

**Division 02-32 Technical Specifications**

SECTION 024113  
SELECTIVE SITE DEMOLITION

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. Demolition of designated curbs, sidewalks, pavement and aggregate bases, and other site improvements shown to be removed
  2. Abandoning in place or removing below-grade construction.
  3. Disconnecting, capping or sealing, and abandoning in place or removing site utilities.
  4. Saw-cutting pavement.
  5. Disposal and/or recycling of demolished materials.
- B. This section does not include demolition of buildings or other above-grade structures.

1.3 REFERENCES

- A. The most current version of the publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. City of Philadelphia Building Code.
- C. Philadelphia Water Department: Standard Details and Specifications for Sewers.
- D. AMERICAN NATIONAL STANDARDS INSTITUTE
1. ANSI A10.6: Safety Requirements for Demolition Operations.
- E. NATIONAL FIRE PROTECTION ASSOCIATION
1. NFPA 241: Standard for Safeguarding Construction, Alteration, and Demolition Operations.
- F. The Contractor is required to have one copy of the latest edition of each of the following publications available for review in the job-site construction office at all times while performing the work described in this Section. The Contractor is to comply with each of the following unless more stringent requirements are indicated or specified.

1. City of Philadelphia, Department of Streets: Standard Construction Items, except that measurement and payment sections do not apply.

#### 1.4 RELATED WORK

- A. Section 312000, Earth moving.

#### 1.5 SUBMITTALS

- A. Pre-demolition Photographs, 35 mm or digital or Videotape/DVD: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Submit before Work begins.
- B. Schedule of Demolition Activities to be submitted before work begins: Indicate the following:
  1. Detailed sequence of demolition and removal work, methods, and equipment required for demolition and disposal, with starting and ending dates for each activity.
  2. Coordination for shutoff, and capping of utility services.
- C. Evidence of disposal and recycling contracts (for information only)
- D. Record drawings of removed and abandoned utilities, indicating locations, sizes, materials, and elevations. Drawings shall be legible, drawn to scale, and contain sufficient information to locate abandoned utilities after excavations are backfilled.

#### 1.6 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with governing local, State, and Federal notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI A10.6.

#### 1.7 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or recycled.
- B. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or recycled.

#### 1.8 MATERIALS OWNERSHIP

- A. Unless otherwise noted, all cleared or demolished materials shall become Contractor's property and shall be promptly removed from the site.

#### 1.9 PROJECT CONDITIONS

- A. Work on the site under other contracts may be concurrent with this contract. The Contractor shall coordinate the demolition sequence with all other contractors. The Contractor shall

provide all temporary bracing, shoring, and supports that may be required to ensure the safety of personnel in areas of the site adjacent to the demolition area.

- B. Owner assumes no responsibility for site features to be demolished.
- C. Conditions existing at time of inspection for bidding purposes will be maintained by Owner as far as practicable.
- D. Storage or sale of removed items or materials on-site is not permitted.

#### 1.10 COORDINATION

- A. Arrange demolition schedule so as not to interfere with other contractor's on-site operations.
- B. Contact utility owners to arrange for shutoff of utilities prior to removal.

#### PRODUCTS (NOT USED)

#### EXECUTION

#### 1.11 EXAMINATION

- A. Survey existing conditions and correlate with requirements indicated to determine extent of site demolition required.
- B. Review Project Record Documents of existing construction available by Owner. Owner does not guarantee that existing conditions are the same as those indicated in Project Record Documents.
- C. When unanticipated elements are encountered, investigate and measure the nature and extent of the element. Promptly submit a written report to the Owner.

#### 1.12 PREPARATION

- A. Notify the Pennsylvania One-Call System at 1-800-242-1776 in accordance with Pennsylvania Act 287 and all amendments. Retain the services of a utility locator for identification of underground utilities on private property.
- B. Predemolition Conference: Conduct conference at Project site with Owner to discuss the following:
  - 1. Inspect and discuss condition of construction to be demolished.
  - 2. Review and finalize demolition schedule and verify availability of demolition personnel, equipment, and facilities needed to make progress and avoid delays.
  - 3. Notify owner of procedures which may affect property, of potential noise, utility outage, or disruption. Coordinate with Owner.
- C. Review and finalize protection requirements.
- D. Arrange to discontinue utility service with utility companies and other agencies:

- E. Obtain all required permits and post all required notifications prior to beginning the work.
- F. Existing Utilities: Do not start demolition work until utility disconnection/de-energization have been completed and verified in writing.
- G. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished.
- H. Strengthen or add new supports when required during progress of demolition.

#### 1.13 SAW CUTTING

- A. Saw-cut pavement at limits of removal where remaining pavement is to be incorporated into new work.
- B. Footway: In accordance with Philadelphia Streets Department Standard Construction Item No. 7-0050.
- C. Street Pavement: Full depth saw cuts will be required where cutting utility trenches in the street and at the limits of full depth pavement removal. Full depth saw cuts shall be in accordance with Philadelphia Streets Department Standard Construction Item No. 7-0050 except as follows:
  - 1. Saw-cut pavement at limits of removal where remaining pavement is to be incorporated into new work. Saw cuts shall be neat, straight, and a minimum of 1” in depth. Full depth saw cuts will be required where cutting utility trenches in the street.

#### 1.14 PROTECTION

- A. Existing Facilities: Protect adjacent walkways, bike trails, building entries, and other building facilities during demolition operations.
- B. Temporary Protection: Erect temporary protection, such as walks, fences, barriers, railings, and security devices where required by authorities having jurisdiction or as indicated.
- C. Protect existing site appurtenances and landscaping which are to remain.
- D. Protect existing site items which are not indicated to be removed.
- E. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities which are to remain.
- F. Provide protection to ensure safe passage of people and vehicles around demolition areas, and to and from occupied portions of adjacent buildings and structures.

#### 1.15 GENERAL DEMOLITION

- A. General: Demolish indicated site improvements completely. Use methods required to complete the Work within limitations of governing regulations.

- B. Engineering Surveys: Perform regular engineering surveys of the entire work area as the Work progresses to detect hazards that may result from demolition activities. Maintain a written log of survey times, dates, and findings.
- C. Site Access and Temporary Controls: Conduct demolition and debris-removal operations to ensure minimum interference with roads, streets, sidewalks, walkways, and other adjacent occupied and used facilities.
  - 1. Do not close or obstruct streets, walks, walkways, bike trails, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
  - 2. Use water mist, dust control palliatives, and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, contaminated runoff, and pollution.
- D. Cease operations immediately if adjacent structure appears to be in danger. Notify Engineer.

#### 1.16 EXPLOSIVE DEMOLITION

- A. Explosives: Use of explosives is not permitted.

#### 1.17 TREE REMOVAL

- 1. No trees shall be removed except as specifically directed by the Professional and indicated on the plans.

#### 1.18 RESTORATION

- A. Below-Grade Areas: Fill below-grade areas and voids resulting from utility demolition operations with satisfactory soil materials. Refer to Division 31, Earth Moving Section for soil materials and compaction.

#### 1.19 REPAIRS

- A. General: Promptly repair damage to adjacent construction.
- B. Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.
- C. Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.

#### 1.20 RECYCLING DEMOLISHED MATERIALS

- A. Recycling Incentives: Revenues for recycling demolition materials shall accrue to the contractor unless otherwise noted in the Project Documents.

#### 1.21 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials planned to be recycled, salvaged, reused, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in a permitted, regulated disposal facility.
  - 1. Do not allow demolished materials to accumulate on-site.
  - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning or burial: Do not burn or bury demolished materials unless otherwise specified.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

## 1.22 CLEANING

- A. Clean adjacent structures, streets, sidewalks, and other pavement surfaces to remain free of dust, dirt, and debris caused by demolition operations. Return adjacent areas to condition existing before demolition operations began.

- END -

SECTION 033000  
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
  - 1. Footings.
  - 2. Cast-in-place concrete curbs and walls.
  - 3. Cast-in-place concrete stairs.
  - 4. Cast-in-place concrete foundations.
  - 5. Cast-in-place concrete pavement.
- B. Related Sections:
  - 1. None.

1.3 DEFINITIONS

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
  - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- D. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
  - 1. Locations of all joints in concrete, including construction joints, expansion joints, isolation joints, cold joints, and contraction joints, in plan and elevation views.



2. Location of construction joints is subject to approval of the Engineer.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, manufacturer, testing agency.
- B. Welding certificates.
- C. Material Certificates: For each of the following, signed by manufacturers:
  1. Cementitious materials.
  2. Admixtures.
  3. Steel reinforcement and accessories.
  4. Curing compounds.
  5. Floor and slab treatments.
  6. Bonding agents.
  7. Adhesives.
  8. Semirigid joint filler.
  9. Joint-filler strips.
  10. Repair materials.
- D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
  1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- E. Field quality-control reports.
- F. Minutes of preinstallation conference.

#### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
  1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
  1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."
- F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
  1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
  2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- G. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- H. Mockups: Cast concrete formed-surface panels to demonstrate typical joints, surface finish, texture, tolerances, floor treatments, and standard of workmanship.
  1. Build curb, approximately 10 linear feet for formed surface in the location indicated or, if not indicated, as directed by the Engineer or Landscape Architect.
  2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- I. Preinstallation Conference: Conduct conference at Project site.
  1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following (if applicable):
    - a. Contractor's superintendent.
    - b. Independent testing agency responsible for concrete design mixtures.
    - c. Ready-mix concrete manufacturer.
    - d. Concrete subcontractor.
    - e. Special concrete finish subcontractor.

## 1.7 PERFORMANCE REQUIREMENTS

- A. American Concrete Institute (ACI):

306R Cold Weather Concreting

316R Recommendations for Construction of Concrete Pavements and Concrete Bases

B. American Society for Testing and materials (ASTM):

- A 185 Specification for Steel Welded Wire Fabric. Plain, for Concrete Reinforcement.
- C 33 Specifications for Concrete Aggregates
- C 94 Specifications for Ready-Mixed Concrete
- C 143 Test Method for Slump of Hydraulic Cement Concrete
- C 150 Specification for Portland Cement
- C 171 Specification for Portland Cement
- C 231 Test method for Air Content of Freshly Mixed Concrete by the Pressure Method
- C 309 Specification for Liquid Membrane-Forming Compounds for Curing Concrete
- C 494 Specification for Chemical Admixtures for Concrete
- D 545 Test Methods for Preformed Expansion Joint Fillers for Concrete Construction (Nonextruding and Resilient Types)
- D 1752 Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

1.8 DELIVERY, STORAGE, AND HANDLING

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

PART 2 PRODUCTS

2.1 FORM-FACING MATERIALS (NOT USED)

2.2 STEEL REINFORCEMENT

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from galvanized-steel wire into flat sheets.
- C. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.
- D. Epoxy-Coated Welded Wire Reinforcement: ASTM A 884/A 884M, Class A, plain steel.
- E. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- F. Galvanized Reinforcing Bars: ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A 615/A 615M, Grade 60 deformed bars.
- G. Epoxy-Coated Reinforcing Bars: ASTM A 775/A 775M or ASTM A 934/A 934M; with ASTM A 615/A 615M, Grade 60 deformed bars.
- H. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60 (Grade 420), deformed bars; assembled with clips.
- I. Plain-Steel Wire: ASTM A 82/A 82M galvanized.
- J. Deformed-Steel Wire: ASTM A 496/A 496M.

- K. Epoxy-Coated-Steel Wire: ASTM A 884/A 884M, Class A coated, plain.
- L. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420) plain-steel bars; zinc coated (galvanized) after fabrication according to ASTM A 767/A 767M, Class I coating. Cut bars true to length with ends square and free of burrs.
- M. Epoxy-Coated, Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60, plain-steel bars.
- N. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.
- O. Hook Bolts: ASTM A 307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.
- P. P. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:
  - 1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
  - 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
- Q. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.
- R. Zinc Repair Material: ASTM A 780..

## 2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
  - 1. Portland Cement: ASTM C 150, Type I, white. Supplement with the following:
    - a. Fly Ash: ASTM C 618, Class F or C.
    - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
  - 2. Blended Hydraulic Cement: ASTM C 595, Type IS, portland blast-furnace slag cement.
- B. Silica Fume: ASTM C 1240, amorphous silica.
- C. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
  - 1. Maximum Coarse-Aggregate Size: 1-1/2 inches nominal.

2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Lightweight Aggregate: ASTM C 330, 1-inch nominal maximum aggregate size.
  - E. Water: ASTM C 94/C 94M and potable.
- 2.4 WATERSTOPS (NOT USED)
- 2.5 VAPOR RETARDERS (NOT USED)
- 2.6 CURING MATERIALS
- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
    1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      - a. Axim Italcementi Group, Inc.; CATEXOL CimFilm.
      - b. BASF Construction Chemicals - Building Systems; Confilm.
      - c. ChemMasters; SprayFilm.
      - d. Conspec by Dayton Superior; Aquafilm.
      - e. Dayton Superior Corporation; Sure Film (J-74).
      - f. Edoco by Dayton Superior; BurkeFilm.
      - g. Euclid Chemical Company (The), an RPM company; EucoBar.
      - h. Kaufman Products, Inc.; Vapor-Aid.
      - i. Lambert Corporation; LAMBCO Skin.
      - j. L&M Construction Chemicals, Inc.; E-CON.
      - k. Meadows, W. R., Inc.; EVAPRE.
      - l. Metalcrete Industries; Waterhold.
      - m. Nox-Crete Products Group; MONOFILM.
      - n. Sika Corporation; SikaFilm.
      - o. SpecChem, LLC; Spec Film.
      - p. Symons by Dayton Superior; Finishing Aid.
      - q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
      - r. Unitex; PRO-FILM.
      - s. Vexcon Chemicals, Inc.; Certi-Vex Envio Set.
  - B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
  - C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
  - D. Water: Potable.
  - E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
    1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
- b. BASF Construction Chemicals - Building Systems; Kure 200.
- c. ChemMasters; Safe-Cure Clear.
- d. Conspec by Dayton Superior; W.B. Resin Cure.
- e. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
- f. Edoco by Dayton Superior; Res X Cure WB.
- g. Euclid Chemical Company (The), an RPM company; Kurez W VOX; TAMMSCURE WB 30C.
- h. Kaufman Products, Inc.; Thinfilm 420.
- i. Lambert Corporation; AQUA KURE - CLEAR.
- j. L&M Construction Chemicals, Inc.; L&M Cure R.
- k. Meadows, W. R., Inc.; 1100-CLEAR.
- l. Nox-Crete Products Group; Resin Cure E.
- m. Right Pointe; Clear Water Resin.
- n. SpecChem, LLC; Spec Rez Clear.
- o. Symons by Dayton Superior; Resi-Chem Clear.
- p. TK Products, Division of Sierra Corporation; TK-2519 DC WB.
- q. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.

## 2.7 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.
- C. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
  1. Types I and II, non-load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

## 2.8 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
  1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
  2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
  3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.

4. Compressive Strength: Not less than 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, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
  2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
  3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
  4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

## 2.9 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials:
1. Fly Ash: 25 percent.
  2. Combined Fly Ash and Pozzolan: 25 percent.
  3. Ground Granulated Blast-Furnace Slag: 50 percent.
  4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
  5. Silica Fume: 10 percent.
  6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
  7. Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing admixture in concrete, as required, for placement and workability.
  2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
  3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
  4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
- E. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

#### 2.10 FABRICATING REINFORCEMENT

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

#### 2.11 CONCRETE MIXING

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

### PART 3 EXECUTION

#### 3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.



- C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
  - 1. Install keyways, reglets, recesses, and the like, for easy removal.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

### 3.2 EMBEDDED ITEMS

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

### 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 supports 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.
- 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 SHORES AND RESHORES
- A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.
1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
- B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.
- C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.
- 3.5 VAPOR RETARDERS (NOT USED)
- 3.6 STEEL REINFORCEMENT
- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

- F. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.
- G. Zinc-Coated Reinforcement: Repair cut and damaged zinc coatings with zinc repair material according to ASTM A 780. Use galvanized steel wire ties to fasten zinc-coated steel reinforcement.

### 3.7 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Expansion Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
  - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
  - 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
  - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
  - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
  - 5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
  - 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
  - 7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

### 3.8 WATERSTOPS (NOT USED)

### 3.9 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
  - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
  
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
  - 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
  - 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
  - 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
  
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
  - 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
  - 2. Maintain reinforcement in position on chairs during concrete placement.
  - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
  - 4. Slope surfaces uniformly to drains where required.
  - 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
  
- F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
  - 1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
  - 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

G. Hot-Weather Placement: Comply with ACI 301 and as follows:

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

### 3.10 FINISHING FORMED SURFACES

- A. Architectural Concrete Formed Finish: For architectural concrete on formed stepped seating. See specification Section 033300.
- B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

### 3.11 MISCELLANEOUS CONCRETE ITEMS

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

### 3.12 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

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

### 3.13 JOINT FILLING

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

- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

### 3.14 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
  - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
  - 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
  - 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
  - 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
  - 2. After concrete has cured at least 14 days, correct high areas by grinding.
  - 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
  - 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.

5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
  6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
  7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

### 3.15 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- C. Inspections:
1. Steel reinforcement placement.
  2. Steel reinforcement welding.
  3. Headed bolts and studs.
  4. Verification of use of required design mixture.
  5. Concrete placement, including conveying and depositing.
  6. Curing procedures and maintenance of curing temperature.
  7. Verification of concrete strength before removal of shores and forms from beams and slabs.
- D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.



2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
  - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
3. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
4. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
5. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
6. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
7. Compression Test Specimens: ASTM C 31/C 31M.
  - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
  - b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.
8. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
  - a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
  - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
10. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
11. 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.

12. 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.
  13. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by 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.
  14. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
  15. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- E. Measure floor and slab flatness and levelness according to ASTM E 1155 within 24 hours of finishing.

- END -

SECTION 033001  
LANDSCAPE CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes cast-in-place concrete, including but not limited to formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes of the following:
  - 1. Flushed Concrete Curbs
  - 2. Concrete Bases, Foundations & Footings
  - 3. Miscellaneous Concrete Work
  
- B. Related Sections:
  - 1. Section 03 30 00 – Cast-In-Place Concrete
  - 2. Section 03 45 01 - Precast Architectural Concrete.
  - 3. Section 05 52 13 - Metal Railings.
  - 4. Section 12 93 00 – Landscape Site Furnishings.
  - 5. Section 31 20 00 – Earth Moving.
  - 6. Section 32 13 00 - Concrete Paving.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
  
- B. Design Mixtures: For each concrete mixture.
  
- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement.
  
- D. Welding certificates.
  
- E. Material certificates.
  
- F. Material test reports.

- G. Floor surface flatness and levelness measurements.

### 1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
  - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- B. Testing Agency Qualifications: An independent agency, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
- C. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
  - 1. ACI 117 – Specification for Tolerances for Concrete Construction and Materials
  - 2. ACI 301 – Specification for Structural Concrete
  - 3. ACI 318 – Building Code Requirements for Structural Concrete
- D. Concrete Testing Service: Contractor is responsible for all concrete testing (strength, slump, and air content).
- E. Design of type and size of footing and foundation system will be based on soil bearing capacity as established by geotechnical test borings and geotechnical report foundation recommendations.

## PART 2 - PRODUCTS

### 2.1 FORM-FACING MATERIALS

- A. 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.

### 2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Plain-Steel Wire: ASTM A 82, galvanized.
- C. Galvanized-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from galvanized

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LANDSCAPE CAST-IN-PLACE CONCRETE

steel wire into flat sheets.

- D. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice.

## 2.3 CONCRETE MATERIALS

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

- 1. Portland Cement: ASTM C 150, Type I

- a. Fly Ash: ASTM C 618, Class F
- b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- c. Gray color.

- B. Normal-Weight Aggregates: ASTM C 33, Coarse Aggregate, graded, from of single source.

- 1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
- 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

- C. Water: ASTM C 94/C 94M and potable.

## 2.4 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.

- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

- 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
- 2. Retarding Admixture: ASTM C 494/C 494M, Type B.

## 2.5 CURING MATERIALS

- A. Evaporation Retarder: Plastic Vapor Retarder: ASTM E1745, Class A or B, 10 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.

- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

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- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

## 2.6 RELATED MATERIALS

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

## 2.7 CONCRETE MIXTURES

- A. Prepare design mixtures for each type and strength of concrete, proportioned based on laboratory trial mixture or field test data, or both, according to ACI 301.
- B. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.
- C. Admixtures: Use admixtures according to manufacturer's written instructions.
  - 1. Use water-reducing admixture in concrete, as required, for placement and workability.
  - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
- D. Proportion normal-weight concrete mixture as follows:
  - 1. Minimum Compressive Strength: 4000 psi at 28 days.
  - 2. Maximum Water-Cementitious Materials Ratio: 0.45
  - 3. Slump Limit: 4 inches before adding high-range water-reducing admixture or plasticizing admixture.
  - 4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.
  - 5. Contractor is responsible for providing the mix design.

## 2.8 FABRICATING REINFORCEMENT

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

## PART 3 - EXECUTION

### 3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

### 3.2 EMBEDDED ITEMS

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

### 3.3 STEEL REINFORCEMENT

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

### 3.4 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 Landscape Architect.
- C. Contraction Joints / Control Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated.
  - 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.
- 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.

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CAST-IN-PLACE CONCRETE

### 3.5 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
  - 1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
- C. Cold-Weather Placement: Comply with ACI 306.1.
- D. Hot-Weather Placement: Comply with ACI 301.

### 3.6 FINISHING FORMED SURFACES

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

### 3.7 FINISHING SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, re-straightening, 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 re-straightening until surface is left with a uniform, smooth, granular texture.

### 3.8 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

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CAST-IN-PLACE CONCRETE



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. 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.
  - 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.
  - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

### 3.9 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.

### 3.10 FIELD QUALITY CONTROL

- A. Testing and Inspecting: An Inspection Agency must be present for all concrete deliveries and must get tickets for each truck.
- B. Philadelphia Parks & Recreation's project inspector must be notified prior to every concrete pour.

- END -

SECTION 034501  
LANDSCAPE PRECAST ARCHITECTURAL CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
  - 1. Architectural precast concrete benches
- B. Related Sections:
  - 1. Division 31 Section "Earth Moving" for drainage fill under slabs-on-grade.
  - 2. Division 03 Section "Landscape Cast-In-Place Concrete"

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each precast concrete mixture. Include compressive strength and water- absorption tests.
- C. Shop Drawings: Detail fabrication and installation of architectural precast concrete units. Indicate locations, plans, elevations, dimensions, shapes, and cross sections of each unit. Indicate joints, reveals, and extent and location of each surface finish. Indicate details at building corners.
- D. Samples: For each type of finish indicated on exposed surfaces of architectural precast concrete units, in sets of 3, illustrating full range of finish, color, and texture variations expected; approximately 12 by 12 by 2 inches (300 by 300 by 50 mm).
- A. Mock-ups: For each type of architectural precast concrete element, construct a full-size mock-up to demonstrate typical joints, surface finish, texture, color, and standard of workmanship:
  - 1. Build a minimum of 5-foot-long segment of precast concrete bench as mockup on site. If location not indicated, as directed by Owner's representative.
  - 2. Notify Owner's representative seven days in advance of dates and times when mockups will be constructed.
  - 3. Obtain approval from Owner's representative before starting mockup construction.
  - 4. Maintain approved mockups during construction in an undisturbed condition as

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a standard for judging the completed pavement.

5. Mock-ups may not become part of the completed work. Demolish and remove approved mockups from the site when directed by Owner's representative.

- E. Welding certificates.
- F. Material test reports: For aggregates.
- G. Material Certificates: Signed by manufacturers

### 1.3 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm that assumes responsibility for engineering architectural precast concrete units to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
  1. Participates in PCI's plant certification program and is designated a PCI-certified plant for Group A, Category A1 - Architectural Cladding and Load Bearing Units
- B. Design Standards: Comply with **ACI 318 (ACI 318M)** and design recommendations of PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of architectural precast concrete units indicated.
- C. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL 117, "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products."
- D. Sample Units: After sample approval and before fabricating architectural precast concrete units, produce a minimum of [3] sample units of each type of specified precast concrete approximately Full Size in area for review by Architect. Incorporate full-scale details of architectural features, finishes, textures, and transitions in sample units.

## PART 2 - PRODUCTS

### 2.1 REINFORCING MATERIALS

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

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- C. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 117.

## 2.2 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I, gray, unless otherwise indicated.
  - 1. For surfaces exposed to view in finished structure, mix gray with white cement, of same type, brand, and mill source.
- B. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C 33, with coarse aggregates complying with Class 5S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.
- C. Coloring Admixture: ASTM C 979, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures, temperature stable, and nonfading.
- D. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
- E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.

## 2.3 STEEL CONNECTION MATERIALS

- A. Deformed-Steel Wire or Bar Anchors: ASTM A 496 or ASTM A 706/A 706M.
- B. Carbon-Steel Bolts and Studs: **ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6)**; carbon-steel, hex-head bolts and studs; carbon-steel nuts, **ASTM A 563 (ASTM A 563M)**; and flat, unhardened steel washers, ASTM F 844.

## 2.4 GROUT MATERIALS

- A. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107, Grade A for drypack and Grades B and C for flowable grout and of consistency suitable for application within a 30-minute working time.
- B. Epoxy-Resin Grout: Two-component, mineral-filled epoxy resin; ASTM C 881/C 881M, of type, grade, and class to suit requirements.

## 2.5 CONCRETE MIXTURES

- A. Prepare design mixtures for each type of precast concrete required.
- B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at architectural precast concrete fabricator's option.
- C. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by **ACI 318 (ACI 318M)** or PCI MNL 117 when tested according to ASTM C 1218/C 1218M.
- D. Normal-Weight Concrete Mixtures: Proportion mixtures by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:
  - 1. Compressive Strength (28 Days): **5000 psi (34.5 MPa)** minimum.
- E. Water Absorption: 6 percent by weight or 14 percent by volume, tested according to PCI MNL 117.
- F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 117.
- G. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.

## 2.6 FABRICATION

- A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.
  - 1. Weld headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."
- B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing architectural precast concrete units to supporting and adjacent construction.
- C. Cast-in reglets, slots, holes, and other accessories in architectural precast concrete units as indicated on the Contract Drawings.

- D. Reinforcement: Comply with recommendations in PCI MNL 117 for fabricating,  
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placing, and supporting reinforcement.

- E. Reinforce architectural precast concrete units to resist handling, transportation, and erection stresses.
- F. Comply with requirements in PCI MNL 117 and requirements in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.
- G. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast concrete units.
  - 1. Place backup concrete mixture to ensure bond with face-mixture concrete.
- H. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air on surfaces. Use equipment and procedures complying with PCI MNL 117.
  - 1. Place self-consolidating concrete without vibration according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants."
- I. Comply with PCI MNL 117 for hot- and cold-weather concrete placement.
- J. Identify pickup points of architectural precast concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each architectural precast concrete unit on a surface that will not show in finished structure.
- K. Cure concrete, according to requirements in PCI MNL 117, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.
- L. Discard and replace architectural precast concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 117 and Architect's approval.

## 2.7 FABRICATION TOLERANCES

- A. Fabricate architectural precast concrete units straight and true to size and shape with exposed edges and corners precise and true so each finished panel complies with PCI MNL 117 product tolerances as well as position tolerances for cast-in items.

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## 2.8 FINISHES

- A. Precast Concrete Units shall be free of joint marks, grain, and other obvious defects. Corners, including false joints shall be uniform, straight, and sharp. Finish exposed-face surfaces of architectural precast concrete units to match approved sample material and mock-ups and as follows:
  - 1. PCI's "Architectural Precast Concrete - Color and Texture Selection Guide," of plate numbers indicated.
  - 2. Color: White
  - 3. Finish: Acid-Etched - Use acid and hot-water solution, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces. Protect hardware, connections, and insulation from acid attach.
- B. Finish exposed surfaces of architectural precast concrete units to match face-surface finish.
- C. Finish unexposed surfaces of architectural precast concrete units by float finish.

## 2.9 SOURCE QUALITY CONTROL

- A. Quality-Control Testing: Test and inspect precast concrete according to PCI MNL 117 requirements. If using self-consolidating concrete, also test and inspect according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants."

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install clips, hangers, bearing pads, and other accessories required for connecting architectural precast concrete units to supporting members and backup materials.
- B. Erect architectural precast concrete level, plumb, and square within specified allowable tolerances. Provide temporary supports and bracing as required to maintain position, stability, and alignment as units are being permanently connected.
  - 1. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
  - 2. Unless otherwise indicated, provide for uniform joint widths as shown on plans
- C. Connect architectural precast concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.

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- D. Welding: Comply with applicable AWS D1.1/D1.1M and AWS D1.4 for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.
- E. Grouting Connections: Grout connections where required or indicated. Retain grout in place until hard enough to support itself. Pack spaces with stiff grout material, tamping until voids are completely filled. Place grout to finish smooth, level, and plumb with adjacent concrete surfaces. Keep grouted joints damp for not less than 24 hours after initial set. Promptly remove grout material from exposed surfaces before it affects finishes or hardens.
- F. Erect architectural precast concrete units level, plumb, square, true, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 117, Appendix I.

### 3.2 REPAIRS

- A. Repair damaged architectural precast concrete units if permitted by Architect. The Architect reserves the right to reject repaired units that do not comply with requirements.
- B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet (6 m).
- C. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A 780.
- D. Remove and replace damaged architectural precast concrete units when repairs do not comply with requirements.

### 3.3 CLEANING

- A. Clean surfaces of precast concrete units exposed to view.
- B. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.
- C. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.
  - 1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's recommendations. Clean soiled precast concrete surfaces with



- detergent and water, using stiff fiber brushes and sponges, and rinse with clean water. Protect other work from staining or damage due to cleaning operations.
2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

- END -

SECTION 055213  
METAL RAILINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Landscape/site railing and guardrail assemblies.
- B. Free-standing railings at exterior steps.

1.2 RELATED REQUIREMENTS

- A. 033000 - Cast-In-Place Concrete
- B. 033001 - Landscape Cast-In-Place Concrete

1.3 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design 2010.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
- C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2022.
- D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
- E. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes 2017.
- F. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength 2021.
- G. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing 2021.
- H. ASTM A554 - Standard Specification for Welded Stainless Steel Mechanical Tubing 2021.
- I. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.

- J. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.
- K. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings 2021.
- L. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength 2022.
- M. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification 2021.
- N. AWS C3.4M/C3.4 - Specification for Torch Brazing 2016.
- O. AWS C3.5M/C3.5 - Specification for Induction Brazing 2016, with Amendment (2017).
- P. AWS C3.9M/C3.9 - Specification for Resistance Brazing 2020.
- Q. AWS D1.1/D1.1M - Structural Welding Code - Steel 2020, with Errata (2022).
- R. AWS D1.6/D1.6M - Structural Welding Code - Stainless Steel 2017, with Amendment (2021).
- S. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic) 2019.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Installation Meeting: Schedule and conduct a preinstallation meeting one week before starting work of this section. Attendees shall include, but not be limited to:
  - 1. Contractor.
  - 2. Architect.
  - 3. Owner's representative.
  - 4. Other subcontractors of adjacent work.

#### 1.5 SUBMITTALS

- A. Product Data: Submit manufacturer's product data, including description of materials, components, finishes, fabrication details, glass, anchors, and accessories.
- B. Shop Drawings: Indicate railing system elevations and sections, details of profile, dimensions, sizes, connection attachments, anchorage, size and type of fasteners, and accessories. Indicate anchor and joint locations, brazed connections, transitions, and terminations.
- C. Samples: Submit one (1) of each item below for each type and condition shown.
  - 1. Railing: 12-inch-long section of handrail illustrating color, finish, and connection detail.
  - 2. See mock-up requirements.
- D. Test Reports: Submit test reports from an independent testing agency showing compliance with specified design and performance requirements.
- E. Maintenance Data: Manufacturer's instructions for care and cleaning.
- F. Welders' qualification statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.
- G. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

#### 1.06 QUALITY ASSURANCE

- A. The requirements for the assemblies shown on the Contract Drawings establish basis dimensions, profiles, and sightlines. Within the limitations established by design intent as shown in drawings and specifications, the Contractor is responsible for the design and engineering of the railing system including anchorage to structure. The system must be capable of meeting all specified performance requirements.
  - 1. Provide test data which indicates the system(s) meets the specified performance requirements.
  - 2. Verify with calculations from an engineer licensed in the State of Massachusetts railings, guards, and fencing serving as railings for fall protection or security of pool or other spaces are designed to resist the

simultaneous application of the greater of the specified loads or code-required loads.

#### 1.7 MOCK-UPS

- A. Provide mock-up of Guardrail system, minimum 10 feet long by width of rail wide, illustrating each type of material, cladding, and finish.
- B. Provide mock-up of Tree Pit Rail system, minimum 10 feet long by width of rail wide, illustrating each type of material, cladding, and finish.
- C. Provide mock-up of Handrail system, minimum 10 feet long by width of rail wide, illustrating each type of material, cladding, and finish.
- D. Locate where directed.
- E. Approved mock-up may remain as part of the work.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in factory-provided protective coverings and packaging.
- B. Protect materials against damage during transit, delivery, storage, and installation at site.
- C. Inspect materials upon delivery for damage. Repair damage to be indistinguishable from undamaged areas; if damage cannot be repaired to be indistinguishable from undamaged parts and finishes, replace damaged items.
- D. Prior to installation, store materials and components under cover in a dry location.

#### 1.9 WARRANTY

- A. Warranty: Manufacturer's standard one year warranty against defects in materials, fabrication, finishes, and installation commencing on Date of Substantial Completion.

### PART 2 PRODUCTS

## 2.1 MANUFACTURERS

A. Custom metal railings per the drawings.

1. Approved by Landscape Architect.

## 2.2 RAILING SYSTEMS

A. Railing Systems - General: Shop-fabricated in design indicated, to suit specific project conditions, and for proper connection to building structure, and in largest practical sizes for delivery to site.

1. Performance Requirements: Design and fabricate railings and anchorages to resist the following loads without failure, damage, or permanent set: loads need to be applied simultaneously.
  - a. Lateral Force: 75 lb minimum, at any point, when tested in accordance with ASTM E935.
  - b. Distributed Load: 50 lb/ft minimum, applied in any direction at the top of the handrail, when tested in accordance with ASTM E935.
  - c. Concentrated Loads on Intermediate Rails: 50 psf, minimum.
  - d. Concentrated Load: 200 lbs minimum, applied in any direction at any point along the handrail system, when tested in accordance with ASTM E935.
  - e. Handrails: Comply with applicable accessibility requirements of ADA Standards.
2. Assembly: To achieve details in the drawings:
  - a. Shop fabricate and shop weld to the longest lengths possible.
  - b. Join lengths, seal open ends, and conceal exposed mounting bolts and nuts using slip-on non-weld mechanical fittings, flanges, escutcheons, and wall brackets.
3. Joints: Tightly fitted and secured, machined smooth with hairline seams.
4. Field Connections: Minimize field connections.
  - a. Field-weld connections unless otherwise noted.
  - b. Provide sleeves to accommodate site assembly and installation where indicated in the details.

5. Welded and Brazed Joints: Make visible joints butt tight, flush, and hairline; use methods that avoid discoloration and damage of finish; grind smooth, polish, and restore to required finish.
  - a. Ease exposed edges to a small uniform radius.
  - b. Welded Joints:
    - 1) Carbon Steel: Perform welding in accordance with AWS D1.1/D1.1M.
    - 2) Stainless Steel: Perform welding in accordance with AWS D1.6/D1.6M.
  - c. Brass/Bronze Brazed Joints:
    - 1) Perform torch brazing in accordance with AWS C3.4M/C3.4.
    - 2) Perform induction brazing in accordance with AWS C3.5M/C 3.5.
    - 3) Perform resistance brazing in accordance with AWS C3.9M/C3.9.
- B. Guardrail, Tree Pit Rail, and Handrail systems: Engineered, post-supported railing system with vertical metal pickets.
  1. Configuration: Per the drawings..
    - a. Top rail: painted steel tube. Profiles per details.
    - b. Grip rail: painted steel tube. Profiles per details.
  2. Decorative Flanges for Embedded Posts: Posts anchored to structure below finished floor per the drawings. No visible flanges. Continuous angles to receive same finishes as railing components.
  3. Wall Mounted Components: Components necessary to support railing with 1-1/2 inch clearance from wall, and as follows:
    - a. Underslung support brackets: Supports at 60 inches, maximum.
    - b. Wall return without support: Terminates 1/4 inch from side wall.
  4. Handrail Brackets: Same metal as railing.
  5. Fasteners: Concealed.
  6. Infill at Picket Railings: Shop-welded vertical pickets.
    - a. Horizontal Spacing: Maximum 4 inches on center.

- b. Material: Galvanized and painted steel bar stock.
  - c. Top Mounting: Welded to underside of top rail.
  - d. Bottom Mounting: Welded to top surface of stringer.
- 7. Infill at Grate Railing Infill: Metal grate panels.
    - a. Per the drawings and materials schedule.
  - 8. End and Intermediate Posts: As shown on drawings.
    - a. Horizontal Spacing: As indicated on drawings.
    - b. Mounting: Welded.

## 2.3 MATERIALS

### A. Steel Components:

- 1. Sections, Shapes, Plate and Bar: ASTM A36/A36M.
- 2. Tubing: ASTM A501/A501M structural tubing, round and shapes as indicated.
- 3. All steel for landscape/exterior use to be galvanized unless otherwise noted.
- 4. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS) Grade 33/230 with G40/Z120 coating.
- 5. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, and galvanized to ASTM A153/A153M where connecting galvanized components.
- 6. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

## 2.4 ACCESSORIES

- A. Welding Fittings: Factory- or shop-welded from matching pipe or tube; joints and seams ground smooth.
- B. Anchors and Fasteners: Provide anchors and other materials as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
  - 1. For anchorage to concrete, provide inserts to be cast into concrete for bolt anchors.
    - a. Per details provide continuous steel angle embed where indicated.
  - 2. For anchorage to masonry, provide brackets to be embedded in masonry for bolt anchors.
  - 3. For anchorage to stud walls, provide backing plates for bolt anchors.
  - 4. Exposed Fasteners: No exposed bolts or screws.



- C. Carbon Steel Bolts and Nuts: ASTM A307.
- D. Sealant: Silicone; color selected by the Architect. Coordinate with Section 07 92 00 - Joint Sealants.
- E. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20 Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that substrate and site conditions are acceptable and ready to receive work.
- B. Verify field dimensions of locations and areas to receive work.
- C. Notify Landscape Architect immediately of conditions that would prevent satisfactory installation.
- D. Do not proceed with work until detrimental conditions have been corrected.
- E. Furnish components to be installed in other work to installer of that other work, including but not limited to blocking, sleeves, inserts, anchor bolts, embedded plates, and supports for attachment of anchors.

### 3.2 PREPARATION

- A. Protect existing work.
- B. Review installation drawings before beginning installation. Coordinate diagrams, templates, instructions, and directions for installation of anchorages and fasteners.
- C. Clean surfaces to receive units. Remove materials and substances detrimental to the installation.

### 3.3 INSTALLATION

- A. Comply with manufacturer's drawings and written instructions.
- B. Install components plumb and level, accurately fitted, free from distortion or defects, and with tight joints, except where necessary for expansion.
- C. Anchor securely to structure.

- D. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.
- E. Isolate dissimilar materials with bituminous coating, bushings, grommets, or washers to prevent electrolytic corrosion.

#### 3.4 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per floor level, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

#### 3.5 CLEANING

- A. Remove protective film from exposed metal surfaces.
- B. Metal: Clean exposed metal finishes with potable water and mild detergent, in accordance with manufacturer recommendations; do not use abrasive materials or chemicals, detergents, or other substances that may damage the material or finish.

#### 3.6 PROTECTION

- A. Protect installed components and finishes from damage after installation.
- B. Repair damage to exposed finishes to be indistinguishable from undamaged areas.
  - 1. If damage to finishes and components cannot be repaired to be indistinguishable from undamaged finishes and components, replace damaged items.

- END -

SECTION 061300  
HEAVY TIMBER CONSTRUCTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- 1.1.1 Grove
- 1.1.2 Seating Circle
- 1.1.3 Balance Beam and Steppers
- 1.1.4 Scrambler

1.2 RELATED SECTIONS

- 1.2.1 Section 03300 - Cast-In-Place Concrete
- 1.2.2 Section 033001 – Landscape Cast-In-Place Concrete
- 1.2.3 Section 116816 – Play Structures
- 1.2.4 Section 311816 – Protective Playground Surfacing
- 1.2.5 Section 321817 – Corkeen

1.3 REFERENCES

- 1.3.1 International Log Builders Association (ILBA): Log Span Tables for Floor Joists, Beams and Roof Support Systems.
- 1.3.2 US Green Building Council (USGBC): LEED v4.
- 1.3.3 US Dept of Agriculture Forest Service: Wood Handbook - Wood as an Engineering Material.
- 1.3.4 Timber Construction Manual, Herzog, Natterer, Schweitzer, Bolz, Winter.
- 1.3.5 American Institute of Timber Construction: AITC 108 - Standard for Heavy Timber Construction.

1.4 PERFORMANCE REQUIREMENTS

- 1.4.1 Structural Performance: Provide engineered round timber structural assemblies meeting or exceeding code required design loads:
  - a) Comply with manufacturer's structural engineering data.
- 1.4.2 Delegated Design: Provide structural engineering shop drawings for timber construction, prepared by a professional engineer licensed in the jurisdiction of the Project site and engaged by the supplier of timbers.
- 1.4.3 Fire Rating: Decorative unmilled timber is a combustible material. Fire retardants can be applied, when necessary, in Types 1 & 2 construction. Follow ASTM fire rating

standards to assess the rating of untreated timbers. Non-structural timbers of 5” or greater may qualify for a 1-hour or greater fire rating. Always communicate fire rating requirements to round timber manufacturers.

## 1.5 SUBMITTALS

1.5.1 Submit under provisions of Section 01300.

1.5.2 Product Data: Manufacturer's data sheets on each product to be used.

- a) Preparation instructions and recommendations.
- b) Storage and handling requirements and recommendations.
- c) Installation methods.

1.5.3 Shop Drawings: Provide detailed shop drawings including materials, connections and relationship with adjacent construction. Include small diameter timber beams, columns, branched columns and trusses with engineered connection points using wood and steel connectors and fasteners. Shop drawings shall be stamped by a professional engineer licensed in the jurisdiction of the Project.

## 1.6 QUALITY ASSURANCE

1.6.1 Manufacturer Qualifications: Minimum 8 years’ experience in timber frame construction.

1.6.2 Installer Qualifications: Minimum 2 years’ experience installing similar products and acceptable to the manufacturer.

## 1.7 DELIVERY, STORAGE, AND HANDLING

1.7.1 Deliver and store products in accordance with manufacturer's recommendations. Keep materials under cover and dry. Protect from weather and contact with damp or wet surfaces. Provide for air circulation within and around stacks and under temporary coverings. Handle materials to avoid damage.

## 1.8 PROJECT CONDITIONS

1.8.1 Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by the manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

## 1.9 PRE-INSTALLATION MEETINGS

1.9.1 Convene minimum two weeks prior to starting work of this Section. Agenda shall include sequence of construction, work of related trades, protection of materials and similar items.

## 1.10 SMALL DIAMETER (4” to 24”) ROUND TIMBER CONSTRUCTION

1.10.1 Round Timber Structure Contractor shall have experience in design, shop fabrication and installation of small diameter round timber construction with beams, straight columns, y-

branch columns and trusses with engineered connection points using steel connectors and fasteners. Provide PE-stamped shop drawings based on International Log Builders Association Span Table Guidelines, NDS guidelines and design values database derived from destructive testing at the United States Department of Agriculture Forest Products Lab in Madison, WI.

#### 1.11 MANUFACTURER QUALIFICATIONS

- 1.11.1 Round Timber Structure Contractor shall have experience building with small diameter round timber (4" to 24") for more than 5 years and experience in prefabricated engineered connection points with steel connectors and fasteners for more than 5 years. Round Timber Structure Contractor shall have a minimum of 10 small diameter round timber agricultural and/or commercial structures completed. Provide a list available as requested.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- 2.1.1 Acceptable Manufacturer: WholeTrees® Structures, which is located at: 800 Williamson St.; Madison, WI 53703; Tel: 608-310-5282; Email: [info@wholetrees.com](mailto:info@wholetrees.com); Web: [www.wholetrees.com](http://www.wholetrees.com)
- 2.1.2 No substitutions accepted.

#### 2.2 MATERIALS

- 2.2.1 Columns: Factory fabricated with engineered connection points using either wood and steel connectors or fasteners.
- a) Column diameters within manufacturer's standard limits, typically 4 inches (101 mm) to 24 inches (610 mm).
  - b) Column lengths within manufacturer's standard limits, typically 7 feet (2 m) to 40 feet (11 m).
  - c) Treated with one coating of Timbor or another approved insecticide/fungicide.
  - d) Finish: One coat of TWP1500 clear finish or approved alternative.
  - e) Species as selected by Architect and acceptable to manufacturer.
  - f) Source columns from Forest Stewardship Council certified forests.
- 2.2.2 Branched Columns: Factory fabricated with engineered connection points using wood or steel connectors or fasteners.
- a) Column diameters within manufacturer's standard limits, typically 4 inches (101 mm) to 24 inches (610 mm).
  - b) Column lengths within manufacturer's standard limits, typically 7 feet (2 m) to 40 feet (11 m).
  - c) Treated with one coating of Timbor or another approved insecticide/fungicide.
  - d) Finish: One coat of TWP1500 clear finish or approved alternative.

- e) Species as selected by Architect and acceptable to manufacturer.
  - f) Columns milled flat on one or two sides to accept wall assemblies.
  - g) Source columns from Forest Stewardship Council certified forests.
- 2.2.3 Beams: Factory fabricated with engineered connection points using wood or steel connectors or fasteners.
- a) Beam diameters within manufacturer's standard limits, typically 4 inches (101 mm) to 24 inches (610 mm).
  - b) Beam lengths within manufacturer's standard limits, typically 3 feet (1 m) to 50 feet (15 m).
  - c) Treated with one coating of Timbor or another approved insecticide/fungicide.
  - d) Finished with one coating of TWP1500 clear finish or alternative.
  - e) Species as selected by Architect and acceptable to manufacturer.
  - f) Beams milled flat on one or two sides to accept floor deck or roof deck.
  - g) Columns can be sourced from Forest Stewardship Council certified forests.
- 2.2.4 Connectors and Fasteners: Interior grade or exterior grade finishes and steel per service and engineering requirements.
- 2.2.5 All structural round timber to be 3rd party graded.

## 2.3 FABRICATION

- 2.3.1 Inspect columns, beams, and truss members with regard to ability to select stand, visual, and digital timber grading as applicable, and post peeling inspection process.
- 2.3.2 Mill structural system wood members flat on one side to accept wall, roof, ceiling or deck assemblies in accordance with approved shop drawings.
- 2.3.3 Factory fabricates timbers to the greatest extent practical, including pre-drilling.
- 2.3.4 Fabricate, disassemble, stage and ship structural system connections to job site.

## 2.4 TIMBER SELECTION

- 2.4.1 Round Timber Structure Contractor shall source timber from suitable stands. All external columns shall be Black Locust or White Oak.
- 2.4.2 Round Timber members shall be peeled and seasoned or kiln dried to 19% or lower moisture level at 3" depth. Sand smooth to 80 grit. Treated with one coating of Timbor or another approved insecticide. Treated with one coating of Heritage Natural finish or approved alternative.
- 2.4.3 Round Timber members shall pass a three-step grading process including 3rd Party grading or ASTM-derived design values (ASTM D2555, D2899, D3200, D3957) – ability to select stand, visual, or non-destructive evaluation timber grading, and post peeling inspection process. Shop fabrication of small diameter round timber shall be to the greatest extent practical, including predrilling, fastening, connectors and joinery. Y-Branching connections shall be prefabricated with engineered connection points using steel connectors or fasteners. The structural system shall have connection points that are

shop fabricated, disassembled, staged, and shipped to job site. Connectors and Fasteners shall be rated exterior grade.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- 3.1.1 Do not begin installation until the substrates have been properly prepared. If substrate preparation is improper, notify the Architect before proceeding.

### 3.2 PROTECTION

- 3.2.1 Protect installed products from construction activities until completion of the project to ensure no damage occurs in construction.
- 3.2.2 Touch-up, repair minor nicks, dings, and gouges to timber members before Substantial Completion. Replace damaged members as directed where damage is beyond satisfactory repair.
- 3.2.3 Keep materials under cover and dry. Protect from weather and contact with damp or wet surfaces. Provide for air circulation within and around stacks and under temporary coverings.

### 3.3 INSTALLATION

- 3.3.1 Install materials in accordance with manufacturer's recommendations and with approved shop drawings. Installation shall be performed by the manufacturer or an installer acceptable to the manufacturer.
- 3.3.2 Time delivery and installation of timber to avoid extended on-site storage and to avoid delaying the work of other trades that follow.
- 3.3.3 Avoid extra cutting after fabrication. Where field fitting is unavoidable, comply with requirements on the provided shop drawings.
- 3.3.4 Do not cut members without first receiving approval from the manufacturer. Where field fitting is required, consult, and comply with manufacturer's recommendations.
- 3.3.5 Touch-up, repair or replace minor damage to timber members before substantial completion. Replace damaged members as directed where damage is beyond satisfactory repair.
- 3.3.6 Install in accordance with approved shop drawings and in proper relationship with adjacent Construction.
- 3.3.7 Do not begin installation until substrates have been properly prepared per the shop drawings. If substrate preparation is the responsibility of another installer, notify the architect of unsatisfactory preparation before proceeding.
- 3.3.8 Prepare surfaces using methods recommended by the manufacturer (including sanding and finishes, etc.).
- 3.3.9 Installation of members in accordance with the details and notes on the approved construction documents and shop drawings.

3.3.10 Erect framing true and plumb and in proper relationship with adjacent construction.

- END -



SECTION 062013  
EXTERIOR FINISH CARPENTRY

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. Work Included: The Work of this Section shall include but not be limited to the following:
  - 1. Collection Table fabricated from Douglas fir lumber or approved equal.

1.3 SUBMITTALS

- A. Product Data: Submit product data that verify or are required to ensure compliance with the Contract Documents, to include technical information, Shop Drawings, samples, calculations, product test reports, etc.
- B. Test Reports: Submit product test reports showing compliance with project requirements.

1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: Arrange for fabrication by a firm that can demonstrate successful experience in fabricating and installing items similar in type and quality to those required for this Project.
- B. Mockups: Build full size mockups in dimension indicated on the Drawings to demonstrate aesthetic effects and set quality standards for fabrication and installation.
- C. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Protect and keep materials during transit, delivery, storage and handling to prevent damage, soiling and deterioration. Protect against exposure to weather and contact with damp or wet surfaces. Stack materials to provide air circulation within stacks.

PART 2 - PRODUCTS

2.1 WOOD

- A. Subject to compliance with requirements provide Douglas fir wood as approved by the Landscape Architect.
- B. Preservative Treatment by Pressure Process: AWPA U1.
- C. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- D. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.
- E. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- F. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

## 2.2 FASTENERS

- A. General: Provide fasteners of size and type required by design intent that comply with requirements specified in this article for material and manufacture. Provide bolts, nails, and screws, of sufficient length, to penetrate not less than 1-1/2 inches into wood substrate.
- B. Use stainless steel fasteners.
- C. Nails: ASTM F 1667.
- D. Power-Driven Fasteners: NES NER-272.
- E. Wood Screws: ASME B18.6.1.
- F. Stainless Steel Lag Screws: Stainless steel Series 300, ASME B18.2.1.
- G. Stainless-Steel Bolts and Through Bolts: Series 300 stainless steel with hex nuts and, where required by design intent, flat washers.
- H. Refer to Section 32 3300 "Site Furnishings" for metals for supports and elements of custom furnishings.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Advise Installers of other work about specific requirements relating to placement of inserts, and similar items which will be used by exterior finish carpentry Installer for anchoring and supporting exterior finish carpentry. Furnish Installers of other work with drawings or templates showing locations of these items. Clean wood surfaces which have become dirty or stained prior to setting to remove soil, stains, and foreign materials. Use a soft cloth and only mild cleaning compounds that contain no caustic or harsh filler or abrasives.

### 3.2 EXTERIOR FINISH CARPENTRY SEALING

- A. Seal exterior finish carpentry according to sealer manufacturer's written instructions. Allow to cure as directed.
- 3.3 EXTERIOR FINISH CARPENTRY INSTALLATION
- A. Install exterior finish carpentry in locations indicated on the Drawings after all other Work and field operations have been completed.
- 3.4 CLEANING AND PROTECTION
- A. Clean exterior finish carpentry with a soft cloth and cleaners recommended by finish manufacturer.

- END -

SECTION 099113  
EXTERIOR PAINTING

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Work of this Section includes all labor, materials, equipment, and services associated with:
1. Misting supergraphic

1.2 RELATED WORK

1.3 SUBMITTALS

- A. Painter qualifications.
- B. Manufacturer's Literature and Data:
1. Before work is started, or sample panels are prepared, submit manufacturer's literature and technical data, the current Master Painters Institute (MPI) "Approved Product List" indicating brand label, product name and product code as of the date of contract award, will be used to determine compliance with the submittal requirements of this specification. The Contractor may choose to use subsequent MPI "Approved Product List", however, only one (1) list may be used for the entire contract and each coating system is to be from a single manufacturer. All coats on a particular substrate must be from a single manufacturer. No variation from the MPI "Approved Product List" where applicable is acceptable.
- C. Sample Panels:
1. After painters' materials have been approved and before work is started, submit sample panels showing each type of finish and color specified.
  2. Panels to Show Color: Composition board, 100 x 250 mm (4 x 10 inch).
  3. Panel to Show Transparent Finishes: Wood of same species and grain pattern as wood approved for use, 100 x 250 mm (4 x 10 inch face) minimum, and where both flat and edge grain will be exposed, 250 mm (10 inches) long by sufficient size, 50 x 50 mm (2 x 2 inch) minimum or actual wood member to show complete finish.
  4. Attach labels to panel stating the following:
    - a. Federal Specification Number or manufacturers name and product number of paints used.
    - b. Product type and color.
    - c. Name of project.
- D. Manufacturers' Certificates indicating compliance with specified requirements:

1. Manufacturer's paint substituted for Federal Specification paints meets or exceeds performance of paint specified.

#### 1.4 DELIVERY AND STORAGE

- A. Deliver materials to site in manufacturer's sealed container marked to show following:
  1. Name of manufacturer.
  2. Product type.
  3. Batch number.
  4. Instructions for use.
  5. Safety precautions.
- B. In addition to manufacturer's label, provide a label legibly printed as following:
  1. Federal Specification Number, where applicable, and name of material.
  2. Surface upon which material is to be applied.
  3. Specify Coat Types: Prime; body; finish; etc.
- C. Maintain space for storage, and handling of painting materials and equipment in a ventilated, neat and orderly condition to prevent spontaneous combustion from occurring or igniting adjacent items.
- D. Store materials at site at least 24 hours before using, at a temperature between 7 and 30 degrees C (45 and 85 degrees F).

#### 1.5 QUALITY ASSURANCE

- A. Qualification of Painters: Use only qualified journeyman painters for the mixing and application of paint on exposed surfaces. Submit evidence that key personnel have successfully performed surface preparation and application of coating on a minimum of three (3) similar projects within the past three (3) years.
- B. Paint Coordination: Provide finish coats which are compatible with the prime paints used. Review other Sections of these specifications in which prime paints are to be provided to ensure compatibility of the total coatings system for the various substrates. Upon request from other subcontractors, furnish information on the characteristics of the finish materials proposed to be used, to ensure that compatible prime coats are used. Provide barrier coats over incompatible primers or remove and re-prime as required. Notify the Contracting Officer Representative (COR) in writing of any anticipated problems using the coating systems as specified with substrates primed by others.

#### 1.6 MOCK-UP PANEL

- A. Mock-up must be approved by Landscape Architect.
- B. In addition to the samples specified herein to be submitted for approval, apply in the field, at their final location, each type and color of approved paint materials, applied 3.05m (10 feet) wide,

floor to ceiling of wall surfaces, before proceeding with the remainder of the work, for approval by the Landscape Architect.

- C. Finish and texture approved by Landscape Architect will be used as a standard of quality and workmanship for remainder of work.
- D. Repaint individual areas which are not approved, as determined by the Landscape Architect, until approval is received.

## 1.6 REGULATORY REQUIREMENTS

- A. Paint materials are to conform to the restrictions of the local Environmental and Toxic Control jurisdiction.
- B. Volatile Organic Compounds (VOC) Emissions Requirements: Field applied paints and coatings that are inside the waterproofing system to not exceed limits of authorities having jurisdiction.
- C. Lead-Base Paint:
  - 1. Comply with Section 410 of the Lead-Based Paint Poisoning Prevention Act, as amended, and with implementing regulations promulgated by Secretary of Housing and Urban Development.
  - 2. Regulations concerning prohibition against use of lead-based paint in federal and federally assisted construction, or rehabilitation of residential structures are set forth in Subpart F, Title 24, Code of Federal Regulations, Department of Housing and Urban Development.
  - 3. Do not use coatings having a lead content over 0.06 percent by weight of non-volatile content.
  - 4. For lead-paint removal, see Section 02 83 33.13, LEAD-BASED PAINT REMOVAL AND DISPOSAL.
- D. Asbestos: Provide materials that do not contain asbestos.
- E. Chromate, Cadmium, Mercury, and Silica: Provide materials that do not contain zinc-chromate, strontium-chromate, Cadmium, mercury or mercury compounds or free crystalline silica.
- F. Human Carcinogens: Provide materials that do not contain any of the ACGIH-BKLT and ACGHI-DOC confirmed or suspected human carcinogens.
- G. Use high performance acrylic paints in place of alkyd paints.

## 1.7 SAFETY AND HEALTH

- A. Apply paint materials using safety methods and equipment in accordance with the following:
- B. Comply with applicable Federal, State, and local laws and regulations.
- C. Safety Methods Used During Paint Application: Comply with the requirements of SSPC PA Guide 10.
- D. Toxic Materials: To protect personnel from overexposure to toxic materials, conform to the most stringent guidance of:
  - 1. The applicable manufacturer's Material Safety Data Sheets (MSDS) or local regulation.

2. 29 CFR 1910.1000.
3. ACHIH-BKLT and ACGHI-DOC, threshold limit values.

## PART 2 – PRODUCTS

### 2.1 MATERIALS:

- A. Submit manufacturer's technical data sheets for specified coatings and solvents.
- B. Colors to be selected and approved by Landscape Architect.
  1. Custom colors may apply.

### 2.2 PAINT PROPERTIES:

- A. Use exterior rated, waterproof, and slip-resistant paint.

### 2.3 MANUFACTURER:

- A. Acrytech, or approved equal.

## PART 3 – EXECUTION

### 3.1 JOB CONDITIONS:

- A. Safety: Observe required safety regulations and manufacturer's warning and instructions for storage, handling and application of painting materials.
  1. Take necessary precautions to protect personnel and property from hazards due to falls, injuries, toxic fumes, fire, explosion, or other harm.
  2. Deposit soiled cleaning rags and waste materials in metal containers approved for that purpose. Dispose of such items off the site at end of each day's work.
- B. Atmospheric and Surface Conditions:
  1. Do not apply coating when air or substrate conditions are:
    - a. Less than 3 degrees C (5 degrees F) above dew point.
    - b. Below 10 degrees C (50 degrees F) or over 35 degrees C (95 degrees F), unless specifically pre-approved by the COR and the product manufacturer. Under no circumstances are application conditions to exceed manufacturer recommendations.
    - c. When the relative humidity exceeds 85 percent; or to damp or wet surfaces; unless otherwise permitted by the paint manufacturer's printed instructions.
  2. Do no exterior painting when it is windy and dusty.
  3. Apply only on clean, dry and frost-free surfaces.

### 3.2 INSPECTION:

- A. Examine the areas and conditions where painting and finishing are to be applied and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

### 3.3 GENERAL WORKMANSHIP REQUIREMENTS:

- A. Application may be by brush or roller. Spray application only upon acceptance from the COR in writing.
- B. Furnish to the Landscape Architect a painting schedule indicating when the respective coats of paint for the various areas and surfaces will be completed. This schedule is to be kept current as the job progresses.
- C. Protect work at all times. Protect all adjacent work and materials by suitable covering or other method during progress of work. Upon completion of the work, remove all paint and varnish spots from floors, glass and other surfaces. Remove from the premises all rubbish and accumulated materials of whatever nature not caused by others and leave work in a clean condition.
- D. Remove and protect hardware, accessories, device plates, lighting fixtures, and factory finished work, and similar items, or provide in place protection. Upon completion of each space, carefully replace all removed items by workmen skilled in the trades involved.
- E. Materials are to be applied under adequate illumination, evenly spread and flowed on smoothly to avoid runs, sags, holidays, brush marks, air bubbles and excessive roller stipple.
- F. Apply materials with a coverage to hide substrate completely. When color, stain, dirt or undercoats show through final coat of paint, the surface is to be covered by additional coats until the paint film is of uniform finish, color, appearance and coverage, at no additional cost to the Government.
- G. All coats are to be dry to manufacturer's recommendations before applying succeeding coats.

### 3.4 SURFACE PREPARATION:

#### A. General:

1. The Contractor shall be held wholly responsible for the finished appearance and satisfactory completion of painting work. Properly prepare all surfaces to receive paint, which includes cleaning, sanding, and touching up of all prime coats applied under other Sections of the work. Broom clean all spaces before painting is started. All surfaces to be painted or finished are to be completely dry, clean and smooth.
2. See other sections of specifications for specified surface conditions and prime coat.
3. Perform preparation and cleaning procedures in strict accordance with the paint manufacturer's instructions and as herein specified, for each particular substrate condition.
4. Clean surfaces before applying paint or surface treatments with materials and methods compatible with substrate and specified finish. Remove any residue remaining from



cleaning agents used. Do not use solvents, acid, or steam on concrete and masonry. Schedule the cleaning and painting so that dust and other contaminants from the cleaning process will not fall in wet, newly painted surfaces.

5. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

- a. Concrete: 12 percent.

B. Concrete:

1. Clean and remove dust, dirt, oil, grease efflorescence, form release agents, laitance, and other deterrents to paint adhesion.
  2. Use emulsion type cleaning agents to remove oil, grease, paint and similar products. Use of solvents, acid, or steam is not permitted.
6. Repair broken and spalled concrete edges with concrete patching compound to match adjacent surfaces as specified in Division 03, CONCRETE Sections. Remove projections to level of adjacent surface by grinding or similar methods.

3.5 PAINT PREPARATION:

- A. Thoroughly mix painting materials to ensure uniformity of color, complete dispersion of pigment and uniform composition.
- B. Do not thin unless necessary for application and when finish paint is used for body and prime coats. Use materials and quantities for thinning as specified in manufacturer's printed instructions.
- C. Remove paint skins, then strain paint through commercial paint strainer to remove lumps and other particles.
- D. Mix two (2) component and two (2) part paint and those requiring additives in such a manner as to uniformly blend as specified in manufacturer's printed instructions unless specified otherwise.
- E. For tinting required to produce exact shades specified, use color pigment recommended by the paint manufacturer.

3.6 APPLICATION:

- A. Start of surface preparation or painting will be construed as acceptance of the surface as satisfactory for the application of materials.
- B. Apply each coat evenly and cover substrate completely.
- C. Allow not less than 48 hours between application of succeeding coats, except as allowed by manufacturer's printed instructions, and approved by Landscape Architect.
- D. Apply by brush or roller. Spray application for new or existing occupied spaces only upon approval by acceptance from Landscape Architect in writing.

3.7 PAINT COLOR:

- A. Color and gloss of finish coats is to be selected and approved by Landscape Architect.

3.8 PROTECTION CLEAN UP, AND TOUCH-UP:

- A. Protect work from paint droppings and spattering by use of masking, drop cloths, removal of items or by other approved methods.
- B. Upon completion, clean paint from hardware, glass and other surfaces and items not required to be painted of paint drops or smears.
- C. Before final inspection, touch-up or refinished in a manner to produce solid even color and finish texture, free from defects in work which was damaged or discolored.

- END -

SECTION 101419  
DIMENSIONAL LETTER SIGNAGE

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, and (4) any Addendums.

1.2 SUMMARY

A. Section Includes:

1. Lettering on bench: Using the following as indicated and to suit project application.
  - a. Cutout dimensional characters.

1.3 COORDINATION

- A. Must coordinate with precast concrete bench manufacturer and shop drawings.

1.4 ACTION SUBMITTALS

A. Product Data: For each type *or* product.

B. Shop Drawings: For 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, and layout for each sign at least half size.

C. 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. Dimensional Characters: Half-size Sample of each type *or* dimensional character.

D. Product Schedule: For dimensional letter signs. Use same designations indicated on Drawings or specified.

E. Engineering Services Submittal:

1. Include structural analysis calculations for signs indicated to comply with design loads; signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.

B. Sample Warranty: For special warranty.

## 1.6 CLOSEOUT SUBMITTALS

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

## 1.7 QUALITY ASSURANCE

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

## 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. 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. Engineering Services: Engage a qualified professional engineer licensed in the State of Pennsylvania, to design sign structure and anchorage of dimensional characters sign type(s) according to structural performance requirements.
- B. Structural Performance: Signs and supporting elements shall withstand the effects of gravity and other loads within limits and under conditions indicated.
1. Concentrated Horizontal Load: As indicated on Structural Drawings.
  2. Uniform and concentrated loads need not be assumed to act concurrently.
- C. Thermal Movements: For exterior fabricated channel dimensional characters, allow for thermal movements from ambient and surface temperature changes.
1. Temperature Change: 120 deg F, ambient; 150 deg F, material surfaces.

### 2.2 DIMENSIONAL CHARACTERS

- A. Cutout Characters: Characters with uniform faces; square-cut, smooth, eased edges; precisely formed lines and profiles; and as follows:
1. Manufacturers: to be approved by Landscape Architect.

2. Character Material: Sheet or plate galvanized steel.
3. Character Height: As indicated on Drawings.
4. Thickness: Manufacturer's standard for size of character.
5. Finishes:
  - a. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard, in color as indicated or selected by Landscape Architect from manufacturer's full range.
  - b. Overcoat: Manufacturer's standard baked-on clear coating.
6. Mounting: As indicated on Drawings.
7. Typeface: As indicated on Drawings.

### 2.3 DIMENSIONAL CHARACTER MATERIALS

- A. Steel Castings: ASTM B 26/B 26M, alloy and temper recommended by sign manufacturer for casting process used and for type of use and finish indicated.
- B. Steel Sheet and Plate: ASTM B 209, alloy and temper recommended by steel producer and finisher for type of use and finish indicated.
- C. Steel Extrusions: ASTM B 221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- D. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

### 2.4 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:
  1. Use concealed fasteners and anchors unless indicated to be exposed.
  2. For exterior exposure, furnish stainless-steel devices unless otherwise indicated.
  3. Sign Mounting Fasteners:
    - a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.
- B. Post-Installed 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 AC193 or ICC-ES AC308.
  1. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 2 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.
- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1157/D 1187M.

## 2.5 FABRICATION

- A. General: Fabricate products from sheet metal without pitting, seam marks, roller marks, stains, discolorations, or other imperfections where exposed to view on finished units.
- B. 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. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
  - 4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
  - 5. Internally brace dimensional characters for stability, to meet structural performance loading without oil—canning or other surface deformation, and for securing fasteners.
  - 6. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
  - 7. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.
- C. Brackets: Fabricate brackets, fittings, and hardware for bracket—mounted signs to suit sign construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.
  - 1. Steel Brackets: Factory finish brackets with baked-enamel or powder-coat finish to match sign-background color unless otherwise indicated.

## 2.6 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Organic Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

## 2.7 STEEL FINISHES

- A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

## 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.
- B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION OF DIMENSIONAL CHARACTERS

- 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. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
  - 3. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- B. Mounting Methods:
  - 1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
  - 2. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
  - 3. Back Bar and Brackets: Remove loose debris from substrate surface and install backbar or bracket supports in position, so that signage is correctly located and aligned.

### 3.3 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed characters and signs that do not comply with specified requirements.
- B. Replace characters with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedure.
- C. Remove temporary protective coverings and strippable films as signs are installed.

- D. 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 them from damage until acceptance by Commissioner.

- END -



SECTION 101420  
PLAYFUL LEARNING SIGNAGE

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, and (4) any Addendums.

1.2 SUMMARY

- A. Section includes:
  - a. Playful Learning signage
- B. Related Sections:
  - a. Section 033000 - Cast-In-Place Concrete
  - b. Section 033001 - Landscape Cast-In-Place Concrete
  - c. Section 321300 - Concrete Paving
  - d. Section 321342 - Pervious Concrete Paving
  - e. Section 321540 - Bonded Aggregate Paving
  - f. Section 321816 - Protective Playground Surfacing
  - g. Section 321817 - Corkeen

1.3 PERFORMANCE REQUIREMENTS

- A. Design metal signs, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Accommodate thermal movement from ambient and surface temperature changes acting on exterior metal fabrications to prevent buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.4 QUALITY ASSURANCE

- A. Conform to governing laws, building code, and following standards, as applicable:
  - a. AISC Code and AISC Specification.
  - b. National Association of Architectural Metal Manufacturers (NAAMM), applicable publications.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
  - a. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

- C. Fabricator / Installer: A company with at least five years experience in Work of type required by this Section and with sufficient experience in the handling, fabricating, welding, and installation of metal elements of architectural quality.
- D. Source: For each type of material required for Work of this Section, provide primary materials that are products of one manufacturer. Provide secondary materials that are acceptable to manufacturers of primary materials.
- E. Engineering: Provide services of a Professional Engineer, registered in the State of Pennsylvania, to design and certify that Work of this Section meets or exceeds performance requirements specified.
- F. Shop Assembly: Preassemble signs to greatest extent possible to minimize field splicing. Disassemble units as required for shipping and handling. Clearly mark units for reassembling in field.
- G. Steel Supplier: Approved by Landscape Architect.
- H. Handling, Welding, and Fabrication: To conform to strict requirements of steel supplier/producer, or as indicated.

#### 1.5 SUBMITTALS

- A. Qualification data for professional engineer.
- B. Mill Certificates, signed by manufacturers that products comply with requirements.
- C. Welding Certificates.
- D. Product Data: Submit manufacturer's product data, installation instructions, use limitations and recommendations for each material used. Provide certifications stating that materials comply with requirements.
- E. Shop Drawings: Provide shop drawings for fabrication, installation, and erection of parts of all work. Provide plans, elevations, and details of anchorages, connections, and accessory items.
- F. Provide installation templates for Work installed by others. Show in detail provisions for anchoring, thermal expansion, and similar conditions. Show type and location of all fasteners.
- G. Field Measurements: Take accurate field measurements before preparation of shop drawings and fabrication. Do not delay job progress. Allow for field cutting and fitting where taking field measurements before fabrication is not possible.
- H. Calculations: Provide professionally prepared stamped calculations by a registered engineer and certification of performance of this Work. Show how design load requirements and other performance criteria have been satisfied.
- I. Samples: Submit representative samples of each material that is to be exposed in finished Work, showing full range of color and finish variations expected. Provide minimum 12 in. long samples of each metal item. Provide welded sample to demonstrate weld quality.
- J. Mock-ups: Before beginning primary Work of this Section, provide mock-ups at locations acceptable to Landscape Architect and obtain Landscape Architect's acceptance of visual qualities of metal signs. Protect and maintain acceptable mock-ups throughout Work of this Section to serve as criteria for acceptance of this Work.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials wrapped in protective coverings or protective wrapping.
- B. Store and handle in strict compliance with fabricator's instructions and recommendations.
- C. Protect from all possible damage.

## 1.7 SEQUENCING AND SCHEDULING

- A. Sequence deliveries to avoid delays but minimize on-site storage.
- B. Conference: Convene a pre-installation conference to establish procedures to maintain optimum working conditions and to coordinate this Work with related and adjacent Work.
- C. Coordinate installation of anchorages, plates, and angles for casting into concrete. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry.
- D. Deliver such items to Project site in time for installation.

## PART 2 - PRODUCTS

### 2.1 GENERAL

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

### 2.2 FABRICATORS

- A. Fabricators shall be subject to approval by Landscape Architect:

### 2.3 METAL SIGNS AND FOUNDATION

- A. Signs made as indicated on Drawings, to be shop fabricated from individual panels and steel tubing, welded at seams.
- B. Solid Panels: dimensions as indicated on Drawings, steel gauge to be determined by engineer.
- C. Finish: powdercoat, color to be selected by Landscape Architect.
- D. Edge Tubing: 2.5" diameter, gauge of steel to be determined by engineer.
- E. U-Bracket: 3/8" steel U-bracket, or as determined by engineer.
- F. Foundation: See Section 033000- Cast-In-Place Concrete

### 2.4 FASTENERS

- A. Select fasteners for type, grade, and class required.

- B. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts, and, where indicated, flat washers; ASTM F 593 (ASTM F 738M) for bolts and ASTM F 594 (ASTM F 836M) for nuts, Alloy Group 1 (A1). Provide tamper-resistant heads.
- C. Anchors: Provide cast-in-place, chemical, or torque-controlled expansion anchors with capability to sustain, without failure, a load equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

## 2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy that is welded.
- B. Isolation Barrier: Preformed sheet membrane barrier sheet to isolate dissimilar metals.

## 2.6 FABRICATION

- A. General: Fabricate metal signs with dimensions and details shown. Provide members in sizes and profiles indicated, with layout, size and spacings shown, but not less than required to support indicated design loads.
- B. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- C. Fabricate Work to be truly straight, plumb, level, and square.
- D. 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.
- E. Corners shall be cut and welded and ground smooth. No sharp edges will be accepted.
- F. Bent-metal corners will not be accepted for metal sculpture.
- G. Form exposed work with accurate angles and surfaces and straight edges.
- H. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- I. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- J. Provide for anchorage of type indicated, coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- K. Fittings and Anchors: Provide fittings and anchors for interconnection of components to other Work.
- L. Welded Connections: Perform welding to comply with AWS for recommended practices and specified tolerances, using appropriate welding speeds, pre and post heating, alignment of individual pieces, pre-bending, clamps and fixtures, and any other methods appropriate to maintain the specified tolerances and appropriate for metal and finish indicated. Grind exposed welds flush and smooth to blend with adjoining finish metal surfaces.

M. Close exposed ends of members as indicated on approved shop drawings.

## 2.7 FINISH

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.
- C. Finish exposed surfaces to remove tool and die marks and stretch lines and to blend into surrounding surface.
- D. Finish for work of this Section shall match the approved mockup. Finish shall be acceptable to the Landscape Architect.

## PART 3 - EXECUTION

### 3.1 INSPECTION

- A. The Installer/Erector shall examine substrates, supports, and conditions under which this Work is to be performed and notify Contractor, in writing, of conditions detrimental to proper completion of Work. Do not proceed with Work until unsatisfactory conditions are corrected.
- B. Beginning Work means Installer accepts substrates and conditions.

### 3.2 PREPARATION, INSTALLATION/ERECTION

- A. Strictly comply with manufacturer's instructions and recommendations, except where more restrictive requirements are specified in this Section.
- B. Installation, General: Provide anchorage devices and fasteners necessary for anchoring or attaching components to in-place construction. Coordinate and furnish anchorages, templates, setting drawings, instructions, and recommendations for installation of items.
- C. Attach removable units to supporting members with type and size of clips and fasteners indicated or, if not indicated, as recommended by grating manufacturer for type of installation conditions shown.
- D. Attach nonremovable units to supporting members by welding where both materials are same; otherwise, fasten by bolting as indicated above.
- E. Thoroughly separate dissimilar materials from each other using approved protective barrier coating, membrane, or other acceptable method.
- F. Joints between components shall be flush and seamless.

### 3.3 TOLERANCES

- A. The following allowable installed tolerances are allowable variations from locations and dimensions indicated by Contract Documents and shall not be added to allowable tolerances indicated for other Work.

- B. Allowable Variation from True Plumb: Less than 1/8 in. in 20 ft.-0 in.
- C. Allowable Variation from True Level: Less than 1/8 in. in 20 ft.-0 in.
- D. Allowable Variation from True Line: Less than 1/8 in. in 20 ft.-0 in.

#### 3.4 ADJUSTING, CLEANING, TOUCH-UP, AND PROTECTION

- A. Repair minor damage to eliminate evidence of repair. Clean exposed surfaces using non-abrasive materials and methods recommended by manufacturer of material or product being cleaned.
- B. Remove and replace Work that cannot be successfully cleaned or repaired.
- C. Provide temporary protection to ensure Work is without damage or deterioration at time of final acceptance. Remove protections and reclean as necessary immediately before final acceptance.

- END -

SECTION 116816  
PLAY STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
  - 1. Composite playground equipment.

1.2 DEFINITIONS

- A. Definitions in ASTM F1487 apply to Work of this Section.
- B. IPEMA: International Play Equipment Manufacturers Association.

1.3 PREINSTALLATION MEETINGS

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Submit no later than (4) four months prior to the scheduled installation.
  - 1. Include plans, elevations, sections, and attachment details.
  - 2. Include fall heights, use zones, footings layout, and compliance with ADA requirements including access details and the ratio of elevated versus ground level events for playground equipment, coordinated with the critical-height values of protective surfacing specified in Section 321816 - Protective Playground Surfacing and Section 321817 - Corkeen. Include the distance in linear feet from outside edge of the protective surfacing to a minimum of three (3) closest adjacent fixed outside structures such as curbs, fences, benches or trees.
- C. Samples for Initial Selection: For each type of exposed finish.
  - 1. Manufacturer's color charts.
  - 2. Include Samples of accessories involving color selection.
- D. Samples for Verification: For each type of exposed finish on the following products:
  - 1. Include Samples of accessories to verify color and finish selection.
  - 2. Posts and Rails: Minimum 6 inches long.
  - 3. Molded Plastic: Minimum 3 inches square.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each play structure.
- C. Material Certificates: For the following items:
  - 1. Shop finishes.
- D. Field quality-control reports.
- E. Document of Acceptance: Prepared by manufacturer's representative stating that a field inspection of the composite playground equipment was conducted, and the installation is accepted by the manufacturer's representative.
- F. Sample Warranty: For manufacturer's special warranties.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Insurance Certificate: Manufacturer's Certificate of Product Liability Insurance for one (1) million dollars.
- B. Guarantee: Original guarantee for replacement of any items or components found to be defective during the manufacturers' guarantee period. The Contractor shall submit the original guarantee certificate to the Owner at the completion of the project. The Contractor shall furnish the original and 4 (four) copies of the manufacturers' guarantee.
- C. Document of Acceptance: An authorized representative of the play equipment manufacturer must inspect and approve the completed installation. Submit a Document of Acceptance signed by the authorized Manufacturers' representative.
- D. Maintenance Data: For play structures and finishes to include in maintenance manuals.

#### 1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
  - 1. Member of the International Play Equipment Manufacturers Association (IPEMA), a third-party certification inspection organization which continually validates a manufacturer's compliance with ASTM F1487-Latest Rev.
  - 2. A firm whose play structures components have been certified by IPEMA's third-party product certification service.
- B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

#### 1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of play structures that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures.



b. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

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

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain play structures from single source from single manufacturer.
- B. Play structures and components shall have the IPEMA Certification Seal.
- C. Manufacturer: Landscape Structures Inc., Delano, MN. (Basis of Design) or approved equal.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Safety Standards:
  - 1. Provide play structures that meet or exceed the requirements as published in the Handbook for Public Playground Safety issued by the U.S. Consumer Product Safety Commission, the Consumer Product Safety Improvement Act (CPSIA) of 2008.
  - 2. Provide play structures according to ASTM F1487-Latest Rev.
- B. Accessibility Standards:
  - 1. "Guide to ADA Accessibility Guidelines for Play Areas", Final Ruling (ADA).

### 2.3 COMPOSITE PLAYGROUND EQUIPMENT

- A. Steel Members:
  - 1. Posts: Schedule 40 pipe or structural steel tubing pipe or tubing with a minimum thickness of 0.120" (11 gauge); Galvanized.
    - a. Color: As indicated on Contract Drawings and as selected by Landscape Architect from manufacturer's full range.
  - 2. Railings and Fixtures: Schedule 40 pipe or structural tubing of such thickness that the railings shall not sag or bend during use.
  - 3. Tubular Steel: Structural tubing of the sizes and shapes shown in the approved shop drawings. Steel shall meet ASTM A500, Grade B which has a minimum tensile strength of 58,000 psi (for round and shaped) and a minimum yield point of 42,000 psi for round structural tubing and a minimum yield point of 46,000 psi for shaped structural tubing. Material shall be load-tested under ASTM 1487-Latest Rev., after fabrication.
  - 4. Pipe: Pipe for climbers, ladders, shall be Schedule 40 or structural tubing steel pipe conforming to the requirements of ASTM A53 and shall be of the same sizes, indicated on the plans. Steel pipe shall be load tested under ASTM F1487-Latest Rev., requirements after fabrication. The outside diameter of all hand gripping components including rungs on horizontal ladders, climbing bars, handrails, etc. shall comply with the anthropometric dimensions as listed in the ASTM 1487-Latest Rev. standards.

5. Pipe Caps: All exposed ends of steel members shall be plugged with metal caps riveted in place with self-sealing rivets or spot welded.
- B. Fittings and Clamps:
1. All fittings and clamps shall be as indicated on the approved shop drawings and as may be required to complete the installation.
  2. All fittings shall be of the best quality malleable iron, drop-forged steel or steel plate as indicated.
  3. Clamp fittings shall be cast aluminum or 12 gauge drawn quality or better steel and finished to match vertical components and shall be smoothly constructed with no projections or sharp edges.
  4. All clamps shall have tamper resistant fasteners. Clamps used on component subjected to vertical loads shall be pinned to prevent slipping and twisting.
- C. Fasteners:
1. All fasteners including, but not limited to, bolts, lag screws, tie rods, threaded rods, nuts, and washers, shall be of the sizes indicated on the approved shop drawings.
  2. Fasteners shall be either stainless steel per ASTM F879 or carbon steel treated with a corrosion resistant coating per applicable ASTM plating specifications.
  3. All threaded fasteners shall include a locking patch-type material that will meet the minimum torque requirements of Industrial Fastener's Institute (IFI)-125 "Test Procedure for the Locking Ability Performance of Chemical Coated Lock Screws".
  4. The play equipment Manufacturer shall provide special tools for pinned tamperproof fasteners.
  5. All protruding bolts, screws and other threaded connectors shall be cut off to within two threads of nut, washer, etc., then satisfactorily peened to prevent removal by unscrewing, and filed completely smooth to remove all sharp edges
- D. Plastic Lumber: Plastic lumber shall be made from UV stabilized recycled high-density polyethylene.
1. Recycled lumber shall be protected during transportation.
  2. Recycled plastic lumber may not be used on spans greater than two (2') feet unless additional structural support is provided. An engineering analysis of structural integrity based on ASTM F1487 shall be submitted upon request.
  3. Plastic Lumber shall be smooth on all sides and ends. Plastic Lumber shall be free from all but minor marks, blemishes, discolorations, warp, wane, twist, quirk or other imperfections. The intersection of all planes of faces, edges and ends shall be eased to one-eighth(1/8") inch radius.
- E. Rotationally Molded Polyethylene:
1. Parts shall be rotationally molded from color-compounded, first quality, linear low-density polyethylene with a tensile strength of 2,500 psi per ASTM D638 and with color and UV-stabilizing additives. Dry-blended or molded-in resins are not acceptable.
  2. Polyethylene shall be ultraviolet stabilized to UV-8 and have anti-static additives.
  3. Wall thickness shall vary by component and as shown on the approved shop drawings.

F. Sheet Plastic Parts:

1. Sheet plastic parts shall be manufactured from three-quarter (3/4") inch high-density polyethylene that has been specially formulated for optimum UV stability and color retention.
2. Products shall have a minimum density of 0.933 G/cc in accordance with ASTM D1505 and a minimum tensile strength of 2,400 psi in accordance with ASTM D638.
3. All edges shall be free of burrs, sharp edges, and points.

2.4 STEEL FABRICATION

A. All steel components to be welded shall be welded in complete accordance with the standards of the American Welding Society. All welds shall be continuous around the entire perimeter. All welds shall be ground smooth. NO TACK WELDING AND NO FIELD WELDING SHALL BE PERMITTED.

B. Corrosion Resistant Treatment:

1. All fabrication and welding shall be completed prior to application of the corrosion resistant coating; metal pieces shall be cleaned of all weld spatter, mill scale, varnish, rust, grease, and the like and the surface mechanically and chemically prepared to receive the coating.
2. This corrosion resistant coating shall a thermal spray zinc coating or electrostatic applied primer with a minimum thickness of 3 mils. All metal pieces, including welds, shall receive the coating.

C. Polyester Powder Coating:

1. A surface coat shall be applied to the thermal zinc coated metal pieces in such a manner that the coating will not peel off. The manufacturer shall perform all processes required to achieve a smooth material bond.
2. An epoxy or acrylic polymer primer shall be applied prior to application of powdercoating. The surface coat shall be an electrostatically sprayed, lead-free, super durable TGIC (triglycidyl isocyanurate) polyester powder coating applied to a minimum of five (5) mil thickness which shall be oven cured. The TGIC polyester powder coating shall comply with the ASTM standards below:
3. Colors shall be as shown on the drawings. Material manufacturer's directions for storage and use shall be adhered to. Material surfaces shall be protected during shipment so as to arrive mar and scratch free in the field.

D. Platforms and Steps:

1. Products shall have a minimum density of 0.933 G/cc in accordance with ASTM D1505 and a minimum tensile strength of 2,400 psi in accordance with ASTM D638.
2. All edges shall be free of burrs, sharp edges, and points.
3. Completely factory assembled in a configuration that is ready for attachment to the frame on site.

E. Roofs: Designed to discourage and minimize climbing by users.

1. Fabricated from metal.

- F. Age-Appropriate Signage: Manufacturer's standard sign panels, fabricated from two-color sheet plastic, located in clearly conspicuous place at entry point attached to freestanding, upright support posts and/or directly to playground equipment as indicated on shop drawings.
  - 1. Text: As appropriate for play structure.
    - a. "This play equipment is designed for Preschool Children Ages 2 to 5 years. Adult supervision is recommended".
    - b. "This play equipment is designed for School Age Children ages 5 to 12 years. Adult supervision is recommended".
- G. Manufacturer Identification Sticker: Placed in an inconspicuous place on the equipment for M & O reference. (For example, under a slide bed at the lowest point). The sticker shall identify the manufacturer's address and a toll-free phone number.

## 2.5 CAST-IN-PLACE CONCRETE

- A. Concrete Materials and Properties: Comply with requirements in Section 033000 "Cast-in-Place Concrete" ACI 301 for normal-weight, air-entrained concrete with minimum 28-day compressive strength of 3200 psi, 3-inch slump, and 1-inch- maximum-size aggregate.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for earthwork, subgrade elevations, surface and subgrade drainage, and other conditions affecting performance of the Work.
  - 1. Do not begin installation before final grading required for placing play structures and protective surfacing is completed.
- B. Final installation of play structures (concrete footings) shall not proceed until the Contractor has demonstrated to the satisfaction of Owner's Representative that the use zones comply with ASTM F1487-Latest Rev. and CPSC guidelines.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Comply with manufacturer's written installation instructions for each play structure type unless more stringent requirements are indicated. Anchor play structures securely, positioned at locations and elevations indicated.
  - 1. Maximum Play Structure Height: Coordinate installed fall heights of play structures with finished elevations and critical-height values of protective surfacing. Set play structures so fall heights and elevation requirements for age group use and accessibility are within required limits. Verify that play structures' elevations comply with requirements for each type and component of play structure.

- B. Post and Footing Excavation: Excavate holes for posts and footings as indicated in firm, undisturbed or compacted subgrade soil.
- C. Post Set with Concrete Footing: Comply with Section 033000 "Cast-in-Place Concrete" for measuring, batching, mixing, transporting, forming, and placing concrete.
  - 1. Set equipment posts in and on concrete footing as shown on approved shop drawings. Protect portion of posts above footing from concrete splatter. Verify that posts are set plumb or at the correct angle, alignment, height, and spacing. Place concrete around posts and vibrate or tamp for consolidation. Hold posts in position during placement and finishing operations until concrete is sufficiently cured.
  - 2. Embedded Items: Follow equipment manufacturer's written instructions and drawings to ensure correct installation of anchorages for equipment.
  - 3. Finishing Footings: Smooth top, and shape to shed water.
- D. Assemble play structures to configuration as shown on the approved shop drawings.
- E. Fastenings:
  - 1. As shown on drawings and securely tightened with an impact and/or torque wrench (as per manufacturer's specification).
  - 2. Take precautions while trimming bolt projections, if necessary, to prevent metallic contamination (rust bloom) of the corrosion resistant bolts to the satisfaction of the Owner's Representative. Precautions include use of previously unused grinding wheels and applying zinc rich paint on trimmed galvanized bolts. No hazardous projections or rust bloom shall be left in the finished work

### 3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of an authorized manufacturer's representative, who is not the qualified installer.
  - 1. Perform inspection and testing for each type of installed play structure according to ASTM F1487-Latest Rev. and certify that play structures were correctly installed in accordance with the manufacturer's written instructions, all fastenings are securely installed meeting the manufacturers' maximum torque value.
- B. Playground equipment items will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.
- D. Notify Owner's Representative 48 hours in advance of date(s) and time(s) of testing and inspection.

### 3.4 EXTRA MATERIALS

- A. Furnish and deliver to Owner's Representative additional new materials obtained from the play structures manufacturer.
- B. Graffiti Remover for Polyester Powdercoated Steel Surfaces: (192) ounces in spray bottles: six (6) thirty-two (32) ounce spray bottles; or twelve (12) sixteen (16) ounce spray bottles; Go-Away graffiti remover, manufactured by Nexgen, North Hollywood, CA; Erase Graffiti Cleaner as

manufactured by Landscape Structures, Delano, MN; or Gametime Graffiti Remover as manufactured by Gametime, Fort Payne, AL, or approved equal. Each container Clearly label each container using a minimum of 1/4-inch high lettering: "For Play Structures".

- END -

SECTION 129301  
LANDSCAPE SITE FURNISHINGS

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials, and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Benches
2. Precast Concrete Pebble Benches, Type 1 - 3
3. Café Tables
4. Picnic Tables
5. Litter Receptacles
6. Bike Racks
7. Drinking Fountain

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 033000 - Cast-In-Place Concrete.
2. Section 033001 - Landscape Cast-In-Place Concrete.
3. Section 321300 - Concrete Paving.
4. Section 321342 - Pervious Concrete Paving
5. Section 321540 - Bonded Aggregate Paving
6. Section 321816 - Protective Playground Surfacing
7. Section 321817 - Corkeen

1.2 SUBMITTALS

A. Product Data: For all products specified; including color chips for initial selection.

B. Samples for Verification: Provide samples for verification for the following materials:

1. Benches – (1) material sample of metal slat topper

2. Precast Concrete Pebble Benches – (3) material samples of different finish options
3. Café Tables – (1) material sample of wood slat toppers
4. Picnic Tables – (1) material sample of wood slat toppers
5. Litter Receptacle – (1) material sample
6. Bike Racks – (1) material sample
7. Drinking Fountain – (1) material sample

C. Shop Drawings: Provide complete shop drawings detailing fabrication and installation of all specified site furnishings. Indicate locations, plans, elevations, dimensions, shapes, and cross sections of each unit.

### 1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of site furnishing(s) through one source from a single manufacturer.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

A. Steel and Iron: Free of surface blemishes and complying with the following:

1. Plates, Shapes, and Bars: ASTM A 36/A 36M.
2. Steel Pipe: Standard-weight steel pipe complying with ASTM A 53, or electric-resistance-welded pipe complying with ASTM A 135.
3. Tubing: Cold-formed steel tubing complying with ASTM A 500.
4. Mechanical Tubing: Cold-rolled, electric-resistance-welded carbon or alloy steel tubing complying with ASTM A 513, or steel tubing fabricated from steel complying with ASTM A 1011/A 1011M and complying with dimensional tolerances in ASTM A 500; zinc coated internally and externally.
5. Sheet: Commercial steel sheet complying with ASTM A 1011/A 1011M.

B. Stainless Steel: Free of surface blemishes and complying with the following:

1. Sheet, Strip, Plate, and Flat Bars: ASTM A 666.
2. Pipe: Schedule 40 steel pipe complying with ASTM A 312/A 312M.



3. Tubing: ASTM A 554.
- C. Wood: Surfaced smooth on four sides with eased edges; kiln dried, free of knots, solid stock of species indicated.
    1. Wood Species: Manufacturer's standard.
      - a. Finish: Manufacturer's standard stain and transparent sealer.
  - D. Anchors, Fasteners, Fittings, and Hardware: Stainless steel or Manufacturer's standard, corrosion-resistant-coated or noncorrodible materials.
  - E. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107; recommended in writing by manufacturer, for exterior applications.

## 2.2 BENCHES

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

1. Dumor

Address: P.O. Box 142, Mifflintown, PA, 17059

Phone: 800 598 4018

Website: <https://dumor.com/>

- a. Bench 160

Product Number: 160 ARMREST

Dimensions: 6' length

Finish: painted steel, black

## 2.3 PRECAST CONCRETE PEBBLE BENCHES

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

1. Urbastyle by Wausau Tile

Address: PO Box 1520, Wausau, WI, 54402-1520

Phone: (715) 359-3121

Email: [wtile@wausautile.com](mailto:wtile@wausautile.com)

Website: <https://wausautile.com/>

a. Galet I Bench

Product Number: ZB.GL.01

Dimensions: 50" L x 50" W x 16" H

Mounting: Free standing

Finish: acid wash and waterproofed

Color: A30

b. Galet II Bench

Product Number: ZB.GL.02

Dimensions: 63" L x 63" W x 19-1/2" H

Mounting: Free standing

Finish: acid wash and waterproofed

Color: A30

c. Galet III Bench

Product Number: ZB.GL.03

Dimensions: 94" L x 52" W x 17" H

Mounting: Free standing

Finish: acid wash and waterproofed

Color: A30

## 2.4 CAFÉ TABLES

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

1. Dumor

Address: P.O. Box 142, Mifflintown, PA, 17059

Phone: 800 598 4018

Website: <https://dumor.com/>

- a. Table 76
  - Product Number: 76-33D
  - Dimensions: 4' x 4' Square
  - Seats: (3) seats (ADA)
  - Color: black
  - Finish: powdercoat
  - Topper: Douglas fir, 3x4

## 2.5 PICNIC TABLES

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

1. Dumor

Address: P.O. Box 142, Mifflintown, PA, 17059

Phone: 800 598 4018

Website: <https://dumor.com/>

- a. Table 71
  - Product Number: 71-68-1D
  - Color: black
  - Finish: powdercoat
  - Topper: Douglas fir

## 2.6 LITTER RECEPTACLES

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

1. Dumor

Address: P.O. Box 142, Mifflintown, PA, 17059

Phone: 800 598 4018

Website: <https://dumor.com/>

- a. Receptacle 157
  - Product Number: 157-32SH

Color: black  
Finish: powdercoat

## 2.7 BIKE RACKS

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

1. Dumor

Address: P.O. Box 142, Mifflintown, PA, 17059

Phone: 800 598 4018

Website: <https://dumor.com/>

a. Bike Rack 83

Product Number: 83-00/S-1

Color: black

Finish: powdercoat

Mounting: embedment

## 2.8 DRINKING FOUNTAIN

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

1. Elkay

Address: 1333 Butterfield Road, Suite 200, Downers Grove, IL 60515

Phone: 630-574-8484

Website: <https://www.elkay.com/>

a. Elkay Outdoor ezH2O® Upper Bottle Filling Station Tri-Level Pedestal  
Non-Filtered Non-Refrigerated

Model Number: LK4430BF1U

Color: black

Finish: powdercoat

Mounting: floor mount

## 2.10 FINISHES, GENERAL

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

## 2.11 STEEL AND GALVANIZED STEEL FINISHES

- A. Baked-Enamel, Powder-Coat Finish: Manufacturer's standard, baked, polyester, powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

## 2.12 STAINLESS-STEEL FINISHES

- A. Remove tool and die marks and stretch lines or blend into finish.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance.

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

### 3.2 INSTALLATION, GENERAL

- A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.
- B. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.
- C. Install site furnishings level, plumb, true, and securely anchored or positioned at locations indicated on Drawings.
- D. Post Setting: Set cast-in support posts in concrete footing with smooth top, shaped to shed water. Protect portion of posts above footing from concrete splatter. Verify that posts are set plumb or at correct angle and are aligned and at correct height and spacing. Hold posts in position during placement and finishing operations until concrete is sufficiently cured.
- E. Posts Set into Voids in Concrete: Form or core-drill holes for installing posts in concrete to depth recommended in writing by manufacturer of site furnishings and 3/4 inch (19 mm) larger than OD of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout] [or] [anchoring cement], mixed and placed to comply with anchoring material manufacturer's written instructions, with top smoothed and shaped to shed water.

### 3.3 CLEANING

- A. After completing site furnishing installation, inspect components. Remove spots, dirt, and debris. Repair damaged finishes to match original finish or replace component.

- END -

SECTION 220523  
BALL VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Brass ball valves.
  2. Bronze ball valves.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of valve.
1. Certification that products comply with NSF 61 Annex G and NSF 372.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
1. ASME B1.20.1 for threads for threaded end valves.
  2. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  3. ASME B16.18 for solder-joint connections.
  4. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 Annex G for valve materials for potable-water service.
- D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- F. Valve Sizes: Same as upstream piping unless otherwise indicated.
- G. Valve Actuator Types:
1. Hand lever: For quarter-turn valves smaller than NPS 4.

H. Valves in Insulated Piping:

1. Include 2-inch stem extensions.
2. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
3. Memory stops that are fully adjustable after insulation is applied.

2.2 BRASS BALL VALVES

A. Brass Ball Valves, One-Piece:

1. Description:

- a. Standard: MSS SP-110.
- b. CWP Rating: 400 psig.
- c. Body Design: One piece.
- d. Body Material: Forged brass or bronze.
- e. Ends: Threaded and soldered.
- f. Seats: PTFE.
- g. Stem: Brass or stainless steel.
- h. Ball: Chrome-plated brass or stainless steel.
- i. Port: Reduced.

PART 3 - EXECUTION

3.1 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.

3.2 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.
- B. Select valves with the following end connections:



1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Steel Piping, NPS 2 and Smaller: Threaded ends.

#### DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

##### C. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Brass ball valve, one piece.
3. Bronze ball valve, one piece with bronze trim.
4. Brass ball valves, two-piece with full port and brass trim.
5. Bronze ball valves, two-piece with full port and bronze or brass trim.

- END -

SECTION 220524  
CHECK VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bronze swing check valves.
2. Iron swing check valves.
3. Iron swing check valves with closure control.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61 Annex G and NSF 372.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
1. ASME B1.20.1 for threads for threaded end valves.
  2. ASME B16.1 for flanges on iron valves.
  3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  4. ASME B16.18 for solder joint.
  5. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 Annex G and NSF 372 for valve materials for potable-water service.
- D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- F. Valve Sizes: Same as upstream piping unless otherwise indicated.

- G. Valve Bypass and Drain Connections: MSS SP-45.

## 2.2 BRONZE SWING CHECK VALVES

- A. Bronze Swing Check Valves with Bronze Disc, Class 125:

- 1. Description:

- a. Standard: MSS SP-80, Type 3.
- b. CWP Rating: 200 psig.
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded or soldered. See valve schedule articles.
- f. Disc: Bronze.
- g. .

## PART 3 - EXECUTION

### 3.1 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install swing check valves for proper direction of flow in horizontal position with hinge pin level.

### 3.2 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

### 3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
- B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.
- C. End Connections:

1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded or soldered.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged or threaded.
3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flanged.

3.4 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe connections. NPS 2 and Smaller: Bronze swing check valves bronze disc, Class 125, with soldered or threaded end.

- END -

SECTION 220529  
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Metal pipe hangers and supports.
  2. Trapeze pipe hangers.
  3. Thermal-hanger shield inserts.
  4. Fastener systems.
  5. Pipe positioning systems.
  6. Equipment supports.

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
1. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
  2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
  3. Design seismic-restraint hangers and supports for piping and equipment[ and obtain approval from authorities having jurisdiction.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer.] Show fabrication and installation details and include calculations for the following; include Product Data for components:
1. Trapeze pipe hangers.
  2. Equipment supports.

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

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

#### 1.5 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

### PART 2 - PRODUCTS

#### 2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

- B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

- C. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of **copper-coated steel**

## 2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

## 2.3 THERMAL-HANGER SHIELD INSERTS

- A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
- B. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength.
- C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

## 2.4 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear.

## 2.5 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

## 2.6 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

## 2.7 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  - 1. Properties: Non staining, noncorrosive, and nongaseous.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.

## PART 3 - EXECUTION

### 3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
  - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
  - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- D. Fastener System Installation:
  - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
  - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- E. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

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HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT



- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- K. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- M. Insulated Piping:
  - 1. Attach clamps and spacers to piping.
    - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
  - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 4. Shield Dimensions for Pipe: Not less than the following:
    - a. NPS 1/4 to NPS 3-1/2:
  - 5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### 3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### 3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

### 3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches Insert dimension. PAINTING
- C. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- D. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Section 099113 "Exterior Painting."

- E. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

### 3.5 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and attachments for general service applications.
- F. Use stainless-steel pipe hangers and stainless-steel attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal-hanger shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
  - 2. Yoke-Type Pipe Clamps MSS Type 2: For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
  - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
  - 4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  - 5. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
  - 6. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
  - 7. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
  - 8. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.

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#### HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

9. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.
  3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb.
    - b. Medium (MSS Type 32): 1500 lb .
    - c. Heavy (MSS Type 33): 3000 lb.
  8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.

3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
  2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
  3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
- P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- Q. Use powder-actuated fasteners instead of building attachments where required in concrete construction.
- R. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

- END -

SECTION 220719  
PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes insulating the following plumbing piping services:
  - 1. Domestic hot-water piping.
  - 2. Domestic recirculating hot-water piping.
  - 3. Sanitary waste piping exposed to freezing conditions.
  - 4. Storm-water piping exposed to freezing conditions.
  - 5. Roof drains and rainwater leaders.
  - 6. Supplies and drains for handicap-accessible lavatories and sinks.
  
- B. Related Sections:
  - 1. Section 220716 "Plumbing Equipment Insulation."

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
  
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail attachment and covering of heat tracing inside insulation.
  - 3. Detail insulation application at pipe expansion joints for each type of insulation.
  - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
  - 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
  - 6. Detail application of field-applied jackets.
  - 7. Detail application at linkages of control devices.

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

## 1.4 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- B. Comply with the following applicable standards and other requirements specified for miscellaneous components:
  - 1. Supply and Drain Protective Shielding Guards: ICC A117.1.

## PART 2 - PRODUCTS

### 2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Special-Shaped Insulation: ASTM C 552, Type III.
  - 2. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
  - 3. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2.
  - 4. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

- G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
- H. Mineral-Fiber, Preformed Pipe Insulation:
  - 1. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, without factory-applied jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- I. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials.

## 2.2 INSULATING CEMENTS

- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

## 2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.
  - 1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
  - 1. Double click to insert sustainable design text for adhesive for flexible elastomeric and polyolefin VOC content.
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- E. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
- F. PVC Jacket Adhesive: Compatible with PVC jacket.



## 2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
  - 1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
  - 2. Service Temperature Range: Minus 20 to plus 180 deg F.
  - 3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
  - 4. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
  - 1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms. 0625-inch dry film thickness.
  - 2. Service Temperature Range: Minus 20 to plus 180 deg F.
  - 3. Solids Content: 60 percent by volume and 66 percent by weight.
  - 4. Color: White.

## 2.5 SEALANTS

- A. Joint Sealants for Cellular-Glass Products:
  - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 2. Permanently flexible, elastomeric sealant.
  - 3. Service Temperature Range: Minus 100 to plus 300 deg F.
  - 4. Color: White or gray.
- B. FSK and Metal Jacket Flashing Sealants:
  - Materials shall be compatible with insulation materials, jackets, and substrates.
  - 1. Fire- and water-resistant, flexible, elastomeric sealant.
  - 2. Service Temperature Range: Minus 40 to plus 250 deg F.
  - 3. Color: Aluminum.
- C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
  - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 2. Fire- and water-resistant, flexible, elastomeric sealant.
  - 3. Service Temperature Range: Minus 40 to plus 250 deg F.
  - 4. Color: White.

## 2.6 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
  - 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

## 2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. (34 g/sq. m) with a thread count of 10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm), in a Leno weave, for pipe.

## 2.8 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
  1. Adhesive: As recommended by jacket material manufacturer.
  2. Color: White.
  3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
    - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

## 2.9 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
  1. Width: 3 inches.
  2. Thickness: 11.5 mils.
  3. Adhesion: 90 ounces force/inch in width.
  4. Elongation: 2 percent.
  5. Tensile Strength: 40 lbf/inch in width.
  6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
  1. Width: 3 inches.
  2. Thickness: 6.5 mils.
  3. Adhesion: 90 ounces force/inch in width.
  4. Elongation: 2 percent.
  5. Tensile Strength: 40 lbf/inch in width.
  6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
  - 1. Width: 2 inches
  - 2. Thickness: 3.7 mils.
  - 3. Adhesion: 100 ounces force/inch in width.
  - 4. Elongation: 5 percent.
  - 5. Tensile Strength: 34 lbf/inch in width.

#### 2.10 SECUREMENTS

- A. Aluminum Bands: ASTM B 209, Aoy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch 1/2 inch wide with wing seal.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch wide, stainless steel or Monel.
- C. Wire: 0.080-inch nickel-copper alloy.

#### 2.11 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers:
  - 1. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.
- B. Protective Shielding Piping Enclosures:
  - 1. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

### 3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth. Seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches 4 inches o.c.
    - a. For below-ambient services, apply vapor-barrier mastic over staples.

2. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
  3. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
  2. Testing agency labels and stamps.
  3. Nameplates and data plates.
  4. Cleanouts.

### 3.3 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
  4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
  2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

### 3.4 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
  2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
  3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
  4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
  5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating

- cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
  7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
  8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
  9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
  2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
  3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
  4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least **2 inches (50 mm)** over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
  5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

### 3.5 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
  - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

### 3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, locations of threaded strainers, two locations of welded strainers, for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### 3.7 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
  - 1. Drainage piping located in crawl spaces.
  - 2. Underground piping.
  - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.



### 3.8 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Hot and Recirculated Hot Water: Insulation shall be[ one of] the following:
  - 1. Flexible Elastomeric: 1 inch thick.
  - 2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
  - 3. Polyolefin: 1 inch thick.
- B. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities: Insulation shall be[ one of] the following:
  - 1. Flexible Elastomeric: 1 inch thick.
  - 2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
  - 3. Polyolefin: 1 inch thick.
- C. Sanitary Waste Piping Where Heat Tracing Is Installed: Mineral-fiber, preformed pipe insulation, Type I, 1-1/2 inches thick.

### 3.9 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Domestic Water Piping: Insulation shall be[ one of] the following:
  - 1. Cellular Glass: 2 inches thick.
  - 2. Flexible Elastomeric: 2 inches thick.
  - 3. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
  - 4. Polyolefin: 2 inches thick.
- B. Domestic Hot and Recirculated Hot Water: Insulation shall be one of the following:
  - 1. Cellular Glass:2 inch thick.
  - 2. Flexible Elastomeric:2 inches thick.
  - 3. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
  - 4. Polyolefin: 2 inches thick.
- C. Sanitary Waste Piping Where Heat Tracing Is Installed: Insulation shall be[ one of] the following:
  - 1. Cellular Glass: 2 inches thick.
  - 2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

### 3.10 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. None.
2. PVC: 20 mils thick.
3. Aluminum, 0.040 inch thick.

3.11 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.

3.12 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

- A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

- END -

SECTION 221116  
DOMESTIC WATER AND GAS PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper tube and fittings.
2. Ductile-iron pipe and fittings.
3. Galvanized steel pipe and fittings.
4. CPVC piping.
5. PVC pipe and fittings.
6. PP pipe and fittings.
7. Piping joining materials.
8. Transition fittings.
9. Dielectric fittings.

B. Related Requirements:

1. Section 221113 "Facility Water and Gas Distribution Piping" for water & gas-service piping inside the building from source to the point where water-service and gas piping enters the building.

1.2 ACTION SUBMITTALS

A. Product Data: For transition fittings and dielectric fittings.

B. Sustainable Design Submittals:

1.3 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.

B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

- B. Potable-water piping and components shall comply with NSF 14 and NSF 61 Annex G. Plastic piping components shall be marked with "NSF-pw."
- C. Comply with NSF 372 for no lead.

## 2.2 WATER PIPING COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L and ASTM B 88, Type M water tube, drawn temper.
- B. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- C. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- E. Copper Unions:
  - 1. MSS SP-123.
  - 2. Cast-copper-alloy, hexagonal-stock body.
  - 3. Ball-and-socket, metal-to-metal seating surfaces.
  - 4. Solder-joint or threaded ends.
- F. Copper Pressure-Seal-Joint Fittings:
  - 1. Fittings for NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
  - 2. Fittings for NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
- G. Copper Push-on-Joint Fittings:
  - 1. Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22.
  - 2. Stainless-steel teeth and EPDM-rubber, O-ring seal in each end instead of solder-joint ends.

## 2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials:
  - 1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
  - 2. Full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys.

- D. Flux: ASTM B 813, water flushable.
- E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

## 2.4 TRANSITION FITTINGS

- A. General Requirements:
  - 1. Same size as pipes to be joined.
  - 2. Pressure rating at least equal to pipes to be joined.
  - 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- C. Plastic-to-Metal Transition Fittings:
  - 1. corrosive, propylene.

## PART 3 - EXECUTION

### 3.1 EARTHWORK

- A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

### 3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of gas and domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install copper tubing inside building above floor slab according to CDA's "Copper Tube Handbook." For water. For Gas NFPA 54, National Fuel Gas Code, AGA, and International Fuel Gas Code.
- C. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."
- D. Install shutoff valve immediately upstream of each dielectric fitting.

- E. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."
- F. Install domestic water piping level without pitch and plumb.
- G. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- H. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- I. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- J. Install piping to permit valve servicing.
- K. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- L. Install piping free of sags and bends.
- M. Install fittings for changes in direction and branch connections.
- N. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- O. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- P. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- Q. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

### 3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
  2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for water Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Braze Joints" chapter.
  - E. Soldered Joints for water Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
  - F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
  - G. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.
- 3.4 TRANSITION FITTING INSTALLATION
- A. Install transition couplings at joints of dissimilar piping.
  - B. Transition Fittings in above ground Domestic Water and Gas Piping:
    1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
    2. Fittings for NPS 2 and Larger: Sleeve-type coupling.
  - C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Copper-to-Steel transition fittings or unions.
- 3.5 DIELECTRIC FITTING INSTALLATION
- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
  - B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings.
  - C. Dielectric Fittings for NPS 2-1/2 to NPS : Use dielectric flange.
  - D. Dielectric Fittings for NPS 525)] <Insert pipe size> and Larger: Use dielectric flange kits.
- 3.6 HANGER AND SUPPORT INSTLLATION
- A. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
  - B. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Vertical Piping: MSS Type 8 or 42, clamps.
  2. Individual, Straight, Horizontal Piping Runs:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
  3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
  2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
  3. NPS 1-1/2 and NPS 2): 96 inches with 3/8-inch rod.
  4. NPS 2-1/2: 108 inches with 1/2-inch rod.
  5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
  6. NPS 6 ): 10 feet with 5/8-inch rod.
  7. NPS 8: 10 feet with 3/4-inch rod.
- F. Install supports for vertical copper tubing every 10 feet.
- G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
  2. NPS 1-1/2: 108 inches with 3/8-inch rod.
  3. NPS 2: 10 feet with 3/8-inch rod.
  4. NPS 2-1/2: 11 feet with 1/2-inch rod.
  5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
  6. NPS 4 and NPS 5 : 12 feet with 5/8-inch rod.
  7. NPS 6: 12 feet with 3/4-inch rod.
  8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.
- H. Install supports for vertical steel piping every 15 feet.
- I. Support piping and tubing not listed in this article according to MSS SP-58 and manufacturer's written instructions.



### 3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
  - 1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
  - 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
  - 3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
  - 4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

### 3.8 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."
- B. Label pressure piping with system operating pressure.

### 3.9 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Piping Inspections:
    - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
    - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
      - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
      - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.

- c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
- d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

- a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
- b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
- c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
- d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
- e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
- f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.10 ADJUSTING

A. Perform the following adjustments before operation:

- 1. Close drain valves, hydrants, and hose bibbs.
- 2. Open shutoff valves to fully open position.
- 3. Open throttling valves to proper setting.
- 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
  - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
  - b. Adjust calibrated balancing valves to flows indicated.
- 5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
- 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
- 7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
- 8. Check plumbing specialties and verify proper settings, adjustments, and operation.

### 3.11 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
  - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
  - 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
    - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    - b. Fill and isolate system according to either of the following:
      - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
      - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
    - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    - d. Repeat procedures if biological examination shows contamination.
    - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

### 3.12 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Under-building-slab, domestic water, building-service piping, NPS 3 and smaller, shall be one of the following:
  - 1. Soft copper tube, ASTM B 88, Type K, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and brazed copper pressure-seal fittings; and pressure-sealed joints.
- E. Under-building-slab/below grade, domestic water piping, NPS 2, shall be the following:

1. Hard copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and brazed copper pressure-seal-joint fittings; and pressure-sealed joints.
  2. PVC, Schedule 40; socket fittings; and solvent-cemented joints.
- F. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:
1. Hard copper tube, ASTM B 88, Type L; cast or wrought copper, solder-joint fittings; and soldered joints.
  2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.
- G. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be the following:
1. Hard copper tube, ASTM B 88, Type.

- END -

SECTION 221119  
DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Temperature-actuated, water mixing valves.
6. Strainers.
7. Drain valves.
8. Water-hammer arresters.
9. Trap-seal primer valves.

B. Related Requirements:

1. Section 220519 "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
2. Section 221116 "Domestic Water Piping" for water meters.
3. Section 223200 "Domestic Water Filtration Equipment" for water filters in domestic water piping.
4. Section 224300 "Medical Plumbing Fixtures" for thermostatic mixing valves for sitz baths, thermostatic mixing-valve assemblies for hydrotherapy equipment, and outlet boxes for dialysis equipment.
5. Section 224500 "Emergency Plumbing Fixtures" for water tempering equipment.
6. Section 224713 "Drinking Fountains" for water filters for water coolers.
7. Section 224716 "Pressure Water Coolers" for water filters for water coolers.
8. Section 224723 "Remote Water Coolers" for water filters for water coolers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Potable-water piping and components shall comply with NSF 61 Annex G and NSF 14.

2.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers <Insert drawing designation if any>:

1. Standard: ASSE 1001.
2. Size: NPS 1/4 to NPS 3, as required to match connected piping.
3. Body: Bronze.
4. Inlet and Outlet Connections: Threaded.
5. Finish: Rough bronze.

- B. Hose-Connection Vacuum Breakers:

1. Standard: ASSE 1011.
2. Body: Bronze, nonremovable, with manual drain.
3. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
4. Finish: Chrome or nickel plated Rough bronze.

2.4 BACKFLOW PREVENTERS

- A. Intermediate Atmospheric-Vent Backflow Preventers:

1. Standard: ASSE 1012.
2. Operation: Continuous-pressure applications.
3. Size: NPS 1/2 and NPS 3/4.
4. Body: Bronze.
5. End Connections: Union, solder joint.
6. Finish: Rough bronze.

- B. Reduced-Pressure-Principle Backflow Preventers:

1. Standard: ASSE 1013.
2. Operation: Continuous-pressure applications.
3. Pressure Loss: 12 psig maximum, through middle third of flow range.
4. Size: 1-1/4" and 1-1/2" NPS.
5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved.
6. End Connections: Threaded for NPS 2 and smaller.
7. Configuration: Designed for vertical-inlet, horizontal-center-section, and vertical-outlet flow.
8. Accessories:
  - a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
  - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

C. Double-Check, Backflow-Prevention Assemblies:

1. Standard: ASSE 1015.
2. Operation: Continuous-pressure applications unless otherwise indicated.
3. Pressure Loss: 5 psig maximum, through middle third of flow range.
4. Body: Bronze for NPS 2 (DN 50) and smaller; [cast iron with interior lining that complies with AWWA C550 or that is FDA.
5. End Connections: Threaded for NPS 2 and smaller;
6. Accessories:
  - a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
  - b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.

## 2.5 BALANCING VALVES

A. Memory-Stop Balancing Valves:

1. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 2 or smaller.
4. Body: Copper alloy.
5. Port: Standard or full port.
6. Ball: Chrome-plated brass.
7. Seats and Seals: Replaceable.
8. End Connections: Solder joint or threaded.
9. Handle: Vinyl-covered steel with memory-setting device.

## 2.6 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Water-Temperature Limiting Devices Insert drawing designation if any:

1. Standard: ASSE 1017.
2. Pressure Rating: 125 psi.
3. Type: Thermostatically controlled, water mixing valve.

4. Material: Bronze body with corrosion-resistant interior components.
5. Connections: Thread inlets and outlet.
6. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
7. Tempered-Water Setting: deg 105 F.
8. Valve Finish: Rough bronze.

B. Primary, Thermostatic, Water Mixing Valves:

1. Standard: ASSE 1017.
2. Pressure Rating: 125 psig (860 kPa) minimum unless otherwise indicated.
3. Type: exposed-mounted, thermostatically controlled, water mixing valve.
4. Material: Bronze body with corrosion-resistant interior components.
5. Connections: Threaded union inlets and outlet.
6. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
7. Tempered-Water Setting: deg 105 F.
8. Valve Finish: Rough bronze
9. Piping Finish: Copper.
10. Cabinet: Factory fabricated, stainless steel, for recessed mounting and with hinged, stainless-steel door.

## 2.7 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron [with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and] for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:

- a. Strainers NPS 2 and Smaller:

## 2.8 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

1. Standard: ASSE 1010 or PDI-WH 201.
2. Type: [Metal bellows] [Copper tube with piston].
3. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.



## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
  - 1. Locate backflow preventers in same room as connected equipment or system.
  - 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
  - 3. Do not install bypass piping around backflow preventers.
- B. Install Y-pattern strainers for water on supply side of each control valve.

### 3.2 CONNECTIONS

- A. Comply with requirements for ground equipment in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Fire-retardant-treated-wood blocking is specified in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical connections.

### 3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections: -principle backflow preventer] [double-check, backflow-prevention assem
- B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

### 3.4 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

- END OF SECTION -

SECTION 221316  
SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Hub-and-spigot, cast-iron soil pipe and fittings.
  2. Copper tube and fittings.
  3. ABS pipe and fittings.
  4. Specialty pipe fittings.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:

1.3 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.
- B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
1. Soil, Waste, and Vent Piping: 10-foot head of water.
- B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.2 PIPING MATERIALS

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

- B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

### 2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service class.
- B. Gaskets: ASTM C 564, rubber.
- C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

### 2.4 COPPER TUBE AND FITTINGS

- A. Copper Type DWV Tube: ASTM B 306, drainage tube, drawn temper.
- B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- C. Copper Pressure Fittings:
  - 1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
  - 2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- D. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
  - 1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
  - 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- E. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

### 2.5 ABS PIPE AND FITTINGS

- A. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.
- B. Solid-Wall ABS Pipe: ASTM D 2661, Schedule 40.
- C. Cellular-Core ABS Pipe: ASTM F 628, Schedule 40.
- D. ABS Socket Fittings: ASTM D 2661, made to ASTM D 3311, drain, waste, and vent patterns.
- E. Solvent Cement: ASTM D 2235.

## SPECIALTY PIPE FITTINGS

### F. Transition Couplings:

1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
2. Unshielded, Nonpressure Transition Couplings:
  - a. Standard: ASTM C 1173.
  - b. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
  - c. End Connections: Same size as and compatible with pipes to be joined.
  - d. Sleeve Materials:
    - 1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
3. Shielded, Nonpressure Transition Couplings:
  - a. Standard: ASTM C 1460.
  - b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
  - c. End Connections: Same size as and compatible with pipes to be joined.

## PART 3 - EXECUTION

### 3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

### 3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
  1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
  2. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
  - 1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
  - 2. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
    - a. Straight tees, elbows, and crosses may be used on vent lines.
  - 3. Do not change direction of flow more than 90 degrees.
  - 4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
    - a. Reducing size of waste piping in direction of flow is prohibited.
- K. Lay buried building waste piping beginning at low point of each system.
  - 1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
  - 2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
  - 3. Maintain swab in piping and pull past each joint as completed.
- L. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
  - 1. Building Sanitary Waste: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
  - 2. Horizontal Sanitary Waste Piping: 2 percent downward in direction of flow.
  - 3. Vent Piping: percent down toward vertical fixture vent or toward vent stack.

- M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- N. Plumbing Specialties:
  - 1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
    - a. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
  - 2. Install drains in sanitary waste gravity-flow piping.
    - a. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."
- O. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- P. Install sleeves for piping penetrations of walls, ceilings, and floors.
  - 1. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- Q. Install sleeve seals for piping penetrations of concrete walls and slabs.
  - 1. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- R. Install escutcheons for piping penetrations of walls, ceilings, and floors.
  - 1. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

### 3.3 JOINT CONSTRUCTION

- A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.
- C. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.

### 3.4 SPECIALTY PIPE FITTING INSTALLATION

#### A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in ODs.
2. In Waste Drainage Piping: [Unshielded] [Shielded], nonpressure transition couplings.

### 3.5 VALVE INSTALLATION

#### A. Comply with requirements in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," Section 220523.14 "Check Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping" for general-duty valve installation requirements.

#### B. Shutoff Valves:

1. Install shutoff valve on each sewage pump discharge.
2. Install gate or full-port ball valve for piping NPS 2 and smaller.
3. Install gate valve for piping NPS 2-1/2 and larger.

#### C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

### 3.6 HANGER AND SUPPORT INSTALLATION

#### A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

#### B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42, clamps.
6. Install individual, straight, horizontal piping runs:
  - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
  - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
  - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
8. Base of Vertical Piping: MSS Type 52, spring hangers.

- C. Support horizontal piping and tubing within 12 inches of each fitting valve, and coupling.
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
  - 2. NPS 3: 60 inches with 1/2-inch rod.
  - 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
  - 4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
  - 5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
  - 6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- G. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).
- H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1-1/: 84 inches with 3/8-inch.
  - 2. NPS 1-1/2: 108 inches with 3/8-inch rod.
  - 3. NPS 2: 10 feet with 3/8-inch rod.
  - 4. NPS 2-1/2: 11 feet with 1/2-inch rod.
  - 5. NPS 3: 12 feet with 1/2-inch rod.
  - 6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
  - 7. NPS 6 and NPS 8: 12 feet with 3/4-inch rod.
  - 8. NPS 10 and NPS 12 : 12 feet with 7/8-inchrod.
- I. Install supports for vertical steel piping every 15 feet.
- J. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 2: 84 inches with 3/8-inch rod.
  - 2. NPS 3: 96 inches with 1/2-inch rod.
  - 3. NPS 4: 108 inches with 1/2-inch rod.
  - 4. NPS 6: 10 feet with 5/8-inch rod.
- K. Install supports for vertical stainless-steel piping every 10 feet.
- L. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1-1/4: 72 inches with 3/8-inch rod.
  - 2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.



3. NPS 2-1/2: 108 inches with 1/2-inch rod.
4. NPS 3 and NPS 5: 10 feet with 1/2-inch rod.
5. NPS 6: 10 feet with 5/8-inch rod.
6. NPS 8: 10 feet with 3/4-inch rod.

M. Install supports for vertical copper tubing every 10 feet.

N. Support piping and tubing not listed above according to MSS SP-58 and manufacturer's written instructions.

### 3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect waste and vent piping to the following:

1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
5. Install horizontal backwater valves with cleanout cover flush with floor.
6. Equipment: Connect waste piping as indicated.
  - a. Provide shutoff valve if indicated and union for each connection.
  - b. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

E. Make connections according to the following unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

### 3.8 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping.

- B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

### 3.9 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
  - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
  - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary waste and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
  - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
    - a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  - 2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
    - a. Expose work that was covered or concealed before it was tested.
  - 3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
    - a. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.
    - b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
    - c. Inspect joints for leaks.
  - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.
    - a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg.
    - b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.

- c. Air pressure must remain constant without introducing additional air throughout period of inspection.
  - d. Inspect plumbing fixture connections for gas and water leaks.
- 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  - 6. Prepare reports for tests and required corrective action.

### 3.10 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Exposed [ABS] [and] [PVC] Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.
- E. Repair damage to adjacent materials caused by waste and vent piping installation.

### 3.11 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 and smaller shall be the following:
  - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  - 2. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.
- C. Aboveground, soil and waste piping NPS 5 shall be any of the following:
  - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
- D. Aboveground, vent piping NPS 4 and smaller shall be the following:
  - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  - 2. Copper Type DWV tube, copper drainage fittings, and soldered joints.
    - a. Option for Vent Piping, NPS 2-1/2 and NPS 3-1/2: Hard copper tube, Type M; copper pressure fittings; and soldered joints.
- E. Aboveground, vent piping NPS 5 shall be the following:
  - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  - 2. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.

- F. Underground, soil, waste, and vent piping NPS 4 and smaller shall be the following:
  - 1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
  - 2. Dissimilar Pipe-Material Couplings: [Unshielded] [Shielded], nonpressure transition couplings.
  
- G. Underground, soil and waste piping NPS 5 and larger shall be the following:
  - 1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
  - 2. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.

- END -

SECTION 224100  
PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - A. Drinking fountains
  - B. Sprinklers

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted plumbing fixtures.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

PART 2 - PRODUCTS

2.1 DRINKING FOUNTAINS

- A. Drinking Fountains: See plumbing drawing P-001 detail = Plumbing Fixtures Connection Schedule.
- B. Model: Elkay Outdoor ezH2O Upper Bottle Filling Station Tri-Level Pedestal Non-Filtered Non-Refrigerated
  - A. Color: Black
  - B. Model Number: LK4430BF1U

## 2.2 SPRINKLER

- A. Sprinkler: See plumbing drawing P-200.
- B. Model: Mister Mister
  - A. Product code: 0011-1293
  - B. Shall be constructed of schedule 40 stainless steel structural tubing with an outside diameter of 2.875 inches with a wall thickness of 0.203 inches. The canister shall be a total height of 11.38 inches tall with a .25 inch thick X 5.5 inch diameter base plate. The canister shall be secured into place by securing three (3) 3/8 inch x 1 1/2 inches L bolts (SS) through three (3) anchor holes on the side of the canister. The Acetal spray nozzle and winter cap shall be seated into the canister with an o-ring and secured using a tamper resistant security bolt. The spray nozzle shall consist of four (4) brass misting nozzles inset into the acetal to be flush to grade after installation. Tamper resistant winter caps are included. One (1) blank acetal nozzles shall be provided for winterization.
  - C. Dimensions: Flush to grade mount with an overall height of 60 inches
  - D. Recommended flow rate: The hydraulic requirements shall be 1 gpm @ 21 psi

## 2.3 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install plumbing fixtures level and plumb according to roughing-in drawings.
- B. Install counter-mounting fixtures in and attached to casework.
- C. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

- A. Exception: Use ball or gate valves if supply stops are not specified with fixture. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping" and Section 220523.15 "Gate Valves for Plumbing Piping."
- D. Install traps on fixture outlets.
  - A. Exception: Omit trap on fixtures with integral traps.
  - B. Exception: Omit trap on indirect wastes unless otherwise indicated.
- E. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- F. Seal joints between plumbing fixtures, counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

### 3.2 CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."
- D. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories and sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

### 3.3 ADJUSTING

- A. Operate and adjust plumbing fixtures and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow.

### 3.4 CLEANING AND PROTECTION

- A. After completing installation of plumbing fixtures, inspect and repair damaged finishes.

- B. Clean plumbing fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed plumbing fixtures and fittings.
- D. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

- END -



## SECTION 260519

### LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

#### PART 1 GENERAL

##### 1.1 RELATED DOCUMENTS

- A. The following documents apply to all required work for the Project: (1) the Contract Drawings, (2) the Specifications, (3) the General Conditions, (4) the Addendum to the General Conditions and (5) the Contract [City of New York Standard Construction Contract].

##### 1.2 SUMMARY

- A. Section Includes:
  - 1. Building wires and cables rated 600 V and less.
  - 2. Connectors, splices, and terminations rated 600 V and less.
- B. Related Requirements:
  - 1. Section 260513 "Medium-Voltage Cables" for single-conductor and multiconductor cables, cable splices, and terminations for electrical distribution systems with 2001 to 35,000 V.

##### 1.3 DEFINITIONS

- A. VFC: Variable frequency controller.

##### 1.4 ACTION SUBMITTALS

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

##### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Field quality-control reports.

##### 1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
  - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

#### PART 2 - PRODUCTS

##### 2.1 CONDUCTORS AND CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Alcan Products Corporation; Alcan Cable Division.
  - 2. Alpha Wire.
  - 3. Belden Inc.
  - 4. Encore Wire Corporation.
  - 5. General Cable Technologies Corporation.
  - 6. Southwire Incorporated.

PENNYPACK PARK UNIVERSAL PLAYGROUND

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LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

- B. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.
- C. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN-2-THWN-2, Type XHHW-2, and Type UF.
- D. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for metal-clad cable, Type MC, and mineral-insulated, metal-sheathed cable, Type MI with ground wire.
- E. VFC Cable:
  - 1. Comply with UL 1277, UL 1685, and NFPA 70 for Type TC-ER cable.
  - 2. Type TC-ER with oversized crosslinked polyethylene insulation, spiral-wrapped foil plus 85 percent coverage braided shields and insulated full-size ground wire and dual spirally wrapped copper tape shields and three bare symmetrically applied ground wires, and sunlight- and oil-resistant outer PVC jacket.
  - 3. Comply with UL requirements for cables in direct burial applications.

## 2.2 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. AFC Cable Systems, Inc.
  - 2. Gardner Bender.
  - 3. Hubbell Power Systems, Inc.
  - 4. Ideal Industries, Inc.
  - 5. Ilsco; a branch of Bardes Corporation.
  - 6. NSi Industries LLC.
  - 7. O-Z/Gedney; a brand of the EGS Electrical Group.
  - 8. 3M; Electrical Markets Division.
  - 9. Tyco Electronics.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

## 2.3 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

## PART 3 - EXECUTION

### 3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller, except VFC cable, which shall be extra flexible stranded.

### 3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN-2-THWN-2, single conductors in raceway, Type XHHW-2, single conductors in raceway or Type SE or Type USE multiconductor cable.
- B. Exposed Feeders: Type THHN-2-THWN-2, single conductors in raceway, Type XHHW-2, single conductors in raceway, Metal-clad cable, Type MC.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-2-THWN-2, single conductors in raceway, or Metal-clad cable, Type MC Coordinate "Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground" Paragraph below with Section 260543 "Underground Ducts and Raceways for Electrical Systems."
- D. Exposed Branch Circuits, Including in Crawlspace: Type THHN-2-THWN-2, single conductors in raceway, or Metal-clad cable, Type MC.
- E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-2-THWN-2, single conductors in raceway, or Metal-clad cable, Type MC.
- F. VFC Output Circuits: Type XHHW-2 in metal conduit.

### 3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

### 3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

### 3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor and identify as spare conductor.

- 3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS
- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."
- 3.7 FIRESTOPPING
- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."
- 3.8 FIELD QUALITY CONTROL
- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors and conductors feeding critical equipment and services for compliance with requirements.
  2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
    - a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
    - b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
    - c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- B. Test and Inspection Reports: Prepare a written report to record the following:
1. Procedures used.
  2. Results that comply with requirements.
  3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- C. Cables will be considered defective if they do not pass tests and inspections.

- END -

SECTION 260526  
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. For definitions of grounding and bonding terms see NFPA 70.

1.2 SUMMARY

- A. Section includes grounding and bonding systems and equipment.
- B. Related Requirements:
  - 1. Section 280526 "Grounding and Bonding for Electronic Safety and Security" for grounding conductors, connectors, busbars for electronic security system.

1.3 ACTION SUBMITTALS

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

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Burndy; Part of Hubbell Electrical Systems.
  - 2. ERICO International Corporation.
  - 3. Harger Lightning and Grounding.
  - 4. ILSCO.
  - 5. O-Z/Gedney; A Brand of the EGS Electrical Group.
  - 6. Robbins Lightning, Inc.
  - 7. Siemens Power Transmission & Distribution, Inc
  - 8. Or Engineer approved equal

2.2 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

### 2.3 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
  - 1. Solid Conductors: ASTM B 3.
  - 2. Stranded Conductors: ASTM B 8.
- C. Grounding & Bonding Conductors
  - 1. All raceways and equipment shall be provided with an Equipment Grounding Conductor as shown on the drawings. When the Equipment Grounding Conductor is not shown on the drawings, provide an Equipment Grounding Conductor per Table 250.122 of the NEC

### 2.4 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

## PART 3 - EXECUTION

### 3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6AWG and larger unless otherwise indicated.
- B. Conductor Terminations and Connections:
  - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  - 2. Connections to Structural Steel: Welded connectors.

### 3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

### 3.3 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard

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GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

### 3.4 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
  - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
  - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- C. Grounding and Bonding for Piping:
  - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
  - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.

### 3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
  - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
  - 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
  - 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.
    - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    - b. Perform tests by fall-of-potential method according to IEEE 81 and NETA Standards.

- B. Grounding system will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.
- D. Report measured ground resistances that exceed the following values:
  - 1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: **5**ohms.
  - 2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: **5** ohms.
  - 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: **3** ohms.
  - 4. Power Distribution Units or Panelboards Serving Electronic Equipment: **3** ohm(s).
- E. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

- END -



## SECTION 260553

### IDENTIFICATION FOR ELECTRICAL SYSTEMS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

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

##### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Identification for raceway.
  - 2. Identification for conductors, communication and control cable.
  - 3. Warning labels and signs.
  - 4. Instruction signs.
  - 5. Equipment identification labels.
  - 6. Miscellaneous identification products.

##### 1.3 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.
- B. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

##### 1.4 QUALITY ASSURANCE

- A. Comply with ANSI A13.1, ANSI C2, and ANSI Z635.4.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.145.

##### 1.5 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install all signs and labels horizontal (level) and consistent for similar equipment and panels.

#### PART 2 - PRODUCTS

##### 2.1 RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

- C. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches wide; compounded for outdoor use.
- 2.2 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS
- A. Aluminum Wraparound Marker Labels: Cut from 0.014-inch- thick aluminum sheet, with stamped, embossed, or scribed legend, and fitted with tabs and matching slots for permanently securing around wire or cable jacket or around groups of conductors.
- 2.3 MISCELLANEOUS IDENTIFICATION PRODUCTS
- A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.
    - 1. Minimum Width: 3/16 inch.
    - 2. Tensile Strength: 50 lb, minimum.
    - 3. Temperature Range: Minus 40 to plus 185 deg F.
    - 4. Color: Black, except where used for color-coding.
  - B. Paint: Paint materials and application requirements are specified in Division 9 painting Sections.

### PART 3 - EXECUTION

#### 3.1 APPLICATION

- A. Accessible Raceways and Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A: Identify with snap-around label.
  - 1. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- B. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with color-coded, snap-around, color-coding bands:
  - 1. Snap-Around Labels: Slit, pre-tensioned, flexible, preprinted, color-coded acrylic sleeves, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
  - 2. Security System: Blue and yellow.
  - 3. Mechanical and Electrical Supervisory System: Green and blue.
  - 4. Telecommunication System: Green and yellow.
  - 5. Control Wiring: Green and red.
- C. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use color-coding conductor tape. Identify each ungrounded conductor according to source and circuit number.
  - 1. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- D. Conductor Color Code Identification: Where the premises wiring system has branch circuits supplied from more than one nominal voltage system, each ungrounded conductor of a given branch circuit shall be identified by color coded tape or cable insulation at all termination, connection or splice points.
- E. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source and circuit number.

1. Write-On Tags: Polyester tag, 0.015 inch thick, with corrosion-resistant grommet and polyester or nylon tie for attachment to conductor or cable.
  2. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
- F. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data connections.
1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
  2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
  3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual.
  4. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- G. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
    - a. Power transfer switches.
    - b. Controls with external control power connections. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.
  2. Comply with NFPA 70 and 29 CFR 1910.145.
  3. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.
- H. Instruction Signs:
1. Operating Instructions: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with ENGINEER/OWNER APPROVED instructions where needed for system or equipment operation. Instructions are needed for all equipment unless otherwise noted.
    - a. Signs shall be engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.
    - b. The engraved legend shall be ½ "White letters on Brown face, and punched or drilled for mechanical fasteners.
    - c. The signs shall be installed with stainless hardware.
- I. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power,

communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:
  - a. Indoor and Outdoor Equipment: Use engraved, laminated acrylic or melamine labels, punched or drilled for screw mounting. Identification labels shall have white letters on a dark-gray background. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where 2 lines of text are required, use labels 2 inches high. Mount labels with stainless hardware.
2. Equipment to Be Labeled:
  - a. Identification labeling of some items listed below may be required by individual Sections or by NFPA 70.
  - b. Panelboards, electrical cabinets, and enclosures.
  - c. Access doors and panels for concealed electrical items.
  - d. Security and intrusion-detection control stations, control panels, terminal cabinets, and racks.
  - e. Monitoring and control equipment.
  - f. Uninterruptible power supply equipment.
  - g. Terminals, racks, and patch panels for data communication and for signal and control functions.
  - h. Radio system.
  - i. Field mounted devices
  - j. Field mounted instruments

### 3.2 INSTALLATION PRACTICES

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Attach non-adhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.
- D. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.
  1. Color shall be factory applied or, for sizes LARGER than No. 10 AWG if authorities having jurisdiction permit, field applied.
  2. Colors for 208/120-V Circuits:
    - a. Phase A: Black.
    - b. Phase B: Red.
    - c. Phase C: Blue.
  3. Colors for 480/277-V Circuits:
    - a. Phase A: Brown.
    - b. Phase B: Orange.
    - c. Phase C: Yellow.

4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches 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. Locate bands to avoid obscuring factory cable markings.
  5. Where the premises wiring system has branch circuits supplied from more than one nominal voltage system, the color codes used to identify each phase, neutral (if applicable) and ground conductor throughout the system shall be permanently posted at each branch-circuit panelboard or similar branch-circuit distribution equipment. Provide factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.
- E. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

- END -

SECTION 260800  
ELECTRICAL SYSTEMS COMMISSIONING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.
- B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.2 SUMMARY

- A. The purpose of this Section is to define Contractor responsibilities in the commissioning process, which are being directed by the Contractor. Other electrical system testing is required under other Division 26 Specification Sections. National Electrical Installation Standards (NEIS) NECA 90-2004, "Recommended Practice for Commissioning Building Electrical Systems", 27<sup>th</sup> Volume of the NEIS Series, provides additional guidance for the commissioning of electrical systems.
- B. Commissioning requires the participation of the Contractor to ensure that all systems are operating in a manner consistent with the Contract Documents. General Commissioning requirements and coordination are detailed in Division 01. Division 26 shall be familiar with all parts of Division 01 and the Commissioning Plan issued by the Contractor and shall execute all Commissioning responsibilities assigned to them in the Contract Documents and include the cost of Commissioning in the Contract price.
- C. Electrical systems to be commissioned include the following:
  - 1. Lighting Fixtures and Controls.
  - 2. Grounding Equipment and Grounding System.

1.3 REFERENCE STANDARDS

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
- C. All materials, installation and workmanship shall comply with the applicable requirements and standards.

1.4 DEFINITIONS

- A. Refer to Specification Section 019113 – General Commissioning Requirements for definitions.

## 1.5 SUBMITTALS

- A. Contractor shall prepare Prefunctional Checklists and Functional Performance Test (FPT) procedures and execute and document results. All Prefunctional Checklists and tests must be documented using specific, procedural forms in Microsoft Word or Excel software developed for that purpose. Prior to testing, Contractor shall submit those forms to the Owner for review and approval.
- B. Contractor shall provide Owner with documentation required for Commissioning work. At minimum, documentation shall include: Detailed Start-up procedures, Full sequences of operation, Operating and Maintenance data, Performance data, Functional Performance Test Procedures, Control Drawings, and details of Owner-Contracted tests.
- C. Contractor shall submit to Owner installation and checkout materials actually shipped inside equipment and actual field checkout sheet forms used by factory or field technicians.
- D. Contractor shall review and approve other relative documentation for impact on FPT's of the systems:
  - 1. Shop Drawings and product submittal data related to systems or equipment to be commissioned. The Subcontractor responsible for the FPT shall review and incorporate comments from the Owner and Architect/Engineer via the Contractor.
  - 2. Incorporate manufacturer's Start-up procedures with Prefunctional checklists.
  - 3. Draft Electrical Testing Agency (ETA) Reports: Review and provide comments to Owner.
  - 4. Factory Performance Test Reports: Review and compile all factory performance data to assure that the data is complete prior to executing the FPT's.
  - 5. Completed equipment Start-up certification forms along with the manufacturer's field or factory performance and Start-up test documentation: Subcontractor performing the test will review the documentation prior to commencing with the scheduled FPT's.
  - 6. Final ETA Reports: Subcontractor performing the test will review the documentation prior to commencing with the scheduled FPT's.
  - 7. Operating and Maintenance (O&M) information per requirements of the Technical Specifications and Division 01 requirements: To validate adequacy and completeness of the FPT, the Contractor shall ensure that the O&M manual content, marked-up record Drawings and Specifications, component submittal drawings, and other pertinent documents are available at the Project Site for review.

## PART 2 - PRODUCTS

### 2.1 TEST EQUIPMENT

- A. Testing Equipment:
  - 1. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified.

## PART 3 - EXECUTION

### 3.1 PREPARATION

#### A. Construction Phase:

1. In each purchase order or subcontract that is written for changes in scope, include the following requirements for submittal data, commissioning documentation, testing assistance, Operating and Maintenance (O&M) data, and training, as a minimum.
2. Attend Pre-Commissioning Meeting(s), Pre-Installation Meeting(s), and other Project meetings scheduled by the Contractor to facilitate the Commissioning process.
3. Provide manufacturer's data sheets and shop drawing submittals of equipment.
4. Provide additional requested documentation to the Contractor, prior to O&M manual submittals, for development of Prefunctional Checklist and Functional Performance Tests procedures.
  - a. Typically, this will include detailed manufacturer's installation and Start-up, operating, troubleshooting and maintenance procedures, full details of any Owner-contracted tests, full factory testing reports, if any, and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified.
  - b. In addition, the installation, Start-up, and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Contractor.
  - c. This information and data request may be made prior to normal submittals.
5. With input from the Architect/Engineer, Clarify the operation and control of commissioned equipment in areas where the Specifications, or equipment documentation are not sufficient for writing detailed test procedures.
6. Prepare the specific Functional Performance Test procedures specified in Section 26 08 16. Ensure that Functional Performance Test procedures address feasibility, safety, and equipment protection and provide necessary written alarm limits to be used during the tests.
7. Develop the Commissioning Plan using manufacturer's Start-up procedures and the Prefunctional Checklists. Submit manufacturer's detailed Start-up procedures and the Commissioning Plan and procedures and other requested equipment documentation to Owner for review.
8. During the Start-up and initial checkout process, execute and document related portions of the Prefunctional Checklists for all commissioned equipment.
9. Perform and clearly document all completed Prefunctional Checklists and Start-up procedures. Provide a copy to the Owner prior to the Functional Performance Test.
10. Address current Architect/Engineer and Owner punch list items before Functional Performance Tests. Air and water test, adjust and balance shall be completed with discrepancies and problems remedied before Functional Performance Tests of the respective air or water related systems are executed.



11. Provide skilled technicians to execute starting of equipment and to assist in execution of Functional Performance Tests. Ensure that they are available and present during the agreed-upon schedules and for a sufficient duration to complete the necessary tests, adjustments, and problem solving.
  12. Correct deficiencies (differences between specified and observed performance) as interpreted by the Owner's Project Manager and Architect/Engineer and retest the system and equipment.
  13. Compile all Commissioning records and documentation to be included in a Commissioning and Closeout Manual.
  14. Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to Record Drawing conditions.
  15. During construction, maintain marked-up Record Drawings and Specifications of all Contract Documents and Contractor-generated coordination Drawings. Update after completion of Commissioning activities (include deferred tests). The Record Drawings and Specifications shall be delivered to the Owner both in electronic format as required by the Owner.
  16. Provide training of the Owner's operating personnel as specified.
  17. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.
- B. Warranty Phase:
1. Execute seasonal or deferred tests, witnessed by the Owner, according to the Specifications.
    - a. Complete deferred tests as part of this Contract during the Warranty Period. Schedule this activity with Owner. Perform tests and document and correct deficiencies. Owner may observe the tests and review and approve test documentation and deficiency corrections.
    - b. If any check or test cannot be completed prior to Substantial Completion due to the building structure, required occupancy condition, or other condition, execution of such test may be delayed to later in the Warranty Period, upon approval of the Owner. Contractor shall reschedule and conduct these unforeseen deferred tests in the same manner as deferred tests.
  2. Correct deficiencies and make necessary adjustments to O&M manuals, Commissioning documentation, and Record Drawings for applicable issues identified in any seasonal testing.
- C. Electrical Testing Agency (ETA):
1. When requested by Owner, the Contractor shall retain an independent Electrical Testing Agency (ETA). Their specific testing responsibilities requires checking and testing of the electrical power distribution equipment per National Electrical Testing Association (NETA).
  2. Attend Pre-Commissioning Meeting(s), Pre-Installation Meeting(s), and other Project meetings scheduled by the Contractor to facilitate the Commissioning process.

3. Obtain all required manufacturer's data to facilitate tests.
4. Provide assistance to the Contractor in preparation of the specific Prefunctional Checklist and Functional Performance Test procedures specified in Section 260813 and 260816. ETA shall provide their standard forms to document the NETA tests to be incorporated into the Prefunctional Checklist and Functional Performance Tests record.
5. During related tests, execute and document the tests in the approved forms and/or test record.
6. Perform and clearly document all completed Start-up and system operational checkout procedures, providing a copy to the Contractor.
7. Clearly indicate any deficiencies identified during testing and add to an action list for resolution and tracking. The field technicians shall keep a running log of events and issues. Submit hand-written reports of discrepancies, deficient or uncompleted work by others, Contract interpretation requests and lists of completed tests to the Contractor at least twice a week and provide technical assistance in the resolution of deficiencies.
8. Provide skilled technicians to execute testing. Ensure that they are available and present during the agreed-upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem solving.

### 3.2 TESTING

#### A. Prefunctional Checklists and Start-up:

1. Follow the Start-up and initial checkout procedures listed in this Section and in Division 01. Start-up and complete systems and sub-systems so they are fully functional, meeting the requirements of the Contract Documents.
2. Prefunctional Checklists shall be complete prior to commencement of a Functional Performance test.
3. Refer to Section 260813 for specific details on required Prefunctional Checklists.

#### B. Functional Performance Tests:

1. Functional Performance Tests are conducted after system Start-up and checkout is satisfactorily completed.
2. Refer to Section 260816 for specific details on the required Functional Performance Tests.

#### C. Coordination Between Testing Parties:

1. Factory Start-ups: Factory Start-ups are specified for certain equipment. Factory Start-ups generally are Start-up related activities that will be reviewed and checked prior to Functional Performance Tests. All costs associated with factory Start-ups shall be included with the contract price unless otherwise noted. Notify the Commissioning Team of the factory Start-up schedule and coordinate these factory Start-ups with witnessing parties. The Commissioning Team members may witness these Start-ups at their discretion.

2. Independent Testing Agencies: For systems that specify testing by an independent testing agency, the cost of the test shall be included in the Contract price unless otherwise noted. Testing performed by independent agencies may cover aspects required in the Prefunctional Checklists, Start-ups, and Functional Performance Tests. Coordinate with the independent testing agency so that Owner and/or A/E can witness the test to ensure that applicable aspects of the test meet requirements.

### 3.3 TRAINING

- A. Refer to Specification Section 01 79 00 – Demonstration and Training.

- END -

SECTION 260923  
LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Time switches.
2. Photoelectric switches.
3. Switchbox-mounted occupancy and vacancy sensors
4. High-bay occupancy and vacancy sensors.
5. Outdoor motion sensors.
6. Lighting contactors.

B. Related Requirements:

1. Section 262726 "Wiring Devices" for wall-box daylighters, non-networkable wall-switch occupancy sensors, and manual light switches.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Show installation details for the following:
  - a. Occupancy sensors.
  - b. Vacancy sensors.
2. Interconnection diagrams showing field-installed wiring.
3. Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and elevations, drawn to scale and coordinated with each other, using input from installers of the items involved.
- B. Field quality-control reports.
- C. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.
- B. Software and firmware operational documentation.

1.5 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.

1. Warranty Period: Two year(s) from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 TIME SWITCHES

- A. Tork
- B. GE
- C. Topgreener
- D. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.
  1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  2. Contact Configuration: SPST, DPST, DPDT.
  3. Contact Rating: 20-A ballast load, 120-/240-V ac.
  4. Programs: Eight on-off set points on a 24-hour schedule and an annual holiday schedule that overrides the weekly operation on holidays.
  5. Programs: Two on-off set points on a 24-hour schedule, allowing different set points for each day of the week and an annual holiday schedule that overrides the weekly operation on holidays.
  6. Programs: four channels; each channel is individually programmable with eight on-off set points on a 24-hour schedule.
  7. Programs: eight channels; each channel is individually programmable with two on-off set points on a 24-hour schedule with a skip-a-day weekly schedule.
  8. Programs: twelve channels; each channel is individually programmable with two on-off set points on a 24-hour schedule, allowing different set points for each day of the week.
  9. Programs: sixteen channels; each channel is individually programmable with 40 on-off operations per week and an annual holiday schedule that overrides the weekly operation on holidays.
  10. Programs: twenty channels; each channel is individually programmable with 40 on-off operations per week, plus four seasonal schedules that modify the basic program and an annual holiday schedule that overrides the weekly operation on holidays.
  11. Programs: and an annual holiday schedule that overrides the weekly operation on holidays.
  12. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program on selected channels.
  13. Astronomic Time: All channels.
  14. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.
- E. Electromechanical-Dial Time Switches: Comply with UL 917.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Contact Configuration: SPST.
3. Contact Rating: 20-A ballast load, 120-/240-V ac.
4. Circuitry: Allows connection of a photoelectric relay as a substitute for the on-off function of a program.
5. Astronomic time dial.
6. Eight-Day Program: Uniquely programmable for each weekday and holidays.
7. Skip-a-day mode.
8. Wound-spring reserve carryover mechanism to keep time during power failures, minimum of 16 hours.

## 2.2 OUTDOOR PHOTOELECTRIC SWITCHES

A.Omron

B.Hubbell

C.Description: Solid state, with SPST dry contacts rated for 1000 W incandescent or 1800 VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A, and compatible with ballasts and LED lamps.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lux), with an adjustment for turn-on and turn-off levels within that range and a directional lens in front of the photocell to prevent fixed light sources from causing turn-off.
3. Time Delay: Fifteen-second minimum, to prevent false operation.
4. Surge Protection: Metal-oxide varistor.
5. Mounting: Twist lock complies with NEMA C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.
6. Failure Mode: Luminaire stays ON.

D. Description: Solid state; one set of NO dry contacts rated for 24 V ac at 1 A, to operate connected load, complying with UL 773, and compatible with luminaire power pack [lighting control panelboard].

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lux), with an adjustment for turn-on and turn-off levels within that range.
3. Time Delay: Thirty-second minimum, to prevent false operation.
4. Mounting: 1/2-inch (13-mm) threaded male conduit.

5. Failure Mode: Luminaire stays ON.
6. Power Pack: Dry contacts rated for 20-A ballast or LED load at 120- and 277-V ac, for 13-Atungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
  - a. LED status lights to indicate load status.
  - b. Plenum rated.
7. Power Pack: Digital controller capable of accepting four RJ45 inputs with two outputs rated for 20-A incandescent or LED load at 120- and 277-V ac, for 13-A 16-A ballast or LED at 120- and 277-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, Class 2 power source, as defined by NFPA 70.
  - a. With integral current monitoring
  - b. Compatible with digital addressable lighting interface.
  - c. Plenum rated.

### 2.3 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

#### A. Lutron

#### B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor with manual on-off switch, suitable for mounting in a single gang switchbox, with provisions for connection to BAS using hardwired connection.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application, and shall comply with New York Title 24.
2. Occupancy Sensor Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn lights off when unoccupied; with a time, delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
3. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F (0 to 49 deg C).
4. Switch Rating: Not less than 800-VA ballast or LED load at 120 V, 1200-VA ballast or LED load at 277 V, and 800-W incandescent.

#### C. Wall-Switch Sensor Tag WS1:

1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 2100 sq. ft (196 sq. m).
2. Sensing Technology: PIR-Dual technology.
3. Switch Type: SP, dual circuit.
4. Capable of controlling load in three-way application.
5. Voltage: Match the circuit voltage 120 V.
6. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc (108 to 1600 lux). The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
7. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.

8. Concealed, "off" time-delay selector at 30 seconds and 5, 10, and 20 minutes.
9. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.
10. Color: Black.
11. Faceplate: Color matched to switch.

D. Wall-Switch Sensor Tag WS2:

1. Standard Range: 210-degree field of view, with a minimum coverage area of 900 sq. ft. (84 sq. m).
2. Sensing Technology: PIR.
3. Switch Type: SP, dual circuit.
4. Capable of controlling load in three-way application.
5. Voltage: Match the circuit voltage 120 V.
6. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc (108 to 1600 lux). The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
7. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
8. Concealed, "off" time-delay selector at 30 seconds and 5, 10, and 20 minutes.
9. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.
10. Color: Black.
11. Faceplate: Color matched to switch.

2.4 OUTDOOR MOTION SENSORS

A. Rab

B. Leviton

C. General Requirements for Sensors: Solid-state outdoor motion sensors.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application, and shall comply with New York Title 24.
2. PIR-Dual-technology type, weatherproof. Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm). Comply with UL 773A.
3. Switch Rating:
  - a. Luminaire-Mounted Sensor: 1000-W incandescent, 500-VA fluorescent/LED.
  - b. Separately Mounted Sensor: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
4. Switch Type: SP, dual circuit.



5. Voltage: Match the circuit voltage 120-V type.
6. Detector Coverage:
  - a. Standard Range: 210-degree field of view, with a minimum coverage area of 900 sq. ft. (84 sq. m).
  - b. Long Range: 180-degree field of view and 110-foot (34-m) detection range.
  - c. .
7. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc (108 to 1600 lux). The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
8. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
9. Concealed, "off" time-delay selector at 30 seconds and 5, 10, and 20 minutes.
10. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and help eliminate false "off" switching.
11. Operating Ambient Conditions: Suitable for operation in ambient temperatures ranging from minus 40 to plus 130 deg F (minus 40 to plus 54 deg C), rated as "raintight" according to UL 773A.

## 2.5 LIGHTING CONTACTORS

- A. Square D
- B. GE
- C. Siemens
- D. Description: Electrically operated and electrically held, combination-type lighting contactors with nonfused disconnect, complying with NEMA ICS 2 and UL 508.
  1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less THD of normal load current).
  2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
  3. Enclosure: Comply with NEMA 250.
  4. Provide with control and pilot devices as indicated on drawings, and matching the NEMA type specified for the enclosure.

## 2.6 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18, No. 22, No. 24 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than [No. 14, No. 16, No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.
- C. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- D. Install and aim sensors in locations to achieve not less than 90-percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.
- E. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration unless contactors are installed in an enclosure with factory-installed vibration isolators.

### 3.2 WIRING INSTALLATION

- A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch (13 mm).
- B. Wiring within Enclosures: Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

### 3.3 IDENTIFICATION

- A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."
- B. Label time switches and contactors with a unique designation.

### 3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Lighting control devices will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

### 3.5 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
2. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

### 3.6 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

### 3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

- END -

SECTION 262726  
WIRING DEVICES

PART 1        GENERAL

1.1        RELATED DOCUMENTS

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

1.2        SUMMARY

A. Section Includes:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Twist-locking receptacles.
3. Tamper-resistant receptacles.
4. Weather-resistant receptacles.
5. Snap switches and wall-box dimmers.
6. Solid-state fan speed controls.
7. Wall-switch and exterior occupancy sensors.
8. Communications outlets.
9. Cord and plug sets.

1.3        DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. TVSS: Transient voltage surge suppressor.
- F. UTP: Unshielded twisted pair.

1.4        ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1.5        ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Samples: One for each type of device and wall plate specified, in each color specified.

1.6 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

1.8 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. Service/Power Poles: One for every 10, but no fewer than one.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
  - 1. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper).
  - 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
  - 3. Leviton Mfg. Company Inc. (Leviton).
  - 4. Pass & Seymour/Legrand (Pass & Seymour).
- B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
  - 1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
  - 2. Devices shall comply with the requirements in this Section.

2.3 STRAIGHT-BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; 5351 (single), CR5362 (duplex).
    - b. Hubbell; HBL5351 (single), HBL5352 (duplex).
    - c. Leviton; 5891 (single), 5352 (duplex).
    - d. Pass & Seymour; 5361 (single), 5362 (duplex).

- B. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, and FS W-C-596.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; TR8300.
    - b. Hubbell; HBL8300SGA.
    - c. Leviton; 8300-SGG.
    - d. Pass & Seymour; TR63H.
  - 2. Description: Labeled shall comply with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.

#### 2.4 GFCI RECEPTACLES

- A. General Description:
  - 1. Straight blade, feed-through type.
  - 2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
  - 3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; VGF20.
    - b. Hubbell; GFR5352L.
    - c. Pass & Seymour; 2095.
    - d. Leviton; 7590.
- C. Tamper-Resistant GFCI Convenience Receptacles, 125 V, 20 A:
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Hubbell; GFTR20.
    - b. Pass & Seymour; 2095TR.

#### 2.5 TVSS RECEPTACLES

- A. General Description: Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 1449, and FS W-C-596, with integral TVSS in line to ground, line to neutral, and neutral to ground.
  - 1. TVSS Components: Multiple metal-oxide varistors; with a nominal clamp-level rating of 400 V and minimum single transient pulse energy dissipation of 240 J, according to IEEE C62.41.2 and IEEE C62.45.
  - 2. Active TVSS Indication: Visual and audible, with light visible in face of device to indicate device is "active" or "no longer in service."
- B. Duplex TVSS Convenience Receptacles:
  - 1. Products: Subject to compliance with requirements, provide one of the following:

- a. Cooper; 5362BLS.
- b. Hubbell; HBL5362SA.
- c. Leviton; 5380.
- d. Pass & Seymour; 5362BLSP.

2. Description: Straight blade, 125 V, 20 A; NEMA WD 6 Configuration 5-20R.

## 2.6 HAZARDOUS (CLASSIFIED) LOCATION RECEPTACLES

A. Available Wiring Devices for Hazardous (Classified) Locations: Comply with NEMA FB 11 and UL 1010.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Cooper Crouse-Hinds.
  - b. EGS/Appleton Electric.
  - c. Killark; Division of Hubbell Inc.

## 2.7 TWIST-LOCKING RECEPTACLES

A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.

- 1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Cooper; CWL520R.
  - b. Hubbell; HBL2310.
  - c. Leviton; 2310.
  - d. Pass & Seymour; L520-R.

## 2.8 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:

- 1. Products: Subject to compliance with requirements, provide one of the following:
  - 1) Single Pole:
    - 2) Cooper; AH1221.
    - 3) Hubbell; HBL1221.
    - 4) Leviton; 1221-2.
    - 5) Pass & Seymour; CSB20AC1.
  - 6) Two Pole:
    - 7) Cooper; AH1222.
    - 8) Hubbell; HBL1222.
    - 9) Leviton; 1222-2.

- 10) Pass & Seymour; CSB20AC2.
- 11) Three Way:
- 12) Cooper; AH1223.
- 13) Hubbell; HBL1223.
- 14) Leviton; 1223-2.
- 15) Pass & Seymour; CSB20AC3.
- 16) Four Way:
- 17) Cooper; AH1224.
- 18) Hubbell; HBL1224.
- 19) Leviton; 1224-2.
- 20) Pass & Seymour; CSB20AC4.

C. Key-Operated Switches, 120/277 V, 20 A:

- 1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Cooper; AH1221L.
  - b. Hubbell; HBL1221L.
  - c. Leviton; 1221-2L.
  - d. Pass & Seymour; PS20AC1-L.
- 2. Description: Single pole, with factory-supplied key in lieu of switch handle.

D. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 V, 20 A; for use with mechanically held lighting contactors.

- 1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Cooper; 1995.
  - b. Hubbell; HBL1557.
  - c. Leviton; 1257.
  - d. Pass & Seymour; 1251.

E. Tamper-Resistant Convenience Receptacles: Square face, 125 V, 15 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-15R, and UL 498.

- 1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Cooper; TR6252.
  - b. Hubbell; DR15TR.
  - c. Pass & Seymour; TR26252.
- 2. Description: Labeled to comply with NFPA 70, "Receptacles, Cord Connectors, and Attachment Plugs (Caps)" Article, "Tamper-Resistant Receptacles in Dwelling Units" Section.



- F. Tamper-Resistant and Weather-Resistant Convenience Receptacles: Square face, 125 V, 15 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-15R, and UL 498.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; TWRBR15.
    - b. Hubbell; DR15TR.
    - c. LevitonTRW15.
    - d. Pass & Seymour; TRW26252.
  - 2. Description: Labeled to comply with NFPA 70, "Receptacles, Cord Connectors, and Attachment Plugs (Caps)" Article, "Tamper-Resistant Receptacles in Dwelling Units" Section, when installed in wet and damp locations.
- G. GFCI, Feed-Through Type, Convenience Receptacles: Square face, 125 V, 15 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-15R, UL 498, and UL 943 Class A.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; VGF15.
    - b. Hubbell; GF15LA.
    - c. Leviton; 8599.
    - d. Pass & Seymour; 1594.
- H. GFCI, Tamper-Resistant and Weather-Resistant Convenience Receptacles: Square face, 125 V, 15 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-15R, UL 498, and UL 943 Class A.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; TWRVGF15.
    - b. Hubbell; GFTR15.
    - c. Pass & Seymour; 1594TRWR.
  - 2. Description: Labeled to comply with NFPA 70, "Receptacles, Cord Connectors, and Attachment Plugs (Caps)" Article, "Tamper-Resistant Receptacles in Dwelling Units" Section.

## 2.9 WALL PLATES

- A. Single and combination types shall match corresponding wiring devices.
  - 1. Plate-Securing Screws: Metal with head color to match plate finish.
  - 2. Material for Finished Spaces: Type 302 stainless steel [0.04-inch- (1-mm-) thick, brushed brass with factory polymer finish.
  - 3. Material for Unfinished Spaces: Galvanized steel.
  - 4. Material for Damp Locations: Cast aluminum] with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

## 2.10 FINISHES

### A. Device Color:

1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
2. TVSS Devices: Blue.

### B. Wall Plate Color: For plastic covers, match device color.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

#### A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

#### B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

#### C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
  - a. Cut back and pigtail, or replace all damaged conductors.
  - b. Straighten conductors that remain and remove corrosion and foreign matter.
  - c. Pigtailling existing conductors is permitted, provided the outlet box is large enough.

#### D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.

4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

- A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

- A. Comply with Section 260553 "Identification for Electrical Systems."
- B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
  2. Test Instruments: Use instruments that comply with UL 1436.
  3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- B. Tests for Convenience Receptacles:
  1. Line Voltage: Acceptable range is 105 to 132 V.
  2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.

3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

- END -

SECTION 262816  
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
  - 1. Fusible switches.
  - 2. Nonfusible switches.
  - 3. Molded-case circuit breakers (MCCBs).
  - 4. Molded-case switches.
  - 5. Enclosures.

1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
  - 1. Enclosure types and details for types other than NEMA 250, Type 1.
  - 2. Current and voltage ratings.
  - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
  - 4. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
  - 5. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in electronic format.
- B. Shop Drawings: For enclosed switches and circuit breakers.
  - 1. Include plans, elevations, sections, details, and attachments to other work.
  - 2. Include wiring diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
    - b. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

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. Fuses: 10 percent of quantity installed for each size and type, but no fewer than three (3) of each size and type.
  - 2. Fuse Pullers: One (1) for each size and type.

1.8 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by UL and marked for intended location and application.
- B. Comply with NFPA 70.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
  - 1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
  - 2. Altitude: Not exceeding 6600 feet (2010 m).

1.10 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: One (1) year from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- C. Comply with NFPA 70.

### 2.2 FUSIBLE SWITCHES

- A. Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton Corp. Electrical Group
  - 2. Siemens Industry Inc.
  - 3. Schneider (Square D)
- B. Type HD, Heavy Duty:  
Single Throw, 240v or 600v AC rated as required by the applicable system voltage, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
  - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
  - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
  - 3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
  - 4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
  - 5. Auxiliary Contact Kit: One (1) NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
  - 6. Lugs: Mechanical type, suitable for number, size, and conductor material.
  - 7. Service-Rated Switches: Labeled for use as service equipment.

### 2.3 NON-FUSIBLE SWITCHES

- A. Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton Corp. Electrical Group.
  - 2. Siemens Industry Inc.

- B. Type GD, General Duty, Three Pole, Single Throw, 240-V ac, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- C. Type HD, Heavy Duty, Three Pole, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- D. Accessories:
  - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
  - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
  - 3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
  - 4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
  - 5. Auxiliary Contact Kit: One (1) NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open
  - 6. Lugs: Mechanical or Compression type as recommended by the switch manufacturer, suitable for number, size, and conductor material.
  - 7. Service-Rated Switches: Labeled for use as service equipment.

#### 2.4 MOLDED-CASE CIRCUIT BREAKERS

- A. Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton Corp. Electrical Group.
  - 2. Siemens Industry Inc.
- B. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.
- C. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.
- D. MCCBs shall be equipped with a device for locking in the isolated position.
- E. Lugs shall be suitable for 40 deg F (60 deg C) rated wire on 125-A circuit breakers and below, 167 deg F (75 deg C) rated wire, sized according to the temperature rating in NFPA 70.
- F. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.



- G. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- H. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- I. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
  - 1. Instantaneous trip.
  - 2. Long- and short-time pickup levels.
  - 3. Long- and short-time time adjustments.
  - 4. Ground-fault pickup level, time delay, and I-squared t response.
- J. Ground-Fault Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
- K. Ground-Fault Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).
- L. Features and Accessories:
  - 1. Standard frame sizes, trip ratings, and number of poles.
  - 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
  - 3. Application Listing: Appropriate for application.
  - 4. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

## 2.5 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure Finish: The enclosure shall be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1) Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both endwalls.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
  - 1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

### 3.2 PREPARATION

- A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
  - 1. Notify Architect and Owner no fewer than seven (7) days in advance of proposed interruption of electric service.
  - 2. Indicate method of providing temporary electric service.
  - 3. Do not proceed with interruption of electric service without Architect's and/or Owner's written permission.
  - 4. Comply with NFPA 70E.

### 3.3 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

- A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.
  - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
  - 2. Outdoor Locations: NEMA 250, Type 3R.

### 3.4 INSTALLATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- C. Install fuses in fusible devices.
- D. Comply with NFPA 70 and NECA 1.

### 3.5 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
  - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

### 3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections with the assistance of a factory-authorized service representative.
- B. Tests and Inspections for Switches:
  - 1. Visual and Mechanical Inspection:
    - a. Inspect physical and mechanical condition.
    - b. Inspect anchorage, alignment, grounding, and clearances.
    - c. Verify that the unit is clean.
    - d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.

- e. Verify that fuse sizes and types match the Specifications and Drawings.
  - f. Verify that each fuse has adequate mechanical support and contact integrity.
  - g. Inspect bolted electrical connections for high resistance using one of the two following methods:
    - 1) Use a low-resistance ohmmeter.
      - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
    - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
      - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
  - h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
  - i. Verify correct phase barrier installation.
  - j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
2. Electrical Tests:
- a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
  - b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
  - c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
  - d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
  - e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."
- C. Tests and Inspections for Molded Case Circuit Breakers:
- 1. Visual and Mechanical Inspection:

- a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
  - b. Inspect physical and mechanical condition.
  - c. Inspect anchorage, alignment, grounding, and clearances.
  - d. Verify that the unit is clean.
  - e. Operate the circuit breaker to ensure smooth operation.
  - f. Inspect bolted electrical connections for high resistance using one of the two following methods:
    - 1) Use a low-resistance ohmmeter.
      - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
    - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
      - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
  - g. Inspect operating mechanism, contacts, and chutes in unsealed units.
2. Electrical Tests:
- a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
  - b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
  - c. Perform a contact/pole resistance test. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
  - d. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values shall be no less than two megohms.
  - e. Determine the following by primary current injection:

- 1) Long-time pickup and delay. Pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
  - 2) Short-time pickup and delay. Short-time pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
  - 3) Ground-fault pickup and time delay. Ground-fault pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
  - 4) Instantaneous pickup. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances.
3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.
1. Test procedures used.
  2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
  3. List deficiencies detected, remedial action taken, and observations after remedial action.

### 3.7 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly and lubricate as recommended by manufacturer.

- END -

SECTION 265613  
LIGHTING POLES AND STANDARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Poles and accessories for support of luminaires.
  - 2. Luminaire-lowering devices.

1.2 DEFINITIONS

- A. EPA: Equivalent projected area.
- B. Luminaire: Complete luminaire.
- C. Pole: Luminaire-supporting structure, including tower used for large-area illumination.
- D. Standard: See "Pole."

1.3 ACTION SUBMITTALS

- A. Product Data: For each pole, accessory, and luminaire-supporting and -lowering device.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and **mounting and attachment** details.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Detail fabrication and assembly of **poles and pole accessories**.
  - 4. Foundation construction details, including material descriptions, dimensions, anchor bolts, support devices, and calculations, signed and sealed by a professional engineer licensed in the state of installation.
  - 5. Anchor bolt templates keyed to specific poles and certified by manufacturer.
  - 6. Method and procedure of pole installation. Include manufacturer's written installations.

1.4 INFORMATIONAL SUBMITTALS

- A. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements according to AASHTO LTS-6-M and that load imposed by luminaire and attachments has been included in design. The certification shall be based on design calculations signed and sealed by a professional engineer.
- B. Seismic Qualification Certificates: For Pole lights, accessories, and components, from manufacturer.
- C. Material test reports.
- D. Field quality-control reports.
- E. Sample warranty.

F. Soil test reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data for pole-lowering devices and pole-mounted accessories.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of **pole(s) and luminaire-lowering device(s)]** that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within a specified warranty period. Manufacturers may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs from special warranty period.

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

PART 2 - PRODUCT.

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design pole foundation and pole power system.

B. Seismic Performance: Foundation and pole shall withstand the effects of earthquake motions determined according to **ASCE/SEI 7**.

1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified **and the system will be fully operational after the seismic event.**"

2. Component Importance Factor: **1.5**.

3. **Requirements for Component Amplification Factor and Component Response Modification Factor.**

C. Structural Characteristics: Comply with AASHTO LTS-6-M.

D. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied according to AASHTO LTS-6-M.

E. Live Load: Single load of 500 lbf distributed according to AASHTO LTS-6-M.

F. Ice Load: Load of 3 lbf/sq. ft., applied according to AASHTO LTS-6-M for applicable areas on the Ice Load Map.

G. Wind Load: Pressure of wind on pole and luminaire, calculated and applied according to AASHTO LTS-6-M.

1. Basic wind speed for calculating wind load for poles exceeding 50 feet in height is **100 mph value from AASHTO LTS-6-M for this Project**.

a. Wind Importance Factor: **1.0 value from AASHTO LTS-6-M**.

b. Minimum Design Life: **50 years value from AASHTO LTS-6-M**.

c. Velocity Conversion Factor: **1.0 Insert value from AASHTO LTS-6-M**.

2. Basic wind speed for calculating wind load for poles 50 feet high or less is **100 mph value from AASHTO LTS-6-M for this Project**.

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- a. Wind Importance Factor: **1.0 from AASHTO LTS-6-M.**
    - b. Minimum Design Life: **25 years from AASHTO LTS-6-M.**
    - c. Velocity Conversion Factor: **1.0 from AASHTO LTS-6-M.**
  - H. Strength Analysis: For each pole, multiply the actual EPA of luminaires and brackets by a factor of **1.1** to obtain the EPA to be used in pole selection strength analysis.
  - I. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.
- 2.2 STEEL POLES
- A. Source Limitations: Obtain poles from single manufacturer or producer.
  - B. Source Limitations: For poles, obtain each color, grade, finish, type, and variety of pole from single source with resources to provide products of consistent quality in appearance and physical properties.
  - C. Poles: Comply with ASTM A500/A500M, Grade B carbon steel with a minimum yield of 46,000 psig; one-piece construction up to 40 feet in height with access handhole in pole wall.
    - 1. Shape: **Round, straight.**
    - 2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
  - D. Poles: Comply with **ASTM A240/A240M**, stainless steel with a minimum yield of 55,000 psig; one-piece construction up to 40 feet in height with access handhole in pole wall.
    - 1. Shape: **Round, straight.**
    - 2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
  - E. Steel Mast Arms: **Truss** type, continuously welded to pole attachment plate. Material and finish same as plate.
  - F. Brackets for Luminaires: Detachable, cantilever, without underbrace.
    - 1. Adaptor fitting welded to pole, allowing the bracket to be bolted to the pole-mounted adaptor, then bolted together with **stainless** or **galvanized**-steel bolts.
    - 2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire. Match pole material and finish.
  - G. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.
  - H. Fasteners: **Stainless steel** or **Galvanized steel**, size and type as determined by manufacturer. Corrosion-resistant items compatible with support components.
    - 1. Materials: Compatible with poles and standards as well as the substrates to which poles and standards are fastened and shall not cause galvanic action at contact points.
    - 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot dip galvanized after fabrication unless otherwise indicated.



- I. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Section 260526 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size indicated, and accessible through handhole.
- J. Handhole: Oval shaped, with minimum clear opening of 2-1/2 by 5 inches, with cover secured by stainless-steel captive screws.
- K. Intermediate Handhole and Cable Support: Weatherproof, 3-by-5-inch handhole located at midpoint of pole, with cover for access to internal welded attachment lug for electric cable support grip.
- L. Cable Support Grip: Wire-mesh type with rotating attachment eye, sized for diameter of cable and rated for a minimum load equal to weight of supported load multiplied by a 5.0 safety factor.
- M. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.
- N. Galvanized Finish: After fabrication, hot dip galvanizes according to ASTM A123/A123M.
- O. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
  - 1. Surface Preparation: Clean surfaces according to SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
  - 2. Interior Surfaces of Pole: One coat of bituminous paint, or otherwise treat for equal corrosion protection.
  - 3. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high gloss, high-build polyurethane enamel.
    - a. Color: **As indicated by manufacturer's designations.**
- P. Powder-Coat Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
  - 1. Surface Preparation: Clean surfaces according to SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair powder coat bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
  - 2. Powder Coat: Comply with AAMA 2604.
    - a. Electrostatic-applied powder coating; single application and cured to a minimum 2.5- to 3.5-mils dry film thickness. Coat interior and exterior of pole for equal corrosion protection.
    - b. Color: **As indicated by manufacturer's designations**
  - 3. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.
  - 4. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I clear coating of 0.018 mm or thicker), complying with AAMA 611.

5. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.

Q. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
2. Interior Surfaces of Pole: One coat of bituminous paint, or otherwise treat for equal corrosion protection.
3. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
  - a. Color: **As indicated by manufacturer's designations.**

R. Powder-Coat Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair powder coat bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
2. Powder coat shall comply with AAMA 2604.
  - a. Electrostatic applied powder coating; single application with a minimum 2.5- to 3.5-mils dry film thickness; cured according to manufacturer's instructions. Coat interior and exterior of pole for equal corrosion protection.
  - b. Color: **As indicated by manufacturer's designations**

## 2.3 POLE ACCESSORIES

- A. Base Covers: Manufacturers' standard metal units, finished same as pole, and arranged to cover pole's mounting bolts and nuts.
- B. Transformer-Type Base: Same material and color as pole. Coordinate dimensions to suit pole's base flange and to accept **ballast(s)**. Include removable flanged access cover secured with bolts or screws.

## 2.4 MOUNTING HARDWARE

- A. Anchor Bolts: Manufactured to **ASTM F1554, Grade 55**, with a minimum yield strength of 55,000 psi.
  1. Galvanizing: **Hot dip galvanized according to ASTM A153, Class C**
  2. **Bent** rods 40 **inches** in diameter by 50 **inches** in length.
  3. Threading: **Uniform National 8**, Class 2A.
- B. Nuts: ASTM A563, Grade A, Heavy-Hex.
  1. Galvanizing: **Hot dip galvanized according to ASTM A153, Class C.**

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2. **Four** nuts provided per anchor bolt, **shipped with nuts pre-assembled to the anchor bolts.**
- C. Washers: ASTM F436, Type 1.
1. Galvanizing: **Hot dip galvanized according to ASTM A153, Class C**
  2. **Two** washer(s) provided per anchor bolt.

## 2.5 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## PART 3 - EXECUTION

### 3.1 POLE FOUNDATION

- A. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Structural steel complying with ASTM A36/A36M and hot-dip galvanized according to ASTM A123/A123M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."
- B. Pre-Cast Foundations: Factory fabricated, with structural steel complying with ASTM A36/A36M and hot-dip galvanized according to ASTM A123/A123M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."
- C. Power-Installed Screw Foundations: Factory fabricated by pole manufacturer, with structural steel complying with ASTM A36/A36M and hot-dip galvanized according to ASTM A123/A123M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories.
  1. Baseplate: Stamped with manufacturer's name, date of production, and cable entry.
- D. Direct-Buried Foundations: Install to depth indicated on Drawings, but not less than **as indicated**. Add backfill **in 6-inch to 9-inch layers, tamping each layer as shown on Drawings**. To ensure a plumb installation, continuously check pole orientation with plumb bob while tamping.
- E. Direct-Buried Poles with Concrete Backfill: Set poles in augered holes to depth below finished grade indicated on Drawings, but not less than **as indicated**. To ensure a plumb installation, continuously check pole orientation with plumb bob while tamping.
  1. Make holes 6 inches in diameter larger than pole diameter.
  2. Fill augered hole around pole with air-entrained concrete having a minimum compressive strength of 3000 psi at 28 days and finish in a dome above finished grade.
  3. Use a short piece of 1/2-inch diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.

4. Cure concrete a minimum of 72 hours before performing work on pole.

F. Anchor Bolts: Install plumb using manufacturer-supplied **steel** template, uniformly spaced.

### 3.2 POLE INSTALLATION

A. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Section 033000 "Cast-in-Place Concrete."

B. Foundation-Mounted Poles: Mount pole with leveling nuts and tighten top nuts to torque level according to pole manufacturer's written instructions.

C. Poles and Pole Foundations Set in Concrete-Paved Areas: Install poles with a minimum 6-inch wide, unpaved gap between the pole or pole foundation and the edge of the adjacent concrete slab. Fill unpaved ring with pea gravel. Insert material to a level 1 inch below top of concrete slab.

D. Raise and set pole using web fabric slings (not chain or cable) at locations indicated by manufacturer.

### 3.3 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum using insulating fittings or treatment.

B. Steel Conduits: Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch thick, pipe-wrapping plastic tape applied with a 50-percent overlap.

### 3.4 GROUNDING

A. Ground Metal Poles and Support Structures: Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole unless otherwise indicated.

2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

B. Ground Nonmetallic Poles and Support Structures: Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole.

2. Install grounding conductor and conductor protector.

3. Ground metallic components of pole accessories and foundation.

- END -

SECTION 265619  
LED EXTERIOR LIGHTING

PART 1 - GENERAL

Includes:

1. Exterior solid-state luminaires are designed for and exclusively use LED lamp technology.
2. Luminaire supports.
3. Luminaire-mounted photoelectric relays.

B. Related Requirements:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
2. Section 260926 "Lighting Control Panelboards" for panelboard-based lighting control.
3. Section 260943.16 "Addressable-Luminaire Lighting Controls" and Section 260943.23 "Relay-Based Lighting Controls" for manual or programmable control systems with low-voltage control wiring or data communication circuits.
4. Section 265613 "Lighting Poles and Standards" for poles and standards used to support exterior lighting equipment.

1.2 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color rendering index.
- C. Fixture: See "Luminaire." Type XA, 7700 lumens, Type XA1, 4200 lumens
- D. IP: International Protection or Ingress Protection Rating.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of luminaire.
- B. Delegated-Design Submittal: For luminaire supports.
  1. Include design calculations for luminaire supports.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, drawn to scale and coordinated.
- B. Product Certificates: For each type of the following:
  1. Luminaire.

- 2. Photoelectric relay.
- C. Sample warranty.
- 1.5 CLOSEOUT SUBMITTALS
  - A. Operation and maintenance data.
    - 1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.
    - 2. Provide a list of all photoelectric relay types used on Project, use manufacturers' codes.
- 1.6 FIELD CONDITIONS
  - A. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.
- 1.7 WARRANTY
  - A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
    - 1. Warranty Period: 2 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. UL Compliance: Comply with UL 1598 and listed for wet location.
- D. CRI of 90. CCT of 4000 K.
- E. L70 lamp life of 50,000 hours.
- F. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- G. Nominal Operating Voltage: 120 V ac
- H. In-line Fusing: On the primary for each luminaire
- I. Lamp Rating: Lamp marked for outdoor use.
- J. Source Limitations:
  - 1. Obtain luminaires from single source from a single manufacturer.

### 2.2 LUMINAIRE TYPES

- A. Area and Site: Type XA, XA1-Exterior
  - 1. Luminaire Shape: Exterior Wall Up / Down  
90 CRI-4000K CCT

2. Mounting: Building mounted with one piece die-cast aluminum housing and hinged revolvable die-cast aluminum door 16-5/8" (422mm) in length and 11-3/8" wide (290mm).
3. Luminaire-Mounting Height: To be determined.

### 2.3 MATERIALS

- A. Metal Parts: Free of burrs and sharp corners and edges.
- B. Sheet Metal Components: Corrosion-resistant aluminum Form and support to prevent warping and sagging.
- C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without 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.
- D. Diffusers and Globes:
  1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
  2. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.
- E. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- F. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
  1. Specular Surfaces: 83 percent.
- G. Housings:
  1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
  2. Provide filter/breather for enclosed luminaires.

### 2.4 FINISHES

- A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- B. 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.
  - a. Color: Finish by Architect
  - b. Retain "Factory-Applied Finish for Steel Luminaires" Paragraph below when luminaire material is steel that is not to be field painted and is not required to match finish of pole or support materials.

- C. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
  - 1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
  - 2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
    - a. Color:
      - 1) As selected by Architect from manufacturer's full range.

## 2.5 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

## PART 3 - EXECUTION

### 3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Comply with NECA 1.
- B. Supports:
  - 1. Sized and rated for luminaire weight.
  - 2. Able to maintain luminaire position after cleaning and relamping.
  - 3. Support luminaires without causing deflection of finished surface.
  - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- C. Wall-Mounted Luminaire Support:
  - 1. Attached to structural members in walls Attached to a minimum 1/8 inch (3 mm) backing plate attached to wall structural members Attached using through bolts and backing plates on either side of wall
- D. Wiring Method: Install cables in raceways. Conceal raceways and cables.
- E. Install luminaires level, plumb, and square with finished grade unless otherwise indicated. Install luminaires at height and aiming angle as indicated on Drawings.
- F. Coordinate layout and installation of luminaires with other construction.
- G. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.
- H. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.



### 3.2 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- (0.254-mm-) thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

### 3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### 3.4 FIELD QUALITY CONTROL

- A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.
- B. Perform the following tests and inspections[ with the assistance of a factory-authorized service representative:
  - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
  - 2. Verify operation of photoelectric controls.
  - 3. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
- C. Luminaire will be considered defective if it does not pass tests and inspections.
- D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

### 3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain luminaires and photocell relays.

- END -

## SECTION 282300

### VIDEO SURVEILLANCE AND SONIC DEVICES

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

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

##### 1.2 SUMMARY

- A. Section includes a video surveillance system consisting of cameras, network video recorder, data transmission wiring, and a control station with its associated equipment.
- B. Video surveillance system shall be integrated with existing PPR network equipment.

##### 1.3 DEFINITIONS

- A. AGC: Automatic gain control.
- B. BNC: Bayonet Neill-Concelman - type of connector.
- C. B/W: Black and white.
- D. CCD: Charge-coupled device.
- E. FTP: File transfer protocol.
- F. IP: Internet protocol.
- G. LAN: Local area network.
- H. MPEG: Moving picture experts group.
- I. NTSC: National Television System Committee.
- J. PC: Personal computer.
- K. PTZ: Pan-tilt-zoom.
- L. RAID: Redundant array of independent disks.
- M. TCP: Transmission control protocol - connects hosts on the Internet.
- N. UPS: Uninterruptible power supply.
- O. WAN: Wide area network.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Video surveillance system shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include dimensions and data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For video surveillance. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Functional Block Diagram: Show single-line interconnections between components for signal transmission and control. Show cable types and sizes.
  - 3. Dimensioned plan and elevations of equipment racks, control panels, and consoles. Show access and workspace requirements.
  - 4. UPS: Sizing calculations.
  - 5. Wiring Diagrams: For power, signal, and control wiring (if provided).
  - 6. Storage Device Calculations.
  - 7. Network Bandwidth Requirements and Fiber Optic Channel Link-Loss Budgets .
  - 8. Existing Equipment Frame Elevations, where new equipment is being added.
- C. Equipment List: Include every piece of equipment by model number, manufacturer, serial number, location, and date of original installation. Add pretesting record of each piece of equipment, listing name of person testing, date of test, set points of adjustments, name and description of the view of preset positions, description of alarms, and description of unit output responses to an alarm.
- D. Installer qualifications. Refer to section 1.11.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For video surveillance, cameras, camera-supporting equipment, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Field quality-control reports.
- C. Warranty: Sample of special warranty.

#### 1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For cameras, power supplies, infrared illuminators, monitors, videotape recorders, digital video recorders, video switches, and control-station components to include in emergency, operation, and maintenance manuals. Include the following as well:

#### 1.8 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NECA 1.
- C. Comply with NFPA 70.
- D. Electronic data exchange between video surveillance system with an access-control system shall comply with SIA TVAC, if access-control system is provided.

#### 1.9 PROJECT CONDITIONS

- A. Environmental Conditions: Capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
1. Control Station: Rated for continuous operation in ambient temperatures of 50 to 95 deg F (10 to 35 deg C) and a relative humidity of 20 to 80 percent, noncondensing.
  2. Interior, Controlled Environment: System components, except central-station control unit, installed in temperature-controlled interior environments shall be rated for continuous operation in ambient temperatures of 36 to 122 deg F (2 to 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing. Use NEMA 250, Type 1 enclosures.
  3. Interior, Uncontrolled Environment: System components installed in non- temperature-controlled interior environments shall be rated for continuous operation in ambient temperatures of 0 to 122 deg F (minus 18 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing. Use NEMA 250, Type 3R enclosures.
  4. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambient temperatures of minus 30 to plus 122 deg F (minus 34 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, condensing. Rate for continuous operation when exposed to rain as specified in NEMA 250, winds up to 85 mph (137 km/h) and snow cover up to 24 inches (610 mm) thick. Use NEMA 250, Type 4X enclosures.

5. Hazardous Environment: System components located in areas where fire or explosion hazards may exist because of flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers shall be rated, listed, and installed according to NFPA 70.
6. Corrosive Environment: System components subject to corrosive fumes, vapors, and wind-driven salt spray in coastal zones. Use NEMA 250, Type 4X enclosures.
7. Security Environment: Camera housing for use in high-risk areas where surveillance equipment may be subject to physical violence.

#### 1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of cameras, equipment related to camera operation, and control-station equipment that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Three years from date of Final Acceptance by the City.

- B. Warranty Requirements: Contractor shall warrant DPP (or PPR) that the equipment will be free and clear of any lien or encumbrance on the final acceptance date. Contractor shall further warrant for a period of three (3) year from the date of Substantial Completion that the Security System will, under normal use and service, be free from defects and faulty workmanship except as set forth below:

1. Contractor's obligation under this warranty is to repair or replace defective equipment, parts, and associated labor thereto at its expense. Contractor shall warrant that replacement or repaired equipment furnished hereunder and labor shall be in accordance with current industry standards.
2. PPR is granted a nontransferable fully paid license (Genetec) to use all software furnished by the Contractor as part of furnishing the security system equipment provisions under terms established by the software manufacturer. The Authority will be provided with a copy of all applicable licenses. Contractor shall warrant that it has the right to grant such licenses.
3. A copy of Contractor's standard warranty agreement must be provided and must match or exceed manufacturer's warranty, minimum of 3 years.
4. Upgrade of software during warranty period.
5. Provide Service for three (3) years after substantial completion, includes all labor and material cost associated with the repair, with the exception of third party negligence or acts of vandalism.
6. Contractor's personnel shall respond to all system failures within four (4) hours of the occurring event. All failure shall be corrected within eight (8) hours of the arrival on site of Contractor's personnel.

#### 1.11 INSTALLER'S QUALIFICATIONS

1. Installer must be a Genetech certified installer. Submit certificate, or applicable qualifications as part of the action submittals.

## PART 2 - PRODUCTS

### 2.1 GENERAL SYSTEM REQUIREMENTS

- A. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor's entry connection to components.
- B. Tamper Protection: Tamper switches on enclosures, control units, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled. Control-station, control-unit alarm display shall identify tamper alarms and indicate locations.
- C. Compatibility: Video Management Software must be compatible with IP video equipment. The contractor, if submitting components from different manufactures must submit with either shop drawings, or product data, statements of compatibility from each manufacturer guaranteeing IP video components are compatible with the IP video management software submitted.

### 2.2 IP VIDEO SYSTEMS

- 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. Genetec
  - 2. Vivotek
  - 3. Axis Communications
  - 4. DVTEL
- B. Description:
  - 1. System shall provide high-quality delivery and processing of IP-based video, audio, and control data using standard Ethernet-based networks.
  - 2. System shall have seamless integration of all video surveillance and control functions.
  - 3. Graphical user interface software shall manage all IP-based video matrix switching and camera control functions, two-way audio communication, alarm monitoring and control, and recording and archive/retrieval management. IP system shall also be capable of integrating into larger system environments.
  - 4. System design shall include all necessary compression software for high-performance, dual-stream, MPEG-2/MPEG-4 video and H.264 video. Unit shall provide connections for all video cameras, bidirectional audio, discreet sensor inputs, and control system outputs.
  - 5. All camera signals shall be compressed, encoded, and delivered onto the network for processing and control by the IP video-management software.
  - 6. Camera system units shall be ruggedly built and designed for extreme adverse and urban environments, complying with NEMA Type environmental standards. Where required provide vandal proof exterior camera housings.
  - 7. Encoder/decoder combinations shall place video, audio, and data network stream that can be managed from multiple workstations on the user's LAN or WAN at the same time.
  - 8. All system interconnect cables, workstation PCs, and network intermediate devices shall be provided for full performance of specified system.

## 2.3 STANDARD IP CAMERAS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Genetec (AutoVu SharpV)
  2. Vivotek
  3. Axis Communications
  4. DVTEL
- B. Network Indoor Dome Camera, HD/2Megapixel: Assembled and tested as a complete manufactured unit.
1. Image Sensor - 1/3" Progressive scan CMOS
  2. Lens - 2.7-9mm Motorized Verifocal
  3. Day/Night Sensor – Electronic or True
  4. Minimum Illumination/Light Sensitivity (lux) - 0.5 color, 0.1 black and white
  5. Maximum Resolution (pixels) - 1920x1080 (2MP)
  6. Video Compression - H.264/MPEG4/M-JPEG
  7. Frames per Second - 30
  8. Alarm Inputs/Outputs - 2
  9. Network Protocol - TCP/IP, HTTP, DHCP, DNS, DDNS, RTP/RTSP, PPPoE, SMTP, NTP
  10. Power - PoE or DC Input
  11. Vandal Resistant - Yes
  12. Digital Pan/Tilt/Zoom
  13. 20M IR LED
  14. Mounting:
    - a. Indoor Ceiling Mount (Vandal Proof)
    - b. Wall Mount (Vandal Proof)
- C. Network Indoor Dome Camera, HD/3Megapixel: Assembled and tested as a complete manufactured unit.
1. Image Sensor - 1/3" Progressive scan CMOS
  2. Lens - 2.7-9mm Motorized Verifocal
  3. Day/Night Sensor – Electronic or True
  4. Minimum Illumination/Light Sensitivity (lux) - 0.8 color, 0.1 black and white
  5. Maximum Resolution (pixels) - 2048x1536 (3MP)
  6. Video Compression - H.264/MPEG4/M-JPEG
  7. Frames per Second – 30
  8. Alarm Inputs/Outputs - 2
  9. Network Protocol - TCP/IP, HTTP, DHCP, DNS, DDNS, RTP/RTSP, PPPoE, SMTP, NTP
  10. Power - PoE or DC Input
  11. Vandal Resistant - Yes
  12. Digital Pan/Tilt/Zoom
  13. 20M IR LED
  14. Mounting:
    - a. Indoor Ceiling Mount (Vandal Proof)
    - b. Wall Mount (Vandal Proof)
- D. Network Outdoor Dome Camera, HD/ (2) Megapixel: Assembled and tested as a complete manufactured unit.
1. Image Sensor - 1/3" Progressive scan CMOS
  2. Lens – 2.7-9mm Motorized Verifocal

3. Minimum Illumination/Light Sensitivity (lux) - 0.08 color, 0.1 black and white
4. Maximum Resolution (pixels) - 1920x1080
5. Video Compression - H.264/MPEG4/M-JPEG
6. Frames per Second - 30
7. Intelligent Alarm
8. Network Protocol - TCP/IP, HTTP, DHCP, DNS, DDNS, RTP, RTSP, PPPoE, SMTP, NTP, SNMP, HTTPS, FTP, 802.1x, Qos
9. Power - PoE
10. Outdoor Use - Outdoor Ready
11. Vandal Resistant - Yes
12. Digital Pan/Tilt/Zoom
13. 20M IR LED
14. Heater - Integrated with housing
15. Mounting:
  - a. Outdoor Wall Mount (Vandal Proof)
  - b. Outdoor Wall Mount on Pole Mount Adapter, Min. Three Clamps (Vandal Proof)

E. Network Outdoor Dome Camera, HD/ (3) Megapixel: Assembled and tested as a complete manufactured unit.

1. Image Sensor - 1/3" Progressive scan CMOS
2. Lens – 2.7-9mm Motorized Verifocal
3. Minimum Illumination/Light Sensitivity (lux) 0.5 color, 0 black and white
4. Maximum Resolution (pixels) - 2048x1536 (3MP)
5. Video Compression - H.264/MPEG4/M-JPEG
6. Frames per Second - 30
7. Intelligent Alarm
8. Network Protocol - TCP/IP, HTTP, DHCP, DNS, DDNS, RTP, RTSP, PPPoE, SMTP, NTP, SNMP, HTTPS, FTP, 802.1x, Qos
9. Power - PoE
10. Outdoor Use - Outdoor Ready
11. Vandal Resistant - Yes
12. Digital Pan/Tilt/Zoom
13. 20M IR LED
14. Heater - Integrated with housing
15. Mounting:
  - a. Outdoor Wall Mount(Vandal Proof)
  - b. Outdoor Wall Mount on Pole Mount Adapter, Min. Three Clamps(Vandal Proof)

F. Mini Dome Camera, HD/ 2 Megapixel: Assembled and tested as a complete manufactured unit.

1. Image Sensor - 1/3" Progressive scan CMOS
2. Lens - 4mm
3. Day/Night Sensor - Automatic
4. Minimum Illumination/Light Sensitivity (lux) - 0.5 color, 0.1 black and white with dynamic capture, 1.1 color, 0.2 black and white with light finder
5. Maximum Resolution (pixels) - 1920x1080 (2MP)
6. Video Compression - H.264/MPEG4/M-JPEG
7. Frames per Second - 15
8. Intelligent Alarm
9. Network Protocol - TCP/IP, HTTP, DHCP, DNS, DDNS, RTP/RTSP, PPPoE, SMTP, NTP
10. Power - PoE
11. Outdoor Use - Outdoor Ready
12. Vandal Resistant – Yes



13. Mounting:
  - a. Indoor Ceiling Mount (Vandal Proof)
  - b. Wall Mount (Vandal Proof)

G. Network Outdoor PTZ Camera HD/ 3Megapixel: Assembled and tested as a complete manufactured unit.

1. Image Sensor - 1/3" Progressive scan CMOS
2. Lens - 2.7-9mm Motorized Verifocal
3. Day/Night Sensor - Auto
4. Minimum Illumination/Light Sensitivity: 0.05LUX at (F1.6, on color), 0.01LUX at (F1.6, on black and white)
5. Maximum Resolution (pixels) - 2048x12536 (3MP)
6. Video Compression - H.264/MPEG4/M-JPEG
7. Frames per Second min- 30
8. Alarm Inputs/Outputs - 7/2
9. Network Protocol - TCP/IP, HTTP, DHCP, DNS, DDNS, RTP/RTSP, PPPoE, SMTP, NTP
10. Power - PoE or DC Input
11. Vandal Resistant - Yes
12. PTZ Function: 360deg. Endless pan range and -20deg to 90der. Tilt range
13. 20M IR LED
14. Mounting:
  - a. Indoor Ceiling Mount (Vandal Proof)
  - b. Wall Mount (Vandal Proof)

H. Network Indoor Dome Camera (360deg. or fish eye lens), HD/2Megapixel: Assembled and tested as a complete manufactured unit.

1. Image Sensor - 1/1.8" Progressive scan CMOS
2. Lens - 1.27mm, F2.8 angle of view 180 deg. (wall mount) 360 deg. (ceiling mount).
3. Day/Night Sensor - Auto
4. Minimum Illumination/Light Sensitivity: 0.05 LUX at (F1.2, AGC on color), 03 LUX at (F2.8, AGC on color), 0.0 LUX black and white
5. Maximum Resolution - 3072x2048
6. Video Compression - H.264/MPEG4/M-JPEG
7. Frames per Second - 50
8. Network Protocol - TCP/IP, HTTP, DHCP, DNS, DDNS, RTP/RTSP, PPPoE, SMTP, NTP
9. Power - PoE or DC Input
10. Vandal Resistant - Yes
11. Mounting:
  - a. Indoor Ceiling Mount (Vandal Proof)
  - b. Wall Mount (Vandal Proof)

## 2.4 VIDEO DECODERS

- A.
1. Network - IPv4 or IPv6
  2. Power - PoE, DC
  3. Monitor Support - Up to 2 DVI or Analog

4. Network Configurable
5. Camera Viewing capability only, no control

## 2.5 POWER SUPPLIES

- A. Low-voltage power supplies matched for voltage and current requirements of cameras and accessories, and of type as recommended by manufacturer of camera and lens.
- B.
  1. Enclosure: NEMA 250, Type 3.
  2. Input - 115VAC
  3. Output - 16 fuse protected outputs:
    - a. 12VDC or 24VDC
    - b. 4A total continuous supply
    - c. 3.5A rated outputs
  4. Temperature Operating Range - 0 to 49 C
  5. Input/Output LED Indicators
  6. On/Off Switch
  7. Locking Enclosure

## 2.6 CAMERA-SUPPORTING EQUIPMENT

- A. Manufacturers: Subject to compliance with requirements of:
  1. Genetec
- B. Minimum Load Rating: Rated for load in excess of the total weight supported times a minimum safety factor of two.
- C. Mounting Brackets for Fixed Cameras: Type matched to items supported and mounting conditions. Include manual pan-and-tilt adjustment.
- D. Protective Housings for Fixed Cameras: Steel enclosures with internal camera mounting and connecting provisions that are matched to camera/lens combination and mounting and installing arrangement of camera to be housed.
  1. Tamper switch on access cover sounds an alarm signal when unit is opened or partially disassembled. Central-control unit shall identify tamper alarms and indicate location in alarm display.
  2. Camera Viewing Window: Polycarbonate window, aligned with camera lens.
  3. Duplex Receptacle: Internally mounted.
  4. Alignment Provisions: Camera mounting shall provide for field aiming of camera and permit removal and reinstallation of camera lens without disturbing camera alignment.
  5. Built-in, thermostat-activated heater units. Units shall be automatically controlled so the environmental limits of the camera equipment are not exceeded.

6. Sun shield shall not interfere with normal airflow around the housing.
7. Mounting bracket and hardware for wall or ceiling mounting of the housing. Bracket shall be of same material as the housing; mounting hardware shall be stainless steel.
8. Finish: Housing and mounting bracket shall be factory finished using manufacturer's standard finishing process suitable for the environment.

## 2.7 MONITORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. NEC Display (security monitor not TV)
  2. Samsung (security monitor not TV)
  3. Sharp (security monitor not TV)
  4. LG (security monitor not TV)
  5. TATUNG (security monitor not TV)
- B. Monitors shall be sized per the drawings. If size is not specified, the size shall be 26" to 32" minimum.
- C. Monitors shall be mounted within a see through vandal proof enclosure. Vandal proof enclosure shall be lockable and wall mountable.

## 2.8 NETWORK VIDEO RECORDERS/VIDEO SERVERS

- A. Manufacturers: Subject to compliance with requirements, provide products:
  1. Genetec
- B. Internal 12 TB min hard disk.
  1. Contractor shall provide storage calculations based on quantity of cameras and recording parameters, 40TB shall be the minimum size NVR acceptable, contractor shall increase size based on number of cameras maintaining 20% spare capacity for recording and expansion.
  2. Video and audio recording over TCP/IP network.
  3. Video recording of MPEG-2 and MPEG-4 streams.
  4. Video recording up to 48 Mbps for internal storage and up to 100 Mbps for external storage.
  5. Duplex Operation: Simultaneous recording and playback.
  6. Continuous and alarm-based recording.
  7. Full-Featured Search Capabilities: Search based on camera, time, or date.
  8. Automatic data replenishment to ensure recording even if network is down.
  9. Digital certification by watermarking.
  10. Internal RAID storage of up to 40 TB.
  11. Full integration with LAN, Intranet, or Internet through standard Web browser or video management software, see next section.
  12. Integrated Web server FTP server functionality.

13. Network video recording/storage devices shall be sized to store video at 2MP for 30 days with 20% capacity remaining, 30 fps, record on motion. Multiple storage devices shall be required as necessary. At a minimum, one storage device per facility will be required.

C. Minimum Device Requirements:

1. OS Windows 10 Enterprise LTSC.
2. Intel Core i5-8500 3.00GHz
3. RAM 16 GB DDR4
4. Onboard 1GB Network adapter

- D. Each NVR shall be supplied with a keyboard and mouse for IP camera control at the viewing station. The Keyboard shall be connected directly to the NVR. The keyboard shall allow user logon, display selection, monitor configuration and camera control.

- E. Contractor shall configure all new cameras for each building or each specified location for viewing, recording and playback on the NVR. Each NVR setup will be unique and configuration will be determined by the Department of Public Property. Contractor shall submit NVR and recording setup and configuration of cameras for review and approval.

- F. NVR shall be mounted with a vandal proof enclosure. Vandal Proof enclosure shall be lockable and mountable.

## 2.9 POWER OVER ETHERNET (POE) POWER INJECTORS

A. Minimum Device Requirements:

1. Ports - 16 (min.) actual device quantities on drawings, use 24 port if necessary.
2. Power Input - 115VAC.
3. Max Power - 30W per port, Total Power 300W.
4. 19" Rack Mountable

## 2.10 MOSQUITO TYPE SONIC SECURITY DEVICES

- A. Mosquito Sonic Devices Model Number–MK 4 with Multi-Age as manufactured by Moving Sound Technologies, or PPR approved equal.

- B. Devices shall be secured with Standard Security Cage as manufactured by Moving Sound Technologies, or PPR approved equal.

- C. Devices shall be connected to existing electrical panel and circuited through a new time clock. Electromechanical timer model number Tork 7200 or PPR approved equal.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine pathway elements intended for cables. Check raceways and other elements for compliance with space allocations, installation tolerance, hazards to camera installation, and other conditions affecting installation.
- B. Examine roughing-in for LAN, WAN, and IP network before device installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 WIRING

- A. Comply with requirements in Division 26 – Raceways and Boxes for Electrical Systems. If Division 26 is not provided, install wiring per below.
- B. Wiring Method: Install cables in raceways unless otherwise indicated.
  - 1. Except raceways are not required in accessible indoor ceiling spaces and attics.
  - 2. Except raceways are not required in hollow gypsum board partitions.
  - 3. Conceal raceways and wiring except in unfinished spaces.
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.
- D. Splices, Taps, and Terminations: For power and control wiring, use numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- E. For LAN connection and fiber-optic and copper communication wiring, comply with Section 271500-1.4 "Horizontal Cabling Description."
- F. Grounding: Provide independent-signal circuit grounding recommended in writing by manufacturer.

### 3.3 VIDEO SURVEILLANCE SYSTEM INSTALLATION

- A. Install cameras and infrared illuminators level and plumb.
- B. Install cameras with an 84-inch minimum clear space below cameras and their mountings to the finished floor or grade. Change type of mounting to achieve required clearance. For exterior camera mount cameras on building exteriors or steel poles to match exterior lighting system poles.
- C. Set pan unit and pan-and-tilt unit stops to suit final camera position and to obtain the field of view required for camera. Connect all controls and alarms, and adjust.
- D. Install power supplies and other auxiliary components at control stations unless otherwise indicated.

- E. Install tamper switches on components indicated to receive tamper switches, arranged to detect unauthorized entry into system-component enclosures and mounted in self-protected, inconspicuous positions.
- F. Avoid ground loops by making ground connections only at the control station.
  - 1. For 12- and 24-V dc cameras, connect the coaxial cable shields only at the monitor end.
- G. Identify system components, wiring, cabling, and terminals.

### 3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections:
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Tests and Inspections:
  - 1. Inspection: Verify that units and controls are properly installed, connected, and labeled, and that interconnecting wires and terminals are identified.
  - 2. Pre-testing: Align and adjust system and pretest components, wiring, and functions to verify that they comply with specified requirements. Conduct tests at varying lighting levels, including day and night scenes as applicable. Prepare video-surveillance equipment for acceptance and operational testing as follows:
    - a. Prepare equipment list described in "Informational Submittals" Article.
    - b. Verify operation of auto-iris lenses.
    - c. Set back-focus of fixed focal length lenses. At focus set to infinity, simulate nighttime lighting conditions by using a dark glass filter of a density that produces a clear image. Adjust until image is in focus with and without the filter.
    - d. Set back-focus of zoom lenses. At focus set to infinity, simulate nighttime lighting conditions by using a dark glass filter of a density that produces a clear image. Additionally, set zoom to full wide angle and aim camera at an object 50 to 75 feet (17 to 23 m) away. Adjust until image is in focus from full wide angle to full telephoto, with the filter in place.
    - e. Set and name all preset positions; consult Owner's personnel.
    - f. Set sensitivity of motion detection.
    - g. Connect and verify responses to alarms.
    - h. Verify operation of control-station equipment.
  - 3. Test Schedule: Schedule tests after pretesting has been successfully completed and system has been in normal functional operation for at least 14 days. Provide a minimum of 10 days' notice of test schedule.
  - 4. Operational Tests: Perform operational system tests to verify that system complies with Specifications. Include all modes of system operation. Test equipment for proper operation in all functional modes.
  - 5. Video surveillance system will be considered defective if it does not pass tests and inspections.
  - 6. Prepare test and inspection reports and submit to PPR for review.

3.5 LABELING OF CAMERA DEVICES AND CONTROL SYSTEMS

- A. Contractor to provide a recommended Labeling System to Project Coordinator prior to camera installation.

3.6 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits for this purpose at 6 months and 12 months. Tasks shall include, but are not limited to, the following:
  - 1. Check cable connections.
  - 2. Check proper operation of cameras and lenses. Verify operation of auto-iris lenses and adjust back-focus as needed.
  - 3. Adjust all preset positions; consult Owner's personnel.
  - 4. Recommend changes to cameras, lenses, and associated equipment to improve Owner's use of video surveillance system.
  - 5. Provide a written report of adjustments and recommendations.
  - 6. Cleaning per Section 3.7

3.7 CLEANING

- A. Clean installed items using methods and materials recommended in writing by manufacturer.
- B. Clean video-surveillance-system components, including camera-housing windows, lenses, and monitor screens.

3.8 DEMONSTRATION/TRAINING

- A. Provide a minimum of 8 hours of training to Owner's maintenance personnel to adjust, operate, and maintain video-surveillance equipment.

- END -

## SECTION 312000

### EARTH MOVING

#### 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. The Work in this Section includes furnishing all materials, labor, supervision, tools, equipment, tools, and performing all operations and incidentals necessary for earthwork. Earthwork activities include but are not limited to subgrade preparation, excavating, backfilling, and compaction for structures and foundations, pavements, sidewalks, landscape areas, and utilities. The Contractor shall pay for and coordinate the services of a geotechnical engineer and testing agency to perform quality control of the earthworks.

##### 1.3 REFERENCES

- A. The most current version of the publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

###### 1. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- a. C 33 Concrete Aggregates
- b. D 1556 Density and Unit Weight of Soil in Place by the Sand-Cone Method
- c. D 1557 Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>.)
- d. D 2167 Density and Unit Weight of Soil in Place by the Rubber Balloon Method
- e. D 2216 Laboratory Determination of Water (Moisture) Content of Soil, and Rock
- f. D 2487 Classification of Soils for Engineering Purposes (Unified Soil Classification System)
- g. D 2922 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
- h. D 2937 Density of Soil in Place by the Drive-Cylinder Method ASTM D 3017 Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
- i. D 3740 Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
- j. D 4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- k. D 4254 Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.

- 2. Commonwealth of Pennsylvania, Department of Transportation, Specifications, Publication 408, (PENNDOT 408), except that measurement and payment sections do not apply.

- B. The Contractor is required to have one copy of the latest edition of each of the following publications available for review in the job-site construction office at all times while performing the work described in this Section. The Contractor is to comply with each of the following unless more stringent requirements are indicated on the Drawings or within these specifications.

PENNYPACK PARK UNIVERSAL PLAYGROUND

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EARTH MOVING



1. PECO Energy, Requirements for Developer Trenching.
2. 2003 International Building Code as amended by The Philadelphia Code Title 4 Subcode B.
3. City of Philadelphia Streets Department, Standard Construction Items.

#### 1.4 RELATED WORK

- A. Section 033000, CAST-IN-PLACE CONCRETE
- B. Section 321216, ASPHALT PAVING.

#### 1.5 SUBMITTALS

- A. Testing Agency Qualifications: Provide a statement of qualifications of the geotechnical engineer and testing agency that will perform the quality control tasks required in Paragraph 3.178.
  1. The geotechnical engineer shall be an experienced inspector working under the direction of a professional engineer licensed to practice in the Commonwealth of Pennsylvania who is experienced in providing engineering services related to earthworks.
  2. The testing agency shall be an independent laboratory having a minimum of 3 years experience in conducting the testing indicated herein.
  3. The testing laboratory shall meet the requirements of ASTM D 3740.
- B. Material Test Reports: Shall be provided from the testing agency indicating and interpreting test results for compliance on the following:
  1. Classification according to ASTM D 2487 of each on-site or borrow soil material proposed for fill and backfill.
  2. Laboratory compaction curve according to ASTM D 1557 for each on-site or borrow soil material proposed for fill and backfill; provide for each material type and for every 5,000 cubic yards of each material.
  3. Material Gradation Tests.

#### 1.6 QUALITY ASSURANCE

- A. The Contractor shall engage the services of a geotechnical engineer and testing agency to perform quality control of the earthworks.

#### 1.7 DEFINITIONS

- A. Backfill: Soil materials used to fill an excavation.
- B. Structural fill: On-site soils should not be used as fill beneath foundations. Soils to be imported for use as structural or load-bearing fill should be granular material meeting the PennDOT 2A stone specification and should be compacted to a level equivalent to at least 95 percent of the maximum

dry density as determined by the laboratory procedures set forth in ASTM D1557 (modified Proctor). This material should be placed in horizontal lifts of not more than 8 inches in loose thickness when compacted with heavy compaction equipment and not more than 6 inches in loose thickness when compacted with hand-operated equipment.

- C. Base Course: Layer placed between the subgrade and paving.
  - D. Bedding Course: Layer placed over the excavated subgrade in a trench before laying pipe.
  - E. Borrow: Approved soil materials imported from off-site for use as fill or backfill.
  - F. Classification: All material shall be classified as either Regular, Hard Material, or Rock.
  - G. Degree of Compaction: Degree of compaction required is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557 abbreviated hereinafter as percent laboratory maximum density. For granular material, relative density is determined in accordance with ASTM D 4254.
  - H. Excavation: Removal of material encountered down to subgrade elevations:
    - 1. Bulk Excavation: Excavation more than 10 feet in width.
    - 2. Over-excavation: Excavation of existing unsuitable material beyond limits shown on the Drawings for replacement with structural fill as directed by the Owner.
    - 3. Unauthorized Excavation: Excavation below subgrade elevations or beyond limits shown on the Drawings without direction by the Owner.
  - I. Hard Material: Weathered rock, dense consolidated deposits, or buried construction debris (i.e., demolished brick walls, concrete, etc.) which are not included in the definition of "rock" but which usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.
  - J. Rock: Rock material in beds, ledges, unstratified masses, and conglomerate deposits and boulders of rock material exceeding 1 cubic yard. for bulk excavation or 3/4 cubic yard. for footing, trench, and pit excavation that cannot be removed by rock excavating equipment without systematic drilling, ram hammering, ripping, or blasting, when permitted
  - K. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below base or topsoil materials.
  - L. Subbase: Material between the pavement base and subgrade.
  - M. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.
- 1.8 REGULATORY COMPLIANCE
- A. Codes and Standards: Perform earthwork complying with federal, state, and local regulations including the Occupational Safety and Health Act of 1970 as amended.

- B. Conform with Pennsylvania Act 287 and all amendments and other applicable regulations regarding notification of utility companies.
- C. Any pumped water shall be discharged from the Site in accordance with federal, state and local codes and regulations. Comply with all Philadelphia Water Department permit requirements.

#### 1.9 PROJECT CONDITIONS

- A. Utility Identification: Notify PA One-Call System at 1-800-242-1776 at least 3 days prior to excavation.
- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Owner and then only after arranging to provide temporary utility services according to requirements indicated:
  - 1. Notify the Owner not less than 72 hours in advance of proposed utility interruptions.
  - 2. Do not proceed with utility interruptions without the Owner's written permission.
- C. 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.
- D. Existing improvements, adjacent property, and other facilities and trees and plants that are not to be removed shall be protected from injury or damage, which may result from Contractor's operation.
- E. Existing roads, sidewalks, and curbs not indicated to be removed, that are damaged during the project work shall be repaired or replaced to at least the condition that existed at the start of operations.

#### PART 2 PRODUCTS

##### 2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil or suitable backfill materials are not available from excavations.
- B. Satisfactory Soil Materials: ASTM D 2487 soil classification groups GW, GP, GM, SP, SM, SW, SC, GC, SC, ML and CL or a combination of these group symbols.
  - 1. Low plasticity (plasticity index less than 10).
  - 2. Less than 15 percent, by weight, of particles larger than 2 inches in greater dimension.
  - 3. Less than 2 percent deviation from optimum moisture content.
- C. Unsatisfactory Soil Materials: ASTM D 2487 soil classification groups MH, CH, OL, OH, and PT, or a combination of these group symbols, or materials not conforming to the requirements for satisfactory soils, including:
  - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

2. Debris, waste, frozen materials, vegetation and other deleterious matter.
3. Otherwise not meeting the requirements for satisfactory soil materials.
4. Materials containing excessive amounts of deleterious materials including construction debris, wood, glass, ash, or organic material as determined by Owner.

D. Backfill and Fill Materials: Satisfactory soil materials.

1. Class B backfill shall be granular, well graded friable soil; free of rubbish, ice, snow, tree stumps, roots, clay and organic matter; with 30% or less passing the No. 200 sieve; no stone greater than two-third (2/3) loose lift thickness, or six inches, whichever is smaller.
2. Select backfill shall be granular, well graded friable soil, free of rubbish, ice snow, tree stumps, roots, clay and organic matter, and other deleterious or organic material; graded within the following limits:

<u>Sieve Size</u>	<u>Percent Finer by Weight</u>
3"	100
No. 10	30-95
No. 40	10-70
No. 200	0-10

E. Structural Fill: Satisfactory soil materials.

F. Dense Graded Aggregate Base Course: 2A coarse aggregate, Type C or better, as specified in PENNDOT 408. Recycled crushed concrete will not be allowed.

G. Bedding: No. 8 (AASHTO) coarse aggregate as specified in PENNDOT 408 or as specified herein.

H. Planting soils per Section 329115, PLANTING SOILS AND MIXES.

I. Drainage Aggregate: Narrowly graded mixture of clean, crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1 ½ sieve and 0 to 5% passing a No. 8 sieve.

J. Bedding Material (3/4" CLEAN STONE): Narrowly graded mixture of clean, crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1 ½ sieve and 0 to 5% passing a No. 8 sieve.

2.2 ACCESSORIES

A. Detectable Warning Identification Tape: Acid-and-alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities. Warning tape shall be a minimum 6 inches wide, 6 mils thick, have a minimum tensile strength 7,500 lbs/in<sup>2</sup>, continuously inscribed with a description of the utility in permanent printing with caution striping, with metallic core

encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; APWA color-coded as follows:

1. Red: Electric
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

## 2.3 GEOTEXTILES

- A. General: Provide geotextiles in areas and extents as indicated in the Contract Drawings.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that me incorporated into the work include the following or approved equal:
  1. Mirafi 180N, non-woven.
  2. Amoco ProPex 4553, non-woven.

## 2.4 GEOGRIDS

- A. General: Provide geogrid in areas and extents as indicated in the Contract Drawings.
- B. Manufacturers: Subject to compliance with requirements, the basis of design is the following or approved equal:
  1. Tensar International Corporation  
2500 Northwinds Pkwy.  
Atlanta, Georgia 30009  
Phone: 800-TENSAR-1  
[www.tensar-international.com](http://www.tensar-international.com)
  2. Approved geogrids are as follows (see the Drawings for application):  
TX 5 or engineer approved equal
  3. Geogrid products calibrated and validated by Giroud-Han.
  4. Products submitted must be punched and drawn extrusions of polypropylene.
  5. Aperture dimension must be minimum 1.3” rib length and 1.7” maximum to permit the effective use of the specified aggregate fill material.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Protect existing utilities, sidewalks, structures, pavements, and other facilities to remain free from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways in accordance with the Drawings.
- C. Clear, grub, and excavate to the design subgrade elevation, stripping topsoil, deleterious debris and unsuitable material from the site.
- D. Smooth grade and compact the soils using appropriate compaction equipment. Very soft soils (CBR < 0.5) may be difficult to compact. In these instances, create a surface that is as uniformly smooth as possible.

### 3.2 DRAINAGE AND DEWATERING

- A. Prevent surface water and subsurface or groundwater from entering or flowing into excavations, from ponding on prepared subgrades, and from flooding the project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
- C. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
- D. Provide pumping to remove any water encountered in accordance with Paragraph 1.5.

### 3.3 EXPLOSIVES

- A. Explosives: The use of explosives are prohibited on this Project.

### 3.4 FROST PROTECTION AND SNOW REMOVAL

- A. Keep earthwork operations clear and free of accumulations of snow as required to carry out the work.
- B. Protect the subgrade beneath structures and pipes from frost penetration when freezing temperatures are expected.

### 3.5 GENERAL EXCAVATION

- A. Excavate to depths and limits shown on the Drawings. Compact subgrade surface in accordance with Contract Drawings.

- B. In all excavation areas, strip the surficial topsoil layer and underlying subsoil layer separate from underlying soils. In paved areas, first cut pavement as specified in paragraph 3.6 A of this specification, strip pavement and pavement subbase separately from underlying soils.
- C. All excavated materials shall be stockpiled separately from each other within the limits of work.
- D. Any soft or unstable material as characterized in the geotechnical report or by visual inspection of the geotechnical engineer shall be overexcavated and replaced by the contractor with compacted load bearing fill. Any areas of instability shall be overexcavated to a depth of at least 2 feet and replaced with structural fill in accordance with this section.
- E. Provide shoring and bracing necessary to comply with Paragraph 1.5.
- F. All footing excavation surfaces should be protected until the concrete and backfill is placed. Footing bearing surfaces should be cleaned of all material loosened by the excavation process and be recompactd using hand-operated compaction equipment prior to concrete placement. Should loose or soft materials be encountered or if the bearing materials become disturbed or softened, the disturbed materials should be removed and the footing should be lowered to undisturbed bearing materials or the undercut zone should be filled with lean concrete or compacted structural fill.

### 3.6 EXCAVATION FOR UTILITY TRENCHES

- A. Prior to excavation, trenches in pavement shall be the traveled way surface cut in a straight line by concrete saw or equivalent method, to the full depth of pavement. Excavation shall only between these cuts. Excavation support shall be provided as required to avoid undermining of pavement. Cutting operations shall not be done by ripping equipment.
- B. Perform all dewatering requirements specified in paragraph 3.2 before performing trench excavations.
- C. Trenches shall be excavated to such depths as will permit pipe to be laid at the elevations, slopes, and depths of cover indicated on the Drawings. Trench widths shall be as shown on the drawings or as specified.
- D. 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 12 inches higher than top of pipe or conduit, unless otherwise indicated.
- E. Pipe trenches shall be made as narrow as practicable and shall not be widened by scraping or loosening materials from the sides. Every effort shall be made to keep the sides of the trenches firm and undisturbed until backfilling has been completed.
- F. Clearance: 12 inches on each side of pipe or conduit or as indicated.
- G. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Remove projecting stones and sharp objects along trench subgrade.
  - 1. Provide bedding depth as indicated on the drawings.
  - 2. Shape bedding to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

3. For pipes and conduit less than 6 inches in nominal diameter and flat-bottom, multiple-duct conduit units, hand-excavate trench bottom to accurate elevations and support pipe and conduit on an undisturbed subgrade.
4. For pipes and conduit 6 inches or larger in normal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with bedding material. At each pipe joint, dig bellholes to relieve pipe bell of loads and to ensure continuous bearing of pipe barrel on bearing surface.

### 3.7 EXCAVATION FOR FOUNDATIONS

- A. Excavations shall not be wider than required to set, brace, and remove forms for concrete, or perform other necessary work.
- B. After the excavation has been made, and before forms are set for footings, mats, slabs, or other structures, and before reinforcing is placed, all loose or disturbed material shall be removed from the subgrade. The bearing surface shall then be compacted to meet the requirements of this specification.
- C. If, in the opinion of the Engineer, the existing material at subgrade elevation is unsuitable for structural support; excavate and dispose of the unsuitable material to the required width and depth as directed by the Engineer. If, in the opinion of the Engineer, filter fabric is required; place filter fabric as approved by the Engineer and per the manufacturer's recommendations. Structural fill shall then be placed in lifts and compacted to required densities. Backfill shall be placed to the bottom of the proposed excavation.

### 3.8 EXCAVATION NEAR EXISTING STRUCTURES

- A. Attention is directed to the fact that there are pipes, manholes, drains, and other utilities in certain locations. An attempt has been made to locate all utilities on the drawings, but the completeness or accuracy of the given information is not guaranteed.
- B. As the excavation approaches pipes, conduits, or other underground structures, digging by machinery shall be discontinued and excavation shall be done by means of hand tools, as required. Such manual excavation, when incidental to normal excavation, shall be included in the work to be done under items involving normal excavation.
- C. Where determination of the exact location of a pipe or other underground structure is necessary for properly performing the work, the Contractor shall excavate test pits to determine the locations.

### 3.9 UNAUTHORIZED EXCAVATION

- A. Unauthorized excavations shall be filled with satisfactory fill materials and compacted in accordance with the relevant paragraphs of this Section.
- B. The Contractor is responsible for furnishing all materials, labor, supervision, tools, and equipment associated with unauthorized excavations without additional compensation.

### 3.10 STORAGE OF SOIL MATERIALS



- A. Stockpile borrow materials and excavated satisfactory materials sufficiently far away from the edge of excavations to preclude excavation instability. Stockpile soil materials without intermixing. Cover to prevent windblown dust.
- B. Install erosion control measures around stockpiles as required to comply with Paragraph 1.8.

3.11 GENERAL BACKFILL

- A. Backfill shall not be placed on a subgrade which contains frozen material, or which has been subjected to freeze-thaw action. This prohibition encompasses all subgrade types, including the natural ground, all prepared subgrades (whether in an excavation or in a trench) and all layers of previously placed and compacted earth fill which become the subgrade for successive layers of earth fill. All material that freezes or has been subjected to freeze-thaw action during the construction work, or during periods of temporary shutdowns, such as, but not limited to, nights, holidays, weekends, winter shutdowns, or earthwork operations, shall be removed to a depth that is acceptable to the Owner and replaced with new material. Alternatively, the material will be thawed, dried, reworked, and recompact to the specified criteria before additional material is placed. The geotechnical engineer will determine when placement of fill shall cease due to cold weather.
- B. Prior to backfilling, compact the exposed natural subgrade to the densities as specified herein.
- C. Place and compact backfill in excavations promptly, but not before completing the following:
  - 1. Construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.
  - 2. Surveying locations of underground utilities for record documents.
  - 3. Inspecting and testing underground utilities.
  - 4. Removing concrete formwork.
  - 5. Removing temporary shoring, bracing, and sheeting unless directed to remain.
  - 6. Removing trash and debris.
  - 7. Place and compact materials to the specified density in continuous horizontal layers. The degree of compaction shall be based on maximum dry density as determined by ASTM Test D1557, Method C. The minimum degree of compaction for fill placed shall be as follows:

LOCATION	PERCENT OF MAXIMUM DENSITY
BELOW PIPE CENTERLINE	95
ABOVE PIPE CENTERLINE	92
BELOW PAVEMENT (UPPER 3 FT.)	95
EMBANKMENTS	95

BELOW PIPE IN EMBANKMENTS	95
ADJACENT TO STRUCTURES	92
BELOW STRUCTURES	95

- D. The Engineer reserves the right to test backfill for conformance to the specification and the Contractor shall assist as required to obtain the information. Compaction testing will be performed by the Engineer or by an inspection laboratory designated or approved by the Engineer, engaged and paid for by the Contractor. If test results indicate work does not conform to specification requirements, the Contractor shall remove or correct the defective Work by recompacting where appropriate or replacing as necessary and approved by the Engineer, to bring the work into compliance, at no additional cost to the Owner. All backfilled materials under structures and buildings shall be field tested for compliance with the requirements of this specification.
- E. Where horizontal layers meet a rising slope, the Contractor shall key each layer by benching into the slope.
- F. If the material removed from the excavation is suitable for backfill with the exception that it contains stones larger than permitted, the Contractor has the option to remove the oversized stones and use the material for backfill or to provide replacement backfill at no additional cost to the Owner.
- G. The Contractor shall remove loam and topsoil, loose vegetation, stumps, large roots, etc., from areas upon which embankments will be built or areas where material will be placed for grading. The subgrade shall be shaped as indicated on the Drawings and shall be prepared by forking, furrowing, or plowing so that the first layer of the fill material placed on the subgrade will be well bonded to the subgrade.

### 3.12 UTILITY TRENCH BACKFILL

- A. Place and compact bedding course on trench bottoms where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies or ducts.
- B. Place and compact bedding material by hand shovel in 6-inch lifts to a height of 12 inches above and below the top of utility pipe or conduit. This area of backfill is considered the zone around the pipe and shall be thoroughly compacted before the remainder of the trench is backfilled.
  - 1. Carefully compact material under pipe haunches and bring backfill up evenly on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.
  - 2. Place and compact materials to the specified density in continuous horizontal layers. The degree of compaction shall be based on maximum dry density as determined by ASTM Test D1557, Method C.
- C. Coordinate backfilling with utilities testing.
- D. Fill voids with approved backfill or satisfactory soil materials as shoring, sheeting and bracing is removed. Place and compact final backfill of satisfactory soil material to final subgrade.

- E. Install warning and identification tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

### 3.13 BACKFILLING ADJACENT TO STRUCTURES

- A. The Contractor shall not place backfill against or on structures until they have attained sufficient strength to support the loads to which they will be subjected. Excavated material approved by the Engineer may be used in backfilling around structures. Backfill material shall be thoroughly compacted to meet the requirements of this specification.
- B. Contractor shall use extra care when compacting adjacent to pipes and drainage structures. Backfill and compaction shall proceed along sides of drainage structures so that the difference in top of fill level on any side of the structure shall not exceed two feet (2') at any stage of construction.
- C. Where backfill is to be placed on only one side of a structural wall, only hand-operated roller or plate compactors shall be used within a lateral distance of five feet (5') of the wall for walls less than fifteen feet (15') high and within ten feet (10') of the wall for walls more than fifteen feet (15') high.

### 3.14 MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content.
  - 1. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
  - 2. Remove and replace, or scarify and air-dry satisfactory soil material that exceed optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.
  - 3. Construction during wet weather may also create unnecessary delays and undercutting of subgrades due to disturbance by construction traffic.

### 3.15 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 adjacent existing grades and new grades.
  - 2. Cut out soft spots, fill low spots, and trim high spots to comply with the required grading surface tolerances.
- B. Site Grading: Slope grades to direct water away from buildings and prevent ponding. Where paved, finish grades shall slope away from the building by a minimum 1/4" per foot for a distance of 8 feet unless otherwise indicated. In unpaved areas, finish grades shall slope away from the building by a minimum 1/2" per foot for a distance of 10 feet, unless otherwise indicated.
- C. Finish subgrades to required elevations within the following tolerances:

1. Lawn or unpaved areas: Plus or minus 1 inch.
2. Pavements: Plus or minus ½ inch.

### 3.16 SUBBASE AND BASE COURSES

- A. Under pavements and walks outside the right-of-way, place base course on prepared subgrade and as follows:
  1. Place base course material over prepared subgrade.
  2. Compact base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit density according to ASTM D 1557 or to a relative density exceed 75 percent as determined in accordance with ASTM D 4254, as applicable.
  3. Shape base to required crown elevations and cross slope grades.
  4. When thickness of compacted base course is 6 inches or less, place materials in a single layer.
  5. When thickness of compacted base course exceeds 6 inches, place materials in equal layers, with no layer more than 6 inches thick or less than 3 inches thick when compacted.
- B. Under street pavements, place subbase material in accordance with City of Philadelphia Streets Department Standard Construction Items, Division 10-0020.

### 3.17 GEOSYNTHETIC INSTALLATION

- A. Geosynthetic shall be laid at the proper elevation and orientation as shown on the Contract Drawings or as directed by the Engineer. Correct orientation of the geosynthetic shall be verified by Contractor.
- B. Geosynthetic may be temporarily secured in-place with staples, pins, sand bags or backfill as required by fill properties, fill placement procedure or weather condition, or as directed by the Engineer.
- C. Unroll the geosynthetic in the direction of travel so that the long axis of the roll is parallel with channelized traffic patterns. For very soft subgrades (CBR < 0.5), unrolling geogrid transversely or perpendicular to the roadway embankment alignment, may be preferred, particularly if lateral spreading and separation of overlaps is a concern.
- D. Overlap geosynthetics in accordance with manufacturer's recommendations.
- E. Cut and overlap geogrid to accommodate curves. Cutting may be done with sharp shears, a knife-like implement or handheld power (i.e., "cutoff") saws. Cut grid to conform to manhole covers and other immovable protrusions.
- F. Geomembranes to conform to protrusions per details provided in the Contract Drawings.

- G. Place geosynthetics in daily work sections so that proper alignment is maintained.
- H. Backfill material shall be placed in lifts and compacted as directed under project specifications. Backfill shall be placed, spread and compacted in such a manner as to minimize the development of wrinkles in and/or movement of the geosynthetic. A minimum fill thickness of 6 inches is required prior to the operation of tracked vehicles over the geosynthetic. Follow manufacturer's recommendations.
- I. Turning of tracked vehicles should be kept to minimum to prevent tracks from displacing the fill and damaging the geosynthetic. Rubber tired equipment may pass over the geosynthetic reinforcement at low speeds, less than 10 mph. Sudden braking and sharp turns shall be avoided. Any geosynthetic damaged during installation shall be replaced by the Contractor at no additional cost to the Owner.

### 3.18 FIELD QUALITY CONTROL

- A. The contractor shall coordinate all earthwork with the testing agency and geotechnical engineer to allow for inspection and testing. The geotechnical engineer shall provide full-time observation and testing of the compaction operations and provide documentation to the Owner.
- B. Allow geotechnical engineer to inspect and test each subgrade and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.
- C. The geotechnical engineer shall test compaction of soils in place according to ASTM D 1556, ASTM D 1557, ASTM D 2167, ASTM D 2922, ASTM D 2937, and ASTM D 4254 as applicable. Tests shall be performed at the following locations and frequencies:
  - 1. Paved Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2200 sq. ft. or less of paved areas or building slab, but in no case fewer than three tests.
  - 2. Trench Backfill: At each compacted initial and final backfill layer, at least one test for each 150 feet or less of trench, but no fewer than two tests.
  - 3. Structural Backfill: At each compacted initial and final backfill layer, at least one test for each 150 feet or less of trench, but no fewer than two tests.
- D. When the geotechnical engineer reports that subgrades, fills or backfills have not achieved degree of compaction specified, recompact and retest until specified compaction is obtained.

### 3.19 PROTECTION

- A. Protect newly graded areas from traffic, freezing, and erosion. 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 where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by the Owner or the geotechnical engineer; reshape and recompact to the required density, at no additional cost to the Owner.
- C. Where settling occurs before the project correction period elapses, remove finished surfacing, backfill with additional approved material, compact, and reconstruct.
1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible at no additional cost to the Owner.
- D. Provide temporary underpinning, bracing, sheeting, and/or shoring as required to maintain the conditions of existing utilities or structures adjacent to excavation work. Prepare shop drawings of design details sealed by a professional engineer.
- E. Provide fencing, barricades, and/or protective barriers for all excavation.
- 3.20 DISPOSAL OF SURPLUS AND WASTE MATERIALS
- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off site to a regulated and permitted facility. Provide two copies of load manifest and permit from owner of the property where material is deposited.

- END -

SECTION 321216  
ASPHALT PAVING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes all labor, equipment, and materials necessary for the installation and testing of Warm Mix Asphalt Superpave Wearing Course, Warm Mix Asphalt Superpave Binder Course, and Warm Mix Asphalt Superpave Base Course of specified depths.

B. Section Includes:

1. Asphalt paving base course, binder course, and wearing course.

- C. For bituminous asphalt paving in public right-of-way. Refer to the City of Philadelphia, Department of Streets, Standard Construction Items for materials, equipment, installation, and testing requirements.

D. Related Sections

1. Section 312000 Earth Moving.

1.3 REFERENCES

- A. The most current version of the publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

1. Pennsylvania Department of Transportation (PennDOT):
  - a. Publication 408/2020 Specifications
  - b. Publication 242 Pavement Policy Manual
2. PennDOT Bulletin No. 15: Qualified Products List for Construction
3. Asphalt Institute (AI): "The Asphalt Handbook"
4. American Society for Testing and Materials (ASTM):
  - a. ASTM C 131 Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
  - b. ASTM C 977 Standard Specification for Quicklime and Hydrated Lime for Soil Stabilization
  - c. ASTM D 692 Coarse Aggregate for Bituminous Paving Mixtures
  - d. ASTM D 979 Sampling Bituminous Paving Mixtures
  - e. ASTM D 1073 Fine Aggregate for Asphalt Paving Mixtures
  - f. ASTM D 1188 Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples
  - g. ASTM D 2041 Theoretical Maximum Specific Gravity and Density of Asphalt Mixtures

- h. ASTM D 2726 Bulk Specific Gravity and Density of Non-Absorptive Compacted Asphalt Mixtures
  - i. ASTM D 2950 Density of Bituminous Concrete in Place by Nuclear Methods
  - j. ASTM D 3203 Standard Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures
  - k. ASTM D 3549 Thickness or Height of Compacted Asphalt Mixture Specimens
  - l. ASTM D 3666 Minimum Requirements for Agencies Testing and Inspecting Road and paving materials
  - m. ASTM D 4867 Standard Test Method for Effect of Moisture on Asphalt Concrete Paving Mixtures
  - n. ASTM D 5148 Standard Test Method for Centrifuge Kerosene Equivalent
  - o. ASTM D 6390 Standard Test Method for Determination of Draindown Characteristics in Uncompacted Asphalt Mixtures
5. American Association of State Highway And Transportation (AASHTO):
- a. Guide for Design of Pavement Structures with 1998 Supplement (GDPS-4-M)
  - b. AASHTO T30 – Standard Method of Test for Mechanical Analysis of Extracted Aggregate
  - c. AASHTO M320 – Standard Specification for Performance-Graded Asphalt Binder
- B. The Contractor is required to have one copy of the latest edition of each of the following publications available for review in the job-site construction office at all times while performing the work described in this Section. The Contractor is to comply with each of the following unless more stringent requirements are indicated on the Drawings or within these specifications.
- 1. City of Philadelphia, Department of Streets: Standard Construction Items, except that measurement and payment sections do not apply
  - 2. Publication 408: Specifications, except that measurement and payment sections do not apply.

#### 1.4 SUBMITTALS

- A. Product Data: For each product specified. Include technical data and tested physical and performance properties.
- B. Job-Mix Design: Certification, by PennDOT and other authorities having jurisdiction, of approval of each job mix proposed for the Work.
- C. 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.
- D. Material Test Reports: Test Reports shall be from the approved testing agency. Indicate and interpret test results for compliance of materials with requirements indicated.
- E. Material Certificates: Certificates signed by manufacturers certifying that each material complies with the requirements.



## 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who has completed warm-mix asphalt paving and/or pervious asphalt pavement, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Manufacturer Qualifications: Engage a firm experienced in manufacturing warm-mix asphalt and/or pervious asphalt pavement similar to that indicated for this project and with a record of successful in-service performance.
  - 1. Firm shall be a registered and approved paving mix manufacturer listed in PennDOT Bulletin No. 15.
- C. Testing Agency Qualifications: Demonstrate to the Owner's satisfaction, based on Owner's evaluation of criteria conforming to ASTM D 3666, that the independent testing agency has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work.
- D. Obtain materials from the same source throughout the project.
- E. Pre-construction conference: Conduct conference at the project site to comply with the requirements of Division 1 sections and to review the methods and procedures related to asphalt paving including but not limited to the following:
- F. Review proposed sources of paving materials, including capabilities and location of plant that will manufacturer warm-mix asphalt.
  - 1. Review condition of substrate and preparatory work performed by other trades.
  - 2. Review requirements for protecting paving work, including restriction of traffic during installation period for remainder of construction period.
  - 3. 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.
  - 4. Review inspection and testing requirements, governing regulations, and proposed installation procedures.
  - 5. Review forecasted weather conditions and procedures for coping with unfavorable conditions.

## 1.6 REGULATORY REQUIREMENTS

- A. Contractor shall obtain all necessary City of Philadelphia Streets Department road opening permits and approvals, and City of Philadelphia Department of Licenses and Inspections permits and approvals, upon the Contractor receiving Notice to Proceed and prior to proceeding with the Work.

## 1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if substrate is wet or excessively damp or if the following conditions are not met:

1. Asphalt Base Course: Minimum air or surface temperature of 35 deg F at time of placement in accordance with PennDOT Publication 408, Section 313.3(b).
2. Asphalt Wearing Course: Minimum air or surface temperature of 40 deg F at time of placement in accordance with PennDOT Publication 408, Section 413.3(b).

## PART 2 PRODUCTS

### 2.1 AGGREGATES

- A. Aggregates shall be in accordance with the latest version of PennDOT Publication 408, Section 413.2(b). Provide aggregate from sources listed in PennDOT Bulletin 14.

### 2.2 ASPHALT MATERIALS

- A. Asphalt Cement: PG-64-22 emulsion in accordance with PennDOT Publication 408, Section 413.2(a)1.

1. Water: Potable
2. Mix designs shall contain a maximum of 15% reclaimed asphalt pavement.

- B. Auxiliary Materials

1. Herbicide: Commercial chemical for weed control, registered by Environmental Protection Agency (EPA) and PADEP. Provide granular, liquid, or wettable powder form.
2. Sand: Type B in accordance with PennDOT Publication 408, Section 703.
3. Joint Sealant: ASTM D 3405 or AASHTO M 301, hot applied, single component, polymer-modified bituminous sealant.
4. Geotextile: Class 4, Type C Woven Geotextile Fabric in accordance with PennDOT Publication 408, Section 735.

- C. Mixes

1. Warm-mix Asphalt: Provide dense, hot-laid, warm mix asphalt plant mixes approved by PennDOT and complying with the following requirements.
  - a. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
  - b. Superpave Base Course: Superpave Asphalt Mixture Design, WMA Base Course, PG 64-22, 3 to <10 Million ESALs, 25 mm Mix, in accordance with PennDOT Publication 408, Section 313.
  - c. Superpave Binder Course: Superpave Asphalt Mixture Design, WMA Binder Course, PG 64-22, 3 to < 10 Million ESALs, 19 mm Mix, in accordance with PennDOT Publication 408, Section 413.
  - d. Superpave Wearing Course: Superpave Asphalt Mixture Design, WMA Wearing Course, PG 64-22, 3 to < 10 Million ESALs, 9.5 mm Mix, in accordance with
  - e. PennDOT Publication 408, Section 413.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that subgrade is dry and in suitable condition to support paving and imposed loads
- B. Refer to Section 312000 Earth Moving for subgrade preparation requirements.
- C. Verify gradients and elevations of base are correct.
- D. Asphalt paving courses shall be installed in accordance with PennDOT Publication 408, Section 413.
- E. Protect adjacent work and structures from splashing of paving materials.

### 3.2 CONDITION OF EXISTING SURFACE

- A. Asphalt paving courses shall be installed in accordance with PennDOT Publication 408, Section 413.

### 3.3 COLD MILLING

- A. Clean existing pavement surface of loose and deleterious material immediately before 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. Repair or replace curbs, manholes, and other construction damaged during cold milling.
  - 5. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.
  - 6. Patch surface depressions deeper than 1 inch after milling, before wearing course is laid.
  - 7. Keep milled pavement surface free of loose material and dust.
  - 8. Do not allow milled materials to accumulate on-site.

### 3.4 SURFACE PREPARATION – ASPHALT PAVEMENT

- A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
  - 1. Sweep loose granular particles from surface of unbound-aggregate base course. Do not dislodge or disturb aggregate embedded in compacted surface of base course.

- B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted aggregate base before applying paving materials.
  - 1. Apply herbicide only if absolutely necessary. Owner approval in writing is required prior to any herbicide application. Herbicide application must comply with all federal, state and local regulations.
- C. Adjust elevation of existing utility structure tops to remain, including but not limited to manholes, inlet grates, valve boxes, etc. to final grades. Depending on the type of utility structure, adjustment shall be accomplished by the installation of factory-fabricated adjustment rings, installation of additional masonry courses under existing manhole castings or inlet tops, or resetting structures. Coordinate with utility owners prior to disturbing existing underground utilities to remain.
- D. At existing curbs to remain, mill existing pavement as required to maintain existing curb reveal unless otherwise noted on the Drawings.

### 3.5 DEMOLITION

- A. Saw cut and notch existing paving as indicated on Drawings.
- B. Clean existing paving to remove foreign material, excess joint sealant and crack filler from paving surface.
- C. Repair surface defects in existing paving to provide uniform surface to receive new paving.

### 3.6 WARM-MIX ASPHALT PAVING

- A. Machine place warm-mix asphalt mix on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and compacted thickness as indicated on the Drawings.
  - 1. Place warm-mix asphalt base course in a single lift and thickness indicated on the Drawings or within these specifications.
  - 2. Place warm-mix asphalt binder course in a single lift and thickness indicated on the Drawings or within these specifications.
  - 3. Place warm-mix asphalt wearing surface course in single lift and thickness indicated on the Drawings or within these specifications.
  - 4. Spread mix at minimum temperature as indicated in PennDOT Publication 408, Section 413.
  - 5. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes, unless otherwise indicated on the Drawings or within these specifications.

- B. Place paving in consecutive strips not less than 10 feet wide, except where infill edge strips of a lesser width are required. After the first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete asphalt binder course for a section before placing asphalt wearing surface course.
- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with warm-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

### 3.7 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 warm-mix asphalt course:
  - 1. Clean contact surfaces and apply tack coat.
  - 2. Offset longitudinal joints in successive courses a minimum of 6 inches, however, the joint at the top layer shall be at the centerline of the roadway for 2-lane roads, and at the lane lines for roads with more than two lanes.
  - 3. Offset transverse joints in successive courses a minimum of 24 inches.
  - 4. Construct transverse joints by bulkhead method or sawed vertical face method as described in AI's "The Asphalt Handbook".
  - 5. Compact joints as soon as warm-mix asphalt will bear roller weight without excessive displacement.
  - 6. Compact asphalt at joints to a density within 2 percent of specified course density.
- B. Apply bituminous material of the class and type designated for the surface course where new pavement meets existing bituminous pavement, and where bituminous pavement meets curbs and utility structures. Apply sealant in layer thickness that provides for curing and will not cause tracking or lifting of sealant to other surfaces. Apply a fine sand covering temporarily over sealant during curing period

### 3.8 ASPHALT PAVEMENT COMPACTION

- A. When the subgrade is exposed proof roll according to the requirements shown. Densify to a stable subgrade. If the Owner determines that the subgrade cannot be densified to a stable condition, then the Owner may direct the Contractor to remove additional subgrade material to the depth required for a stable condition. The Contractor shall then replace unstable subgrade material with 2A stone compacted in 6-inch loose lifts
- B. Begin new pavement compaction as soon as placed warm-mix paving will bear roller weight without excessive displacement. Compact warm-mix paving with hot, hand tampers, or vibratory-plate compactors in areas inaccessible to rollers.
  - 1. Complete compaction before mix temperature cools to 185 F.

- C. Breakdown Rolling: Accomplish breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Repair surfaces by loosening displaced material, filling with warm-mix asphalt, and rerolling to required elevations.
- D. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling, while warm-mix asphalt is still hot enough to achieve specified density. Continue rolling until warm-mix asphalt course has been uniformly compacted to the following density:
  - 1. Density: not less than 95 percent of the density requirements established by the Marshall method at the time of approval of the mix design.
- E. Finish Rolling: Finish roll paved surfaces to remove roller marks while warm-mix asphalt is still warm.
- F. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while still hot, with back of rake or smooth iron. Compact thoroughly using tamper or other satisfactory method.
- G. Repairs: Remove newly paved areas that are defective or contaminated with foreign materials. Remove paving course over areas affected and replace with fresh, warm-mix asphalt. Compact by rolling to specified density and surface smoothness.
- H. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- I. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

### 3.9 INSTALLATION TOLERANCES

- A. Thickness: Compact each course to produce the thickness indicated on the Drawings within the following tolerances.
  - 1. Base Course: Plus or minus ¼ inch
  - 2. Binder Course: Plus or minus ¼ inch
  - 3. Wearing Surface Course: Plus ¼ inch, no minus.
- B. Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10 foot straightedge applied transversely or longitudinally to paved areas:
  - 1. Base Course: 1/4 inch
  - 2. Binder Course: 1/4 inch
  - 3. Wearing Surface Course: 1/8 inch
  - 4. Crowned Surfaces: Test with crowned template centered at right angle to crown. Maximum allowable variance from template is 1/4 inch.

### 3.10 FIELD QUALITY CONTROL

- A. Testing Agency: As part of this contract, the Contractor shall engage a qualified independent testing agency meeting the requirements of paragraph 1.05 to perform field inspections and test and to prepare test reports.
  - 1. Testing agency shall conduct and interpret tests and state in each report whether tested Work complies with or deviates from specified requirements.
- B. Additional testing, at Contractor's sole expense, will be performed to determine compliance of corrected Work with specified requirements.
- C. Thickness: In-place compacted thickness of warm-mix asphalt courses will be determined according to ASTM D3549.
- D. Surface Smoothness: Finished surface of asphalt paving will be tested for compliance with smoothness tolerances.
- E. In-Place Density: Samples of uncompacted paving mixtures and compacted pavement will be secured by the testing agency according to ASTM D 979.
  - 1. Reference laboratory density shall be determined by averaging results from 4 samples of warm-mix asphalt-paving mixture delivered daily to site and compacted according to job-mix specifications.
  - 2. Reference maximum theoretical density shall be determined by averaging results from 4 samples of warm-mix asphalt paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
  - 3. In-place density of compacted pavement shall be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.
  - 4. One core sample shall be taken for every 1000 sq. yd. or less of installed pavement, but no case will fewer than 3 cores be taken.
    - a. 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.
    - b. The Contractor shall fill all holes from which cores were taken. Restore and seal the surface to conditions similar to the adjacent areas.
- F. Remove and replace or install additional warm-mix asphalt, at the Contractor's sole expense, where test results or measurements indicate that it does not comply with specified requirements.

### 3.10 IDENTIFICATION

- A. Install green warning tape directly over piping and at outside edge of underground structures.

### 3.11 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Prior to final acceptance, provide a video record of all piping from the building to the City connection to show the lines are free from obstructions, properly sloped and joined.
  - 1. Submit separate reports for each system inspection.
  - 2. Defects requiring correction include the following:
    - a. Alignment: Less than full diameter of inside of pipe is visible between structures.

- b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
  - c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
  - d. Infiltration: Water leakage into piping.
  - e. Exfiltration: Water leakage from or around piping.
- 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
  - 4. Reinspect and repeat procedure until results are satisfactory.

### 3.11 CLEAN UP

- B. Remove bituminous material from utility structure frames and covers. Open and reset utility manhole covers and inlet grates to ensure castings are not sealed shut.
- C. Clean up debris and unused material and remove from the site. Dispose of all material in accordance with local, state, and federal regulations. Do not dump material in manholes or inlets.

- END -



## SECTION 321300

### CONCRETE PAVING

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Concrete paving with exposed aggregates

- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 03 33 01 - Landscape Architectural Cast-In-Place Concrete.
2. Section 03 45 01 - Landscape Precast Architectural Concrete.
3. Section 12 93 00 - Site Furnishings.
4. Section 31 20 00 - Earthwork.

##### 1.2 REFERENCES

- B. American Concrete Institute (ACI):

1. Sp66-(88) - ACI Detailing Manual.

- C. American Society For Testing And Materials (ASTM)

1. A185 - Standard Specification For Steel Welded Wire, Fabric, Plain For Concrete Reinforcement.
2. C31 - Standard Methods Of Making And Curing Concrete Test Specimens In The Field.
3. C33 - Standard Specification For Concrete Aggregates.
4. C78 - Standard Test Method For Flexural Strength Of Concrete (Using Simple Beam With Third-Point Loading).
5. C94 - Standard Specification For Ready-Mixed Concrete.
6. C150 - Standard Specification For Portland Cement.

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7. C173 - Standard Test Method For Air Content Of Freshly Mixed Concrete By The Volumetric Method.
8. C494 - Standard Specification For Chemical Admixtures For Concrete.

D. Concrete Reinforcing Steel Institute (CRSI)

1. MSP - Manual Of Standard Practice.

1.3 SUBMITTALS

- A. Qualification Data for Installer, manufacturer, and testing agency.
- B. Welding certificates.
- C. Material Certificates: Submit at least 15 days prior to installation of materials, material data and certificates signed by manufacturer and contractor, certifying that materials comply with, or exceed, specified requirements.
  1. Cementitious materials.
  2. Admixtures.
  3. Steel reinforcement and accessories.
  4. Curing compounds.
  5. Joint filler material & backer rod
  6. Sealant
- D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements
- E. Concrete Mix Reports: Submit at least 15 days before placing concrete, reports for each concrete mix type that contains the information specified herein.
- F. Laboratory Reports: Submit results of tests performed within one working day after tests are performed.
- G. Concrete Repairs: Submit repair procedures, including materials and methods to the Landscape Architect for approval.

1.4 QUALITY ASSURANCE

- H. 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. Prior to award of the contract, the placing contractor shall furnish the Construction Manager a statement attesting to qualifications and experience and the following: A minimum of 3 completed projects within the last 5 years, including a total square footage to exceed 10,000 sf, submitted with addresses and owner's contact information.
- I. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
  1. Manufacturer certified according to NRMCA's "Certification of Ready

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Mixed Concrete Production Facilities."

- J. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
- K. 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.
- L. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."
- M. Standards Compliance: Comply with the following unless modified by requirements in the Contract Documents:
  - 1. ACI 117 – Specifications for Tolerances for Concrete Construction and Materials."
  - 2. ACI 318 – Building Code Requirements for Reinforced Concrete
  - 3. PennDOT 408 – Construction Specifications
  - 4. PennDOT RC-67M – Curb Ramp and Sidewalk Construction Details
- N. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- O. The Contractor shall conform to the requirements of Specification 031000 –Concrete Forming And Accessories and Specification 033000 – Cast-In-Place Concrete.
- P. Contractor to perform Field Tests as per paragraph 3.7 Field Test Specimens herein.
- Q. Mockups: Cast mockups of full-size sections of concrete pavement to demonstrate typical joints, surface finish, texture, color, and standard of workmanship.
  - 1. Build a 10' x 10' mockup on site. If location not indicated, as directed by Owner's representative.
  - 2. Notify Owner's representative seven days in advance of dates and times when mockups will be constructed.
  - 3. Obtain approval from Owner's representative before starting mockup construction.
  - 4. Maintain approved mockups during construction in an undisturbed condition as a standard for judging the completed pavement.
  - 5. Approved mockup may not become part of finished work. Demolish and remove approved mockups from the site when directed by Owner's representative.

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## PART 2 - PRODUCTS

### 2.1 REINFORCING MATERIALS

- A. Welded Wire, Fabric: ASTM A185, sheet type only. Ensure that sheets are free from loose flaky rust, loose scale, oil, grease, mud, or other coatings that might reduce the bond with concrete.
- B. Dowels: Furnish epoxy coated steel bars conforming to ASTM A615, Grade 60. Fabricate dowels or cut to length at the shop or mill prior to delivery to the site. Ensure that dowels are free of loose flaky rust and scale, clean and straight. Before delivery, paint a minimum of two thirds the length of each dowel with one coat of epoxy paint. Shear dowels to length provided that the deformation from true shape caused by shearing does not exceed 0.04 inch on the diameter of the dowel and does not extend more than 0.04 inch from the end of the dowel.
- C. Support for Reinforcement: Conform to recommendations by CRSI: Manual Of Standard Practice.

### 2.2 CONCRETE MATERIALS

- A. Portland Cement: Gray Cement - Lehigh Portland/Type I/II ASTM C150. Do not use air entraining cement.
- B. Aggregates: ASTM C33
- C. Joints
  1. Sawed Control Joints, as per the drawings and this specification, see Execution herein.
  2. Expansion and Isolation Joints: Pre-molded bituminous fiber joint filler system, with a bond breaker and sealant.
    - a. Expansion and Isolation Joint Filler Strips: ASTM D 1752, Closed cell flexible foam expansion joint filler, compatible with sealants, shall be installed as recommended by manufacturer.
    - b. Bond Breaker: Joint bond breaker, polyethylene tape or expanded closed cell polyethylene foam backer rod, shall be installed as recommended by manufacturer.
    - c. Sealant: Prepared expansion and Isolation joints shall be coated with a primer followed by installation of a bond breaker and a self-leveling two-component polyurethane-based elastomeric sealant. Color of sealant shall match color of adjacent paving, as approved by the Landscape Architect.
- D. Water: Fresh and free from injurious amounts of oil, acid, salt, alkali, organic matter, or other deleterious substances.

### 2.3 COMPACTED AGGREGATE SUBBASE

- A. Compacted Aggregate Subbase: Broken stone, NYCDOT, Bureau of Highway Operations Standard Specifications, Section 2.02, Aggregate-Coarse, Type 1, Grade

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B, Sizes No. 1, No. 2 and No. 4. Provide bottom course consisting of a uniform mixture of broken stone, Size Nos. 1 and 2, and add No. 4 as a filler after the coarser mixture has been rolled and compacted.

## 2.4 PROPORTIONING AND DESIGN OF MIXES

### A. Mix design criteria:

1. Mix shall include a Medium Range Water Reducing admixture with a final slump of 5" +/- 1/2".
2. Air Entraining Admixture: shall be in all concrete exposed to weather conditions in the finished work.
3. Air Content: 6% +/- 1% at point of delivery for 3/8" nominal maximum aggregate size.
4. Coarse aggregate shall be 3/4" with a designation of 4S per ASTM C33.
5. Compressive Strength (28 days): 4,000 PSI strength minimum.
6. Submit mix design to the owner's representative for approval. The owner's representative may reject design mix for non-compliance.

## 2.5 CONCRETE MIXING

- ### A.
- Refer to Specification Section 033000, Cast in Place Concrete.

## 2.6 EQUIPMENT, APPROVAL AND MAINTENANCE

- ### A.
- Furnish dependable equipment appropriate and adequate to meet approved plan and schedule of work. Assemble equipment sufficiently early before start of paving to permit thorough inspection, calibration of weighing and measuring devices, and adjustment of parts. Equipment shall be subject to the approval of the Landscape Architect. Maintain equipment in good working condition at all times.
- ### B.
- Furnish and maintain at the jobsite, in good condition, one 12-foot straightedge for each paving spread in testing hardened Portland cement concrete surfaces. Straightedges constructed of aluminum or magnesium alloy must have blades of box or box-girder cross section with flat bottom, adequately reinforced to ensure rigidity and accuracy. The straightedges must have handles for operation on the pavement.

## PART 3 - EXECUTION

### 3.1 GRADE CONTROL

- #### A.
- Establish and maintain lines and grades shown, by means of line and grade stakes placed at the jobsite.

### 3.2 PREPARATION

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- A. Proof-roll prepared subbase surface to check for unstable areas and to verify need for additional compaction. Proceed with pavement work only after non-complying conditions have been corrected and subgrade is ready to receive pavement.

### 3.3 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Construct forms tight enough to prevent loss of concrete mortar.
- D. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
  - 1. Install keyways, reglets, recesses, and the like, for easy removal.
  - 2. Do not use rust-stained steel form-facing material.
- E. 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.
- F. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- G. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- H. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

### 3.4 FIELD TEST SPECIMENS

- A. General: Prepare concrete samples in the field to determine slump, air content, and strength of concrete. Make test specimens to determine conformance with strength requirements and, when required, to determine the time at which pavements may be placed in service. Determine air content in conformance with ASTM C173. Mold test specimens and cure in conformance with ASTM C31.
- B. Specimens for Strength Tests: Make a group of test specimens for every 400 square yards of pavement placed. As a minimum, however, make a set of test specimens each shift that concrete is placed. Mold each group of test specimens from the same batch of concrete. A group of specimen consist of four (4) beams to be tested as follows: One specimen at 7 days of age, two at 28 days, and one as a spare. Perform strength tests in accordance with ASTM C78, flexural tests from concrete beams.

### 3.5 JOINTS

- A. General: Construct joints and tool edges true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated on the drawings.
- B. Construction Joints: Set construction joints at side and end terminus of pavement and at locations where pavement operations are stopped for more than one-half hour, unless pavement terminates at a planned joint. When concrete placement cannot be continued, install the transverse construction joint within the slab unit but not less than 10 feet from a planned transverse joint. Dowel transverse construction joints as shown. When the construction joint is located at planned transverse joints, plant ½ of each dowel and oil to permit movement at the joint. Edge joints and saw to obtain a groove at the top conforming to the details and dimensions indicated. When concrete placing is resumed, use planned joint spacing beginning with the first regularly scheduled transverse joint.
1. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip pavements, unless otherwise indicated.
  2. Install dowels, keys or keys with tie bars in the longitudinal construction joints as specified herein.
- C. Isolation and Expansion Joints:
1. Form isolation joints of preformed joint filler strips abutting concrete curbs, catch basins, manholes, inlets, walks, walls other fixed objects, and where indicated.
  2. Locate expansion joints at intervals of 20 feet unless otherwise indicated.
  3. Extend filler joints full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
  4. Furnish joint fillers in one-piece lengths for full width being placed where possible. Where more than one length is required, lace or clip joint-filler sections together.
  5. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
  6. Install Bond Breaker, expanded closed cell polyethylene foam backer rod or polyethylene tape, as recommended by manufacturer.
  7. Install approved Sealant as recommended by the manufacturer. Sealant shall be applied cleanly without deviating more than 1/8" from the joint or from the terminations. Any sealant on adjacent paving shall be removed carefully without damaging the adjacent surface.
- D. Contraction Joints / Control Joints: Sawed transverse and longitudinal contraction joints shall be of the weakened-plane or dummy-groove type. Construct transverse contraction joint, as specified herein.
1. Construct sawed joints by sawing a groove in the hardened concrete with a 1/8 inch thick blade to the full depth as indicated on the drawings and specified herein.

- a. After expiration of curing period, widen upper portion of groove by sawing to width and depth indicate on the drawings.
- b. Vary time of sawing depending on existing and anticipated weather conditions, so as to prevent uncontrolled cracking of pavement.
- c. Commence sawing of joints as soon as concrete has hardened sufficiently to permit cutting concrete without chipping, spalling, or tearing.
- d. Inspect sawed faces of joints for undercutting or washing of the concrete due to early sawing.
- e. Delay sawing if undercutting or washing is sufficiently deep to cause structural weakness or excessive roughness in the joint.
- f. Saw joints at required spacing consecutively in sequence of concrete placement. Use a chalk line or other suitable guide to mark alignment of joint.
- g. The saw cut shall not vary more than ½ inch from the true joint alignment.
- h. Before sawing a joint, examine concrete closely for cracks.
- i. Saw joint if a crack has occurred near the joint location.
- j. Discontinue sawing when a crack develops ahead of the saw cut.
- k. Workmen and inspectors must wear clean, rubber-soled footwear.
- l. Limit number of persons walking on the pavement to those actually performing the sawing operation. Immediately after joint is sawed, thoroughly flush saw cut and adjacent concrete surface with water until all waste from sawing is removed from the joint.
- m. Respray membrane-cured surface damaged during the sawing operations as soon as surface become dry.

E. Dowels and Tie Bars - Fixed Form Installation

1. Use bonded-in-place method.
2. Place tie bars and dowels across joints where indicated on the drawings.
3. Correctly align and securely hold in proper horizontal and vertical position during placing and finishing operations.
4. Install tie bar in front of paver along longitudinal contraction joints, by insertion into the unconsolidated concrete.
5. Do not install by removing and replacing dowels in preformed holes.
6. Hold dowel assemblies securely in proper location by means of suitable pins or anchors.
7. Furnish an approved template for checking the position of dowels.
8. Paint the portion of each dowel intended to move within the concrete or expansion cap with one coat of red-lead or blue-lead paint.
9. Wipe clean the painted portion and coat with a thin even film of lubricating oil before concrete is placed.

3.6 PLACING

- A. General: Do not place steel or concrete until tests on underlying courses are completed and the courses approved by the Landscape Architect.



- B. Placing Welded Wire Fabric: Furnish and install the wire fabric shown on the drawings. Position wire fabric on suitable metal chairs prior to concrete placement. Lap one spacing of wire fabric pattern with transverse reinforcing members touching and wire together.
- C. Placing Concrete
1. Deposit concrete as close as possible to its final position in pavement cross section.
  2. Place concrete continuously and at a uniform rate without unscheduled stops except for equipment failure or other emergencies.
  3. Do not drop concrete freely more than 3 feet.
  4. Do not allow workmen with foreign material on their footwear or construction equipment that might deposit foreign material to walk or operate in or on the concrete during placement and finishing operations.
  5. Do not use re-tempered concrete or concrete which is non-plastic and unworkable, or does not meet the specified mix properties, or which is contaminated by foreign materials.
- D. Vibration
1. Consolidate concrete with mechanical vibrating equipment during spreading.
  2. Supplement consolidation by hand-spading, rodding, or tamping to maintain concrete members free of honeycomb, rock pockets and voids.
  3. Do not insert vibrators into lower layers of concrete that have begun to set.
  4. Do not allow vibrators to touch forms, tie bars, dowels, or other embedded items.
  5. Bring pavement surfaces to correct elevation and strike off.
  6. Use bull float, darby or highway straightedge to level surface free of lumps or hollows.
- E. Placing During Cold Weather
1. Discontinue concrete placement when air temperature reaches 40 degrees F and is falling.
  2. Do not resume until air temperature reaches 35 degrees F and is rising.
  3. Furnish and install covers for maintaining concrete at a temperature of at least 50 degrees F for not less than 72 hours after placing.
- F. Placing During Warm Weather: During periods of warm weather when the maximum daily air temperature is likely to exceed 85° F.
1. Sprinkle forms and/or underlying material with water immediately before concrete is placed.
  2. Place concrete at coolest temperature practicable, but in no case will the temperature of concrete when placed exceed 90° F.
  3. Cool aggregates and/or mix with water as necessary.
  4. Chipped ice in mixing water may be required to cool concrete, subject to

approval of the Landscape Architect.

5. Place concrete continuously and rapidly at a rate of not less than 100 feet of paving lane per hour.
6. Keep finished surface of newly laid pavement damp by applying a water fog or mist with approved spraying equipment.

### 3.7 FINISHING OPERATIONS

- A. Machine or Hand Finish: The sequence of operations is as follows: finishing, floating, straight-edging, texturing, and edging of joints.
- B. Finishing and Floating
  1. As soon as placed and vibrated, strike-off concrete and screed to crown and cross section and to such elevation above grade that, when consolidated and finished, surface of pavement will be at the required elevation.
  2. Tamp surface until required compaction and reduction of internal and surface voids are accomplished.
  3. Immediately following final tamping of surface, float pavement longitudinally from bridges resting on side forms and spanning but not touching concrete.
  4. If necessary, place and screed additional concrete, and then float until a satisfactory surface is produced.
  5. Advance floating operation not more than half the length of float, and continue floating over new and previously floated surfaces.
- C. Surface Correction and Testing
  1. After finishing and floating, but while concrete is still plastic, eliminate minor irregularities and score marks in pavement surface by means of straightedges.
  2. Operate straightedges from sides of pavement or from bridges.
  3. Test surface for trueness with a 12-foot straightedge held in successive positions parallel and at right angles to centerline of pavement.
  4. Cover whole area as necessary to detect variations.
  5. Advance straightedge along pavement in successive stages of not more than one-half the length of the straightedge.
  6. Fill depressions with freshly mixed concrete, strike off, consolidate, and refinish.
  7. Strike-off projections above required elevations and refinish.
  8. Continue straightedge testing and finishing, until entire surface of the concrete is free from observable departure and conforms to surface requirements specified herein.
- D. Finish: Light Broom, non-slip finish perpendicular to direction of pedestrian flow.
- E. Edging: After texturing with light broom, carefully finish edge of pavement along forms and at joints, where indicated or directed by the Landscape Architect, with an edging tool to form a smooth rounded surface of the required radius. Eliminate tool marks and smooth edges true to line.

### 3.8 CURING AND PROTECTION

- A. General: Protect concrete against loss of moisture and rapid temperature changes for at least seven (7) days from the beginning of curing operation. Protect unhardened concrete from rain, flowing water and wind. Furnish and install covers as necessary to prevent cracking of the pavement due to temperature changes. If any selected method of curing does not afford the proper curing and protection against concrete cracking and pavement is damaged, remove and replace damaged payment and employ another method of curing as directed by the Landscape Architect.
- B. Curing Methods: Cure concrete for at least seven days by one or more of the following methods:
  - 1. Keep concrete surface continuously wet by covering with water. Cover concrete surface with specified mat, saturated and continuously wet. Ensure that mat covers concrete surfaces and edges, with 6-inches lap over adjacent mat. Moist cure all concrete work and commence moist curing as soon as finishes will not be marred. Insulating blankets waterproofed kraft paper, or polyethylene film as per ASTM C171 shall be used to keep the concrete continuously moist during the curing process.
  - 2. Apply water-fog spray continuously to concrete surface.

### 3.9 PLAN GRADE AND SURFACE-SMOOTHNESS REQUIREMENTS

- A. Ensure that finished surfaces of pavements, when tested as specified herein, conform to grade line and elevations shown and surface-smoothness requirements specified herein.
- B. Plan Grade: Ensure that finished surfaces of pavements do not vary more than ½ inch above or below plan grade line or elevation established and approved at jobsite. Finished surfaces of new abutting pavements will coincide at their juncture.
- C. Surface Smoothness: Ensure that finished surfaces of pavements have no abrupt change of 1/8 inch or more and do not deviate from the testing edge of an approved 12-foot straightedge more than 1/4 inch.

### 3.10 SURFACE TEST, DEFICIENCIES AND CORRECTIONS

- A. Test finished surface for conformance with plan grade and surface smoothness requirements.
- B. Grade Conformance Tests: Check pavement for conformance with plan grade requirements. Test finished surface of each approved pavement area by running lines of levels at intervals of 25 feet or less longitudinally and transversely to determine elevation of completed pavement. Furnish level surveys to Landscape Architect as

surveys are completed. Within 30 days after receipt of level surveys the Landscape Architect will inform this Contractor in writing of areas defective in plan-grade requirements.

- C. Drainage: Pavements shall have positive drainage off of the surface. Provide a minimum cross pitch of 1.0% and a maximum cross pitch of 2.0%.
  
- D. Surface-Smoothness Determinations: After concrete has hardened sufficiently to permit walking thereon, but not later than 36 hours after placement, test surface of pavement with a straightedge 12-foot. Test across longitudinal construction joints within 48 hours after the end of the curing period of the concrete placed in the adjacent lane. Inform Landscape Architect when straightedge testing is planned. Operate straightedge in such manner as to reveal surface irregularities exceeding tolerances specified herein. Test entire area of pavement in both longitudinal and transverse direction on parallel lines 10 feet or less apart. Hold straightedge in contact with surface and move ahead one-half the length of the straightedge for each successive measurement. Carry lines of straight edging continuously across joints.

### 3.11 PAVEMENT TOLERANCES

- A. Comply with the following tolerances:
  - 1. Elevation: 1/8 inch.
  - 2. Horizontal Perpendicular Alignments: 1/8 inch.
  - 3. Thickness: Plus 3/8 inch, minus 1/8 inch.
  - 4. Pavements in longitudinal direction, the gap below a 10 ft unlevelled straightedge resting on high spots shall not exceed 1/8 inch.
  - 5. Pavements in transverse direction, the gap below a 10 ft unlevelled straightedge resting on high spots shall not exceed 1/4 inch.
  - 6. Ramps, sidewalks, and intersections, in any direction, the gap below a 10 ft unlevelled straightedge resting on high spots shall not exceed 1/4 inch.
  - 7. Lateral Alignment and Space of Dowels: 1 inch.
  - 8. Vertical Alignment of Dowels: 1/4 inch.
  - 9. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge:  
Length of dowel 1/4 inch per 12 inches.
  - 10. Joint Spacing: 1 inch
  - 11. Contraction Joint Depth: Plus 1/4 inch, no minus.
  - 12. Joint Width: Plus 1/8 inch, no minus.
  - 13. No honeycombs at finish surface concrete will be accepted.
  - 14. In no case shall grades on any pavements either designated or intended to be accessible per the Americans with Disabilities Act (ADA) exceed the grade maximums noted in the ADA or ADA Accessibility Guidelines (ADAAG).

### 3.1 REMOVAL AND REPLACEMENT OF DEFECTIVE PAVEMENT AREAS

- A. Remove defective pavement areas and replace as specified herein with pavements of thickness and quality required by these specifications.
  
- B. In no case will the removal and replacement of concrete result in a slab less than the full paving width or a joint less than 10 feet from a regularly scheduled transverse

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joint.

- C. Remove defective pavement carefully so that adjacent pavement is not damaged and existing keys or dowels at the joint are left intact.
- D. When a portion of an un-fractured slab is replaced, make a saw cut 2 inches deep transversely across the slab in the required location.
- E. Remove concrete and provide an essentially vertical face in the remaining portion of the slab.
- F. Prior to placement of fresh concrete, clean face of slab of debris and loose concrete, and then thoroughly coat with a thixotropic epoxy-resin grout manufactured specifically for bonding fresh Portland cement concrete to existing hardened concrete.
- G. Apply epoxy resin coating approximately 1/16 inch thick, by scrubbing a thin coat of epoxy grout into the surface with a stiff-bristle brush followed by a second application.
- H. Place strips of polyethylene sheeting on vertical joint faces of adjacent slabs at juncture with slab to be patched as a bond-breaking medium.
- I. Place fresh dry packed Portland cement concrete while the epoxy resin is still tacky and in such a manner that grout coating will not be removed.
- J. Construct longitudinal and transverse joints of the replaced slab or portion thereof as indicated on the drawings.
- K. No payment will be made for the defective pavements removed and replaced nor for the cost of removing the defective pavements.

### 3.2 PAVEMENT PROTECTION

- A. Protect pavement against damage prior to final acceptance by the Landscape Architect. Repair any damage to pavement before final acceptance at no cost to the Owner. Do not permit construction traffic on concrete pavement. Protect against spillage of any deleterious materials.

- END -

SECTION 321343  
PERVIOUS CONCRETE PAVING

1. DESCRIPTION:
  - 1.1. Furnish and place non-reinforced pervious Portland cement concrete in accordance with the plans and specifications. Common applications include, but not limited to, parking lots, shoulders, bicycle paths, sidewalks and driveways.
  
2. MATERIALS:
  - 2.1. Pervious Portland cement concrete shall be manufactured in accordance with the requirements of §501-2, with the following modifications:
  - 2.2. Design a pervious Portland cement concrete mixture as specified in this document. Produce a homogeneous mixture of cement, pozzolan (fly ash or GGBFS), coarse aggregate, set retarding water reducing admixture, water reducing admixture, viscosity modifying admixture (VMA) and water.
  - 2.3. Coarse aggregate gradation shall meet the requirements of size 1 or 1A in table 703-4 of the Department of Transportation's Standard Specifications, Section 703-AGGREGATES. Aggregate/cement ratio shall be in the range of 4:1 to 4.5:1.
  - 2.4. Use Type I, II or I/II cement. Cementitious content shall be a minimum of 520 lb/yd<sup>3</sup> for size 1 aggregate, and a minimum of 580 lb/ yd<sup>3</sup> for size 1A aggregate. Water/cementitious ratio shall be in the range of 0.27 – 0.34.
  - 2.5. At least one (1) week prior to placement of the test panel, provide the Landscape Architect with the following:
    - a) List of all materials and source numbers.
    - b) Proposed mix design batch weights, including design unit weight.
    - c) Proposed production facility and location.
  
3. CONSTRUCTION DETAILS:
  - 3.1. The Contractor shall provide a minimum of one National Ready Mix Concrete Association (NRMCA) Certified Pervious Concrete Technician at the placement site.
  - 3.2. Mix the concrete in approved transit mix trucks. Load trucks to a maximum of 80% of the rated mixer capacity.
  - 3.3. Thoroughly wet the entire subbase surface for a minimum of 2 hours immediately prior to placement. Remove all standing water prior to placement.
  - 3.4. The NRMCA Certified Technician shall check each truck for uniformity during discharge. Mix water shall be such that the cement paste displays a "wet metallic sheen" without causing the paste to flow from the aggregate. Additions of water to the mix, as directed by the Certified Technician, shall be followed by 20 mixing revolutions.
  - 3.5. The concrete shall be deposited as close to its final position as practicable and such that fresh concrete enters the mass of previously placed concrete. The practice of discharging onto subbase and pulling or shoveling to final placement is not allowed.

- 3.6 Unless otherwise approved by the Landscape Architect in writing, the Contractor shall provide mechanical equipment of either slipform or form riding with a following compactive unit that will provide a minimum of 10 psi vertical force. The pervious concrete pavement will be placed to the required cross section and shall not deviate more than +/- ¼ inch in 10 feet from profile grade.
- 3.7 Preferred method of strike off and compaction is the use of a form riding roller screed (i.e. NRMCA “One step method”). If allowed by the Engineer, the NRMCA “two step method” may be employed. If the two step method is used, strike off the concrete to approximately 3/8 in. to ¾ in. above the forms to allow for compaction. After strike off, compact the concrete to the height of the forms. Compaction shall be accomplished by rolling over the concrete with a steel roller, compacting the concrete to the height of the forms. Concrete shall be covered with minimum 6 mil plastic prior to rolling to prevent aggregate pull outs. Compaction shall be completed within 15 minutes of placement. Edges near forms shall be compacted using a 1 ft. by 1 ft. steel tamp, a float, or other similar device to prevent raveling of the edges. If vibration, internal or surface applied, is used, it shall be shut immediately when forward progress is halted for any reason.
- 3.8 After mechanical or other approved strike-off and compaction operation, no other finishing operation will be allowed.
- 3.9 The Contractor will be restricted to pavement placement widths of a maximum of fifteen (15') feet unless the Contractor can demonstrate competence to provide pavement placement widths greater than the maximum specified, to the satisfaction of the Landscape Architect.
- 3.10 Curing procedures shall begin within 15 minutes after placement. The pavement surface shall be covered with polyethylene curing covers or other pre-approved covering material. Overlap curing covers a minimum of 18 inches. Prior to covering, a fog or light mist shall be sprayed above the surface. The cover shall overlap all exposed edges and shall be fully secured throughout the curing period (without using dirt) to prevent dislocation due to winds or adjacent traffic conditions. The polyethylene covering shall remain on the surface for the full duration of the cure time. Supply form insulating materials when the air temperature is expected to fall below 40°F at any time during the curing period.
- 3.11 Cure Time:
- a) Minimum of 7 days.
  - b) No truck traffic shall be allowed for 10 days (no passenger car/light trucks for 7 days).
- 3.12 Jointing: Control (contraction) joints shall be installed at maximum 20-foot intervals. They shall be installed at a depth of least 1/4 the thickness of the pavement. It is recommended that these joints be installed in the plastic concrete with a rolling joint tool. Saw cut joints, if used, should be installed as soon as the pavement has hardened sufficiently to prevent raveling and uncontrolled cracking (normally immediately after curing). Transverse construction joints shall be installed whenever placing is suspended a sufficient length of time that concrete may begin to harden. In order to assure aggregate bond at construction joints, a bonding agent suitable for bonding fresh concrete shall be brushed, rolled, or sprayed on the existing pavement surface edge. Isolation (expansion) joints will not be used except when pavement is abutting slabs or other adjoining structures.
4. TESTING, INSPECTION, AND ACCEPTANCE

- 4.1 Test panel(s): At least one week prior to use, the Contractor shall place, joint, and cure a test panel, a minimum of 100 sq. ft. at the required project thickness, designed in-place unit weight, and finish. The test panel will be constructed at a location designated by the Landscape Architect and will remain in place for the duration of the project to be used as a reference for acceptance of the pavement surface.
- 4.1.1. Satisfactory performance of the test panels will be determined by:
- a) Void Structure: 15% minimum; 25% maximum as per ASTM C1688.
  - b) Unit weight (Density): Unit weight shall be within 5 lb/ft<sup>3</sup> of the design unit weight as per ASTM C1688.
  - c) Infiltration Rate: Infiltration rate shall be a minimum of 100 in./hr as per ASTM C1701. Perform this test after 7 day cure.
  - d) Compacted Thickness: Core the test panel at a minimum of 7 days and determine the compacted thickness as per ASTM C42. Compacted thickness shall be within ¼" of the specified thickness.
- 4.1.2. If the test panel does not meet performance criteria, it shall be removed and redone at the Contractor's expense, and the failed test panel disposed of in an appropriate manner.
- 4.1.3 The test panel will not be incorporated into the work, and will be removed when ordered by the Landscape Architect.
- 4.2. Testing:
- 4.2.1 During production, the following shall be conducted at the Contractor's expense:
- a) A minimum of one test for each day's placement of pervious concrete in accordance with ASTM C 1688 to verify unit weight and percent void content. Unit weight shall be within 5 lb/ft<sup>3</sup> of the design unit weight.
  - b) In a slipform paving operation, determine plastic thickness according to §502-3.08. Perform this test at the frequency indicated in the §502-3.08, but at a minimum of twice per day. Fixed form thickness shall be determined by measuring from grade to top of forms prior to paving. Thickness shall be within ¼" of the specified thickness.
  - c) Infiltration Rate: Test as per ASTM C1701 after 7 day cure at a minimum of three locations chosen by the Engineer. Infiltration rate shall be a minimum of 100 in./hr.
- 4.2.2 Should any of these test results fall outside of the specified limits, the concrete shall be removed, replaced, and retested at no additional cost.

- END -



## SECTION 321540

### BONDED AGGREGATE PAVING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

A. Section includes:

1. Materials and execution information for construction with aggregate with organic binder for foot traffic applications.

##### 1.2 REFERENCES

- A. ASTM C136 / C136M – 14, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates, ASTM International, West Conshohocken, PA, 2014, [www.astm.org](http://www.astm.org)
- B. ASTM D2419 – 14, Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregates, ASTM International, West Conshohocken, PA, 2014, [www.astm.org](http://www.astm.org)
- C. ASTM F1951 – 14, Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment, ASTM International, West Conshohocken, PA, 2014, [www.astm.org](http://www.astm.org)

##### 1.3 SUBMITTALS

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

B. Samples:

1. A 1-quart-bag sample of base course.
2. A 1-quart-bag sample of stabilized crushed aggregate paving.
3. Stabilized crushed aggregate gradation indicating that the product meets specifications.
4. Manufacturer's Material Safety Data Sheet.

C. Mockup: Contractor shall provide full-scale mock-up of all bonded aggregate paving. Mock up shall be minimum of 5' by 5'. Contractor shall provide up to 3 mock-ups for approval. Receive approval of the Landscape Architect and the Owner's Representative before starting installation. Mockups may not become part of completed work. Maintain mock-up as a standard for judging completed work.

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D. Warranty: Standard product warranty.

#### 1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Quality management system certified to ISO 9001:2000.

B. Installation: Choose an installer with a satisfactory record of performance on landscaping and/or paving projects of comparable size, complexity, and quality. Workers must be qualified to accomplish similar tasks. Installer shall have minimum of five years of experience with installation of the approved bonded aggregate paving system.

#### 1.5 SITE CONDITIONS

- A. Ensure that the subgrade and base are properly graded and compacted to required specifications.
- B. Do not install the Organic-Lock pathway aggregate during rain. Rain within 3-5 days after installation will increase curing time.
- C. Protect all nearby surfaces, plants, and structures from possible contamination from materials or damage by equipment.
- D. It is not recommended to install when temperatures are below 40 degrees Fahrenheit (5 degrees Celsius).

#### 1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery:

Deliver materials in manufacturer's original packaging, with identification labels clearly intact.

B. Handling:

When dealing with un-blended binder, wear appropriate respirators when ventilation is inadequate. Avoid contact with skin and eyes.

C. Storage:

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Protect stabilized crushed aggregate mix from contamination. Store undercover. If the blended aggregate is sitting for long periods of time and subject to rainfall, it needs to be turned with a skid steerer or loader to ensure consistent moisture content throughout prior to installation. Verify hydration level with snowball test before installation. For any questions regarding storage, contact the manufacturer or local dealer.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

Bonded aggregated paving provided by:

- A. Kafka Granite, LLC  
Address: 550 E HWY 153, Mosinee, WI 54455  
Phone: 800-852-7415  
Email: [kafka@kafkagranite.com](mailto:kafka@kafkagranite.com)  
Website: [www.kafkagranite.com](http://www.kafkagranite.com)
  
- B. Chameleon Ways  
Address: 188 Jefferson Street, Emmaus, PA 18049  
Phone: 877-426-5687  
Email: [info@chameleonways.com](mailto:info@chameleonways.com)  
Website: [chameleonways.com](http://chameleonways.com)  
Contact: James Keenan, National Sales & Installation Manager  
Phone: 877-426-5687 ext. 206  
Email: [james@chameleonways.com](mailto:james@chameleonways.com)
  
- C. Or approved equal.

### 2.2 SURFACE CRUSHED STONES

A. Crushed Aggregate Materials:

1. Crushed Aggregate Material shall consist of sound, angular, durable particles.
2. Gradation, in accordance with ASTM C136:

Optimal Gradation		
Sieve	Sieve Size (mm)	Percent Passing
4	4.75	80% - 100%
8	2.36	65% - 90%
16	1.18	40% - 65%
30	0.6	25% - 55%
50	0.3	15% - 35%
100	0.15	10% - 20%

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200	0.075	5% - 15%
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Color:

Type 1: Salt and Pepper Granite

Type 2: Caramel Quartzite

**B. Organic Binder**

1. Patented powdered organic binder designed to be blended with crushed aggregate.
2. Made from 100% naturally occurring materials.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

**A.** Evaluate site conditions. If a subcontractor handled the preparation of subbase, notify architects and engineers about any derogation from specified preparation and refrain from excavation until site conditions have been corrected.

**B.** Evaluate that the layout of the project is as indicated on the drawings. Notify the Engineer and do not proceed until the layout of the project matches the drawings.

**C.** Make sure all required materials and tools are on-site and available to proceed to the installation properly.

**3.2 INSTALLATION**

**A. Subgrade Preparation**

Excavate the area to the depth required so that finish grade can be established as noted on plans.

A Foot-Traffic Pathway will require a full depth of 7-9 inches: 4-6 inches of compacted base depth together with 3 inches of compacted Bonded Aggregate.

Compact the subgrade to 95% Modified Proctor Density.

**B. Base Preparation**

Foot-Traffic Pathway will require 4-6 inches of compacted base material.

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Depending upon the method of compaction the installation of base material may require separate lifts. 4 inches can be compacted in a single lift with a minimum 2-ton compaction roller.

Compact the subgrade to 95% Modified Proctor Density using a single or double drum static roller or vibratory compactor.

### 3.3 WATERSHED MANAGEMENT

Crowns and/or cross-slopes must be incorporated into the compacted base material.

If the slope is 2% or lower, a crown should be incorporated into the pathway. If the slope is greater than 2%, incorporate a cross-slope.

Note: The addition of crowns and cross-slopes is heavily dependent upon surrounding watershed.

### 3.4 SPREADING

The use of a paving machine is recommended for large projects to evenly spread Crushed Aggregate at the specified depth. It's recommended to screed the material to ensure the depth is consistent for smaller projects or projects with tight areas.

Spread the loose and uncompacted Crushed Aggregate over the compacted base material.

Typically, a lift of 4 inches of loose, pre-wet Crushed Aggregate will compact to the required 3-inch depth for Foot-Traffic Pathways.

### 3.5 COMPACTION

Make 4-6 passes using a 1-ton double or single static drum roller, or equivalent. A Foot-Traffic Pathway will typically require one lift, compacted to 3 inches.

Compaction will vary with different aggregates due to particle shape and size. It will compact 20-25%, less if using paving machinery. This level of compaction needs to be monitored as early as possible (starting during the test plot) to determine the actual degree of compaction. It is better to put down too much material and to remove it from the top than to put down too little and add a layer later.

Compact to 95% Modified Proctor Density.

Note: Vibratory compaction is acceptable for the base material but generally not suitable for the blended Crushed Aggregate as it risks disassociating the bonds of the stabilized aggregate or allowing the fines and moisture to migrate to the surface, causing the surface to take on a smooth, concrete-like appearance.

The blended Crushed Aggregates should be compacted using a single or double drum static roller wherever possible. For tight spaces that are not accessible by drum

rollers, a hand tamper is recommended. However, in certain circumstances, a vibratory or plate tamper can be used where the installer deems it to be more effective as hand-tamping over large spaces will create inconsistent results.

Provided the moisture content of the blended aggregate is adequate, additional hydration should not be necessary. On dry, sunny days, however, the surface layer may start to dry out while installing, in which case, a light misting would be appropriate to prevent surface cracks from appearing during compaction.

### 3.6 COMPLETING INSTALLATION

Apply a light spray to the surface of the material to give a clean appearance. Apply water until the water begins to run-off.

Do not allow any traffic on the newly installed pathway until fully cured, a minimum of 24-72 hours.

### 3.7 REPAIRS AND PROTECTION

Excavate the damaged area and scarify exposed Organic-Lock Pathway Aggregate.

When possible, attic stock should be on hand for small repairs. Water the material to achieve an 8-10% moisture content. Use the "snowball test" to determine moisture content - refer to manufacturer for details. Apply the material to the excavated area and compact.

Allow the newly installed bonded aggregate to cure.

When necessary, re-water and re-compact the material, ensuring that the final grade and crown are maintained.

### 3.8 MAINTENANCE

All outdoor products require a level of maintenance analysis. It is recommended to do a thorough analysis of the installed bonded aggregate 7 days after installation followed by monthly analysis to ensure no alterations are required.

#### A. Erosion Damage

The greatest element of concern is rainfall erosion. Often, this problem can be greatly reduced by adjusting the watershed areas surrounding the product itself. The best way to determine how the water is building up, is to examine your project area during a rainstorm. Learning where the water is coming from can lead to water diverting that dramatically reduces the stress on your surface.

Installing culverts, drains, cross slopes, crowns, or diverters can limit the majority of stress causing damage.

If you do experience erosion damage, first look at ways to get the water away or slow the water down, that's causing the damage...secondly, replace the lost material with new material following the guidelines below.

#### B. Excess Loose Material

Directly after the installation, the aggregate surface will be smooth because of the weight of the fresh compaction. As the surface weathers with traffic and time, the larger particles of the aggregate will loosen on the surface to create a natural look and feel which is often sought after. The loose aggregate particles on your surface should not exceed 1/4" in depth.

Sweeping off the excess particles can be accomplished in areas where excess 1/4" chip is not detrimental. These loose particles can also be shoveled and removed from site. The remaining surface will eventually chip loose again, so new material is recommended as a top up (see instructions below) after doing this more than once.

If material exceeds a 1/4", redistribute the particles over a greater surface, scarify the surface to a depth of 1" and water to a 1" depth and compact with a roller of no less than 1000-lbs. Keep traffic off for 24-72 hours.

#### C. Removing Debris

You can remove grass clippings, soil, debris or organic material by mechanically blowing or hand raking as needed.

#### D. Snow Plowing

When plowing snow, use a shoe lift or rubber baffle on the blade of the plow to lift the blade up 1/4" off the surface. Extra precautions should always be taken after the first snow and last snow of the season, as this is when the material is most prone (i.e. the ground is not frozen).

### 3.9 ADDING NEW BLENDED BONDED AGGREGATE MATERIAL TO DAMAGED AREAS

Below the loose surface particles, the firmed material should be stable to resist erosion and support the intended traffic.

If this lower-level material incurs damage, we recommend the following:

#### A. Fixing Lightly Damaged Areas

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Lightly damaged areas can be repaired by soaking, scarifying with a rake to 1-2 inches and compacting the scarified area using a roller or a hand tamper.

## B. Adjusting Blended Aggregate

The binding gel activates each time it comes in contact with water, which allows for the blended aggregate to be physically broken up, re-worked and returned back to its initial state. This self-healing nature allows for a simplified maintenance procedure that leaves no sign of the maintenance itself.

For example:

If you have to run an irrigation line below your finished pathway, all you need to do is add water, dig the material up, put down your irrigation line, spread the material back in place, then water and compact it using a roller or a hand tamper back to new.

## C. Fixing Larger or More Severely Damaged Areas

Excavate the damaged area to a depth of 2” to an approximate 50% increase in area (i.e. if your area is in a 4-foot radius circle, excavate a total of 6 feet in diameter).

Estimate amount of material lost or material needed to be topped up. Add this amount of preblended aggregate in the area.

Blend this newly blended aggregate in by one of the following methods:

### 1. Rototill to a Depth of 2 Inches

This needs to be done with multiple passes and should not exceed the depth of the blended aggregate (i.e. avoid disrupting the base material). Spray the surface with a light spray and begin to till this material to achieve a homogeneous blend of the new and existing material. Add further water as you mix to achieve the optimal snowball (as seen in the snowball test).

### 2. Remove and Blend the Material Off Site

Add the new blended aggregate to the existing material on a clean pad. Using a front-end loader (or shovels for smaller projects) mechanically turn the material over until you achieve a homogeneous blend. Add water into this mixture until you achieve an optimal snowball (as seen in the snowball test).



Spread this newly blended material back into the area where the excavation was completed and compact using a roller or a hand tamper.

- END -

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SECTION 321816

PLAYGROUND PROTECTIVE SURFACING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Unitary synthetic poured-in-place rubber seamless surface.

B. Related Sections:

1. Division 03 Section "Cast-in-Place Concrete" for adjacent curbs, walls and edges
2. Division 32 Section "Concrete Paving" for adjacent paving
3. Division 32 Section "Playground Equipment" for play equipment

1.2 DEFINITIONS

- A. Critical Height: Standard measure of shock attenuation. According to CPSC No. 325, this means "the fall height below which a life-threatening head injury would not be expected to occur."

- B. SBR: Styrene-butadiene rubber.

1.3 PERFORMANCE REQUIREMENTS

A. Protective playground surfacing shall meet or exceed the following standards (current version):

1. The Americans with Disabilities Act (ADA) and the Americans with Disabilities Act Accessibility Guidelines (ADAAG).
2. ASTM F1951 – Determination of Accessibility of Surface Systems under and Around Playground Equipment.
3. U.S. Consumer Product Safety Commission – Public Playground Safety Handbook Publication No. 325.
4. ASTM F1292 – Standard Specification for Impact Attenuation of Surfacing Materials Within the Use Zone of Playground Equipment.
  - a. Impact attenuation of 200 G's or less from the actual fall height and test results shall meet or exceed HIC (Head Injury Criteria) test results shall be

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less than 1000 at this fall height. At initial installation surface shall be a minimum of 25% below required G's (150 or less) or HIC (750 or less) ratings to allow for compaction of the surface over time.

- b. Installed playground area shall be impact/drop tested per the requirements of ASTM F1292 to show conformance with the G-Max and HIC criteria listed above. Per ASTM F1292 the impact/drop test shall be performed at the most adverse location on the playground. The impact/drop test shall be conducted by a Certified Playground Safety Inspector (CPSI) who will prepare a certification report of the results. If the surface fails to meet the stated criteria the surface shall be corrected/removed and reinstalled.
5. ASTM F2479 – Standard Guide for Specification, Purchase, Installation and Maintenance of Poured-In-Place Playground Surfacing.
  6. ASTM F2223 – Standard Guide for ASTM Standards on Playground Surfacing.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each playground surface system, include materials, plans, cross sections, drainage, installation and edge termination. Include patterns made by varying colors of surfacing. Include details of graphics.
- C. Samples for Initial Selection: For each type of playground surface system indicated.
  1. Include similar Samples of playground surface system and accessories involving color selection.
- D. Samples for Verification: For each type of playground surface system indicated.
  1. Minimum **6-by-6-inch (150-by-150-mm)** Sample of synthetic rubber seamless surface.
- E. Qualification Data: For qualified Installer
- F. Material Certificates: For each type of loose-fill playground surface system, from manufacturer.
- G. Material Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each loose-fill playground surface system.
- H. Product Certificates: For each type of unitary synthetic playground surface system, from manufacturer.
- I. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each unitary synthetic playground surface system.
- J. Maintenance Data: For playground surface system to include in maintenance manuals.
- K. Warranty: Sample of special warranty.

## 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Source Limitations: Obtain playground surface system materials, including primers and binders, from single source from single manufacturer.
- C. Standards and Guidelines: Comply with CPSC No. 325, "Handbook for Public Playground Safety"; ASTM F 1292; and ASTM F 1487.

## 1.6 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit playground surface system installation to be performed according to manufacturers' written instructions and warranty requirements.

## 1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of playground surface system that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Reduction in impact attenuation.
    - b. Deterioration of surface and other materials beyond normal weathering.
  - 2. Warranty Period: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 UNITARY SYNTHETIC DUAL-DENSITY SEAMLESS SURFACE

- A. Surface System: Poured-in-place, two-layer system with wearing course over cushion course. Provide manufacturer's standard thickness for each layer as required for overall thickness indicated, tested for impact attenuation according to ASTM F 1292 and for accessibility according to ASTM F 1951.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Hanover Specialties, Inc.; Vitriturf.
    - b. No Fault Sport Group, LLC; Safety Surface.
    - c. Surface America Incorporated; Play Bound Poured-in-Place.

2. Wearing Course: Formulation of EPDM rubber particles, with minimum of 20 percent and maximum of 26 percent of ethylene propylene-diene-saturated polymethylene main chain along with other organic and inorganic components.
    - a. Thickness: ½ inch minimum. Thicken to ¾ inch under swings, ends of slides, play equipment entrances/exits, and areas where there will be increased foot traffic such as around spinning play equipment. Provide a ¼” minimum radius on edges when abutting concrete.
  3. Cushion Course: Manufacturer's standard formulation of SBR particles and polyurethane, site mixed and applied. SBR recycled crumb rubber shall be free of contaminants and metals. All cushion course depths shall meet ASTM-F1487-11 for fall heights as dictated by the specified play and/or fitness equipment.
  4. Binder: Weather-resistant, UV-stabilized, flexible, nonhardening, 100 percent solids polyurethane complying with requirements of authorities having jurisdiction for nontoxic and low VOC content. Binders shall be aromatic. Aliphatic binders shall only be used with the approval of Philadelphia Parks and Recreation. The following are approved binder manufacturers:
    - a. VORAMER by DOW Chemical Company
    - b. STOBIELAST by Stockmeier Urethanes USA, Inc.
    - c. FLEXILON by Rosehill
    - d. Equal approved Philadelphia Parks and Recreation.
  5. Lacquer Top Coat: Manufacturer's standard polyurethane-based formulation.
  6. Critical Height: 6 feet (1.8 m)
  7. Overall Thickness: Not less than as required for critical height indicated.
  8. Slope: Wearing and Cushion Coarses shall be suitable for use on slopes up to 2:1
  9. Primer/Adhesive: Manufacturer's standard primer and weather-resistant, moisture-cured polyurethane adhesive suitable for unit, substrate, and location indicated.
  10. Wearing Course Color(s): As selected by Architect from manufacturer's full range.
    - a. Color and Pattern: As indicated on Drawings.
- B. Approved Poured-In-Place (PIP) Rubber Safety Surfacing Manufacturers:
1. Safety Turf, Inc. – 201 N. 4th Ave., Royersford, PA 19468, Phone: (800) 804-4595, Web: [www.safetyturf.com](http://www.safetyturf.com)
  2. ProPour™ – 154 N. Sheridan RoadNewmanstown, PA 17073, Phone: 610-589-1763, Web: [www.theplaygroundpros.com/ProPour.php](http://www.theplaygroundpros.com/ProPour.php)

3. Equal approved Philadelphia Parks and Recreation.
- C. Base Requirements: Poured-In-Place (PIP) Rubber Safety Surfacing shall be installed on a stable and compacted crushed aggregate base or a paved (asphalt or concrete) base. The paved base may be existing pavement as long as it is in good condition.
    1. Compacted Crushed Aggregate Base: Minimum 6 inches thick of compacted crushed aggregate (PennDOT 2A modified, 2B Clean Aggregate, AASHTO No. 57 Stone, or equivalent) placed on a compacted un-yielding subgrade compacted to 95% minimum per ASTM D698 Standard Proctor.
  - D. Leveling and Patching Material: Portland cement-based grout or epoxy- or polyurethane-based formulation suitable for exterior use and approved by playground surface system manufacturer.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for maximum moisture content, subgrade and substrate conditions, drainage, and other conditions affecting performance of the Work.
  1. Concrete Substrates: Verify that substrates are dry, free from surface defects, and free of laitance, glaze, efflorescence, curing compounds, form-release agents, hardeners, dust, dirt, loose particles, grease, oil, and other contaminants incompatible with playground surface system or that may interfere with adhesive bond. Determine adhesion, dryness, and acidity characteristics by performing procedures recommended in writing by playground surface system manufacturer.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. General: Prepare substrates to receive surfacing products according to playground surface system manufacturer's written instructions. Verify that substrates are sound and without high spots, ridges, holes, and depressions.

#### 3.3 INSTALLATION, GENERAL

- A. General: Comply with playground surface system manufacturer's written installation instructions. Install playground surface system over area and in thickness indicated.

#### 3.4 INSTALLATION OF SEAMLESS PLAYGROUND SURFACE SYSTEMS

- A. Seamless Surface: Mix and apply components of playground surface system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface and impact-attenuating system of total thickness indicated.

PENNYPACK PARK UNIVERSAL PLAYGROUND

[PROJECT No. 16-21-7062-01]

321816-5

PLAYGROUND PROTECTIVE SURFACING

1. Substrate Primer: Apply over prepared substrate at manufacturer's standard spreading rate for type of substrate.
2. Poured Cushion Course: Spread evenly over primed substrate to form a uniform layer applied at manufacturer's standard spreading rate in one continuous operation, with a minimum of cold joints.
3. Intercoat Primer: Over cured cushion course, apply primer at manufacturer's standard spreading rate.
4. Wearing Course: Spread over primed base course to form a uniform layer applied at manufacturer's standard spreading rate in one continuous operation and, except where color changes, with no cold joints. Finish surface to produce manufacturer's standard wearing-surface texture.
  - a. Where colored pattern is indicated, place adjacent colored material as soon as placed colored material is sufficiently cured, using primer or adhesive if required by manufacturer's written instructions. Joints shall be back-cut and receive a heavy coat of polyurethane to ensure firm connection between colored areas and joints.

### 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Testing Services: Testing and inspecting of completed applications of playground surface system shall take place according to ASTM F 1292.
- C. Remove and replace applications of playground surface system where test results indicate that it does not comply with requirements.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with requirements.

### 3.6 PROTECTION

- A. Seamless Systems: Prevent traffic over system for not less than 48 hours after installation.

- END -

## SECTION 321817

### CORKEEN

#### 1. General

##### 1.1. Poured In Place Cork Playground Surfacing:

- A Corkeen® Play Original Playground Surfacing is a 2-layer, seamless system comprised of a base layer of 100% subproduct from cork stoppers extraction, granulated cork & polyurethane binder and a top layer of the same origin granulated cork and polyurethane binder. The porous system is field applied in any configuration and dimension to achieve required fall heights.

##### 1.2. Safety and Testing

- A American Society for Testing and Materials (ASTM):
  - 1 ASTM-F1292 (Latest Edition) - Standard Specification for Impact Attenuation of Surfacing Materials within the Use Zone of Playground Equipment.
  - 2 ASTM-F3313 (Latest Edition) – Standard Test Method for Determining Impact Attenuation of Playground Surfaces Within the Use Zone of Playground Equipment as Tested in the Field.
- B BS and EN:
  - 1 BS 7188 – Ease of ignition, Tensile properties, Elongation, Resistance to wear, Slip resistance wet and dry, Resistance to indentation.
  - 2 EN ISO 5470 – Resistance to wear.
  - 3 EN 12616 – Permeability.

##### 1.3. Performance Requirements:

- A. Shock attenuation (ASTM F1292 and ASTM F3313) Gmax - Less than 200
- B. Head injury criteria (ASTM F1292 and ASTM F3313) HIC - Less than 1000
- C. Accessibility: Expected to test according to requirements of ASTM F1951.
- D. Ease of ignition BS 7188: Pass
- E. Tensile properties BS 7188: 0.38 MPa (informational only, relevant for synthetic surfaces).
- F. Elongation BS 7188: 12% (informational only, relevant for synthetic surfaces).
- G. Permeability EN 12616: 72,000 mm/h
- H. Resistance to wear EN ISO 5470-1: 0.55 g



- I. Resistance to wear BS 7188 and ISO 5470 H18 wheels 500g weight per arm:
  - a. New – Pass (Wear index = 0.525 g, Wear ratio = 1.27)
  - b. After hot air aging – Pass (Wear index = 0.621 g, Wear ratio = 1.44)
  - c. After hot water aging – Pass (Wear index = 0.643 g, Wear ratio = 1.32)
- J. Dry Slip Resistance BS 7188: 100, Pass
- K. Wet Slip Resistance BS 7188: 42, Pass
- L. Resistance to indentation BS 7188:
  - a. Residual indentation: 32.6 mm (informational only, relevant for synthetic surfaces).
  - b. No damage: Perforation (informational only, relevant for synthetic surfaces).

**Approvals:**

- A Corkeen® Play Original is in the process of being certified by the International Play Equipment Manufacturers Association (IPEMA). Contact manufacturer for information on approvals by major owners, agencies and other industry entities. Environmental Consideration; this system makes extensive use of granulated cork which is a natural CO2 retention material and a subproduct from the cork-stoppers industry.

**1.4. Submittals:**

- A General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.
- B Product Data: Submit manufacturer’s product data and installation instructions.
- C Verification Samples: Submit manufacturer’s standard verification samples of 9" x 9" minimum.
- D Quality Assurance/Control Submittals: Submit the following:
  - 1 Certificate of qualifications of the surfacing installer.
- E Closeout Submittals: Submit the following:
  - 1 Warranty documents specified herein.

**1.6. Quality Assurance:**

- A. Utilize an installer trained and approved by the manufacturer, having experience with other projects of the scope and scale of the work described in this section.
  - 1 Approved installer: Safety Turf, Inc. P.O. Box 908, Royersford PA 19468. 1-800-804-4595 (<http://safetyturf.com>).
  - 2 If requested, impact attenuation results can be provided per ASTM-F3313 Impact Attenuation of Playground Surfaces Within the Use Zone of Playground Equipment as Tested in the Field for an additional cost.

**1.7. Delivery and Storage:**

- A. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- B. Store materials protected from exposure to harmful environmental conditions and at a minimum temperature of 40 degrees F and a maximum temperature of 90 degrees F.

**1.8. Project Site Conditions:**

- A. Install surfacing on a dry sub-surface with no prospect of rain within initial drying period, and within 50 degrees F and 90 degrees F.
- B. An inclination of 1 % for "flat" surfaces is important, especially if the subbase has low or no permeable properties, like asphalt or concrete.
- C. There are three (3) Sub-Base applications acceptable for Poured In Place.
  - 1 Applications. Any of these suggestions needs to be able to comply with permeability of Corkeen® and assure stability and adhesion
    - 1.8.C.1.1. Installations may be performed over 4" minimum compacted stone base PennDot 2B (3/4" clean) or #57 Crushed Stone.
    - 1.8.C.1.2. Installations may be performed over fully cured (30 days) Asphalt (with proper drainage).
    - 1.8.C.1.3. Installations may be performed over Concrete (porous or not, porous preferable) with a minimum of 7 Days cure time and as much as 30 days dependent on conditions and temperature.
- D. Other Sub-Base requirements:
  - 1 Load bearing capacity - The subbase needs to have a capacity to support the loads applied to the ground. The key is to make sure that no shoe marks show, when walking on the subbase prior to installation.
  - 2 Hardness - The subbase should be hard, and compacted, no flexibility appearing in the subbase.
  - 3 Other Conditions - We recommend a clean surface with no organic material on top of the subbase. The subbase should be dry and waste free. The subbase should always be inspected and approved by the installation supervisor prior to installation.
- E. Barricade area to prohibit foot traffic on the surface for the time specified by the manufacturer.

**1.9. Limitations:**

- A. Some chemicals may cause damage to the playground surface and should be avoided. They include disinfectants, concentrated chlorine bleach, gasoline, diesel fuel, hydraulic and lubricating oils, acids and organic solvents. Though not commonly used in water play areas, pool surrounds and similar applications, dissolved minerals and other chemicals (hydrochlorides) may cause surface discoloration over time. This condition, should it occur, is not considered to be a product failure.

### **1.10. Warranty:**

- A. Playground surface shall maintain required impact attenuation characteristics and be guaranteed against defects in workmanship and materials for a period of no less than (5) Five Years from date of completion of work. Typical wear, abuse, or neglect will be excepted. Maintenance requirements must be maintained for duration of warranty period.

### **1.11. Maintenance:**

- A. Hose off entire playground surface to remove food, drink, sand, dirt and loose debris. The surface is best cleaned with brushes and water. While surface is still damp, apply a mild household or commercial cleaner to a small area using a sprayer. Scrub using a medium bristle brush. Once entire surface has been cleaned, rinse using a garden hose with spray nozzle attachment. To increase longevity and performance of your surfacing it is recommended to maintain monthly maintenance work.
- B. As a preventative measure, leaves and other organic material must be removed with a leaf blower and/or regular sweeping. This kind of cleaning prevents aging of the system, rotting caused by moss, algae, and weeds. It also prevents other vegetation to take roots.
- C. Remove sand and gravel, which can cause the risk of breaking down and deteriorating the surface. Should additional maintenance recommendations be necessary contact the manufacturer or technical services.

### **1.12. Technical Services:**

- A. For technical assistance contact Brand Master – William (Bill) D. Famiglietti, CEO Joint Ventures North America, AMORIM Cork Composites USA, 26112 110th St, Trevor WI 53179 (262)869-9002.

## **2. Products**

**2.1.** Playground surface shall consist of a mix of natural materials with an agglomeration binder meeting the requirements of this specification. A primer application should be considered before the base layer is applied. Corkeen® Play Original components shall be installed by a certified installer.

- A Certified Installer: Safety Turf, Inc. P.O. Box 908, Royersford PA 19468. 1-800-804-4595 (<http://safetyturf.com>).

### **2.2. Base Layer:**

- A Primer: Polyurethane. Corkeen binder BT01.1 or similar as per manufacturers instructions.
- B Corkeen® Base Layer Engineered Cork Granules L. Color: Natural Cork Color (beige).
- C Corkeen® Play Original: Blend 100% granulated cork and Polyurethane to the proper ratios based on weight.

- D Base Thickness: May vary as determined by the fall height of the play equipment and as required to meet ASTM F1292 requirements for critical fall height.

### **2.3. Top Layer:**

- A Aromatic Polyurethane Primer. Corkeen binder BT01.1 or similar as per manufacturers instructions.
- B Corkeen® Top Layer Engineered Cork Granules
- C Colors: Cork natural color (some variation expected, given that it is a natural material).
- D Poured In Place Top Layer: Blend of Top layer engineered cork granules and Polyurethane.
- E Nominal thickness of Cork Top Layer 0.59", with a minimum 0.325" and a maximum 0.625".
- F System Total Thickness: To be not less than the fall height of the play equipment which may vary and as required meet ASTM F1292 requirements for critical fall height.

### **2.4. Performance Requirements:**

- A Impact Attenuation: Critical fall height tested according to ASTM F 1292 for equipment as specified in Drawings.
- B Accessibility Standard: Minimum surfacing performance expected to meet ASTM F 1951 (Testing in process).

## **3. Execution**

- A Comply with the instructions and recommendations of the surfacing manufacturer.

### **3.2. Examination:**

- A Verification of Site Conditions: Verify that substrate conditions are suitable for installation of the poured in place surfacing. Do not proceed with installation until unsuitable conditions are corrected.
- B Drainage: Proper drainage is critical to the longevity of the surfacing system. Inadequate drainage will cause premature breakdown of the poured system in affected areas; and void the warranty.

### **3.3. Preparation:**

- A Existing Sub-base Preparation: Remove any loose or delaminated material that would be deleterious to application of the new surface. Fill cracks in existing concrete with cementitious patching compound.
- B Surface Preparation: Using a brush or short nap roller, apply primer to the sub-base surface, sub-base perimeter and any adjacent vertical barriers (such as playground equipment). The sub-base will show different consumption levels according to its characteristics.

### **3.4. Installation:**

- A Do not proceed with playground surfacing installation until all applicable site work, including sub-base preparation, fencing, playground equipment installation and other relevant work, has been completed. Consider dust and traffic in adjacent work areas that may impact surfacing finish.
- B Primer Application: Using a brush or short nap roller, apply primer to the base layer, base layer perimeter and any adjacent vertical barriers that will contact the surfacing system. The approved Brand Master should use Corkeen's recommended and approved installation tools.
- C Base Layer Installation:
  - 1 Using screeds and hand trowels, install the base layer to the specified thickness. The Brand Master should use Corkeen's recommended and approved installation tools and methods to achieve the target density.
  - 2 Allow base layer to cure for sufficient time so that indentations are not left in the base layer from applicator foot traffic or equipment.
  - 3 Do not allow foot traffic or use of the base layer surface until it is sufficiently cured.
- D Top Layer Installation:
  - 1 Using a hand trowel, install top layer to a nominal thickness of 0.5". The Brand Master should use Corkeen's recommended and approved installation tools and methods to achieve the target density.
  - 2 Allow top layer to cure for a minimum of 48 hours with Aromatic binder and up to 72 hours with Aliphatic binder, (dependent on weather conditions).
  - 3 At the end of the minimum curing period, verify that the surface is sufficiently dry and firm to allow foot traffic and use without damage to the surface.
  - 4 Do not allow foot traffic or use of the surface until it is sufficiently cured.

### **3.5. Field Quality Control:**

- A Testing Agency: CSPI certified representative or another qualified testing agency to perform tests and inspections.
- B Perform the following tests and inspections:
  - 1 Perform inspection and testing for installed playground surface according to ASTM F 1292. Must meet the critical fall height requirements of the playground equipment (may be additional cost).
- C Playground surfacing will be considered defective if they do not pass tests and inspections.
- D Prepare test and inspection reports.

### **3.6. Protection**

- A Protect the installed surface from damage resulting from subsequent construction activity on the site.

**3.7. Product Substitutions:**

A Substitutions: No Substitutions Permitted.

- END -

SECTION 323113  
CHAIN-LINK FENCING AND GATES

1.1 Chain-Link Fencing shall conform to the following minimum standards:

A. General Site Fencing Standards (Chain-link):

1. Height: All chain-link fencing will measure 8' tall (96") in height from the finished grade, unless otherwise requested or approved by Philadelphia Parks and Recreation.
2. Gates: All gates are to match the height of the new fencing that they are linked to. Gate widths will either be 4' (48") for single man gates or 8' (96") for double man gates. Fabric will match the specifications of the new fence that it is linked to.
3. Fabric: All chain-link fabric will be vinyl coated and have a minimum weave of 2"x2" with 9GA tie wire, knuckled on both top and bottom. Cut ends of fence fabric shall be turned or knuckled over in the field to sharp wire ends are not exposed. Tie wires will be 24" on center, unless otherwise approved by Philadelphia Parks and Recreation. The color will be black, unless otherwise stated/approved by Philadelphia Parks and Recreation.
4. Posts: Minimum 2" (outside diameter) galvanized steel, painted black. Posts should have a maximum spacing of 8' (96") on center per section of chain-link fencing. All Terminal posts will have caps and tension bar. All line posts will have top and bottom connectors.
5. Rails: Minimum 1-5/8" (outside diameter) galvanized steel, painted black. The bottom rail will be a 2" from finished grade.
6. Footings: Footings will be minimum 3500 PSI concrete at 36" depth below finished grade and have a 12" diameter, unless otherwise required. The new post will be set at a depth of 30" from finished grade within the new footing.
7. Approved Manufacturers:
  - a. Northeast Fence and Iron Works – 8451 Hegerman Street, Philadelphia, Pennsylvania 19136, Phone: (215) 335-1681, Web: <http://www.northeastfence.net/>
  - b. Stephens Pipe and Steel, LLC – 300 Streibeigh Lane, Montoursville,

Pennsylvania 17754, Phone: (888) 275-1638, Web: <http://www.spsfence.com>

- c. Master Halco – 3010 Lyndon B Johnson Freeway, Suite 800, Dallas, Texas 75234, Phone: (800) 883-8384, Web: [www.masterhalco.com](http://www.masterhalco.com)
- d. Equal approved Philadelphia Parks and Recreation.

- END -



SECTION 323119  
DECORATIVE METAL FENCING AND GATES

1.1 Decorative metal fencing will conform to the following standards:

A. General Fencing Standards (Decorative Metal):

1. Approved Materials:

a. Steel

b. Wrought Iron

2. Height: The height for decorative metal fences is 8' (96").

3. Gates: Gates are to match the height of the new fencing that it is linked to. Color to match.

4. Color: All decorative metal fences are to be powder coated flat black.

5. Posts: Minimum 2" Square galvanized steel, painted black. Posts should have a maximum spacing of 8' (96") on center per section of fencing. All Terminal posts will have caps. All line posts will have top and bottom connectors.

6. Rails: Minimum 1-1/2" square rail (2 top rails, 2 bottom rails), painted black. The bottom rail will be a maximum 2" above finished grade.

7. Footings: Footings will be minimum 3500 PSI concrete at 36" depth below finished grade and have a 12" diameter, unless otherwise required. The new post will be set at a depth of 30" from finished grade within the new footing.

8. Approved Manufacturers:

a. Northeast Fence and Iron Works, 8451 Hegerman Street, Philadelphia, Pennsylvania 19136, (215) 335-1681

b. Stephens Pipe and Steel, LLC, 300 Streibeigh Lane, Montoursville, Pennsylvania 17754, (888) 275-1638

- c. Iron World Fencing, 9390 Davie Avenue, Laurel , Maryland 20723, (301) 776-7448
- d. Ameristar Fence – 1555 N. Mingo Rd Tulsa, OK 74116, Phone: (888) 333-3422, Web: [www.ameristarfence.com](http://www.ameristarfence.com)
- e. Equal approved by Philadelphia Parks and Recreation.

- END -

SECTION 328400  
GENERAL AQUATIC PLAY AREA/ SPRAYGROUND/ SPLASH PAD DESIGN

PART 1 DESIGN – AQUATIC PLAY AREAS / SPRAYGROUNDS / SPLASH PADS

- 1.1 Aquatic Play Areas / Spraygrounds / Splash Pads that are to be designed and installed on City of Philadelphia, Department of Public Property, and/or for Philadelphia Parks and Recreation sites shall include the following:
- A. Aquatic Play Areas / Spraygrounds / Splash Pads should only be installed at staffed facilities.
  - B. The City of Philadelphia current design standard is for spraygrounds / splash pads to be fed with potable City water and the flows from the spray features are to drain to waste or flow through. Recirculation systems are not permitted for use. Drain lines from spray grounds are to connect to combined sanitary sewer or separate storm sewer flowing to sewer lines in the surrounding streets per direction of Philadelphia Department of Licenses + Inspections. Care should be taken so that sprayground drainage is not connected to or is connected downstream of any green stormwater infrastructure or stormwater management facilities. Total daily flows should not exceed Philadelphia Water Department requirements for an exemption request of the Act 537 Sewerage Planning Facilities Module requirements. Designer shall evaluate waste line capacity to handle both the potential spray ground flows as well as any existing or new building waste flows.
  - C. The designer shall assess the existing building water service(s) for potential connection to serve spray ground area. The designer should verify capacity and pressure is available to support the spray ground system and not degrade building water service or evaluate potential upgrades to the existing building water service or obtain a separate dedicated water service for the spray ground as required. In general, water service specifically for a spray ground should not be less than 2 inches in diameter.
  - D. The designer shall evaluate the available water pressure at the existing building and in the area. There are parts of the City where there is insufficient pressure to support a spray ground. Likewise there are other parts of the City where the water pressure is too high and a pressure reducing valve must be installed to reduce working pressures acceptable for spray ground use. Allowable and required pressures will be dependent on the spray ground equipment manufacturer's requirements.
  - E. Spray grounds require backflow prevention to maintain separation from the site's/building's potable water supply but also the City water supply in the street. If connecting to a building water supply where there is existing backflow prevention between the building and the City water in the street, provide backflow prevention between the building and spray ground. If a dedicated water service is being installed separate from the building service backflow prevention

must be provided between the spray ground and the City water in the street. Backflow prevention must meet Philadelphia Water Department's Cross Connection Control requirements. Philadelphia Parks and Recreation prefers any backflow prevention equipment between the City water in the street and the spray ground be located within the recreation center building, if there is room available preferably in a mechanical room. If the backflow prevention equipment cannot be located within a building it will need to be located in an above-grade heated exterior enclosure (hot box). The exterior enclosure shall be steel with maintenance access doors. See attached detail for reference.

- F. In general, PPR classifies spraygrounds/splash pads in 2 categories: Small and Large.
1. Small Spraygrounds / Splash Pads: Small spraygrounds typically only include up to 8 to 10 water play features and only include ground jets, no above grade mounted features. The piping systems for these spraygrounds are typically much simpler and do not require a larger underground manifold pit (described below). Typically water is distributed via underground piping and a basic pipe manifold with balancing ball valves located in a low depth/at-grade utility or irrigation box. Care should be taken with the selection of the spray features and design of the piping system so that the ground spray flows are balanced and even. Control of a small sprayground is accomplished via a single solenoid valve connect to a timer switch (located inside the Recreation Center or Rec Leaders Office). Include a manual override to the timer switch. The intent is for all of the water features to be on for specified times as established by PPR or the Rec Leader. Small spraygrounds typically have lower flows.
- G. Water to spray ground features are generally distributed via a manufacturer's distribution manifold with control valves. The manifold is housed in an underground high-density polyethylene enclosure manufactured by Hubbell Power Systems, Inc. The manifold pit shall be located outside of the spray ground or adjacent paved areas, typically in a lawn or landscape area outside of pedestrian foot traffic. The location of the manifold pit shall be coordinated with the spray ground equipment manufacturer. Top of the manifold pit is preferred to be flush with grade, but shall be set no higher than 2 feet above finished grade,
- H. Water service to the manifold pit shall meet the Philadelphia Plumbing Code.
- I. Distribution piping from manifold to spray features shall meet manufacturer's requirements.
- J. Manifold pit shall be the low point of the spray ground system to allow for draining via gravity for winterization. Dry well can be installed below a portion of the manifold pit using clean stone (No. 57) and leaving a 12" square opening in the floor of the manifold pit. Designer shall ensure there is no high water table, impermeable soils, or contaminated soils present for this option.
- K. Manifold should be detachable so it can be removed and left on the bottom of the pit during the winter. The lines coming in the manifold and the lines going out to the jets need to have union fittings that can be unscrewed.

- L. Provide for winterizing drains within the sprayground water piping system within the manifold pit to include the sprayground feature supply lines and the city water service feeding the sprayground. Provide isolation valves to segregate city water from manifold pit.
- M. Provide isolation valves to segregate city water from manifold pit as well as segregate the manifold pit or water supply from the spray features.
- N. Spray grounds paving shall be cast-in-place concrete meeting the requirements of Section 321313 or decorative/colored concrete paving meeting the requirements of Section 321316. Concrete reinforcing shall be per spray feature manufacturer's requirements. In-ground spray features can be generally cast into the concrete slab or the slab may be thickened, verify with manufacturer's requirements. Above-ground spray features may be anchored to the thickened slab or to a separate below grade footing, verify with manufacturer's requirements. Grade sprayground surface a minimum of 1.0 % and maximum of 2.0% in any direction.
- O. Provide adequate drainage for the full flow of the spray ground so that water does not backup or stand on the pad. Drains shall be trench or area type. Metal grates shall be painted light colored pool deck type paint approved by Philadelphia Parks and Recreation.
- P. Large spray ground shall be sequenced utilizing manufacturer's recommended controller system. System shall include a rain sensor to shut spray ground down during rain events.
- Q. Activation bollards or buttons are not permitted. Non-mechanical activation systems may be approved on a case by case basis by Philadelphia Parks and Recreation.
- R. Above-grade spray features shall be stainless steel and finished with a polyester powder color coating.
- S. Spray features and drains shall be bonded to the nearest grounding rod.
- T. Spray grounds / splash pads shall be designed to meet Philadelphia Water Department stormwater management requirements.
- U. Stormwater management facilities shall not be placed below spray ground areas due to conflicts with spray ground piping, etc.
- V. The following spray ground equipment manufacturers have been approved by Philadelphia Parks and Recreation as providers for spray feature equipment:
  - 1. Aquatix by Landscape Structures Inc. – 6500 Carlson Drive, Eden Prairie, MN 55346-1729 , Phone: (877) 632-0503, Web: [www.aquatix.playlsi.com](http://www.aquatix.playlsi.com). Local Representative: General Recreation, Inc. –

P.O. Box 440, Newtown Square, PA 19073, Phone: (610) 353-3332, Web: [www.generalrecreationinc.com](http://www.generalrecreationinc.com)

2. WaterPlay, 1451B Ellis Street, Kelowna, BC Canada V1Y 2A3, Phone 800 -590-5552, Web: [www.waterplay.com](http://www.waterplay.com) .

3. Equal approved by Philadelphia Parks and Recreation.

- END -

SECTION 328740  
SITE BOULDERS & BLOCKS

PART 1 GENERAL

**1.1 SUMMARY**

- A. This Section includes the following:
  - 1. Site Boulders
  - 2. Granite Block Seating
  
- B. Related Sections include, but are not limited to, the following:
  - 1. Section 03 33 01 - Landscape Architectural Cast-In-Place Concrete.
  - 2. Section 31 20 00 - Earthwork.
  - 3. Section 32 13 00 - Concrete Paving.

**1.2 PERFORMANCE REQUIREMENTS:**

- A. General: Provide to the site and hand set large boulders in conformance with the Drawings and under the direction of the Consultant.

**1.3 SUBMITTALS**

- A. General: Refer to and comply with Division 1 Section 013300 "Submittal Procedures," for procedures and other submittal criteria.
  
- B. Submit Samples for selection and verification purposes of Site Boulders.
  - a. Submit digital photographs for each boulder. Images shall be at least 3" x 5" at 300 dpi and shall be .jpg format.
  - b. Submit stone samples that match boulder form, color, grade, finish, type, and variety. Sample shall consist of stones not less than 6 inches square. Include 2 or more stones in each set of samples showing the full range of variations in appearance characteristics to be expected in the completed work.
  
- C. Submit Samples for selection and verification purposes of Granite Block Seating.
  - a. Submit digital photographs for each boulder. Images shall be at least 3" x 5" at 300 dpi and shall be .jpg format.
  
- D. Submit shop drawings of specifically identified and approved Site Boulders and Granite Block Seating that show approximate layout plan, elevations indicating approximate elevation heights.

#### **1.4 QUALITY ASSURANCE:**

- A. Single-Source Responsibility for Stone: Obtain stone from a single quarry with resources to provide materials of consistent quality in appearance and physical properties, including the capacity to cut and finish the material without delaying the progress of the work.

#### **1.5 DELIVERY, STORAGE AND HANDLING:**

- A. Deliver materials to the project site in undamaged condition.
- B. Store and handle the boulders and related materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breakage, chipping, or other causes.
- C. Do not use pinch or wrecking bars.
- D. Lift with wide-belt-type slings where possible; do not use wire rope or ropes containing tar or other substances that might cause staining.

### **PART 2 - PRODUCTS**

#### **2.1 SITE BOULDERS**

- A. SOURCE
  - 1. Varieties and Source: Subject to compliance with requirements, provide stone of the following variety and from the following source:
    - a. Granite Source: Wissahickon Stone Quarry LLC  
Address: 1A Waverly Rd, Glenside, PA 19038  
Contact: Corey Miller, Manager  
Office: (215) 887-3330  
Email: wissstonequarry@gmail.com
- B. MATERIAL
  - 1. Finish: Natural stone boulder
  - 2. Dimensions: Small (3x3'), Medium (4.5x4.5'), Large (6x6')
    - a. Or similar, to be approved by Landscape Architect.

#### **2.2 GRANITE BLOCK SEATING**

- A. SOURCE



1. Varieties and Source: Subject to compliance with requirements, provide stone of the following variety and from the following source:
  - a. Source: Stone Farm  
Address: 754 Main St., Monroe, CT 06468  
Contact: Steve Singlak  
Phone: (203) 270-2900  
Email: [ssinglak@stonefarmliving.com](mailto:ssinglak@stonefarmliving.com)  
Website: <https://stonefarmliving.com/>
- B. MATERIAL
  1. Reclaimed stone block benches.
  2. Finish: Flat face with rectangular shape
  3. Dimensions: As indicated on Drawings.
  4. Or approved equal.
- C. Blocks should match the sizes and shapes as indicated on the Contract Drawings.
- D. Blocks shall be free from sharp edges, cracks, flaking and deterioration, and any other obstruction, such as embedded iron or other metal remaining from prior use.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine the surfaces to receive the boulders, and the conditions under which they will be installed, with the Installer present, for compliance with the requirements for installation and other conditions affecting the performance of the stonework.
- B. Landscape Architect to be present for siting of Site Boulders and Granite Block Seating, to verify facing, rotation, and placement.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. Use all means necessary to protect materials of this Section before, during and after installation and to protect the installed work and materials of all other trades.
- B. Clean boulder surfaces that have become dirty and stained prior to setting. Remove soil, stains, and foreign materials. Clean stones by thoroughly scrubbing stones with fiber brushes followed by a thorough drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh filler or abrasives.
- C. For Boulders to be installed on a concrete base, roughen surface.

### **3.3 SETTING BOULDERS & BLOCKS, GENERAL**

- A. Set the boulders and blocks to comply with the requirements indicated on the Contract Drawings and the final shop drawings.
- B. Shim and adjust supports and accessories to set the boulders accurately and plumb in the locations noted on the drawings and in the field.
- C. Do not place any boulder within fall zones of any play element.
- D. Layouts shall be approved by the Landscape Architect before installation.
- E. Broken, chipped, stained, or otherwise damaged boulders, blocks, and stairs shall be replaced until the methods and results are acceptable to the Landscape Architect.
- F. Clean the boulders and blocks not less than 2 days after completion of the work, using clean water and stiff-bristle fiber brushes. Do not use wire brushes, acid-type cleaning agents, cleaning compounds with caustic or harsh fillers, or other materials or methods that could damage the stone.

- END -

**SECTION 329210  
TURF GRASS SEEDING**

**PART 1       GENERAL**

1.1       SECTION SUMMARY

- A.       Provide seed, sod and related items. Seeding shall be where indicated and at a time allowed by environmental conditions, by adjacent construction operations, and as specified.
- B.       Review of conditions and materials affecting seed installations.
- C.       Maintenance of seeded or sodded areas.

1.2       RELATED SECTIONS

- A.       Applicable Sections: Division 1
- B.       Section 31 20 00 – Earth Moving
- C.       Section 32 93 00 – Plants

1.3       SUBMITTALS

- B.       Notices and Scheduling
  - 1.       Submit a schedule itemizing lawn and meadow work to be performed. This schedule shall be in addition to Project Contract Schedule(s) required by General Conditions and shall be submitted within 45 calendar days after Contract Notice to Proceed.
    - a.       Include in this schedule anticipated dates for commencement and sequencing of lawn and meadow seeding, including but not limited to seed bed fertilizer and water applications, seeding, sodding and commencement of maintenance period.
    - b.       Schedule shall also include, and relate to, work specified in other sections, such as subgrade preparations; landscape soil placements and grading; utility installations paving and site wall installations; and other elements of site. Obtain related scheduling information from General Contractor.
  - 2.       Prior to seed and sod installation, submit confirmation of understanding that the following elements of work have been inspected and approved prior to start of any work of this Section:

- a. Complete placement of planting soil mix including verification of acceptability of grades, quality of soil mixes, and quality of material placement.
  - b. Confirm, also, that no construction access will be required across lawn or meadow areas.
- C. Product Data:
1. Submit manufacturers or supplier's literature or tear sheets giving name of product, manufacturers or supplier's name and evidence of compliance with Contract Documents.
  2. Commercial fertilizer
  3. Herbicides, pesticides and fungicides
  4. Mulch(s)
- D. Certificates:
1. Submit certified analysis for each treatment, amendment, and fertilizer material specified and as used. Include guaranteed analysis and weight for packaged material.
  2. Prior to the use on site of any chemical weed control materials, submit a list of the weed control materials and quantities per acre intended for use in controlling the weed types expected on the site. Submittal shall include data demonstrating the compatibility of the weed control materials and methods of installation or application with the intended planting and seed or sod varieties.
- E. Test Reports: Submit written reports of each grass and meadow seed mixture or sod composition. Each report shall include the following as a minimum and such other information required specific to material tested:
1. Date issued;
  2. Project Title and names of Contractor and supplier;
  3. Testing laboratory name, address and telephone number, and name(s), as applicable, of each field and laboratory inspector;
  4. Date, place, and time of sampling and test;
  5. Location of material source;
  6. Type of test;
  7. Recommendations for soil additives, mix proportions, and methods of preparation, as applicable, for optimum lawn and meadow conditions;

8. Test for purity, proportion by weight, weed seed content and germination percentage of seed mixtures proposed for use.
  9. No seed shall be delivered until the test reports are approved. Seed shall be tested within six months immediately preceding date of sowing. Owner reserves the right to have seed tested independently.
- F. Samples:
1. Mulch: Two-pound bag of each type, with manufacture's recommendations on application rate for Hydro mulch.
- G. Statement(s) of Qualifications: Submit to confirm qualifications as specified in Article 1.4, herein.
- H. Maintenance Program: Submit a program for continued maintenance of lawn and meadow areas after Substantial Completion. Program shall include a report of conditions unique to site that has been identified during Contractor's maintenance of lawn and meadow work (Article 3.6, herein). Refer also to Article 1.4, herein.

#### 1.4 QUALITY ASSURANCE

- A. Qualifications:
1. Installation and maintenance foreman on the job shall be competent English-speaking supervisor(s), experienced in landscape installation and maintenance. Perform work with personnel totally familiar with lawn and meadow preparations and installations under the supervision of an experienced landscape foreman.
  2. Exhibit and identify a record of at least three (3) lawn and meadow installations of similar scope or size to this Project.
- B. Pre-Installation Review of Related Work: Within 45 calendar days after Contract Notice to Proceed for seeding work or such later date as approved by Owner's Representative, but prior to first Pre-Installation Conference, obtain data as necessary and review plant mix materials and soil amendments to be used for lawn and meadow areas of this Project. Become familiar with proposed plant mixes and on-site grading conditions. Reference Section 02920, Soil Preparation and Mixes, and design drawings.
1. Submit a report of acceptance of soil mixes as being appropriate for seed and sod installation and, if deemed necessary, recommendations for possible SOC adjustment of amendments.
  2. Review conditions and coordinate findings of report at Pre-Installation Conference.
- C. Pre-Installation Conference: Prior to commencement of any of the work of this section, Contractor shall arrange a conference at the site of this Project with the Owner's

Representative, Construction Manager, and Landscape Architect. At least five-(5) working days notice shall be given prior to the conference.

1. Conference attendance will include the Contractor, the foreman appointed to oversee the work of this Section, the foreman responsible for soil preparation and mixes and soil placement (Section 02920), other representatives of Owner, and other persons as deemed appropriate for coordination of work and quality control.
2. At the conference, review lawn and meadow installation and sequence schedules, specification criteria and installation, procedures, outstanding submittals and approvals, and such other subjects necessary for coordination of Work.
3. Establish follow up meeting(s) as necessary including but not limited to a final pre-installation review of lawn and meadow area plant mix soil placement.

D. Inspection for Substantial Completion

1. Maintain all lawn and meadow areas until Substantial Completion. Maintenance will be in accordance with requirements specified in Article 3.6 of this Section.
2. The Landscape Architect will make an inspection for Substantial Completion of the work of this Section at the time of Substantial Completion of the entire Contract. The Contractor shall submit a full and complete written program for maintenance of the lawns and meadows for review by the Landscape Architect and Owner's Representative at the time of the request for substantial completion.
  - a. Submit a written request for inspection at least 14 calendar days prior to the day on which the inspection is requested.
  - b. Contractor shall prepare a list with status of items to be completed or corrected for review by the Landscape Architect, prior to inspection.
  - c. At time of the Landscape Architect's inspection, all lawns and meadows shall show a uniform, thick, well-developed stand of plants. If the stand is unsatisfactory, as determined by the Landscape Architect, the Contractor's maintenance responsibility shall continue until an acceptable stand of plants is achieved.
  - d. Upon completion of the inspection, the Landscape Architect will amend Contractor's list of items to be completed or corrected as determined necessary and will indicate the anticipated time period for their completion or correction.
3. Lawns and meadows will not be accepted until all items of lawn and meadow work have been completed or corrected. The Landscape Architect, after Contractor's completion of outstanding work, will recommend to the Owner, in writing, the Substantial Completion of the lawn and grasses work of this Section.

- a. The Contractor's responsibility for maintenance, however, shall terminate only upon issuance of acceptance by Owner for Substantial Completion.

## 1.5 REFERENCES

- A. SPN: "Standardized Plant Names," latest edition, by the American Joint Committee on Horticultural Nomenclature.
- B. Association of Official Agricultural Chemists.
- C. ASTM: American Society for Testing and Materials using test criteria as specified or required by other references.
- D. AASHTO: American Association of State Highway and Transportation Officials.

## 1.6 REGULATORY REQUIREMENTS

- A. Comply with all rules, regulations, laws and ordinances of local, state and federal authorities having jurisdiction. Provide labor, materials, equipment and services necessary to make Work comply with such requirements without additional cost to Owner.
- B. Procure and pay for permits and licenses required for work of this section.

## 1.7 PROJECT/SITE CONDITIONS

- A. Acquaintance With Existing Site Conditions:
  - 1. Through study of all Contract Documents, and by careful examination of the site, become informed as to the nature and location of the Work, the nature of surface and subsurface soil conditions, the character, quality and quantity of the materials to be encountered, the character of equipment and facilities needed preliminary to and during the prosecution of the Work, the general and local conditions, and all other matters which can in any way affect the Work.
  - 2. Investigate the conditions of public thoroughfares and roads as to availability, clearances, loads, limits, restrictions, and other limitations affecting transportation to, ingress and egress of this work site. Conform to all governmental regulations in regard to the transportation of materials to, from, and at the job site, and secure in advance such permits as may be necessary.
- B. Should the Contractor, in the course of Work, find any discrepancies between Contract Drawings and physical conditions or any omissions or errors in Drawings, or in layout as furnished by the Owner, it will be Contractor's duty to inform the Landscape Architect (Design Consultant) immediately in writing for clarification. Work done after such discovery, unless authorized by the Landscape Architect, shall be done at the Contractor's risk.
- C. Sequencing and Scheduling:

1. Adjust, relate together, and otherwise coordinate work of this Section with Work of Project and all other Sections of Specification.
2. Seed installations shall not begin until all other constructions, including installation of all utilities and placement of planting soil mixes, are complete and possibility from damage caused by operations does not exist.

D. Environmental Requirements:

1. Perform soil work only during suitable weather conditions. Do not disc, rototill, or work soil when frozen, excessively wet, or in otherwise unsatisfactory condition.
2. Place grass seed or sod only at seasonal times within appropriate temperature range and wind conditions for plant development as approved by Landscape Architect:
  - a. Acceptable Seeding Seasons/Times:
    - 1) Spring: April 1st - June 15th
    - 2) Fall: September 1st - October 15<sup>th</sup>
  - b. Seeding or sodding at any time other than within the above seasons shall be allowed only when the Contractor submits a written request for permission to do so and permission is granted in writing by the Owner. Newly seeded or sodded areas, if installed out of season, must be continuously watered according to best recommended and Landscape Architect approved practice. Contractor shall be responsible for providing an acceptable stand of grass as specified.

1.8 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Packaged Materials: Deliver packaged materials in unopened bags or containers, each clearly bearing the name, guarantee, and trademark of the producer, material composition, manufacturers' certified analysis, and the weight of the material.
- B. Bulk Materials
  1. Deliver bulk materials with each individual shipment accompanied by an affidavit from the vendor (supplier), countersigned by the Contractor upon receipt, identifying the material type, composition, analysis, and weight and certifying that the material furnished complies with specification requirements of this Project.
  2. Affidavits shall be furnished in duplicate with one copy submitted to Construction Manager at the end of day of shipment receipt at the Project site and the second copy retained with material or on file with Contractor.



- C. Mulch, amendment materials, or soil stored on site temporarily in stockpiles prior to placement shall be protected from intrusion of contaminants, erosion and from mechanical or environmental damage.

**PART 2 PRODUCTS**

2.1 TEMPORARY TURF

- A. Temporary turf seed mix shall be as specified on the Erosion Control Plans, Notes, and Details.

2.2 PERMANENT TURF

- A. Permanent turf seed mix shall be the following:

Seed Type	Proportion by Weight	Minimum Purity	Minimum Germination
1. Turf-Type Tall Fescue	60%	95%	80%
2. Perennial Rye Grass	30%	95%	85%
3. Kentucky Blue Grass	10%	90%	80%

2.3 SOD

- A. Nursery-grown and cultivated from certified seed containing seed mix as specified for Permanent Turf. Sod shall be from 11 to 36 months in age before lifting, uniform in density, natural green color, free of noxious weeds. Cut sod to a 3/4 inch depth. 1/8 inch tolerance plus or minus, with grass height at 1 1/2 inches to 2 inches, wetted before cutting. Obtain approval of sod and certify its grass types and percentages before cutting or delivery to Project Site.

2.4 TOPSOIL

- A. Existing topsoil stripped from the project site, disturbed areas only, may be used for lawns, planting and transplanting work. Contractor shall verify if available project site topsoil is sufficient in quantity to perform the required work. If project site topsoil is insufficient the contractor shall provide topsoil from an approved off project site source(s) as required to complete work.
- B. Topsoil to be imported to the project site shall be a sandy loam topsoil (as defined in USDA Soil Texture Classification) and be fertile, friable, well-drained, pH range of 6.0 to 6.5, free of subsoil, toxic substances harmful to plant growth, without clay lumps, stones, roots or debris. The imported topsoil shall have a mechanical analysis as follows:
  - 1. Sand: 35 percent to 40 percent.
  - 2. Clay: 15 percent to 20 percent.
  - 3. Organic Matter: 2.5 percent.
  - 4. Silt: Balance

2.5 FERTILIZER

- A. Conforming to standards of Association of Official Analytical Chemists, delivered to Project Site in sealed and labeled bags, or in bulk with certification as to quality and analysis. Nitrogen source shall be at least 33 percent water insoluble. Fertilizer shall have the following formulations:
  - 1. Basic Fertilizer: 10-10-10 or 10-6- 4 analysis.
  - 2. Starter Fertilizer: 5-10-10 or 10-20-20 analysis.
- B. Fertilizer shall be delivered to the site, mixed as specified, in the original unopened standard size bags showing weight, analysis and name of manufacturer. Containers shall bear the manufacturer's guaranteed statement of analysis or a manufacturer's certificate of compliance covering analysis shall be furnished to the Landscape Architect. Store fertilizer in a weatherproof place and in such a manner that it shall be kept dry and its effectiveness shall not be impaired.

## 2.6 LIMESTONE

- A. Ground agricultural dolomitic limestone, 90 percent calcium carbonate equivalent, conforming to standards of Association of Official Analytical Chemists and applicable State and Federal Regulations. Material shall have a total of 100% passing the 10 mesh sieve, minimum of 90% passing the 20 mesh sieve, and a minimum of 60% passing the 100 mesh sieve.

## 2.7 SOIL-STABILIZING AGENT

- A. For use in hydroseed mix only. Material shall be one (1) of the following:
  - 1. "Verdyol Complex": Weyerhaeuser Company,
  - 2. "Curasol": Wolbert Master Associates,
  - 3. "Terra-Tack": Grass Growers, Inc,
  - 4. "J-Tac": Reclamare Company,
  - 5. Approved Equal.

## 2.8 MULCH MATERIALS

- A. General Use: Straw, salt marsh hay, or a combination of both. Material shall be:
  - 1. Reasonably weed free, not brittle or overly decomposed.
  - 2. Cured to less than 20% moisture content by weight.
  - 3. Contain no stems of tobacco, soybeans, or other coarse or woody material.

## 2.9 HYDROSEEDING MATERIALS

- A. Fiber mulch shall be biodegradable, non-toxic green dyed-wood cellulose-fiber mulch; nontoxic; free of plant-growth or germination inhibitors; with maximum mixture content of 15 percent and a pH range of 4.5 to 6.5.

- B. Nonasphaltic tactifier shall be a colloidal tactifier recommended by the fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors. Material shall be one (1) of the following:
  - 1. "Verdyol Complex": Weyerhaeuser Company,
  - 2. "Curasol": Wolbert Master Associates,
  - 3. "Terra-Tack": Grass Growers, Inc,
  - 4. "J-Tac": Reclamare Company,
  - 5. Approved Equal.

## 2.10 EROSION CONTROL BLANKET/FABRIC NETTING

- A. Contractor shall provide and install where indicated on civil drawings "Curlex" blankets: by American Excelsior Company; "Polyjute" Style465 CT: by Synthetic Industries or approved equal.
- B. The area to be covered shall be properly prepared, fertilized, and seeded before blanket is applied. When blanket is unrolled, the netting shall be on top and the fibers in contact with the soil over the entire area. In ditches, the blanket shall be applied in the direction of the flow of water, butted snugly at ends and side and stapled. On slopes, the blankets shall be applied either horizontally or vertically to the slope. Ends and sides shall be butted snugly and stapled. Staple to manufacturer's recommendations.

## 2.11 WATER

- A. Potable, clean, fresh and free from harmful material. Water shall be furnished by Owner as necessary for lawn installation and maintenance. Include all hoses and other irrigation equipment required for correct use of water without waste.

## 2.12 ACCESSORY MATERIALS

- A. Herbicides: For possible use if there is seed germination in lawn areas after plant soil mix placement and prior to seed installation. Herbicides shall be approved before use for type and rate of application by the Landscape Architect and by local and state agencies with jurisdiction.
  - 1. Post-emergent shall be Roundup, as manufactured by Monsanto Agricultural Products Company, C3NJ, St. Louis, MO 63166, or an approved equal.
- B. Sod Stables: 11 Gauge steel wire staples, one (1) inch wide and six (6) inches long for securing sod to slopes 4:1 (25%) or greater.
  - A. Lawn areas shall have fertilizer applied in two (2) applications with a thorough watering immediately following application. The first application shall be one (1) week before the seeding at the rate of 35 pounds per 1,000 square feet harrowed into the top two inches (2") of seedbed. The second application shall be done at the rate of 25 pounds per 1,000 square feet, immediately following the second mowing.

- B. Commercial fertilizer for temporary turf seed areas shall be a 10-10-10-grade fertilizer (600lbs/acre).

### **PART 3 EXECUTION**

#### **3.1 VERIFICATIONS**

- A. Prior to construction of lawn and meadow areas, ascertain the location of all electric cables, conduits, underdrainage systems and utility lines. Take proper precautions so as not to disturb or damage sub-surface elements. Contractor failing to take these precautions shall be responsible for making requisite repairs to damaged utilities at Contractors own expense.
- B. Verify that required underground utilities are available, in proper location and ready for use. Coordinate with other trades.
- C. Verify that all final grades blend with adjacent grades and that area(s) to be seeded is free from depressions and abrupt changes in slope and that all grades as placed have been approved by, and remain satisfactory to Landscape Architect.
- D. Verify that all tree planting in lawn areas and all shrub beds adjacent to lawn areas have been installed, will remain as approved, and no further construction work will occur which will or may require access through lawns and meadows.

#### **3.2 SUBSOIL PREPARATION**

- A. Inspect rough grade subsoil. Eliminate uneven areas and low spots. Remove, for example, debris, roots, branches and stones in excess of 2 inches in size. Remove subsoil which has been contaminated with petroleum, concrete spills, and toxic substances.
- B. Bring subsoil to required levels, profiles and contours. Cut out areas to receive topsoil specified in this Section, and otherwise to subgrade elevations as specified in Section 02200 – Earthwork.
- C. Cultivate subgrade to a depth of 6 inches where topsoil is to be placed. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted subsoil.
- D. Maintain during grading operations the specified compaction, restore previously compacted areas and test soil compaction according to Section 02200 - Earthwork.

#### **3.3 TOPSOIL PLACEMENT AND LAWN BED PREPARATION**

- A. Inspect subsoil prior to placing topsoil to confirm subsoil conditions meet the requirements of this specification. If subsoil conditions do not meet the requirements repeat subsoil preparation work as specified under this Section.

- B. Place topsoil in areas where seeding, sodding and planting are to be performed. Place to the following minimum depths, up to finished grade elevations: Six (6) Inches for seeded and sodded areas.
- C. Incorporate the following materials uniformly throughout entire depth of topsoil:
  - 1. Limestone: 100 pounds per 1,000 square feet or as determined by agricultural soil test reports.
  - 2. Basic Fertilizer: 3 pounds per 1,000 square feet or as determined by agricultural soil test reports.
- D. Use topsoil in relatively dry state. Place during dry weather. Do not spread wet or clumpy topsoil.
- E. Fine grade topsoil to the required levels, profiles and contours. Eliminate rough and low areas to ensure positive drainage. Establish proper flowline gradients and profiles for swales and other storm management features. Drag smooth and hand rake topsoil to final grade elevations. Roll if necessary to stabilize in order to commence seeding. Remove all ruts, mounds, and ridges on surface of topsoil. Remove all stones greater than 1 inch, roots, weeds, or other debris visible on soil surface. Resulting holes shall be filled with specified topsoil, leaving a uniform planar surface. Grade uniformly so soil surface does not have low spots which may collect water. Finish grades shall be within ¼ inch +/- tolerance of finish grades indicated on the plans.
- F. Manually spread topsoil around trees, plants, and other construction to prevent possible damage by grading equipment.
- G. Blend topsoil smoothly into undisturbed areas. Do not place topsoil on existing vegetation in undisturbed areas. Maintain required depth of topsoil at limit of grading line.
- H. Lightly compact and roll placed topsoil.
- I. Clean all paved and building surfaces and remove soil to maintain quality of finished surface.
- J. Allow for and verify that planting soils of lawn and meadow areas, completed in placement with deficiencies corrected as necessary, to settle for a minimum fourteen (14) days prior to beginning of lawn and meadow installation.
- K. Coordinated sequencing of work shall allow immediate seed and sod installation after completion of verifications and preparations. \

### 3.4 ADDITIONAL SEED AND SOIL AMENDMENTS

- A. Starter fertilizer: Add starter fertilizer at the following rates to surface of seed bed or include as an ingredient in hydroseed mix: 40 pounds per 1,000 square feet.

### 3.5 SEEDING

- A. Seeding shall be done between the following dates:
1. Permanent Seeding:
    - a. Spring Seeding: April 1 to June 15.
    - b. Fall Seeding: August 15 to November 1.
  2. Temporary (Non-Permanent) Seeding:
    - a. January 1 to December 31.
- B. Prior to seeding contractor shall inspect surface soil bed conditions to assure they meet the requirements for receiving seed. At minimum the soil bed surface shall be roughened to break-up large clods and surface crust, to scarify and fine rake to remove irregularities that will hold water.
- C. Manual or mechanical sowing of seed may be by the following optional methods:
1. Mechanical Power-Drawn Seeder: Combination grass planter and land packer or pulverizer. Plant seed not deeper than [1/4 inch] {6 mm}. Keep seeding operation as close as possible to contours and not up and down slopes. After seeding, compact with land roller, such as a cultipacker. With proper equipment, sowing seed and cultipacking in one (1) operation is satisfactory.
  2. Hopper Type Spreader: Manually-propelled or power-drawn hopper devices. Uniformly distribute seed by sowing half seed in one (1) direction and remainder at right angles to direction of first sowing. Cover seed an average depth of [1/4 inch] {6 mm} by means of chain harrow, cultipacker, or other approved method.
- D. Hydroseeding: Mix specified seed, fertilizer and fiber mulch in water using clean, washed equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into a homogenous slurry suitable for hydraulic application. Hydraulic broadcasting of prepared material.
1. Hydroseed at the following rates per acre:
    - a. Water: As specified.
    - b. 1,500 pounds of wood cellulose, plus 15 percent for slopes 5 percent and steeper.
    - c. Fertilizer: As specified for starter fertilizer. Starter fertilizer may be added to surface of seed bed.
    - d. Soil stabilizer of type and at rate recommended in writing by manufacturer.
    - e. Seed Mix: As specified.
    - f. For a 3,000 gallon tank, multiply specified quantities by 0.75. Mix and agitate all materials, except wood cellulose, in 2,200 gallons of water; then add wood cellulose, fill tank with water and continue agitation. Seed promptly, under constant agitation of mix, beginning when complete mix is a uniform slurry. Limit coverage for 3,000 gallon tank to 0.75 acre.

- g. Take precautions against overspray onto roads, curbs, sidewalks, building walls, and other surfaces except ground areas. Contractor shall promptly clean all areas of overspray to satisfaction of Owner's Representative and Landscape Architect.

### 3.6 SODDING

- A. Provide sod as indicated on Drawings.
- B. Place sod on topsoil bed prepared as indicated for seeded areas, including lime, basic fertilizer and starter fertilizer applied to bed surface. At time sod is placed, topsoil shall be in a damp, friable, loose condition, with no surface crust.
- C. Retain sod on slopes equal to or steeper than four (4) horizontal to one (1) vertical and in drainage swales, using sod staples driven into sod until top is flush with sod.
- D. In placing sod, keep rows parallel with contour lines. Keep Work true to finished grade, and tamp or roll to establish firm contact with topsoil bed. Butt pads tightly and stagger ends with those in adjacent rows. If sod separates less than [1/2 inch] {13 mm}, backfill with topsoil flush with sod and overseed. If sod separates [1/2 inch] {13 mm} or greater, overlay with sod and spade cut to fit.

### 3.7 MULCHING

- A. Except hydroseeded areas, seeded areas sloped four (4) horizontal to one (1) vertical or greater, and areas where lawn would be difficult to establish, shall be mulched at rate of 1.5 tons per acre.
- B. Use wood fiber mulch or soil stabilizing agents, hydraulically applied in water at rate of 1,500 pounds of wood fiber per acre, plus 15 percent on slopes greater than four (4) to one (1).
- C. For dry-mulched areas, spray with soil-stabilizing agent/tackifier material immediately after spreading straw or salt marsh hay or both, at rate of 200 gallons of asphalt per acre, in a method to bind mulch to soil and inhibit wind loss of mulch. Do not apply soil-stabilizing agent/tackifier material within when ambient temperature is below 55 degrees F. Clean off misplaced spray from building walks, paving, light standards and bases, and other surfaces to satisfaction of Owner's Representative or Landscape Architect.

### 3.8 WATERING

- A. Keep newly sodded areas moistened until grass becomes well established and have shown signs of knitting with topsoil.
- B. In event of insufficient rainfall, moisten areas every two (2) or three (3) days until sod becomes established. Thereafter, water in absence of rain every seven (7) to ten (10) days. When watering sod, make sure that water soaks through sod into topsoil bed below.

### 3.9 PROTECTIVE WORK

- A. Provide materials and Work necessary to protect Work from damage. Prevent damage to Owner's property and Work specified in other Sections during these operations.

- B. Protective Work shall include wire line and stakes along walkways with cloth strips at 4 feet intervals as evidence of wire and also "KEEP OFF" signs.
- C. Defer Work when continuation of construction Work must occur over certain lawn areas.

### 3.10 MAINTENANCE PRIOR TO ACCEPTANCE

- A. Maintain all sodded areas by properly mowing, watering, weeding, and similar care to keep Work in a clean and neat condition at all times. Advise Owner's Representative, in writing, when Work is in condition to meet acceptance.

### 3.11 CONDITIONS OF ACCEPTANCE

- A. Fine Lawns shall be approved to begin one (1) year Maintenance and Guarantee Period based on the following requirements:
  - 1. Bare spots, not greater than 1 square foot, shall be permitted up to a maximum of 3 percent of Fine Lawn Area.
- B. Sod Areas shall be approved to begin one (1) year Maintenance and Guarantee Period based on the following requirements:
  - 1. Sodded areas shall have been mowed at least twice since time of installation.
  - 2. Sod shall have shown signs of knitting with topsoil layer and adjoining sod pads. Open joints between sod pads nor sod slippage on slopes shall not be accepted.
  - 3. Sod shall be in a thriving and vigorous condition exhibiting a healthy green color. Bare spots or brown spots shall not be accepted.
- C. During one(1) year Maintenance and Guarantee Period, Owner shall do no Maintenance Work, watering or cutting of lawns provided under this Contract.
- D. Contractor may use existing underground irrigation systems if available.
- E. When Work meets conditions specified above, Date of Acceptance shall be Date that Guarantee Period commences. Design Professional shall notify Contractor in writing of said Date.

### 3.12 MAINTENANCE AND GUARANTEE OF LAWN AREAS AND SODDED AREAS

- A. Provide all Maintenance Work throughout Guarantee Period, which shall be one (1) year from Date of Acceptance.
- B. Guarantee Work to be in vigorous and thriving condition by end of Guarantee Period, free of objectionable quantities of weeds and other undesirable growth. Maximum percentage allowed for scattered bare spots shall not exceed 3 percent of fine lawn area. Each bare spot shall not be larger than 1 square foot.
- C. Maintenance Work shall include watering, remedial Work such as repair of eroded areas, and resodding if required. Provide general cleanup of stakes, strings, temporary signs,



and sweeping of paving and sidewalks. Cut grass a minimum of 26 cuttings a year. Include other Work as maintenance as necessary, for example, lawn feeding, grub control and weeding, broadleaf weed control as deemed required by Contractor in support of Guarantee, or as may be brought to his/her attention during Guarantee Period.

- D. Additional fertilization and limestone shall be required. Spread one (1) additional application of 10-6-4 fertilizer evenly over fine lawn area at rate of 25 pounds per 1,000 square feet and spread one (1) additional application of limestone at rate of 100 pounds per 1,000 square feet. Complete applications in fall season of year approaching termination of Maintenance and Guarantee Period.
- E. Cutting of fine lawn areas shall occur when grass is dry and to maintain a height of about 2 inches. Cut grass a maximum of 1/3 of total grass blade height. Maintain a neatly-trimmed edge condition throughout at all times.
- F. During one (1) year Maintenance and Guarantee Period, Owner shall do no Maintenance Work, watering or cutting of lawns provided under this Contract.

### 3.13 FINAL INSPECTION AND ACCEPTANCE

- A. Toward end of Maintenance and Guarantee Period, give notice in writing to Owner's Representative stating desired Date for Final Inspection.
- B. At time of Final Inspection, lawn Work shall be in condition required by Maintenance and Guarantee Work indicated.
- C. If Work is accepted at time of Final Inspection, Guarantee shall be considered fulfilled and terminated. Should any Work need replacement at time of Final Inspection, continue Guarantee Period until such replacements are made and deemed acceptable.
- D. Design Professional shall notify Contractor in writing of Date of Final Acceptance.

END OF SECTION

## SECTION 329300

### PLANTS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Plants.
2. Planting soils.

###### B. Related Sections:

1. Division 31 Section "Earth Moving" for excavation, filling, and rough grading and for subsurface aggregate drainage and drainage backfill materials.
2. Division 32 Section "Turf and Grasses" for turf (lawn) and meadow planting, hydroseeding, and erosion-control materials.

##### 1.2 DEFINITIONS

- A. Backfill: The earth used to replace or the act of replacing earth in an excavation.
- B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.
- C. Balled and Potted Stock: Plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required.
- D. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.
- E. Finish Grade: Elevation of finished surface of planting soil.
- F. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

- G. Pests: Living organisms that occur where they are not desired, or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- H. Planting Area: Areas to be planted.
- I. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- J. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.
- K. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.
- L. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.
- M. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.
- N. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- O. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated, including soils.
  - 1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
- B. Samples for Verification: For each of the following:
  - 1. Organic Mulch: 1-quart (1-liter) volume of each organic mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.
  - 2. Mineral Mulch: 2 lb (1.0 kg) of each mineral mulch required, in sealed plastic bags labeled with source of mulch. Sample shall be typical of the lot of material to be delivered and installed on the site; provide an accurate indication of color, texture, and makeup of the material.

3. Edging Materials and Accessories: Manufacturer's standard size, to verify color selected.
- C. Qualification Data: For qualified landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.
- D. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:
  1. Manufacturer's certified analysis of standard products.
  2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
- E. Material Test Reports: For imported or manufactured topsoil.
- F. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before start of required maintenance periods.
- G. Warranty: Sample of special warranty.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape Installer whose work has resulted in 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: Five years' experience in landscape installation in addition to requirements in Division 01 Section "Quality Requirements."
  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 shall have certification in all of the following categories from the Professional Landcare Network:
    - a. Certified Landscape Technician - Exterior, with installation specialty area, designated CLT-Exterior.
    - b. Certified Ornamental Landscape Professional, designated COLP.
- B. Soil-Testing Laboratory Qualifications: An independent or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.
- C. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.
  1. Tree caliper to be 3.5-4".

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- D. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.
  - 1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches (150 mm) above the root flare for trees up to 4-inch (100-mm) caliper size, and 12 inches (300 mm) above the root flare for larger sizes.
  - 2. Other Plants: Measure with stems, petioles, and foliage in their normal position.
- E. Plant Material Observation: Architect shall observe plant material either at place of growth before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Architect retains right to observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, 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.
  - 1. Notify Architect of sources of planting materials 14 days in advance of delivery to site.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws if applicable.
- B. Bulk Materials:
  - 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
  - 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
  - 3. Accompany each delivery of bulk fertilizers, lime, and soil amendments with appropriate certificates.
- C. Deliver bare-root stock plants freshly dug. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting.
- D. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.
- E. Handle planting stock by root ball.

- F. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.
  - 1. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
  - 2. Do not remove container-grown stock from containers before time of planting.
  - 3. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly-wet condition.

## 1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.
- B. Interruption of Existing Services or Utilities: Do not interrupt services or utilities to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary services or utilities according to requirements indicated:
  - 1. Notify Owner no fewer than 10 days in advance of proposed interruption of each service or utility.
  - 2. Do not proceed with interruption of services or utilities without Owner's written permission.
- C. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.
  - 1. Spring Planting: Feb 15 to May 15 (Trees, Shrubs, Ornamental Grasses and Perennials)
  - 2. Fall Planting: October 15 until ground is frozen.(Trees and shrubs ONLY – Trees must be completely dormant before digging)
- D. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.
- E. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.
  - 1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

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1.7 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner, or incidents that are beyond Contractor's control.
    - b. Structural failures including plantings falling or blowing over.
    - c. Faulty performance of tree stabilization and edgings
    - d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  - 2. Warranty Periods from Date of Substantial Completion
    - a. Trees, Shrubs, Vines, and Ornamental Grasses: 12 months.
    - b. Ground Covers, Biennials, Perennials, and Other Plants: 12 months.
  - 3. Include the following remedial actions as a minimum:
    - a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
    - b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
    - c. A limit of one replacement of each plant will be required except for losses or replacements due to failure to comply with requirements.
    - d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

1.8 MAINTENANCE SERVICE

- A. Initial Maintenance Service for Trees and Shrubs: Provide maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than maintenance period below.
  - 1. Maintenance Period: 12 months from date of Substantial Completion.
- B. Initial Maintenance Service for Ground Cover and Other Plants: Provide maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than maintenance period below.
  - 1. Maintenance Period: 12 months from date of Substantial Completion
  - 2. Retain paragraph below if needed. Revise starting date if required.

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## PART 2 - PRODUCTS

### 2.1 PLANT MATERIAL

- A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant Schedule or Plant Legend shown on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
  - 1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch (19 mm) in diameter; or with stem girdling roots will be rejected.
  - 2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.
- B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Architect, with a proportionate increase in size of roots or balls.
- C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which shall begin at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

### 2.2 INORGANIC SOIL AMENDMENTS

- A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
  - 1. Class: T, with a minimum of 99 percent passing through No. 8 (2.36-mm) sieve and a minimum of 75 percent passing through No. 60 (0.25-mm) sieve.
  - 2. Provide lime in form of ground dolomitic limestone
- B. Aluminum Sulfate: Commercial grade, unadulterated.

### 2.3 ORGANIC SOIL AMENDMENTS

- A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1/2-inch (13-mm) sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
- B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or granular texture, with a pH range of 3.4 to 4.8.

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- C. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.

## 2.4 FERTILIZERS

- A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
  - 1. Composition: 1 lb/1000 sq. ft. (0.45 kg/92.9 sq. m) of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
  - 2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.
- B. Chelated Iron: Commercial-grade FeEDDHA for dicots and woody plants, and commercial-grade FeDTPA for ornamental grasses and monocots.

## 2.5 PLANTING SOILS

- A. Planting Soil Mix Type 1: Sandy Loam (USDA Soil Texture Triangle) ASTM D 5268 topsoil, with pH range of 5.5 to 7, a minimum of 4 percent organic material content; free of stones 1 inch (25 mm) or larger in any dimension and other extraneous materials harmful to plant growth.

## 2.6 MULCHES

- A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:
  - 1. Type: Shredded hardwood
  - 2. Size Range: 2 inches (50 mm) maximum, 1/2 inch (13 mm) minimum.
  - 3. Color: Natural.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas to receive plants for compliance with requirements and conditions affecting installation and performance.
  - 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.

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2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
  3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
  4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

### 3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Architect's acceptance of layout before excavating or planting. Make minor adjustments as required.
- D. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

### 3.3 PLANTING AREA ESTABLISHMENT

- A. Loosen subgrade of planting areas to a minimum depth as shown on plans. Remove stones larger than 1 inch (25 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
1. Thoroughly blend planting soil off-site before spreading.
    - a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
    - b. Mix lime with dry soil before mixing fertilizer.
- B. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.
- C. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

### 3.4 EXCAVATION FOR TREES AND SHRUBS

- A. Planting Pits and Trenches: Excavate circular planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are not acceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
  - 1. Excavate at least 12 inches (300 mm) wider than root spread and deep enough to accommodate vertical roots for bare-root stock or as shown on plans and details.
  - 2. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
  - 3. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
  - 4. Maintain required angles of repose of adjacent materials as shown on the Drawings. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
  - 5. Maintain supervision of excavations during working hours.
  - 6. Keep excavations covered or otherwise protected overnight
- B. Obstructions: Notify Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.
- C. Drainage: Notify Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.
- D. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

### 3.5 TREE, SHRUB, AND VINE PLANTING

- A. Before planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.
- B. Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.
- C. Set balled and burlapped stock plumb and in center of planting pit or trench with root flare 1 inch (25 mm) above adjacent finish grades.
  - 1. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
  - 2. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly

- before placing remainder of backfill. Repeat watering until no more water is absorbed.
  3. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside the root ball about 1 inch (25 mm) from root tips; do not place tablets in bottom of the hole.
  4. Continue backfilling process. Water again after placing and tamping final layer of soil.
- D. Set container-grown stock plumb and in center of planting pit or trench with root flare 1 inch (25 mm) above adjacent finish grades.
1. Carefully remove root ball from container without damaging root ball or plant.
  2. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
  3. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside the root ball about 1 inch (25 mm) from root tips; do not place tablets in bottom of the hole.
  4. Continue backfilling process. Water again after placing and tamping final layer of soil.

### 3.6 GROUND COVER AND PLANT PLANTING

- A. Dig holes large enough to allow spreading of roots.
- B. For rooted cutting plants supplied in flats, plant each in a manner that will minimally disturb the root system but to a depth not less than two nodes.
- C. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
- D. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
- E. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

### 3.7 PLANTING AREA MULCHING

- A. Mulch backfilled surfaces of planting areas and other areas indicated.
  1. Organic Mulch in Planting Areas: Apply 2-inch (50-mm) over whole surface of planting area, and finish level with adjacent finish grades.

### 3.8 PLANT MAINTENANCE

- A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to

proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.

- B. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.
- C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

### 3.9 CLEANUP AND PROTECTION

- A. During planting, keep adjacent paving and construction clean and work area in an orderly condition.
- B. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.
- C. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

### 3.10 DISPOSAL

- A. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

- END -