2. G-max testing.
 - 3. Field maintenance training for Owner's personnel.
 - 4. Field grooming equipment.
- B. Related Sections:
 - 1. Division 31, Section 31 20 00 "Earthwork" for excavation, backfill, subgrade preparation, aggregate base material, and installation.
 - 2. Division 32, Section 32 18 00 "Athletic Equipment" for football goals, soccer goal safety tie-downs, manhole access frame and covers.
 - 3. Division 33, Section 33 41 00 "Storm Drainage System" for connection of synthetic turf field subdrain system.

1.3 SUBMITTALS

- A. Manufacturer's Qualifications.
- B. Installer's Qualifications (if separate entity from Manufacturer).
- C. Product Data for synthetic turf, groomer, and accessories.
- D. Product samples:
 - a. 12" x 12" samples of turf with infill
 - b. Color samples for inlaid markings.
- E. Shop Drawings: Submit full-color, scale shop drawings indicating dimensions, seaming, line features, and markings layout plans.
- F. As-built field survey and certification.
- G. Test Results.
- H. Lead-free certification.
- I. Sample Warranty.
- J. Maintenance Manuals: Manufacturer's recommendations for the care and maintenance of the completed field including necessary equipment to facilitate care and maintenance.

1.4 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firm regularly engaged in manufacture of products of types, materials and sizes required, whose products have been in satisfactory use in similar service for not less than 8 years.
- B. Synthetic Turf Installer's Qualifications: Firm certified by the manufacturer with at least 8 years of successful installation experience on projects with similar installation of specified product. Provide a minimum of six (6) references of past projects of like size and scope.
- C. Acceptance of Base Course Preparation: Synthetic Turf installer shall review the conditions of the base course preparation and accept the conditions in writing prior to commencing work.
- D. Synthetic Turf System: Provide a complete system designed, manufactured and installed for the intended sports. At time of substantial completion, the system's shock attenuation value shall be an average G-max value of less than 110 for a padded system and less than 135 for a non-padded system. At no time shall the G-max value exceed 145 for a padded system or 170 for a non-padded system throughout the life of the warranty.
- E. G-Max testing by Contractor's testing agency. Engage a qualified sportsfield testing agency to perform the following tests:
 - 1. Shock Attenuation/Gmax
- F. Employ a qualified Registered Surveyor in Pennsylvania to stake out all construction, perform as-built survey, certify the completed field measurements and markings, elevation tolerances, and issue a certificate to this effect.
- G. As-built Field Survey: Provide a topographic survey of the finished turf area and verify the accuracy of the stone base course surface elevations and field dimensions. Survey shall be submitted in digital format (AutoCAD .dwg) with spot elevations taken on a 10 ft. grid. Topography shall be delineated by contour lines in 0.10' foot intervals. Any unacceptable surface deviations or conditions will be reported in writing to the contractor.
- H. Design Standards: All designs, game markings and layouts shall conform to all currently applicable National Federation State High School Association rules.
- I. Pre-Installation Conference: Conduct a meeting between the General Contractor, Sub-Contractors, Owner, Testing Agency and the Design Professional to review the scope of work in this section, coordination with other work, special project conditions and quality standards. Notify all parties and schedule the meeting a minimum of two (2) weeks prior to the anticipated start of the work specified under this Section.
 - 1. Verify scope of work responsibility of each contractor and subcontractor.
 - 2. Review proposed sources of all synthetic turf field materials, including capabilities and location of plant that will manufacture materials.
 - 3. Review condition of substrate and preparatory work performed by other trades.
 - 4. Review requirements for protecting all stages of work, including restriction of traffic during installation period and for remainder of construction period.
 - 5. Review and finalize construction schedule for all work. Verify availability of materials, Installer's personnel, and equipment required to execute the Work without delays.
 - 6. Review inspection and testing requirements, governing regulations, and proposed installation procedures.
 - 7. Review forecasted weather conditions and procedures for coping with unfavorable conditions.

1.5 PROJECT CONDITIONS

- A. Site Information: Comply with conditions of Section 31 10 00 Site Clearing.
- B. Traffic: Do not close or obstruct streets, walks, or other occupied or used facilities without permission from the Owner and authorities having jurisdiction.
- C. Control dust caused by the work. Dampen surfaces as required. Comply with pollution control regulation of governing authorities.
- D. Protect existing paving and other services or facilities on site and adjacent to the site from damage caused by site work operations. The cost of repair and/or restoration of damaged items shall be borne by the Contractor.
 - 1. Restore damaged improvements to their original condition as acceptable to property owner.
- E. Comply with project conditions requirements of other sections specified under related sections.

1.6 WARRANTY

- A. Special Warranty: Provide warranty from synthetic turf manufacturer against defects in materials and workmanship for period of eight (8) years from date of substantial completion.
 - 1. Warranty must be supported by a third party insured eight (8) year policy from an A-Rated domestic insurance carrier. Submit actual and current policy for verification.
 - 2. Include general wear and damage caused by UV degradation. Vandalism and damage from natural causes beyond the control of the owner or the manufacturer are excluded from the warranty.
 - 3. Certify that the completed synthetic turf athletic field installation and work meets or exceeds the manufacturer's requirements.
 - 4. The warranty shall guarantee the average G-max value of 135 (110-padded) at time of installation and below 170 (145-padded) for the remaining term of the warranty.
 - 5. Perform a maintenance check including a Gmax test of the surface once each year during the warranty period.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURER

- A. FieldTurf USA Inc.
175 N. Industrial Blvd
Calhoun, GA 30701
Ph: 1-800-724-2969

2.2 APPROVED PRODUCT

- A. FieldTurf Vertex Prime 2.5"
 - 1. 2.5" pile height.
 - 2. Sand and rubber infill

2.3 SYNTHETIC TURF MATERIALS

- A. Turf system materials shall consist of the following:
1. Carpet made of slit-film and monofilament polyethylene fibers tufted together into each individual stitch, into a non-perforated backing. Alternating row monofilament and slit-film carpet constructions are not permitted.
 2. Infill: Controlled mixture of graded sand and cryogenic rubber crumb that partially covers the carpet.
 3. Glue, thread, paint, seaming fabric and other materials used to install and mark the artificial grass slit-film/monofilament.
- B. Required Markings
1. Provide standard NFHS field markings for Football, Soccer, Boy's and Girl's Lacrosse, and Field Hockey.

- C. The installed artificial grass slit-film/monofilament FieldTurf shall have the following properties:

Standard	Property	Specification
ASTM D1577	Pile Yarn Type	UV-resistant polyethylene
	Yarn Structure – A	Slit-Film
	Yarn Denier - A	5,000
	Yarn Structure – B	Ridged Monofilament
	Yarn Denier – B	14,500
ASTM D5823	Pile Height	2.5"
ASTM D5793	Stitch Gauge	3/4"
ASTM D5848	Pile Weight	47+oz/square yard
ASTM D5848	Primary Backing	7+oz/square yard
ASTM D5848	Secondary Backing	14+oz/square yard
ASTM D5848	Total Weight	68+oz/square yard
ASTM D1335	Tuft Bind (Without Infill)	8+lbs
ASTM D5034	Grab Tear (Width)	200 lbs/force
ASTM D5034	Grab Tear (Length)	200 lbs/force
ASTM D4491	Carpet Permeability	>40 inches/hour
ASTM F1936	Impact Attenuation (Gmax)	<200
	Infill Material Depth	1.75 inches
	Sand Infill Component	6.2lbs/square foot
	Cryogenic Infill Component	3lbs/square foot
	Total Product Weight	1393oz/square yard

Variation of +/- 5% on above listed properties is within normal manufacturing tolerances

- D. Carpet shall consist of slit-film/monofilament fibers tufted into a primary backing with a secondary backing.
- E. Carpet Rolls shall be 15' wide rolls.
1. Rolls shall be long enough to go from field sideline to sideline.
 2. Where the playing field is for football, the perimeter white line shall be tufted into the individual sideline rolls.
- F. Backing:
1. Primary backing shall be a double-layered polypropylene fabric.
 2. Secondary backing shall consist of an application of porous, heat-activated urethane to permanently lock the fiber tufts in place.
 3. Perforated (with punched holes), backed carpet is unacceptable.

- G. Monofilament fibers shall be 14,500 denier, slit-film fibers shall be 5000 denier - both fibers shall be low friction, and UV-resistant, measuring not less than 2.5 inches high.
 - 1. Systems with less than 2.5 inch fibers are unacceptable.
- H. Infill materials shall be approved by the manufacturer.
 - 1. Infill shall consist of a resilient 3-layered granular system, comprising selected and graded dust-free silica sand and SBR rubber crumb.
 - 2. Turf products without SBR rubber will not be acceptable.
- I. Non-tufted or inlaid lines and markings shall be painted with paint approved by the synthetic turf manufacturer.
- J. Thread for sewing seams of turf shall be as recommended by the synthetic turf manufacturer.
- K. Glue and seaming fabric for inlaying lines and markings shall be as recommended by the synthetic turf manufacturer.

2.4 FIELD GROOMING EQUIPMENT

- A. Provide one (1) each of the following tow-behind grooming attachments to the Owner upon completion of the project:
 - 1. FieldTurf Groomright or approved equal.

PART 3 - EXECUTION

3.1 SUBGRADE AND STONE BASE INSPECTION

- A. Refer to Section 31 20 00 Earthwork for subgrade and stone base preparation. Do not proceed with synthetic turf installation until requirements have been met.
- B. The synthetic turf installer shall inspect the finished stone base course and certify in writing that the surface is acceptable for the installation of the synthetic turf. Submit certification to Owner and Design Professional.

3.2 WEATHER CONDITIONS

- A. Installation of synthetic surface shall not be performed at any time when inclement weather threatens, rain is imminent or falling, or when conditions are, in the opinion of the Owner or Contractor, unsuitable.

3.3 ACCESS COVERS

- A. Coordinate installation of turf with the placement of football goals, soccer goal safety tie-downs, manhole access frame and covers.
- B. Provide synthetic turf and infill over access covers to create a seamless installation.

3.4 SYNTHETIC TURF SURFACE

- A. The installer shall strictly adhere to the procedures specified herein and manufacturer's guidelines. Any variance must be accepted in writing by the manufacturer, and submitted to the Design Professional, verifying that the changes do not in any way affect the warranty.
- B. The turf shall be loose laid across the field sideline to sideline and attached to the perimeter edge where applicable. The synthetic turf must be of sufficient length to permit full cross-field installation. No head or cross seams will be allowed, except as required for lining.
- C. When all of the rolls of the playing surface have been installed, install sideline areas at right angles to the playing field turf.
- D. Seams must be flat, tight, and permanent with no separation or fraying. Sew seams in a manner suitable for the installation. Inlay pre-cut fiber markings with backing such as the twelve inch (12") white sideline, soccer circles, logos, numerals, and hash marks. Install markings over the shaved carpet areas to receive them and cement with manufacturer's recommended urethane gel glue.
- E. Apply infill material in numerous thin lifts using broad-casting equipment. Brush grass fabric or otherwise fibrillate prior to applying the infill. Continue brushing or fibrillating as the infill is applied and roll with weighted rollers. Install infill material to the depth specified. Do not apply infill material when it is raining or materials are damp.

3.5 TESTING BY CONTRACTOR'S TESTING AGENCY

- A. General: Engage a qualified testing agency to perform the following tests. Provide copies of reports to the Owner, Manufacturer, and Architect.
- B. Shock Attenuation/Gmax: Provide a minimum of ten (10) Gmax tests upon the finished field in random locations.
 - 1. Test in accordance with ASTM-F355, Method A.
 - 2. A plan showing the location of tests shall accompany the test results.

3.6 AS-BUILT SURVEY

- A. Engage a qualified surveyor to perform a topographical survey and certify dimensions and elevation tolerances.
 - 1. Survey shall be submitted in digital format (AutoCAD .dwg) with spot elevations taken on a 30 ft. grid.
 - 2. Topography shall be delineated by contour lines in 0.10' foot intervals.
 - 3. Any unacceptable surface deviations or conditions will be reported in writing to the contractor.
 - 4. Submit final survey to Design Professional in PDF format.

3.7 CLEANING AND PROTECTION

- A. Do not permit construction traffic over unprotected surface.
- B. Provide final cleaning of surfaces and installed items.
- C. All usable remnants of new material shall become the property of the Owner.
- D. Keep the field area clean throughout the project and clear of debris.

3.8 MAINTENANCE MATERIALS

- A. Deliver leftover turf and infill materials, replacement panels, and turf groomer to the Owner's designated storage facility on campus.

3.9 MAINTENANCE PERSONNEL TRAINING

- A. Provide 2 hours of training time to Owner's maintenance staff in the care and upkeep of the field.

END OF SECTION 32 18 13

SECTION 32 31 13 - CHAIN LINK FENCES AND GATES (VINYL COATED)

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. This Section includes the following:
 - 1. Polyvinyl chloride (PVC) coated steel chain link fabric, framework, gates and posts.
 - 2. Cantilever slide gates.
- B. Related Sections:
 - 1. Division 03, Section 03 30 00 "Cast-in-Place Concrete" for concrete for post footings.
 - 2. Division 31, Section 31 20 00 "Earthwork" for filling and grading work.
 - 3. Division 32, Section 32 18 00 "Athletic Equipment" for ball control systems.

1.3 SUBMITTALS

- A. Installer's Qualifications.
- B. Product data in the form of manufacturer's technical data, specifications, and installation instructions for fence and gate posts, fabric, gates, gate operators, and accessories.
- C. Shop Drawings showing location of fence, gates, each post, and details of post foundation, gate swing, hardware, and accessories. Include elevations of typical fence and gate sections.
- D. Samples for verification of PVC color in form of six inch (6") lengths of actual fabric wire to be used in color selected.
 - 1. Include similar samples of polymer coating applied on posts, rails, and accessories in color selected.
- E. Product Certificates: Signed by manufacturers of chain link fences and gates certifying that products furnished comply with requirements.
- F. Delegated-Design Submittals: For fence systems 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 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer having skilled craftsmen or individuals with a minimum of five (5) years of experience who has successfully completed chain-link fence installations same in material, design, and extent to that indicated for this Project.

- B. Source Limitations for Chain Link Fences and Gates: Obtain each color, grade, finish, type, and variety of component for chain link fences and gates from one source with resources to provide chain link fences and gates of consistent quality in appearance and physical properties.
- C. Pre-Installation Conference: Conduct a meeting between the Prime/General Contractor, Sub-Contractors, Owner and the Design Professional to review the scope of work in this section, coordination with other work, special project conditions and quality standards. Notify all parties and schedule the meeting a minimum of two (2) weeks prior to the anticipated start of the work specified under this Section.

1.5 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design indicated systems including comprehensive engineering analysis by a qualified professional engineer; using performance requirements and design criteria indicated.
 - 1. Fencing with Windscreen. Delegated-design engineer shall assume all fencing of six (6) height will support a mesh windscreen without failure or deflection. Windscreen will be provided by Owner.
- B. Structural Performance: Engineering design shall be based on withstanding minimum wind loading required by local building codes but no less than:
 - 1. Wind: $V_{ULT} = 115$ MPH
 - 2. Windscreen opacity: 80% closed mesh/20% open mesh.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify layout information for fences and gates shown on the Drawings in relation to the property survey and existing structures. Verify dimensions by field measurements.

PART 2 - PRODUCTS

2.1 CHAIN LINK FENCE FABRIC

- A. Available Manufacturer's: Subject to compliance with requirements provide products by one of the following:
 - 1. Master – Halco
 - 2. Merchants Metals
 - 3. Wheatland Tube
 - 4. Stephen's Pipe and Steel
- B. Selvage: Knuckled on both selvages.
- C. Steel Chain-Link Fence Fabric: Fabricated in one (1) piece widths for fencing twelve feet (12') and less in height to comply with Chain Link Fence Manufacturers Institute (CLFMI) "Product Manual" and with requirements indicated below:
 - 1. Mesh and Wire Size: Two-inch (2") mesh, 0.148-inch diameter (9 gauge).
 - 2. Coating: ASTM F 668, Class 2b, PVC, 7 mil (0.18 mm) thickness thermally fused.
 - a. PVC Coating color: Black

2.2 FRAMING

- A. Delegated Design: Design football goal and foundations, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated. Submit stamped engineering analysis for support pole and foundation design.
- B. Framework: All framework, consisting of line posts, terminal posts, top rail, braces and gate frames, shall be thermal fusion coated with a Polyvinyl Chloride (PVC) coating class 2b which has been thermally fused to the metal surface. The thickness of the coating shall be ten (10) to fifteen (15) mils. The vinyl shall be plasticised and thoroughly compounded so there are no undispersed pigments, stabilizers or other discrete particles present. PVC color: Black.
1. Round Steel Pipe: Standard weight, Schedule 40, galvanized steel pipe complying with ASTM F 1083. Comply with ASTM F 1043, Material Design Group IA, external and internal coating Type A, consisting of not less than 1.8-oz./sq. ft. (0.55-kg/sq. m) zinc.
- C. Line Posts: Type I or II vinyl coated thermally fused with polyvinyl chloride, class 2b over galvanized steel of sufficient length to allow for installation to a depth of approximately 3'-0" below ground level. All posts shall be spaced in the line of fence not further apart than 10'-0" and fabric shall be fastened to them by means of permafused No. 9 gauge vinyl coated ties spaced approximately fifteen inches (15") apart.

Minimum post size for fence height:

1. Four (4) feet (no windscreen): 1.90" O.D., 2.72 lbs./ft.
2. Six (6) with windscreen: As determined by delegated design engineer.

- D. Terminal and Gate Posts: End, corner and gate posts shall be vinyl coated steel of sufficient length to allow for a depth of approximately 3'-0" below ground level. Fabric shall be attached to these round posts by means of a vinyl coated steel or reinforced fiberglass tension strip held in place by specially designed clips.

Minimum Post size for fence height:

3. Four (4) feet (no windscreen): 2.375" O.D., 3.65 lbs./ft.
4. Six (6) with windscreen: As determined by delegated design engineer.

- E. Post Brace Rails: Match top rail for coating and strength and stiffness requirements. Provide brace rail with truss rod assembly for each gate, end, and pull post. Provide two brace rails extending in opposing directions, each with truss rod assembly, for each corner post and for pull posts. Provide rail ends and clamps for attaching rails to posts.
- F. Top Rail: The fence shall have a continuous top rail for its full length of vinyl coated steel 1.66" O.D. tubing, 1.84 pounds per foot. The top rail shall pass through openings provided in the vinyl coated post tops and each length shall be coupled with a vinyl coated sleeve coupling, or by a three inch (3") long swaged end. Fabric shall be attached to the top rail by means of double wrapped Permafused vinyl coated tie wires spaced at intervals of approximately 2'-0".

Manufacturer's longest lengths (17 to 21 feet) with swaged-end or expansion-type coupling, approximately six inches (6") long for joining. Provide rail ends or other means for attaching top rail securely to each gate corner, pull, and end post.

1. Round Steel: 1.660-inch OD Type I or II steel pipe.

- G. Bottom Rail: Install same as top rail. Bottom rail is to be tied to fabric by means of a 13 gage vinyl coated tie wire double wrapped at twenty-four-inch (24") intervals (turn ends in). Bottom rail is required on all fencing.
 - 1. Bottom Rail: 1.660-inch OD Type I or II steel pipe.
- H. Swing Gate Posts: Furnish posts to support single gate leaf, or one leaf of a double-gate installation, according to ASTM F 900, sized as follows for steel posts.
 - 1. Posts: Steel posts for fabric height of six feet (6') or less and gate leaf width:
 - a. Up to and including four (4) feet: 2.375-inch OD pipe weighing at least 3.11 lbs. per foot. Over four feet (4') to ten feet (10'): 2.875-inch OD pipe weighing at least 4.64 lbs. per foot.
 - b. Provide greater diameter or heavier pipe material as determined by delegated design engineer where windscreen is to be applied to fence.

2.3 FITTINGS AND ACCESSORIES

- A. Fittings: All fixed component parts, such as post tops, bands, connectors, and rail ends shall be vinyl coated on visible surfaces. Non-visible portions or parts may be uncoated in the case of aluminum components. Visible portions of steel or iron components not vinyl coated shall be galvanized. All threaded parts shall be coated in the field with a vinyl base compound after installation.
- B. Material: Comply with ASTM F 626. Mill-finished aluminum, galvanized iron or pressed steel to suit manufacturer's standards.
 - 1. Steel and Iron: Unless specified otherwise, hot-dip galvanize pressed steel or cast-iron fence fittings and accessories with at least 1.2 oz. Zinc per square foot, as determined by ASTM A 90.
 - 2. Supplemental Color Coating: In addition to above metallic coatings, provide a 10 mil minimum polyvinyl chloride (PVC) plastic resin finish applied to exterior surfaces and, except inside cap shapes, to exposed interior surfaces. Color to match chain link fabric.
- C. Post and Line Caps: Provide weather-tight closure cap for each post. Provide line post caps with loop to receive or top rail.
- D. Top rail and brace rail ends: Pressed steel per ASTM F626, for connection of rail and brace to terminal posts.
- E. Top rail sleeves: 7-inch expansion sleeve with spring, allowing for expansion and contraction of top rail.
- F. Bottom Rail: Provide manufacturer's standard galvanized steel, cast-iron, or cast-aluminum cap for each end.
- G. Tension or Stretcher Bars: Hot-dip galvanized steel with a minimum length two inches (2") less than the full height of fabric, a minimum cross section of three-sixteenths inch (3/16") by three-fourths inch (¾") inch, and a minimum of 1.2 oz. of zinc coating per square foot. Provide one (1) bar for each gate and end post, and two (2) for each corner and pull post, except where fabric is integrally woven into the post.
 - 1. Coating Type II Zinc in the following class as determined by ASTM A 90.a.Class 2, with a minimum coating weight of 1.20 oz. Per sq. ft. of uncoated wire surface.

- H. Wire ties: 9 gauge [0.148" (3.76 mm)] galvanized steel wire for attachment of fabric to line posts. Double wrap 13 gauge [0.092" (2.324 mm)] for rails and braces.
- I. Brace and tension (stretcher bar) bands: Pressed steel. At square post provide tension bar clips.
- K. Truss rods & tightener: Steel rods with minimum diameter of 5/16" (7.9 mm). Capable of withstanding a tension of minimum 2,000 lbs.
- N. Nuts and bolts are galvanized but not vinyl coated.

2.4 SWING GATES

- A. Gates: Comply with ASTM F 900, provide single or double gate openings as shown on the plan. Gate Posts shall be vinyl coated steel sized in accordance with Section 2.2.,C. Gate Frame shall be filled with chain link fabric of the same gauge as the fence. The fabric shall be fastened in the frame on all four (4) sides by means of coated fasteners and tension rods.

Substantial vinyl clad galvanized gate frame and gate post hinges shall be furnished of adequate strength for the gate size specified and to allow 270° swing. Gates shall be equipped with a galvanized positive latching device that will accommodate padlocking.

- B. Fabricate perimeter frames of gates from same material and finish as fence framework. Assemble gate frames by welding. Provide horizontal and vertical members to ensure proper gate operation and attachment of fabric, hardware, and accessories. Space frame members maximum of eight feet (8') apart unless otherwise indicated.
 - 1. Fabric: Same as for fence unless otherwise indicated. Secure fabric at vertical edges with tension bars and bands and to top and bottom of frame with tie wires.
 - 2. Bracing: Install diagonal cross-bracing consisting of five-sixteenth inch (5/16") diameter adjustable-length truss rods on gates to ensure frame rigidity without sag or twist.
 - 3. Steel: Gates up to eight feet (8') wide:
 - a. Up to Six feet (6') High: Fabricate perimeter frames of 1.660 inch minimum OD Type I or II steel pipe or one and one-half inch (1 ½") square galvanized steel tubing weighting 1.84 lbs. per square feet.
 - 4. Gate Hardware: Provide hot dipped galvanized steel hardware and accessories for each gate according to the following:
 - a. Hinges: Size and material to suit gate size, non-lift-off type, offset to permit the 270-degree gate opening. Provide one and one-half (1- ½) pair of hinges for each leaf over six foot (6') nominal height.
 - b. Latch: Forked type or plunger-bar type to permit operation from either side of gate, with padlock eye as an integral part of latch.
 - c. Gate Stops: Provide gate stops for double gates consisting of mushroom-type flush plate with anchors, set in concrete, and designed to engage a center drop rod or plunger bar. In addition, provide gate stops for open position of gates. Include a locking device and padlock eyes as an integral part of the latch, permitting both gate leaves to be locked with a single padlock.
 - d. Field coat moveable parts (e.g. hinges, latch, keeper), with PVC touch up paint, provided by manufacturer, to match adjacent finishes.

2.5 CANTILEVER SLIDE GATES

- A. Chain link cantilever slide gates vinyl coated thermally fused with enclosed aluminum track and hardware.
- B. Special Warranty
 - 1. Provide manufacturer's standard limited warranty covering cantilever slide gate and truck assembly against failure resulting from normal use for a period of five (5) years from date of purchase. Failure is defined as any defect in manufacturing that prevents the gate from operating in a normal manner.
- C. Manufacturer
 - 1. Products from qualified manufacturers having a minimum of five (5) years experience manufacturing internal roller cantilever slide gate, will be acceptable by the Design Professional as equal if they meet all of the following specifications for design, size, gauge of metal parts and fabrication.
- D. Cantilever Slide Gate Fabrication
 - 1. Gate Frames: Fabricate chain link cantilever slide gates in accordance with ASTM F 1184, Type II, Class 2, using two inch (2") square aluminum members, ASTM B 221, alloy and temper 6063-T6, weighing 0.94 lbs./ft. Weld members together forming rigid one-piece frame integral with top track. Provide two (2) truck assemblies for each gate leaf.
 - 2. Internal Uprights: Two inches by two inches (2" x 2") aluminum members welded in gate frames, at eight feet (8') on center, subdividing frame into panels.

Gate Width: Cantilever Support (overhang)
15' to 22' 10'-0"
 - 3. For gate leaf sizes three feet (3') to forty feet (40'), weld two (2) top track/rails together forming a dual enclosed track. Provide two (2) truck assemblies for each track for each gate leaf, total four (4) truck. Both rail shall consist of two inches by four inches (2" x 4") aluminum member weighing 1.71 lbs./ft.
 - 4. Gate Frame Finish: PVC Vinyl Coated except track 10 to 15 mils thick thermally fused. Chain Link Filler Finish: PVC thermally fused, ASTM Class-2b. Install fabric with hook bolts and tension bars at all four (4) sides. Attach to gate frame at not more than fifteen inches (15") on center.
 - 5. Bracing: Provide diagonal adjustable length truss rods, of three-eighths inch (3/8") galvanized steel, in each panel of gate frames.
 - 6. Top Track / Rail: Enclosed, combination one-piece track and rail, aluminum extrusion with weight of 3.72 lbs./ft. Track to withstand reaction load of 2,000#.
 - 7. Truck Assembly: Swivel type, zinc die cast, with four (4) sealed lubricant ball bearing rollers, two inches (2") in diameter by nine-sixteenth inches (9/16") in width, and two (2) side rolling wheels to ensure track alignment in track. Mount trucks on post brackets using seven-eighths inch (7/8") diameter ball bolts with one-half inch (1/2") shank. Design truck assembly to withstand same reaction load as track, 2,000#.
 - 8. Gate Hangers, Latches, Brackets, Guide Assemblies, and Stops: Malleable iron or steel, galvanized after fabrication. Provide positive latch and provisions for padlocking (these fittings do not receive PVC coating).
 - 9. Bottom Guide Wheel Assemblies: Each assembly shall consist of two four-inch (4") diameter rubber wheels, straddling bottom horizontal gate rail, allowing

- adjustment to maintain gate frame plumb in proper alignment. Attach one (1) assembly to each guide post. These fittings do not receive PVC coating.
10. Gate Posts: For gates under 31'-0" (9449 mm) galvanized steel four inches (4") (100 mm) OD Schedule 40 Pipe, ASTM F 1083 weighing 9.1 lbs./ft. Provide one (1) latch post and two (2) support posts for single slide gates.
 - a. PVC coating to match fence.

2.6 CAST-IN-PLACE CONCRETE

- A. General: Comply with ACI 301 for cast-in-place concrete.
- B. Materials: Portland cement complying with ASTM C 150, aggregates complying with ASTM C 33, and potable water for ready-mixed concrete complying with ASTM C 94.
 1. Concrete Mixes: Normal-weight concrete (air entrained) with not less than 4000 psi compressive strength (28 days), 3-inch slump, and 1-inch maximum size aggregate.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install fence to comply with ASTM F 567. Do not begin installation and erection before final grading is completed, unless otherwise permitted. Coordinate fencing installation with ball control netting system installer.
 1. Apply fabric to inside of framework of fencing enclosing play areas, recreation areas and sports fields.
 2. Apply fabric to outside of framework of security and barrier fencing.
- B. Post Setting: Set posts in cylindrical concrete footing. Protect portion of posts aboveground from concrete splatter. Place concrete around posts and vibrate or tamp for consolidation. Using mechanical devices to set line posts per ASTM F 567 is not permitted. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during placement and finishing operations until concrete is sufficiently cured.
 1. The post hole shall be excavated six (6) inches more than the full depth of post embedment.
 2. Line post footings diameter: As determined by the delegated-design engineer but no less than ten (10) inches in diameter.
 3. Terminal post footing diameter: As determined by the delegated-design engineer but no less than twelve (12) inches in diameter.
- D. Excavation: Excavate for posts to diameters and spacing indicated, in firm, undisturbed or compacted soil.
 1. Unless otherwise indicated, excavate hole depths approximately six inches (6") lower than post bottom, with bottom of posts set not less than thirty-six inches (36") below finish grade surface.
- E. Setting Posts: Center and align posts in holes six inches (6") above bottom of excavation. Space a maximum of ten feet (10') o. c., unless otherwise indicated.

1. Protect portion of posts above ground from concrete splatter. Place concrete around posts and vibrate or tamp for consolidation. Check each post for vertical and top alignment and hold in position during placement and finishing operations.
- F. Top Rails: Run rail continuously through line post caps, bending to radius for curved runs and at other posts terminating into rail end attached to posts or post caps fabricated to receive rail. Provide expansion couplings as recommended by fencing manufacturer.
- G. Brace Assemblies: Install braces at end and gate posts and at both sides of corner and pull posts. Locate horizontal braces at mid-height of fabric on fences with top rail and at two thirds fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.
- H. Fabric: Leave approximately one-inch (1") between finish grade and bottom selvage or bottom rail unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Install fabric on side of fence indicated in 3.1.A above, and anchor to framework so that fabric remains under tension after pulling force is released.
- I. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts with tension bands spaced not over fifteen inches (15") o.c.
- J. Tie Wires: Use wire of proper length to secure fabric firmly to posts and rails. Bend ends of wire to minimize hazard to persons or clothing.
 1. Maximum Spacing: Tie fabric to line posts twelve inches (12") o.c. and to rails and braces twenty-four inches (24") o.c. Ends shall be twisted at least two (2) full turns.
- K. Fasteners: Install nuts for tension bands and carriage bolts on the side of the fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts for added security.

3.2 GATE INSTALLATION

- A. Install gates plumb, level, and secure for full opening without interference. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary. Install gates according to manufacturer's instructions, plumb, level, and secure.
- B. Install gate stops to secure gate in open position at a 95-degree swing sector.

3.3 ADJUSTING

- A. Gates: After repeated operation of completed installation equivalent to three (3) days' use by normal traffic, readjust gates for optimum operating condition and safety. Lubricate operating equipment and clean exposed surfaces. Ensure that latches, keepers and locks engage accurately and securely without forcing or binding.

END OF SECTION 32 31 13

SECTION 32 32 23 – SEGMENTAL RETAINING WALLS

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. This Section includes the following:
 - 1. Single-depth segmental gravity retaining walls without soil reinforcement.
 - 2. Multiple-depth segmental gravity retaining walls without soil reinforcement.
 - 3. Segmental retaining walls with soil reinforcement.
- B. Related Sections:
 - 1. Division 31 Section 31 20 00 "Earthwork" for excavation and subgrade preparation for segmental retaining walls.

1.3 PERFORMANCE REQUIREMENTS

- A. Basis of Design: Design of segmental retaining walls is based on products indicated. If comparable products of other manufacturers are proposed, provide engineering design for proposed products, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Delegated Design: Design segmental retaining walls, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Structural Performance: Engineering design shall be based on the following loads and be according to NCMA's "Design Manual for Segmental Retaining Walls."
 - 1. Include the effects of sloped backfill as indicated on Drawings.
 - 2. Include the effects of superimposed loads as indicated on Drawings.

1.4 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform the following preconstruction testing:
 - 1. Test soil reinforcement and backfill materials for pullout resistance according to ASTM D 6706.
 - 2. Test soil reinforcement and backfill materials for coefficient of friction according to ASTM D 5321.

1.5 SUBMITTALS

- A. Qualification Data: For firms and persons specified in the Quality Assurance article to demonstrate their capabilities and experience. Include the following information:
 - a. Project name and location
 - b. Date of construction
 - c. Contact information of Owner or General Contractor

- d. Type of MSE facing system used and if modular block provide type
 - e. Maximum MSE structure height constructed
 - f. Face area of MSE structure
- B. Delegated-Design Submittal: For segmental retaining 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. Compliance Review: Qualified professional engineer responsible for segmental retaining wall design shall review and approve submittals and source and field quality-control reports for compliance of materials and construction with design.
- C. Product Data: For each type of segmental retaining wall and other manufactured products specified.
- D. Shop Drawings: Provide shop drawings indicating cross-sections, dimensions of wall thickness, height, wall batter, backfill, soil reinforcement, corner and cap treatment, drainage, wall footing materials and depth, etc.
 - 1. Structural analysis calculations report incorporating soils data for the project site, signed and sealed by a registered professional engineer responsible for its preparation.
 - 2. Foundation Soil Preparation: Evidence that that actual foundation soil strength meets or exceeds the assumed design strengths for the wall system. This submission of evidence shall be sealed by a Pennsylvania Registered Professional Engineer. Soil not meeting the required strength shall be removed and replaced with acceptable material.
- E. Samples for Verification: Sets for each color, finish, cap and pattern of unit required. Include 2 or more samples in each set showing the full range of variations expected.
- F. Product Test Reports: Indicate compliance of retaining wall units and soil reinforcement with requirements based on comprehensive testing of current products.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Experience:
 - a. Five years experience in construction of segmental block structures with a total face area of no less than 20,000 square feet.
 - b. Construction experience with a minimum 10,000 square feet of segmental block structures with the proposed facing system for this project.
 - c. Construction of five (5) segmental block structures with heights that are comparable (within 4 feet) to that proposed.
 - d. Construction of at least 5,000 square feet of the modular block system proposed within the past two years.
- B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where the Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of systems that are similar to those indicated for this Project in material, design, and extent.

- C. Pre-Construction Test Reports.
- D. Source Quality Control Reports.
- E. Pre-Installation Conference: Conduct a meeting between the Prime/General Contractor, Sub-Contractors, Owner, Geotechnical Engineer and the Design Professional to review the scope of work in this section, coordination with other work, special project conditions and quality standards. Notify all parties and schedule the meeting a minimum of two (2) weeks prior to the anticipated start of the work specified under this Section.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project Site in an undamaged condition.
- B. Store and handle retaining wall units and related materials to prevent deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping, or other causes.
- C. Store accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.
- D. Store and handle geotextiles according to ASTM D 4873.

1.8 PROJECT CONDITIONS

- A. Site Information: Prior to beginning earthwork operations the contractor shall investigate existing underground utility locations, research public and site utility records, and dig test pits in areas indicated on the construction drawings to verify existing utility depths and locations and to the extent necessary to verify that the wall system may be installed in compliance with original design and referenced standards. If the contractor determines that the original design is in conflict with existing utilities, he shall immediately notify the Design Professional of such conflict. Contractor is cautioned not to order any materials until such verification and/or Design Professional clarification has been provided.
- B. Coordinate wall construction with other work in progress on schedules to occur near same location.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Retaining Wall Units:
 - Licensees of Anchor Diamond
 - Licensees of ICD Corp. Stone Wall Select
 - Licensees of Keystone Retaining Wall Systems, Inc.
 - Licensees of Versa-Lok Retaining Wall Systems Division
 - 2. Soil Reinforcement:
 - Provide soil reinforcement required by approved retaining wall system manufacturer or supplier and qualified registered professional engineer.

2.2 RETAINING WALL UNITS

- A. Concrete Units: High-strength, regular-weight concrete units, designed for use in segmental retaining walls, complying with ASTM C 90, except with net-area compressive strength of 3000 psi (20.7 MPa) for average of 3 units and 2500 psi (17.2 MPa) for individual unit, maximum water absorption of 8 percent, and variation in height limited to 1/16 inch (1.6 mm).
 - 1. Provide units with lugs, projections, or holes and pins that locate successive courses in relation to the course below and maintain that alignment as backfill is placed, and that interlock with units above and below.
- B. Colors: Provide units that result in colors of exposed wall surfaces complying with the following requirements:
 - 1. Provide Design Professional's selection from manufacturer's full range of colors for materials and products of type indicated.
- C. Surface Texture: Provide units with rough-split faces and smooth, as-cast beds.
- D. Shapes: Provide units of basic shapes and dimensions indicated.
 - 1. Exposed Face: Flat face with rough-split texture.
- E. Batter: In accordance with manufacturer's and engineering requirements. Maximum 1.25h:8v.
- F. Special Units: Provide corner units, end units, cap units, and other special shapes as necessary to produce retaining walls of dimensions and profiles indicated and to provide indicated textures on exposed surfaces.
 - 1. Cap units shall provide closed, tight horizontal and vertical joints. Wedge-shaped open joints are not acceptable.

2.3 INSTALLATION MATERIALS

- A. Pins: Product supplied by retaining wall unit manufacturer for use with units provided, made from non-degrading polymer reinforced with glass fibers.
- B. Cap Adhesive: Product supplied or recommended by retaining wall unit manufacturer for adhering cap units to units below.
- C. Base: Quality-controlled, graded aggregate complying with ASTM D 2940 for base material.
- D. Drainage Fill: Comply with requirements of Division 31 Section "Earthwork."
- E. Drainage Pipe: Perforated polyethylene pipe and fittings. Complying with ASTM F 405, corrugated, for coupled joints. Provide with manufacturer's standard, band-type couplings.
- F. Weep Pipe: Solid polyethylene pipe. Complying with ASTM F 405, corrugated, for coupled joints. Provide with manufacturer's standard, band-type couplings.

- G. Soil Reinforcement: Provide the soil reinforcement required by the qualified registered professional engineer and manufacturer according to the following properties as applicable:

1. Tensile Strength
2. Elongation
3. Apparent Open Area
4. Tearing Strength
5. Ultraviolet Stability
6. Junction Strength

2.4 SOURCE QUALITY CONTROL

- A. Test and inspect each roll of soil reinforcement at the factory for minimum average roll values for geosynthetic index property tests including the following:
1. Weight.
 2. Roll size.
 3. Grab or single-rib strength.
 4. Aperture opening.
 5. Rib or yarn size.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive segmental retaining walls and conditions under which walls will be installed, with Installer present, for compliance with requirements for excavation tolerances, condition of subgrades, and other conditions affecting performance of retaining walls.
- B. Do not proceed with installation until unsatisfactory conditions have been corrected.
- C. Verify layout information shown on the drawings and existing benchmarks before proceeding to layout the wall.
- D. Layout retaining wall to lines and grades shown on the drawings.
- E. Calculate and measure required dimensions within indicated tolerances. DO NOT scale drawings to determine dimensions.
- F. The contractor shall excavate to lines and grades indicated for construction of the retaining wall including the Geogrid soil reinforcement and backfill system.

3.2 RETAINING WALL INSTALLATION

- A. General: Place units according to manufacturer have written instructions. Lay units in running bond, overlapping half units of course below.
1. Form corners and ends by using special units.
- B. Leveling Base: Place and compact base material to thickness indicated and with not less than 95 percent of maximum dry density according to ASTM D 698.

- C. First Course: Place first course of retaining wall units on leveling base/course for full length of wall. Place units in firm contact with each other, properly aligned and level.
 - 1. Tamp units into leveling base as necessary to bring tops of units into a level plane.
 - 2. Place and compact fill, either drainage fill or soil fill as indicated, to top of first course. Place fill on both sides of wall at same time without disturbing alignment of units. Fill voids between and within units with drainage fill.
- D. Subsequent Courses: Sweep excess fill from tops of course below. Place units in firm contact, properly aligned, and directly on course below.
 - 1. For units with lugs designed to fit into holes in units of adjacent course, lay units so lugs are accurately aligned with holes and bedding surfaces are firmly seated on beds of units below.
 - 2. For units with lips of front of units, slide units as far forward as possible for firm contact with lips of units below.
 - 3. For units with pins, carefully align holes in units above with holes below and insert pins according to manufacturer's written instructions.
 - 4. Place and compact fill as each course is laid. Place fills on both sides of wall at same time, where both sides are indicated to be filled.
 - 5. Fill voids between and within units with drainage fill.
- E. Cap Units: Place cap units and secure with cap adhesive according to manufacturer's written instruction.
- F. Cap units shall provide closed, tight joints. Wedge shaped, open joints will be rejected.

3.3 FILL PLACEMENT

- A. General: Comply with requirements of Division 31 Section "Earthwork" and retaining wall unit manufacturer's written instructions.
- B. Place, spread, and compact fill in uniform lifts for full width and length of embankment as wall is laid. Begin at back of wall and place and spread fill toward embankment.
 - 1. Use only hand-operated compaction equipment within 36 inches of wall.
 - 2. Compact drainage fill to not less than 95 percent maximum dry density according to ASTM D 698.
 - 3. Compact reinforced soil fill to not less than 95 percent maximum dry density according to ASTM D 698.
 - 4. Compact unreinforced soil fill to not less than 90 percent maximum dry density according to ASTM D 698.
- C. Place a layer of drainage fill at least 12 inches deep behind the block units to within 12 inches of finished grade.
- D. Wrap drainage pipe with filter fabric and place in drainage fill as indicated, sloped ¼ inch per foot to drain.
- E. Place impervious fill over top edge of drainage fill layer.
- F. Where soil reinforcement is required, place in horizontal joints of retaining wall where indicated and according to soil reinforcement manufacturer's written instructions. Embed reinforcement a minimum of 8 inches (200 mm) into retaining wall and stretch tight horizontally over compacted backfill. Anchor soil reinforcement before placing fill on it.

- G. Use additional soil reinforcement at corners and curved walls to provide continuous reinforcement and to comply with manufacturer's written instructions.

3.4 CONSTRUCTION TOLERANCES

- A Variation in Plan Position: For ends and faces of walls in relation to property lines, buildings, and other objects, do not vary from plan dimensions by more than 1 inch or from depicted plan relationship (scaled dimensions) by more than 3 inches.
- B Variation in Linear Wall Line: For walls indicated as straight, do not exceed ¼ inch in 10 feet or 1 inch in 40 feet or more from a straight line.

3.5 FIELD QUALITY CONTROL

- A. Comply with requirements of Division 31 Section "Earthwork" for in-place soil density testing.

3.6 ADJUSTING AND CLEANING

- A. Remove and replace segmental retaining walls of the following description:
 - 1. Broken, chipped, stained, or otherwise damaged units. Units may be repaired if methods and results are approved by Design Professional.
 - 2. Segmental retaining walls not matching approved samples and mockups.
 - 3. Segmental retaining walls not complying with other requirements indicated.
- B. Replace in a manner that result in segmental retaining wall's matching approved samples and mockups, complying with other requirements, and showing no evidence of replacement.

END OF SECTION 32 32 23

SECTION 129300 - SITE FURNISHINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This section includes the following:
 - 1. Security Gates.
 - 2. Flagpoles.
 - 3. Bollards.
 - 4. Benches.
 - 5. Gable Roof Pavilions.
- B. Related Sections:
 - 1. Division 03, Section 033000, "Cast In Place" concrete for concrete footings.
 - 2. Division 09, Section 099123 "Interior Painting" for painting of shop-fabricated bollards.
 - 3. Division 31, Section 312000 "Earthwork" for footing excavation.
 - 4. Division 32, Section 321313 "Concrete Paving" for concrete flatwork.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instruction for the materials and products.
- B. Shop Drawings: Plans, sections, elevations, details showing all components, layouts and relationship to other work. Provide sealed drawings by a registered professional engineer where indicated.
- C. Delegated-Design Submittals: For systems 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 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in the manufacture of products of types, materials and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.
- B. Comply with standards specified.
- C. Pre-Installation Conference: Conduct a meeting between the Prime/General Contractor, Sub-Contractors, the Owner and the Design Professional to review the scope of work in this section, coordination with other work, special project conditions and quality standards. Notify all parties and schedule the meeting a minimum of two (2) weeks prior to the anticipated start of the work specified under this Section.

1.5 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design pavilions and foundations including comprehensive engineering analysis by a qualified professional engineer; using performance requirements and design criteria indicated.
- B. Structural Performance: Engineering design shall be based on withstanding minimum loading required by local building codes but no less than:
 - 1. Wind: $V_{ULT} = 115$ MPH
 - 2. Ground snow $P_g = 30$ psf

1.5 ALLOWABLE TOLERANCES

- A. Erect manufactured accessories with vertical members plumb to within one-fourth inch ($\frac{1}{4}$ ") per ten feet (10'). Horizontal members shall be level to within one-fourth inch ($\frac{1}{4}$ ") per ten feet (10').

1.6 DELIVERY AND STORAGE OF MATERIALS AND EQUIPMENT

- A. Materials and equipment shall be delivered with manufacturers' labels intact. They shall be protected during delivery against damage and weather conditions. Materials and equipment shall be delivered as shipped by the product source. Damaged materials and equipment and incomplete orders shall not be accepted.
- B. Materials and equipment shall be stored off the ground and protected against weather, damage due to surrounding activity and vandalism.

1.7 PROJECT CONDITIONS

- A. Report any conflicts between proposed locations furnishings and other site improvements including underground utility systems.

PART 2 - PRODUCTS

2.1 SECURITY GATES

- A. Manufacturer/Product: Aluminum Vehicular Barrier Gate No. VBG-6 by Security Fabricators, Inc. or approved equal.
- B. Materials:
 - 1. Frame material alloy 6063T-6; Schedule 40 pipe; ASTM B429.
 - a. Finish: Polyester powder-coating. Color: Yellow.
 - 2. Anchor bolts: Hot-dipped galvanized.
 - 3. Shoe base for aluminum pipe: permanent mold of 356 aluminum alloy casting with natural finish.
 - 4. Stud post: Aluminum schedule 40 pipe.
 - 5. Sleeve post: Aluminum pipe with .375" wall.
 - 6. Footing: 4000 psi cast-in-place concrete.
 - 7. Width: As indicated.

2.2 FLAGPOLES

A. Approved Manufacturers:

1. American Flagpole & Flag Co.
2. Eder Flag Mfg. Co., Inc.
3. Acme Lingo Flagpole Co.

B. Basis of Design:

1. Eder Flag Model ECA40. Ground-set, cone-tapered aluminum flagpole with external halyard system.
2. Exposed height: 40'
3. Single revolving Truck.
4. Pole Finish: Brushed aluminum.
5. Spun aluminum flash collar.
6. Ornamental Ball finish: Anodized aluminum w/ gold finish.
7. Footing: 4000 psi cast in place concrete with manufacturer's provided foundation tube.

C. Structural Performance: Provide flagpoles capable of withstanding the effects of wind loads as determined according to the building code in effect for this project or NAAMM FP1001, "Guide Specifications for Design Loads of Metal Flagpoles", whichever is more stringent. Base flagpole design on maximum standard- size flag suitable for use with pole or flag size indicated, whichever is more stringent.

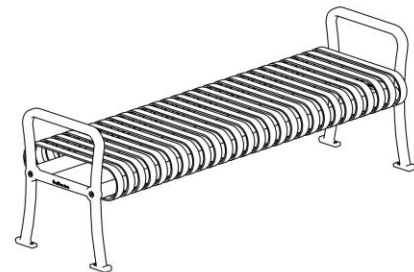
2.3 BOLLARDS

- A. Shop-fabricated steel pipe bollards: ASTM A53 Grade B, Schedule 80 pipe.
- B. Footings: 4000 psi cast in place concrete.
- C. Finish: Paint as indicated.

2.4 BENCHES

A. Dumor, Inc. Bench Model 95-60:

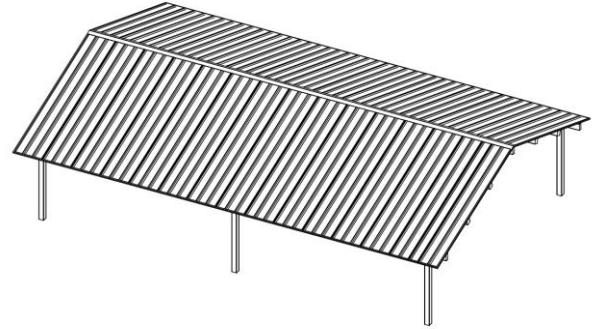
1. Size: 6 feet long.
2. Style: Backless with armrests on each end. No center armrests.
3. Material: Steel.
4. Finish: Polyester powder coat. Provide Architect's color selection from manufacturer's standard range.
5. Bolt down installation.



- B. Bench Pads: 4000 psi concrete slab as indicated.
- C. Bench shims: Type 316 stainless steel sheet or plate. Thickness as required by site conditions.
- D. Fastening hardware: Manufacturer's provided Type 316 stainless steel expansion bolts.

2.5 GABLE ROOF PAVILIONS

- A. Polygon Gable Roof Pavilions
 - 1. Model REK-30x44 (Pavilion #1)
 - 2. Model REK-20x44 (Pavilion #2)
- B. Features:
 - 1. Metal roofing: Multi-Rib metal roof deck panels
 - 2. Roof Deck: Tongue & Groove 2x6 Hem Fir with stain.
 - 3. Coating: Duplex coating system; galvanized steel with TGIC powder coating.
 - 4. Colors: Provide architect's selections from Manufacturer's standard range.



- C. Materials:

<u>DESCRIPTION</u>	<u>ASTM DESIGNATION</u>
TUBE STEEL	A500 (GRADE B)
SCHEDULE PIPE	A53 (GRADE B)
RMT PIPE	A519
LIGHT GAGE COLD FORMED	A1003 (GRADE 50)
STRUCTURAL STEEL PLATE	A36
ROOF PANELS (STEEL)	A653

- D. Provision for electrical: Provide prefabricated cut outs for electrical outlets in pavilion structural posts as indicated on electrical drawings. Run all conduit internal to posts.
- E. Delegated Design: Design pavilion and foundations, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated. Submit stamped engineering analysis for pavilion and foundation design.

PART 3 - EXECUTION

3.1 SECURITY GATES

- A. Install in accordance with plans and manufacturer's recommendations and details with concrete footings at locations indicated.
- B. Gate Wing Sector: 90 degrees minimum.

3.2 FLAGPOLES

- A. Excavation: For foundation, excavate to neat clean lines in undisturbed soil. Remove loose soil and foreign matter from excavation and moisten earth before placing concrete.
- B. Install flagpole foundation, concrete foundation and flagpole in accordance with manufacturer's written instructions.
- C. Trowel exposed concrete surfaces to a smooth, dense finish, free of trowel marks and

uniform in texture and appearance. Provide positive slope for water runoff.

- D. Set flagpole plumb with hardwood wedges and backfill with compacted sand.

3.3 PIPE BOLLARDS

- A. Install bollards plumb in concrete footings as indicated.
- B. Thoroughly clean and remove all rust and corrosion from surface of bollard prior to application of paint and primer.

3.4 BENCHES

- A. Secure benches on concrete bench pads where indicated using manufacturer's provided hardware.
- B. Shim benches to sit level end to end.

3.5 GABLE ROOF PAVILIONS

- A. Install pavilion and foundations in accordance with manufacturer's written instructions and approved shop drawings.
- B. Coordinate provision of duplex outlets with electrical contractor.

END OF SECTION 323300

SECTION 32 33 43 - SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Traffic Control Signs
 - 2. Accessible Parking signs
 - 3. Parking Lot Number signs
 - 4. Sign Posts

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instruction for the materials and products.

1.4 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of products of types, materials and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.
- B. Comply with standards specified.

1.5 DESIGN CRITERIA

- A. Design, size, material of and location of signs as shown on the plans shall not be altered without permission of the Design Professional.
- B. Placement of signs within public right-of-ways shall be in compliance with the local agency's jurisdiction requirements.

1.6 ALLOWABLE TOLERANCES

- A. Erect manufactured accessories with vertical members plumb to within one-fourth inch ($\frac{1}{4}$ ") per ten feet (10'). Horizontal members shall be level to within one-fourth inch ($\frac{1}{4}$ ") per ten feet (10').

1.7 PROJECT CONDITIONS

- A. Report any conflicts between proposed sign locations, underground utilities and other site improvements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements provide sign products from one of the following:
 - 1. Seton, www.seton.com
 - 2. MD Solutions, Inc., www.md-signs.com
 - 3. Barco Products, www.barcoproducts.com
 - 4. A PennDOT Bulletin 15 listed sign manufacturer.
- B. Subject to compliance with requirements provide sign posts from one of the following:
 - 1. Chicago Heights Steel, www.chs.com
 - 2. Franklin Industries, www.franklinindustriesco.com
 - 3. Nucor Steel Marion, www.nucorhighway.com
 - 4. A PennDOT Bulletin 15 listed sign post manufacturer.

2.2 TRAFFIC CONTROL SIGNS

- A. General: All signs to conform to the Manual of Uniform Traffic Control Devices (MUTCD) latest edition, unless otherwise noted.
- B. Signs to be fabricated from heavy gauge aluminum with baked enamel finish (reflectorized).
- C. Provide tamper-proof fasteners in galvanized steel.

2.3 ACCESSIBLE PARKING SIGNS

- A. Provide signs fabricated from heavy gauge aluminum incorporating the universal white symbol and lettering on blue background with baked enamel finish.
- B. Provide tamper-proof fasteners in galvanized steel.

2.4 PARKING LOT NUMBER SIGNS

- A. Provide signs fabricated from heavy gauge aluminum with baked enamel finish.
- B. Match colors and graphics of existing lot number signs. Owner will provide numbering scheme.
- C. Provide tamper-proof fasteners in galvanized steel.

2.5 SIGN POSTS

- A. PennDOT approved breakaway steel breakaway U-channel posts, Type B, rolled steel 3.71 Kg/m in accordance with Form 408, Section 1103.08.
 - 1. Finish: galvanized, baked enamel, powder coated.

PART 3 - EXECUTION

3.1 SIGN POST INSTALLATION

- A. Install direct embed posts at locations indicated on the drawings.
- B. Set posts plumb and to dimensions as shown on drawings.
- C. Install steel breakaway posts in accordance with PennDOT Traffic-Control Signing Standards, Publication 111 M, TC-8700 Series, erection details.

3.2 SIGN PANEL INSTALLATION

- A. Attach sign panel to posts at height indicated on drawings.
- B. Attach sign panel to posts in accordance with PennDOT Traffic-Control Signing Standards, Publication 111 M, TC-8700 Series, erection details.

END OF SECTION 32 33 43

SECTION 05 73 00 – EXTERIOR ORNAMENTAL HANDRAILS AND RAILINGS

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

- B. This Section includes the following:
 - 1. Aluminum ornamental handrails and railing systems.

1.3 DEFINITIONS

- C. Definitions in ASTM E 985 for railing-related terms apply to this Section.

1.4 PERFORMANCE REQUIREMENTS

- D. General: In engineering handrail and railing systems to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
 - 1. Aluminum: AA "Specifications for Aluminum Structures."
- E. Structural Performance of Handrails and Railing Systems: Engineer, fabricate, and install handrails and railing systems to comply with requirements of ASTM E 985 for structural performance based on the following:
 - 1. Testing performed according to ASTM E 894 and ASTM E 935.
 - 2. Structural computations.
- F. Structural Performance of Handrails and Railing Systems: Engineer, fabricate, and install handrails and railing systems to withstand the following structural loads without exceeding the allowable design working stress of the materials for handrails, railing systems, anchors, and connections. Apply each load to produce the maximum stress in each of the respective components comprising handrails and railing systems.
 - 1. Top Rail of Guardrail Systems: Capable of withstanding the following loads applied as indicated:
 - a. Concentrated load of 200 lbf (890 N) applied at any point and in any direction.
 - b. Uniform load of 50 lbf per linear foot (730 N/m) applied horizontally and concurrently with uniform load of 100 lbf per linear foot (1460 N/m) applied vertically downward.
 - c. Concentrated and uniform loads above need not be assumed to act concurrently.
 - 2. Handrails Not Serving as Top Rails: Capable of withstanding the following loads applied as indicated:
 - a. Concentrated load of 200 lbf (890 N) applied at any point and in any direction.
 - b. Uniform load of 50 lbf per linear foot (730 N/m) applied in any direction.
 - c. Concentrated and uniform loads above need not be assumed to act concurrently.

3. Infill Area of Guardrail Systems: Capable of withstanding a horizontal concentrated load of 200 lbf (890 N) applied to 1 sq. ft. (0.09 sq. m) at any point in the system, including panels, intermediate rails, balusters, or other elements composing the infill area.
 - a. Above load need not be assumed to act concurrently with loads on top rails of railing systems in determining stress on guard.
- G. Thermal Movements: Allow for thermal movement resulting from the following maximum change (range) in ambient temperature in engineering, fabricating, and installing handrails and railing systems to prevent buckling, opening of joints, overstressing of components and connections, and other detrimental effects. Base engineering calculation on actual surface temperatures of materials due to both solar heat gain and nighttime sky heat loss.
 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- H. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.5 SUBMITTALS

- I. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.
- J. Product data for manufacturer's product lines of handrails and railing systems assembled from standard components. Submit product data for grout, anchoring cement, and paint products.
- K. Shop drawings: Scale drawings illustrating fabrication and installation of handrails and railings, including plans, elevations, sections, details of components, and attachments to other units of Work.
 1. For installed handrails and railing systems indicated to comply with certain design loadings, include structural analysis data sealed and signed by the qualified professional engineer who was responsible for their preparation.
- L. Samples for initial selection in the form of short sections of railing or flat sheet metal samples showing available mechanical finishes.
- M. Samples for verification of each type of exposed finish required, prepared on components indicated below of same thickness and metal indicated for final unit of Work. Where finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.
 2. 6-inch-long sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
 3. Fittings and brackets.
 4. Welded connections.
 5. Assembled sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Show method of finishing members at intersections. Sample need not be full height.
- N. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with

project names and addresses, names and addresses of architects and owners, and other information specified.

- O. Product test reports from a qualified independent testing agency evidencing compliance of handrails and railing systems with requirements based on comprehensive testing of current products.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: To qualify for acceptance, an independent testing agency must demonstrate based on evaluation of agency-submitted criteria conforming to ASTM E 548, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work.
- B. Installer Qualifications: Engage an installer having skilled craftsmen or individuals with a minimum of seven (7) years experience who has successfully completed installations similar in material, design, and extent to that indicated for Project.
- C. Single-Source Responsibility: Obtain handrails and railing systems of each type and material from a single manufacturer.
- D. Engineer Qualifications: A professional engineer legally authorized to practice in the jurisdiction where Project is located and experienced in providing engineering services of the kind indicated that have resulted in the installation of handrails and railing systems similar to this Project in material, design, and extent and that have a record of successful in-service performance.
- E. Pre-Installation Conference: Conduct a meeting between the Prime/General Contractor, Sub-Contractors, Owner, Geotechnical Engineer and the Design Professional to review the scope of work in this section, coordination with other work, special project conditions and quality standards. Notify all parties and schedule the meeting a minimum of two (2) weeks prior to the anticipated start of the work specified under this Section.

1.7 STORAGE

- P. Store handrails and railing systems inside a well-ventilated area, away from uncured concrete and masonry and protected from weather, moisture, soiling, abrasion, extreme temperatures, and humidity.

1.8 PROJECT CONDITIONS

- Q. Field Measurements: Where handrails and railings are indicated to fit to other construction, check actual dimensions of other construction by accurate field measurements before fabrication; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with fabricating handrails and railing systems without field measurements. Coordinate other construction to ensure that actual dimensions correspond to guaranteed dimensions.

1.9 SEQUENCING AND SCHEDULING

- R. Sequence and coordinate installation of wall handrails as follows:

2. Mount handrails only on completed walls. Do not support handrails temporarily by any means not satisfying structural performance requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering handrails and railing systems that may be incorporated in the Work include, but are not limited to, the following:

1. Aluminum Ornamental Railing Systems:
 - a. Aluminum Tube Railings, Inc.
 - b. Architectural Metal Works.
 - c. Julius Blum & Co., Inc.
 - d. Blumcraft of Pittsburgh.
 - e. J.G. Braun Co.
 - f. CraneVeyor Corp.
 - g. Livers Bronze Co., Inc.
 - h. Newman Brothers, Inc.
 - i. Pisor Industries, Inc.
 - j. Poma Corporation.
 - k. Rippel Architectural Metals, Inc.
 - l. Sterling Factories, Inc.
 - m. Superior Aluminum Products, Inc.
 - n. Wagner, R & B, Inc.
 - o. Wausau Specialty Products.
 - p. Wylie Systems.

2.2 METALS

- B. General: Provide metal free from surface blemishes where exposed to view in the finished unit. Exposed-to-view surfaces exhibiting pitting, seam marks, roller marks, stains, discolorations, or other imperfections on finished units are not acceptable.
- C. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of the alloy and temper designated below for each aluminum form required:
 2. Extruded Bar and Tube: ASTM B 221 (ASTM B 221M), alloy 6063T5/T52.
 3. Extruded Structural Pipe and Tube: ASTM B 429, 6063-T6.
 4. Drawn Seamless Tube: ASTM B 210 (ASTM B 210M), 6063-T832.
 5. Plate and Sheet: ASTM B 209 (ASTM B 209M), 6061-T6.
 6. Die and Hand Forgings: ASTM B 247 (ASTM B 247M), 6061-T6.
 7. Castings: ASTM B 26/B 26M, A356-T6.
- C. Brackets, Flanges, and Anchors: Cast or formed metal of the same type material and finish as supported rails, unless otherwise indicated.

2.3 MISCELLANEOUS MATERIALS

- A. Filler Metal and Electrodes: Provide type and alloy of filler metal and electrodes as recommended by producer of metal to be welded or brazed and as required for color match, strength, corrosion resistance, and compatibility in fabricated items.

2.4 FASTENERS

- D. General: Provide the following:
 - 1. Aluminum Components: Type 304 316 stainless-steel fasteners.
 - 2. Dissimilar Metals: Type 304/316 stainless-steel fasteners.
- E. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
- F. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work, unless otherwise indicated exposed fasteners are unavoidable exposed fasteners are the standard fastening method for railings indicated.
 - 1. Provide Phillips tamper-resistant square or hex socket flat-head machine screws for exposed fasteners, unless otherwise indicated.

2.5 GROUT

- G. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturers for exterior applications.
 - 1. Diamond-Crete Grout; Concrete Service Materials Co.
 - 2. Congrout GP; Cormix Construction Chemicals.
 - 3. Sure-grip High Performance Grout; Dayton Superior Corp.
 - 4. Sika Masterflow 928; Master Builders Technologies, Inc.
 - 5. Sealtight 588-10K Grout; W.R. Meadows, Inc.

2.6 FABRICATION

- A. General: Fabricate handrails and railing systems to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of hollow members, post spacings, and anchorage, but not less than that required to support structural loads.
- B. Assemble railing systems in shop to the greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove flux immediately.
 4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- H. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.
- I. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.
- J. Form changes in direction as follows:
1. As detailed.
 2. By bending or by inserting prefabricated elbow fittings.
- K. Form simple and compound curves by bending members in jigs to product uniform curvature for each repetitive configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- L. Close exposed ends of hollow railing members with prefabricated end fittings.
- M. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated. Close ends of returns, unless clearance between end of rail and wall is $\frac{1}{4}$ inch (6 mm) or less.
- N. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work, unless otherwise indicated.
- O. Provide inserts and other anchorage devices to connect handrails and railing systems to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by handrails and railing systems. Coordinate anchorage devices with supporting structure.
- P. For railing posts set in concrete, provide preset sleeves of steel not less than 6 inches (150 mm) long with inside dimensions not less than $\frac{1}{2}$ inch (12 mm) greater than outside dimensions of post, and steel plate forming bottom closure.
- Q. Shear and punch metals cleanly and accurately. Remove burrs from exposed cut edges.
- R. Ease exposed edges to a radius of approximately $\frac{1}{32}$ inch (1 mm), unless otherwise indicated. Form bent-metal corners to the smallest radius possible without causing grain separation or otherwise impairing work.

2.7 FINISHES, GENERAL

- H. Comply with NAAMM "Metal Finishes Manual" for recommendations relative to applying and designating finishes.
- I. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering prior to shipment.
- J. 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 they are assembled or installed to minimize contrast.

2.8 ALUMINUM FINISHES

- K. Mechanical Finish: #4 Architectural Finish: Brushed/Satin.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installing anchorages, such as sleeves, concrete inserts, anchor bolts, and miscellaneous items having integral anchors that are to be embedded in concrete as masonry construction. Coordinate delivery of such items to Project site.

3.2 INSTALLATION, GENERAL

- B. Fit exposed connections accurately together to form tight, hairline joints.
- C. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing handrails and railings. Set handrails and railings accurately in location, alignment, and elevation, measured from established lines and levels and free from rack.
 - 1. Do not weld, cut, or abrade surfaces of handrails and railing components that have been coated or finished after fabrication and are intended for field connection by mechanical or other means without further cutting or fitting.
 - 2. Set posts plumb within a tolerance of 1/4 inch in 12 feet (2 mm in 1 m).
 - 3. Align rails so that variations from level for horizontal members and from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (2 mm in 1 m).
- C. Adjust handrails and railing systems prior to anchoring to ensure matching alignment at abutting joints. Space posts at interval indicated but not less than that required by structural loads.
- D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing handrails and railings systems and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

- D. Non-welded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing

members and fittings. Seal recessed holes of exposed locking screws using plastic cement filler, colored to match finish of handrails and railing systems.

- E. Welded Connections: Use fully welded joints for permanently connecting railing components by welding. Cope or butt components to provide 100 percent contact, or use fittings designed for this purpose.
- F. Expansion Joints: Install expansion joints at locations indicated but not further apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches (50 mm) beyond joint on either side; fasten internal sleeve securely to one side; locate joint within 6 inches (150 mm) of post.

3.4 ANCHORING POSTS

- A. Anchor posts in concrete by core-drilling holes not less than 6 inches deep and 3/4 inch greater than outside diameter of post. Clean holes of all loose material, insert posts, and fill annular space between post and concrete with the following anchoring material, mixed and placed to comply with anchoring material manufacturer's directions.
 - 1. Non-shrink, nonmetallic grout.
- B. Leave anchorage joint exposed, wipe off surplus anchoring material, and leave 1/8-inch buildup, sloped away from post.

3.5 FIELD QUALITY CONTROL

- G. Testing Agency: Owner will employ a qualified independent testing agency to perform field quality-control testing.
- H. Extent and Testing Methodology: The testing agency will randomly select completed railing assemblies for testing that are representative of the different railing designs and conditions in the completed Work. Railings will be tested according to ASTM E 894 and ASTM E 935 for compliance with ASTM E 985.
- I. Testing agency will report test results promptly and in writing to Contractor and Architect.
- J. Remove and replace railings where test results indicate that they do not comply with specified requirements, unless they can be repaired in a manner satisfactory to the Architect so that they will comply with specified requirements.
- K. Additional Testing: Where railings are removed and replaced or are repaired, additional testing will be performed to determine compliance with specified requirements.

3.6 ADJUSTING AND CLEANING

- L. Clean the following metals by washing thoroughly with clean water and soap, followed by rinsing with clean water.
 - 1. Aluminum.

3.7 PROTECTION

- M. Protect finishes of railing systems and handrails from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at the time of Substantial Completion.

- N. Restore finishes damaged during installation and construction period so that no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 32 73 00

SECTION 329200 – SEEDED TURF AND GRASSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Topsoil Testing.
 - 2. Fine grading and preparing of turf areas.
 - 3. Furnishing and applying soil amendments.
 - 4. Furnishing and applying fertilizers.
 - 5. Seeding new turf areas.
 - 6. Preparation and seeding rain garden grasses.
 - 7. Replanting unsatisfactory or damaged turf.
 - 8. Maintenance.
- B. Related Sections:
 - 1. Division 31, Section 312000 "Earthwork" for excavation, filling, rough grading, subsurface aggregate drainage, drainage backfill, testing of topsoil and placement of topsoil.
 - 2. Division 32, Section 329300 "Exterior Plants" for coordination.

1.3 WORK NOT INCLUDED

- A. Items of work excluded from this Section:
 - 1. Topsoil placement
 - 2. Excavation and grading to the subgrade.
 - 3. Fine grading and compaction of subgrade.

1.4 SUBMITTALS

- A. Installer's Qualifications.
- B. Certification of Grass Seed: Submit seed vendor's certified statement for each grass seed monostand or mixture required, stating botanical and common name, percentage by weight, and percentages of purity, germination, and weed seed for each grass seed species. Include the year of production and date of packaging.
- C. Product Certificates: For soil amendments, from manufacturer.
- D. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful establishment of turf.

1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
 2. Experience: Three years' experience in turf installation.
 3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
 4. Personnel Certifications: Installer's field supervisor assigned to the Work shall have certification in one of the following categories from the Professional Landcare Network:
 - a. Landscape Industry Certified Lawncare Manager.
 - b. Landscape Industry Certified Lawncare Technician.
 5. Pesticide Applicator: State licensed, commercial.
- B. Soil-Testing Laboratory: An independent laboratory, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.
- C. General: Ship landscape materials with certificates of inspection required by governing authorities. Comply with regulations applicable to landscape materials.
- D. Substitutions: Do not make unauthorized substitutions of materials. If specified material is not obtainable, submit proposal for use of equivalent material for approval.
- E. Analysis and Standards: Package standard products with manufacturer's certified analysis. For other materials, provide analysis by recognized laboratory made in accordance with methods established by the Association of Official Agriculture Chemists, wherever applicable.
- F. Topsoil Analysis Report: Test on-site topsoil and imported topsoil using a qualified agronomist. State percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; deleterious material; pH; and mineral and plant-nutrient content of topsoil.
1. Report suitability of topsoil for turf growth. State recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory topsoil.
 2. Essential Topsoil Nutrients: All topsoil for turf (both on-site and new) to receive proper amendments so the following nutrients fall within the ideal range based on fertility tests of the topsoil receiving the sod:

Macronutrients

pH
N
P
K
Ca
Mg
S

Micronutrients

B
Fe
Mn
Cu
Mo
Zn

- G. Pre-Installation Conference: Conduct a meeting between the Prime/General Contractor, Sub-Contractors, the Owner and the Design Professional to review the scope of work in this section, coordination with other work, special project conditions and quality standards. Notify all parties and schedule the meeting a minimum of two (2) weeks prior to the anticipated start of the work specified under this Section.

- H. Prior to initiating work, conduct whatever investigations necessary, including timely site visits, to ensure that areas comply with requirements and other conditions affecting performance of work under this Section.
 - 1. Refer to Section 312000 Earthwork for such interfacing activities as establishment of grades, preparation of subsoil and provision of topsoil. Verify that subsoil and topsoil condition comply with requirements to the extent that no adverse growing conditions are present. Adverse conditions may include, but are not limited to, presence of construction debris, rock, toxic substances; overly compacted soils; shallow bedrock, improper grades, and/or inadequate depth of topsoil.
 - 2. Refer to Section 334100 Storm Utility Drainage Piping for implementation of stormwater controls. Verify that conditions comply with requirements to the extent that no adverse growing conditions are present. Adverse conditions may include, but are not limited to, improperly graded swales or channels, clogged inlets or subdrains or other factors contributing to standing water or poorly drained soils.
 - 3. Do not proceed with work until deficiencies are corrected. By proceeding, the installer agrees that conditions are acceptable for performance of the work covered under this Section.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Packaged Materials: Deliver packaged materials in undamaged containers showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery, and while stored at site.

1.7 JOB CONDITIONS

- A. Planting Time: Sow turf seed only during normal planting seasons for each type of turf work required. Correlate planting time with maintenance schedule to provide required maintenance up to date of "Substantial Completion of turf".
- B. Proceed with and complete seeding work as rapidly as portions of site become available, working within seasonal limitations for each kind of seeding work required.
 - 1. Planting Time: Permanent grass to be seeded no later than May 15th for Spring seeding and only between August 1 and October 15 for Fall planting.
 - 2. Temporary grass seeding is required if areas are exposed for longer than 20 days or areas are not permanently established prior to the Winter season.
- C. Utilities: Determine locations of underground utilities and perform work in a manner which will avoid possible damage. Hand excavate, as required. Maintain grade stakes set by others until removal is mutually agreed upon by all parties concerned.
- D. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify the Design Professional before seeding.
- E. Coordination with Turf: Trees and shrubs should be planted after final grades are established and prior to planting of turf, unless otherwise acceptable to the Design Professional. If planting of trees and shrubs occurs after turf work, protect turf areas and promptly repair damage to turf resulting from planting operations.

1.8 PROJECT MAINTENANCE

- A. Provide maintenance in accordance with Part 3 of this Section beginning immediately after planting and continuing until turf is established but not less than 90 days.

PART 2 - PRODUCTS

2.1 TOPSOIL

- A. Stripping, storage, bulk placement of topsoil and imported topsoil is provided for in Sections 31 25 00 and 31 20 00. If depth of topsoil is not as specified notify Design Professional for directions prior to proceeding.
- B. Topsoil may be stockpiled for re-use in landscape work. If quantity or quality of stockpiled topsoil is insufficient, provide additional topsoil as required to complete landscape work at no additional cost to owner.
 - 1. Refer to 31 20 00 Earthwork for imported topsoil requirements.

2.2 INORGANIC SOIL AMENDMENTS

- A. Commercially prepared products for specific use in the development of turf and grasses. Amendments to be incorporated into topsoil per soil analysis tests and recommendations by a qualified agronomist or testing agency may include but are not limited to the following: lime, sulfur, iron sulfate, perlite, agricultural gypsum, diatomaceous earth.
- B. Provide not less than the amendment quantities as determined by topsoil analysis test by a certified laboratory or agronomist.

2.3 FERTILIZER

- A. Commercially prepared products consisting of nitrogen, potassium and phosphorous for the purpose for providing essential levels of these elements for optimum growth and development of turf and grasses, as determined by topsoil analysis tests and recommendations of a qualified agronomist or testing agency; including but not limited to:
 - 1. 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 composition determined by qualified agronomist.
 - 2. Starter fertilizer: Granular or pelletized fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in composition determined by qualified agronomist.
 - 3. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.
- B. Apply fertilizer in accordance with the recommendations of an experienced certified agronomy testing service hired by the contractor and based upon site soil sample tests. Submit lab recommendations to the Design Professional for review.

2.4 SCHEDULE OF SEED MIXTURES

- A. Grass Seed: Provide fresh, clean, new-crop seed complying with tolerance for purity and germination established by Official Seed Analysts of North America. Provide certified

seed of specified grass species, with proportions to meet minimum percentage of purity and germination.

B. General Turf Mix – Verify seed mixture for site specific environmental and soil conditions:

Proportion By Weight	Common Name	Min. % Germ.	Min. % Pure Seed
25%	Kentucky Bluegrass Variety*	80%	98%
25%	Kentucky Bluegrass Variety*	80%	98%
30%	Perennial Ryegrass	90%	95%
20%	Hard Fescue	80%	97%

*Provide equal amounts of two different Kentucky blue varieties.

Rate: 6.50 lbs./1,000 sq. ft.

C. Temporary Cover Crop: Perennial Ryegrass or annual rye, dependent upon project conditions. Apply at the rate of six (6) pounds per 1,000 sq. ft.

D. Rain Garden Seed Mixture: ERNMX-180 (with cover crop of oats, Japanese millet, or grain rye) by Ernst Conservation Seeds or approved equal.

Proportion By Weight	Common Name
24.9%	Little Bluestem
20.0%	Virginia Wildrye
11.0%	River Oats
10.0%	Redtop Panicgrass
7.5%	Purple Coneflower
5.0%	Fox Sedge
3.0%	Blackeyed Susan
3.0%	Lanceleaf Coreopsis
2.0%	Blue Vervain
2.0%	Partridge Pea
1.7%	Tall White Beardtongue
1.5%	Oxeye Sunflower
1.3%	Swamp Milkweed
1.2%	Golden Alexanders
1.2%	Deertongue
1.0%	Soft Rush
0.6%	Narrowleaf Mountainmint
0.5%	New York Ironweed
0.5%	Wild Senna
0.5%	Blue False Indigo
0.4%	Heath Aster
0.3%	Wild Bergamot
0.3%	Boneset
0.2%	Square Stemmed Monkeyflower
0.2%	Calico Aster
0.1%	Culver's Root
0.1%	Early Goldenrod

Seeding Rate: 20 lbs./acre

Proportion By Weight	Common Name
100%	Oats, Japanese millet, or grain rye*
Rate:	Oats: 30 lbs./acre Japanese millet: 10 lbs./acre Grain rye: 30 lbs./acre

*Seasonally dependent - Consult with seed supplier for the proper cover crop species selection.

2.5 MISCELLANEOUS MATERIALS

- A. Wood Cellulose Fiber Mulch: Degradable green dyed wood cellulose fiber or 100% recycled long fiber pulp, free from weeds or other foreign matter toxic to seed germination and suitable for hydro-mulching.
- B. Straw Mulch: Provide clean, seed-free, threshed straw of wheat, rye, oats or barley.
- C. Tackifier: Liquid concentrate diluted with water forming a transparent 3-dimensional film-like crust permeable to water and air and containing no agents toxic to seed germination.

PART 3 - EXECUTION

3.1 SOIL PREPARATION AND GRADING

- A. Limit preparation to areas that will be planted in immediate future.
- B. Avoid any excessive heavy traffic over topsoil.
- C. If topsoil is hardened, loosen to a minimum depth of 4 inches. Mechanically and/or manually, remove stones larger than 1 inch in any dimension, sticks, roots, rubbish, and other extraneous matter throughout process of preparation prior to seeding.
- D. Clean topsoil of roots, plants, sods, stones, clay lumps, weeds, and other extraneous materials harmful or toxic to plant growth and legally dispose of such materials off- site.
- E. Operate rock-picking equipment at a controlled speed to allow thorough, efficient removal of all rocks and stones.
- F. Mix soil amendments and fertilizers with topsoil at rates specified by soil analysis. Delay mixing of fertilizer if planting will not follow placing of topsoil mixture within two days. Apply soil amendments on surface of spread topsoil and mix thoroughly into top 4 inches of topsoil before planting.
 - 1. Mix lime with dry soil before mixing in fertilizer.
 - 2. Apply phosphoric acid fertilizer (other than that constituting a portion of complete fertilizers) directly to subgrade before tilling.
- G. Re-grade, re-firm and rake the soil surface to establish the final surface so that it is uniform and free of irregularities.
- H. Fine grade turf areas to smooth, even surface with loose, uniformly fine texture. Roll, rake, and drag turf areas, remove ridges and fill depressions, as required to meet finish grades. Remove stones and extraneous matter and objects larger than 1" in any

dimension and dispose. Limit fine grading to areas, which can be planted immediately after grading. Do not over-compact seeding media.

- I. Adjacent to paved surfaces and top edges of curbs, finish topsoil flush with edge of pavement or curb, within one-quarter inch, plus or minus.
- J. Restore turf areas to specified condition if eroded or otherwise disturbed after fine grading prior to planting.
- K. Preparation of Unchanged Grades: Where turf is to be planted in areas that have not been altered or disturbed by excavating, grading, or stripping operations, prepare soil for turf and grass planting as follows: Till to a depth of at least 6 inches. Apply soil amendments and initial fertilizers as specified and mix thoroughly into top 6 inches of soil. Remove high areas and fill in depressions eliminating irregularities. Till soil to a homogenous mixture of fine texture, free of lumps, clods, stones, roots, and other extraneous matter.
 - 1. Before preparing of unchanged areas, remove existing grass, vegetation, and turf. Legally dispose of such material off Owner's property; do not turn over into soil being prepared for turf.
- L. Stormwater BMP Areas (Amended Soils): Refer to Sheets C-003 and C-505 for additional execution requirements in areas of Amended Soils.

3.2 SEEDING AND MULCHING NEW TURF

- A. Sow seed with a broadcast spreader or a seeding drill. When broadcasting, do not seed when wind velocity exceeds 5 miles per hour. Distribute seed evenly over entire area by sowing equal quantity in 2 directions at right angles to each other.
 - 1. Do not use wet seed or seed that is moldy or otherwise damaged in transit or storage.
 - 2. Sow no less than the quantity of seed specified.
- B. Protect seeded areas against erosion by spreading specified turf mulch after completion or in combination with seeding operations. Spread uniformly to form a continuous blanket. Spread by hand, blower, or other suitable equipment.
 - 1. Anchor mulch by application of a tackifier in accordance with manufacturer's recommendations. Take precautions to prevent damage or staining of structures or other plantings adjacent to mulched areas. Immediately clean such areas where damage occurs.
 - 2. Do not allow mulch to accumulate in concentrated areas ie. ponding from rain, wind, etc, throughout maintenance period.

3.3 SEEDING AND MULCHING RAIN GARDEN GRASSES

- A. Site Preparation
 - 1. Loosen soil surface by lightly scarifying. Avoid deep tilling.
 - 2. Do not apply fertilizers or soil amendments to rain garden grasses.
- B. Seed Application
 - 1. Apply seed according to seed supplier's recommendations.

2. Rake in lightly, covering seeds to a maximum depth of two to three times seed thickness.

C. Watering

1. Maintain ample soil moisture by thoroughly soaking initially and repeated soaking for 4-6 weeks until seedlings are established.

3.4 RECONDITIONING TURF

- A. Recondition existing turf areas damaged by construction activity and where settlement or washouts occur or where minor regrading is required.
- B. Provide fertilizer, seed or sod, and soil amendments as specified for new turf and as required to provide satisfactorily reconditioned turf. Provide new planting soil as required to fill low spots and meet new finish grades.
- C. Cultivate bare and compacted areas to provide a planting bed depth of 6 inches.
- D. Remove diseased or unsatisfactory turf areas; do not bury into soil. Remove topsoil containing foreign materials resulting from construction activity including oil drippings, concrete and masonry waste, stone, gravel, and other construction materials; replace with new topsoil. Legally dispose of removed material off site.
- E. Where substantial turf remains (but is thin), mow, rake, aerate if compacted, fill low spots, remove humps, cultivate soil, fertilize, and seed. Remove weeds before seeding. If weeds are extensive, apply selective herbicides as required. Apply seedbed mulch, if required, to maintain moist condition.

3.5 PROTECTION

- A. Erect barricades and warning signs as required to protect newly planted areas from pedestrian and vehicular traffic. Maintain barricades throughout maintenance period until turf is accepted.

3.6 GENERAL TURF MAINTENANCE

- A. Begin maintenance of turf immediately after each area is planted and continue for the period required to establish an acceptable turf.
- B. Maintain all turf by watering, fertilizing, weeding, mowing and other operations such as rolling, regrading, re-seeding as required to establish a smooth, acceptable turf, free of eroded or bare areas. Remove all stones 1" and larger in any dimension and legally dispose of offsite.
- C. Mow turf as soon as there is enough top growth to cut with mower and as required to maintain specified height.
 1. Remove no more than 1/3 of grass height in initial or subsequent mowings.
 2. Do not delay mowing until grass blades bent over and become matted.
 3. Do not mow when grass is wet.
 4. Time initial and subsequent mowings to maintain grass height of 2½ inches to 3 inches high.
 5. Do not mow to less than 2½ inches in height.
- D. Provide the equipment and labor necessary to irrigate all seeded areas until acceptance. The Owner shall provide a source of water for irrigation.

- E. Apply second fertilizer application 3 to 4 weeks after seeding emergence and when grass is dry.
 - 1. Use fertilizer that will provide at least 1.0 lb. of actual nitrogen per 1,000 square feet of turf area.
- F. Re-mulch in areas where mulch has been disturbed by wind, rain or maintenance operations sufficiently to nullify its purpose. Anchor as required to prevent displacement.
- G. Re-seed repair areas with original seed materials specified. Do not introduce new varieties unless approved by Design Professional.
- H. If seeded in the fall and turf is not judged acceptable at that time, continue maintenance during following spring until an acceptable turf is established.

3.7 RAIN GARDEN GRASS MAINTENANCE

- A. Maintain by watering, weeding, and re-seeding as required to establish a dense coverage of grasses free of eroded or bare areas. Do not apply fertilizer to Rain Garden grass areas.

3.8 ACCEPTANCE

- A. When work is complete, including maintenance requirements, notify Design Professional. The Design Professional will then make an inspection to determine acceptability.
- B. Replant rejected work and continue specified maintenance until re-inspected by Design Professional and deemed to be acceptable.
- C. Criteria for Acceptance of General Turf: An acceptable turf is one which is full, even, healthy, uniform stand of specified grass established at least two and one half (2 ½) inches in height. Turf must be free of weeds, stones, surface irregularities, disease, or bare spots greater than 100 square inches.
- D. Criteria for Acceptance of Rain Garden grass: Grasses must provide a minimum of 70% coverage to be acceptable.

3.9 CLEANUP AND PROTECTION

- A. During preparation and seeding work, keep pavements clean and work areas in an orderly condition.
- B. Protect seeding work and materials from damage due to landscape operations, by other contractors, trades, and trespassers. Maintain protection during installation and maintenance periods. Treat, repair and replace damaged landscape work as directed.
- C. Remove all debris ie, stones, roots, construction materials, as well as excess soil and legally disposed of off site.

END OF SECTION 329200

SECTION 329223 – SOD TURF

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. The General Conditions, Supplementary Conditions and Division 01 General Requirements are part of this section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Topsoil Testing.
 - 2. Fine grading topsoil.
 - 3. Soil amendments
 - 4. Fertilizers
 - 5. Turfgrass sod.
 - 6. Maintenance.
- B. Related Sections:
 - 1. Division 31, Section 312000 "Earthwork" for subgrade preparation and topsoil placement.
 - 2. Division 32, Section 329200 "Seeded Turf and Grasses" for general lawn applications.

1.3 WORK NOT INCLUDED

- A. Items of work excluded from this Section:
 - 1. Topsoil placement.
 - 2. Excavation and grading to the subgrade.
 - 3. Fine grading and compaction of subgrade.

1.4 SUBMITTALS

- A. Installer's Qualifications.
- B. Certification of Grass Seed: Submit seed vendor's certified statement for each grass seed monostand or mixture required, stating botanical and common name, percentage by weight, and percentages of purity, germination, and weed seed for each grass seed species. Include the year of production and date of packaging.
- C. Product Certificates: For soil amendments, from manufacturer.
- D. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape Installer whose work has resulted in the successful establishment of sod turf.

1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
 2. Experience: Three years' experience in turf installation.
 3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
 4. Personnel Certifications: Installer's field supervisor assigned to the Work shall have certification in one of the following categories from the Professional Landcare Network:
 - a. Landscape Industry Certified Lawncare Manager.
 - b. Landscape Industry Certified Lawncare Technician.
 5. Pesticide Applicator: State licensed, commercial.
- B. Soil-Testing Laboratory: An independent laboratory, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.
- C. General: Ship specified materials with certificates of inspection required by governing authorities. Comply with regulations applicable to landscape materials.
- D. Substitutions: Do not make unauthorized substitutions of materials. If specified material is not obtainable, submit proposal for use of equivalent material for approval.
- E. Analysis and Standards: Package standard products with manufacturer's certified analysis. For other materials, provide analysis by recognized laboratory made in accordance with methods established by the Association of Official Agriculture Chemists, wherever applicable.
- F. Topsoil Analysis Report: Test on-site topsoil and imported topsoil using a qualified agronomist. State percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; deleterious material; pH; and mineral and plant-nutrient content of topsoil.
1. Report suitability of topsoil for turf growth. State the recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory topsoil.
 2. Essential Topsoil Nutrients: All topsoil for turf (both on-site and new) to receive proper amendments so the following nutrients fall within the ideal range based on fertility tests of the topsoil receiving the sod:
- | Macro-nutrients | Micro-nutrients |
|-----------------|-----------------|
| pH | B |
| N | Fe |
| P | Mn |
| K | Cu |
| Ca | Mo |
| Mg | Zn |
| S | |
- G. Pre-Installation Conference: Conduct a meeting between the Prime/General Contractor, Sub-Contractors, the Owner, and the Design Professional to review the scope of work in this section, coordination with other work, special project conditions and quality standards. Notify all parties and schedule the meeting a minimum of two (2) weeks prior to the anticipated start of the work specified under this Section.

- H. Prior to initiating work, conduct whatever investigations necessary, including timely site visits, to ensure that areas comply with requirements and other conditions affecting performance of work under this Section.
 - 1. Refer to Section 312000 Earthwork for such interfacing activities as establishment of grades, preparation of subsoil and provision of topsoil. Verify that subsoil and topsoil condition comply with requirements to the extent that no adverse growing conditions are present. Adverse conditions may include, but are not limited to, presence of construction debris, rock, toxic substances; overly compacted soils; shallow bedrock, improper grades, and/or inadequate depth of topsoil.
 - 2. Refer to Section 334100 Storm Utility Drainage Piping for implementation of stormwater controls. Verify that conditions comply with requirements to the extent that no adverse growing conditions are present. Adverse conditions may include, but are not limited to, improperly graded swales or channels, clogged inlets or subdrains or other factors contributing to standing water or poorly drained soils.
 - 3. Do not proceed with work until deficiencies are corrected. By proceeding, the installer agrees that conditions are acceptable for performance of the work covered under this Section.

1.6 JOB CONDITIONS

- A. Proceed with and complete sodding work as portions of site become available, working within seasonal limitations.

1.7 PROJECT MAINTENANCE

- A. Provide maintenance in accordance with Part 3 of this Section beginning immediately after planting and continuing until an acceptable lawn is established but not less than 60 days.

PART 2 – PRODUCTS

2.1 TOPSOIL

- A. Stripping, storage bulk placement of topsoil and imported topsoil is provided for in Sections 311000 and 312000.
- B. Topsoil may be stockpiled for re-use in landscape work. If quantity or quality of stockpiled topsoil is insufficient, provide additional topsoil as required to complete landscape work at no additional cost to owner.

- 1. Refer to 312000 Earthwork for imported topsoil requirements.

2.2 TURFGRASS SOD

- A. Sod shall be a nursery cultivated, certified bluegrass blend not more than 18 months old from time of seeding.
- B. Sod: Provide machine-cut, strongly rooted, certified turfgrass sod, and free of weeds and undesirable native grasses. Provide sod capable of vigorous growth and development when planted (viable, not dormant) and complying with the following requirements:
 - 1. Sod Pad Size: Uniform thickness cut to a depth equal to the growth of the fibrous roots but not less than ¼ inch, measured at time of cutting and excluding top growth and thatch. Provide in wide roll sod to minimize seams.

- C. The sod blend will consist of three hybrid Bluegrass varieties.
- D. Soil Type where grown shall match and be consistent with on-site topsoil properties.
- E. Sod Conditions: Uniform color, density and thickness.
- F. Sod shall be delivered within 24 hours and placed within forty-eight (48) hours after being harvested.

2.3 INORGANIC SOIL AMENDMENTS

- A. Commercially prepared products for specific use in the development of turf and grasses. Amendments to be incorporated into topsoil per soil analysis tests and recommendations by a qualified agronomist or testing agency, include but not limited to the following: lime, sulfur, iron sulfate, perlite, agricultural gypsum, diatomaceous earth.

2.4 FERTILIZER

- A. Commercially prepared products consisting of nitrogen, potassium and phosphorous for the purpose for providing essential levels of these elements for optimum growth and development of turf and grasses, as determined by topsoil analysis tests and recommendations of a qualified agronomist; including but not limited to:
 - 1. 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 composition determined by qualified agronomist.
 - 2. Starter fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in composition determined by qualified agronomist.
 - 3. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.
- B. Basic H Surfactant: Basic H Surfactant containing 28% active ingredients of Linear Alcohol Alkoxylates shall be applied at the rate of 2 oz. Per 1,000 sq. ft.
- C. Micronutrient Fertilizer: Shall be Chelated Plant Nutrients such as Agri-Plex 4X. Guaranteed Minimum Analysis shall be as follows:

Primary Nutrients	
Available Phosphoric Acid	4.00%
Soluble Potash	4.00%
Secondary Nutrients	
Magnesium	3.00%
Sulfur	4.00%
Micronutrients	
Boron	0.08%
Iron	5.00%
Manganese	0.20%
Zinc	0.20%
- D. Pre-emergent herbicide:
 - 1. Tupersan by Dupont.
 - 2. ProGrass EC by Bayer.
 - 3. Surflan A.s. by Southern Ag.

- E. Wetting Agent: A non-ionic agent formulated to reduce water surface tension.
 - 1. Aqua-Gro by Smithers Oasis.
 - 2. Jetwet by Poulenger USA, Inc.
 - 3. Aquabond-HL by NaEx Corp.

2.5 TOP DRESSING

- A. Shall consist of the following:
 - 1. 100% of screened topsoil.

PART 3 - EXECUTION

3.1 TOPSOIL PREPARATION

- A. Soil Structuring and Nutrient Replenishment:
 - 1. After topsoil is installed and graded to the proper elevations, the following materials shall be applied and tilled (mixed) into the top 4" in accordance with agronomy soil test analysis and recommendations: lime, peat, humus, starter fertilizer, basic fertilizer.
 - 2. After incorporation of the above materials, the topsoil shall be reformed by dry-rolling with a five (5) ton roller on a dual flotation tired agricultural tractor.
- B. Final Grading
 - 1. Cultivate and restructure the topsoil to a depth of 4". Grade tolerance shall be held at ¼" per 10 feet for the turf area. Adjacent to paved surfaces and curbs, the finished sod shall be flush within one-quarter inch, with the edge of the pavement or top of curb.
 - 2. Re-grade, re-firm and rake the soil surface to establish the final surface so that it is uniform and free of irregularities.
 - 3. Final grading shall be accomplished utilizing an automatic sonic grade control laser system with a hydraulic land plane attached to a flotation tired agricultural tractor.
 - 4. Final stone pick the surface of any stones larger that 1" in any dimension.

3.2 SOD PLACEMENT

- A. Do not allow any sod trucks or other heavy pieces of equipment on the turf area before, during or after sodding.
- B. Dry sod beds shall be watered lightly prior to laying sod to prevent rapid desiccation.
- C. The first row of sod should be laid in a straight line with subsequent rows placed parallel and tightly against one another. Lateral joints shall be staggered to promote more uniform growth and strength. Care shall be exercised to insure that the sod is not stretched or overlapped and that all joints are butted in order to prevent voids which would permit air drying of the roots.
- D. Sod shall be "dry rolled" prior to heavy watering, providing the soil conditions do not allow the sod to move under the roller.
- E. After sod is installed, apply pre-emergence herbicide material before heavy watering begins, at the rate determined by an approved testing agency to all sod areas.

- F. After sod is installed, apply Nitrogen Fertilizer at the rate determined by an approved testing agency to all sod areas.
- G. Apply topdressing conforming to the top-dressing specification under Part 2, at a thickness of 1/8" to 1/4" (0.8 to 0.16 cu. yd/1000 sq. ft).
- H. During periods of high temperatures, the sod shall be lightly watered to prevent wilting during the progress of the work. Immediately after sodding is completed in any one section, that entire section shall be thoroughly irrigated to a minimum depth of 5 inches.
- I. The contractor shall not use any pieces of sod which have been damaged or torn during shipment or handling, or smaller than 6 s.f.
- J. It is the responsibility of the contractor to protect the new sod from the day of sodding until acceptance.
- K. Inspection for approval of sod areas shall be made within 24 hours of sod installation. On large sod areas, inspections may be made by sections prior to completion of the overall sod area.
- L. Contractor shall return to the site four weeks later and after irrigation or rainfall of one-half inch, to re-roll the sodded areas.
- M. Sod will be installed flush with the surrounding grades or pavements to make a smooth transition.

3.3 MAINTENANCE BY INSTALLER

- A. Provide a minimum of 3 mowings or as many as necessary until acceptance. Mow lawn as soon as there is enough top growth to cut with mower and as required to maintain specified 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. Time initial and subsequent mowings to maintain grass height of 2½ inches to 3 inches high. Do not mow to less than 2½ inches in height.
- B. Maintain sod by re-fertilizing, weeding, rolling, re-sodding or other operations as required to establish an acceptable a lawn.
- C. Irrigate lawn to establish adequate moisture when rainfall is lacking. In the absence of rainfall, the lawn shall be watered to frequencies necessary to maintain moisture in the upper 4 inches of soil. The Owner shall provide a source of water for irrigation and the Contractor shall provide the necessary equipment, labor and monitoring of irrigation. The Contractor shall operate and maintain the temporary irrigation system until acceptance.
- D. Repair any areas damaged following installation until acceptance.
- E. Post-Fertilization: Apply second fertilizer application 3 to 4 weeks after seeding emergence and when grass is dry.
 - 1. Use fertilizer that will provide at least 1.0 lb. of actual nitrogen per 1,000 sq. ft. of lawn area unless determined otherwise by an approved testing agency.

3.4 ACCEPTANCE

- A. When work is complete, including maintenance requirements, notify the Design Professional. The Design Professional will then inspect to determine acceptability.
- B. Replant rejected work and continue specified maintenance until re-inspected by Design Professional and deemed to be acceptable.
- C. Criteria for Acceptance: An acceptable turf is one which is full, even, healthy, uniform stand of specified grass established at least two (2) inches in height. Turf shall be free of weeds, stones, surface irregularities, disease, or bare spots greater than 100 square inches.

3.5 CLEANUP AND PROTECTION

- A. During preparation and sod work, keep pavements clean and work areas in an orderly condition.
- B. Promptly remove soil and debris created by turf work from paved area. Clean wheels of vehicles before leaving site to avoid tracking soil onto surface of roads, walks, or other paved areas.
- C. Protect sod work and materials from damage due to operations by other contractors. Maintain protection during installation and maintenance periods. Treat, repair and replace damaged sod work as directed.
- D. All debris ie, stones, roots, construction materials, as well as excess soil, is to be gathered, removed, and legally disposed of off site.

END OF SECTION 329223

SECTION 32 93 00 – EXTERIOR PLANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Preparation of planting pits and beds.
 - 2. Furnishing and planting plant material.
 - 3. Maintenance of plant material.
- B. Related Sections:
 - 1. Division 31, Section 31 20 00 "Earthwork" for preparation of subgrade, subsurface aggregate drainage and drainage backfill and topsoil placement.
 - 2. Division 32, Section 32 92 00, "Seeded Turf and Grasses".

1.3 SUBMITTALS

- A. Installer qualifications.

1.4 QUALITY ASSURANCE

- A. General: Comply with applicable federal, state, county, and local regulations governing landscape materials.
- B. Installer Qualifications: A qualified landscape Installer whose work has resulted in the successful establishment of plants.
 - 1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
 - 2. Experience: The Installer shall have been actively and directly engaged in planting installations for a period of five (5) years or more and provide proof of ten (10) or more successful installations completed by them which have been in use for three (3) or more years.
- C. Substitutions: Do not make unauthorized substitutions of materials. If specified material is not obtainable, submit proposal for use of equivalent material for approval.
- D. Source Quality Control:
 - 1. General: Ship landscape materials with certificates of inspection required by governing authorities. Comply with regulations applicable to landscape materials.
 - 2. Analysis and Standards: Package standard products with manufacturer's certified analysis. For other materials, provide analysis by recognized laboratory made in accordance with methods established by the Association of Official Agriculture Chemists, wherever applicable.
 - 3. Trees, Shrubs and Other Plants: Provide trees, shrubs, and other plants of quantity, size, genus, species, and variety shown and scheduled for landscape work and complying with recommendations and requirements of ANSI Z60.1

- “American Standard for Nursery Stock. Provide healthy, vigorous stock, grown in recognized nursery in accordance with good horticultural practice and free of disease, insects, eggs, larvae, mold, mildew, and defects such as knots, sun-scale, injuries, abrasions, or disfigurement. Provide plants grown in USDA Hardiness Zone 6a or 6b.
4. Label one of each tree and shrub species and variety with securely attached waterproof tag bearing legible designation of botanical and common name.
 - a. Where formal arrangements or consecutive order of trees or shrubs are shown, select stock for uniform height and spread, and label with number to assure symmetry in planting.
 5. Provide plant material in compliance with requirements and obtain Design Professional's acceptance of their visual qualities before they are prepared for transplanting.
 6. Measurements: Measure trees and shrubs with branches and trunks or canes in their normal position. Do not prune to obtain required sizes. Take caliper measurements 6 inches above ground for trees up to 4 inches caliper size, and 12 inches above ground for trees larger than 4 inches. Measure main body of tree or shrub for height and spread dimensions; do not measure from branch or root tip-to-tip.
 7. Inspection: Design Professional reserves the right to inspect trees and shrubs either at place of growth or at site before planting for compliance with requirements for genus, species, variety, size and quality, size and condition of balls and root systems, insects, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from project site.
- E. Pre-Installation Conference: Conduct a meeting between the Prime/General Contractor, Sub-Contractors, Owner, and the Design Professional to review the scope of work in this section, coordination with other work, special project conditions and quality standards. Notify all parties and schedule the meeting a minimum of two (2) weeks prior to the anticipated start of the work specified under this Section.
- F. Prior to initiating work, conduct whatever investigations necessary, including timely site visits, to ensure that areas comply with requirements and other conditions affecting performance of work under this Section.
1. Refer to Section 31 20 00 Earthwork for such interfacing activities as establishment of grades, preparation of subsoil and provision of topsoil. Verify that subsoil and topsoil condition comply with requirements to the extent that no adverse growing conditions are present. Adverse conditions may include, but are not limited to, presence of construction debris, rock, toxic substances; overly compacted soils; shallow bedrock, improper grades, and/or inadequate depth of topsoil.
 2. Refer to Section 33 41 00 Storm Utility Drainage Piping for implementation of stormwater controls. Verify that conditions comply with requirements to the extent that no adverse growing conditions are present. Adverse conditions may include, but are not limited to, improperly graded swales or channels, clogged inlets or subdrains or other factors contributing to standing water or poorly drained soils.
 3. Do not proceed with work until deficiencies are corrected. By proceeding, the installer agrees that conditions are acceptable for performance of the work covered under this Section.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Delivery of Trees and Shrubs: Provide freshly dug trees and shrubs to the greatest extent possible. Do not prune before delivery, except as approved by Design Professional.

Provide adequate protection of root systems and balls from drying winds and sun. Do not bend or bind-tie trees or shrubs in such a manner as to damage bark, break branches, or destroy natural shape. Provide protective covering during delivery. Do not drop balled and burlapped stock during delivery.

- B. Deliver plants after preparations for planting have been completed and plant immediately. If planting is delayed more than 6 hours after delivery, set plants in shade, protect from weather and mechanical damage, and keep roots moist as follows:
 - 1. Set balled stock on ground and cover the ball with soil, peat moss, sawdust or other acceptable material.
 - 2. Do not remove container-grown stock from containers before the time of planting.
 - 3. Periodically water root systems of trees and shrubs stored on site with a fine mist spray. Water as often as necessary to maintain root systems in a moist condition.

1.6 JOB CONDITIONS

- A. Planting Time: Proceed with, and complete landscape work as soon as portions of the site become available, working within seasonal limitations for each kind of landscape work required.
 - 1. Plant or install materials during normal planting seasons for each type of plant material required. Correlate planting with specified maintenance periods to provide maintenance from date of substantial completion.
 - 2. Plant frost-tender trees and shrubs only after danger of frost is past or sufficiently before frost season to allow for establishment before first frost. Do not plant in frozen ground.
- B. Coordination with Turf: Plant trees and shrubs after final grades are established and before planting of turf, unless otherwise acceptable to Design Professional. If planting of trees and shrubs occurs after turf work, protect turf areas and promptly repair damage to turf resulting from planting operations.
- C. Utilities: Determine location of underground utilities and perform work in a manner which will avoid possible damage. Hand-excavate, as required. Maintain grade stakes set by others until removal is mutually agreed upon by parties concerned.
- D. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify Design Professional before planting for instructions to proceed.

1.7 WARRANTY

- A. Warrant plants for the following duration after date of substantial completion, against defects including death and unsatisfactory growth, but excepting defects resulting from neglect by Owner, abuse or damage by others, or unusual phenomena or incidents beyond Contractor's control:
 - 1. Trees, shrubs, vines, ornamental grass, groundcover, and perennials: One year
- B. Remove and replace trees, shrubs, or other plants found to be dead or in unhealthy condition during warranty period. Make replacements during the growth season following the end of warranty period. Replace trees and shrubs which are more than 25% dead at the end of warranty period; unless, in the opinion of Design Professional, it is advisable to extend warranty period for a full growing season.

1. Another warranty inspection will be conducted at the end of the extended warranty period, if any, to determine acceptance or rejection. Only one replacement (per tree, shrub, or plant) will be required at the end of the warranty period, except for losses or replacements due to failure to comply with specified requirements.

PART 2 - PRODUCTS

2.1 TREE AND SHRUB MATERIAL

- A. General: Provide nursery grown trees and shrubs, except as otherwise indicated, grown in a recognized nursery in accordance with good horticultural practice, with healthy root systems developed by transplanting or root pruning. Provide only healthy, vigorous stock free of disease, insects, eggs, larvae, mildew, mold and defects such as knots, sun scale, injuries, abrasions, and disfigurement.
- B. Size: Provide trees and shrubs of the sizes indicated in planting list and in accordance with dimensional relationship requirements of ANSI Z60.1 for kind and type of trees and shrubs required. Trees and shrubs of larger size than specified may be used if acceptable to Design Professional; in that case, increase size of roots or balls proportionately.
- C. Label at least one tree and one shrub of each variety with a securely attached waterproof tag bearing legible designation of botanical and common name.
 1. Where formal arrangements or consecutive order of trees or shrubs are shown, select stock for uniform height and spread, and label with number to assure symmetry in planting.

2.2 DECIDUOUS TREES

- A. Size: Provide trees of height and caliper indicated.
 1. Take caliper measurements 6 inches above ground level if 4 inches or less. If greater than 4 inches, take measurements at 12 inches above ground level.
- B. Where shade trees are required, provide single-stem trees with straight trunk and intact leader, free of branches to a point about 50 percent of their height, as recommended by ANSI Z60.1 for size and kind of trees required.
- C. Where small trees of upright or spreading type are required, provide trees with single stem, branched, or pruned naturally according to species and type, and with relationship of caliper and branching recommended by ANSI Z60.1, unless otherwise indicated.
 1. Where shown as "brush form", provide trees with branching starting close to ground in manner of a shrub.
 2. Where shown as "clump", provide trees with 3 or more main stems starting from ground.
- D. Except as otherwise indicated, provide balled and burlapped trees.
 1. Container-grown deciduous trees will be acceptable in lieu of balled and burlapped deciduous trees, subject to the specified limitations for container stock.

2.3 REQUIREMENTS FOR B&B STOCK

- A. General: Where indicated to be balled and burlapped, provide trees and shrubs dug with firm, natural ball of earth in which they are grown.
- B. Provide ball size of not less than diameter and depth recommended by ANSI Z60.1 for type and size of tree or shrub required. Increase ball size or modify ratio of depth to diameter as required to encompass fibrous and feeding root system necessary for full recovery of trees and shrubs subject to unusual or non-typical conditions of growth, soil conditions, or horticultural practice.
- C. Wrap and tie earth ball as recommended by ANSI Z60.1 for size of balls required. Drum-lace balls with a diameter of 30 inches or greater.

2.4 REQUIREMENTS FOR CONTAINER GROWN-STOCK

- A. General: Where specified as acceptable, provide healthy, vigorous, well-rooted trees or shrubs established in container in which they are sold. Provide balled and burlapped stock when required trees or shrubs exceed maximum size recommended by ANSI Z60.1 for container-grown stock.
- B. Established container stock is defined as a tree or shrub transplanted into container and grown in container for a length of time sufficient to develop new fibrous roots, so that root mass will retain its shape and hold together when removed from container.
- C. Containers: Use rigid containers that will hold ball shape and protect root mass during shipping. Provide trees and shrubs established in containers of not less than minimum sizes recommended by ANSI Z60.1 for kind, type, and size of trees and shrubs required.

2.5 SOIL AMENDMENTS

- A. General: Fertilizers and soil amendments application shall be based upon topsoil analysis report.
- B. Aluminum Sulfate: Commercial-grade.
- C. Bonemeal: Commercial-grade, raw, finely ground; 4 percent nitrogen and 20 percent phosphoric acid.
- D. Fertilizers: Commercial-grade controlled release fertilizer, of neutral character, with some elements derived from organic sources, containing at least 10 percent available phosphoric acid, 3 percent to 5 percent total nitrogen, and 3 percent to 5 percent soluble potash.
- E. Organic Matter:
 - a. Manure: Composted cow manure.
 - b. Compost: Decomposed vegetable matter.
 - c. Leafmold: Shredded, partially decomposed leafy vegetation.
- F. Perlite: Conforming to National Bureau of Standard PS 23.
- G. Sand: Clean, washed sand, free of toxic materials.
- H. Superphosphate: Soluble mixture of treated minerals; 20 percent available phosphoric acid.

2.6 TREE AND SHRUB PLANTING PIT SOIL MIX

- A. Soil mix components:
 - 1. Satisfactory excavated native soil (topsoil and subsoil).
 - 2. Organic matter.

2.7 MISCELLANEOUS MATERIALS

- A. Anti-Dessicant: Emulsion type, film-forming agent designed to permit transpiration, but retard excessive loss, of moisture from plants.
- B. Bark Mulch: Double-shredded and cured hardwood bark of varying particle sizes uniformly blended, free of large chunks, pieces or slabs. Mulch containing chipped lumber products is not acceptable. Color to be natural (free of dyes).
- C. Herbicides: EPA registered and approved.
 - 1. Pre-emergent herbicide: Treflan EC or approved equal (active ingredient: trifluralin).
 - 2. Non-selective herbicide: Roundup or approved equal (active ingredient: glyphosate).
- D. Stakes and Guys: Provide stakes of sound hardwood, free of knot holes and other defects. Provide wire ties and guys of 12 gage, 2-strand, twisted, pliable galvanized steel wire. Provide rubber hose at least ½ inch diameter, cut to required lengths to protect tree trunks from damage by wires.

PART 3 - EXECUTION

3.1 PREPARATION FOR PLANT MATERIAL - GENERAL

- A. Cooperate with other trades working in and adjacent to landscape work areas. Examine drawings that show the development of entire site and become familiar with scope of other work required.
- B. Stake out individual tree and shrub locations for approval. Spray paint planting bed outlines for approval. Adjust as directed by Design Professional. Do not begin plant installation until the layout has been approved by the Design Professional.
- C. Excavation: Excavate planting pits and beds to the dimensions shown. Dispose of unsatisfactory subsoil or construction debris removed from landscape excavations. Do not mix with planting soil or use as backfill.
- D. Obstructions: If rock, underground construction, or other obstructions are encountered in excavation for planting of trees or shrubs, notify Design Professional immediately.
- E. Drainage: Fill excavations with water and allow them to percolate out before setting trees and shrubs. If subsoil conditions indicate retention of water in planting areas, notify Design Professional immediately.
- F. Thoroughly and uniformly roto-till all topsoil. Before mixing, clean topsoil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.
- G. Treat all planting beds with pre-emergent herbicide prior to planting.

- H. Mix fertilizers with topsoil at rates specified by the topsoil analysis report. Delay mixing of fertilizer if planting will not follow placing of planting soil within a few days.
- I. For planting pit backfill, prepare soil mixes before backfilling.

3.2 INSTALLATION OF PLANT MATERIAL

- A. Setting and Backfilling:
 - 1. Set balled and burlapped stock plumb and in center of pit or trench. Remove all twine and top one third of burlap from root ball. Remove pallets, if any, and wire baskets completely before setting. Replace plant material if the ball is cracked or broken before or during planting operation.
 - 2. Set container-grown stock as specified for balled and burlapped stock, except that containers shall be cut away from the root ball completely. Carefully remove containers so that root ball is not damaged. Lightly tease away roots which are girdling around the edge of the root ball.
 - 3. When the root ball is set, place additional backfill around base and sides of ball, and work each layer to settle backfill and eliminate air pockets. When excavation is approximately 2/3 full, water thoroughly before placing remainder of backfill. Repeat watering until no more is absorbed. Water again after placing final layer of backfill. Do not place backfill against trunk or cover the root crown.
 - 4. Trees and shrubs in native backfill: Backfill with four parts satisfactory native soil to one-part organic matter.
 - 5. When backfilling is complete, form saucer as indicated.
- B. Apply anti-dessicant to provide an adequate film over trunks, branches, stems twigs, and foliage.
 - 1. If deciduous trees or shrubs are moved in full-leaf, spray with anti-dessicant at nursery before moving and again two weeks after planting.
- C. Prune, thin out, and shape trees and shrubs in accordance with standard horticultural practice. Prune trees to retain the required height and spread. Unless otherwise directed by Design Professional, do not cut tree leaders, and remove only injured or dead branches from trees. Prune shrubs to retain natural character. Required shrub sizes indicated are size after pruning.
- D. Guy and stake trees immediately after planting.
 - 1. Stake trees of two inch through five-inch caliper as shown on the drawings. Stake trees of less than two-inch caliper only as required to prevent wind tip-out. Set stakes vertical and space to avoid penetrating balls or root masses. Support trees with wire encased in hose sections at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree. Provide not less than one stake for trees 10 ft. to 12 ft. high and two inches or less in caliper, except no fewer than two shorter stakes may be used for low-branched trees. Use no fewer than 2 stakes for trees over 12 ft. high and less than four-inch caliper size and use no fewer than three stakes for trees of four inch to five-inch caliper size. Space stakes equally around trees.

3.3 PLANTING GROUNDcover, PERENNIAL PLANTS AND ORNAMENTAL GRASSES

- A. Space plants as shown on drawings.

- B. Dig holes large enough to allow spreading of roots and backfill with planting soil. Work soil around roots to eliminate air pockets, taking care not to cover plant crowns with soil. Water thoroughly after planting.
- C. Planting Seasons: March 15th thru June 15th and September 1st thru December 1st.

3.4 MULCHING

- A. Mulch backfilled surfaces of pits, trenches, planting beds and raised planters.
 - 1. Thickness: 3 inches.
- B. Do not place mulch against the trunk or cover the root crown of trees and shrubs.
- C. Where mulch edge abuts turf, provide crisp, well-defined edge between mulch and turf.

3.5 MAINTENANCE

- A. Begin maintenance immediately after planting.
- B. Maintain trees, shrubs, and other plants until final acceptance, but in no case, less than the following period:
 - 1. 60 days after substantial completion of planting.
- C. General: Prune, water, cultivate, and weed during maintenance period as required for healthy growth. Restore planting saucers. Tighten and repair stake and guy supports, but not to the point of rigidity, and reset trees and shrubs to proper grades or vertical position as required. Restore or replace damaged wrappings. Spray as required to keep trees and shrubs free of insects and disease using organic insect and disease control products.
- D. Remove and replace trees and shrubs found to be dead or unhealthy during warranty period. Make replacements during growth season following end of warranty period. Replace trees and shrubs that are in doubtful condition at end of warranty period unless, in opinion of Design Professional, it is advisable to extend warranty period for a full growing season.
- E. Remove stakes and guy wires upon final acceptance of the plant material after warranty period.

3.6 CLEANUP AND PROTECTION

- A. During landscape work, keep pavements clean and work area in an orderly condition.
- B. Protect landscape work and materials from damage due to operations by other trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged landscape work as directed.

3.7 DISPOSAL OF SURPLUS SOIL AND WASTE MATERIALS

- A. Disposal: Remove surplus soil and waste material, including excess subsoil, trash and debris, and legally dispose of it off the Owner's property.

3.8 INSPECTION AND ACCEPTANCE

- A. When landscape work is complete, including maintenance, notify Design Professional who will, inspect to determine acceptability.
 - 1. Landscape work may be inspected for acceptance in portions as agreeable to Design professional provided each portion of work offered for inspection is complete - including maintenance.
- B. When inspected landscape work does not comply with requirements, replace rejected work and continue specified maintenance until re-inspected by Design Professional and found to be acceptable. Remove rejected plants and materials promptly from project site.

END OF SECTION 32 93 00

SECTION 33 11 16 – SITE WATER UTILITY DISTRIBUTION PIPING

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. This Section includes the following:
 - 1. Site water systems including piping and associated appurtenances for potable water, fire protection and irrigation to within five (5) feet of building line.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 22, "Plumbing" for fire suppression systems within buildings.
 - 2. Division 22, "Mechanical" for domestic water systems within buildings.
 - 3. Division 31, Section 31 20 00 "Earthwork" for trench excavation and backfill.
- C. Work Not Included: This Section does not include tapping of mains by local water authority personnel and charged directly to the owner by the local water authority.

1.3. DEFINITIONS

- A. AWWA: American Water Works Association.
- B. SDR: Standard Dimension Ratio. This ratio (OD/t) represents the measurement of the pipe outside diameter (OD) divided by the pipe wall thickness (t). This term is also synonymous with DR (Dimension Ratio). The standards refer to particular SDR numbers, though other DR / SDR numbers are commonly used on the market.
- C. SIDR: Standard Inside Dimension Ratio: In addition to SDR, this ratio (ID/t) is an alternate term commonly used for PE piping (polyethylene tubing). SIDR is a standard for measuring tube wall thickness based on the inside diameter of the pipe (ID) divided by the wall thickness (t).
- D. NSF Rated: Piping that has been rated by the "National Sanitation Foundation" as certified for use in transmitting potable water.

1.4. SYSTEM PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure Ratings: Except where otherwise indicated, the following are minimum pressure requirements for water system piping and appurtenances.
 - 1. Underground Piping, tubing and appurtenances: 150 psig.
 - 2. All service line and service connection materials and appurtenances shall be able to withstand a pressure of at least 150 psig.
 - 3. Ductile Iron Piping, 3 inch diameter through 12 inch diameter, 350 psig.
 - 4. Cast / Gray Iron Fittings (push-on, mechanical and flanged joints), 250 psig.
 - 5. Ductile Iron Normal and Compact Fittings, 350 psig.

1.5. SUBMITTALS

- A. Product data, including pressure rating, rated capacity, and settings of selected models for each product indicated.
- B. Test reports.
- C. Cleaning and disinfecting reports.
- D. Maintenance data for the following:
 - 1. Valves.
 - 2. Yard Hydrants.
- E. Test Pit Data: Provide drawings indicating relationships of utilities discovered including top and bottom elevations, horizontal locations of pipes, conduits, etc., and elevations / locations of all adjacent utility lines within area indicated to be located or confirmed by a test pit.
- F. Record drawings of installed piping and products. Format drawings in AutoCAD Civil 3d, latest version. Provide all information required by authority having jurisdiction but no less than the following:
 - 1. Final locations of water lines, fittings, valves, and tap-in locations.
 - 2. Top elevation of all valve covers.
 - 3. Signature and seal of registered surveyor responsible for the as-built survey.
 - 4. Benchmark and datum consistent with project documents.
- G. Lead-Free Plumbing Material Certification.

1.6. QUALITY ASSURANCE

- A. Comply with requirements of the local water authority and / or municipality having jurisdiction. Include tapping of water mains where required or indicated on the drawings.
- B. Comply with standards of fire department and any authorities having jurisdiction for fire protection systems. Include materials, hose threads, installation, and testing.
- C. Comply with standards of authorities having jurisdiction for potable water piping and plumbing systems. Include materials, installation, testing, and disinfection.
- D. Comply with standards of authorities having jurisdiction as well as NFPA 24 "Standard For the Installation of Private Fire Service Mains and their Appurtenances" for materials, installation procedures, testing and flushing.
- E. Provide listing/approval stamp, label, or other marking on equipment made to specified standards.
- F. Listing and Labeling: Provide equipment and accessories that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in "National Electrical Code", Article 100.
 - 2. Listing and labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
 - 3. AWWA

4. Plastic Pipe must bear logo "NSF-pw" indicating approval by the NSF (National Sanitation Foundation) per NSF Standard 14. Comply with NSF/ANSI 61 for materials for water service piping and specialties for domestic water.
- G. Structural Design Loading: Unless otherwise noted, utilities, structures and underground conveyance systems shall be constructed to withstand traffic loading designation AASHTO HS 20.

1.7. DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves, including fire hydrants, for shipping as following:
 1. Ensure that valves are dry and internally protected against rust and corrosion.
 2. Protect valves against damage to threaded ends, and weld ends.
 3. Set valves in best position for handling. Set valves closed to prevent rattling.
- B. Storage: Use the following precautions for valves, including fire hydrants, during storage:
 1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
 2. Protect valves from weather. Store valves indoors and maintain a temperature greater than ambient dew point temperature. Support valves off ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use sling to handle valves and fire hydrants whose size requires handling by crane or lift. Rig valves to avoid damage to exposed valve parts. Do not use handwheels or stems as lifting or rigging points.
- D. Deliver pipes and tubes with factory-applied end-caps. Maintain end-caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- E. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect fittings and piping specialties from moisture and dirt.
- G. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.8. PROJECT CONDITIONS

- A. Site Information: Prior to beginning earthwork operations, investigate existing underground utility locations, research public and site utility records, and excavate test pits in areas indicated to verify existing utility depths and locations and to the extent necessary to verify that proposed improvements may be installed in compliance with original design and referenced standards. If the original design is in conflict with the existing utilities, immediately notify the Design Professional of such conflict.
- B. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where project is located.
- C. Verify that water system piping may be installed in compliance with original design and referenced standards.

1.9. SEQUENCING AND SCHEDULING

- A. Coordinate connection to water main with the local water authority having jurisdiction. Confirm advance notice requirements of authority having jurisdiction.
- B. Coordinate with pipe materials, sizes, entry locations, and pressure requirements of building fire protection water systems piping.
- C. Coordinate with pipe materials, sizes, entry locations, and pressure requirements of building domestic water system piping.
- D. Coordinate installation of water systems piping and appurtenances with other utility work.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following:
 - 1. Tapping Valves:
 - a. Mueller co., Grinnell Corp.
 - b. A.P. Smith Co.
 - c. C. Clow
 - 2. Gate Valves:
 - a. American Darling Valve Div., American Cast Iron Pipe Co.
 - b. Mueller Co., Grinnell Corp.
 - c. C. Clow
 - 3. Grooved Couplings for AWWA Ductile-Iron Piping:
 - a. Gustin-Bacon Div., Tyler Pipe Subsid., Tyler Corp.
 - b. Victaulic Co. of America
 - 4. Yard Hydrants:
 - a. Murdock, Inc.,
 - b. Simmons Manufacturing Company
 - 5. Irrigation Quick-Coupling Valves and Valve Boxes:
 - a. Rainbird
 - b. Toro
 - c. Hunter

2.2. PIPES AND TUBES

- A. Refer to Part 3 Article "Piping Applications" for identification of systems where pipe and tube materials specified below are to be used.
- B. Ductile-Iron Pipe: AWWA C150 and AWWA C151.
 - 1. Ductile Iron Pipe, 3-inch diameter through 12-inch diameter, 350 psig.
 - 2. Use AWWA Special Class Wall Thickness, Class 52 for piping with mechanical and push-on joints.
 - 3. Interior Lining: AWWA C104, cement mortar. Exterior coating: Polyethylene for corrosion protection per AWWA C105.
 - 4. Gaskets, Glands, and Bolts and Nuts: AWWA C111.
 - 5. Push-On-Joint-Type Pipe: AWWA C151, rubber gaskets AWWA C 111.

6. Mechanical Joint-type pipe AWWA C151, ductile or cast iron glands, and stainless steel bolts and nuts, C111.
- C. Polyethylene (PE) Plastic Piping (SIDR-PR): three-quarter (3/4) inches through three (3) inch diameter AWWA C-901; ASTM D 2239, Standard Dimension Ratio 11; Standard PE code designation PE4710. pressure class 200 (200 psi). Include NSF listing mark "NSF pw".

2.3. PIPE AND TUBE FITTINGS

- A. Refer to Part 3 Article "Piping Applications" for identification of systems where pipe and tube fitting materials specified below are to be used.
- B. Gray / Cast Iron Normal Pipe Fittings: AWWA C110, 250 psig minimum pressure rating. Ductile Iron Normal Pipe fittings: AWWA C110, 350 psig. Ductile-iron compact fittings: AWWA C153, 350 psig pressure rating.
 1. Interior Lining: AWWA C104, cement mortar. Exterior Coating: Polyethylene for corrosion protection per AWWA C105.
 2. Gaskets: AWWA C111, rubber.
- C. Ductile-Iron Pipe, Grooved-End Fittings: ASTM A 47 malleable-iron or ASTM A 536 ductile-iron, AWWA-pipe-size, grooved-end fittings having cement mortar lining per AWWA C104 and exterior polyethylene corrosion protective coating per AWWA C105. Designed to accept AWWA C606 copings, for AWWA-size grooved-end piping joints.
- D. PE Piping Fittings: AWWA C-901; ASTM D 2609, made of PA, PP, or PVC with serrated, male insert ends matching inside of pipe. Include bands or crimp rings. Insert fittings or mechanical fittings per AWWA C-901. For pipe sizes of 1 ½ inch and larger use double clamping to preclude pull-out of insert fittings from piping per AWWA C-901. Fittings shall have equal or greater pressure rating than piping.

2.4. JOINING MATERIALS

- A. Refer to Part 3 Article "Piping Applications" for identification of system where joining materials specified below are used.
- B. Ductile-Iron Pipe and Ductile-Iron or Cast-Iron Fittings: The following materials apply:

Push-On Joints: AWWA C111 rubber gaskets and lubricant.

 1. Mechanical Joints: Fitting Joint dimensions per AWWA C110, AWWA C 111; Glands per AWWA C111 ductile-iron or gray-iron glands, high-strength steel bolts and nuts, and rubber gaskets.
- C. PE Piping Fittings: AWWA C-901; ASTM D 2609, made of PA, PP, or PVC with serrated, male insert ends matching inside of pipe. Include bands or crimp rings. Insert fittings or mechanical fittings per AWWA C-901. For pipe sizes of 1 ½ inch and larger use double clamping to preclude pull-out of insert fittings from piping per AWWA C-901.
- D. Couplings for Grooved-End Ductile-Iron Pipe and Fittings: AWWA C606, consisting of ASTM A 536 ductile-iron housing having enamel finish, with synthetic-rubber gasket having central-cavity, pressure-responsive design, with carbon-steel bolts and nuts to secure grooved pipe and fittings and gasket suitable for hot water, except where otherwise indicated.

2.5. VALVES

- A. All valves shall open counter-clockwise unless otherwise directed by authorities having jurisdiction. All valves shall be UL listed or FM approved.
- B. Non-rising Stem Gate Valves.
 - 1. Non-rising Stem Gate Valves 3 Inches and larger: AWWA C509-15, resilient seated; bronze stem, cast-iron or ductile-iron body and bonnet, stem nut, 200 psig (1380 kPa) working pressure, mechanical joint ends. UL listed or FM approved.
 - 2. Non-rising Stem Indicating Gate Valves 4 Inches and Larger: Use indicating valves where required by Fire Department and / or Codes Department having jurisdiction. UL 262, FM approved, iron body and bonnet with flange for indicator post, bronze seating material, inside screw, 175 psig working pressure, mechanical joint ends.
 - 3. Non-rising Stem Gate Valves 2 Inches and Smaller: MSS SP-80; body and screw bonnet of ASTM B 62 cast bronze; with Class 125 threaded ends, solid wedge, non-rising copper-silicon alloy stem, brass packing gland, polytetrafluoroethylene (PTFE) impregnated packing, and malleable-iron handwheel.
- C. Valve Boxes: Cast-iron box having top section and cover with lettering "WATER", bottom section with base of size to fit over valve and barrel approximately 7 inches in diameter, and adjustable cast-iron extension of length required for depth of bury of valve. Coat inside and outside with black bituminous paint.
 - 1. Provide a steel tee-handle operating wrench with each valve box. Wrench shall have tee handle with one pointed end, stem of length to operate valve, and socket-fitting valve-operating nut.
- D. Curb Stops: Bronze body, ball type, and wide tee head, with inlet and outlet to match service piping material.
- E. Service Boxes for Curb Stops: Cast-iron box with telescoping top section of length required for depth of bury of valve. Include cover having lettering "WATER" and bottom section with base of size to fit over curb stop and barrel approximately 3 inches in diameter. Coat inside and outside with black bituminous paint.
 - 1. Provide steel tee-handle shutoff rod with each service box. Shutoff shall have tee handle with 1 pointed end, stem of length to operate curb stop, and slotted end fitting curb stop head.
- F. Service Clamps and Corporation Stops: Complete assembly, including service clamp, corporation stop, and bolts and nuts. Use service clamp and stop compatible with drilling machine.
 - 2. Service Clamp: Cast iron or ductile iron with gasket and AWWA C800 threaded outlet for corporation stop, and threaded end straps.
 - 3. Corporation Stops: Bronze body, ball type, with AWWA C800 threaded inlet and outlet matching the service piping material.
 - 4. Manifold: Copper with 2 to 4 inlets as required, with ends matching corporation stops and outlet matching service piping.

- G. Tapping Sleeve and Tapping Valve: valve meeting AWWA C509-15; Complete valve assembly including tapping sleeve, tapping valve, and bolts and nuts. Use a sleeve and valve compatible with tapping machine. UL listed or FM approved.
 - 1. Tapping Sleeve: Cast-iron or ductile-iron 2-piece bolted sleeve with a flanged outlet for new branch connection. Sleeve may have mechanical joint ends with rubber gaskets or sealing rings in sleeve body. Use a sleeve that matches the size and type pipe material being tapped. Outlet flange shall be in size required for branch connection.

2.6. ANCHORAGES

- A. Mechanical
 - 1. Clamps, straps, rods, rod couplings, bolts and Washers: Type 304 stainless steel.
 - 2. Rods: 3/4 inch Type 304 stainless steel.
- B. Concrete Reaction Backing: Portland cement concrete mix, 3000 psi (20.7 MPa).
 - 1. Cement: ASTM C 150, Type I.
 - 2. Fine Aggregate: ASTM C 33, sand.
 - 3. Coarse Aggregate: ASTM C 33, crushed gravel.
 - 4. Water: Potable.

2.7. DETECTABLE WARNING TAPE

- A. 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 deep; colored in accordance with authorities having jurisdiction.

2.8. YARD HYDRANTS

- A. Simmons Model 6804LF Contaminant-Free, Frost-proof Yard Hydrant or approved equal.
- B. Yard hydrants that are to be connected to potable water systems shall be of a "Sanitary" type designed to prevent backflow contamination and freezing of the service line / system. Yard hydrants shall be entirely closed / sealed systems with vacuum breakers and sealed drain tanks. Weep hole type yard hydrants will not be permitted.
- C. Features:
 - 1. 3/4" NPT female inlet
 - 2. 3/4" Male Hose Thread Outlet
 - 3. Cast Iron Head & Handle
 - 4. Stainless Steel Valve Body
 - 5. Fully Self-contained
 - 6. Polyester powder coated finish
 - 7. Bury depth: 4 ft.

2.9. IRRIGATION QUICK-COUPLING VALVES

- A. Basis of Design: Rainbird 1-1/2" One-piece quick coupling valve. Red Brass.

2.10. IRRIGATION VALVE BOXES

- A. Basis of Design: Rainbird 10-inch round PVB valve box.
- B. All irrigation valves boxes to be permanently marked as non-potable.

PART 3 - EXECUTION

3.1. PIPING APPLICATIONS

- A. Refer to Part 2 of this Section for detailed specifications for pipe and fittings products listed below. Use pipe, tube, fittings, and joining methods according to the following applications. Use ductile iron piping and fittings in pits or buildings when using buried PVC piping systems.
 - 1. Three (3) inches to twelve (12) inches (buried service): Class 350, Special Wall Thickness Class 52 ductile-iron pipe, ductile-iron normal or compact fittings, and push-on or mechanical joints unless specified otherwise by local municipality or authority.
 - 2. Three-quarter (3/4) inch to three (3) inches diameter: PE Plastic Pipe (SIDR/SDR).

3.2. VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Buried valves, 1/2" to 2"; in accordance with AWWA C800-01, curb stops with valve box; may be of an angle design or straight-through design and shall provide a drip-tight shutoff in the closed position. The stop head shall be of the tee design or flat design unless otherwise specified by the owner.
 - 2. Buried Valves 3 inches to 14 inches: AWWA, resilient-seated gate valves, non-rising stem, with valve box.

3.3. JOINT CONSTRUCTION

- A. Ductile-Iron Piping Gasketed Joints: Construction joints according to AWWA C 600.
- B. PE Plastic Pipe: Insert fittings for PE pipe and clamped joints, or molded PE fittings and heat fusion joints per AWWA C-901. Joints and fittings shall meet pressure rating of piping.
- C. Dissimilar Materials Piping Joints: Use couplings that are compatible with both piping materials, inside and outside diameters, and system working pressure. Refer to "Piping Systems - Common Requirements" Article for joining piping of dissimilar metals.

3.4. PIPING SYSTEMS - COMMON REQUIREMENTS

- A. General Locations and Arrangements: Drawings indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated except where deviations to layout are approved on coordination drawings.

- B. Install components having pressure rating equal to or greater than system operating pressure.
- C. Install piping free of sags and bends.
- D. Locate groups of pipes parallel, spaced a minimum of two (2) feet outside wall to outside wall to permit valve servicing and future piping servicing or replacement.
- E. Install fittings for changes in direction and branch connections.
 - 1. Use ductile iron piping for above grade or exposed applications when using buried PVC piping systems.
- F. Piping Connections: Except as otherwise indicated, make piping connections as specified below.
 - 1. Install unions, in piping 2 inches and smaller, adjacent to each valve and at final connection to each piece of equipment having 2 inch or smaller threaded pipe connection.
 - 2. For buried services and mains, use mechanical joint or push-on joint connections.
- G. Maintain a minimum 18-inch clearance between water and sanitary line crossings.

3.5. PIPING INSTALLATION

- A. Water Main Connection: Install tap into existing water systems main with size and in location as indicated according to requirements of the water authority having jurisdiction or arrange for the tap to be performed by the local water authority at the cost and expense of the contractor.
 - 1. Three (3)-inch and smaller PE service line connections to DICT and PVC mains:
 - a. Use mechanical fittings designed for the pipe material being joined.
 - 1. Install the mechanical service saddle designed for the pipe being tapped per manufacturer's recommendations using only fittings approved and certified for this application.
 - 2. Install the corp stop.
 - 3. Make the tap. Use transition fitting to connect the threaded outlet on the corp stop to the PE service tubing.
 - 2. Three (3)-inch and larger DICT connections:
 - a. Install tapping sleeve in size and arrangement required by Water Authority Standards and in accordance with the manufacturer's installation instructions. Tapping sleeve shall be AWWA approved construction, split sleeve mechanical joint.
 - b. Use tapping machine compatible with tapping sleeve. Drill hole in main. Remove tapping machine and connect water line.
- B. Comply with requirements of NFPA 24 for materials and installation.
- C. Install ductile-iron pipe and ductile-iron and cast-iron fittings according to AWWA C 600.
- D. Bury piping to provide a minimum cover of 48 inches below finished grade and not less than 18 inches below average local frost depth.
- E. Boring: Install pipe under streets or other obstructions that cannot be disturbed by boring, jacking, or a combination of both.

- F. Where indicated on the drawings, provide casing pipe for protection of internal carrier pipe when pass through walls, foundations, etc. Fill the space between the casing and carrier pipes 90 percent full. Seal ends of casing pipe with flexible sealant.

3.6. ANCHORAGE INSTALLATION

- A. Anchorages: Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages according to AWWA C 600 using concrete reaction backings against undisturbed earth or mechanical restraints or a combination of these systems.
- B. Apply full coat of asphalt or other acceptable corrosion-retarding material to surfaces of installed ferrous anchorage devices.

3.7. VALVE INSTALLATION

- A. General Application: Use mechanical-joint-end valves for 3 inch and larger buried installation. Use bronze corporation stops and valves, with ends compatible with piping, for 2-inch and smaller installation.
- B. AWWA-Type Gate Valves: Comply with AWWA C 600. Install buried valves with stem pointing up and with cast-iron valve box.
- C. Bronze Corporation Stops and Curb Stops: Comply with manufacturer's installation instructions. Install buried curb stops with head pointed up and with cast-iron curb box.

3.8. YARD HYDRANT

- A. Install post-type yard hydrants in pavement or with concrete anchor, and make provision for drainage into a 3' x 3' x 3' stone sump drywell area of AASHTO No. 57 stone as indicated.

3.9. CLOSING ABANDONED WATER DISTRIBUTION FACILITIES

- A. Abandoned Piping: Close open ends of abandoned underground piping that is indicated to remain in place. Provide sufficiently strong closures to withstand hydrostatic or earth pressure that may result after ends of abandoned utilities have been closed.
 - 1. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Wood plugs are not acceptable.
- B. Abandoned Structures: Remove structure and close open ends of the remaining piping, or remove top of structure down to not less than three (3) feet below final grade; punch or drill holes in bottom slab or base of side walls to allow drainage through structure; fill structure with 1-B stone to the top of structure remaining, and backfill the excavation with compacted earth fill.

3.10. IDENTIFICATION INSTALLATION

- A. Install underground warning tape per manufacturer's recommendations and at a depth of 12 inches in unpaved areas and below pavement subgrade in paved areas.

3.11. FIELD QUALITY CONTROL

- A. Testing: As per Water Authority or governing authority methods. Conduct piping tests before joints are covered and after thrust blocks have hardened sufficiently. Use only potable water. Representatives from the applicable governing authority as well as the Design Professional must be notified prior to testing. Written authorization must be obtained from governing authority. Governing authority should be present to witness or document results at their discretion. If no testing method specified, perform as follows:
 - 1. Hydrostatic Testing: Test once all thrust blocks, supports and anchors have fully hardened. Test at pressure at the greater of 1 1/2 times the anticipated system working pressure or 150 psig, for a minimum of two (2) hours per AWWA C600.
 - a. Ductile Iron Piping Systems: Hydrostatic leakage test according to AWWA C 600 or as required by governing authority.
 - b. PVC Piping: Test according to AWWA M 23 or as required by governing authority.

3.12. CLEANING

- A. Clean and disinfect water distribution piping as follows:
 - 1. Purge new water distribution piping systems and parts of existing systems that have been altered, extended, or repaired prior to use.
 - 2. Use purging and disinfecting procedure prescribed by authority having jurisdiction or, if method is not prescribed by that authority, use procedure described in AWWA C 651 or as described below:
 - a. Flush piping system with clean, potable water until visibly dirty water does not appear at points of outlet.
 - b. Fill system or part of system with water/chlorine solution containing at least 50 parts per million of chlorine. Isolate (valve off) system or part thereof and allow to stand for 24 hours.
 - c. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 parts per million of chlorine; isolate and allow to stand for 3 hours.
 - d. Following allowed standing time, flush system with clean, potable water until chlorine does not remain in water coming from system.
 - e. Submit water samples in sterile bottles to authority having jurisdiction. Repeat procedure if biological examination made by authority shows evidence of contamination.
- B. Prepare reports for purging and disinfecting activities.
- C. Provide a Lead-Free Plumbing Material Certification as required under the Pennsylvania Plumbing System Lead Ban and Notification Act.

END OF SECTION 33 11 16

SECTION 33 31 00 - SANITARY UTILITY SEWERAGE PIPING

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

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

1.2. SUMMARY

- A. This Section includes the following:
 - 1. Site sanitary sewerage system piping and appurtenances from a point five (5) feet outside any building to the point of disposal.
- B. Related Sections:
 - 1. Division 03, Section 03 30 00 "Cast-in-Place Concrete" for cast-in-place concrete manhole channels and benches.
 - 2. Division 22, "Plumbing" for sewer systems within buildings and sanitary sewerage pumps.
 - 3. Division 31, Section 31 20 00 "Earthwork" for trench excavation and backfill.

1.3. SUBMITTALS

- A. Test Results.
- B. Product Data: For each type of product indicated.
- C. Shop Drawings for sanitary manholes including pipe opening locations and elevations, frames and covers.
- D. Test Pit Data: Provide drawings indicating relationships of utilities discovered including top and bottom elevations, horizontal locations of pipes, conduits, etc., and elevations / locations of all adjacent utility lines within area indicated to be located or confirmed by a test pit.
- E. Record drawings of installed piping and products. Format drawings in AutoCAD Civil 3d, latest version. Provide all information required by authority having jurisdiction but no less than the following:
 - 1. Final locations of sewer lines, manholes, service tees, tap-in locations,
 - 2. Top and invert elevations of cleanouts, and other structures such as manholes and wet-wells.
 - 3. Signature and seal of registered surveyor responsible for the as-built drawings.
 - 4. Benchmark and datum consistent with project documents and reference relationship to sewer authority datum where applicable.

1.4. QUALITY ASSURANCE

- A. Environmental Compliance: Comply with applicable portions of federal, state and local environmental agency regulations pertaining to sanitary sewerage systems.
- B. Utility Compliance: Comply with local utility regulations and standards and applicable plumbing codes pertaining to sanitary sewerage systems. Obtain a

copy of the governing authority's specifications and details. If there is a discrepancy with the contract documents, the authority documents shall take precedence.

- C. Structural Design Loading: Unless otherwise noted, utilities, structures and underground conveyance systems shall be constructed to withstand traffic loading designation AASHTO HS-20.

1.5. PROJECT CONDITIONS

- A. Site Information: Prior installation, perform a site survey, research public utility records and dig test pits to verify existing utility depths and locations. Verify that sanitary sewerage system piping may be installed in compliance with original design and referenced standards. If the original design is in conflict with existing utilities, immediately notify the Design Professional. Locate existing sanitary sewerage system piping and structures that are to be abandoned and closed.
- B. 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. Follow the requirements of the governing authority where applicable.
 - 1. Notify Owner and Design Professional not less than two days in advance of proposed utility interruptions.
 - 2. Notify the governing authority per authority's advanced notice requirements.
 - 3. Do not proceed with utility interruptions without written permission from the Professional, Owner and governing authority.

1.6. SEQUENCING AND SCHEDULING

- A. Coordinate connection to sewer main with the local sewer authority having jurisdiction. Confirm advance notice requirements of authority having jurisdiction.
- B. Coordinate with interior building sanitary drainage piping.
- C. Coordinate with other utility work.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work includes but are not limited to the following:
 - 1. Manhole frames and cover.
 - a. Neenah Foundry Company
 - b. East Jordan Iron Works
 - 2. Heavy duty cleanout covers:
 - a. Neenah Foundry Company
 - b. East Jordan Iron Works
 - c. Josam Company

2.2. PIPE AND FITTINGS

- A. General: Provide pipe and pipe fitting materials compatible with each other and of the type of pipe and size specifically called out and indicated on the drawings. Pipe and joint materials indicated on the drawings shall, unless otherwise indicated, conform to the material requirements herein specified.
- B. PVC (Polyvinyl Chloride) Gravity Sewer Pipe and Fittings (4-inch through 15-inch diameters): Type PSM SDR-35, ASTM D 3034, for elastomeric gasket joints; ASTM D 3212.
 - 1. Elastomeric gasket joints: Gaskets per ASTM F 477.
- C. Couplings: Rubber or elastomeric sleeve and stainless steel band assembly fabricated to match outside diameters of pipes to be joined.
 - 1. Sleeves: ASTM C 564, rubber for cast-iron soil pipe; and AASTM F 477, elastomeric seal for plastic pipe. Sleeves for dissimilar or other pipe materials shall be compatible with pipe materials being joined.
 - 2. Bands: Stainless steel, one (1) at each pipe insert.
- D. Couplings: Rubber or elastomeric compression gasket, made to match pipe inside diameter or hub, and adjoining pipe outside diameter.
 - 1. Gaskets: ASTM C 564, rubber for cast-iron soil pipe; and ASTM F 477, elastomeric seal for plastic pipe. Gaskets for dissimilar or other pipe materials shall be compatible with pipe materials being joined.

2.3. MANHOLES

- A. Precast Concrete Manholes: ASTM C 478 and AASHTO M 199, precast reinforced concrete, of dimensions and depth indicated with provision for rubber gasket joints. Top section and grade rings shall match the frame and cover specified.
 - 1. Base Section: Eight (8) inch minimum thickness for floor slab and five (5) inch minimum thickness for walls and base riser section and having a separate base slab or a base section with integral floor.
 - 2. Riser Sections: Five (5) inch minimum thickness; forty-eight (48) inch diameter, and lengths to provide depth indicated.
 - 3. Top Section: Eccentric cone type, unless concentric cone or flat-slab-top type is indicated. Top of cone to match grade rings.
 - 4. Grade Rings: Provide reinforced concrete rings as necessary to match twenty-four (24) inch diameter frame and cover.
 - 5. Gaskets: ASTM C 443, rubber.
 - 6. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.
 - 7. Channel and Bench: Concrete.
- B. Steps: Copolymer polypropylene "Press fit" by M.A. Industries, Inc.
 - 1. Material: Plastic manhole steps shall be in conformance with ASTM C-478, OSHA STD 1910.24 (b). Plastic covering shall be of copolymer polypropylene conforming to ASTM D-4101 propylene copolymers. The copolymer polypropylene compound shall encase a one-half inch ($\frac{1}{2}$ ") Grade 60 steel reinforcing rod conforming to ASTM A-615.

2. Steps shall be inserted as per manufacturer's recommendations into manhole walls and elsewhere as indicated and shall be aligned to form a continuous ladder with rungs equally spaced vertically at a maximum distance of twelve (12) inches apart. The top step should be a maximum of sixteen (16) inches below the manhole cover. Steps shall be embedded in the manhole wall a minimum distance of three (3) inches and rungs or cleats shall project a minimum clear distance of five (5) inches from the interior manhole wall, measured from the point of embedment.
- C. Frames and Covers: Manhole lid and frame: ASTM A 536, Grade 60-40-18, heavy-duty, ductile iron frame and cover or ASTM A 48 class 35 cast iron, 24 inch inside diameter by minimum 7-inch riser with minimum 4-inch width flange, and 26-inch diameter cover, indented top design, with lettering "SANITARY SEWER" or as required by authority having jurisdiction cast into cover.
1. Watertight Manhole Frame and Cover: Provide at locations indicated on contract drawings. Incorporate inner sealing lid, gasket and locking bar. Provide inner sealing lid consisting of gray or ductile iron casting with steel locking bar and stainless steel locking screw. Provide rubber gasket of commercial grade rubber.
- D. Concrete: Portland Cement Mix, 3000 psi.
1. Cement: ASTM C 150, Type II.
 2. Fine Aggregate: ASTM C 33, sand.
 3. Coarse Aggregate: ASTM C 33, crushed gravel.
 4. Water: Potable.
- E. Reinforcement: Steel conforming to the following:
1. Fabric: ASTM A 185, welded wire fabric, plain.
 2. Reinforcement Bars: ASTM A 615, Grade 60, deformed.
- F. Exterior Manhole Waterproofing:
1. 25 mil bitumastic coating
- G. Manhole Protection Posts: Where indicated on drawings, provide protection posts for manholes located in open or cultivated areas.
1. Four (4) inch diameter ductile iron or steel pipe imbedded in a concrete footing and filled with concrete. Paint yellow. Slope top of concrete in-fill. Extend five (5) feet above grade.
- H. Protection: Protect manholes during pavement and construction operations. Provide temporary pavement surrounding manhole frame exposed during pavement operations to protect manhole frame from traffic and equipment.
- 2.4. CLEANOUTS
- A. PVC Cleanouts: PVC female fitting with PVC threaded brass plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping. Provide risers and fittings as necessary to meet differential inverts at the cleanout.
- B. Heavy duty cover: For cleanouts in paved areas exposed to automobile traffic, round cast-iron access frame and heavy-duty, secured, scoriated cast-iron cover.

- C. Concrete Encasement for Riser: For cleanouts in paved areas exposed to automobile traffic, provide 3000 P.S.I. minimum concrete encasement around riser as shown on drawings.

2.5. VENTS AND TRAPS

- A. General: If required by local sewer authority, provide vent and trap on all building services at a location meeting sewer authority requirements. Materials and joint construction to match that of the connecting pipes. Provide vent cap.
- B. Maximum one (1) foot drop in trap below service invert.
- C. Provide risers and fittings as necessary to meet differential inverts at the cleanout.

2.6. DETECTABLE WARNING TAPE

- A. 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 in accordance with authorities having jurisdiction.

PART 3 - EXECUTION

3.1. EARTHWORK

- A. Excavation, trenching, backfilling and abandonment of pipes shall be as specified in Division 31, Section 31 20 00, "Earthwork", and Section 31 50 00 "Excavation Support and Protection".

3.2. INSTALLATION, GENERAL

- A. General Locations and Arrangement: Drawings indicate the general location and arrangement of the underground sanitary sewerage system piping. Install the piping as indicated, to the extent practical. Any proposed variation of location, invert or pipe slope requires approval of the Design Professional.
- B. Install piping beginning at low point of systems, 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 recommendations for use of lubricants, cements, and other installation requirements. Maintain swab or drag in line and pull past each joint as it is completed.
- C. Use manholes for changes in direction for gravity sewerage lines, except where a fitting is indicated. Use appropriate fittings and thrust blocking or mechanical restraints for changes in direction of force main piping. Use fittings for branch connections, except where direct tap into existing pipe is indicated.
- D. Use proper size increasers, reducers, and couplings, where different size or material of pipes and fittings are connected. Reduction of the size of piping in the direction of flow is prohibited.
- E. Install piping pitched down in direction of flow, at minimum slope of two (2) percent, except where indicated otherwise.

- F. Extend sanitary sewerage system piping to connect to building sanitary drains, of sizes and in locations indicated. Provide a trap, cleanout and vent in accordance with requirements of authority having jurisdiction for each building service.
- G. Piping Insulation: Provide where indicated on drawings.
 - 1. Install polystyrene blanket over buried underground sewerage piping. Width of insulation shall extend minimum of twelve (12) inches beyond each side of pipe. Install directly over and center on pipe center line.
 - 2. Piping insulating jacket: encapsulate piping per manufacturer's recommendations.
- H. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed, by tunneling, jacking, or a combination of both.
- I. Bury all sewer gravity main and force main piping to provide a minimum cover of 48 inches below finished grade and not less than 18 inches below average local frost depth. All service lines and laterals shall have a minimum cover of 36 inches.
- J. Where indicated on the drawings, provide casing pipe for protection of internal carrier pipe when pass through walls, foundations, etc. Fill the space between the casing and carrier pipes 90 percent full. Seal ends of casing pipe with brick and mortar block.

3.3. PIPE JOINT CONSTRUCTION AND INSTALLATION

- A. PVC (Polyvinyl Chloride) Gravity Sewer Pipe and Fittings (4-inch through 15-inch diameters): Type PSM SDR-35, ASTM D 3034, for elastomeric gasket joints; ASTM D 3212.
 - 1. Elastomeric gasket joints: Assembly per ASTM D 3212.
 - 2. Underground installation per ASTM D 2321.
- B. Join different types of pipe with standard manufactured couplings and fittings intended for that purpose.

3.4. MANHOLES

- A. General: Install manholes complete with accessories as indicated on the drawings. Form continuous concrete or split pipe section channels and benches between inlets and outlet. Set tops of frames and covers flush with the finished pavement surface where manholes occur in pavements. In lawn areas, set the top elevation to be set flush with grade, unless otherwise required by the sewer authority.
- B. Place precast concrete manhole sections as indicated, and install in accordance with ASTM C 891.
- C. In floodplain areas top elevations shall be elevated to the appropriate levels to meet flood protection requirements of the governing sewer authority.
- D. Provide rubber joint gasket complying with ASTM C 443 at joints of sections.
- E. Apply bituminous mastic coating at joints of sections.

3.5. CLEANOUTS

- A. Install cleanouts and riser extension from sewer pipe to cleanout at grade as indicated. Encase in concrete where indicated or specified. Set top of cleanout one (1) inch above surrounding unpaved grade or flush with grade when installed in paving.

3.6. TAP CONNECTIONS

- A. Make connections to existing piping and underground structures so that finished work conforms as nearly as practicable to the requirements specified for new work.
- B. 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 six (6) inch overlap, with not less than six (6) inches of 3000 psi twenty-eight (28) day compressive-strength concrete.
- C. Make branch connections from side into existing four (4) inch diameter or larger piping by removing section of existing pipe and installing wye fitting, into existing piping. Encase entire wye with not less than six (6) inches of 3000 psi twenty-eight (28) day compressive-strength concrete.
- D. Make branch connections from side into existing twenty-four (24) inch or larger piping or to underground structures by cutting opening into existing unit sufficiently large to allow three (3) inches 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 or structure wall, encase entering connection in six (6) inches of concrete of minimum length of twelve (12) inches to provide additional support of collar from connection to undisturbed ground.
 - 1. Provide concrete that will attain minimum twenty-eight (28) day compressive strength of 3000 psi, unless otherwise indicated.
 - 2. Use epoxy bonding compound as interface between new and existing concrete and piping materials.
- E. Protect existing piping and structures to prevent concrete or debris from entering while making tap connections. Remove debris, concrete, or other extraneous material that may accumulate.

3.7. CLOSING ABANDONED SANITARY SEWERAGE SYSTEM

- A. Refer to Section 31 20 00 Earthwork for abandonment provisions.

3.8. FIELD QUALITY CONTROL

- A. Testing: Perform testing of completed piping, trenches and sewerage appurtenances in accordance with local authorities having jurisdiction. Representatives from the applicable sewer authority or municipal agency with jurisdiction as well as the design professional must be notified prior to testing and written authorization obtained. Governing authorities should be present to witness or document results at their discretion.
- B. Test results shall be submitted within five (5) days, unless otherwise agreed upon in writing.
- C. Testing includes but is not limited to the following:
 - 1. Gravity Sewer Main Testing:

- a. Alignment: Perform "Light Test" to check for full roundness of piping. Perform "Mandrel or Rigid Ball Test" as necessary or as directed to check for alignment or damage. The pipe shall be evaluated based upon ASTM D 2122.
 - b. Leakage:
 - 1) Perform hydrostatic leakage test. For PVC piping: Allowable leakage the smaller of the governing authority's requirements or 50 gallons per inch of nominal pipe size per mile. Perform by closing all openings in system with water. Purge the air and refill with water. Disconnect the water supply. Test and inspect joints for leaks. For ductile iron piping: Test according to AWWA C 600 with a testing pressure of at least 10 psig.
 - 2) Perform air test as required by governing authority. If no method prescribed, follow method outlined in UNI-B-6-90 (UNI-BELL PVC Pipe Association, phone 214-243-3902).
 - c. Other testing as deemed necessary by the governing authority.
2. Manhole Testing:
- a. Perform hydraulic testing in accordance with ASTM C 969 or as required by governing authority.
3. Trench Backfill Compaction Testing:
- a. Perform soil compaction testing at minimum one-hundred (100) foot intervals after approximately two (2) feet of initial backfill is in place over the top of the pipe and on every lift thereafter up to the subgrade elevation. Where the compaction fails to meet the level required under Section 31 20 00, "Earthwork" the backfill material shall be removed and replaced in properly compacted lifts until the specified degree of compaction is reached for the full backfill depth.
- D. Cleaning: Clear interior of piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed.
- 1. Place plugs in ends of uncompleted pipe at end of day or whenever work stops.
 - 2. Flush piping between manholes, if required by local authority, to remove sediment or debris.
- E. Interior Inspection: Inspect piping to determine whether line displacement or other damage has occurred.
- 1. Make inspections after pipe between manholes and manhole locations has been installed and approximately two (2) feet of backfill is in place, and again at completion of project.
 - 2. If inspection indicates poor alignment, debris, displaced pipe, sagging, deflection, infiltration or other defects correct such defects to the satisfaction of the Design Professional and reinspect.

END OF SECTION 31 31 00

SECTION 33 41 00 - STORM UTILITY DRAINAGE PIPING

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.
- B. Geotechnical Reports:
 - 1. *Geotechnical Engineering Report prepared by Barry Isett & Associates, Inc., dated April 27, 2025.*
 - 2. *Stormwater Infiltration Evaluation Report prepared by Barry Isett & Associates, Inc., dated March 17, 2026.*
 - 3. *Stormwater Infiltration Report prepared by Barry Isett & Associates, Inc., dated November 24, 2020.*
 - 4. *These reports and attachments are provided as Owner's information for bidders' convenience and are intended to supplement rather than serve in lieu of Contractor's own investigations. The reports and attachments are not a warranty of existing conditions nor are they a part of the Contract Documents.*

1.2. SUMMARY

- A. This Section includes the following:
 - 1. Site stormwater piping.
 - 2. Drainage structures.
 - 3. Downspout boots.
- B. Related Sections:
 - 1. Division 22, "Plumbing" for storm sewer systems within buildings.
 - 2. Division 31, Section 31 20 00 "Earthwork" for trench excavation and backfill required for installation of the storm drainage system piping and appurtenant drainage structures, swales, and geotextiles.
 - 3. Division 32, Section 32 18 00 "Athletic Equipment" for manhole access frame and cover where utilities are located in synthetic turf playing field.

1.3. SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop drawings for storm drainage structures; including frames, covers, and grates.
- C. Test Pit Data: Provide drawings indicating relationships of utilities discovered including top and bottom elevations, horizontal locations of pipes, conduits, etc., and elevations / locations of all adjacent utility lines within area indicated to be located or confirmed by a test pit.
- D. Record drawings of installed piping and products. Format drawings in AutoCAD Civil 3d, latest version. Provide all information required by the authority having jurisdiction but no less than the following:

1. Final locations of storm water pipes, infiltration trenches, underground stone beds, manhole and inlet structures (including tops and inverts), headwalls/endwalls, pipe sizes and pipe lengths.
2. Post-construction contour grading of rain gardens, detention, and retention ponds.
3. Signature and seal of registered surveyor responsible for the record drawings.
4. Benchmark and datum consistent with project documents.

1.4. QUALITY ASSURANCE

- A. Environmental Compliance: Comply with applicable portions of federal, state and local environmental agency regulations pertaining to storm drainage systems.
- B. Municipal Compliance: Comply with local municipal regulations and standards pertaining to storm drainage systems.
- C. Structural Design Loading: Unless otherwise noted, utilities, structures and underground conveyance systems shall be constructed to withstand traffic loading designation AASHTO HS-20.

1.5. PROJECT CONDITIONS

- A. Site Information: Prior to beginning earthwork operations, investigate existing underground utility locations, research public and site utility records, and excavate test pits in areas indicated to verify existing utility depths and locations and to the extent necessary to verify proposed improvements may be installed in compliance with original design and referenced standards. If the original design conflicts with the existing utilities, immediately notify the Design Professional.
 1. Locate existing storm drainage system piping and structures that are to be abandoned and closed.
- B. 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. Follow the requirements of the governing authority where applicable.
 1. Notify Owner and Design Professional not less than two days in advance of proposed utility interruptions.
 2. Notify the governing authority per their advanced notice requirements. Do not proceed with utility interruptions without Owner's / Design Professional's and governing utility authority's written permission.

1.6. SEQUENCING AND SCHEDULING

- A. Coordinate connection to public drainage system with the municipality or agency having jurisdiction.
- B. Coordinate connection of interior building storm drainage piping with the plumbing contractor.
- C. Coordinate with other utility work.

1.7. DELIVERY, STORAGE AND HANDLING

- A. Do not store plastic structures, pipes, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings and seals from dirt and drainage.
- C. Handle precast concrete structures according to manufacturer's written rigging instructions.

PART 2 - PRODUCTS

2.1. PIPE AND FITTINGS

- A. General: Provide pipe and pipe fitting materials compatible with each other and of the type of pipe and size specifically indicated. Where more than one type of materials or products is indicated, selection is Installer's option. Pipe and joint materials for the type of pipe indicated shall, unless otherwise indicated, conform to the material requirements herein specified.
- B. Perforated and non-perforated PVC (Polyvinyl Chloride) Gravity Sewer Pipe and Fittings (4-inch through 15-inch diameters): Type PSM SDR-35, ASTM D 3034, for solvent cement or elastomeric gasket joints; ASTM D 3212.
 - 1. Solvent Cement: Solvent cement per ASTM D 2564.
 - 2. Elastomeric gasket joints: Gaskets per ASTM F 477.
- C. Reinforced Concrete Culvert Pipe and Fittings: ASTM C 76-22 and AASHTO M 170-23, Class III, Wall B, for rubber gasket joints, except as modified by PENNDOT Publication 408, Section 601.2.
 - 1. Gaskets: ASTM C 443-21, rubber.
- D. Smooth-Lined Corrugated High-Density Polyethylene (SLHDPE) Solid and Slotted Pipe and Fittings, Gravity Flow Storm Drainage Application 12-inch diameter and larger:
 - 1. References:
 - a. AASHTO M 294-21: Standard Specification for Corrugated Polyethylene Pipe, 12" to 60" Diameter.
 - b. AASHTO M252-23: Standard Specification for Corrugated Polyethylene Drainage Pipe, 3" to 10" Diameter.
 - c. ASTM D2321-20: Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
 - d. ASTM D3350-21: Standard Specification for Polyethylene Plastic Pipe and Fittings Materials.
 - e. ASTM F477-21: Specifications for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
 - 2. Material Properties:
 - a. Pipe and fitting materials shall be made from virgin high-density polyethylene compounds which conform with the requirements of ASTM D3350-21 resin cell classification 335420C or ASTM D1248-16 Type III, Class C, Category 4, Grade P33.
 - 3. Joints and Fittings:
 - a. Joint Requirements: Joints shall consist of a bell and spigot type joint with an o-ring rubber gasket meeting ASTM F477-21 placed on the spigot end. The bell end shall engage a minimum of two (2) corrugations

- to provide sufficient longitudinal strength, preserve pipe alignment, and prevent separation at the joints.
- b. Fittings Requirements: Pipe fittings shall be manufactured to conform to AASHTO M294-21. They shall not reduce or impair the overall integrity of function of the pipeline. Only fittings supplied or recommended by the pipe manufacturer shall be used.
- 4. Slotted pipe shall be factory wrapped with geotextile filter fabric.

2.2. STRUCTURES

- A. Precast Concrete Structures: ASTM C 478-22 or ASTM C913-21 and AASHTO M 199-23 and PennDOT Publication 72, RC-39M. Provide precast reinforced concrete structures, of depth indicated, with provision for rubber gasket joints. Top section and grade rings shall match the frame and cover specified.
 - 1. Base Section: 6-inch minimum thickness for floor slab and 6-inch minimum thickness of walls and base riser section for rectangular structures and 5-inch minimum thickness of walls and base riser section for 48-inch circular structures and having a separate base slab or a base section with integral floor.
 - 2. Riser Sections: 6-inch minimum thickness for rectangular structures and 5-inch minimum thickness for 48-inch circular structures and lengths required to provide the depth indicated.
 - 3. Top Section: Flat slab-type with opening to match grade rings and frame and grate.
 - 4. Eccentric cone type, where indicated, for manholes, with top of cone to match grade rings.
 - 5. Grade Rings: Provide reinforced concrete rings, as necessary to match dimensions of frame and grate.
 - 6. Gaskets: ASTM C 443, rubber.
 - 7. Pipe Connectors: ASTM C 270-25, "Standard Specification for Mortar for Unit Masonry" requirements. Mortar joints shall be smooth and flush with manhole walls.
 - 8. Channel and Bench: Concrete.
 - 9. Corner intersections of pipes and structures are prohibited.
- B. Steps: ASTM C 476-23; Copolymer polypropylene, press-fit design (PF) by M.A. Industries, Inc. or approved equal.
 - 1. Provide manhole steps in inlet boxes when depth between the finished grade and the top of the bottom slab is greater than 5 feet.
- C. Manhole Frames and Covers: ASTM A 536-24, Grade 60-40-18, heavy-duty ductile iron; or AASHTO M105-23 class 35B, AASHTO M306-23 cast iron; 24- to 30-inch inside diameter by 5- to 8-inch riser with 4-inch minimum width flange; and 26- to 32-inch diameter cover, indented top design, with lettering "STORM DRAIN" cast into cover. Frames and covers shall conform to PennDOT Publication 408, Section 605 and 1105.02.
- D. Rectangular Inlet Frames and Grates: ASTM A 536-24 Grade 60-40-18, heavy-duty ductile iron PennDOT Type M frames with 3 ¼-inch riser, 4- to 6"-inch minimum width flange and PennDOT Structural Steel Bicycle Safe Grates, all conforming to PENNDOT Publication 72, RC-45M and PennDOT Publication 408, Section 1105.02.
- E. Curb Inlet Frames and Grates: Precast concrete PennDOT Type C frame with PENNDOT Structural Steel Bicycle Safe Grates, all conforming to PennDOT Publication 72, RC-45M and PennDOT Publication 408, Section 1105.02.

2.3. DRAIN BASINS

- A. Basins: Nyloplast Drain Basins by Advanced Drainage Structures (ADS)
 - 1. Size as indicated.
- B. Grates: ADS drop-in frames and grates.
 - 1. Epoxy coated ductile iron grates.
 - 2. ADA compliant openings where located in walking surfaces.

2.4. CLEANOUTS

- A. PVC Cleanouts: PVC female fitting with PVC threaded brass plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping. Provide risers and fittings as necessary to meet differential inverts at the cleanout.
- B. Heavy duty cover: For cleanouts in paved areas exposed to automobile traffic, round cast-iron access frame and heavy-duty, secured, scoriated cast-iron cover.
- C. Concrete Encasement for Riser: For cleanouts in paved areas exposed to automobile traffic, provide concrete encasement around riser as indicated.

2.5. CONCRETE AND REINFORCEMENT

- A. Concrete: Portland cement mix, 4,000 psi, 5.5% Air Entrained.
 - 1. Cement: ASTM C150-24, Type II.
 - 2. Fine Aggregate: ASTM C33-24, sand.
 - 3. Coarse Aggregate: ASTM C33-24, crushed gravel.
 - 4. Water: Potable.
- B. Reinforcement: Steel conforming to the following:
 - 1. Fabric: ASTM A1064-24, welded wire fabric, plain.
 - 2. Reinforcement Bars: ASTM A615-22, Grade 60, deformed.

2.6. DOWNSPOUT BOOTS

- A. Basis of Design: O-Series Offset Downspout Boots by J.R. Hoe, Inc. or approved equal.
 - 1. Material: ASTM A-48 Class Gray Iron.
 - 2. Finish: Primer Coated. Final finish by contractor (field-applied).
 - 3. Length: 24"
 - 4. Accessories:
 - a. Rubber boots for connection to underground rainwater conductors.
 - b. Stainless steel fasteners for mounting.
 - c. Above grade cleanout panel

PART 3 - EXECUTION

3.1. EARTHWORK

- A. Excavation, trenching, backfilling and abandonment of pipes shall be as specified in Division 31, Section 31 20 00, "Earthwork".

3.2. INSTALLATION, GENERAL

- A. General: Install the piping as indicated, to the extent practical. Any proposed variation of locations, invert or pipe slope requires prior approval of the Design Professional.
- B. Install piping beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of pipe facing upstream. Install gaskets, seals, sleeves, and couplings in accordance with manufacturer's recommendations for use of lubricants, cements, and other installation requirements. Maintain swab or drag in line and pull past each joint as it is completed.
- C. Use manholes or inlets for changes in direction, except where a fitting is specifically indicated. Use fittings for branch connections, except where direct tap into existing pipe is specifically indicated.
- D. Use proper size increasers, reducers, and couplings, where different size or material of pipes and fittings are to be connected. Reduction of the size of pipe in the direction of flow is prohibited.
- E. Install piping pitched down in direction of flow, at minimum slope of 1 percent, except where indicated otherwise.
- F. Extend storm drainage system piping to connect to building storm drains, of sizes and in locations indicated.
- G. Pipe trench backfilling shall comply with the requirements of Earthwork Section 31 20 00.
- H. Pipe Sleeving: Where indicated, provide casing pipe for protection of internal carrier pipe when pass through walls, foundations, etc. Fill the space between the casing and carrier pipes with grout up to 90% (ninety percent) full. Seal ends of casing pipe with expansive foam or other impermeable sealant.

3.3. PIPE JOINT CONSTRUCTION AND INSTALLATION

- A. PVC (Polyvinyl Chloride) Gravity Sewer Pipe and Fittings (4-inch through 15-inch diameters): Type PSM SDR-35, ASTM D3034-21, for solvent cement or elastomeric gasket joints; ASTM D3212-20.
 - 1. Solvent Cement Joints: Assembly per ASTM D2855-20.
 - 2. Elastomeric Gasket Joints: Assembly per ASTM D3212-21.
- B. Join and install Reinforced Concrete Pipe as follows:
 - 1. Bell and spigot or tongue and groove fittings with rubber gaskets in accordance with ASTM C443-21 and install piping in accordance with applicable provisions of ACPA "Concrete Pipe Installation Manual".
- C. Join and install Corrugated Polyethylene Pipe as follows:
 - 1. Pipe and gasketed coupling in accordance with ASTM F 667-21 and AASHTO M294-21.
 - 2. Installation shall be in accordance with ASTM D2321-20.

3.4. ANTI-SEEP COLLARS

- A. Construct earthen collars using Impervious Fill where indicated.

3.5. STRUCTURES

- A. General: Install structures complete with accessories as indicated. Form continuous concrete or split pipe section channel and benches at the level indicated between inlets and outlet of the manhole. Set tops of frames and covers flush with finish surface where structures occur in pavements. Elsewhere, set tops flush with finish surface, unless otherwise indicated.
- B. Place precast concrete manhole sections as indicated and install in accordance with ASTM C891-20.
- C. Provide rubber joint gaskets complying with ASTM C443-21 at joints of sections.
- D. Install structures of sizes and shapes indicated.
- E. Set frames and grates to elevations indicated.
- F. Provide protection for Inlets from heavy equipment and traffic during construction period.
- G. Piping shall be installed to be flush with the inside wall of the structure.
- H. Verify all structures are adequately sized to properly receive all pipes prior to shop drawing submittal. Utilize oversized base structures as necessary.
- I. Corner intersection of pipes is prohibited.
- J. For pipe openings without flexible gasket, provide openings at least 2" but not more than 4" larger than the outside diameter of the specified pipe.
- K. Locate pipe openings to provide a minimum of 4" of concrete between top or bottom of a structure section and the pipe opening.

3.6. CLEANOUTS

- A. Install cleanouts and extension from drainpipe to cleanout at grade as indicated on the plans. Set top of cleanout above surrounding earth grade or flush with grade when installed in paving. Encase in concrete where indicated.

3.7. CLOSING ABANDONED STORM DRAINAGE SYSTEM

- A. Refer to Section 31 20 00 for abandonment provisions.

3.8. FIELD QUALITY CONTROL

- A. Cleaning: Clear interior of piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed.
 - 1. In large, accessible piping, brushes and brooms may be used for cleaning.
 - 2. Place plugs in ends of uncompleted pipe at end of day or wherever work stops.
 - 3. Flush piping between manholes, if required by local authority, to remove collected debris.
- B. Interior Inspection: Inspect piping to determine whether line displacement or other damage has occurred.

1. Make inspections after pipe between manholes and manhole locations has been installed and approximately two (2) feet of backfill is in place, and again at completion of project.
2. If inspection indicates poor alignment, debris, displaced pipe, sagging, deflection, infiltration, or other defects, correct such defects to the satisfaction of the Design Professional and re-inspect.

END OF SECTION 33 41 00