

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of courtyard masonry wall and selected site elements.
2. Salvage and reinstallation of existing selected site elements.

B. Related Requirements:

1. Section 011200 "Summary of the Work"
2. Section 015639 "Temporary Tree and Plant Protection"
3. Section 017329 "Cutting, Patching, Sleeves, and Inserts"
4. Section 050170 "Decorative Metal Repair"
5. Section 311000 "Site Clearing"

1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- C. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

1.3 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.4 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.
1. Inspect and discuss condition of construction to be selectively demolished.
 2. Review structural load limitations of existing structure.

3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.5 SUBMITTALS

- A. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property. Indicate proposed locations and construction of barriers.
- B. Schedule of Selective Demolition Activities: Indicate the following:
 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 3. Coordination for shutoff, capping, and continuation of utility services.
 4. Use of elevator and stairs.
 5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- C. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by salvage and demolition operations. Comply with Section 013233 "Photographic Documentation." Submit before Work begins.
- D. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.
- E. Inventory: Submit a list of items that have been removed and salvaged.

1.6 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- C. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- D. Historic Areas: Demolition and hauling equipment and other materials shall be of sizes that clear surfaces within historic spaces, areas, rooms, and openings, including temporary protection, by 12 inches or more.
- E. Storage or sale of removed items or materials on-site is not permitted.

- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

1.7 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding.
- B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

1.8 COORDINATION

- A. Arrange selective demolition schedule so as not to interfere with Owner's operations.
- B. Coordinate with Owner on any necessary utility or service/systems shut-off.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSP A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped, as necessary, before starting selective demolition operations.
- B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Survey of Existing Conditions: Record existing conditions by use of measured drawings, preconstruction photographs or video, and templates.
 - 1. Inventory and record the condition of items to be removed and salvaged.

2. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
 1. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 2. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
 - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.

3.3 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain. Comply with requirements specified in Section 015000 "Temporary Facilities and Controls."
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished. Strengthen or add new supports when required during progress of selective demolition.
- C. Remove temporary barricades and protections where hazards no longer exist.

3.4 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.

2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 3. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 4. Dispose of demolished items and materials promptly. Comply with requirements in Section 017419 "Construction Waste Management and Disposal."
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- C. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse.
 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 3. Protect items from damage during transport and storage.
 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.
- B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
- C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.
- D. Decorative Metal: Cut metal elements cleanly and support existing to remain elements where necessary to complete alterations and reinstallation indicated on Drawings. Comply with requirement in Section 050170 "Decorative Metal Repair".

3.6 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

SECTION 044300 – SITE STONE MASONRY

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes the following:
 - 1. Brick Veneer and Coping
 - 2. Granite Curb
 - 3. Salvaged Flagstone Pavers
 - 4. Salvaged Flagstone Stair Treads and Coping
 - 5. Salvaged Cobblestone Curbing
 - 6. Edge restraints and accessories

1.3 RELATED REQUIREMENTS

- A. Section 033000 Cast-in-place Concrete
- B. Section 312000 Earth Moving
- C. Section 321500 Stone Fines Pavement
- D. Section 329100 Planting Preparation

1.4 SUBMITTALS

- A. Product data: Submit product literature or tear sheets with name of product (brick or stone type, color, finish, size, and photograph), and manufacturer for each type of new product specified herein.
- B. Samples: Provide brick, sealant, and jointing materials for on-site review and color selection.
 - 1. Include manufacturers full range of standard colors.
- C. Shop Drawings: Field verify size, thickness, and quantity of all salvaged stone types. Notify Landscape Architect of any differences between field verified quantity and extent of reinstallation shown on Drawings. Indicate layout, pertinent dimensions, and anchorages for each. Provide shop drawings of all site stone:
 - 1. Layout of brick veneer and coping on new site wall, showing extent of whole bricks and alignment on VIF wall length. Include extent of replacement brick layout on ends of existing masonry walls.
 - 2. Reinstalled salvaged stone coping.
 - a. Show adjustment of size or layout of coping to reuse existing cut holes or remove existing cut holes that do not work with new guardrail posts.
 - 3. Reinstalled salvaged stone pavers.
 - a. Indicate where pavers will be cut to fit new pavement area and create symmetrical pavement pattern.
 - 4. Include layout of new granite curb lengths and field verified extent of salvaged cobblestone where shown on Drawings.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs experienced stonemasons and stone fitters.
- B. Source Limitations for Stone: Obtain each variety of stone, regardless of finish, from one quarry with resources to provide materials of consistent quality in appearance and physical properties.
- C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.
- D. Mockups: Build mock-up to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Location and extent of mockups to be confirmed with Landscape Architect prior to constructing mockups.
 - 2. Build mockups for each masonry wall condition, including,
 - a. New and existing brick veneer and coping at existing masonry wall. Show extent of new brick to meet existing whole brick.
 - b. New and existing brick veneer and coping at (1) end of new masonry wall. Include 3 ft length and full height of courtyard face and (1) gate face of wall.
 - 3. Protect accepted mockups from the elements with weather-resistant membrane.
 - 4. Approval of mockups is for color, texture, and blending of masonry units; relationship of sealant or grout color to masonry unit color; tooling of joints; and aesthetic qualities of workmanship.
 - 5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Landscape Architect specifically approves such deviations in writing.
 - 6. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

1.7 PROJECT CONDITIONS

- A. Protection of Stone Masonry: Cover partially completed stone masonry when construction is not in progress to protect from inclement weather.
- B. Stain Prevention: Immediately remove mortar and soil to prevent them from staining the exposed surfaces of stone masonry.
 - 1. Protect base of walls from rain-splashed mud and mortar splatter by coverings spread on the ground and over the wall surface.
 - 2. Protect all exposed surfaces from mortar droppings, including adjacent constructions such as exposed aggregate concrete pavement or any other adjacent surface.

- C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace stone masonry damaged by frost or freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
 - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning. Protect all exposed surfaces from mortar droppings, including adjacent constructions such as exposed aggregate concrete pavement or any other adjacent surface.
- D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 60.

1.8 COORDINATION

- A. Advise installers of other work about specific requirements for placement of reinforcement, veneer anchors, and similar items to be built into stone masonry.
- B. Verify field measurements prior to fabrication. Notify Landscape Architect of any discrepancies prior to fabrication.

1.8 WARRANTY

- A. Unless stated otherwise in these Specifications, warranty shall state that all work is in accord with drawings and Specifications, as amended by any changes thereto authorized by the Landscape Architect, free from defects in materials and workmanship for a period of five (5) years from date of acceptance of the work by the Owner or failure of system to meet performance requirements. Contractor shall agree to repair or replace defective materials and workmanship during the guarantee period at no additional cost to the Owner.
 - 1. Defective materials and workmanship are hereby defined to include evidence of abnormal deterioration, aging, structural failure of components resulting from exposure to normal load and forces, failure of operating parts to function normally, sealant failures, deterioration or discoloration of finishes in excess of normal aging, and failure to fulfill other specified performance.

PART 2 – PRODUCTS

- 2.1 Defective Material: Industry standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defect will be exposed in the completed Work.
- 2.2 BRICK VENEER AND COPING
 - A. Basis of Design: Cushwa Series, molded face brick, available from Church Brick, 118 Burlington Road, Bordentown, NJ 08505, www.churchbrick.com.
 - 1. Field verify existing brick color and size from removed masonry wall.
 - 2. Color: TBD
 - 3. Modular Size 3-5/8 inches deep, 2-1/4 inches high, 7-5/8 inches long. Confirm with field verified existing brick size.
- 2.3 GRANITE CURB
 - A. Provide White Mount Airy Granite Curbing as available from The North Carolina Granite Corporation, A Polycor Company, PO Box 151, Mount Airy, North Carolina 27030, 800-227-6242, www.polycor.com.
 - 1. Color: White Mount Airy

2. Finish: Rockface sides and exposed ends, Thermal top, Sawn all other non-exposed surfaces. Provide Sawn arris line at unit paver intersections. Rockface shall be field dressed at curbing intersections.

2.4 FABRICATION

- A. Fabricate stone to comply with sizes, shapes, and tolerances recommended by applicable stone association or, if none, by stone source, for faces, edges, beds, and backs.
 1. For granite, comply with recommendations in NBGQA's "Specifications for Architectural Granite."
- B. Cut stone to produce pieces of thickness, size, and shape indicated, including details on Drawings. Dress joints (bed and vertical) straight and at right angle to face unless otherwise indicated.
- C. Cut and drill slots, sinkages and holes in stone for anchors and supports.
- D. Carefully inspect stone at quarry or fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units before shipment.

2.5 AGGREGATE MATERIALS

- A. Graded Aggregate for foundation Subbase: Sound, crushed stone or gravel complying with requirements in Section 31 20 00 "Earth Moving" for subbase material.

2.6 SETTING BED AND JOINT MATERIALS

- A. Sand setting bed for pavers: Clean, washed, well graded sand free of deleterious materials, conforming to ASTM C-33. Do not use mason's sand, stone dust or limestone screenings.
- B. Joint filler for stone pavement: 5:1 mix of sand:cement. Sand shall be clean, washed, well graded sand free of deleterious materials, conforming to ASTM C144.
- C. Mortar bed for stone blocks and granite walls: subject to compliance with requirements, available products that may be incorporated into the Work include the following, or approved comparable products:
 1. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color cement as required to produce mortar color indicated.
 2. Hydrated Lime: ASTM C 207, Type S.
 3. Mortar Cement: ASTM C 1329.
 4. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
 5. Water: Potable.
- D. Mortar Mixes
 1. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in the form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
 2. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide Type N unless another type is indicated.
 3. Water: potable, clean and free from deleterious acids, alkalies, and organic matter.

4. Mixing: Combine and thoroughly mix pre-blended dry materials to water in a mechanical batch mixer; comply with ASTM C270 proportion specification and manufacturer's instructions for mixing time and water content, unless otherwise indicated.
5. Use colored aggregate mortar at brick wall veneer and coping to match existing courtyard wall jointing color.

2.7 ANCHORS AND FASTENERS

- B. Anchor Material: Stainless steel, ASTM A 666, Type 304. Sizes and configurations: As required for vertical and horizontal support of masonry units and applicable loads.
- C. Dowels and Pins Material: Stainless steel, ASTM A 276, Type 304.

2.8 TIES AND ANCHORS

- A. General: Ties and anchors shall extend at least 1-1/2 inches into veneer but with at least a 5/8-inch cover on outside face.
- B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
 1. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304.
 2. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304.
- C. Corrugated Wall Ties: Metal strips not less than 7/8-inch wide by 18 gauge by 7-inches long.

2.10 MISCELLANEOUS MASONRY ACCESSORIES

- A. Backer Rod for Sealant Joints: Flexible, closed cell, non-gassing, polyethylene, rope-like joint backing material of appropriate diameter for specified joint size as indicated on the Drawings to resist pressure during sealant tooling. Backer rod shall not stain or adhere to sealant materials and shall be fully compatible with sealant compounds.
- B. Sealant for Joints: In compliance with manufacturer's instructions, provide Sonneborn Sonolastic NP 2, or approved comparable product. Landscape Architect shall select color from the full range of standard colors. Intent is to match pointing mortar.
- C. Weep/Vent Products: Use the following unless otherwise indicated:
 1. Round Plastic Weep/Vent Tubing: Medium-density polyethylene, 3/8-inch OD by length required to extend from exterior face of masonry unit to cavity behind.
- D. Setting Shims: Plastic or vulcanized neoprene.
- E. Setting Buttons: Resilient plastic buttons.

2.9 ACCESSORIES

- A. Cleaning Solution: Not harmful to masonry work or adjacent materials.
 1. 1. Prosoco Inc.; Sure Klean Vana Trol for unpolished granite.
 2. 2. Diedrich Technologies, Inc; 202V Vana-Stop.
 3. 3. Stone Care International; Marbalex for Granite.

2.10 EDGE RESTRAINT

- A. Edge restraint for pavers: 1/4" x 6" x lengths as required, black powder coated steel edge restraints, straight sections, as available from Coyote Landscape Products, 800-321-1115 or approved equal.
 1. Provide stakes as required.
 2. Provide touch up paint as required.

2.11 GEOTEXTILE

- A. Nonwoven: TenCate Mirafi 140N or approved equal.

2.12 STONE FABRICATION

- A. Fabricate stone to comply with sizes, shapes, and tolerances recommended by applicable stone association.
- B. Cut stone to produce pieces of thickness, size, and shape indicated, including details on Drawings and details developed during shop drawing process. Dress joints (bed and vertical) straight and at right angle to face unless otherwise indicated.
- C. Carefully inspect stone at quarry or fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units before shipment.
- D. Thickness of Stone: Provide thickness indicated on Drawings.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine surfaces indicated to receive stone masonry, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine substrate to verify that dovetail slots, inserts, reinforcement, veneer anchors, flashing, and other items installed in substrates and required for or extending into stone masonry are correctly installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. Beginning installation means acceptance of existing conditions.

3.2 PREPARATION

- A. Clean dirty or stained stone surfaces by removing soil, stains, and foreign materials before setting. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.

3.3 SETTING OF STONE MASONRY, GENERAL

- A. Perform necessary field cutting and trimming as stone is set. Do not trim exposed ends or faces. Cuts shall be made a joints or hidden surfaces.
 - 1. Use power saws to cut stone that is fabricated with saw-cut surfaces. Cut lines straight and true, with edges eased slightly to prevent snipping
- B. Sort stone before it is placed to remove stone that does not comply with requirements relating to aesthetic effects, physical properties, or fabrication, or that is otherwise unsuitable for intended use.
- C. Arrange stones as indicated on Drawings.
- D. Set stone to comply with requirements indicated on Drawings. Install supports, fasteners, and other attachments indicated or necessary to secure stone masonry in place. Set stone accurately in locations indicated with edges and faces aligned according to established relationships and indicated tolerances.

- E. Maintain uniform joint widths except for variations due to different stone sizes and where minor variations are required to maintain bond alignment if any. Set walls with joints not less than $\frac{1}{4}$ inch at narrowest points or more than $\frac{1}{2}$ inch at widest points.
- F. Provide sealant joints of widths and at locations indicated.
 - 1. Keep sealant joints free of mortar and other rigid materials.
- G. Place weep holes in joints where moisture may accumulate
 - 1. Use specified product herein to form weep holes.
 - 2. Space weep holes as indicated on Drawings.

3.4 CONSTRUCTION TOLERANCES

- A. Variation from Plumb: For vertical lines and surfaces, do not exceed $\frac{1}{4}$ inch in 10 feet or more.
- B. Variation from Level: For joints and lines of coping, horizontal grooves, and other conspicuous lines, do not exceed $\frac{1}{4}$ inch in 20 feet or more.
- C. Measure variation from level, plumb, and position shown in plan as variation of the average plane of the face of each stone from level, plumb, or dimensioned plane.
- D. Variation in Mortar-Joint Thickness: Do not vary from joint size range indicated.
- E. Variation in Plane between Adjacent Rough Stones: Do not exceed one-half of tolerance specified for thickness of stone.

3.5 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or ends.
- C. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

3.6 INSTALLATION OF ANCHORED MASONRY

- A. Set masonry unit in full bed of mortar unless otherwise indicated. Build anchors into mortar joints as unit is set.
- B. Space anchors as indicated, but not more than 18 inches o.c. vertically and horizontally. Install additional anchors within 12 inches of openings and at intervals, not exceeding 24 inches, around perimeter.
- C. Rake out joints for sealant to depth of not less than dimension indicated on Drawings before setting mortar has hardened. Rake joints to uniform depths with square bottoms and clean sides.

3.7 ERECTION TOLERANCES

- A. Variation in Line: Do not exceed $\frac{1}{8}$ inch in 96 inches.
- B. Variation in Joint Width: Do not vary joint thickness more than $\frac{1}{16}$ inch or $\frac{1}{4}$ inch of nominal joint width, whichever is less.

- C. Variation in Surface Plane: Do not exceed 1/8 inch in 10 feet maximum from level or slope
Variation in Plane between Adjacent Units: Do not exceed 1/32-inch difference between planes of adjacent units.

3.8 WALL JOINTING

- A. Prepare joint surfaces for sealant by removing mortar from joint before it sets and brush clean dust and mortar particles from joint prior to application of sealant.
- B. Prepare joint surfaces for sealant by removing mortar from joint before it sets and brush clean dust and mortar particles from joint prior to application of sealant.
- C. Tape-off joints to protect the adjacent surface from contact with the sealant and to create a crisp line. Tool joints, with a smooth jointing tool to produce a concave joint profile set just below the face of the masonry unit.

3.9 ADJUSTING AND CLEANING

- A. Remove and replace stone masonry of the following description:
 - 1. Broken, chipped, stained, or otherwise damaged stone. Stone may be repaired if methods and results are approved by Landscape Architect.
 - 2. Stone masonry not matching approved samples and mockups.
 - 3. Stone masonry not complying with other requirements indicated
- B. Replace in a manner that results in stone masonry matching approved samples and mockups, complying with other requirements, and showing no evidence of replacement.
- C. In-Progress Cleaning: Clean stone masonry as work progresses.
- D. Final Cleaning: Clean stone masonry as follows:
 - 1. Test cleaning methods on mockup; leave one-half of panel uncleaned for comparison purposes. Obtain Landscape Architect's approval of sample cleaning before cleaning stone masonry.
 - 2. Clean stone masonry by bucket and brush hand-cleaning method described in BIA Technical Note No. 20 Revised II, using job-mixed detergent solution.

3.10 TOLERANCES

- A. Variation in Line: Do not exceed 1/8 inch in 96 inches.
- B. Variation in Joint Width: Do not vary joint thickness more than 1/16 inch or 1/4 inch of nominal joint width, whichever is less.
- C. Variation in Surface Plane: Do not exceed 1/8 inch in 10 feet maximum from level or slope
Variation in Plane between Adjacent Units: Do not exceed 1/32-inch difference between planes of adjacent units.

3.11 MORTAR SETTING-BED APPLICATIONS

- A. Saturate concrete subbase with clean water several hours before placing setting bed. Remove surface water about one hour before placing setting bed.
- B. Mix and place only that amount of mortar bed that can be covered with bluestone before initial set. Before placing bluestone, cut back, bevel edge, and remove and discard setting-bed material that has reached initial set.
- C. Place pavers before initial set of cement occurs. Immediately before placing pavers on mortar bed, apply uniform 1/16-inch- thick bond coat to mortar bed or to back of each paver with a flat trowel.

- D. Tamp or beat bluestone with a wooden block or rubber mallet to obtain full contact with setting bed and to bring finished surfaces within indicated tolerances. Set each paver or step in a single operation before initial set of mortar; do not return to areas already set or disturb bluestone for purposes of realigning finished surfaces or adjusting joints.
- E. Spaced Joint Widths: Provide 3/8-inch nominal joint width with variations not exceeding plus or minus 1/16 inch.
- F. Grouted Joints: Grout paver joints complying with ANSI A108.10.
- G. Grout joints as soon as possible after initial set of setting bed.
 - 1. Force grout into joints, taking care not to smear grout on adjoining surfaces.
 - 2. Clean bluestone as grouting progresses by dry brushing or rubbing with dry burlap to remove smears before tooling joints.
 - 3. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
 - 4. If tooling squeezes grout from joints, remove excess grout and smears by dry brushing or rubbing with dry burlap and tool joints again to produce a uniform appearance.
- H. Cure grout by maintaining in a damp condition for seven days unless otherwise recommended by grout or liquid-latex manufacturer.

3.12 PROTECTION OF FINISHED WORK

- A. Do not permit construction traffic over unprotected paver surface.

3.13 CLEAN UP

- A. Maintain the site in an orderly condition during the progress of work. Promptly remove debris and trash. Leave the site in a neat, orderly condition, broom clean.

END OF SECTION 044300

SECTION 050170 - DECORATIVE METAL REPAIR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Decorative metal repairs as follows:

- a. Repairing metal and replacing damaged and missing components in place.
 - b. Removing metal for shop repair and replacement of components; reinstalling repaired metal.
 - c. Painting steel uncovered during the Work.

- B. Related Requirements:

- 1. Section 013516 "Alteration Project Procedures" for general remodeling, renovation, repair, and maintenance requirements.
 - 2. Section 055215 "Exterior Handrails" for new handrails.

1.3 ALLOWANCES

- A. Allowances for decorative metal repairs are specified in Section 012100 "Allowances."

- 1. Perform decorative metal repairs under quantity allowances and only as authorized. Authorized work includes alternation to existing handrail and/or guardrail.
 - 2. Notify Architect of extent of work performed that is attributable to quantity allowances.
 - 3. Perform work that exceeds quantity allowances only as authorized by Change Orders.

1.4 DEFINITIONS

- A. Low-Pressure Spray: 100 to 400 psi; 4 to 6 gpm.
- B. Medium-Pressure Spray: 400 to 800 psi; 4 to 6 gpm.
- C. High-Pressure Spray: 800 to 1200 psi; 4 to 6 gpm.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at project site to review extent of repair.

1.6 ACTION SUBMITTALS

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

1. Include recommendations for product application and use.
2. Include test data substantiating that products comply with requirements.

- B. Shop Drawings:

1. Include plans, elevations, and sections showing locations and extent of repair and replacement work, with enlarged details of replacement parts indicating materials, profiles, methods of attachment, accessory items, and finishes.
2. Include field-verified dimensions and the following:
 - a. Identification of each new metal item and component and its location on the structure in annotated plans and elevations.
 - b. Provisions for expansion, weep holes, and conduits as required for each location and exposure.
 - c. Provisions for sealant joints if required.

- C. Delegated-Design Submittal: For structural performance of repaired railings, handrails, and anchors, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For decorative metal repair specialist.
- B. Evaluation Reports: For post-installed structural anchors, from ICC-ES.

1.8 QUALITY ASSURANCE

- A. Decorative Metal Repair Specialist Qualifications: A qualified decorative metal fabrication and repair specialist. Experience installing and finishing new decorative metalwork is insufficient experience for repairing decorative metal.
- B. Mockups: Prepare mockups of decorative metal repair processes on existing surfaces to demonstrate aesthetic effects and to set quality standards for materials and execution and for fabrication and installation. Prepare mockups so they are inconspicuous.
1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Pack, deliver, and store decorative metal items in suitable packs, heavy-duty cartons, or wooden crates; surround with sufficient packing material to ensure that products are not deformed, cracked, or otherwise damaged.
- B. Store decorative metal inside a well-ventilated area, away from uncured concrete and masonry and protected from weather, moisture, soiling, abrasion, extreme temperatures, and humidity.
- C. Protect strippable protective covering on decorative metal from exposure to sunlight and high humidity, except to the extent necessary for the period of decorative metal installation.

1.10 FIELD CONDITIONS

- A. Weather Limitations: Proceed with decorative metal repairs only when existing and forecasted weather conditions are within the environmental limits set by each manufacturer's written instructions and specified requirements.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design post-installed structural anchors.
- B. Structural Performance: Railings and handrails, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Uniform load of 50 lbf/ft. applied in any direction.
 - 2. Concentrated load of 200 lbf applied in any direction.
 - 3. Uniform and concentrated loads need not be assumed to act concurrently.

2.2 METAL MATERIALS

- A. General: Provide decorative metal materials made of the alloys, forms, and types that match existing metals and have the ability to receive finishes matching existing finishes unless otherwise indicated. Exposed-to-view surfaces exhibiting imperfections inconsistent with existing materials are unacceptable.
- B. Source Limitation for Replacement Cast Materials: Obtain castings for decorative metal repair from single source from single manufacturer with resources to provide materials of consistent quality in appearance and physical properties.
- C. Aluminum: Alloy and temper recommended in writing by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required:

1. Extruded Bars and Shapes: ASTM B221, Alloy 6063-T6.
2. Extruded Structural Pipe and Tubes: ASTM B429/B429M, Alloy 6063-T6.
3. Drawn General-Purpose Seamless Tubes: ASTM B210, Alloy 6063-T832.
4. Plate and Sheet: ASTM B209, Alloy 6061-T6.
5. Die and Hand Forgings: ASTM B247, Alloy 6061-T6.
6. Castings: ASTM B26/B26M, Alloy A356-T6.

D. Stainless Steel: Grade designated below for each form required:

1. Tubing: ASTM A554, Grade MT-316.
2. Pipe: ASTM A312/A312M, Grade TP316.
3. Castings: ASTM A743/A743M, Grade CF8M.
4. Plate, Sheet, and Strip: ASTM A240/A240M or ASTM A666, Type 316.
5. Flat Bar: ASTM A666, Type 316.
6. Bars and Shapes: ASTM A276, Type 316.

E. Steel: Standard and grade designated below for each form required:

1. Tubing: Cold formed, ASTM A500/A500M.
2. Steel Plate, Shapes, and Bars: ASTM A36/A36M.
3. Steel Bars: Mild steel; ASTM A29/A29M, Grade 1010.
4. Steel Sheet: ASTM A1008/A1008M, cold-rolled commercial steel sheet; matte finish; suitable for exposed applications.

2.3 PREPARATORY CLEANING MATERIALS

A. Water: Potable.

B. Hot Water: Water heated to a temperature of 140 to 160 deg F.

C. Detergent Solution, Job Mixed: Solution prepared by mixing 2 cups of tetrasodium pyrophosphate (TSPP), 1/2 cup of laundry detergent, and 20 quarts of hot water for every 5 gal. of solution required.

D. Abrasive Materials:

1. Abrasive Pads for Copper-Alloy Cleaning: Extra-fine bronze wool or plastic abrasive pads.
2. Blasting Abrasive: Pulverized walnut shells or Powdered aluminum silicate.
3. Abrasives for Ferrous Metal Cleaning: Aluminum oxide paper, emery paper, fine steel wool, steel scrapers, and steel-wire brushes of various sizes.

E. Rust Remover: Manufacturer's standard phosphoric acid-based gel formulation, also called "naval jelly," for removing corrosion from iron and steel.

F. Antirust Coating: Fast-curing, lead- and chromate-free, self-curing, universal modified-alkyd primer.

1. Surface Preparation: Prepare surface in accordance with manufacturer's literature or certified statement.
2. VOC Limit: Use coating with a VOC content of 400 g/L or less.

2.4 FASTENERS

- A. Fasteners: Fasteners of the same basic metal as fastened metal unless otherwise indicated. Use metals that are noncorrosive and compatible with each metal joined.
 - 1. Match existing fasteners in material and in type of fastener unless otherwise indicated.
 - 2. Use concealed fasteners for interconnecting decorative metal components and for attaching them to other work unless exposed fasteners are unavoidable or the existing fastening method.
 - 3. For exposed fasteners, use Phillips-type machine screws of head profile flush with metal surface unless otherwise indicated.
 - 4. Finish heads of exposed fasteners to match finish of metal fastened unless otherwise indicated.
- B. Anchors, General: Use bolt heads of same basic metal as fastened metal unless otherwise indicated. Use metals that are noncorrosive and compatible with each metal anchored.
- C. Post-Installed Structural 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 as appropriate for the substrate.
 - 1. Uses: Securing railings and handrails to concrete.
 - 2. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 2 stainless steel bolts, ASTM F593, and nuts, ASTM F594.
- D. Post-Installed Nonstructural Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES as appropriate for the substrate.
 - 1. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 2 stainless steel bolts, ASTM F593, and nuts, ASTM F594.

2.5 MISCELLANEOUS MATERIALS

- A. Welding Electrodes and Filler Metal: Select according to AWS specifications for metal alloy welded; use metal type and alloy as recommended in writing by producer of metal to be welded or filled and as required for color match, strength, and compatibility in fabricated items.
- B. Metal-Patching Compound: Two-part, polyester-resin metal-patching compound; knife-grade formulation as recommended in writing by manufacturer for type of metal repair indicated, tooling time required for the detail of work, and site conditions. Compound shall be produced for filling metal that has deteriorated because of corrosion. Filler shall be capable of filling deep holes and spreading to feather edge.
- C. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended in writing by manufacturer for interior and exterior applications.
- D. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

1. Water-Resistant Product: At exterior locations, provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended in writing by manufacturer for exterior use.
- E. Sealant Materials:
1. Provide manufacturer's standard, elastomeric sealant complying with applicable requirements in Section 079200 "Joint Sealants."
 2. Colors: Provide colors of exposed sealants to match colors of metals in which sealant is placed unless otherwise indicated.
- F. Liquid Strippable Masking Agent: Manufacturer's standard liquid, film-forming, strippable masking material for protecting glass, metal, glazed masonry, and polished stone surfaces from damaging effects of acidic and alkaline cleaners.
- G. Masking Tape: Nonstaining, nonabsorbent material; compatible with chemical solutions being used and substrate surfaces, and that will easily come off entirely, including adhesive.
- H. Other Products: Select materials and methods of use based on the following, subject to approval of a mockup:
1. Previous effectiveness in performing the work involved.
 2. Little possibility of damaging exposed surfaces.
 3. Consistency of each application.
 4. Uniformity of the resulting overall appearance.
 5. Do not use products or tools that could do the following:
 - a. Remove, alter, or in any way harm the present or future condition of existing surfaces, including surrounding surfaces not in the Contract.
 - b. Leave an unintended residue on surfaces.

2.6 METAL FABRICATION

- A. Fabricate repairs of decorative metal items and components in sizes and profiles to match existing decorative metal, with accurate curves, lines, and angles. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
- B. Provide uniform, neat seams with minimum exposure of welds, brazing, solder, and sealant.
- C. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for fasteners. Use concealed fasteners where possible; use exposed fasteners to match existing work.
- D. 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 joints of flux, and dress exposed and contact surfaces.
 1. Use materials and methods that match color of base metal, minimize distortion, and develop maximum strength and corrosion resistance.
 2. Remove flux immediately.

3. At exposed connections, match contours of adjoining surfaces, and finish exposed surfaces smooth and blended so no roughness shows after finishing.

2.7 FINISHES, GENERAL

- 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.

2.8 ALUMINUM FINISHES

- A. Where necessary, match finish of component needing repair.

2.9 FERROUS METAL FINISHES

- A. Repair Primer: Manufacturer's standard, rust-inhibiting, fast-curing, lead- and chromate-free universal primer, compatible with firmly adhered existing paint and applied finish. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.
- B. Finish Primer: Primer complying with applicable requirements in Section 090190.52 "Maintenance Repainting" for finish painting of primed existing metal.

2.10 STAINLESS STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines from new replacement stainless steel, or blend into finish.
- B. Restored Finish: Grind and polish surfaces to produce uniform, directionally textured, polished finish to match existing finish, free of cross scratches.
 1. Run grain to match existing metal.
 2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
- C. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 1. Run grain of directional finishes with long dimension of each piece.
 2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 3. Directional Satin Finish: ASTM A480/A480M, No. 4.
 4. Dull Satin Finish: ASTM A480/A480M, No. 6.
 5. Reflective, Directional Polish: ASTM A480/A480M, No. 7.
 6. Mirrorlike Reflective, Nondirectional Polish: ASTM A480/A480M, No. 8.

- D. Bright, Cold-Rolled, Unpolished Finish: ASTM A480/A480M, No. 2B.

PART 3 - EXECUTION

3.1 PROTECTION

- A. Comply with each manufacturer's written instructions for protecting building and other surfaces against damage from exposure to its products. Prevent chemical solutions from coming into contact with people, motor vehicles, landscaping, buildings, and other surfaces that could be harmed by such contact.
 - 1. Cover adjacent surfaces with materials that are proved to resist chemical solutions being used unless products being used will not damage adjacent surfaces. Use protective materials that are waterproof and UV resistant. Apply masking agents to comply with manufacturer's written instructions. Do not apply liquid masking agent to painted or porous surfaces. When no longer needed, promptly remove masking to prevent adhesive staining.
 - 2. Do not apply chemical solutions during winds of enough force to spread them to unprotected surfaces.
 - 3. Neutralize alkaline and acid wastes before disposal.
 - 4. Dispose of runoff from operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.

3.2 DECORATIVE METAL REPAIR, GENERAL

- A. Repair Appearance Standard: Repaired surfaces are to have a uniform appearance as viewed from 4 feet away by Architect.
- B. Execution of the Work: In repairing items, disturb remaining existing work as minimally as possible and as follows:
 - 1. Stabilize decorative metal to reestablish structural integrity and weather resistance while maintaining the existing form of each item.
 - 2. Remove deteriorated coatings and corrosion.
 - 3. Sequence work to minimize time before protective coatings are reapplied.
 - 4. Repair items where stabilization is insufficient to stop progress of deterioration.
 - 5. Repair items in place where possible.
 - 6. Replace or reproduce items where indicated or scheduled.
 - 7. Install temporary protective measures to stabilize decorative metal that is indicated to be repaired later.
- C. Mechanical Coating Removal: Use gentle methods, such as scraping and wire brushing, that will not abrade metal substrate.
- D. Repair Decorative Metal Item: Match existing materials and features.
 - 1. Repair decorative metals by patching, piecing-in, splicing, or otherwise reinforcing metals with new metal matching existing metal.

- E. Replace Decorative Metal Component: Where indicated, duplicate and replace items with new metal matching existing metal.
 - 1. Replace heavily deteriorated or missing parts or features of decorative metal with compatible materials, using surviving prototypes to create patterns or molds for duplicate replacements.

3.3 PREPARATORY CLEANING

- A. General: Use those methods indicated for each type of decorative metal and its location.
 - 1. Brushes: If using wire brushes, use brushes of same base metal composition as metal being cleaned. Use brushes that are resistant to chemicals being used.
 - 2. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that spray methods do not damage surfaces.
 - a. Equip units with pressure gages.
 - b. For water-spray application, use fan-shaped spray that disperses water at an angle of 25 to 50 degrees.
 - c. For high-pressure water-spray application, use fan-shaped spray that disperses water at an angle of at least 40 degrees.
 - d. For heated water-spray application, use equipment capable of maintaining temperature between 140 and 160 deg F at flow rates indicated.
 - 3. Uniformity: Perform each cleaning method in a manner that results in uniform coverage of all surfaces, including corners, contours, and interstices, and that produces an even effect without streaks or damaging surfaces.
 - 4. Protection: After cleaning is complete, remove protection no longer required. Remove tape and adhesive marks.
- B. Water Cleaning: Clean with water applied by pressure spray. Supplement with natural-fiber-bristle brush. Use small brushes to remove soil from joints and crevices.
- C. Detergent Cleaning:
 - 1. Wet surface with water applied by low-pressure spray.
 - 2. Scrub surface with detergent solution and bristle brush until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet.
 - 3. Rinse with water applied by pressure spray to remove detergent solution and soil.
- D. Cleaning with Abrasive Pads: Clean surfaces to remove dirt by light rubbing with abrasive pads and water. Rinse with cold water to remove residue. Apply rinse by low-pressure spray.
- E. Chemical Rust Removal:
 - 1. Remove loose rust scale with approved abrasives for ferrous metal cleaning.
 - 2. Apply rust remover with brushes or as recommended in writing by manufacturer.

3. Allow rust remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing. Do not allow extended dwell time.
4. Wipe off residue with mineral spirits and either steel wool or soft rags, or clean with method recommended in writing by manufacturer to remove residue.
5. Dry immediately with clean, soft cloths. Follow direction of grain in metal.
6. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.

F. Mechanical Rust Removal:

1. Remove rust with approved abrasives for ferrous metal cleaning.
2. Wipe off residue with mineral spirits and either steel wool or soft rags.
3. Dry immediately with clean, soft cloths. Follow direction of grain in metal.
4. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.

3.4 REMOVAL, REPAIR, AND REINSTALLATION

A. General: Perform removal work as required in Section 024119 "Selective Demolition" for specific requirements relating to selectively demolishing construction, including decorative metal removal for repair or reinstallation elsewhere.

B. Reinstalling Railing Posts: After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions. Leave anchorage joint exposed, wipe off surplus anchoring material, and leave 1/8-inch buildup sloped away from post.

C. Installing Sealant:

1. After metal reinstallation, keep joints to receive sealant dry and free of debris.
2. Clean and prepare joint surfaces according to Section 079200 "Joint Sealants." Prime joint surfaces unless sealant manufacturer recommends against priming. Do not allow primer to spill or migrate onto adjoining surfaces.
3. Fill sealant joints with specified joint sealant as recommended in writing by sealant manufacturer and according to Section 079200 "Joint Sealants" and the following:
 - a. Install sealant using only proved installation methods that ensure sealant is deposited in a uniform, continuous ribbon, without gaps or air pockets, and with complete wetting of the joint bond surfaces equally on both sides. Fill joint flush with surrounding metal.
 - b. Do not allow sealant to overflow or spill onto adjoining surfaces or to migrate into the voids of adjoining surfaces, particularly rough or sculptural textures. Promptly remove excess and spillage of sealant as the work progresses. Clean adjoining surfaces by means necessary to eliminate evidence of spillage, without damage to adjoining surfaces or finishes, as demonstrated in an approved mockup.
4. Cure sealant according to Section 079200 "Joint Sealants."

3.5 PRIMING

A. Repair Primer: Apply immediately after completing a repair.

- B. Finish Primer: Apply as soon after cleaning as possible.

3.6 PAINTING STEEL UNCOVERED DURING THE WORK

- A. Notify Architect if steel is exposed during metal removal. Where Architect determines that the steel is structural, or for other reasons cannot be totally removed, prepare and paint it as follows:
 - 1. Surface Preparation: Remove paint, rust, and other contaminants as applicable to comply with paint manufacturer's recommended preparation.
 - 2. Antirust Coating: Immediately paint exposed steel with two coats of antirust coating, following coating manufacturer's written instructions and without exceeding manufacturer's recommended rate of application (dry film thickness per coat).
- B. If on inspection and rust removal, the thickness of a steel member is found to be reduced from rust by more than 1/16 inch, notify Architect before proceeding.

END OF SECTION 050170

SECTION 055215 – EXTERIOR HANDRAILS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Existing refurbished painted steel tube handrails.
- B. New handrail.
- C. This Section includes requirements for detailing and engineering of railing systems to fulfill performance requirements and conform to design intent indicated on Drawings.

1.2 RELATED SECTIONS

- A. Section 033000 Cast-in-Place Concrete
- B. Section 050170 Decorative Metal Repair
- C. Section 018113 Sustainable Design Requirements for additional LEED requirements.

1.3 PERFORMANCE STANDARDS

- A. Delegated-Design: Install handrails and guardrails to resist the simultaneous application of a lateral force of 50lbs./LF and a vertical load of 100 lbs./LF, both applied to the top of the railing. The rail shall resist a total lateral force and total vertical load of at least 200 lbs. each.
- B. Submit calculations and drawings signed and sealed by a Professional Engineer licensed in the Pennsylvania indicating that the railings can meet these performance criteria. Railings shall be fully coordinated with field measured conditions including but not limited to expansion joint locations.
- C. Control of corrosion: prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.4 SUBMITTALS

- A. Product Data: for each type of product indicated, including finishing materials and color chart for selection.
- B. Shop Drawings: Indicate profiles, sizes, anchorage, and accessories. Indicate materials of each item. Provide plans, elevations, and details as required to clearly illustrate the full scope of work. Include material information, finishes, and types of joinery, fasteners, anchorages, and accessory items.
 - 1. Include structural analysis data, signed and sealed by a qualified professional engineer responsible for analysis preparation.
 - 2. Verify actual conditions by field measurements before fabrication and indicate measurements on shop drawings.

C. Samples

1. Submit one handrail sample, 12 inches long including a typical weld, indicating material and finish.

1.5 QUALITY ASSURANCE

- A. Contractor shall have had experience with at least two (2) other projects of similar scope and complexity and shall perform work with personnel totally familiar with furnishings installation and construction techniques under the supervision of an experienced foreperson.
- B. Manufacturer: Company specializing in the manufacture of products specified in this Section with a minimum of three (3) years of experience.

1.6 DELIVERY STORAGE AND HANDLING

- A. Deliver, store, handle and protect all materials from damage.

1.7 WARRANTY

- A. Manufacturer's Warranty: Provide manufacturer's standard 3-year limited warranty.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

- A. Metal surfaces: provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges and Anchors: Same metal and finish as supported rails, unless otherwise indicated.
- C. LEED Requirement: MR credit 3: Sourcing of Raw Materials: Steel must contain minimum 25% total recycled content (post-consumer plus half pre-consumer recycled content).

2.2 TUBE RAILING MATERIALS

- A. Steel Pipe: ASTM A53, Type S, Grade A, standard weight (Schedule 40), unless another grade and weight are required by structural loads.
- B. Steel tubing: ASTM A500, Grade A, standard weight (Schedule 40), unless another grade and weight are required by structural loads.
- C. Plates, Shapes and Bars: ASTM A36/A36M.
- D. Welding materials: AWS D1.1, type required for materials being welded.

2.3 FASTENERS

- A. Unless otherwise indicated, provide Type 304 stainless steel fasteners.

- B. Provide concealed fasteners for interconnecting components and for attaching rails to other work, unless otherwise indicated.
- C. Anchors: provide chemical or torque-controlled expansion anchors, fabricated from corrosion-resistant materials with capability to sustain, without failure, a load equal to four times the load imposed, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

2.4 PAINTED FINISHES

- A. Shop Painted Finish: Provide a uniform smooth finish on all railing surfaces using the following products, or approved equal. Fully prepare surfaces in accordance with the manufacturer's recommendations.
 - 1. Primer: Rust-Oleum Commercial C740 System DTM Alkyd Enamel Primer.
 - 2. Finish Coat: Rust-Oleum Commercial C740 System 400 VOC DTM Alkyd Enamel.
 - 3. Color: Black.

2.5 ACCESSORIES

- A. Grout: CE CRD-C621; Non-shrink type, premixed compound consisting of nonmetallic aggregate, cement, water reducing and plasticizing additives, capable of developing a minimum compressive strength of 5,000 psi at 7 days.
 - 1. Five Star Products, Inc.; Five Star Grout.
 - 2. L&M Construction Chemicals, Inc.; Duragrout.
 - 3. Euclid Chemical Company; NS Grout.
- B. Cover Flange: Item # 637, Steel Flat Base Flange For 1-1/2" Pipe (1.90" Diameter) With No Mounting Holes and Set Screw, Unfinished, Kit as manufactured by R&B Wagner, Inc., Milwaukee, WI 53224, (888) 243-6914, or approved equal.

2.6 FABRICATION

- A. Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finishes and anchorage, but not less than that required to support structural loads.
- B. Fabricate connections that will be exposed to weather in a manner to exclude water; provide weep holes where water may accumulate and slip joints in handrails that span structure.
- C. Cut, reinforce, drill and tap as indicated to receive finish hardware, screws and similar items.
- D. Welded connections: finish exposed surfaces smooth and blended so not roughness shows after finishing and welded surface matches contours of adjoining materials.
- E. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- F. Close exposed ends of hollow railing members with prefabricated end fittings.
- G. Provide inserts and other anchorage devices for connecting railings to concrete.

- H. For railing posts set in concrete, provide steel sleeves not less than 6 inches long with inside dimensions not less than $\frac{1}{2}$ inch greater than outside dimensions of post, with steel plate forming bottom closure.
- I. Assemble railings in the shop to the greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- J. Nonwelded connections: connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work. Notify Landscape Architect in writing of deviations from the manufacturer's recommended installation tolerances and conditions.
- B. Commencement of installation constitutes acceptance of conditions.

3.2 PREPARATION

- A. Supply items required to be cast into concrete.

3.3 INSTALLATION

- A. Install components plumb and level, accurately fitted, free from distortion or defects.
- B. Install expansion joints as required to accommodate thermal movement. Provide slip joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to one side and locate joint within 6 inches of post.
- C. Use metal sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout mixed and placed to comply with anchoring material manufacturer's written instructions.
- D. Cover anchorage joint with flange of same metal as post either welded to post after placing anchoring material or attached to post with set screws.
- E. Set railing in sleeves where indicated. Grout annular space between sleeves and railing posts.
- F. Field weld anchors as indicated on shop drawings. Touch-up welds with primer. Grind welds smooth.
- G. Conceal bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.
- H. Assemble with spigots and sleeves to accommodate tight, hairline joints and secure installation.

- I. Provide anchorage devices and fittings to secure to in-place construction to adjacent construction. Separate dissimilar materials with bushings, grommets or washers to prevent electrolytic corrosion.
- J. Secure mounting brackets to building structure in a positive manner using manufacturer recommended reinforcement and anchorage methods for substrate conditions. Locate brackets and hardware at spacing required to support structural loads.
- K. Installation of railing system shall be rigid and secure, installed by mechanics experienced in erection of architectural metal. Mounting hardware shall be drawn up tightly. Rails shall be set plumb and aligned.

3.4 ADJUSTING AND CLEANING AND PROTECTION

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting. Apply by brush or spray to provide a minimum of 2.0-mil dry film thickness.
- B. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

3.5 ERECTION TOLERANCES

- A. Maximum Variation from Plumb: 1/4 inch in 10 feet, non-cumulative.
- B. Maximum Offset from True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION 055215

SECTION 061500 - WOOD DECKING AND LUMBER

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Wood Trellis – Add Alternate 01.
- B. Related Requirements:
 - 1. Section 033000 "Cast-In-Place Concrete" for footings.

1.2 DEFINITIONS

- A. Lumber grading agencies, and the abbreviations used to reference them, include the following:
 - 1. NeLMA: Northeastern Lumber Manufacturers' Association.
 - 2. NLGA: National Lumber Grades Authority.
 - 3. RIS: Redwood Inspection Service.
 - 4. SPIB: The Southern Pine Inspection Bureau.
 - 5. WCLIB: West Coast Lumber Inspection Bureau.
 - 6. WWPA: Western Wood Products Association.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trellis assembly, including comprehensive engineering analysis by a qualified professional engineer, licensed in the commonwealth of Pennsylvania using performance requirements and design criteria indicated.
 - 1. Structural performance of trellis and associated connections shall be designed to withstand the effects of gravity and lateral loads typical. Applicable loads shall be considered in accordance with the load combinations specified by the Philadelphia building code.
 - 2. Allow for thermal movements from ambient and surface temperature changes acting on exterior wood fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1.4 SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For preservative-treated wood products. Include chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.
 - 2. For metal attachment fittings. Include installation instructions.
- B. Sustainable Design Submittals:

1. Provide FSC certification on all wood products.

C. Shop Drawings:

1. Include dimensioned plans, elevations, sections, and attachment details.
2. Show locations and sizes of furring, blocking, and hanging strips, including blocking and reinforcement concealed by construction and specified in other Sections.

D. Samples: For each exposed product and for each color and finish specified, showing the range of variation to be expected in appearance of fencing, including surface texture.

1. Size: Not less than 5 inches wide by 12 inches long, for each species.
2. Lumber Products:
 - a. For Exterior Wood-Stain Finish, with one-half of exposed surface finished.
 - b. For Transparent Finish, finished on one side and one edge.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates:

1. For lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by ALSC's Board of Review.
2. For preservative-treated wood products. Indicate type of preservative used and net amount of preservative retained.

B. Certificates of Inspection: Issued by lumber grading agency for exposed wood products not marked with grade stamp.

1.6 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockup of typical wood slat fence assembly as shown on Drawings and approved in shop drawings. Include corner condition at full height and a minimum of 3 consecutive post attachments.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials under cover and protected from weather and contact with damp or wet surfaces. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

1.8 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation of exterior woodwork only when existing and forecasted weather conditions permit work to be performed and at least one coat of specified finish to be applied without exposure to rain, snow, or dampness.
- B. Field Measurements: Where exterior woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings.
- C. Established Dimensions: Where exterior woodwork is indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 WOOD TRELLIS

- A. Hand select wood for freedom from characteristics, on exposed surfaces and edges, that would impair finish appearance, including decay, honeycomb, knot holes, shake, splits, torn grain, and wane.
- B. Dimension Lumber for Trellis Components:
 - 1. Select Structural No. 1 grade and the following species:
 - a. Heart Clear Cedar.

2.2 MOUNTING HARDWARE FOR PROJECTOR SCREEN

- A. Provide and install exterior rated mounting hardware for Owner purchased projector screen.
 - 1. Mounting hardware to meet requirements of projector screen product manufacturer, including but not limited to, connection locations, dimensions, and product weight.
 - 2. Confirm projector screen product and mounting specifications with Owner.
 - a. Assume an approximate screen size of 12' wide by 7' tall, or as recommended by AV professional.
 - b. Assume approximate distance from projector power source to be 20'.
 - c. Assume manual pull-down projector screen to be stored inside and brought out for mounting during movie events.
 - d. Assume ease of mounting for library staff.

2.3 FASTENERS

- A. General: Provide fasteners of size and type indicated, acceptable to authorities having jurisdiction, and that comply with requirements specified in this article for material and manufacture.
 - 1. For pressure-preservative-treated wood, use stainless steel fasteners.
 - 2. Use stainless steel fasteners where fasteners are exposed to view.
- B. Nails: ASTM F1667.

- C. Power-Driven Fasteners: ICC-ES AC70.
- D. Wood Screws and Lag Screws: ASME B18.2.1, ASME B18.6.1, or ICC-ES AC233.
- E. Carbon-Steel Bolts: ASTM A307 with ASTM A563 hex nuts and, where indicated, flat washers all hot-dip zinc coated.
- F. Stainless Steel Bolts: ASTM F593, Alloy Group 1 or 2; with ASTM F594, Alloy Group 1 or 2 hex nuts and, where indicated, flat washers.
- G. Postinstalled Anchors: Stainless steel, chemical or torque-controlled expansion anchors with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing in accordance with ASTM E488 conducted by a qualified independent testing and inspecting agency. Stainless steel bolts / nuts complying with ASTM F593 & ASTM F594, Alloy Group 1 or 2.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.
- B. Stain wood if indicated to be stained, including both faces and edges. Cut to required lengths and stain ends. Comply with requirements in Section 099300 "Staining and Transparent Finishing."

3.3 INSTALLATION, GENERAL

- A. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit work to other construction; scribe and cope as needed for accurate fit.
- B. Do not splice structural members between supports unless otherwise indicated.
- C. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
- D. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of members or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- E. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced and with adjacent rows staggered.

END OF SECTION 061500

SECTION 129300 – SITE FURNISHINGS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes the following:
 - 1. Dining Table & Chairs
 - 2. Outdoor Charging Stations
 - 3. Lounge Chair
 - 4. Lawn Seats
- B. Related Sections:
 - 1. Division 3 Section “Site Concrete.”
 - 2. Division 3 Section “Lawn.”
 - 3. Division 3 Section “Stone Fines Pavement.”

1.3 RELATED REQUIREMENTS

- A. Section 03 30 00 – Cast-In-Place Concrete for installation coordination.

1.4 SUBMITTALS

- A. Product Data: Submit product literature or tear sheets with name of product and manufacturer for each material and product used.
- B. Samples: Submit full range of manufacturer standard color samples for each product. Colors from each manufacturer to be reviewed together for final selection.
- C. Shop Drawings: Include dimensioned plans, elevations, sections, and attachment details.
 - 1. Custom Planter & Bench

1.5 QUALITY ASSURANCE

- A. Contractor shall have had experience with at least two (2) other projects of similar scope and complexity and shall perform work with personnel totally familiar with furnishings installation and construction techniques under the supervision of an experienced foreperson.
- B. Manufacturer: An experience company specializing in the manufacture of products specified in this Section with a record of successful in-service performance.
- C. Source Limitations: Obtain each product specified from a single source with resources to provide components of consistent quality in appearance and physical properties.

1.6 DELIVERY STORAGE AND HANDLING

- A. Deliver, store, handle and protect all materials from damage.

1.7 PROJECT CONDITIONS

- A. Environmental Requirements:
 - 1. Follow accepted industry standards when placing concrete footings in extreme cold weather.

PART 2 – PRODUCTS

2.1 DINING TABLE, CHAIRS, & OUTDOOR CHARGING STATION

- A. Manufacturer: Landscape Forms, 7800 E. Michigan Avenue, Kalamazoo, Michigan, 49098, (800) 521-2546, www.landscapeforms.com

Contact: Adrienne Seery, AdrienneS@landscapeforms.com, (269) 276-4570

- 1. Table: Catena
 - a. Style: 36" diameter, free-standing
 - b. Finish: powdercoat TBD
- 2. Chairs: Every Day Chair
 - a. Style: Loose, with arms
 - b. Finish: powdercoat TBD
- 3. Outdoor Charging Station: Power Pedestal
 - a. BM-PP-1G1U-LBLK
 - b. Include Device Shelf Kit at grove locations shown on Drawings.
 - c. Include A/V – Communication Kit at trellis location shown on Drawings.
 - i. Confirm with requirements on Electrical Drawings.

2.2 LOUNGE CHAIR

- A. Manufacturer: Loll Designs, 5912 Waseca Street, Duluth, MN 55807, (877) 740-3387, www.lolldesigns.com.

- 1. Lollygagger Tall: color TBD.

2.3 LAWN SEATS

- A. Manufacturer: MD3 Contract Ltd., 412 Kelburn Road, Suite 312, Deerfield, Illinois, 60015, (847) 940-7072, www.md3contract.com

Contact: Dario Tainer, tainerd@gmail.com, dt@md3contract.com

- 1. First Impressions Collections, Rio!
 - a. Rio XL, color pink P 4010
 - b. Rio Lounge, color green G P376M
 - c. Rio M, color pink P 4010
 - d. Rio S, color blue B 5024
 - e. Submit all standard color samples for final selection.
 - f. Fill with sand for stabilization.

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 utility connections and paving base have been completed.
- C. Install site furnishings level, plumb, true, and securely anchored, complete with all fittings and accessories, as indicated on Drawings and according to manufacturer's instructions.

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 OF SECTION 129300

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.

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.

3.3 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

- A. 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 OF SECTION 220523

SECTION 220524 - CHECK VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Bronze swing check 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 B16.1 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.

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 OF SECTION 220524

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.
- 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

- D. 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.

2.2 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.

2.3 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.

2.4 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.

2.5 EQUIPMENT SUPPORTS

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

2.6 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.
- 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.
 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-joist 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 OF SECTION 220529

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper tube and fittings - domestic water.
2. Piping joining materials - domestic water.
3. Encasement for piping.
4. Transition fittings - domestic water.

B. Related Requirements:

1. Section 331415 "Site Water Distribution Piping" for water-service piping outside the building from source to the point where water-service piping enters the building.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Copper tube and fittings - domestic water.
2. Piping joining materials - domestic water.
3. Transition fittings - domestic water.

1.3 INFORMATIONAL SUBMITTALS

- A. System purging and disinfecting activities report.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Installers of pressure-sealed joints are to be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

1.5 FIELD CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service in accordance with requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of water service.
2. Do not interrupt water service without Owner's written permission.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS - DOMESTIC WATER

- A. Drawn-Temper Copper Tube: ASTM B88, Type L and ASTM B88, Type M .
- B. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings. Do not use solder joints on pipe sizes greater than NPS 4.
- C. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings. Do not use solder joints on pipe sizes greater than NPS 4.
- D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Do not use solder joints on pipe sizes greater than NPS 4.
- E. Cast Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends. Do not use solder joints on pipe sizes greater than NPS 4.
- F. Wrought Copper Unions: ASME B16.22. Do not use solder joints on pipe sizes greater than NPS 4.
- G. Pressure-Seal-Joint Fittings, Copper or Bronze - Domestic Water:
 - 1. Source Limitations: Obtain pressure-seal-joint fittings, copper or bronze, from single manufacturer.
 - 2. Housing: Copper.
 - 3. O-Rings and Pipe Stops: EPDM.
 - 4. Tools: Manufacturer's special tools.
 - 5. Minimum 200 psig working-pressure rating at 250 deg F
- H. Copper-Tube, Push-on-Joint Fittings - Domestic Water:
 - 1. Source Limitations: Obtain copper-tube, push-on-joint fittings from single manufacturer.
 - 2. Description:
 - a. Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22.
 - b. Stainless steel teeth and EPDM-rubber, O-ring seal in each end instead of solder-joint ends.

2.2 PIPING JOINING MATERIALS - DOMESTIC WATER

- 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 B32, lead-free alloys.

- D. Flux: ASTM B813, water flushable.
- E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.3 TRANSITION FITTINGS - DOMESTIC WATER

- 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. Sleeve-Type Transition Couplings - Domestic Water: AWWA C219.
 1. Source Limitations: Obtain sleeve-type transition couplings from single manufacturer.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- 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. Aboveground domestic water piping, NPS 2 (DN 50) and smaller is to be the following:
 1. Drawn-temper copper tube, ASTM B88, Type L; cast- or wrought-copper, solder-joint fittings; and soldered joints.
 2. Drawn-temper copper tube, ASTM B88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.
 3. Drawn-temper copper tube, ASTM B88, Type L; copper push-on joint fittings; and push-on joints.
- D. Aboveground domestic water piping, NPS 2-1/2 to NPS 4 is to be the following:
 1. Drawn-temper copper tube, ASTM B88, Type L; cast- or wrought- copper, solder-joint fittings; and soldered joints.
 2. Drawn-temper copper tube, ASTM B88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.

3.2 INSTALLATION OF PIPING

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of 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 under building slab in accordance with CDA's "Copper Tube Handbook."
- C. Install valves in accordance with the following:
 - 1. Section 220523.12 "Ball Valves for Plumbing Piping."
 - 2. Section 220523.14 "Check Valves for Plumbing Piping."
- D. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."
- E. Install domestic water piping level without pitch and plumb.
- F. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- G. 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.
- H. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- I. Install piping to permit valve servicing.
- J. 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.
- K. Install piping free of sags and bends.
- L. Install fittings for changes in direction and branch connections.
- M. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- N. 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."
- O. 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 in accordance with 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. Soldered Joints for Copper Tubing: Apply ASTM B813, water-flushable flux to end of tube. Join copper tube and fittings in accordance with ASTM B828 or CDA's "Copper Tube Handbook."
- E. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools and procedure recommended by pressure-seal-fitting manufacturer. Leave insertion marks on pipe after assembly.
- F. Push-on Joints for Copper Tubing: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on joint fittings by inserting tube to measured depth.
- G. Joint Construction for Grooved-End Copper Tubing: Make joints in accordance with AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.
- H. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts in accordance with ASME B31.9.

3.4 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for hangers, supports, and anchor devices in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Install hangers for copper pipe, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- C. Support horizontal piping within 12 inches of each fitting.
- D. Support vertical runs of copper pipe to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.5 PIPING 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 water-service piping with shutoff valve; extend and connect to the following:
 1. Equipment: Cold -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.

3.6 IDENTIFICATION

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

3.7 CLEANING

- A. Clean non-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 procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- 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.

3.8 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. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
 - 5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 - 6. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
 - 7. Check plumbing specialties and verify proper settings, adjustments, and operation.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Hose bibbs.

1.2 ACTION SUBMITTALS

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

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 HOSE BIBBS

- A. Hose Bibbs:
 - 1. Standard: ASME A112.18.1 for sediment faucets.
 - 2. Body Material: Bronze.
 - 3. Seat: Bronze, replaceable.
 - 4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
 - 5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
 - 6. Pressure Rating: 125 psig nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.

7. Operation for Equipment Rooms: Wheel handle or operating key.
8. Operation for Service Areas: Wheel handle.
9. Include operating key with each operating-key hose bibb.
10. Include integral wall flange with each chrome or nickel-plated hose bibb.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

- A. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- B. Prepare test and inspection reports.

END OF SECTION 221119

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

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

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.
- 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 OF SECTION 260519

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 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: **5ohms**.
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 OF SECTION 260526

SECTION 260533.33 - OUTDOOR GROUND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 CONDITIONS AND REQUIREMENTS

- A. The General Conditions, Supplementary Conditions, and Division 01 – General Requirements apply.

1.2 SECTION INCLUDES

- A. Outdoor ground boxes.

1.3 RELATED SECTIONS

- A. Division 26 - Electrical: Electrical systems and components.

1.4 SUBMITTALS

- A. Product Data: Submit for outdoor ground boxes.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Firms regularly engaged in manufacture of outdoor ground boxes of the types and sizes required, whose products have been in satisfactory use in similar service for not less than 10 years. Provide outdoor ground boxes produced by a manufacturer listed in this section.
- B. Outdoor Ground Boxes: Comply with requirements of applicable local codes, NEC, UL, CSA, and NEMA Standards pertaining to outdoor floor boxes. Tested and listed by Underwriters Laboratories, Inc. to meet NEMA 6P and IP68 requirements for use in outdoor locations. Outdoor ground boxes comply with ADA guidelines including unobstructed reach requirements.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver outdoor ground boxes in factory labeled packages.
- B. Store and handle in strict compliance with manufacturer's written instructions and recommendations.
- C. Protect from damage due to weather, excessive temperature, and construction operations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: The design for outdoor ground boxes is based on Outdoor Ground Boxes manufactured by Legrand/Wiremold, 60 Woodlawn Street, West Hartford, CT 06110; toll-free 800-621-0049, telephone 860-233-6251, fax 860-232-2062; Web Site: www.legrand.us/wiremold.
- B. Substitutions will be considered under provisions of Section 01 25 00.

2.2 OUTDOOR GROUND BOXES

- A. Classification and Use: Outdoor ground boxes shall have been examined and tested by Underwriters Laboratories Inc. to meet NEMA 6P and IP68 requirements to be safe to use even during inclement weather and bear the cULus Listing Mark.
- B. Outdoor Ground Boxes, General:
 1. Outdoor ground boxes shall be designed to trap and maintain an air pocket to protect the devices, plugs and connections from water, snow, and ice. Boxes shall be constructed from UV rated chemical resistant materials. Boxes designed to ANSI/SCTE 77 with a

Tier 5 rating to hold up to 5000 lbs of load. Boxes install flush to finished ground reducing tripping hazards. Box shall have a diving bell concept to maintain an air pocket and keep water away from connections. Box shall have an egress door that will auto-adjust to cable diameter and auto-lock in the closed position when no cables are exiting the box.

- C. Model XB814 Exterior Ground Boxes: Single service 2-gang ground box manufactured from UV rated nonmetallic material. Box accepts up to two 1-1/4" trade size PVC conduit feeds. Boxes designed to be installed separately or ganged together for greater capacity and flexibility. Accepts optional XB814 cover assembly. Boxes shall be 16-1/8" L x 8-1/8" W x 10-3/4" H [410mm x 206mm x 273mm]. Box assemblies include main box body, installation cap, and installation plate.
- D. Model XB814C520[] Exterior Box Cover Assembly 5-20R: Assembly prewired with two (2) 20A L5-20R weather-resistant duplex receptacles. Box assemblies shall be 16-1/8" L x 8-1/16" W x 10-3/4" H [410mm x 205mm x 273mm]. Cover assembly includes flange, cover, junction box, (2) 20A 5-20R receptacles, SOOW cord, wet location wire connectors, key, and mounting hardware.
- E. Model XB814CL530[] Exterior Box Cover Assembly L5-30R: Assembly prewired with one (1) 30A L5-30R 120V corrosion-resistant duplex receptacle. Cover assemblies shall be 16-1/8" L x 8-1/16" W x 10-3/4" H [410mm x 205mm x 273mm]. Cover assembly includes flange, cover, junction box, SOOW cord, L5-30R receptacle, wet location wire connectors, key, and mounting hardware.
- F. Model XB814CL630[] Exterior Box Cover Assembly L6-30R: Assembly prewired with one (1) 30A L6-30R 240V corrosion-resistant duplex receptacle. Cover assemblies shall be 16-1/8" L x 8-1/16" W x 10-3/4" H [410mm x 205mm x 273mm]. Cover assembly includes flange, cover, junction box, SOOW cord, L6-30R receptacle, wet location wire connectors, key, and mounting hardware.
- G. Model XB814CLV[] Exterior Box Cover Assembly Low Voltage: Assembly designed to accept up to 12 communication ports or eight (8) Legrand AVIP devices. Cover assemblies shall be 16-1/8" L x 8-1/16" W x 10-3/4" H [410mm x 205mm x 273mm]. Cover assembly includes flange, cover, junction box, corrugated conduit assembly, (1) 12 port communication mounting plate, (1) 8 port Legrand AVIP audio/video mounting plate, key, and mounting hardware.

2.3 ACCESSORIES

- A. Model XB814CP[] Exterior Box Cover Plate Kit: Replacement cover plate including new handle and required mounting hardware.
- B. Model XB814ED Replacement Egress Door Kit: Replacement door can be changed out if the door is ever wears out or becomes damaged.
- C. Model XB814SP Replacement Egress Door Spring Pin Set: Locks egress door in the closed position when cover is closed.
- D. Model XBLNT Exterior Box Locknut Tool: Exterior box locknut wrench; used to tighten locknut on the junction box.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions under which outdoor ground boxes are to be installed. Notify the Landscape Architect and Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Strictly comply with manufacturer's installation instructions and recommendations. Coordinate installation with adjacent work to ensure proper clearances and to prevent electrical hazards.

3.3 CLEANING AND PROTECTION

- A. Clean exposed surfaces using non-abrasive materials and methods recommended by manufacturer.
- B. Protect boxes until acceptance.

END OF SECTION

A copyright license to reproduce this specification is hereby granted to non-manufacturing engineers, architects and specification writers.



Legrand / Wiremold

U.S. and International:

60 Woodlawn Street • West Hartford, CT 06110

1-800-621-0049 • FAX: 860-232-2062 • Outside U.S.: 860-233-6251

Canada:

570 Applewood Crescent • Vaughan, Ontario L4K 4B4

1-800-723-5175 • FAX: 905-738-9721

©2018 Legrand/Wiremold - All Rights Reserved

Edition 2 – February 2018 – For latest specs visit www.legrand.us

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 OF SECTION 260553

SECTION 260800 – ELECTRICAL SYSTEMS COMMISSIONING

PART 1 - GENERAL

1.01 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.

1.02 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", 27th 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.

1.03 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.

1.04 DEFINITIONS

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

1.05 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

2.01 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

3.01 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.

3.02 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.

3.03 TRAINING

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

END OF SECTION 26 08 00

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.
 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.
 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 OF SECTION 260923

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. Pigtailing 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 OF SECTION 262726

SECTION 262736 - OUTDOOR CHARGING STATIONS

PART 1 - GENERAL

1.1 CONDITIONS AND REQUIREMENTS

- A. The General Conditions, Supplementary Conditions, and Division 01 – General Requirements apply.

1.2 SECTION INCLUDES

- A. Power pedestals.

1.3 RELATED SECTIONS

- A. Division 26 - Electrical: Electrical systems and components.

1.4 SUBMITTALS

- A. Product Data: Submit for power pedestal and components.
- B. Shop Drawings: For power pedestal and components. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: Submit one (1) sample for each type of power pedestal component specified with required color and finish. Show standard color and finish ranges available.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Firms regularly engaged in manufacture of charging stations, power pedestals, and components of the types and sizes required, whose products have been in satisfactory use in similar service for not less than 10 years. Provide charging stations, power pedestals, and components produced by a manufacturer listed in this section.
- B. Charging Stations, Power Pedestals, and Components: Comply with requirements of applicable local codes, NEC, UL, and NEMA Standards pertaining to charging stations, power pedestals, and components. UL listed to meet NEMA 3R requirements for use in outdoor locations. cULus listed per File No. E479489 in compliance with UL Standard 1773.
- C. Charging stations and power pedestals comply with ADA requirements.

1.6 DELIVERY, STORAGE AND HANDLIN

- A. Deliver power pedestals and associated components in factory labeled packages.
- B. Store and handle in strict compliance with manufacturer's written instructions and recommendations.
- C. Protect from damage due to weather, excessive temperature, and construction operations.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

- A. Basis-of-Design Product: The design for power pedestals and components is based on the Wiremold® Power Pedestals manufactured by Legrand/Wiremold, 60 Woodlawn Street, West Hartford, CT 06110; toll-free 877-295-3472, telephone 860-233-6251, fax 860-232-2062; Web Site: www.legrand.us/wiremold.
- B. Substitutions will be considered under provisions of Section 01 25 00.

2.2 MATERIALS

- A. Top Cap and Pedestal Body: 0.188-inch thick aluminum extrusion.
- B. Pedestal Base: Steel base with 4-1/4-inch [108mm] opening and four (4) 3/8-inch [9.5mm] diameter “L” bolts, eight inches [203mm] long.
- C. Shelves: 0.25-inch thick aluminum coated with outdoor-rated PlastiKote coating.
- D. Transparent Door: Polycarbonate; UL F1 rated to ensure UV resistance.
- E. Lenses: Polycarbonate; UL F1 rated to ensure UV resistance.
- F. Paint: Outdoor-rated powder coat.

2.3 POWER PEDESTALS

- A. Outdoor power pedestals provided with [two] [three] devices. Power and lighting are prewired on separate circuits. Lighting circuit can be controlled by a timer at the panel if desired. Can also be supplied unwired in two- and three-gang versions.
 1. Supplied with color-matched door that can be easily replaced by a color-matched locking door or a transparent door.
 2. Interior illuminates when door is open. Door closes automatically to meet while-in-use requirements.
- B. Two-Gang Outdoor Power Pedestal: Catalog No. XCSP2GRU with one (1) 20A weather-resistant GFCI and one (1) 4-port 4.2A USB outlets; powder coat finish, [Black (BK)] [Bronze (BZ)] [Silver (SV)] color.
- C. Three-Gang Outdoor Power Pedestal: Catalog No. XCSP3GRRU-[XX] with two (2) 20A weather-resistant GFCI and one (1) 4-port 4.2A USB outlets; powder coat finish, [Black (BK)] [Bronze (BZ)] [Silver (SV)] color.

2.4 OUTDOOR CHARGING STATION ACCESSORIES

- A. A/V-Communication Kit: Catalog No. XCSAV; enables combining power and low voltage in one (1) three-gang pedestal; includes two (2) device plates to accommodate either two (2) decorator-style power devices and one (1) decorator style A/V or communication device or two (2) decorator-style power devices and four (1) charging station manufacturer’s AVIP device plates.
- B. Transparent Door: Catalog No. XCSCLEAR; manufactured from polycarbonate; replaces color-matched door.
- C. Replacement Door: Catalog No. XCSDOOR-[XX]; replacement door for all charging stations included with initial shipment of all models; powder coat finish, [Black (BK)] [Bronze (BZ)] [Silver (SV)] color.

- D. Locking Door: Catalog No. XCSLOCK-[XX]; replacement door for all charging stations included with initial shipment of all models; powder coat finish, [Black (BK)] [Bronze (BZ)] [Silver (SV)] color.
- E. Device Shelves: Catalog No. XCSSHELF-[XX]; pair of shelves hold a mobile device while charging; powder coat finish, [Black (BK)] [Silver (SV)] color. Shelves are designed to mount to pedestal sides and have been tested to hold up to 250 lbs. Use a maximum of two (2) shelves per pedestal. Shelves mount below door opening.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions under which power pedestals and components are to be installed. Notify the Landscape Architect and Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected.
- B. Examine roughing-in for power pedestals and conduit to verify actual locations of installation.

3.2 INSTALLATION

- A. Strictly comply with manufacturer's installation instructions and recommendations and approved shop drawings. Coordinate power pedestals installation with adjacent work to ensure proper clearances and to prevent electrical hazards. Remove any burrs or sharp edges on material.
- B. Anchor Bolts: Install plumb using manufacturer-supplied template, uniformly spaced.
- C. Stub up conduit to a height of eight (8) inches for standard power installations. If using the A/V kit, run the conduit up to bottom of power module/door.

3.3 CLEANING AND PROTECTION

- A. Clean exposed surfaces using non-abrasive materials and methods recommended by manufacturer.
- B. Protect power pedestals and components from damage until acceptance. Replace power pedestals components which are damaged during construction.

END OF SECTION

© 2016 Legrand/Wiremold. All Rights Reserved.
A copyright license to reproduce this specification is hereby granted
to non-manufacturing engineers, architects and specification writers.
Rev. 10/16

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 OF SECTION 262816

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**>.
 - 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.**
 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 OF SECTION 265613

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 OF SECTION 265619

SECTION 271500 – COMMUNICATIONS CABLING AND EQUIPMENT

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. UTP cabling.
2. UTP Cable Hardware
3. UTP Patch Cords
4. Telecommunications outlet/connectors.
5. Communications Equipment Cabinets and Communications Equipment
6. WiFi Kits

B. Related Sections:

1. Division 27 Section 270528 "Pathways for Communications Systems" for horizontal cabling pathways.

1.3 DEFINITIONS

- A. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.
- B. BICSI: Building Industry Consulting Service International.
- C. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.
- D. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- E. EMI: Electromagnetic interference.
- F. IDC: Insulation displacement connector.
- G. LAN: Local area network.
- H. MUTOA: Multiuser telecommunications outlet assembly, a grouping in one location of several telecommunications outlet/connectors.
- I. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.

J. RCDD: Registered Communications Distribution Designer.

K. UTP: Unshielded twisted pair.

1.4 HORIZONTAL CABLING DESCRIPTION

A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.

1. TIA/EIA-568-B.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.
2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
3. Bridged taps and splices shall not be installed in the horizontal cabling.
4. Splitters shall not be installed as part of the optical fiber cabling.

B. A work area is the area identified on the drawings.

C. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to equipment. The maximum allowable length does not include an allowance for the length of 16 feet in the horizontal cross-connect.

1.5 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

1.6 ACTION SUBMITTALS

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

1. For coaxial cable, include the following installation data for each type used:

- a. Nominal OD.
- b. Minimum bending radius.
- c. Maximum pulling tension.

B. Shop Drawings:

1. System Labeling Schedules: Electronic copy of labeling schedules, for all horizontal cabling and termination equipment.
2. Wiring diagrams to show typical wiring schematics, including the following:
 - a. Cross-connects.
 - b. Patch panels.
 - c. Patch cords.

3. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

1.8 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For splices and connectors to include in maintenance manuals.

- B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.9 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. Patch-Panel Units: One of each type.
2. Connecting Blocks: One of each type.
3. Device Plates: One of each type.

1.10 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings, Cabling Administration Drawings, and field testing program development by an RCDD.

- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

- C. 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.

- D. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.

- E. Grounding: Comply with ANSI-J-STD-607-A.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
 - 1. Test each pair of UTP cable for open and short circuits.

1.12 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Project Manager.
- B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

1.13 WARRANTY

- A. Twenty-Five (25) Year Extended Product Warranty
 - 1. The 25 Year Extended Product Warranty shall ensure against product defects, that all approved cabling components exceed the specifications of TIA/EIA 568A and ISO/IEC IS 11801, exceed the attenuation and NEXT requirements of TIA/EIA TSB 67 and ISO/IEC IS 11801 for cabling links/channels, that the installation will exceed the loss bandwidth requirements of TIA/EIA TSB 67 and ISO/IEC 11801 for fiber links/channels, for a twenty-five (25) year period. The end-to-end passive product shall be capable of delivering 1Gb/s half-duplex mode/2Gb/s full-duplex mode to the workstation.
 - 2. The Twenty-Five (25) Year Extended Product Warranty shall cover the replacement or repair of defective product(s) and labor for the replacement or repair of such defective product(s) for a twenty-five (25) year period.
- B. Twenty-Five (25) Year Application Assurance
 - 1. The Twenty-Five (25) Year Application Assurance shall cover the failure of the wiring system to support the application which it was designed to support, as well as additional applications(s) introduced in the future, up to 1Gb/s parallel transmission schemes, by recognized standards or user forums that use the TIA/EIA or ISO/IEC IS 11801 component and link/channel specifications for cabling, for a twenty-five (25) year period.
- C. System Certification
 - 1. Upon successful completion of the installation and subsequent inspection, the customer shall be provided with a numbered certificate, from the manufacturing company, registering the installation.

PART 2 - PRODUCTS

2.1 PATHWAYS

- A. General Requirements: Comply with TIA/EIA-569-A

- B. Cable Support: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
 - 1. Support brackets with cable tie slots for fastening cable ties to brackets.
 - 2. Lacing bars, spools, J-hooks, and D-rings.
 - 3. Straps and other devices.
- C. Conduit and Boxes: Comply with requirements in Division 26 Section 260533 "Raceway and Boxes for Electrical Systems."
 - 1. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.
- D. Comply with requirements in Division 26 Section 260533 "Raceways and Boxes for Electrical Systems."
 - 1. ALL horizontal cabling connected to a CCTV camera shall be installed in min. 3/4" conduit, no exceptions.

2.2 UTP CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
 - 1. Berk-Tek; a Nexans company
 - 2. SYSTIMAX Solutions; a CommScope Inc. brand.
 - 3. Superior Essex and Leviton Network Solutions.
- B. 100 Ohm Enhanced Category 6 Unshielded Twisted Pair (UTP) Cable
 - 1. Physical Characteristics:
 - a. Shall be plenum rated and meet applicable requirements of ANSI/ICEA S- 80-576. All 4 pairs must be insulated with F.E.P. No constructions that use mixed insulation materials will be allowed.
 - b. The diameter of the insulated conductor shall be .026 in. nominal.
 - c. Shall consist of (4) 23 AWG twisted pairs.
 - d. Shall be suitable for the environment in which they are to be installed.
 - e. The color coding of pairs shall be:
 - f. Pair 1: W-BL; BL
 - g. Pair 2: W-O; O
 - h. Pair 3: W-G; G
 - i. Pair 4: W-BR; BR
 - j. The overall diameter of the cable shall be no larger than 0.250 inches.
 - k. The ultimate breaking strength measured in accordance with ASTM D 4565 shall be 400 N minimum.
 - l. Cable shall withstand a bend radius of 1 inch at -20 degrees Celsius without jacket or insulation cracking.
 - m. Cable shall be third party verified to meet ANSI/TIA/EIA-568-B.2-1.

- C. All horizontal data station cable and voice cable shall terminate on modular patch panels or 110 cross-connecting blocks in their respective Telecommunications Room or Equipment Room as specified on the project Drawings.
- D. All cables in a cable run shall be from the same manufacturer and shall be the same type.
- E. A mix of UTP cables from different manufactures shall not be used.

2.3 UTP CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Berk-Tek/Ortronics a Nexans company.
 2. SYSTIMAX Solutions; a CommScope Inc. brand.
 3. Superior Essex and Leviton Network Solutions.
- B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.
- C. Connecting Blocks: 110-style IDC for Category 6. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.
 1. Number of Terminals per Field: One for each conductor in assigned cables.
- D. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
 1. Number of Jacks per Field: One for each four-pair UTP cable indicated.
- E. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.
- F. Patch Cords: Factory-made, 4-pair cables in 36-inch lengths; terminated with 8-position modular plug at each end.
 1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.

2.4 UTP PATCH CORDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
 1. Berk-Tek a Nexans company.
 2. SYSTIMAX Solutions; a CommScope Inc. brand.
 3. Superior Essex and Leviton Network Solutions.
- B. The contractor shall provide factory terminated and tested UTP and patch cords and equipment cords

for the complete cabling system. The UTP patch cables shall meet the requirements of ANSI/TIA/EIA-568-B.2 and ANSI/TIA/EIA-568-B.2-1 for patch cord testing.

C. Copper (UTP) patch cords shall:

1. Use 8 position connector with impedance matched contacts and designed using dual reactance.
2. Be constructed of 100 ohm, 4 pair, 24 AWG, stranded conductor, unshielded twisted pair copper per the requirements of the ANSI/TIA/EIA-568-B.2 and ANSI/TIA/EIA-568-B.2-1 standard.
3. Meet TIA category 6 component specifications in ANSI/TIA/EIA-568-B.2-1
 - a. 100% factory tested to meet category 6 performance and
 - b. ETL or any other nationally recognized 3rd party verification
4. Be center tuned to category 6 performance specifications by using paired bi-level contact array.
5. Be capable of universal T568A or T568B wiring schemes.
6. Modular connector shall maintain the paired construction of the cable to facilitate minimum untwisting of the wires.
7. Have a performance marking indelibly labeled on the jacket (by the manufacturer).
8. Have the ability to accept color-coded labels and icons to comply with ANSI/TIA/EIA-606-A labeling specifications.
9. Have "snagless" protection for the locking tab to prevent snagging and to protect locking tab in tight locations and provide bend relief.
10. Be available in two standard colors.
11. Be available in 3 foot, 5 foot, 7 foot, 9 foot, and 15 foot standard lengths.
12. Be backwards compatible to Category 3, 5 and 5e.

D. Patch cords shall be furnished by the Contractor as required to meet the design requirement of the project, whether indicated on the project drawings or not.

E. The Contractor shall furnish modular patch cords for each assigned port of any Ethernet patch panel installed as part of the project.

F. Jacket:

1. Data Applications: Blue (unless noted otherwise)
2. Voice Applications: Grey (unless noted otherwise)

2.5 TELECOMMUNICATIONS OUTLET/CONNECTORS

A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-B.1.

B. Workstation Outlets: Two -port-connector assemblies mounted in single faceplate.

1. Plastic Faceplate: High-impact plastic.
2. Metal Faceplate: Stainless steel.
3. For use with snap-in jacks accommodating any combination of UTP, optical fiber, and coaxial work area cords.
 - a. Flush mounting jacks, positioning the cord at a 45-degree angle.

4. Legend: Factory labeled by silk-screening or engraving for stainless steel faceplates.
5. Legend: Machine printed, in the field, using adhesive-tape label.
6. Legend: Snap-in, clear-label covers and machine-printed paper inserts.

2.6 COMMUNICATIONS EQUIPMENT CABINETS AND EQUIPMENT

- A. Each recreational center shall have one new equipment cabinet installed at a location to be directed by the owner.
- B. Equipment Cabinet Shall Include
 1. Equipment Cabinet
 - a. 13U locking wall mount or floor mountable cabinet - Quantity 1,
 - b. Color - Black,
 - c. 19" mounting rails
 2. Uninterruptable Power Supply 2000VA Rack Mounted
 - a. Quantity 1
 3. 24 Port CAT6 Patch Panel
 - a. Quantity 1
 4. 24 Port POE Network Switch
 - a. 10/100/1000x24 - POE
 - b. Managed
 - c. Rack mountable
 - d. Quantity 1
 5. Horizontal Cable Management
 - a. Quantity 1
 6. 120V 20A Receptacle
 - a. Quantity 1
 7. Network Video Recorder
 - a. See Specification Section 282300 "Video Surveillance"
- C. Contractor shall furnish and install one new 20A, 120V single phase circuit from an existing electrical panel to a new duplex receptacle within new equipment cabinet for UPS power.

2.7 GROUNDING

- A. Comply with requirements in Division 26 Section 260562 "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.
- B. Comply with ANSI-J-STD-607-A.

2.8 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Comply with requirements in Division 26 Section 260553 "Identification for Electrical Systems" for labeling requirements.

2.9 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test UTP cables on reels according to TIA/EIA-568-B.1.
- C. Factory test UTP cables according to TIA/EIA-568-B.2.
- D. Cable will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 WIRING METHODS

- A. Wiring Method: Install cables in raceways except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.
 - 1. Comply with requirements for raceways and boxes specified in Division 26 Section 260533 "Raceway and Boxes for Electrical Systems."
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.2 INSTALLATION OF PATHWAYS

- A. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.
- B. Comply with requirements in Division 26 Section 260533 "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.

- C. Install manufactured conduit sweeps and long-radius elbows whenever possible.

3.3 INSTALLATION OF CABLES

- A. Comply with NECA 1.

- B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. MUTOA shall not be used as a cross-connect point.
5. Consolidation points may be used only for making a direct connection to telecommunications outlet/connectors:
 - a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
 - b. Locate consolidation points for UTP at least 49 feet from communications equipment room.
6. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
7. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
8. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
9. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
10. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
11. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
12. In the communications equipment room, install a 10-foot- long service loop on each end of cable.
13. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

- C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.
2. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.

- D. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches above ceilings by

cable supports not more than 60 inches apart.

3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

E. Group connecting hardware for cables into separate logical fields.

F. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.4 FIRESTOPPING

- A. Comply with TIA/EIA-569-A, Annex A, "Firestopping."
- B. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.5 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607-A.

- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.6 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 28 Section 282300 "Video Surveillance."
- B. Using cable management system software specified in Part 2, develop Cabling Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable and label cable, jacks, connectors, and terminals to which it connects with same designation. At completion, cable and asset management software shall reflect as-built conditions.
- C. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration.
- D. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- E. Cable and Wire Identification:
 - 1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 - 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
 - 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
 - 4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
 - a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
 - b. Label each unit and field within distribution racks and frames.
 - 5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
- F. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.
 - 1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Visually inspect UTP cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
2. Visually confirm Category 6, marking of outlets, cover plates, outlet/connectors, and patch panels.
3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.

- a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

5. UTP Performance Tests:

- a. Test for each outlet. Perform the following tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.2:

- 1) Wire map.
- 2) Length (physical vs. electrical, and length requirements).
- 3) Insertion loss.
- 4) Near-end crosstalk (NEXT) loss.
- 5) Power sum near-end crosstalk (PSNEXT) loss.
- 6) Equal-level far-end crosstalk (ELFEXT).
- 7) Power sum equal-level far-end crosstalk (PSELFEXT).
- 8) Return loss.
- 9) Propagation delay.
- 10) Delay skew.

C. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

D. End-to-end cabling will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION 271500

SECTION 282300 - VIDEO SERVEILLACE AND MOSQUITO TYPE SONIC SECURITY DEVICES

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 Wynnefield Library 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 Rebuild Philadelphia & Wynnefield Library 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. Rebuild Philadelphia is granted a nontransferable fully paid license (Hanwha Techwin) 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 Hanwha Techwin 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. Hanwha Techwin
- 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. Hanwha Techwin (XNP-6120H)
- 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. Hanwha Techwin
- 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. Exacqvision Monitoring Software
- 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 Rebuild Philadelphia approved equal.

B. Devices shall be secured with Standard Security Cage as manufactured by Moving Sound Technologies, or Rebuild Philadelphia 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 Rebuild Philadelphia 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 Rebuild Philadelphia 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 OF SECTION 282300

SECTION 310000- EARTHWORK

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The work under this Section shall include all labor, material, equipment and all else necessary for cutting, proof rolling, filling and grading to required lines, dimensions, contours and elevations for proposed improvements as hereinafter specified and/or as otherwise required for the proper and timely completion of this Contract. Work under this Section includes, but is not limited to, subgrade preparation, excavating, backfilling, and compaction for structures and foundations, pavements, sidewalks, landscaping 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 earthwork.
- B. Scarifying, compaction, moisture content conditioning and control, and removal of unsuitable material to ensure proper preparation of areas for the proposed improvements.
- C. Undertake any special construction procedures for the project as shown in the drawings and described by these specifications for preparation of pavement areas.

1.2 RELATED DOCUMENTS

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

1.3 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM), latest edition
 - 1. C 33 Concrete Aggregates
 - 2. D 698 Laboratory Compaction Characteristics of Soil Using Standard Effort
 - 3. D 1556 Density and Unit Weight of Soils in Place by the Sand-Cone Method
 - 4. D 1557 Laboratory Compaction Characteristics of Soil Using Modified Effort
 - 5. D 2167 Density and Unit Weight of Soil in Place by Rubber Balloon Method
 - 6. D 2216 Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
 - 7. D 2487 Classification of Soils for Engineering Purposes (Unified Soil Classification System)
 - 8. D 2937 Density of Soil in Place by the Drive-Cylinder Method
 - 9. D 3740 Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
 - 10. D 4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils
 - 11. D 4254 Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
 - 12. D 6938 In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
- B. American Association of State Highway and Transportation Officials (AASHTO), latest edition
 - 1. T 88 Particle Size Analysis of Soils
- C. Associated General Contractors of America
 - 1. Manual of Accident Prevention in Construction

1.4 QUALITY ASSURANCE

- A. A geotechnical engineer familiar with the project requirements, selected and paid by the Owner, may be retained to perform construction inspection on site based on density testing, visual observation, and judgement. This inspection will not relieve the Contractor from their responsibility to complete the work in accordance with the drawings and specifications.
- B. Visual field confirmation and density testing of subgrade preparation and fill placement procedures shall be performed by the field geotechnical engineer as part of the construction testing requirements. The Contractor shall be informed as soon as possible of the test results.
- C. The geotechnical engineer shall prepare field reports that indicate compaction test location, elevation data, testing results and acceptability. The Owner, engineer, and Contractor shall be provided with written copies of the results within 24 hours of time test was performed.
- D. All costs related to reinspection due to failures shall be paid for by the Contractor at no additional expense to Owner. The Owner reserves the right to direct any inspection that is deemed necessary. Contractor shall provide free access to site for inspection activities.

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 Article 3.08.
 - 1. The geotechnical engineer shall be an experienced inspector working under the direction of the professional engineer licensed to practice in the Commonwealth of Pennsylvania who is experienced in providing engineering services related to earthwork.
 - 2. The testing agency shall be an independent laboratory having a minimum of three (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.
 - 4. Electrical Resistivity and pH tests for sand used for water pipe bedding and backfill.
- C. Within 10 days after award of the contract, the Contractor shall submit to the Owner and engineer a schedule detailing the sequence, and time of completion of all phases of work under this section.
- D. At least two weeks in advance of imported fill use, the Contractor shall submit the following laboratory test data to the geotechnical engineer for each type of imported soil/gravel material to be used as compacted fill.
 - 1. Moisture and Density Relationship: ASTM D1557;
 - 2. Particle-Size Analysis: ASTM D2487; and,
 - 3. Plasticity Index: ASTM D 4318.
- E. Together with the above test data, the Contractor shall submit a 25-pound sample of each type of off site fill material in an air tight container for the approval of the geotechnical engineer.

- F. Submit the name of each material supplier and specific type and source of each material. Any change in source or soil type throughout the job requires approval of the Owner and the engineer.

1.6 DEFINITIONS

- A. Backfill: Soil materials used to fill an excavation.
- B. Base Course: Layer placed between the subgrade and paving.
- C. Bedding Course: Layer placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow: Approved soil materials imported from off-site for use as fill or backfill.
- E. Classification: No consideration will be given to the nature of earthen materials, and all excavation required for this Project will be designated as unclassified.
- F. 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.
- G. Excavation: Removal of material encountered down to subgrade elevations:
 - 1. Bulk Excavation: Excavation more than 10 feet in width.
 - 2. Overexcavation: 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.
- H. 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.
- I. Rock:
 - 1. General Excavation - Any material that cannot be excavated with a single-toothed ripper drawn by a crawler tractor having a minimum draw bar pull rated at not less than 71,000 lbs. (Caterpillar D9N or equivalent), and occupying an original volume of at least 2 cubic yards or more; and,
 - 2. Trench Excavation - Any material that cannot be excavated with a backhoe having a break out force rated at not less than 44,000 lbs. (Caterpillar 235D or equivalent), and occupying an original volume of at least 2 cubic yards.
- J. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below base or topsoil materials.
- K. Subbase: Material shown on the Drawings between the pavement base and subgrade.
- L. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.7 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. Excavation and trenching

are regulated by OSHA. The Contractor shall perform all excavation and trenching work in accordance with 29 CFR 1926 Subpart P.

- 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.

1.8 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.

PART 2 - PRODUCTS

2.1 ON-SITE FILL

- A. On-site excavated materials may be used as backfill provided they meet the following criteria:
 - 1. Suitable backfill materials include soil that complies with ASTM D 2487 soil classifications GW, GP, GM, SW, SP, and SM and having a maximum particle size of three (3) inches in any one dimension.
 - 2. Unsuitable backfill materials include any material having an excess of wood, timber, metal, rebar, organics, debris, or any other deleterious materials.
- B. It is not permitted for excavated materials unsuitable for fill in their as-is state to be processed on-site to comply with suitable backfill requirements. Concrete, brick, asphalt debris is not permitted to be broken or crushed on site to meet the above particle size requirement.
- C. The Contractor shall use the on-site soil judiciously to facilitate the construction schedule.
- D. Prior to placement, on-site material to be used as fill shall not contain:
 - 1. Debris other than crushed concrete and brick meeting the above requirements.
 - 2. Timber or railroad ties.
 - 3. Other deleterious materials such as steel rails, rebar, trash, etc.
 - 4. Hazardous material - Unsuitable and deleterious materials and debris shall be disposed of off-site in accordance with all applicable regulations.

- E. Any bituminous concrete on the site shall be milled/removed prior to placing any fill and shall be reused only onsite immediately below the pavement stone base course.

2.2 OFF-SITE IMPORTED FILL

- A. If necessary, off-site fill shall be obtained and provided by the Contractor;
- B. Fill shall be clean, well graded granular soil which is non-expansive and non-collapsible and shall have between 5% and 15% by weight passing the #200 sieve. The portion passing the #200 shall be non-plastic with a plasticity index not greater than five. Fill with less fines (less than #200) may be required on project specific basis and as required by geotechnical engineer. Likewise, fill with more than 20% fines may be acceptable on a project specific basis or as identified in the geotechnical engineering study;
- C. Imported fill shall be free of all hazardous substances. Certification of compliance and, if requested, test results substantiating compliance shall be furnished to the Owner and geotechnical engineer by the Contractor not less than one week prior to its intended use;
- D. The Owner reserves the right to test off-site fill material for conformance with these specifications; and,
- E. The Contractor shall be responsible for all permits and regulatory requirements associated with off-site borrow sources.

2.3 STONE BACKFILL

- A. In accordance with PennDOT Publication 408, Section 703 for AASHTO No. 57 Stone.

2.4 GEOTEXTILES

- A. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
 1. Survivability: Class 2; AASHTO M 288.
 2. Grab Tensile Strength: 247 lbf; ASTM D 4632.
 3. Sewn Seam Strength: 222 lbf; ASTM D 4632.
 4. Tear Strength: 90 lbf; ASTM D 4533.
 5. Puncture Strength: 90 lbf; ASTM D 4833.
 6. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
 7. Permittivity: 0.02 per second, minimum; ASTM D 4491.
 8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

2.5 EQUIPMENT

- A. Compactor for mass earthwork shall be minimum 10-ton static-drum weight vibratory roller or 10-ton static-drum weight sheep foot compactor as appropriate for the type of soil material at the site or other compactor approved by the geotechnical engineer.
- B. Compactor for trenches and where access or maneuverability is limited, use a double drum walk-behind roller or vibratory plate compactor or "jumping jack" tampers.

PART 3 - EXECUTION

3.1 GENERAL

- A. Prior to all work of this section, the Contractor shall become thoroughly familiar with the site, site conditions, and all portions of the work falling under this section.
- B. The Contractor shall refer to the soil erosion and sediment control drawings for staging of earthwork operations and for erosion control measures to be implemented prior to commencement of earthwork.
- C. Locate and identify existing utilities that are to remain and protect them from damage.
- D. Notify utility companies to allow removal and/or relocation of any utilities that are in conflict with the proposed improvements.
- E. Protect fences, structures, sidewalks, paving, curbs, etc. to remain from equipment and vehicular traffic.
- F. Protect benchmarks, property corners and all other survey monuments from damage or displacement. If a marker needs to be removed/relocated it shall be referenced by a licensed land surveyor and replaced, as necessary, by the same at no additional cost to the Owner.
- G. Remove from the site, material encountered in grading operations that, in opinion of Owner or geotechnical engineer, is unsuitable or undesirable for backfilling as per Article 2.01.
- H. Identify required lines, levels, contours and datum to bring site grades to the proposed subgrade conditions inferred from the drawings.
- I. Do not allow or cause any of the work performed or installed to be covered by work of this section prior to all inspections, tests and approvals.
- J. Perform excavation using capable, well maintained equipment and methods acceptable to the Owner and regulatory authorities having jurisdiction.
- K. When performing grading operations during periods of prolonged wet or dry weather, provide adequate measures for surface drainage and ground water control, and moisture control of soils (i.e., wetting or drying, scarify and discing) so as to place and compact the soil within the moisture content range two (2) percentage points of its optimum water content. Any disturbed areas should be proofrolled at the end of each day.
- L. Sloping, shoring, bracing, and fencing shall be installed in accordance with Federal OSHA requirements as well as the requirements of all regulatory authorities having jurisdiction.
- M. Allow no debris to accumulate on-site. Haul debris away from the site and dispose of at no cost to the Owner.

3.2 COMPACTION OF SUBGRADE SURFACES

- A. In areas to receive fill and at the final cut subgrade, proof roll and compact the exposed ground surface following clearing and grubbing and any required excavation with a minimum of four (4) passes of an approved compactor and obtain at least the following density requirement:

Location	Percent of Maximum Dry Density per ASTM D1557
Foundation Support, Pavements, Sidewalks and Wall Backfill	95%
Non-structural	90%

- B. The proof roll, truck and compactor equipment shall traverse the area at speed that permits the geotechnical engineer to comfortably walk alongside the equipment.
- C. Any soft areas exhibiting excessive weaving or unsatisfactory material identified during excavation, fill placement, compaction and proof testing shall be removed, replaced with suitable fill, and compacted as specified above.

3.3 UNDERCUT EXCAVATION

- A. When approved by the Owner and recommended by the geotechnical engineer, the Contractor may be required to remove natural soil materials in areas where fills are to be placed when determined to be undesirable in their location or condition. The Contractor shall be required to remove the undesirable material and backfill with approved material properly compacted.
- B. At locations where unstable or unsuitable soil is shown on the drawings or identified within the geotechnical engineering study, the removal and replacement of such soil shall be as directed on the drawings or as directed by the geotechnical engineer and the Owner.
- C. All material removed in the work of undercut excavation will be classified by the geotechnical engineer and Owner as either suitable for other use without excessive manipulation and utilized by the Contractor elsewhere in the work, or unsuitable for future use and manipulated as per Article 2.01.
- D. The Contractor shall conduct undercut operations in such a way that the necessary measurements can be taken before any backfill is placed.
- E. Backfill in undercut areas shall be placed as a continuous operation along with the undercutting operation. No backfill material shall be placed in water unless otherwise permitted by the geotechnical engineer.

3.4 EXCAVATION, FILL AND SUBGRADE PREPARATION

A. GENERAL

- 1. The Contractor shall cut or fill to the proposed subgrade elevations based on finished grades and the pavement thicknesses as shown on the drawings. Subgrade elevations shall be constructed to within 0 to minus ½ inch of the proposed grades specified.

B. EXCAVATION

1. Where existing grades are above proposed subgrade elevation, excavate materials to line and grade as shown in the drawings being careful not to over excavate beyond the elevations needed for building subgrades;
2. Excavate organic soils that do not provide adequate foundation support. Excavated on-site organic soils, which are unsuitable for fill may be used in landscaped areas and, if approved by the geotechnical engineer, as fill in parking area at least 5 feet below final elevation. Otherwise this material shall be disposed of as directed by Owner;
3. Excavated on-site soils, which meet the requirements of suitable fill may be used as fill; and,
4. Unsuitable material, such as wood and any other deleterious materials determined to be unsuitable by the geotechnical engineer for use as on-site fill, shall be disposed of as directed by Owner.

C. SUBGRADE PREPARATION FOR FILL

1. Existing grades below proposed grades and thus requiring fill shall be leveled prior to fill placement. The Contractor shall remove existing lawn and top soil in these areas prior to placement of any fill; and,
2. All existing grades to receive fill areas shall be proof rolled and compacted per Article 3.02.
3. Loose/Soft and unstable subgrade resulting from excessive moisture may be aerated and dried in-place. Following adequate drying time, the subgrade is to be densified in-place. Subgrade that cannot be aerated, dried, and densified in place shall be removed as described in Article 3.03.

D. FILL PLACEMENT

1. Rock or processed suitable debris pieces larger than six inches (6 inches) across shall not be part of fill;
2. Reduce soil clod size to a maximum of 2 inches before placement. Do not place frozen fill material;
3. No fill material shall be placed in areas of standing water, in areas of frozen or thawing ground, or in areas that have not been approved by the geotechnical engineer;
4. No fill materials shall be placed during unfavorable weather conditions. When work is interrupted by heavy rains, fill operations shall not be resumed until all saturated surficial soils are returned to a satisfactory moisture content as determined by the geotechnical engineer;
5. Fill lift surfaces shall be made smooth and free from ruts or indentations at the end of any work day when precipitation is forecast to prevent saturation of surficial fill material. Fill surfaces shall be graded to drain and sealed with a smooth drum roller at the completion of each work day;
6. The fill shall be placed in uniform loose lifts not exceeding 8-inches thick and compacted with at least 4 coverages of a 10-ton static-drum weight roller;
7. Each lift shall be compacted to the minimum densities listed in Article 3.02 as appropriate for the project and as specified in the geotechnical engineering study;
8. The Contractor shall adjust the water content by aeration or adding water to achieve the required density. Assist drying by discing, harrowing or pulverizing until moisture content is reduced to achieve proper compaction and facilitate the construction schedule;
9. Wet, saturated material shall be air dried as necessary to achieve the field densities specified in this Section. Removal and replacement shall not occur without prior approval or Owner. Removal and replacement shall be used if necessary to facilitate the construction schedule;
10. Remove areas of finished subgrade found to have insufficient compaction density of depth necessary and replace with suitable compacted fill as approved by the Owner or Owners

representative. Surface of subgrade after compaction shall be hard, uniform, smooth, stable, and true to grade and cross section; and,

11. Fill placed on slopes greater than 1 vertical to 3 horizontal shall have each lift benched onto the slope at least 3 feet.

3.5 PROOFROLLING

- A. The work covered by this subsection consists of furnishing and operating, proofrolling equipment at the direction of the Owner's representative and/or geotechnical engineer.
- B. Proofrolling shall be under the observation of the Owner's representative and/or the geotechnical engineer as described herein and under the following schedule:
 1. Immediately following the completion of excavation to proposed subgrades in cut areas, proofrolling shall be performed as specified; and,
 2. Immediately prior to and following stone base course placement, in pavement and building pad areas for final floor slab preparation, all subgrade and stone base areas shall be proofrolled. Any areas which deflect, rut or pump under the roller shall be undercut and replaced with compacted fill material or stone base course as directed by the geotechnical engineer and approved by the Owner.
- C. Proofrolling shall be done with 1 pass of a fully loaded tandem dump truck equal to or exceeding 50,000 lbs., or other construction equipment if approved by the geotechnical engineer.
- D. Construction methods shall be as follows:
 1. After the subgrade or stone base course has been completed within 0.50 foot of final grade, the subgrade or stone base course shall then be compacted and tested prior to commencement of proofrolling. The coverage areas and methods will be identified by the Owner's representative and/or geotechnical engineer. However, the roll shall be operated in a systematic manner so that the number of coverages over all areas to be proofrolled can be readily determined and recorded;
 2. The equipment shall be operated at a speed that the geotechnical engineer can comfortably and slowly walk alongside the equipment;
 3. If it becomes necessary to take corrective action, such as but not limited to underdrain installation, undercut and backfill of an unsuitable material, and aeration of excessively wet material in areas that have been proofrolled, see Article 3.03. These areas shall be proofrolled again following the completion of the necessary corrections. If the corrections are necessary due to the negligence of the Contractor or weather, the corrective work and additional proofrolling shall be performed by the Contractor at no cost to the Owner; and,
 4. The Contractor shall protect all structural facilities on the project, such as but not limited to box culverts, pipe culverts, and utilities, from damage by the proofrolling equipment.

3.6 MAINTENANCE OF SUBGRADE

- A. Finished subgrades shall be verified by the Contractor to ensure proper elevation and conditions for construction above subgrade.
- B. Protect subgrade from excessive construction traffic and wheel loading including concrete and dump trucks.
- C. Remove areas of finished subgrade judged to be unsatisfactory to the depth necessary and replace in a manner that will comply with compaction requirements by use of material equal to or better than the best subgrade material on site. Surface of subgrade after compaction shall be hard, uniform, smooth, stable, and true to grade and cross section.

3.7 FINISH ELEVATIONS AND LINES

- A. For setting and establishing finish elevations and lines, secure the services of a licensed land surveyor acceptable to the Owner and engineer.
- B. Provide elevation grade stakes and any other surveying necessary for the layout of the work. The Contractor shall conduct their work in such a manner that survey stakes will be protected as long as their need exists. Grade stakes, which are damaged or stolen, shall be replaced by the Contractor's surveyor at the Contractor's expense.
- C. Graded areas shall be uniform, hard and smooth, free from rock, debris, or irregular surface changes. Any deviation shall not result in changes in drainage areas or ponding. All ground surfaces shall vary uniformly between indicated elevations. Finish drainage ditches shall be graded to allow for proper drainage without ponding and in a manner that will minimize the potential for erosion.
- D. Correct all settlement and eroded areas for one year after date of project completion at no additional expense to Owner. Bring paved and landscaped areas to proper elevation. Replant or replace any grass, shrubs, bushes, or other vegetation disturbed by construction using corrective measures.

3.8 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.

3.9 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. 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 OF DOCUMENT 310000

SECTION 311000 – SITE CLEARING

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The work under this Section shall include all labor, materials and equipment necessary for the Site Clearing as herein after specified and/or as otherwise required for the proper and timely completion of the Contract.
- B. This Section includes the following:
 - 1. Clearing, grubbing and disposal
 - 2. Demolition of existing features, including, but not limited to inlets, pipes, fencing, trees, stumps, curbing and underground tanks.

1.2 MATERIALS OWNERSHIP

- A. Except for materials indicated to be stockpiled or to remain Owner's property, cleared materials shall become the Contractor's property and shall be disposed of in accordance with all applicable regulations.

1.3 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
- B. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.
- C. Notify utility locator service for area where Project is located prior to site clearing.
- D. Contractor shall verify existing grades prior to performing work under this section. If existing grades are at variance with the drawings, notify the Owner and engineer to receive instructions prior to proceeding. No additional compensation will be considered resulting from grade variances once site clearing has commenced.
- E. All benchmarks and monuments shall be protected during construction. If disturbed or destroyed, they shall be replaced in original position by a licensed surveyor at the Contractor's expense.
- F. Protect areas outside limits of disturbance from encroachment by construction personnel or equipment, regardless of property Ownership. Access shall be by specific, written permission or easement only.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS

- A. Contractor shall provide and use all necessary equipment and materials to perform work.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Provide erosion control measures in accordance with Section 312500, Soil Erosion and Sediment Control, prior to any construction activity.
- B. Locate and clearly flag trees and vegetation to remain or to be relocated (if applicable). All trees and vegetation to remain shall be barricaded and protected during the construction process in accordance with plans and specifications.
- C. Limit of clearing is to be staked and verified by Owner or engineer prior to removal of any material.
- D. All trees and shrubs not designated to remain within the area to be graded, whether shown or not on the drawings, shall be cut and the stumps shall be completely dug out including all major root structures. Burning on site is not permitted.

3.2 UTILITIES

- A. The Contractor shall protect existing underground utilities from damage. The accuracy of the utilities shown on the plan as to line and grade is not guaranteed. Any damage caused by the Contractor to any utility shall be the responsibility of the contractor to correct.
- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted. If utilities are interrupted, arrange to provide temporary utility services.
 - 1. Notify Owner not less than 72 hours in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruption without Owner's written permission.

3.3 CLEARING AND GRUBBING

- A. Perform all clearing and grubbing work in accordance with PennDOT Publication 408 Specifications, Section 201.3, Clearing and Grubbing or as specified here.
- B. Clear the ground of existing organic matter within excavation areas to a depth of eight (8) inches below the existing ground. Remove remaining topsoil over 8 inches in depth, when directed. Stockpile removed topsoil as specified in Section 312500 – Soil Erosion & Sediment Control. Utilize stockpiled topsoil as needed throughout the project. Dispose of unused topsoil in accordance with section 3.03 below.
- C. Remove obstructions, objectionable material, rubbish, junk, trees, shrubs, grass, and other vegetation within the limit of disturbance to permit installation of new construction. Removal includes digging out stumps and obstructions and grubbing roots, unless otherwise specified. Existing three foot high site chain link fence to be cut flush with existing paving, grinded down if necessary and patched to match surrounding asphalt.
- D. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.
 - 1. Place fill material in horizontal layers and compact each layer to a density equal to adjacent original ground as in accordance with Section 31 0000 - Earthwork.

3.4 DISPOSAL

- A. Disposal: Remove surplus soil material, unsuitable or excess topsoil, obstructions, demolished materials, and waste materials, including trash and debris, and legally dispose of them off Owner's property in accordance with all applicable regulations.

END OF SECTION 311000

THIS PAGE INTENTIONALL LEFT BLANK

SECTION 312500 - SOIL EROSION & SEDIMENT CONTROL

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The work of this Section includes all temporary erosion and sediment control and related and incidental operations, including:
 - 1. Filter Bag Inlet protection;
 - 2. Stone and Concrete Block Inlet Protection;
 - 3. Compost filter sock;
 - 4. Temporary seeding and mulching;
 - 5. Rumble Pad Construction Entrance;
 - 6. Pumped Water Filter Bag;
 - 7. Temporary Stockpile Protection;
 - 8. Compost Sock Washout Station; and,
 - 9. Maintenance and repair of erosion and sediment control measures.

1.2 SUBMITTALS

- A. Submit complete shop drawings and product information for all items to be furnished under this Section upon receipt of notice to proceed and prior to construction.

1.3 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary trades and who are completely familiar with the specified requirements and methods needed for proper performance of the work of this Section.
- B. Codes and Standards: Perform work in compliance with applicable requirements of governing authorities having jurisdiction. Construction operations shall be carried out in a manner such that soil erosion, air pollution, and water pollution is minimized. State, County, and Municipal laws concerning pollution abatement shall be followed.
- C. The recommendations and Standards set forth in the Erosion and Sediment Pollution Control Program Manual, published by the PA Department of Environmental Protection, shall be applicable where the work is not specifically detailed in this Specification, the accompanying Drawings, or the Erosion and Sediment Pollution Control Plan.
- D. The Contractor shall take action to remedy unforeseen erosion conditions and to prevent damage to adjacent properties as a result of increased runoff and/or sediment displacement. Stockpiles of wood chips, hay bales, crushed stone, and other mulches shall be held in readiness to deal immediately with emergency problems of erosion. All erosion control checks and structures shall be inspected after heavy rainfalls, and if damaged, repaired or replaced.
- E. No other construction activities may take place until appropriate Erosion and Sedimentation Control devices have been installed and approved by Owner/Authorized Representative. All changes to the Erosion and Sedimentation Control Plan must be approved by Owner/Authorized Representative prior to implementation.

1.4 REFERENCES

- A. PennDOT, Publication 408 Specifications (most recent edition).

- B. Pennsylvania Department of Environmental Protection, Erosion and Sediment Pollution Control Program Manual (most recent version).
- C. Commonwealth of Pennsylvania, Department of Transportation (PennDOT)
 - 1. Bulletin No. 15: Approved Construction Materials.

PART 2 - PRODUCTS

2.1 FILTER BAG INLET PROTECTION

- A. Filter bags shall be provided in accordance with PennDOT Publication 408, Section 860.
- B. Filter bags shall be manufactured to fit the opening of the catch basin or drop inlet. Filter bags will have the following features:
 - 1. Two dump straps attached at the bottom to facilitate the emptying of the bag;
 - 2. Lifting loops as an internal part of the system to be used to lift the filter bag from the basin;
 - 3. Restraint cord approximately halfway up the sack to keep the sides away from the basin walls, this cord is also a visual means of indicating when the sack should be emptied.
- C. Filter bag seams shall have a minimum certified average wide width strength per ASTM D-4884 of 300 psi.
- D. Inlet filter bags for installation in new or existing highway grate and open mouth grate inlets shall be listed in PennDOT Bulletin 15 or approved equal.
- E. City inlet (and curb opening portion of open-mouth grate inlet) protection shall be a synthetic filter manufactured from recycled synthetic fibers listed in PennDOT Bulletin 15 or approved equal.

2.2 STONE AND CONCRETE BLOCK INLET PROTECTION

- A. In accordance with PennDOT Publication 408, Section 860.2(b).
- B. Inlet protection in roadway is not to include stone or berms.

2.3 COMPOST FILTER SOCK

- A. Compost filter sock shall be provided in accordance with PennDOT Publication 408, Section 867.
- B. The compost socks shall be Filtrexx Siltsox manufactured by Filtrexx International LLC of Grafton, Ohio or approved equal as listed in PennDOT Bulletin 15

2.4 PUMPED WATER FILTER BAG

- A. Pumped water filter bags shall be provided in accordance with PennDOT Publication 408, Section 855.
- B. Sediment filter bag shall be manufactured of non-woven geotextile material that filters soil particles while allowing discharge water to pass through the bag.
- C. The sediment filter bag seams shall be a double 401 lock chain stitch seam with minimum 200 lbs/inch sewn seam strength, tested in accordance with ASTM D-4884.

- D. The sediment filter bag shall have an adjustable spout large enough to accommodate a six-inch (6") diameter discharge hose.
- E. The pump discharge hose shall be inserted into the bags in the manner specified by the manufacturer and securely clamped.
- F. Filter bag shall be inspected daily. If any problem is detected pumping shall cease immediately and not resume until the problem is corrected.
- G. Filter bag shall be GTF-FB series from Frank Roberts and Sons, Inc., Dirtbag by ACF Environmental, or approved equal, and shall have a rated flow rate fifty percent (50%) greater than the attached pump.

2.5 TEMPORARY SEEDING AND MULCHING

- A. All stockpiles and inactive disturbed areas shall be seeded and mulched in accordance with the design plans if they are to be left exposed for more than twenty (20) days.

2.6 RUMBLE PAD CONSTRUCTION ENTRANCE

- A. Prefabricated rumble pad shall be installed according to manufacturer's recommendations. A sufficient number of pads shall be installed to provide a minimum of four (4) tire revolutions while on pad.
 - 1. More pads may be needed depending on site conditions.
- B. Accumulated materials shall be cleaned from the pads daily and as necessary and disposed of in accordance with all applicable regulations.

2.7 TEMPORARY STOCKPILE PROTECTION

- A. Compost Filter Sock provided in accordance with PennDOT Publication 408, Section 867.
- B. Seeding in accordance with PennDOT Publication 408, Section 804.2(b), Formula E.

2.8 COMPOST SOCK WASHOUT STATION

- A. Concrete washout water shall be directed to the compost sock washout station as indicated on the plans. The compost sock washout station shall be comprised of a compost filter sock in accordance with this specification.

2.9 TEMPORARY STABILIZATION MEASURES

- A. Rolled Erosion Control Products (RECPs) shall be in accordance with PennDOT Pub. 408 Section 806, and from an approved supplier named in Bulletin 15. Non-biodegradable materials shall not be acceptable (including pins or stakes). Installed RECPs shall also be seeded or mulched as appropriate.
- B. Temporary seeding or sodding shall be in accordance with the specified permanent seeding and/or sod requirements, or in the absence of such specified materials shall be in conformance with PennDOT Pub. 408 Section 804, Formula E seed mixture.
- C. Mulch shall be in accordance with the specified permanent mulch, or in the absence of such specified materials shall be in conformance with PennDOT Pub. 408 Section 805, Wood Fiber or

Wood Chips. Recycled materials shall not be acceptable for use as mulch (wood pulp, cellulose, etc.).

- D. Straw or hay temporary stabilization shall only be permitted when use of seeding/sodding or mulch is impracticable (subject to approval by Owner/Authorized Representative). The use of blown straw shall only be accepted when used in conjunction with a tackifier as specified herein. Straw or hay shall be free of weed seeds or other contaminants.
- E. Tackifier shall be Earth Bond tackifier (Turf Guard Manufacturing Inc.) or approved equal. Tackifier shall be composed of organic compounds, and contain no toxins or hazardous materials.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. All temporary erosion and sediment control measures specified herein shall be in place before the beginning of any earthwork or excavation.
- B. All erosion and sediment control devices shall be installed according to the manufacturer's specifications, or in accordance with PennDOT Pub. 408 if no manufacturer recommendation exists.
- C. When temporary erosion and sediment control measures as described herein do not provide adequate control, replacement or relocation of measures shall be required as directed by the Owner/Authorized Representative.
- D. Erosion and sediment control measures shall be inspected weekly and after every precipitation event.
- E. Contractor shall maintain complete written logs of inspections and shall make them available to PWD Inspector/Owner/Engineer upon request.
- F. All maintenance work, including but not limited to cleaning, repair, replacement, regrading, and restabilization of temporary erosion and sediment control measures shall be performed immediately.
- G. Contractor shall ensure that erosion and sedimentation control measures remain in place and fully functional until site achieves final stabilization.
- H. Orange fencing shall be used to delineate the limits of earth disturbance in all off street applications, and as specified in Section 015639 for tree protection.

3.2 PUMPED WATER FILTER BAG

- A. Sediment-laden water shall be pumped through a pumped water filter bag as specified herein.
- B. Filter bags shall be removed and replaced when they have reached their capacity to filter sediment effectively, or upon any breach of the filter bag.
- C. The Contractor shall not discharge to any sewer without the prior approval of PWD from the Industrial Waste Unit.

3.3 TEMPORARY INLET PROTECTION

- A. The downstream inlets from the site of any disturbance or construction on the project site shall be protected with approved inlet protection practices. Downstream inlets are considered to be the next immediate inlet downslope that will receive runoff from the site of any disturbance, as well as any and all inlets within the site itself.
- B. All new inlets shall be protected with approved inlet protection practices upon installation. Inlets draining exclusively to a stormwater feature shall remain fully closed to runoff until final site cleanup.
- C. Final site cleanup shall include removal of all temporary inlet protection, cleaning of all permanent inlet protection, and cleaning of all inlets (existing downstream inlets and newly installed) of accumulated construction debris and sediment.
- D. Highway grate and open mouth grate inlets shall be protected using inlet filter bags as specified herein.
- E. Open mouth grate inlets and open mouth inlets (city inlets) shall be protected with a compost sock or synthetic filter as specified herein.
- F. Inlet protection shall be installed, inspected, cleaned and replaced according to manufacturer's specifications.
 - 1. Inlet filter bags and open mouth inlet protection shall be removed and replaced when filled with silt or when extended periods of ponding occur following a precipitation event. New inlet filter bags or approved inlet protection devices shall be installed and secured immediately after removal of silted protection devices.

3.4 STORAGE STOCKPLIES

- A. Stockpiles of all loose materials (aggregate, fill, soils, etc) shall be protected from dust and rain by use of a cover. The cover shall be free of defects, and secured adequately to maintain protection of the materials. Owner/Authorized Representative reserves the right to refuse use of any material that has been compromised by inadequate protection onsite.
- B. Stockpiles shall not be placed upslope from any infiltration structure. Any drainage structure (such as but not exclusively inlets) downslope of a stockpile shall be adequately protected from runoff.
- C. Stockpile heights are not to exceed 20 feet high. Stockpile slopes shall be 2:1 or flatter.

3.5 TEMPORARY STABILIZATION

- A. Any disturbed surfaces to remain unfinished and unprotected for more than four (4) days shall be temporarily stabilized. Method to be used shall be approved by the Project Manager and shall be appropriate to the expected length of time employed (for example, use of hay alone without seeding would not be appropriate for a several month application, but could be appropriate for a week-long site delay).

3.6 REMOVAL AND FINAL CLEANUP

- A. Once the site has been fully stabilized and approval is given by Owner/Authorized Representative, temporary erosion and sedimentation control measures and all accumulated silt

and sediment shall be removed. All permanent inlet protection measures shall be cleaned, inspected, and verified to be in working order.

- B. Any remaining dirt or debris within the public right of way shall be removed by the Contractor, using necessary means as sufficient to remove the dirt and debris from the public right of way. This may include, but is not limited to, street sweeping, sidewalk vacuuming, inlet cleaning, power washing, or hand removal.
- C. Silt and waste materials shall be disposed of in a proper manner. No extra construction materials are to remain onsite upon completion of the Work. The Work of this Contract shall not be considered complete until all extraneous construction-related items have been removed (temporary traffic control devices, signage, etc).

END OF SECTION 31 25 00

SECTION 315000 - EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The work under this Section shall include all labor, on-site materials, and equipment necessary for the excavation of trench and grading as hereinafter specified and/or as otherwise required for the proper and timely completion of this Contract.

1.2 RULES AND REGULATIONS

- A. American Society for Testing and Materials (ASTM):

1. ASTM C131 Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
2. ASTM C136 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
3. ASTM C535 Standard Test Method for Resistance to Degradation of Large-Size Aggregate by Abrasion and Impact in the Los Angeles Machine
4. ASTM D653 Standard Terminology Relating to Soil, Rock, and Contained Fluids
5. ASTM D1140 Standard Test Methods for Determining the Amount of Material Finer than 75- μ m (No. 200) Sieve in Soils by Washing
6. ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))
7. ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
8. ASTM D2487 Standard Practice for Classification of Soils for Engineering Purposes
9. ASTM D6938 Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
10. ASTM D4253 Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
11. ASTM D4254 Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
12. ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
13. AASHTO T180 Standard Method of Test for Moisture-Density Relations of Soils Using 4.54-kg (10-lb) Rammer and 457-mm (18-in.) Drop

1.3 SUBMITTALS

- A. Samples

1. Furnish and deliver samples of fill and backfill materials as selected by the Engineer.

1.4 PERFORMANCE REQUIREMENTS

- A. If any hazardous waste materials are discovered on the site, the Contractor shall cease operations in that area until authorized to resume. The Contractor shall notify the Engineer of such material and cooperate with any outside agency or specialist that may be called in to determine the extent of the hazard and methods of its disposition.

- B. Tolerances:

1. Construct finished sub-grades to plus 0 inches minus $\frac{1}{2}$ inch of the elevation indicated.

2. Construct finished grade of slopes not steeper than 3H:1V to plus or minus 1/2 inch and on slopes steeper than 3H:1V to plus or minus 2 inches. Slopes shall not encroach upon roadbeds.
3. Maintain the moisture content of fill material as it is being placed within plus or minus 3 percent of the optimum, moisture content of the material as determined by the laboratory test herein specified.
4. Protect all existing and new construction including utilities, finishes and equipment from water, damage, weakening or other disturbance.

1.5 DEFINITIONS

- A. Earthwork Terminology used in this Section and not defined herein shall be interpreted in accordance with the definitions given in ASTM D653.
1. Sub-grade: Sub-grade is the lowest elevation of excavation and the highest elevation if embankment required to accommodate the indicated construction.
 2. Backfill: Soil or soil-rock material used to refill excavations and to refill excavated spaces around building walls.
 3. Imported Material: Soil or granular material which is hauled in from off-site areas.
 4. Unsuitable Material: Excavated material or material below the natural ground surface in embankment areas or below sub-grade elevation in excavated areas, which is unsuitable for its planned use.
 5. Relative Compaction: The ratio, expressed as a percentage, of the in-place place dry density of fill material as compacted in the field to the maximum dry density of the same material as determined by laboratory test ASTM D1557, Method D.
 6. Optimum Moisture Content: The water content at which a soil can be compacted to a maximum dry unit weight by a given compactive effort.
 7. Relative Density: Refer to ASTM D4253 and ASTM D4254.
 8. Excavation: Excavation is the removing of all materials encountered within the Contract Limits, regardless of the nature of the material encountered and the method by which it is removed, for grading, sub-grading for roadways or paved areas and other structures not specified elsewhere in these specifications. All excavation is unclassified and no additional compensation will be made for rock.

1.6 PROJECT CONDITIONS

- A. Protection
1. Provide the necessary barricades, signs, lights, etc. to prevent accidents, to avoid all hazards and to protect the public, the work and property at all times, including Saturdays, Sundays, and holidays.
 2. Be responsible for any and all damages which may arise or occur to any party whatsoever by reason of neglect in providing proper lights, guards, barriers or any other safeguards to prevent damage to property, life and limb.
 3. Prior to any excavation the Contractor, with the cooperation of the Owner of the respective existing utility or its agents shall locate and paint the location of all water services, gas services, gas mains, water mains, sanitary sewers, telephone raceways or conduits and drains, within five (5) feet of the proposed excavations.
 4. In case water, gas pipes, conduits, or other utilities are broken in the prosecution of the work, the Contractor shall stop work and give immediate notice to the proper authorities and shall be responsible for any damage to persons or property caused by such breaks. Failure to give prompt notice to the authorities shall deem the Contractor responsible for any damages legal or otherwise caused by the interruption or loss of utility service.

- B. Parking and Storage
 - 1. Parking of vehicles and storage of materials shall be confined to designated areas approved by the Owner.
- C. Dust Control
 - 1. During the progress or work, the Contractor shall conduct his operation and maintain the area of his activities so as to minimize the creation and dispersion of dust.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Unfavorable Weather Conditions
 - 1. Excavating, filling, backfilling, and grading work shall not be performed during weather conditions which might damage the condition of existing ground, in-progress work, or completed work. When the work is interrupted by rain, excavating, filling, backfilling and grading work shall not resume until the site is suitable for the work.
 - 2. Sub-grade shall be free from mud, snow, ice, and deleterious material when work is resumed.

PART 2 - PRODUCTS

2.1 FILL AND BACKFILL

- A. Material suitable for use as fill and backfill shall be an inert, non-expansive soil, free from organic matter and of such quality that it will compact thoroughly without the presence of voids. Excavated on-site soil will be considered suitable for fill and backfill.
- B. Suitable excavated material shall be conditioned for reuse and properly stockpiled for later filling and backfilling operations. Conditioning shall consist of spreading material in layers not to exceed 8 inches and raking free of debris and rubble. Rocks exceeding four inches in largest dimension and deleterious material shall be moved from the site and disposed of.

PART 3 - EXECUTION

3.1 EXISTING UTILITIES

- A. Verify on site the location and depth (elevation) of all existing utilities and services before performing any excavation work. Excavation within 3 feet of a utility line shall be performed by hand.

3.2 EXCAVATION

- A. General
 - 1. Excavation consists of the removal and on-site placement or disposal of whatever material is encountered when establishing required sub-grade elevations.
 - 2. Excavation shall be made to the grades as shown on the Contract Drawings.
 - 3. Where excavation grades are not shown on the Contract drawings, excavation shall be made as required to accommodate the installation of all facilities.
- B. Cold Weather Protection
 - 1. Protect excavation bottoms against freezing when atmospheric temperature is less than 35 degrees Fahrenheit.

C. Stability of Excavations

1. Sloped sides of excavation shall comply with state and local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated.
2. Maintain sides and slopes of excavations in a safe condition until completion of backfilling.

D. Shoring and Bracing

1. Provide materials for shoring and bracing, such as sheet piling, uprights, stringers and cross-braces, in good serviceable condition.
2. Establish requirements for trench shoring and bracing to comply with local Codes and authorities having jurisdiction.
3. Maintain shoring and bracing excavations regardless of the time period excavations will be open. Carry down shoring and bracing as excavation progresses.

E. Material Storage

1. Stockpile suitable excavated materials where directed, as required for fill.
2. Locate and retain soil materials away from edge of excavation.

3.3 BACKFILL

A. Backfill excavation as promptly as work permits, but not until waterproofing membrane is applied and is ready to be backfilled, if applicable.

B. Placement and Compaction

1. Place backfill materials in layers not more than 4" in loose depth for materials by hand-operated tampers.
2. Place backfill and fill materials evenly adjacent to structures, to required elevations. Take care to prevent wedging action of backfill against structures by carrying the material uniformly around structure to approximately same elevation in each life.

3.4 GRADING

A. Grade areas adjacent to building lines to drain away from structures and to prevent ponding. Finish below the required sub-grade elevations.

3.5 CLEAN-UP

A. Upon completion of the work of this section, place in stockpile areas all excess excavated material, rubbish, trash and debris resulting from operations. Leave the site in a neat and orderly condition.

END OF SECTION 315000

SECTION 321216 – ASPHALT PAVING

1.1 DESCRIPTION

- A. This Section includes Hot Mix Asphalt Wearing and Binder Course.

1.2 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. The following Standard Specifications and Codes shall be considered a part of this specification where such specifications are applicable, and shall include all current changes and revisions:
 - 1. American Society for Testing and Materials.
 - 2. Ordinances and Laws of the Commonwealth of Pennsylvania, County and Municipality within which the work is being performed.
 - 3. Philadelphia Streets Department Standard Specifications.
 - 4. Pennsylvania Department of Transportation.
- C. Related Requirements:
 - 1. Section 033000 "Cast-in-Place Concrete" for adjacent footers, walls, and curbs.
 - 2. Section 312000 "Earth Moving" for subgrade preparation, fill material, separation geotextiles, unbound-aggregate subbase and base courses, and aggregate pavement shoulders.
 - 3. Section 321313 "Concrete Paving" for concrete pavement and for separate concrete curbs, gutters, and driveway aprons.

1.3 SUBMITTALS

- A. Product data: For each product specified, include technical data and tested physical and performance properties.
- B. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.
- C. Material Test Reports: Indicate and interpret test results for compliance of materials with requirements indicated.
- D. Material Certificates: Certificates signed by manufacturers certifying that each material complies with requirements.

1.4 QUALITY ASSURANCE

- A. Qualifications: Engage an experienced installer, certified in writing by tactile manufacturer as qualified for installation, who has completed asphalt paving similar in material, design, and extent to that indicated for this Project and with a record of successful service performance.

1. Paving contractor to have a minimum of ten (10) years of demonstrated successful experience in the installation of asphalt surfaces.
- B. Manufacturer Qualifications: Paving-mix manufacturer shall be registered with and approved by the DOT of state in which Project is located.
- C. Testing Agency Qualifications: Qualified in accordance with ASTM D3666 for testing indicated.
- D. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of authorities having jurisdiction for asphalt paving work.
- E. Asphalt-Paving Publication: Comply with AI MS-22, "Construction of Hot Mix Asphalt Pavements," unless more stringent requirements are indicated.
- F. Pre-installation Conference: Conduct conference at Project site to comply with requirements in project General and Supplementary Conditions.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:
 1. Prime Coat and Tack Coat: Minimum surface temperature of 60 deg F.
 2. Slurry Coat: Comply with weather limitations in ASTM D3910.
 3. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
 4. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

PART 2 - PRODUCTS

2.1 AGGREGATES

- A. General: Use materials and gradations that have performed satisfactorily in previous installations.
- B. Aggregate Base: In accordance with PennDOT Publication 408, Section 350.2(a).

2.2 ASPHALT MATERIALS

- A. Asphalt Binder: ASTM D6373 binder designation PG 58-28 or as recommended by local DOT.
- B. Asphalt Cement: ASTM D3381 for viscosity-graded material. ASTM D946 for penetration-graded material.
- C. Tack Coat and Fog Seal: ASTM D977 emulsified asphalt, or ASTM D2397 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

- D. Water: Potable.

2.3 AUXILIARY MATERIALS

- A. Recycled Materials for Hot-Mix Asphalt Mixes: Reclaimed asphalt pavement; reclaimed, unbound-aggregate base material; and recycled materials acceptable by local jurisdictions from sources and gradations that have performed satisfactorily in previous installations, equal to performance of required hot-mix asphalt paving produced from all new materials.
 - 1. Surface Course Limit: Recycled content no more than 10 percent by weight.
- B. Herbicide: Commercial chemical for weed control, registered by the EPA, and not classified as "restricted use" for locations and conditions of application. Provide in granular, liquid, or wettable powder form.
- C. Sand: ASTM D1073, Grade No. 2 or No. 3.
- D. Paving Geotextile: AASHTO M 288 paving fabric; nonwoven polypropylene; resistant to chemical attack, rot, and mildew; and specifically designed for paving applications.
- E. Joint Sealant: ASTM D6690, Type II or III hot-applied, single-component, polymer-modified bituminous sealant.

2.4 MIXES

- A. Hot-Mix Asphalt: Dense-graded, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction and complying with the following requirements:
 - 1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
 - 2. Base Course and Wearing Course: PennDOT Superpave, Thickness to achieve conditions indicated on plans.
- B. Emulsified-Asphalt Slurry: ASTM D3910, Type 1.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that subgrade is dry and in suitable condition to begin paving. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Protection: Provide protective materials, procedures, and worker training to prevent asphalt materials from spilling, coating, or building up on curbs, driveway aprons, manholes, and other surfaces adjacent to the Work.

- B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
 - 1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
 - 2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

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, driveway aprons, 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. Handle milled asphalt material in accordance with approved waste management plan required in Section 017419 "Construction Waste Management and Disposal."
 - 8. Keep milled pavement surface free of loose material and dust.
 - 9. Do not allow milled materials to accumulate on-site.

3.4 PATCHING

- A. Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.
- B. Tack Coat: Before placing patch material, apply tack coat uniformly to vertical asphalt surfaces abutting the patch. Apply at a rate of 0.05 to 0.15 gal./sq. yd.
 - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
- C. Placing Single-Course Patch Material: Fill excavated pavement areas with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.
- D. Placing Two-Course Patch Material: Partially fill excavated pavements with hot-mix asphalt base course mix and, while still hot, compact. Cover asphalt base course with compacted layer of hot-mix asphalt surface course, finished flush with adjacent surfaces.

3.5 REPAIRS

- A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch in existing pavements.
 - 1. Install leveling wedges in compacted lifts not exceeding 3 inches thick.
- B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/4 inch.
 - 1. Clean cracks and joints in existing hot-mix asphalt pavement.
 - 2. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.
 - 3. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.

3.6 SURFACE PREPARATION

- A. Ensure that prepared subgrade has been proof-rolled and is ready to receive paving. Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces.
- B. Herbicide Treatment: Apply herbicide in accordance with manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.
- C. Cutback Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.15 to 0.50 gal./sq. yd.. Apply enough material to penetrate and seal, but not flood, surface. Allow prime coat to cure.
 - 1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
 - 2. Protect primed substrate from damage until ready to receive paving.
- D. Emulsified Asphalt Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.10 to 0.30 gal./sq. yd. per inch depth. Apply enough material to penetrate and seal, but not flood, surface. Allow prime coat to cure.
 - 1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
 - 2. Protect primed substrate from damage until ready to receive paving.
- E. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd..
 - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.7 INSTALLATION OF PAVING GEOTEXTILE

- A. Apply tack coat, asphalt binder, or asphalt cement as indicated, uniformly to existing pavement surfaces at a rate of 0.20 to 0.30 gal./sq. yd..
- B. Place paving geotextile promptly in accordance with manufacturer's written instructions. Broom or roll geotextile smooth and free of wrinkles and folds. Overlap longitudinal joints 4 inches and transverse joints 6 inches.
- C. Protect paving geotextile from traffic and other damage, and place hot-mix asphalt overlay the same day.

3.8 HOT-MIX ASPHALT PLACEMENT

- A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
 - 1. Place hot-mix asphalt base course and binder course in number of lifts and thicknesses indicated.
 - 2. Place hot-mix asphalt surface course in single lift.
 - 3. Spread mix at a minimum temperature of 250 deg F.
 - 4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
 - 5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
- B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.
 - 1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Overlap mix placement about 1 to 1-1/2 inches from strip to strip to ensure proper compaction of mix along longitudinal joints.
 - 2. Complete a section of asphalt base course and binder course before placing asphalt 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 hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.9 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.
 - 1. Clean contact surfaces and apply tack coat to joints.
 - 2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
 - 3. Offset transverse joints, in successive courses, a minimum of 24 inches.

4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints as indicated on Drawings.
5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.10 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot hand tampers or with vibratory-plate compactors in areas inaccessible to rollers. Complete compaction before mix temperature cools to 185 deg F.
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
 1. Superpave Gyrotory Compactor Test Method: 96 percent of reference laboratory density in accordance with ASTM D6927, but not less than 94 percent or greater than 100 percent.
 2. Average Density, Rice Test Method: 92 percent of reference maximum theoretical density in accordance with ASTM D2041/D2041M, but not less than 90 percent or greater than 96 percent.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
- F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.11 INSTALLATION TOLERANCES

- A. Pavement Thickness: Compact each course to produce thickness indicated within the following tolerances:
 1. Base Course and Binder Course: Plus or minus 1/2 inch.

2. Surface Course: Plus 1/4 inch, no minus.

B. Pavement Surface Smoothness: Compact each course to produce surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:

1. Base Course and Binder Course: 1/4 inch.
2. Surface Course: 1/8 inch.
3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

3.12 SURFACE TREATMENTS

- A. Fog Seals: Apply fog seal at a rate of 0.10 to 0.15 gal./sq. yd. to existing asphalt pavement and allow to cure. With fine sand, lightly dust areas receiving excess fog seal.
- B. Slurry Seals: Apply slurry coat in a uniform thickness in accordance with ASTM D3910 and allow to cure. Roll slurry seal to remove ridges and provide a uniform, smooth surface.

3.13 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined in accordance with ASTM D3549.
- C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.
- D. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.14 WASTE HANDLING

- A. General: Handle asphalt-paving waste in accordance with approved waste management plan required in Section 017419 "Construction Waste Management and Disposal."

END OF SECTION 321216

SECTION 321313 – Site Concrete

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Concrete paving

- B. Related Sections:

- 1. Division 01 Section "Construction Waste Management"
- 2. Section 015639 Temporary Tree and Plant Protection
- 3. Section 129300 Site Furnishings
- 4. Section 312000 Earthwork

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.4 SUBMITTALS

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

- B. Action Submittals.

- 1. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- 2. Samples for color verification:
 - a. Submit samples of expansion joint filler, range of light gray and tan colors.

- C. Material Certificates: For the following, from manufacturer:

- 1. Cementitious materials.
- 2. Steel reinforcement and reinforcement accessories.
- 3. Fiber reinforcement.
- 4. Admixtures.
- 5. Curing compounds.
- 6. Applied finish materials.
- 7. Bonding agent or epoxy adhesive.
- 8. Joint fillers

- D. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Ready-Mix-Concrete 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" (Quality Control Manual - Section 3, "Plant Certification Checklist").

- B. Testing Agency Qualifications: 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.
- C. Concrete Testing Service: Engage a qualified testing agency to perform material evaluation tests and to design concrete mixtures.
- D. ACI Publications: Comply with ACI 301 and ACI 117 unless otherwise indicated.
- E. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to concrete paving, curbs and footings, including but not limited to, the following:
 - a. Concrete mixture design.
 - b. Quality control of concrete materials and construction practices
 - 2. Require representatives of each entity directly concerned with site concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Concrete paving subcontractor.

1.6 PROJECT CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
- B. Concrete Environmental Requirements:
 - 1. Schedule placement to minimize exposure to wind and hot sun before curing materials are applied.
 - 2. Avoid placing concrete if rain, snow, or frost is forecast within 24 hours. Protect fresh concrete from moisture and freezing.
- C. Schedule delivery of concrete to provide consistent mix times from batching until discharge.

PART 2 – PRODUCTS

2.1 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
 - 1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.2 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 - 1. Plywood, metal, or other approved panel materials.
- B. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not

exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

- C. Chamfer Strips: Wood, metal, PVC, or rubber strips, size per Drawings.
- D. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces:
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- E. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.

2.3 STEEL REINFORCEMENT

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.
- C. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60, deformed bars; assembled with clips.
- D. Epoxy-Coated, Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60, plain-steel bars.
- E. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.
- F. 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.

2.4 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout Project.
 - 1. Portland Cement: ASTM C 150, gray portland cement Type I:
 - a. Fly Ash: ASTM C 618, Class F.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C 33, Class 4S, uniformly graded. Provide aggregates from a single source.
 - 1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: Potable and complying with ASTM C 94/C 94M.
- D. Air-Entraining Admixture: ASTM C 260.

- E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
 - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 - 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
 - 7. Do not use calcium chloride admixtures for Integrally Colored Concrete.

2.5 FIBER REINFORCEMENT

- A. Synthetic Fiber: Monofilament or fibrillated polypropylene fibers engineered and designed for use in concrete paving, complying with ASTM C 1116/C 1116M, Type III, 1/2 to 1-1/2 inches long.
 - 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. Monofilament Fibers:
 - 1) Axim Italcementi Group, Inc.; FIBRASOL II P.
 - 2) Euclid Chemical Company (The), an RPM company; Fiberstrand 100, Fiberstrand 150.
 - 3) FORTA Corporation; FORTA ECONO-MONO or FORTA Mighty-Mono.
 - 4) Grace, W. R. & Co. - Conn.; Grace MicroFiber.
 - 5) Metalcrete Industries; Polystrand 1000.
 - 6) QC Construction Products; QC FIBERS
 - b. Fibrillated Fibers:
 - 1) Axim Italcementi Group, Inc.; FIBRASOL F.
 - 2) Euclid Chemical Company (The), an RPM company; Fiberstrand F.
 - 3) FORTA Corporation; FORTA Econo-Net or FORTA Super-Net.
 - 4) Grace, W. R. & Co. - Conn.; Grace Fibers.
 - 5) Propex Concrete Systems Corp.; Fibermesh 300.

2.6 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

2.7 RELATED MATERIALS

- A. Expansion Joint Fillers: Pre-molded foam rubber joint filler, AASHTO M 153 Type 1 in preformed strips. Color: Light Gray.

2.8 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
- B. Proportion mixtures to provide normal-weight concrete with the following properties:
 - 1. Compressive Strength (28 Days): 3500 psi minimum.
 - 2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.45.
 - 3. Slump Limit: 3 inches.
- C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
 - 1. Air Content: 6 percent plus or minus 1.5 percent for 3/4-inch nominal maximum aggregate size.
- D. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions
 - 1. Use high-range, water-reducing and retarding admixture in concrete as required for placement and workability.
 - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
- F. Cementitious Materials: Limit percentage by weight of cementitious materials other than portland cement according to ACI 301 requirements as follows:
 - 1. Fly Ash or Pozzolan: 25 percent.
- G. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.0 lb/cu. Yd.

2.9 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M and ASTM C1116/C 1116M when synthetic fibers are used. Furnish batch certificates for each batch discharged and used in the Work.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- 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 concrete batches 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 concrete batches 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, mixing time, quantity, and amount of water added.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
 - 1. Class A, 1/8 inch for smooth-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Install keyways, reglets, recesses, and the like, for easy removal.
 - 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement

3.4 EMBEDDED ITEMS

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

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
2. Install dovetail anchor slots in concrete structures as indicated.

3.5 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.6 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
- E. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

3.7 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
 1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
 1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
 2. Provide tie bars at sides of paving strips where indicated.
 3. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
 4. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
 1. Locate expansion joints at intervals as shown on Drawings.
 2. Extend joint fillers full width and depth of joint.
 3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
 4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.

5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
- D. Control Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows, to match jointing of existing adjacent concrete paving.
 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 3/8-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces.
 - a. Tolerance: Ensure that grooved joints are within 3 inches either way from centers of dowels.
 2. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 3/8-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.8 CONCRETE PLACEMENT

- A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.
- B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.
- F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement dowels and joint devices.
- H. Screed paving surface with a straightedge and strike off.
- I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- J. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following.

1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
 2. Do not use frozen materials or materials containing ice or snow.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.
- K. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
1. Cool ingredients before mixing to 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 in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
 3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.9 FINISHING OF PAVING AND CURBS

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
 1. Medium Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 deep with a stiff-bristled broom, perpendicular to line of traffic creating a uniform texture.

3.10 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods according to ACI 308.1: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound or a combination of these as follows:
 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials.
 - a. Water.
 - b. Continuous water-fog spray.

- c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period using cover material and waterproof tape.
 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas that have been subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period
- 3.11 PAVING TOLERANCES
- A. Comply with tolerances in ACI 117 and as follows:
 1. Elevation: 1/2 inch.
 2. Thickness: Plus 3/8 inch, minus 1/4 inch.
 3. Surface: Gap below 10-foot-long, unleveled straightedge not to exceed 1/4 inch.
 4. Lateral Alignment and Spacing of Dowels: 1 inch.
 5. Vertical Alignment of Dowels: 1/4 inch.
 6. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of dowel.
 7. Joint Spacing: 3 inches.
 8. Contraction Joint Depth: Plus 1/4 inch, no minus.
 9. Joint Width: Plus 1/8 inch, no minus.
- 3.12 FIELD QUALITY CONTROL
- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
 - B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 1. Testing Frequency: Obtain at least one composite sample for each truck or batch of each concrete mixture placed each day.
 2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.
 5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
 6. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at 28 days.
 - a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.
 - C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

- D. Test results shall be reported in writing to Landscape Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Owner's Representative but will not be used as sole basis for approval or rejection of concrete.
- F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Owner's Representative.
- G. Concrete paving will be considered defective if it does not pass tests and inspections. Remove and replace concrete pavement at no additional cost to the Owner.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- I. Prepare test and inspection reports.

3.13 REPAIRS AND PROTECTION

- A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Landscape Architect.
- B. Drill test cores, where directed by Owner's Representative, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.
- C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

SECTION 321450 – Stone Fines Paving

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes material and labor requirements at Lovett Library for construction with decomposed granite or crushed 3/8" or 1/4" minus aggregate pathway with Stabilizer binder additive for the following items:
 - 1. Stabilized stone fines paving.
 - 2. Metal edge restraints.
- B. Related Sections:
 - 1. Division 01 Section "Construction Waste Management"
 - 2. Division 31 Section "Earthwork".

1.3 PERFORMANCE REQUIREMENTS

- A. Perform gradation of decomposed granite material or 3/8" or 1/4" minus crushed aggregate in accordance with ASTM C 136 – Method for Sieve Analysis for Fine and Course.

1.4 SUBMITTALS

- A. Products Data:
 - 1. For each product specified, submit a 1-gallon sample and sieve analysis for grading of decomposed granite or crushed 3/8" or 1/4" minus aggregate. Submit range of colors and sizes for review and approval by Owner and Landscape Architect.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install decomposed granite or crushed 3/8" or 1/4" minus aggregate paving during rainy conditions or below 40 degrees Fahrenheit and falling.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Installer to provide evidence to indicate successful experience in providing decomposed granite or crushed 3/8" or 1/4" minus aggregate surfacing containing Stabilizer binder additive.
- B. Mockups: Install full depth 4-foot wide x 5-foot long mock-up of decomposed granite or 3/8" or 1/4" minus crushed aggregate surfacing with Stabilizer additive at location as directed by the Landscape Architect.

1.7 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Warranty: Submit a written warranty executed by the installer agreeing to repair or replace components of stabilized surfacing that fail in materials or workmanship within the specified warranty period. Failures include, but are not limited to, the following:

1. Premature wear and tear, provide the material is maintained in accordance with manufacturer's written maintenance instructions.
 2. Failure of system to meet performance requirements
- C. Warranty Period: Contractor shall provide warranty for performance of product. Contractor shall warranty installation of product for the time of one year from completion.
- D. Contractor shall provide, for a period of sixty days, unconditional maintenance and repairs as required

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Base Course: Provide crushed aggregate consisting of washed, hard, durable crushed rock. Base course aggregate shall conform to the following gradation:

<u>Screen Size</u>	<u>Percent Passing by Weight</u>
2"	100
1-1/2"	85 to 100
3/4"	58 to 78
No. 4	27 to 47
No. 200	2 to 12

- B. Stone Fines: Stone fines shall be gray in color as available from Stancills, Inc. 499 Mountain Hill Road Perrville, MD 21903. 1-877-536-9572, www.stancills.com, info@stancills.com.

1. Anticipated color to be "English Gray". Color range to be reviewed and approved by Landscape Architect and Owner upon receipt of samples.
2. Stone fines gradation: Provide crushed aggregate material consisting of sound, angular, durable particles. Gradation, in accordance with ASTM C136:

Optimal Gradation		
<u>Sieve</u>	<u>Sieve Size (mm)</u>	<u>Percent Passing</u>
3/8"	9.51	100%
4	4.76	80-100%
8	2.36	65-90%
16	1.18	40-60%
30	0.6	25-55%
50	0.3	15-35%
100	0.149	10-20%
200	0.074	5-15%

- C. Organic-Lock Binder: Patented powdered organic binder designed to be blended with crushed aggregate. Made from 100% naturally occurring materials as available from Envirobond Products Corporation, 6191-2100 Bloor Street West, Toronto, Ontario, Canada, M6S 5A5, 1-866-636-8476, info@envirobond.com, www.envirobond.com, www.organic-lock.com.
- D. Stone Fines Pavement mix design: stone fines supplier will mix binder prior to shipping to site for installation and will determine moisture content based upon installation schedule and timing.

2.2 EDGE RESTRAINT

- A. Provide painted steel edging, as available from Border Concepts, P.O. Box 471185, Charlotte, NC 28247, 704-541-5509, or approved equal.
 - 1. Dimensions: Manufacturer's standard or approximately 1/4" thick x 6" high with loops pressed from or welded to face to receive stakes.
 - 2. Color: Black
 - 3. Steel Stakes: 24" long" for each loop

2.3 EXCESS MATERIALS

- A. Provide owner's authorized rep. with the following excess materials for use in future decomposed granite or 3/8" or 1/4" minus crushed aggregate surfacing repair: 40 to 50 lb. Bags of the aggregate paving blended with proper amount of Stabilizer.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify that previously installed protection measures are in place.
- B. Verify that subgrade has been properly compacted and that it is graded properly.
- C. Proof roll prepared subgrade surface to check for unstable areas and areas requiring additional compaction. Subgrade under paving shall be compacted to a minimum 95% modified Proctor density.
- D. Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance.

3.2 PREPARATION

- A. Remove loose material from compacted subgrade surface and shape and trim compacted subgrade for correct drainage slopes.

3.3 INSTALLATION

A. Base Course

- 1. Construct crushed aggregate base course to compacted thickness as shown on Drawings at not less than 90% nor more than 92% relative density.
- 2. During construction of base course, work stone fines mix into top 3/4" to 1" of aggregate base. Work stones fines mix in until aggregate cannot receive any more fines, forming a tightly compacted and smooth base course.

B. Stone Fines Paving

- 1. Spread the loose and uncompacted Organic-Lock Pathway Aggregate over the compacted base material.
- 2. Typically, a lift of 5 inches of loose, pre-wet Organic-Lock Pathway Aggregate will compact to the required 4-inch depth for Light Vehicular Traffic Pathways.
- 3. Using a hand tamper or plate tamper, compact to 95% modified proctor density.
- 4. Provided the moisture content of the Organic-Lock blended aggregate is adequate, additional hydration should not be necessary. If the surface layer starts to dry out while installing, lightly mist to prevent surface cracks from appearing during compaction. Refer to manufacturers instructions.

5. Upon completion of 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.
6. Do not allow any traffic on the newly installed pathway until fully cured.

3.4 REPAIRS AND PROTECTION

- A. Excavate the damaged area and scarify exposed Organic-Lock Pathway Aggregate.
- B. Pre-blend the replacement stone fines with Organic-Lock at 28-34 lbs/imperial ton. Apply the material to the excavated area and compact. Thoroughly water the material to achieve a 8-10% moisture content.
- C. Allow the newly installed Organic-Lock Pathway Aggregate to cure, but not completely dry out.
- D. Re-compact the material, ensuring that the final grade and crown are maintained.

3.5 TOLERANCES

- A. The final paving surface, when measured under a 10 foot long metal straightedge, shall not vary by more than 1/4 inch.
- B. Stone fines surface shall not show any difference in level at adjacent pavements or lawns. All humps or depressions exceeding the specified tolerance shall be corrected.

3.6 ADJUSTING

- A. Finished stone fines surface shall be smooth, uniform and solid, with no evidence of chipping or cracking, Dried, compacted stone fines paving shall be firm all the way through with no spongy areas. Loose material shall not be present on the surface initially.
- B. Loose gravel on the surface or unconsolidated stone fines below the surface is evidence of improper bonding due to poor mixing or insufficient watering, Contractor shall furnish tests for questionable conditions as directed by Owner.
 1. Test the loose material for adequate amount of aggregate binder by wetting, then tamping, and allowing it to dry. If the material is still unconsolidated, the aggregate binder did not get mixed adequately with stone fines. If the material is solid, initial watering was insufficient.
 2. Cracking or sponginess is evidence of excessive aggregate binder in the mix.
- C. Unconsolidated areas shall be dug out and replaced with new stone fines mix. Patched areas then shall be wetted thoroughly and rolled smooth as specified for installation.
- D. Any significant irregularities shall be smoothed out prior to final acceptance of work. Smoothing shall be accomplished by wetting rough areas thoroughly and rolling the surface with a heavy roller (1000-1500 lbs. powered walk-behind or small rider type).

3.7 CLEAN UP

- A. Maintain the site in an orderly condition during the progress of work. Promptly remove debris and trash. Leave the site in a neat, orderly condition, broom clean.

END OF SECTION 321450

SECTION 323119 – Decorative Metal Fences & Gates

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Egress Gates
 - 2. Exit Signage
 - 3. Stair Gates, Guardrail, and Fencing
Extents of Base Bid and Add Alternate 02 as indicated on Drawings.
- B. Related Requirements:
 - 1. Section 033000 Cast-in-Place Concrete
 - 2. Section 050170 Decorative Metal Repair
 - 3. Section 055215 Exterior Handrails

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design gates, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. General: In engineering gates to withstand structural loads indicated, determine allowable design working stresses of gate materials based on the following:
 - 1. Steel: 72 percent of minimum yield strength.
 - 2. Aluminum: The lesser of minimum yield strength divided by 1.65 or minimum ultimate tensile strength divided by 1.95.
- C. Structural Performance: Gates shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Gate Frames:
 - a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
 - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 - 2. Infill:
 - a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
 - b. Infill load and other loads need not be assumed to act concurrently.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

- E. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
- F. Lightning-Protection System: Maximum grounding-resistance value of 25 ohms under normal dry conditions.

1.4 SUBMITTALS

- A. Product Data: Submit product literature or tear sheets with name of product and manufacturer for each material and product used.
- B. Shop Drawings: For all gates, guardrails, fence, and handrail. Include plans, elevations, sections, details, and attachments to other work. Utilize field verified dimensions in preparation of shop drawings.
- C. Samples: For each fence material.
 - 1. Linear components: 12 inches length.
 - 2. Bar grates, sheet and plates: 12 inches square.
 - 3. Finish: Color chips for color selection.
- D. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- E. Product Test Reports: for all specified and required products.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of gate from single source from single manufacturer.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
- C. Contractor shall have had experience with at least three (3) other projects of similar scope and complexity and shall perform work with personnel totally familiar with furnishings installation and construction techniques under the supervision of an experienced foreperson.
- D. Manufacturer: An experienced company specializing in the manufacture of products specified in this Section with a record of successful in-service performance.

1.6 PROJECT CONDITIONS

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

1.7 COORDINATION AND SCHEDULING

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for gates. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Schedule installation so wall attachments are made only to completed walls. Do not support

gates temporarily by any means that do not satisfy structural performance requirements.

PART 2 PRODUCTS

2.1 EGRESS GATES

- A. Manufacturer: Ameristar Perimeter Security, 1555 N. Mingo Rd, Tulsa, OK 74116, www.ameristarfence.com, (888)-333-3422. Or approved equal.
Contact: Bo Mendell, (800) 321-8724, bo.mendell@assaabloy.com
Product: Aegis II Majestic
1. Single-swing, right hand.
 2. Sizes and shapes as shown on Drawings.
 3. Provide with welded fittings to accept mounting plate for fire exit hardware.
 - a. Include Panic Bar on interior of both gates.
 - b. Confirm electrical options with Owner.
 - c. All hardware components to be rated for exterior use and weather-resistant.
 - d. Coordinate with approved panic hardware product.
 4. Provide all hinges, all connection devices and accessories as required for a complete installation.
 5. Industrial ornamental steel.
 6. Finish: Polyester powder-coat, color as selected from manufacturer's full range of standard options.
- B. Manufacturer: Allegion, www.us.allegion.com, (877) 671-7011, allegion_orders@allegion.com, exits_TechProdSupport@allegion.com.
Product: Von Duprin 98/99 Series Exit Device
1. All hardware components to be rated for exterior use and weather-resistant.
 2. Panic exit only hardware.
 3. Stainless steel.
 4. Coordinate size and compatibility with both egress gates shown on drawings.
- C. Wireless Exit Sign as available from The Lighting Source, (800) 282-5600, www.emergencylight.net/wireless-exit-sign.
1. Color Black, one-sided.
 2. Mounting as appropriate for brick masonry wall.

2.2 STAIR GATES, GUARDRAIL, AND FENCING

- A. Manufacturer: Hollaender Structural Engineering Group, 10285 Wayne Avenue, Cincinnati, OH 45215-6399, www.hollaender.com, (800)-772-8800. Or approved equal.
Contact: Frank Trapanotto, (513)-772-8800 x118, frankt@hollaender.com.
- B. Product: Interna-Rail Handrail System
1. Sizes and shapes as shown on Drawings.
 2. Include all structural fasteners, base flanges, and any accessories recommended by manufacturer.

- C. Product: Speed-Rail Gate System
 - 1. Sizes and shapes as shown on Drawings.
 - 2. Include all structural fasteners, base flanges, and any accessories recommended by manufacturer.
- D. Product: Wire Mesh Panel
 - 1. Include panel clips and any accessories recommended by manufacturer.
- E. Dimensions as indicated on drawings.
- F. Extent of base bid and add alternate scopes as indicated on drawings.

2.3 PERFORMANCE REQUIREMENTS

- A. Lighting-protection system: Maximum grounding-resistance value of 25 ohms under normal dry conditions.

2.4 METALS, GENERAL

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

2.5 ALUMINUM

- A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.
- B. Extruded Bars and Tubing: ASTM B 221 (ASTM B 221M), Alloy 6063-T5/T52.
- C. Drawn Seamless Tubing: ASTM B 210 (ASTM B 210M), Alloy 6063-T832.
- D. Plate and Sheet: ASTM B 209 (ASTM B 209M), Alloy 6061-T6.
- E. Die and Hand Forgings: ASTM B 247 (ASTM B 247M), Alloy 6061-T6.
- F. Castings: ASTM B 26/B 26M, Alloy A356.0-T6.

2.6 FASTENERS

- A. General: Provide the following:
- B. Fasteners for Anchoring Gates to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring gates to other types of construction indicated and capable of withstanding design loads.

2.7 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Nonshrink Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M and specifically recommended by manufacturer for exterior applications.

2.8 GROUNDING MATERIALS

- A. Grounding Conductors: Bare, solid wire for No. 6 AWG and smaller; stranded wire for No. 4 AWG and larger.
 - 1. Material above Finished Grade: Copper.
 - 2. Material on or below Finished Grade: Copper.
 - 3. Bonding Jumpers: Braided copper tape, 1 inch wide, woven of No. 30 AWG bare copper wire, terminated with copper ferrules.
- B. Grounding Connectors and Grounding Rods: Comply with UL 467.

2.9 FABRICATION

- A. General: Fabricate gates to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Assemble gates in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate gates with welded connections unless otherwise indicated.
- H. Form changes in direction as follows:
 - 1. As detailed.
- I. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- J. Close exposed ends of gate members with prefabricated end fittings.
- K. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.
- L. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect gate members to other work unless otherwise indicated.

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

2.11 ALUMINUM FINISHES

- A. Polyester Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5

mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: As selected by Landscape Architect from manufacturer's full range.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation before final grading is completed unless otherwise permitted by Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 GATE INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing gates. Set accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
 1. Do not weld, cut, or abrade surfaces of gate components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
- C. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- D. Adjust gates before anchoring to ensure matching alignment at abutting joints.
- E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing and for properly transferring loads to in-place construction.
- F. Post setting: set posts in concrete or with mechanical anchors at spacing as indicated on Drawings.
 1. Verify that posts are set plumb, aligned and at correct height and spacing and hold in position during setting as required.
 2. Concrete Fill: place concrete around posts and vibrate or tamp for consolidation. Protect above ground portion of posts from concrete splatter. Extend concrete footing 2 inches above grade and slope top surface to drain water away from post.
 3. Surface mounting: mount posts as shown on Drawings. Peen anchor bolts after installation to prevent removal.

3.3 GATE INSTALLATION

- A. Install gates according to manufacturer's written instructions, level and plumb and secure for full opening without interference. Attach hardware using tamper-resistant or concealed means. Adjust hardware for smooth operation and lubricate where necessary.
- B. Gates shall be easily opened and properly balanced and shall be able to open to 120 degrees from the closed position.
- C. Install drop bar hole sleeves in pavement in the closed and open positions. Obtain approval of sleeve locations from Owner prior to installation. Install sleeves during concrete installation; do not core drill afterward.

3.4 GROUNDING AND BONDING

- A. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is 6 inches below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at grounding location.
- B. Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.
- C. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
 - 2. Make connections with clean, bare metal at points of contact.
 - 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 - 4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
 - 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- D. Bonding to Lightning-Protection System: If fence terminates at lightning-protected building or structure, ground the fence and bond the fence grounding conductor to lightning-protection down conductor or lightning-protection grounding conductor, complying with NFPA 780.

3.5 ADJUSTING AND CLEANING

- A. Clean by washing thoroughly with clean water and soap and rinsing with clean water.
- B. Touchup Painting, if required: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.6 PROTECTION

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

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
 - 1. Grounding-Resistance Tests: Subject completed grounding system to a megger test at each grounding location. Measure grounding resistance not less than two full days after last trace of precipitation, without soil having been moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural grounding resistance. Perform tests by two-point method according to IEEE 81.
 - 2. Excessive Grounding Resistance: If resistance to grounding exceeds specified value,

notify Architect promptly. Include recommendations for reducing grounding resistance and a proposal to accomplish recommended work.

3. Report: Prepare test reports of grounding resistance at each test location certified by a testing agency. Include observations of weather and other phenomena that may affect test results.

END OF SECTION 323119

SECTION 329100 – PLANTING PREPARATION

PART 1 - GENERAL

1.1 Scope of Work

- A. The scope of work includes all labor, materials, tools, supplies, equipment, facilities, transportation and services necessary for, and incidental to performing all operations in connection with furnishing, delivery, and installation of Planting Soils. Scope of work includes, but is not limited to, sourcing, purchase, delivery and installation of Planting Soil and soil amendments and clean up and disposal of all excess and surplus material.

1.2 The specific soil types in this section include:

- A. Soil Amendment for Existing Soil
- B. Erosion Control Materials

1.3 Related Sections

- A. Division 31, Section 'Earth Moving'
- B. Division 32, Section 'Plants'
- C. Division 32, Section 'Lawn'

1.4 Reference Standards

- A. In the event that the requirements of any of the referenced standards and specifications herein conflict with each other the more stringent requirement shall prevail. Where reference is made to one of the standards, the revision in effect at the time of bid opening shall apply.
- B. American Society for Testing Materials (ASTM):
 - 1. ASTM C33 – Gradation Requirements for Coarse Aggregates.
 - 2. ASTM C602 Standard Specification for Agricultural Liming Materials.
 - 3. ASTM D422 – Standard Test Method for Particle Size Analysis of Soils.
 - 4. ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort.
 - 5. ASTM D3385 – Standard Test Method for Infiltration Rate of Soils in Field Using Double-Ring Infiltrometer.
 - 6. ASTM D4972 – Standard Test Method for pH of Soils.
 - 7. ASTM D5298 – Standard Specification for Topsoil Used for Landscaping Purposes.
 - 8. ASTM D7481 – Standard Test Methods for Determining Loose and Tapped Bulk Densities of Powders using a Graduated Cylinder.
 - 9. ASTM F1632 – Standard Test Method for Particle Size Analysis and Sand Shape Grading of Golf Course Putting Green and Sports Field Rootzone Mixes.
 - 10. ASTM F1647 – Standard Test Methods for Organic Matter Content of Athletic Field Rootzone Mixes.
 - 11. ASTM F1815 – Standard Test Methods for Saturated Hydraulic Conductivity, Water Retention, Porosity, and Bulk Density of Athletic Field Rootzones.
- C. Other Standards:
 - 1. U.S. Department of Agriculture (USDA), Natural Resources Conservation Service, Soil Texture Calculator.

2. USDA, Natural Resources Conservation Service, 2003. National Soil Survey Handbook, title 430-VI, current edition.
3. USDA Soil Survey Laboratory Methods Manual, Soil Survey Investigations Report, current edition.
4. Environmental Protection Agency (EPA) Section 503 Regulations.
5. Department of Environmental Protection (DEP), Pennsylvania Bulletin, Management of Fill, Clean Fill Policy, current edition.
6. U.S. Composting Council (USCC), Test Methods for the Examination of Composting and Compost (TMECC), current edition.
7. USCC, Landscape Architecture / Design Specifications for Compost Use, Planting Bed Establishment with Compost.
8. Association of Official Analytical Chemists (AOAC), Official Methods of Analysis, current edition.
9. Soil Science Society of America (SSSA), Methods of Soil Analysis, current edition.

1.5 Definitions

- A. Amendment: material added to Topsoil to produce Planting Soil Mix. Amendments are classified as general soil amendments, fertilizers, biological, and pH amendments.
- B. Bulk Density: is an indicator of soil compaction calculated as the dry weight of soil by its volume typically expressed in g/cm³.
- C. Coarse Sand: sharp natural or manufactured fine aggregate and further defined in this specification.
- D. Compacted soil: soil where the density of the soil is greater than the threshold for root limiting, and further defined in this specification.
- E. Compost: Well decomposed stable organic material as defined by the US Composting Council and further defined in this specification.
- F. Debris: Elements including, but not limited to, concrete, concrete masonry, wood, excavated rock and rock fragments, rubble, overburden soils, abandoned utility structures, trash, refuse and litter.
- G. Drainage: The process of water moving through the soil, transitioning the soil from dry to saturated to field capacity, the rate of which may be expressed as the saturated hydraulic conductivity rate (K_{sat}; units are inches per hour).
- H. Existing Soil: Mineral soil existing at the locations of proposed planting after the majority of the construction within and around the planting site is completed and just prior to the start of work to prepare the planting area for soil modification and/or planting, and further defined in this specification.
- I. Fertilizer: amendment used for the purpose of adjusting soil nutrient composition and balance.
- J. Fine grading: The final grading of the soil to achieve exact contours and positive drainage, often accomplished by hand rakes or drag rakes or other suitable devices, and further defined in this specification, and further defined in this specification.
- K. Finished grade: surface or elevation of Soil after final grading and 12 months of settlement of the soil, and further defined in this specification.
- L. Planting Soil: Planting soil shall be harvested from fields or development sites or manufactured uniformly mixed individual soil components (Topsoil, Sand, Compost) or existing mineral soil at the locations of proposed planting meeting the criteria specified herein.
- M. Salvaged Topsoil: Stripped native loam removed within the limits of work, but outside of the "Tree Protection Areas", to its entire natural depth.

- N. Scarify: Loosening and roughening the surface of soil and sub soil prior to adding additional soil on top, and further defined in this specification.
- O. Soil Horizons: as defined in the USDA National Soil Survey Handbook (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242)
- P. Soil Tilling: Loosening the surface of the soil to the depths specified with a rotary tine tilling machine, roto tiller, (or spade tiller), and further defined in this specification.
- Q. Subgrade: Surface or elevation of subsoil remaining after completing excavation or backfill immediately beneath Planting Soil.
- R. Topsoil: Topsoil shall be a harvested from fields or development sites and shall be loose, friable mineral particles resulting from natural soil formation from the A, E and upper B horizons, or *solum* where most plant roots grow and as defined further herein.

1.6 Submittals

- A. Submit references of past projects and employee training certifications that support that the Contractors meet all of the installer qualifications and applicable licensures specified herein.
- B. Submit a list of materials to be provided for work under this Section including the name and address of the materials producer and the location from which the materials are to be obtained.
- C. Submit dated certificates or letters, signed by the materials producer, stating that materials meet or exceed the specified requirements.
- D. For each type of manufactured product, submit data and certificates that the product meets the specification requirements, signed by the product manufacturer, and complying with testing requirements and referenced standards and specific requested testing.
- E. Laboratory soil testing requirements:
 - 1. Samples of soil(s) to be submitted to an approved soil testing laboratory for testing in accordance with specifications herein. Submit the soil testing laboratory for review and approval prior to commencing with any soil testing.
 - 2. Test results shall be submitted to the Landscape Architect for approval in conjunction with soil amendment products in accordance with soil testing laboratory recommendations.
 - 3. Submit soil test reports including test results for each criteria listed within the Products section herein for:
 - a. Existing Soil
 - b. In-situ Soil Amendments: Biochar. Topsoil and sand only if needed.
 - c. Amended Soil at Plant Beds and Lawn.
 - d. The source of supply for Individual Components for Soil Mixes and Soil Mixes Using Individual Components must be indicated on the test report submittals.
 - 4. Test reports must be the same material to be supplied and must be current within the period of time defined as follows unless approved otherwise by the Landscape Architect:
 - a. Existing Soil: no more than 6 months old.
 - b. Biochar: no more than 3 months old.
 - c. Amended Soil: test data must be no more than 1 month old.
 - d. Sample test results shall be considered valid until the time of construction and for the material supplied.
 - 5. If tests fail to meet the specifications, obtain other sources of material, retest and resubmit until accepted by the Landscape Architect.
 - 6. Soils shall not contain any traces of hydrocarbons, petroleum products, chemically prohibited substances, or any other elements considered to be toxic to any vegetation that is used. Clean fill certification shall be submitted by the manufacturer.
 - 7. All soil testing will be at the expense of the Contractor.

- F. Physical samples:
 - 1. All samples must be submitted simultaneously with the laboratory test reports. Samples are required for the following:
 - a. Existing Soil
 - b. In-situ Soil Amendments: Biochar. Topsoil and sand, if needed.
 - c. Amended Soil at Plant Beds and Lawn
 - 2. Provide one (1) one-gallon sample in a resealable plastic bag to the Landscape Architect.
- 1.7 In-situ (worksite) verification soil testing requirements:
 - A. Compaction Testing:
 - 1. Maintain an up-to-date written report of compaction test results. Test compaction every 12-inch lift of soil for every 300 square feet of soil installed for each planting area designated on the Drawings. The Landscape Architect may review the written report at any time to confirm conformance with the specification. Submit final report at the completion of soil installation.
 - 2. Maintain at the site at all times a soil cone penetrometer with pressure dial and a soil moisture meter to check soil compaction and soil moisture.
 - a. Penetrometer shall be AgraTronix Soil Compaction Meter or approved equal.
 - b. Moisture meter shall be "general digital soil moisture meter".
 - B. Should any verification test results indicate soil material is not consistent with the approved submittals or requirements specified herein, the Contractor shall remove the installed soil and re-install soil at the Contractors expense until the Contract Document requirements are met.
- 1.8 Accompany each delivery of soil mixes, bulk materials, fertilizers and soil amendments provide the appropriate certificates and delivery tickets to the Landscape Architect. The soil supplier must be indicated on delivery tickets for all soil mix deliveries and the supplier must match the approved submittals.
- 1.9 Quality Assurance
 - A. All materials, methods of construction, and workmanship shall conform to applicable requirements of ASTM, PTM, PennDOT Standard Specifications and AASHTO Standards, PADEP Clean Fill Guidance, unless otherwise specified.
 - B. Soil Testing Laboratory Qualifications: The laboratory shall be an independent laboratory, recognized by the State Department of Agriculture. The testing laboratory must have experience in performing agronomic testing including physical and chemical properties of soil. Tests shall be made in strict compliance with the standards of the Association of Official Analytical Chemists and follow standards from the NRCS Soils Manual and ASTM testing methods applicable to the specific tests requested. Laboratory shall have staff fully qualified to review test results, and to make recommendations to amend samples based on what is planned to grow in the soil. American Association for Laboratory Accreditation (A2LA) certification is preferred.
 - 1. Compost that participates in the US Composting Council's Seal of Testing Assurance (STA) Program and tested through an STA program lab, using appropriate test methods from the TMECC (Test Methods for the Examination of Compost and Composting) is preferred. Test data shall be presented on a Compost Technical Data Sheet.
 - C. Any fill or topsoil sources, disposal areas, or temporary offsite storage locations shall be subject to review and approval by the Landscape Architect.

- D. Installer Qualifications: The installer shall be a firm having at least five (5) years of experience of a scope similar to that required for the work.
 - 1. Installer Field Supervision: When any soil work is in progress, installer shall maintain, on-site, an experienced full-time supervisor.
 - 2. Installer's field supervisor shall have a minimum of five (5) years experience as a field supervisor installing soil, shall be trained and proficient in the use of field surveying equipment to establish grades.

1.10 Delivery, Storage, and Handling

- A. Preparation, amendment, and mixing of soils shall be performed at the soil supplier location.
- B. Weather: Do not mix, deliver, place or grade soils when frozen or with moisture above field capacity. Soils shall not be handled, hauled, placed, or compacted when wet or frozen. Soil shall only be handled when the moisture content is between the specified ranges in percent water by volume.
- C. Protect soil and soil stockpiles, including the stockpiles at the soil blender's yard, from wind, rain and washing that can erode soil or separate fines and coarse material, and contamination by chemicals, dust and debris that may be detrimental to plants or soil drainage. Once spread, soils shall be protected with staked erosion control blankets.
- D. All manufactured packaged products and material shall be delivered to the site in unopened containers and stored in a dry enclosed space suitable for the material and meeting all environmental regulations. Biological additives shall be protected from extreme cold and heat. All products shall be freshly manufactured and dated for the year in which the products are to be used.
- E. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
- F. 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.
- G. None of the soil materials shall be delivered to the site until sample certifications are approved by the Landscape Architect, however, such approval does not constitute final acceptance. Certification submittal shall include recommended soil amendment products if proposed to modify the soils. Any approval of soils made conditional upon utilizing one or more amendments shall be understood to afford to the Landscape Architect the right for further testing and refusal of materials that do not meet these Specifications.

PART 2 - PRODUCTS

2.1 Individual Components for Soil Mixes

- A. The following components to be used if needed to amend existing soil for planting and lawn areas. Requirement of these components to be determined based on initial testing of existing site soil.
- B. Topsoil

1. Topsoil definition: Topsoil shall be a harvested from fields or development sites and shall be loose, friable mineral particles resulting from natural soil formation from the A, E and upper B horizons, or “solum” where most plant roots grow. Manufactured soils where sand, composted organic material, chemical additives or similar elements has been blended to meet the requirements of Topsoil is not acceptable. The soil shall be free of construction and trash debris, rocks, hydrocarbons, petroleum materials, herbicides, or other harmful contaminants that would impact plant growth.
 - a. Topsoil shall comply with the following parameters:
 - i) Organic matter (ASTM F1647, Method A): 1.5% minimum (by dry weight).
 - ii) pH (1 soil : 1 water): 5.0 - 7.0.
 - b. Stockpiled Existing Topsoil at the site meeting the above criteria may be acceptable.

C. Organic Amendment / Compost

1. Compost is as defined by the “US Composting Council Landscape Architecture / Design Specifications for Compost Use, Planting Bed Establishment with Compost”. Compost shall be a well decomposed, stable, weed free organic matter source. It shall be derived from: agricultural, food, or industrial residuals; leaf litter and yard trimmings; or source-separated waste. The product shall contain no substances toxic to plants and shall be reasonably free (< 1% by dry weight) of man-made foreign matter. The compost will possess no objectionable odors and shall not resemble the raw material from which it was derived.
2. Compost shall comply with the following parameters:
 - a. pH: 6.0 - 8.0.
 - b. Soluble salt content (electrical conductivity, 1 soil : 2 water): maximum 5 dS/m (mmhos/cm).
 - c. Compost derived from stabilized mushroom soil compost may possess a maximum EC of 10 dS/m (1:2), if the maturity testing is a minimum of 95% and ammonia (NH₄) content is a maximum of 250 ppm.
 - d. Moisture content %, wet weight basis: 30 – 60.
 - e. Organic Matter Content, % dry weight basis: 30 – 65.
 - f. Particle size, dry weight basis: 98% pass through 1/2 inch screen.
 - g. Stability carbon dioxide evolution rate: mg CO₂-C/ g OM/ day ≤ 3.
 - h. Maturity, seed emergence and seedling vigor, % relative to positive control: minimum 80%.
 - i. Physical contaminants (inerts), %, dry weight basis: <0.5%.
 - j. Chemical contaminants, mg/kg (ppm): meet or exceed US EPA Class A standard, 40CFR § 503.13, Tables 3 levels.
 - k. Biological contaminants select pathogens fecal coliform bacteria, or salmonella, meet or exceed US EPA Class A standard, 40 CFR § 503.32(a) level requirements.

D. Coarse Sand

1. Sharp natural or manufactured fine aggregate shall be hard and durable and free of limestone (calcareous sand), shale and slate particles and free of harmful contaminants that would impact plant growth complying with the following parameters:
 - a. pH shall be lower than 7.0.
 - b. Sieve analysis:

Sieve	Percent passing (by mass)
3/8 inch (9.5 mm)	100
No 4 (4.75 mm)	95-100
No 8 (2.36 mm)	80-100

No 16 (1.18 mm)	50-85
No 30 (.60 mm)	25-75
No 50 (.30 mm)	5-40
No 100 (.15 mm)	2-20
No 200 (0.75 mm)	2-15

- c. Particle analysis must be per USDA classification, Sand.
- | | |
|-------------------------|------|
| Sand (2 - 0.05 mm): | ≥88% |
| Silt (0.05 - 0.002 mm): | ≤9% |
| Clay (< 0.002 mm): | ≤3% |

E. Chemical Amendments

1. Lime, ASTM C 602, agricultural limestone containing a minimum 80 percent calcium carbonate equivalent and as follows:
 - a. Class: Class T, with a minimum 99 percent passing through No. 8 sieve and a minimum 75 percent passing through No. 60 sieve.
 - b. Provide lime in form of dolomitic limestone.

2.2 Soil Mixes Using Individual Components

A. Definition

1. Manufactured uniformly mixed individual soil components meeting the criteria specified herein. Provide Soils at the locations indicated on the Drawings complying with the following parameters.

B. Planting Soil at Plant Beds and Lawn

1. Planting soil shall be harvested from fields or development sites or manufactured uniformly mixed individual soil components (Topsoil, Sand, Compost) or existing mineral soil at the locations of proposed planting meeting the criteria specified herein.
2. Provide Planting Soil at the locations indicated on the Drawings complying with the following parameters:
 - a. Particle analysis must be per USDA classification for loam, sandy loam, sandy clay loam, or silt loam within the following parameters using ASTM D422:

Sand:	45 - 55%
Silt:	no more than 30%
Clay:	no more than 20%

Gravel content larger than 2mm shall be less than 12%.
 - b. pH (1 soil : 1 water): 6.0 - 7.2.
 - c. Organic matter (ASTM F1647, Method A): 3 - 6% (by dry weight).
 - d. Hydraulic conductivity (ASTM F1815) at 80% Proctor (ASTM D698): 1.0 - 2.0 in/hr
 - e. Soluble salt content (electrical conductivity, 1 soil : 2 water): maximum 1.60 mmho/cm. Sodium (Na) salinity shall not exceed 700 ppm.
 - f. Cation Exchange Capacity (CEC): >15 meq/100g.
 - g. Nutrient analysis including macronutrients and micronutrients (Mehlich-3) with soil fertility interpretation and recommendations relevant to the specified plant species.
 - h. Compost shall not be added at more than 30% by volume.

C. Amendments

1. At the time of final grading, add fertilizer if required to the Planting Soil at rates recommended by the testing results for the species of plants to be grown.

2.3 SOIL AMENDMENT FOR EXISTING SOIL TO BE AMENDED

- A. Provide Inoculated Biochar blend as available from The Organic Mechanics Soil Co., 484-557-2961, contact Mark Highland, mark@organicmechanicsoil.com
 - 1. Existing soil to receive 5% effective rate of inoculated biochar. Provide 1 cubic foot of inoculated biochar per 24 square feet of existing soil. Mix 5" deep in existing soil.

PART 3 - EXECUTION

3.1 SITE EXAMINATION

- A. Prior to installation of Soil, examine site to confirm that existing conditions are satisfactory for the work of this section to proceed. The Landscape Architect shall approve the condition of the subgrade and the previously installed subgrade preparation and the installation of subsurface drainage.
 - 1. Confirm that the subgrade is at the proper elevation and compacted as required. Subgrade elevations shall slope toward the under drain lines as shown on the Drawings.
 - a. Subgrade definition: surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing Planting Soil.
 - 2. Confirm that all surface areas to be filled with Soil are free of construction debris, refuse, compressible or biodegradable materials, stones greater than 2 inches diameter, soil crusting films of silt or clay that reduces or stops drainage from the Soil into the subsoil; and/or standing water. Remove unsuitable material from the site.
 - a. Debris definition: Elements including, but not limited to, concrete, concrete masonry, wood, excavated rock and rock fragments, rubble, overburden soils, abandoned utility structures, trash, refuse and litter.
 - 3. Confirm that no adverse drainage conditions are present.
 - 4. Confirm that no conditions are present which are detrimental to plant growth.
- B. If unsatisfactory conditions are encountered, notify the Landscape Architect immediately to determine corrective action before proceeding.

3.2 SOIL INSTALLATION

- A. All equipment utilized to install or grade Soils shall be wide track or balloon tire machines rated with a ground pressure of 4 psi or less. All grading and soil delivery equipment shall have buckets equipped with 6 inch long teeth to scarify any soil that becomes compacted.
- B. In areas of soil installation above existing subsoil, scarify the subgrade material prior to installing Soil.
 - 1. Scarify the subsoil of the subgrade to a depth of 3 – 6 inches with the teeth of the back hoe or loader bucket, tiller or other suitable device.
 - 2. Immediately install the Planting Soil. Protect the loosened area from traffic. DO NOT allow the loosened subgrade to become compacted.
 - 3. In the event that the loosened area becomes overly compacted, loosen the area again prior to installing the Planting Soil.
- C. Install the Planting Soil in 12 - 18 inch lifts to the required depths. Apply compacting forces to each lift as required to attain the required compaction. Scarify the top of each lift prior to adding

more Planting Soil by dragging the teeth of a loader bucket or backhoe across the soil surface to roughen the surface.

1. Approved compaction equipment includes a smooth drum roller or plate compactor. Typically one to three passes per lift will achieve the desired compaction. Contractor to test desired compaction methodology with actual soil to be installed to confirm installation method and material properties are compatible and will achieve the specified compaction rates.
 2. Provide adequate equipment to achieve consistent and uniform compaction of the Soils. Use the smallest equipment that can reasonably perform the task of spreading and compaction. Use the same equipment and methods of compaction for the entire project area once soil, installation methodology, and compaction criteria have been coordinated and confirmed.
- D. Do not pass motorized equipment over previously installed and compacted soil except as authorized below.
1. Light weight equipment such as trenching machines or motorized wheel barrows is permitted to pass over finished soil work.
 2. If work after the installation and compaction of soil compacts the soil to levels greater than the above requirements, follow the requirements of Over Compaction Reduction herein.
- E. Phase work such that equipment to deliver or grade soil does not have to operate over previously installed Planting Soil. Work in rows of lifts the width of the extension of the bucket on the loader. Install all lifts in one row before proceeding to the next. Work out from the furthest part of each bed from the soil delivery point to the edge of each bed area.
- F. Where travel over installed soil is unavoidable, limit paths of traffic to reduce the impact of compaction in Planting Soil. Each time equipment passes over the installed soil it shall reverse out of the area along the same path with the teeth of the bucket dropped to scarify the soil. Comply with Over Compaction Reduction herein in the event that soil becomes over compacted. Access over finished grade soils shall be restricted. If access is required across placed soils, Contractor shall be required to rework compacted soil areas prior to fine grading to the full depth of the placed soils as directed by the Landscape Architect.
- G. The depths and grades shown on the Drawings are the final grades after settlement and shrinkage of the compost material. The Contractor shall install the Planting Soil at a higher level to anticipate this reduction of Soil volume. A minimum settlement of approximately 10 - 15% of the soil depth is expected. All grade increases are assumed to be as measured prior to addition of surface Compost till layer, mulch, or sod.
- H. Maintain moisture conditions within the Soil during installation or modification to allow for satisfactory compaction.
1. Volumetric soil moisture level during installation shall be above permanent wilt point and below field capacity for each type of soil texture within the following ranges.

Soil texture	Permanent wilting point	Field capacity
Sand, Loamy sand, Sandy loam	5-8%	12-18%
Loam, Sandy clay, Sandy clay loam	14-25%	27-36%
Clay loam, Silt loam	11-22%	31-36%

- C. Surface roto tilling shall not be considered adequate to reduce over compaction at levels 6 inches or greater below finished grade.

3.6 INSTALLATION OF CHEMICAL ADDITIVES

- A. Following the installation of each soil and prior to fine grading and installation of the Compost till layer, apply chemical additives as recommended by the soil test, and appropriate to the soil and specific plants to be installed.
- B. Types, application rates and methods of application shall be approved by the Landscape Architect prior to any applications.

3.7 FINE GRADING

- A. Fine grading: The final grading of the soil to achieve exact contours and positive drainage, often accomplished by hand rakes or drag rakes other suitable devices, and further defined in this specification, and further defined in this specification.
- B. The Landscape Architect shall approve all rough grading prior to the installation of Compost, fine grading
- C. Grade the finish surface of all planted areas to meet the grades shown on the Drawings, allowing the finished grades to remain higher than the grades on the grading plan, as defined in paragraph Soil Installation, to anticipate settlement over the first year.
- D. Utilize hand equipment, small garden tractors with rakes, or small garden tractors with buckets with teeth for fine grading to keep surface rough without further compaction. Do not use the flat bottom of a loader bucket to fine grade, as it will cause the finished grade to become overly smooth and or slightly compressed.
- E. Provide for positive drainage from all areas toward the existing inlets, drainage structures and or the edges of planting beds. Adjust grades as directed to reflect actual constructed field conditions of paving, wall and inlet elevations. Notify the Landscape Architect in the event that conditions make it impossible to achieve positive drainage.
- F. Provide smooth, rounded transitions between slopes of different gradients and direction. Modify the grade so that the finish grade before adding mulch and after settlement is one or two inches below all paving surfaces or as directed by the Drawings.

3.8 INSTALLATION OF IN-SITU COMPOST AMENDMENT

- A. After Planting Soil are installed in planting bed areas, spread 2 – 3 inches of Compost over the beds and roto till into the top 4 - 6 inches of the Planting Soil. This step will raise grades slightly above the grades required in Fine Grading herein. This specification anticipates that the raise in grade due to this tilling will settle within a few months after installation as Compost breaks down. Additional settlement as defined in paragraph "Soil Installation" must still be accounted for in the setting of final grades.
- B. Soil Tilling: Loosening the surface of the soil to the depths specified with a rotary tine tilling machine, roto tiller, (or spade tiller), and further defined in this specification.

3.9 EROSION CONTROL MATERIALS

- A. Areas with slopes greater than or equal to 6:1, shall be covered with secured erosion control blanket within two (2) days or prior to any precipitation, whichever is shorter in accordance with the product requirements specified herein.
 - 1. Complete lawn seeding operations prior to installation of erosion control blankets. See Section 'Lawn and Fine Grading' for turfgrass requirements.
 - 2. Install erosion control blankets prior to installation of trees, shrubs, herbaceous plants and groundcovers. See Section 'Plants' for planting requirements.
Install erosion-control blanket and fasten per Drawings. Install from top of slope, working downward.

3.10 PROTECTION

- A. Protection Zone: Identify and coordination protection zones according to Section "Tree and Plant Protection."
- B. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:
 - 1. Storage of construction materials, debris, or excavated material.
 - 2. Parking vehicles or equipment.
 - 3. Vehicle traffic.
 - 4. Foot traffic.
 - 5. Erection of sheds or structures.
 - 6. Impoundment of water.
 - 7. Excavation or other digging unless otherwise indicated.
- C. If planting soil or subgrade is overcompacted, disturbed, or contaminated by foreign or deleterious materials or liquids, remove the planting soil and contamination; restore the subgrade as directed by the Landscape Architect and replace contaminated planting soil with new planting soil.

3.11 CLEANING

- A. Protect areas adjacent to planting-soil preparation and placement areas from contamination. Keep adjacent paving and construction clean and work area in an orderly condition.
- B. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner's property unless otherwise indicated.

END OF SECTION 329100

SECTION 329200 – LAWN

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Sodding.
- B. Related Sections:
 - 1. Section 32 14 50 Stone Fines Paving
 - 2. Section 32 91 00 Planting Preparation

1.3 DEFINITIONS

- A. Finish Grade: Elevation of finished surface of planting soil.
- B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- C. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- D. Topsoil: Native or Imported topsoil. See Soil Preparation section.
- E. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or top surface of a fill or backfill before planting soil is placed.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Certification of Grass Seed: From seed vendor for grass-seed mixture stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging. Include identification of source and name and telephone number of supplier.
 - 1. Certification of each seed mixture for turfgrass sod. Include identification of source and name and telephone number of supplier.
- C. Qualification Data: For qualified landscape Installer.
- D. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of turf during a calendar year. Submit before expiration of required initial maintenance periods.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful turf establishment.

1. Experience: Five (5) years' experience in turf installation in projects of similar complexity in addition to requirements in Division 1 Section "Quality Requirements."
2. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
3. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.
4. Pesticide Applicator: State licensed, commercial.

B. Pre-installation Conference: Conduct conference at Project site.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod in time for planting within 24 hours of harvesting. Protect sod from breakage and drying.

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.

1.7 PROJECT CONDITIONS

A. Planting Restrictions: Coordinate planting periods with initial maintenance periods to provide required maintenance from date of Substantial Completion. Do not work soil when muddy or excessively wet or frozen.

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

1.8 MAINTENANCE SERVICE

A. Initial Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until acceptable turf is established but for not less than the following periods:

1. Sodded Turf: 30 days from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TURFGRASS SOD

A. Turfgrass Sod: Certified, complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture, strongly rooted, and capable of vigorous growth and development when planted.

B. Turfgrass Species: Sod of grass species as follows, with not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed:

1. Proportioned by weight as follows: 90% Turf-type Tall Fescue comprised of at least three varieties and 10% Kentucky Bluegrass.

2. Seed mix shall be considered "no mow" or "low mow" blends, comprised of slow-growing fine fescue grasses.

2.2 PESTICIDES

- A. General: Pesticide, registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Pre-Emergent and Post-Emergent Herbicides (Selective and Non-Selective) shall only be used with written authorization by the Owner.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to be planted for compliance with requirements and other conditions affecting 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.
 2. Do not work soil in frozen, wet, or muddy conditions.
 3. 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 Owner and replace with new planting soil as specified in Division 2 Section "Soil Preparation".

3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 TURF AREA PREPARATION

- A. Remove stones larger than 1 inch in any dimension and sticks, roots, trash, and other extraneous matter.
- B. Finish Grading: Roll the whole surface of lawn bed with a hand roller weighing approximately 100 lbs. per 12-inches of roller width. During the rolling, fill all depressions caused by settlement with additional planting soil and then re-grade by hand raking. Lightly roll and rake until the surface presents a smooth, even, and uniform finish that is at required grade. Use care not over-compact soil by excessive rolling. Grade to within plus or minus 1/2 inch of finish elevation. Limit finish grading to areas that can be planted in the immediate future.
- C. Moistened prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- D. Before planting, obtain Owner's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 SODDING

- A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.
- B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.
 - 1. Lay sod across angle of slopes exceeding 1:3.
 - 2. Anchor sod on slopes exceeding 1:6 with wood pegs spaced as recommended by sod manufacturer but not less than 2 anchors per sod strip to prevent slippage.
- C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below sod.

3.5 TURF RESTORATION

- A. Renovate newly installed or established turf damaged by Contractor's operations. Consult the Owner prior to restoring turf for renovation requirements. Turf shall be restored to the satisfaction of the Owner.

3.6 TURF MAINTENANCE

- A. Maintain and establish turf by watering, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
 - 1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
 - 2. Apply treatments as required to keep turf and soil free of pests and pathogens or disease as specified herein. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.
- B. Watering: To be provided by temporary irrigation system.
 - 1. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
 - 2. Water within 15 minutes of laying each piece of sod.
 - 3. If permanent irrigation system is included in the scope of work and installation has not been completed prior to sod installation, hand water as the sod is being laid.
 - 4. Initially, apply one inch of water. After that, visually check the appearance of the grass and water as needed throughout the day. Do not let the plants wilt or become a blue-gray color. The pad of sod and soil should be kept moist.
 - 5. The sod should be rooted to the soil in approximately 10 days depending on temperatures. At this time, less frequent and deeper watering should begin. Weather conditions will dictate the amount and frequency of watering. Ensure new sod has enough moisture to survive hot, dry or windy conditions. Water areas near buildings, sidewalks, and driveways more often as reflected heat will dry the sod plants in these areas sooner than in other areas.
- C. Mow turf as soon as top growth is tall enough to cut, approximately 3 to 3-1/2 inches tall, and root growth is sufficient. Repeat mowing to maintain specified height without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet.

3.7 SATISFACTORY TURF

- A. Turf installations shall meet the following criteria as determined by Owner:
 - 1. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.
 - 2. Provide at minimum three (3) mowings in accordance with grass height requirements.
- B. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.

3.8 PESTICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents in accordance with requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- B. Post-Emergent Herbicides (Selective and Non-Selective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations.
- C. Notification signage must be posted at every entrance in a highly visible location at least five (5) days in advance of application and maintained five (5) business days following application, or as recommended by the manufacturers instructions, whereby it is then removed from the site.
 - 1. Notification Signage shall be brightly colored, laminated and at least 8.5" by 11" format including the following information:
 - a. Date of Notification.
 - b. Date of Application.
 - c. Name of Chemical.
 - d. Reason for Chemical Application.
 - e. Information informing as to the precautions that must be taken including humans and pets.

3.9 CLEANUP AND PROTECTION

- A. Do not allow soil and debris created by turf work onto permeable unit paving areas. Promptly clean up any soil or debris on impervious paving areas, such as concrete sidewalk or roadway paving. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Protection of newly planted lawn areas is critical to healthy establishment. Erect temporary protection fencing and warning signs to protect newly planted areas from traffic. Maintain fencing throughout initial maintenance period. Remove protection fencing only after lawn areas have become well established and are able to tolerate regular use. Install temporary protection fencing and signage in accordance with the following:
 - 1. Temporary Protection Fencing
 - a. Fencing shall cordon off the entire perimeter of lawn area to prevent access.
 - b. Fencing shall be supported securely as required to remain erect for duration of site protection. Utilize heavy-duty 12 gauge minimum metal fence posts spaced at 6 to 8 feet on center, or as required. Posts shall be driven into the soil sufficient depth to support fencing against heavy wind load.
 - c. Fencing shall be at least 4-foot high. Secure fencing to posts at the top and bottom and in at least one location in the middle with zip or cable ties. Fencing

- may also be woven through each post and secured at the top only with a zip tie.
2. Signage: Notification signage shall be brightly colored, laminated and at least 8.5” by 11” format attached to fencing every 10 to 12 feet, including the following information.
 - a. “Please keep off lawn areas. Lawn will be available once protection fencing has been removed.”
- C. If utilized, remove non-degradable erosion-control measures after grass establishment period.

END OF SECTION

SECTION 329300 – Plants

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes:

1. Provide trees, shrubs, perennials, ornamental grasses, ferns, groundcovers and all necessary accessories.
2. Mulch.
3. Maintenance and replacement during Establishment Period.

1.2 RELATED SECTIONS

A. Section 329110 – Vegetated Roof Assembly

1.3 REFERENCES

A. The following apply to work in this Section:

1. ASNS: "American Standard for Nursery Stock," latest edition, published by the American Nursery and Landscape Association.
2. NAA: "National Arborist Association Standards for Pruning", latest edition, published by the National Arborist Association.
3. ANSI: "American National Standards Institute", latest edition.

1.4 SUBMITTALS

A. Certifications: Submit certificate with names of materials and manufacturer.

1. Plants: Furnish certificates of inspection as may be required by Federal, State or other authorities that plants are free of disease or hazardous insects.
2. Commercial fertilizers: Include guaranteed analysis.
3. Ground limestone: include guaranteed analysis and weight for packaged material.
4. Commercial fertilizers: include guaranteed analysis.

B. Instructions: Submit planting and maintenance schedule.

1. Submit the proposed planting installation schedule indicating dates for tagging and installation, dates and duration of plant storage at an off-site location, and a detailed program of Establishment Period maintenance.

C. Product data: Submit product literature or tear sheets with name of product, and manufacturer.

1. Commercial fertilizer.
2. Mulch.

D. Samples: Submit loose materials in sealed bags labeled with name of material and manufacturer.

1. Mulch, 1/2 lb. bag.

E. Source of supply: Submit in writing all proposed sources.

1. Locate trees and make all pre-selection arrangements at the source of supply required to ensure an efficient selection procedure. Landscape Architect, with Contractor present, will select plants at nursery on the basis of their compliance with the Drawings. Contractor shall inspect the selected plants on the basis that the plants are free of disease and otherwise conform to the requirements of the Contract Documents. The accuracy of the varieties of

species specified for plant material shall be the Contractor's responsibility. Request visit at least 14 days in advance of desired inspection date.

- a. Trees will be inspected and approval given by Landscape Architect at the source for conformity to Specification requirements. Such approval shall not affect the right of inspection and rejection during delivery and installation.
- b. All trees specified as B&B must be in the ground at the growing source at the time of inspection. Pre-dug trees shall not be acceptable.

1.5 QUALITY ASSURANCE

- A. Contractor shall have had experience with at least two (2) other projects of similar scope and complexity and shall perform work with personnel totally familiar with planting installation and general construction techniques under the supervision of an experienced landscape foreperson.
- B. Plants: Meet or exceed applicable AAN standards:
 1. Plant List: Investigate sources of supply prior to submitting bid. Confirm that size, variety and quantity of plants specified on Plant List can be supplied. Failure to take this precaution shall not relieve the successful bidder from responsibility for furnishing and installing all plants in strict accordance with Contract requirements.
 - a. Substitutions shall not be permitted unless substantiated written proof is supplied that a specified plant is not obtainable. In this situation a proposal to use the nearest equivalent size or variety with an equitable adjustment of Contract Price will be considered.
 - b. Plant substitutions will be permitted only upon approval by the Owner and Landscape Architect.
 - c. All plants shall be grown on their own roots. No grafted species shall be acceptable.
 - d. Plants shall be of the quantity and quality indicated, true to name, properly labeled with botanical name and in accordance with the sizes and grades specified.

1.6 PROJECT CONDITIONS

- A. Protection of existing conditions adjacent to and within construction zone.
 1. All necessary precautions for safety including barricades and other protection measures shall be taken during all work.
 2. All heavy equipment shall be driven or parked on the site only where approved by Owner.
 3. Existing pavements, structures, walls, etc. damaged or disturbed during construction shall be repaired or replaced to the satisfaction of the Owner.
 4. Repair and replace all active utility lines, above and below grade, damaged in the course of construction operations.
 5. Avoid damaging existing trees. Damage includes but is not limited to: cutting, breaking, skinning or compacting of roots, skinning and bruising of bark and breaking of branches and limbs.
 - a. Contractor shall not park or store equipment and supplies within four (4) feet of trunk of existing trees to remain.
- B. Environmental requirements:
 1. Plant only within the following dates, weather permitting. Do not plant when ground is frozen, when the soil is excessively wet, when ambient air temperature exceeds 85 degrees or in otherwise unsatisfactory weather conditions.
 - a. Plant trees and shrubs between March 1 and June 15 and August 15 until the ground freezes.
 - b. Plant trees known to be fall digging hazards only in the Spring.

2. Chemical Spraying Program: no spraying of herbicides, insecticides, fungicides, nematicides, fumigants or other chemicals shall be done without first submitting a spray program to the Owner.
3. Seed only between April 1 - May 15 and September 1 - October 15, unless otherwise permitted by the Owner.
4. Do not seed during adverse weather, windy conditions or on wet or frozen ground.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Maintenance period includes three (3) years of maintenance as outlined below:
 1. Meadow maintenance personnel must be familiar with and able to visually identify desirable and undesirable plant species.
 2. Meadow maintenance procedures and scheduling must be coordinated with the Owner.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Packaged materials: Deliver packaged materials in clearly marked containers showing net weight, guaranteed analysis and name of manufacturer. Specified requirements for packaged materials apply to bulk shipments. Protect materials from deterioration during delivery and during storage at site.
 1. Deliver fertilizer in waterproof bags.
 2. All seed shall be labeled to show compliance with requirements of governmental agencies having jurisdiction. All bag tags of seed used shall be retained and if requested, submitted to Owner. Seed shall be kept in dry storage away from contaminants, insects and rodents.
- B. Plants: Notify Owner seven (7) days in advance of any delivery of plants to site.
 1. Dig and handle trees with care to prevent injury to trunks, branches and roots. Do not prune prior to delivery. Do not bend or bind-tie trees in such manner as to damage bark, break branches or destroy natural shape. Pack and ship to ensure arrival at site in good condition. Provide protective covering during delivery. Plants with cracked or broken root balls shall not be accepted.
 2. Deliver plants after preparation of planting areas has been completed and approved, install plants immediately.
 - a. If planting is delayed more than eight (8) hours after delivery, set balled and burlapped plants on the ground well protected with soil, wet mulch or other acceptable material. Protect balls and roots, and container grown material from freezing, sun, drying winds and/or mechanical damage. Water as necessary until planted.
 - b. Do not heel in plants for more than five business days.
 3. Immediately remove rejected plants from site.
 4. Each tree, shrub, perennial container and groundcover flat shall be labeled by grower with botanical plant name and size.
 - a. Plant identification labels shall be durable and waterproof and securely attached to plants or containers. Do not remove labels until final acceptance.

1.8 INSPECTION FOR SUBSTANTIAL COMPLETION

- A. Trees and shrubs:
 1. All trees and shrubs shall be alive, healthy and installed to be accepted.
 2. Guarantee Period for trees and shrubs shall not begin until all items have been completed or corrected.
- B. Ground cover, grasses and perennials:

1. All ground cover shall show a uniform or appropriate coverage.

1.9 GUARANTEE / ESTABLISHMENT PERIOD FOR PLANTS

- A. Contractor shall not be held responsible for acts of vandalism occurring after the beginning of Guarantee Period, nor shall Contractor be held responsible for deleterious effects caused by maintenance procedures performed by Owner without concurrence of Contractor.
- B. Replace at no additional cost for a period of two growing seasons after the beginning date of Guarantee Period, any plants that have died or that are, in the opinion of Owner, in unhealthy or unsightly condition, or that have lost their natural shape due to dead branches, excessive pruning, excessive defoliation.
 1. A growing season is defined as the period during which plant growth takes place from last killing frost of Spring to the first killing frost of Autumn.
 2. Replace unacceptable plants no later than the next succeeding planting season. All replacements shall have a guarantee of one planting season from date of replacement.
 - a. Replace unacceptable plants in accordance with original Specification. Cost is considered to be included in the Bid and Contract Price

PART 2 – PRODUCTS

2.1 PLANTS

- A. Provide freshly dug plants nursery grown in accordance with good horticultural practice.
 1. Sound, healthy and vigorous, well-branched and fully foliated when in leaf, free from disease, insect pests, eggs or larvae with healthy well developed root systems.
- B. Conform to measurements specified on Plant List. Plants shall be measured before pruning, with branches in normal position. Any necessary pruning shall be done at time of planting. Requirements for the measurement, branching, grading, quality, balling, and burlapping of plants shall be in accordance with standards specified in ASNS and conform to ANSI Z.60.1.
- C. Provide B&B stock with a compact natural ball of earth, firmly wrapped and tied in burlap so that upon delivery the soil in the ball is still firm and compact about the small feeding roots. Root ball sizes shall be in accordance with standards specified in ASNS.
- D. Furnish trees and shrubs with rootballs measured from top of rootball which shall begin at root flare according to ANSI Z60.1. Root flare shall be visible before trees are dug to ensure proper rootball depth.
- E. Plants shall be measured before pruning, with branches in normal position. Any necessary pruning shall be done at time of planting. Requirements for the measurement, branching, grading, quality, balling, and burlapping of plants shall be in accordance with standards specified in ASNS.
- F. All container grown shrubs, perennials, grasses and groundcovers shall be healthy, vigorous, well rooted and established in the container in which they are sold. Plant development shall be sufficient so that the root mass will hold together when removed from the container.

2.2 STAKING AND GUYING MATERIALS

- A. Product: D-MAN® Anchor System - Plati-Mat®, model RF2PDMAN including all required components, manufactured by Platipus Tree Anchoring Systems, 1902 Garner Station Boulevard, Raleigh, NC 27603, 919-662-0991, info@platipus.us.
- B. Provide additional sleepers or anchoring devices as required for complete installation and stabilization of trees.

2.3 LIMESTONE

- A. In accordance with soil test recommendations, provide ground, high magnesium limestone containing not less than 85% total carbonates, 95% passing a 20 mesh sieve, 40% passing a 60 mesh sieve and a minimum of 30% percent passing a 100 mesh sieve.

2.4 MULCH

- A. Double shredded hardwood bark. To be natural in color, free of dye.

2.5 WATER

- A. Potable, clean fresh and free from harmful materials.

2.6 HERBICIDES

- A. Herbicides, fungicides, and pesticides: Approved before use for type and rate of application by Owner and local, state and/or federal agencies with jurisdiction. Spraying of all herbicides shall be done in accordance with the Chemical Spraying Program.

- 1. Non-selective herbicide shall be Round-Up as manufactured by Monsanto or approved equal.

- B. A standard complete slow release fertilizer. At least 50% by weight of the nitrogen content of the fertilizer shall be derived from organic materials with the remainder in urea form or equivalent. Fertilizer shall contain percent nitrogen, phosphorous, and potash by weight of ingredients dictated by the topsoil test results.

- 1. Fertilizer shall be in bags showing weight, analysis, and manufacturer's name.

2.7 PROTECTION MATERIALS

- A. Wood stakes, suitable in length so that 30" minimally is exposed above ground.
- B. Durable twine with fluorescent flagging.
- C. Rigid 5-foot (60") tall round polyethylene tubes with pre-fitted, releasable ratchet ties used to fasten the tube to a hardwood stake.

- 1. Products: 60" Miracle Tree Tube Tree Shelter with pre-inserted releasable zip ties as manufactured by Tree Pro, 3180 W 250N, West Lafayette, IN, 47906, 1-800-875-8071, or approved equal.

- 2. Hardwood stake shall be 20-inch by 2-inch with length equal to the tree shelter height with adequate embedment into the ground to firmly secure the stake and shelter against buck rub.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify that previously installed protection measures are in place.
- B. Verify that excavation and grading is complete.
- C. Do not begin planting and lawn work until all other work is complete. Planting areas shall be free of waste and debris generated by other construction activities.
- D. Beginning installation means acceptance of existing conditions.

3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by seeding operations.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3

A. Planting Pits:

1. Verify by testing that planting areas are free draining. If planting areas are not free draining notify Owner and submit alternative method of drainage for approval.
2. Stake out location of trees and shrubs.
 - a. Completely layout planting areas before seeking approval by Landscape Architect and Owner.
3. Planting pits in plant beds shall be excavated to the depth of the rootball and trees shall be planted on undisturbed soil.
 - a. Tree pit excavations shall be circular with vertical sides.
 - b. Install sand, as minimally required, to create a leveling bed under root balls of trees.
 - c. Install 18" of planting soil continuously in plant beds or as indicated on Drawings.
4. Remove all existing materials from tree pits and scarify bottom and sides of planting pits and beds.
5. If an impervious hard pan layer exists in the bottom of the pit after excavation, the pits shall be excavated to the depth of the hardpan or 36 inches below the bottom of the ball. Pit shall then receive a 6 inch layer of AASHTO 57 stone, covered with straw or similar material. Remainder of pit shall be backfilled with topsoil as specified.

3.4 PLANT INSTALLATION

A. Planting trees, shrubs and herbaceous plants:

1. Do not plant until trees and shrubs and planting pits have been approved by Owner and Landscape Architect.
2. Plant trees to a depth such that the bottom of the trunk flare is 1" above finished grade.
3. Plant upright and plumb and faced to give the best appearance or relationship to adjacent plants and structures.
4. Do not pull burlap out from under balls. Remove platforms, wire and surplus binding to the greatest extent possible. Remove burlap from the top and sides of the rootball to the greatest extent possible. Cleanly cut off all broken or frayed roots.
5. Remove all plastic containers. Inspect container plants for circling or girdling roots and vertically score rootballs to promote feeder root growth.
6. Remove all non-biodegradable materials from the planting area.
7. Carefully place planting soil in six (6) inch lifts to avoid injury to roots and to fill all voids. Firmly tamp each lift to prevent settlement.
8. When the planting area is nearly filled, water and allow to soak away. If planting soil settles after watering, add more planting soil to bring to required level.
9. Upon completion of planting operations, water plants thoroughly over the entire planting bed until fully saturated.
 - a. Apply water slowly to ensure penetration into the entire root system.
10. Mulch within two (2) days of planting. Install two (2) inches of mulch over tree rootballs, and continuously over entire planting beds. Keep mulch at least 2 inches away from tree trunk.
11. Staking and guying shall be done immediately after trees are planted. Trees shall stand plumb after staking.

- a. Provide a minimum of two (2) stakes per tree
 12. Neatly prune trees and shrubs to remove broken or badly bruised branches with a clean cut in accordance with NAA standards, and at the time designated by, and to the satisfaction of Owner.
 - a. Preserve the plant's natural character,
 - b. Perform pruning with clean, sharp tools.
- 3.5 PLANT MAINTENANCE PRIOR TO SUBSTANTIAL COMPLETION
- A. Begin maintenance immediately after each planting area is installed.
 1. Provide all care necessary to keep trees and shrubs healthy including but not limited to: watering, mulching, weeding, fertilizing, pruning and spraying.
 2. During periods of inadequate rainfall, as determined by the Owner, all plants shall be watered to maintain a constant suitable moisture level for good plant growth. Contractor shall provide all watering hoses and devices. Owner will provide water source.
 3. Weed control shall be by mechanical or hand weeding.
 4. Use of herbicides, insecticides, fungicides, nematocides, fumigants or other chemicals are only acceptable upon approval by the Owner.
 - B. Prior to inspection for Substantial Completion remove all excess soil and debris from site and repair damage resulting from planting operations.
- 3.6 PLANT GUARANTEE / ESTABLISHMENT PERIOD
- A. The Establishment Period will begin upon notice of substantial completion by the Owner.
 - B. Contractor shall guarantee the plants against defects including death and unsatisfactory growth. Guarantee shall include the purchase of the plants, the rental of any required special equipment necessary to place the plants and the installation of the plants. Contractor shall not be liable for vandalism out of Contractor's control.
 - C. New plants installed during the Establishment Period shall carry a new establishment period guarantee equal to the original that begins at the time of acceptance of the replacements plant(s). Replacement and repair work shall be re-inspected by the Owner.
 - D. At the end of the Plant Establishment Period, Owner shall make an inspection to determine that all plants are living and healthy. Any replacement of plants at this time shall be made according to the specifications for that type of plant. New plants installed as part of the original two-year guarantee, shall carry a new one-year guarantee period that begins at the time of acceptance of the replacement plant(s). Any replacement and repair work that is required shall be re-inspected by the Owner.
- 3.7 PLANT MAINTENANCE DURING ESTABLISHMENT PERIOD
- A. General: Perform procedures set forth in the submitted and approved maintenance program for the duration of Guarantee Period.
 1. Inspect all trees at least once a month to locate any disease or pest infestations. If infestation is present, submit a proposed method of control to Owner for approval prior to application of control measures.
 2. Remove dead plants within five (5) business days of notification by Owner or the Owner will remove the plants and bill the Contractor accordingly.
 - a. Replacement plants may be installed during the next appropriate planting season.
 - b. Replacement plants shall be of the same species and size as specified in the Plant List.

3. Perform all maintenance procedures, including but not limited to: fertilizing, watering, weeding, and mulching.
 - a. Prune, as necessary, to remove dead, diseased and damaged branches.
 - b. During periods of inadequate rainfall, all plants shall be watered to maintain a constant suitable moisture level for adequate plant growth. Apply water slowly so as to penetrate the entire root zone. Contractor shall provide water hoses. The Owner shall provide the water source.
 - c. Completely remove, by hand pulling, all weeds within mulch areas. Under no circumstances are weeds to attain more than two (2) inches of growth. Herbicide use is acceptable with Owner approval.
 - d. Restore mulch around trees as necessary to preserve their appearance and to control weed growth.
 - e. If refertilizing of trees is required, apply Ra-Pid-Gro at manufacturer's suggested rate.
 - f. If any tree settles from its proper elevation, raise it to the proper level.
 - g. If spraying to control insects, fungus, and other diseases is required seek approval from Owner before spraying. Furnish a spray program and product information on all sprays to be used to Owner for approval. After approval, application will only be permitted by licensed applicators. Applicators shall follow Notification requirements and report any Chemical Hypersensitivity Registries for the area.

3.8 FINAL ACCEPTANCE

- A. At end of Establishment Period, submit a written request to the Owner for Inspection for Final Acceptance at least two (2) weeks prior to the day on which inspection is requested.
- B. At the end of the Establishment Period, Owner and Contractor shall make an inspection to determine that all plants are living and healthy. Any plant that is dead or not in satisfactory condition, as determined by the Owner, shall be removed from the site and replaced in accordance with the specifications.

END OF SECTION 329300