



Veterans Park East Lobe Expansion

February 2026

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SECTION 01019
MOBILIZATION AND DEMOBILIZATION

PART 1 GENERAL

1.1 DESCRIPTION

- A. Mobilization consists of preparatory Work and operations, including those necessary for movement of personnel, equipment, supplies and incidentals to and within the Work Area; the cost of bonds and any required insurance; and other pre-construction expenses necessary for start of the Work. All equipment transported to the Site by barge must be floating at all times during the transit to and from the Site of Work, i.e., no grounding of equipment will be permitted during transit.

1.2 ARBITRARY MOBILIZATION BY CONTRACTOR

- A. The Owner will pay for the Schedule of Values Bid Item No. 1 "Mobilization and Demobilization" only once. Should the Contractor demobilize prior to completing the project, such demobilization and subsequent remobilization shall be at no additional cost to the Owner.

1.3 RATIO OF MOBILIZATION AND DEMOBILIZATION

- A. Mobilization and Demobilization is a lump sum price, but will be paid to the Contractor on a percentage basis upon completion of mobilization to the Work Area for that particular pay period.

1.4 JUSTIFICATION OF MOBILIZATION COSTS

- A. In the event that the Owner considers the amount of this item does not bear a reasonable relation to the cost of the Work in this Contract, the Owner may require the Contractor to produce cost data to justify this portion of the Bid. Failure to justify such price to the satisfaction of the Owner will result in payment of actual mobilization costs, as determined by the Owner at the completion of mobilization, and actual demobilization costs at the completion of demobilization, and payment of the remainder of this item in the final payment under this Contract. The determination of the Owner is not subject to appeal.

PART 2 PRODUCTS

2.1 NOT USED

PART 3 EXECUTION

3.1 NOT USED

- 3.2 Seeding: Seeding to protect disturbed areas shall occur as soon as reasonably possible following completion of that earthwork activity.

PART 4 MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

- A. No specific unit of measurement will apply to the lump sum Schedule of Values Bid Item No. 1 "Mobilization and Demobilization".

4.2 PAYMENT

- A. All costs associated with mobilization and demobilization of the entire Contractor's plant, equipment, personnel, and those of his/her Subcontractors and such others costs as may be denoted in the Contract Documents shall be paid for at the Contract lump sum price for Schedule of Values Bid Item No. 1 "Mobilization and Demobilization".

END OF SECTION 01019

SECTION 01050
EROSION-POLLUTION CONTROL

PART 1 GENERAL

1.1 SCOPE

- A. The work consists of installing measures or performing work to control erosion and minimize the production of sediment and other pollutants to water and air from construction activities.

1.2 MATERIAL

- A. All material furnished shall meet the requirements of the Erosion Control Plan in the Construction Documents.

1.3 EROSION AND SEDIMENT CONTROL MEASURES AND WORKS

- A. The measures and works shall include, but are not limited to, the following:
- Staging of earthwork activities: The excavation and moving of soil materials shall be scheduled to minimize the size of areas disturbed and unprotected from erosion for the shortest reasonable time.
 - Seeding: Seeding to protect disturbed areas shall occur as soon as reasonably possible following completion of that earthwork activity.
 - Mulching: Mulching to provide temporary protection of the soil surface from erosion.
 - Diversions: Diversions to divert water from work areas and to collect water from work areas for treatment and safe disposition. They are temporary and shall be removed and the area restored to its near original condition when the diversions are no longer required or when permanent measures are installed.
 - Stream crossings: Culverts or bridges where equipment must cross streams. They are temporary and shall be removed and the area restored to its near original condition when the crossings are no longer required or when permanent measures are installed.
 - Sediment basins: Sediment basins collect, settle, and eliminate sediment from eroding areas from impacting properties and streams below the construction site(s). These basins are temporary and shall be removed and the area restored to its original condition when they are no longer required or when permanent measures are installed.

- Sediment filters: Straw bale filters or geotextile sediment fences trap sediment from areas of limited runoff. Sediment filters shall be properly anchored to prevent erosion under or around them. These filters are temporary and shall be removed and the area restored to its original condition when they are no longer required or when permanent measures are installed.
- Waterways: Waterways for the safe disposal of runoff from fields, diversions, and other structures or measures. These works are temporary and shall be removed and the area restored to its original condition when they are no longer required or when permanent measures are installed.
- Other: Additional protection measures as required by Federal, State, or local government.

1.4 CHEMICAL POLLUTION

- A. The contractor shall provide watertight tanks or barrels or construct a sump sealed with plastic sheets to dispose of chemical pollutants, such as drained lubricating or transmission fluids, grease, soaps, concrete mixer washwater, or asphalt, produced as a by-product of the construction activities. At the completion of the construction work, sumps shall be removed and the area restored to its original condition. Sump removal shall be conducted without causing pollution.
- B. Sanitary facilities, such as chemical toilets, or septic tanks shall not be located next to live streams, wells, or springs. They shall be located at a distance sufficient to prevent contamination of any water source. At the completion of construction activities, facilities shall be disposed of without causing pollution.

1.5 AIR POLLUTION

- A. The burning of brush or slash and the disposal of other materials shall adhere to state and local regulations.
- B. Fire prevention measures shall be taken to prevent the start or spreading of wildfires that may result from project activities. Firebreaks or guards shall be constructed and maintained at locations shown on the drawings.
- C. All public access or haul roads used by the contractor during construction of the project shall be sprinkled or otherwise treated to fully suppress dust. All dust control methods shall ensure safe construction operations at all times. If chemical dust suppressants are applied, the material shall be a commercially available product specifically designed for dust suppression and the application shall follow manufacturer's requirements and recommendations. A copy of the product data sheet and manufacturer's recommended application procedures shall be provided to the engineer 5 working days before the first application.

1.6 MAINTENANCE, REMOVAL, AND RESTORATION

- A. All pollution control measures and temporary works shall be adequately maintained in a functional condition for the duration of the construction period. All temporary measures shall be removed and the site restored to near original condition.

END OF SECTION 01050

SECTION 01110 CLEARING AND GRUBBING

PART 1 GENERAL

1.1 DESCRIPTION

- A. Clear and grub within the areas shown in the Plans. Remove and dispose of all trees, stumps, roots and other such protruding objects, buildings, structures, appurtenances, existing flexible asphalt pavement, concrete, and other facilities necessary to prepare the area for the proposed construction. Remove and dispose of all product and debris not required to be salvaged or not required to complete the construction. Perform miscellaneous work necessary for the complete preparation of the overall project site as specified in 110-10.

PART 2 STANDARD CLEARING AND GRUBBING

- A. Work Included: Completely remove and dispose of all buildings, timber, brush, trees, stumps, roots, rubbish, debris, tree trimming, sawcutting, existing flexible pavement and base, drainage structures, culverts, and pipes. Remove all other obstructions resting on or protruding through the surface of the existing ground and the surface of excavated areas.
- B. Perform standard clearing and grubbing within the following areas:
- All areas where excavation is to be done, including borrow pits, lateral ditches, right-of-way ditches, etc.
 - All areas where roadway embankments will be constructed.
 - All areas where structures will be constructed, including pipe culverts

2.1 DEPTHS OF REMOVAL OF ROOTS, STUMPS, AND OTHER DEBRIS

- A. In all areas where excavation is to be performed, or roadway embankments are to be constructed, remove roots and other debris to a depth of 12 inches below the ground surface. Remove roots and other debris from all excavated material to be used in the construction of roadway embankment or roadway base. Plow the surface to a depth of at least 6 inches, and remove all roots thereby exposed to a depth of at least 12 inches. Completely remove and dispose of all stumps within the roadway right-of-way.
- Remove all roots, etc., protruding through or appearing on the surface of the completed excavation within the roadway area and for structures, to a depth of at least 12 inches below the finished excavation surface.

- Remove or cut off all stumps, roots, etc., below the surface of the completed excavation in borrow pits, material pits, and lateral ditches.
- In borrow and material pits, do not perform any clearing or grubbing within 3 feet inside the right-of-way line.
- Within all other areas where standard clearing and grubbing is to be performed, remove roots and other debris projecting through or appearing on the surface of the original ground to a depth of 12 inches below the surface, but do not plow or harrow these areas.

2.2 BOULDERS

- A. Remove any boulders encountered in the roadway excavation (other than as permitted under the provisions of 120-7.2) or found on the surface of the ground. When approved by the Engineer place boulders in neat piles inside the right of way. The Contractor may stockpile boulders encountered in Department-furnished borrow areas, which are not suitable for use in the embankment construction, within the borrow area.

2.3 ASBESTOS CONTAINING MATERIALS (ACM) NOT IDENTIFIED PRIOR TO WORK

- A. When encountering or exposing any condition indicating the presence of asbestos, cease operations immediately in the vicinity and notify the Engineer, in accordance with 110-6.5.

PART 3 SELECTIVE CLEARING AND GRUBBING

3.1 GENERAL

- A. Remove and dispose of vegetation, obstructions, etc., as shown in the Plans. Provide acceptable fill material, and grade and compact holes or voids created by the removal of the stumps. Perform all selective clearing and grubbing in accordance with ANSI A300.
- B. No staging, storing, stockpiling, parking or dumping will be allowed in selective clearing and grubbing areas. Only mechanical equipment related to selective clearing and grubbing activities will be allowed in selective clearing and grubbing areas. Protect trees to remain from trunk, branch and root damage.

3.2 PROTECTION OF PLANT PRESERVATION AREA

- A. Areas to remain natural may be designated in the Plans. No clearing and grubbing, staging, storage, stockpiling, parking or dumping is allowed in these areas. Do not bring equipment into these areas.

3.3 TREE PROTECTION BARRIER

- A. Construct a tree protection barrier in accordance with FDOT Standard Plans Index 110 100 and the Plans. Maintain barrier for duration of the Contract.

3.4 TREE ROOT AND BRANCH PRUNING

- A. When pruning cuts or root pruning to existing trees are shown in the Plans, work is to be supervised on site by an International Society of Arboriculture (ISA) Certified Arborist and performed in accordance with ANSI A300.

3.5 TREE REMOVAL

- A. Remove trees as shown in the Plans.

3.6 PROTECTION OF THE PROPERTY REMAIN IN PLACE

- A. Protect property to remain in place in accordance with 7-11.

3.7 REMOVAL OF BUILDINGS

A. PARTS TO BE REMOVED

- Completely remove all parts of the buildings, including utilities, plumbing, foundations, floors, basements, steps, connecting concrete sidewalks or other pavement, septic tanks, and any other appurtenances, by any practical manner which is not detrimental to other property and improvements. Remove utilities to the point of connection to the utility authority's cut-in. After removing the sewer connections to the point of cut-in, construct a concrete plug at the cut-in point, as directed by the Engineer, except where the utility owners may elect to perform their own plugging. Contact the appropriate utility companies prior to removal of any part of the building to ensure disconnection of services. Submit demolition schedule 15 working days before beginning any demolition or renovation of a building.

B. REMOVAL BY OTHERS

- Where buildings within the area to be cleared and grubbed are so specified to be removed by others, remove and dispose of any foundations, curtain walls, concrete floors, basements or other foundation parts which might be left in place after such removal of buildings by others.

3.8 REMOVAL OF EXISTING BRIDGES

- A. The work under this Article includes bridges, as defined below. Remove and dispose of the materials from existing bridges. Remove
- Those bridges and approach slabs, or portions of bridges, shown in the Plans to be removed,
 - Those bridges and approach slabs, or portions of bridges, found within the limits of the area to be cleared and grubbed, and directed by the Engineer to be removed,
 - Those bridges and approach slabs, or portion of bridges, which are necessary to be removed in order to complete the work, and
 - Other appurtenances or obstructions which may be designated in the Contract Documents to be included as an item of payment for the work under this Article. Submit schedule information and demolition plan for approval 15 working days before beginning any demolition or renovation of any structures.

3.9 METHOD OF REMOVAL

A. GENERAL

- Remove the structures in such a way so as to leave no obstructions to any proposed new bridge or to any waterways. Pull, cut off, or break off pilings to the requirements of the permit or other Contract Documents, or if not specified, not less than 2 feet below the finish ground line. In the event that the Plans indicate channel excavation to be done by others, consider the finish ground line as the limits of such excavation. For materials which are to remain the property of the Department or are to be salvaged for use in temporary bridges, avoid damage to such materials, and entirely remove all bolts, nails, etc. from timbers to be so salvaged. Mark structural steel members for identification as directed.

B. REMOVAL OF STEEL MEMBERS WITH HAZRDOUS COATING

- Submit to the Engineer for approval the "Contractor's Lead in Construction Compliance Program", QP2 certification from the Society for Protective Coatings (SSPC) from the firm actually removing and disposing of these steel members before any members are disturbed.
- Vacuum power tool cleans any coated steel member to bare metal as defined by SSPC-SP11 a minimum of 4 inches either side of any area to be heated (e.g. torch cutting, sawing, grinding, etc.) in accordance with 29 CFR 1926.354. Abrasive blasting is prohibited.

3.10 PARTIAL REMOVAL OF BRIGES

- A. On concrete bridges to be partially removed and widened, remove concrete by manually or mechanically operated pavement breakers, by concrete saws, by chipping hammers, or by hydro-demolition methods. Do not use explosives. Where concrete is to be removed to neat lines, use concrete saws or hydro-demolition methods capable of providing a reasonably uniform cleavage face. If the equipment used will not provide a uniform cut without surface spalling, first score the outlines of the work with small trenches or grooves. For all demolition methods, submit for review and approval of the Engineer, a demolition plan that describes the method of removal, equipment to be used, types of rebar splices or couplers, and method of straightening or cutting rebar. In addition, for hydro-demolition, describe the method for control of water or slurry runoff and measures for safe containment of concrete fragments that are thrown out by the hydro-demolition machine.

3.11 AUTHORITY OF U.S. COAST GUARD

- A. For bridges in navigable waters, when constructing the project under authority of a U.S. Coast Guard permit, the U.S. Coast Guard may inspect and approve the work to remove any existing bridges involved therein, prior to acceptance by the Department.

3.12 ASBESTOS CONTAINING MATERIALS (ACM) NOT IDENTIFIED PRIOR TO THE WORK

- A. When encountering or exposing any condition indicating the presence of asbestos, cease operations immediately in the vicinity and notify the Engineer. Make every effort to minimize the disturbance of the ACM. Immediately provide provisions for the health and safety of all jobsite personnel and the public that may be exposed to any ACM. Provisions shall meet all applicable Federal, State, and Local Rules and Regulations regarding potentially hazardous conditions due to ACM.
- B. The Engineer will notify the District Contamination Impact Coordinator (DCIC) who will engage the services of the Department's Contamination Assessment/Remediation Contractor (CAR). Provide access to the potential contamination area. Preliminary investigation by the CAR Contractor will determine the course of action necessary for site security and the steps necessary to resolve the contamination issue.
- C. The CAR Contractor will perform an asbestos survey to delineate the asbestos areas and identify any staging or holding areas that will be needed for assessment or abatement of the asbestos material.
- D. The CAR Contractor will maintain jurisdiction over activities within areas contaminated with ACM including staging and holding areas. The CAR Contractor will be responsible for the health and safety of workers within these delineated areas. Provide continuous access to these areas for the CAR Contractor and representatives of regulatory or enforcement agencies having jurisdiction.

- E. Coordinate with the CAR Contractor and Engineer to develop a work plan with projected completion dates for the final resolution of the contamination, in coordination with any regulatory agencies as appropriate. Use the work plan and schedule as a basis for planning the completion of all work efforts. The Engineer may grant Contract Time extensions according to the provisions of 8-7.3.2.
- F. Cooperate with the CAR Contractor to expedite integration of the CAR Contractor's operations into the construction project. Adjustments to quantities or to Contract unit prices will be made according to work additions or reductions on the part of the Prime Contractor in accordance with 4-3.
- G. The Engineer will inform the Prime Contractor when operations may resume in the affected area.

3.13 REMOVAL OF EXISTING CONCRETE

- A. Remove and dispose of existing rigid Portland cement concrete pavement, sidewalk, slope pavement, driveways, ditch pavement, curb, and curb and gutter, etc.,
- B. Remove all gravity walls, noise/sound walls, retaining walls, MSE walls, perimeter walls, and roadway concrete barriers, where shown in the Plans. All ancillary elements of these concrete features being removed including, but not limited to, leveling pads, copings, reinforcing steel or straps, footings, etc, are incidental and included in the cost of the removal.

3.14 OWNERSHIP OF MATERIALS

- A. Except as may be otherwise specified in the Contract Documents, take ownership of all buildings, structures, appurtenances, and other materials removed and dispose of them in accordance with 02110-9.

3.15 DISPOSAL OF MATERIALS

A. GENERAL

- Either stack materials designated to remain the property of the Department in neat piles within the right-of-way, load onto the Department's vehicles, or deliver to location designated in the Plans. Dispose of timber, stumps, brush, roots, rubbish, and other material resulting from clearing and grubbing in areas and by methods meeting the applicable requirements of all Federal, State and Local Rules and Regulations. Do not block waterways by the disposal of debris. With the approval of the Engineer, wood chips may be evenly distributed to a depth of no more than one inch in designated areas in the Department's right-of-way.

B. BURNING DEBRIS

- Contractor shall submit a request in writing for any burning debris. County to approval burning prior to the Contractor starting any burning.

C. TIMBER AND CORPS

- The Contractor may sell any merchantable timber, fruit trees, and crops that are cleared under the operations of clearing and grubbing for his own benefit, subject to the provisions of 7-1.2, which may require that the timber, fruit trees, or crops be burned at or near the site of their removal, as directed by the Engineer. The Contractor is liable for any claims which may arise pursuant to the provisions of this Subarticle.

D. DISPOSAL OF TREATED WOOD

- Treated wood must be handled and disposed of properly during removal. Treated wood should not be cut or otherwise mechanically altered in a manner that would generate dust or particles without proper respiratory and dermal protection. The treated wood must be disposed of in at least a lined solid waste facility or through recycling/reuse. Treated wood shall not be disposed by burning or placement in a construction and demolition (C&D) debris landfill.

E. HAZARDOUS MATERIALS/WASTE

- Handle, transport, and dispose of hazardous materials/waste in accordance with all Federal, State, and Local Rules and Regulations including, but not limited to, the following:
 - SSPC Guide 7
 - Federal Water Pollution Control Act, and
 - Resource Conservation and Recover Act (RCRA).
- Accept responsibility for the collection, sampling, classification, packaging, labeling, accumulation time, storage, manifesting, transportation, treatment, and disposal of hazardous materials/waste, both solid and liquid. Separate all solid and liquid waste and collect all liquids used at hygiene stations and handle as hazardous materials/waste. Obtain written approval from the Engineer for all hazardous materials/waste stabilization methods before implementation.
- Obtain an EPA/FDEP Hazardous Waste Identification Number (EPA/FDEP ID Number) before transporting and/or disposal of any hazardous materials/waste.
- List the Department as the generator for hazardous materials/waste resulting from removal or demolition of Department materials.

- Submit the following for the Engineers' approval before transporting, treatment or disposal of any hazardous materials/waste:
 - Name, address and qualifications of the transporter,
 - Name, address and qualifications of the treatment facility,
 - Proposed treatment and/or disposal of all Hazardous Materials/Waste.
 - EPA/FDEP Hazardous Waste Identification Number Application Form.
 - Manifest forms.
- Transport all hazardous materials/waste in accordance with applicable Federal, State, and Local Rules and Regulations including, but not limited to, the 40 CFR 263 Standards. Submit all final Hazardous Materials/Waste manifest/bills of lading and certificates of disposal to the Engineer within 21 days of each shipment.

F. STEEL MEMBERS WITH HAZARDOUS COATING

- Dispose of steel members with hazardous coating in one of the following manners:
 - Deliver the steel members and other hazardous waste to a licensed recycling or treatment facility capable of processing steel members with hazardous coating.
 - Deliver the steel members with hazardous coating to a site designated by the Engineer for use as an offshore artificial reef. Deliver any other hazardous materials/waste to a licensed hazardous materials/waste recycling treatment facility.
- Dismantle and/or cut steel members to meet the required dimensions of the recycling facility, treatment facility or offshore artificial reef agency.
- All compensation for the cost of removal and disposal of hazardous materials/waste will be included in the Cost of Removal of Existing Structures.

G. CERTIFICATION OF COMPLIANCE

- Submit certification of Compliance from the firm actually removing and disposing of the hazardous materials/waste stipulating, the hazardous materials/waste has been handled, transported and disposed of in accordance with this Specification. The Certification of Compliance shall be attested to by a person having legal authority to bind the company.

- Maintain all records required by this Specification and ensure these records are available to the Department upon request.

PART 4 MISCELLANEOUS OPERATIONS

4.1 WATER WELLS REQUIRED TO BE PLUGGED

- A. Fill or plug all water wells within the right-of-way, including areas of borrow pits and lateral ditches, that are not to remain in service, in accordance with applicable Federal, State, and Local Rules and Regulations.
- B. Cut off the casing of cased wells at least 12 inches below the ground line or 12 inches below the elevation of the finished excavation surface, whichever is lower. Water wells, as referred to herein, are defined either as artesian or non-artesian, as follows:
 - An artesian well is an artificial hole in the ground from which water supplies may be obtained and which penetrates any water-bearing rock, the water in which is raised to the surface by natural flow or which rises to an elevation above the top of the water-bearing bed. Artesian wells are further defined to include all holes drilled as a source of water that penetrate any water-bearing beds that are a part of the artesian water system of Florida, as determined by representatives of the applicable Water Management District.
 - A non-artesian (water-table) well is a well in which the source of water is an unconfined aquifer. The water in a non-artesian well does not rise above the source bed.

4.2 LEVELING TERRAIN

- A. Within the areas between the limits of construction and the outer limits of clearing and grubbing, fill all holes and other depressions, and cut down all mounds and ridges. Make the area of a sufficient uniform contour so that the Department's subsequent mowing and cutting operations are not hindered by irregularity of terrain. Perform this work regardless of whether the irregularities were the result of construction operations or existed originally.

4.3 MAILBOXES

- A. When the Contract Documents require furnishing and installing mailboxes, permit each owner to remove the existing mailbox. Work with the Local Postmaster to develop a method of temporary mail service for the period between removal and installation of the new mailboxes. Install the mailboxes in accordance with the FDOT Standard Plans.

PART 5 METHOD OF MEASUREMENT

5.1 CLEARING AND GRUBBING

A. LUMP SUM PAYMENT

- Price and payment will be full compensation for all clearing and grubbing required for the construction of the drainage and roadway items and ditches, channel changes, or other outfall areas, and any other clearing and grubbing indicated, or required for the construction of the entire project, including all necessary hauling, furnishing equipment, equipment operation, furnishing any areas required for disposal of debris, leveling of terrain, tree removal, and the landscaping work of trimming, etc.

B. PAYMENT ITEMS

- Payment may include but not limited to these items below be made under:
 - Clearing and Grubbing
 - Removal of Existing Bridges
 - Removal of Existing Concrete
 - Plugging Water Wells
 - Plugging Water Wells
 - Mailboxes
 - Tree Protection Barrier
 - Tree Root and Tree trimming
 - Tree Removal
 - Saw cutting
 - Disposal and Disposal Fees
 - Selective clearing around statues

END OF SECTION 01110

SECTION 01240
STABILIZED SUBGRADE

PART 1 GENERAL

1.1 SCOPE

- A. Where it fails to meet the specified Limerock Bearing Ratio (LBR) 40, stabilize the subgrade to the uniformity, density and bearing ratio specified hereinafter. Stabilize parking areas to a minimum depth of 12 inches below the bottom grade of the base material and to a width 6 inches outside each pavement or concrete curb edge. Stabilize roadways and streets to 12 inches unless otherwise indicated on the Drawings.
- B. Definitions: Use FDOT Type B stabilization as described hereinafter to obtain the required bearing ratio by the addition and mixing in of suitable stabilizing material.

PART 2 MATERIAL

2.1 GENERAL

- A. Use either Commercial Materials or Local Materials as defined hereunder, at the Contractor's option.
- B. Commercial Materials: Limerock, limerock overburden or crushed shell meeting the following requirements:
 - At least 97 percent by weight of the total material passing a 1 inch screen and at least 50 percent by weight of the total material retained on the No. 4 sieve.
 - Not more than 7.5 percent by weight of the total material passing the No. 200 sieve as determined by washing the material over the sieve
 - In the event that the shell meets the above requirements without crushing, crushing will not be required. The use of steamed shell will not be permitted.
- C. STABILIZATION
 - Determine bearing value by the Limerock Bearing Ratio (LBR) Method.
 - After grading operations are substantially complete, determine the quantity (if any) of selected stabilizing material to be added for compliance with the bearing value requirements.
 - Ensure that the finished subgrade meets the bearing value requirements, regardless of the quantity of stabilizing materials necessary to be added.

PART 3 EXECUTION

3.1 PREPARATION

A. GENERAL

- Prior to the beginning of stabilizing operations, complete the subgrade to the lines, grades and cross section shown in the plans.
- Stabilize the subgrade in one course, unless the equipment and methods being used do not provide the required uniformity, particle size limitation, compaction and other desired results, in which case, perform the processing in more than one course as approved by the Engineer.

3.2 APPLICATION

- A. Stabilizing Material: Spread the stabilizing material uniformly over the area to be stabilized by means of mechanical material spreaders, except that where use of such equipment is not practicable other means of spreading may be used, but only upon written approval of the Engineer.
- B. Mixing: By means of rotary tillers, or other equipment meeting the approval of the Engineer, thoroughly mix the subgrade throughout the entire depth and width of the area to be stabilized.
- C. Maximum Particle Size Of Mixed Materials: At the completion of mixing, check that all particles of material within the limits of the area to be stabilized pass a 3 ½-inch ring. Remove from the stabilized area any particles not meeting this requirement or break them down so as to meet this requirement.
- D. Compaction: After the mixing operations have been completed and requirements for bearing value, uniformity and particle size have been satisfied, compact the stabilized area to a density of not less than 98% of maximum density as determined by AASHTO T 180. Compact the materials at a moisture content permitting the specified compaction. If the moisture content of the material is improper for attaining the specified density, either add water or allow drying until the proper moisture content for the specified compaction is reached.
- E. Finish Grading: Grade and shape the completed stabilized subgrade to conform with the finished lines, grades and cross-section indicated in the Drawings.
- F. Quality Assurance:
 - After the stabilizing and compacting operations have been completed, check that the subgrade is firm and substantially unyielding, to the extent that it will support construction equipment and will have the bearing value required.

- Remove and replace with suitable material all soft and yielding material, and any other portions of the sub-grade which will not compact readily, and bring the whole subgrade to line and grade, with proper allowance for subsequent compaction.
- G. Maintenance Of Completed Subgrade: Upon completion, maintain the subgrade free from ruts, depressions and any damage resulting from the hauling or handling of materials, equipment, tools, etc. Maintain the required density until the subsequent base or pavement is in place. Make any repairs, replacement, etc., of curb and gutter, sidewalk, etc., which might become necessary in order to recompact the subgrade in the event of underwash or other damage. Construct and maintain ditches and drains as necessary to protect the completed subgrade from damage by storm water.

3.3 FIELD QUALITY CONTROL

A. Bearing Value Requirements:

- General: Obtain bearing value samples and provide test results to the Engineer at completion of satisfactory mixing of the stabilized area. For any area where the bearing value obtained is deficient from the value indicated in the Drawings, in excess of the tolerances established herein, spread and mix in additional stabilizing material as specified above for the full width of the roadway being stabilized and longitudinally for a distance of 50 feet beyond the limits of the area in which the bearing value is deficient. Pay for all retesting required until subgrade meets the specified requirements.
- Tolerances In Bearing Value Requirements: A undertolerance of 5.0 from the specified bearing value of LBR 40 will be allowed as based on tests performed on samples obtained after mixing operations have been completed.

END OF SECTION 01240

SECTION 01300
EARTHWORK

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.
- B. Florida Department of Transportation, Standard Specifications for Road and Bridge Construction (FDOT Specs), Section 120, latest edition. Work shall comply with requirements of FDOT Specs as modified herein.
- C. General Exceptions: Any reference to FDOT Standard Specifications for Road and Bridge Construction (latest edition) Division I General Requirements & Covenants shall be excluded and not applicable to any specification referred herein, or otherwise listed in this document.

1.2 SUMMARY

- A. This Section includes preparing and grading sub-grades for pavements and curbs.
- B. The following Sections contain requirements that relate to this Section.
 - Section 110 "Clearing & Grubbing" for clearing, grubbing, and tree protection.

1.3 DEFINITIONS

A. EXCAVATION

- The removal of material encountered to sub-grade elevations and the reuse or disposal of materials removed.

B. SUB-GRADE

- The uppermost surface of an excavation or the top surface of a fill or backfill immediately below sub-base, base, drainage fill, or topsoil materials.

C. BORROW

- Soil material obtained off-site when sufficient approved soil material is not available from excavations.

D. SUBBASE COURSE

- The layer placed between the subgrade and base course in a paving system or the layer placed between the subgrade and surface of a pavement or sidewalk or the existing layer beneath this base.

E. BASE COURSE

- The layer placed between the subbase and surface pavement in a paving system.

F. UNAUTHORIZED EXCAVATION

- Removing materials beyond indicated subgrade elevations or dimensions without direction by the Engineer. Unauthorized excavation, as well as remedial work directed by the Engineer, shall be at the Contractor's expense.

G. STRUCTURES

- Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below ground surface.

H. UTILITIES

- On-site above ground utilities, overhead utilities and underground utilities including: pipes, conduits, ducts, and cables, as well as related appurtenances and underground services within building lines.

I. UNSUITABLE MATERIAL

- Any material such as muck, wood, rock, organic peat, garbage, very fine soil particles unsuitable for compaction, and any other material that is considered unsuitable by the County or its representative shall be considered unsuitable.

J. TOPSOIL

- Topsoil is defined as friable clay loam surface soil found normally to a depth of at least 4 inches. Satisfactory topsoil is reasonably free of subsoil, clay lumps, stones, and other objects over 2 inches in diameter, and without weeds, roots, and other objectionable material.

1.4 SUBMITTALS

A. GENERAL

- Submit the following in accordance with Section 1300, "Submittals and the General Conditions."

B. PRODUCT DATA AND SAMPLES OF THE FOLLOWING

- 1-lb representative samples of each proposed fill and backfill soil material from borrow sources as selected by the Engineer.
- 12-by-12-inch sample of filter fabric.

C. Test Reports: In addition to test reports required under field quality control, submit the following original copy directly to the Engineer from the testing services, with a copy to the Contractor:

- Laboratory analysis of each soil material proposed for fill and backfill from borrow sources.
- One optimum moisture-maximum density curve for each soil material.
- Report of actual unconfined compressive strength and/or results of bearing tests of each stratum tested.

1.5 QUALITY ASSURANCE

A. CODES AND STANDARDS

- Perform earthwork complying with all requirements of authorities having jurisdiction. All material and construction methods shall be in accordance with the Standard Specifications for Road and Bridge Construction, State of Florida, Department of Transportation, latest edition.

B. TESTING AND INSPECTIONS SERVICE

- During earthwork operations employ, at the Contractor's expense, a qualified independent geotechnical engineering testing agency, under the direction of a Professional Engineer, licensed in the State of Florida to classify, perform soil tests, and provide inspection services for quality control. All proposed borrow soils will require the testing agency to verify that soils comply with specified requirements and to perform required field and laboratory testing. Contractor shall replace materials removed for testing purposes. Should any work or materials fail to meet the requirements set forth in the plans and specifications, contractor shall pay for re-testing of same.

C. TESTING LABORATORY QUALIFICATIONS

- To qualify for acceptance, the geotechnical testing laboratory must demonstrate to the Engineer's satisfaction, based on evaluation of laboratory-submitted criteria, that it has the experience and capability to conduct required field and laboratory geotechnical testing without delaying the progress of the work.

1.6 PROJECT CONDITIONS

A. SITE INFORMATION

- Data in the subsurface investigation report was used for the basis of the design and are available to the contractor for information only. Conditions are not intended as representations or warranties of accuracy or continuity between soil borings. The Engineer/ Owner will not be responsible for interpretations or conclusions drawn from this data by the contractor.

B. EXISTING UTILITIES

- Contractor is responsible for contacting all utility companies to obtain locations of all existing utilities or obstructions that he may encounter during construction. After location of utilities by the appropriate utility company, it is the Contractor's liability to protect all such utility lines, including service lines and appurtenances, and to replace at his own expense any that may be damaged by the Contractor's equipment or forces during construction of the Project.
- Provide a minimum of 48-hours' notice to the Engineer and receive written notice to proceed before interrupting any utility.
- The contractor is responsible for contacting all utility companies to verify locations of all existing utilities, utility-related obstructions, or utility relocations that he may encounter during construction.
- Adequate provision shall be made for the flow of existing sewers, drains, and water courses encountered during construction, and structures which may be disturbed shall be satisfactorily restored by the Contractor.

- C. Should uncharted, or incorrectly charted, piping or other utilities be encountered during the course of the work, consult Engineer immediately for directions. Cooperate with owner and utility companies in keeping respective services and facilities in operation.

1.7 SOIL MATERIALS

A. GENERAL

- Soils used as fill shall be clean sands, similar to existing site soil, with less than 5% passing the number 200 sieve when existing subgrade conditions are considered wet as per the County and/or its representative. Soils as described above with less than 12% passing the number 200 sieve and meeting the requirements of Section 902-6 of the FDOT Specifications may be used when existing subgrade conditions are considered dry as per the County and/or its representative. The sand shall have a maximum dry density of at least 100 pounds per cubic foot, according to the Standard Proctor compaction test, AASHTO T-99, ASTM D698. Provide approved borrow soil materials from off-site when sufficient satisfactory soil materials are not available from excavations. Provide laboratory certification that soils meet requirements of specifications.
- B. If the Contractor elects to import any materials other than that excavated on site, then he will do so only with Engineer's approval and at his own expense, unless separate payment for such items are called for in these specifications.
- C. SUB-BASE MATERIAL
- Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand, ASTM D 2940, with at least 95 percent passing a 1-1/2-inch sieve, and not more than 8 percent passing a No. 200 sieve.

1.8 DEWATERING

- A. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding project site and surrounding area.
- B. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.
- C. The Contractor shall prevent the accumulation of water in excavated areas and shall remove by pumping or other means any water that accumulates in the excavation. The Contractor shall prevent the accumulation of water in both structural and trench excavations and shall remove by well point system or by other means water which accumulates. The Contractor shall provide, install and operate a suitable and satisfactory dewatering system. The contractor shall include the cost of this pumping equipment and work in the unit price bid for the work.
- D. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rainwater and water removed from excavations to collection or runoff areas. Do not use trench excavations as temporary drainage ditches.

1.9 EXCAVATION

- A. EXPLOSIVES

- Not permitted.

B. UNCLASSIFIED EXCAVATION

- Excavation is unclassified and includes excavation to required subgrade elevations regardless of the character of materials and obstructions encountered.
- C. Strip topsoil to whatever depths encountered in a manner to prevent intermingling with underlying subsoil or other objectionable material. Remove heavy growths of grass from areas before stripping. Where existing trees are indicated to remain, leave existing topsoil in place within drip lines to prevent damage to root systems.

1.10 STABILITY OF EXCAVATION

- A. Comply with local codes, ordinances, and requirements of authorities having jurisdiction to maintain stable excavations.
- B. All excavation work shall conform to all applicable OSHA Publications, latest editions. The Contractor's method of providing protective support to prevent cave-ins shall conform to OSHA requirements. Slope excavations, shoring, and trench box usage in the field must be based on tabulated data and designed by the Contractor. The contractor is solely responsible for job site safety.

1.11 EXCAVATION FOR STRUCTURES

A. FOOTINGS AND FOUNDATIONS

- Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

B. PILE FOUNDATIONS

- Stop excavations from 6 inches to 12 inches above bottom of footing before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.

- C. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Appurtenances: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 0.10 foot. Do not disturb bottom of excavations intended for bearing surface.

1.12 EXCAVATION FOR WALKS AND PAVEMENT

- A. Excavate surfaces under walks and pavements to indicated cross sections, elevations, and grades.

1.13 EXCAVATION FOR STORMWATER SYSTEMS

- A. Excavate and compact the backfill of trenches to the densities specified for embankment or subgrade, as applicable, and in accordance with the requirements of Section 2600.

1.14 STORAGE OF SOIL MATERIALS

- A. Stockpile excavated materials acceptable for backfill and fill soil materials, including acceptable borrow materials. Stockpile soil materials without intermixing. Place, grade and shape stockpiles to drain surface water. Cover to prevent wind-blown dust.
- B. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.
- C. Stockpile topsoil and other reusable soils in storage piles in areas indicated or directed. Construct storage piles to provide free drainage of surface water. Cover storage piles, if required, to prevent erosion.

1.15 BACKFILL

- A. Backfill excavations promptly, but not before completing the following:
 - Acceptance of construction below finish grade including, where applicable, filter fabric, installation, and gravel bedding.
 - Surveying locations of underground utilities for record documents.
 - Testing, inspecting, and approval of underground utilities.
 - Removal of trash and debris from excavation.
 - Removal of temporary shoring, bracing, and sheeting unless specified to remain.
- B. No backfill material shall be placed, spread or rolled during unfavorable weather conditions. When the work is interrupted by heavy rain, backfill operations shall not be resumed until the moisture content and density of the fill are as previously specified.

1.16 FILL

- A. PREPARATION

- Remove vegetation, topsoil, debris, wet and unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placing fills. Plow strip, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing surface. In order to insure proper bond and prevent slipping between the original ground and fill, the surface of the original ground shall be scarified to a depth of at least three inches. Each layer of fill material shall be compacted until the required density is achieved.
- B. When sub grade or existing ground surface to receive fill has a density less than that required for fill, break up ground surface to depth required, pulverize, moisture-condition or aerate soil and re-compact to required density.
- C. Place fill material in layers to required elevations for each location listed below.
- Under grass, use satisfactory excavated or borrow soil material.
- D. Under walks and pavements, steps, ramps, building slabs, footings, and foundations use subbase or base material, or satisfactory excavated or borrow soil material.

1.17 MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content.
- B. Do not place backfill or fill material on surfaces that contain excessive moisture.
- C. Remove and replace or scarify and air-dry satisfactory soil material that is too wet to compact to specified density. Stockpile or spread and dry removed wet satisfactory soil material.

1.18 COMPACTION

- A. Place backfill and fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers. The Contractor may construct embankments in successive layers of not more than 12" compacted thickness, if he can demonstrate with field tests that he has compacting equipment efficient to achieve required density for the full depth of a thicker lift. The Engineer reserves the right to terminate the Contractor's use of thick lift construction and have him revert to the 8" loose lifts whenever it is determined that satisfactory results are not being achieved.
- B. Place backfill and fill materials evenly on all sides of structures to required elevations. Place backfill and fill uniformly along the full length of each structure.

C. PERCENTAGE OF MAXIMUM DRY DENSITY REQUIREMENTS

- Compact soil to not less than the following percentages of maximum dry density according to ASTM D698 (Standard Proctor):
 - Under structures, building slabs, steps, and pavements, compact each layer of backfill or fill material at 100 percent maximum dry density.
 - Under lawn or unpaved areas, compact each layer of backfill or fill material at 95 percent maximum dry density.

1.19 GRADING

A. GENERAL

- Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - Provide a smooth transition between existing adjacent grades and new grades.
 - Cut out soft spots, fill low spots, and trim high spots to conform to required surface tolerances.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

- LAWN OR UNPAVED AREAS
 - Plus or minus 0.10 foot.
- WALKS
 - Plus or minus 0.10 foot.
- PAVEMENTS
 - Plus or minus ½ inch.

1.20 STABILIZED SUBGRADE

- A. For stabilized subgrade the type of materials, commercial or local, is at the Contractor's option and no separate payment for stabilizing materials will be made (other than as may be paid for as borrow).

- B. When stabilizing is designated as Type B, compliance with the bearing value requirements will be determined by the Lime rock Bearing Ratio Method. Minimum LBR shall be 40.
- C. It is the Contractor's responsibility that the finished roadbed section meets the bearing value requirements, regardless of the quantity of stabilizing materials necessary to be added. Also, full payment will be made for any areas where the existing subgrade materials meet the design bearing value requirements without the addition of stabilizing additives, as well as areas where the Contractor may elect to place select high bearing materials from other sources, within the limits of the stabilizing.
- D. After the roadbed grading operations have been substantially completed, the Contractor shall make his own determination as to the quantity (if any) of stabilizing material, of the type selected by him, necessary for compliance with the bearing value requirements. The contractor shall notify the Engineer of the approximate quantity to be added, and the spreading and mixing-in of such quantity of materials shall meet the approval of the Engineer as to uniformity and effectiveness.

1.21 FIELD QUALITY CONTROL

A. TESTING AGENCY SERVICES

- Allow testing agency to inspect and test each subgrade and each fill or backfill layer. Do not proceed until test results for previously completed work verify compliance with requirements.
- Perform field in-place density tests according to ASTM D 1556 (sand cone method), ASTM D 2167 (rubber balloon method), or ASTM D 2937 (drive cylinder method), as applicable.
- Field in-place density tests may also be performed by the nuclear method according to ASTM D 2922, provided that calibration curves are periodically checked and adjusted to correlate to tests performed using ASTM D 1556. With each density calibration check, check the calibration curves furnished with the moisture gauges according to ASTM D 3017.
 - When field in-place density tests are performed using nuclear methods, make calibration checks of both density and moisture gauges at beginning of work, on each different type of material encountered, and at intervals as directed by the Engineer.
- PAVED AREAS
 - Make at least one field density test of subgrade, base, and each compacted fill layer for every 300 linear feet of roadway or equivalent area, but in no case less than three tests. Tests shall be staggered to ensure representative sampling.

- UNPAVED AREAS
 - Make at least one field density test of each compacted fill layer or subgrade for every 1000 square yards of area, but in no case less than three tests.
- Other tests may be required at Engineer's discretion.
- If in the opinion of the Engineer, based on testing service reports and inspection, sub grades, fills, or backfills are below specified density, scarify and moisten or aerate, or remove and replace soil to the depth required, re-compact, and re-test until required density is obtained at no additional expense.

1.22 REPAIR AND CORRECTIONS

A. PROTECTING GRADED AREAS

- Protect newly graded areas from traffic and erosion. Keep free of trash and debris. Repair and re-establish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or lose compaction due to subsequent construction operations or weather conditions. Scarify or remove and replace material to depth directed by the Engineer; reshape and re-compact at optimum moisture content to the required density.

B. SETTLING

- Where settling occurs during the warranty period, remove finished surfacing, backfill with additional approved material, compact, and reconstruct surfacing. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

- C. When traffic must cross open trenches, the contractor shall provide suitable bridges. (See Section 4060 for additional requirements.)

D. EROSION CONTROL

- The Contractor shall be responsible for the prevention of erosion from the site and for maintaining filled and graded surfaces for the duration of the project. This includes, but is not limited to, the erection of a silt fence and hay bale barricade as per Florida Department of Transportation Design Standard indexes 102 and 104, as shown in the construction plans. The Contractor shall take whatever steps necessary to prevent erosion and sedimentation, and will be responsible for any damages which might occur to down-land properties as a result of run-off from the site during sitework construction. Provide erosion control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

1.23 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Surplus excavated material remains the property of the county unless otherwise noted. Waste materials, including unsatisfactory soils, trash and debris shall be removed and legally disposed of, off the Owner's property.

1.24 CLEAN-UP AND FINAL INSPECTION

- A. Before final inspection and acceptance the Contractor shall clean ditches, shape shoulders and restore all disturbed areas, including street crossings, grass plots, re-grassing if necessary, to as good a condition as existed before work started.

1.25 MEASUREMENT AND PAYMENT

A. BASIS OF PAYMENT

- EXCAVATION
 - Payment shall be included in the cost of the associated item of work. Payment will be made under: per cubic yard.
- EMBANKMENT
 - Payment shall be included in the cost of the associated item of work. Payment will be made under: per cubic yard.

END OF SECTION 01300

SECTION 01400
TRAFFIC SIGNS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and other Specifications Sections, apply to work of this section.
- B. Unless otherwise specified on the work orders, plan sheets, or in other sections of this contract, all materials and work shall conform to the applicable requirements in the following document:
- USDOT, Federal Highway Administration, Manual on Uniform Traffic Control Devices for Streets and Highways, Latest Edition.
 - USDOT, Federal Highway Administration, Standard Alphabets for Highway Signs and Pavement Markings, Latest Edition.
 - Florida Department of Transportation, Design Standards for Design, Construction, Maintenance and Utility Operations on the State Highway System, Latest Edition.
 - Florida Department of Transportation, Standard Specifications for Road and Bridge Construction, section 700, Latest Edition.
- C. GENERAL EXCEPTIONS
- Any reference to FDOT Standard Specifications for Road and Bridge Construction, Latest Edition, Division I General Requirements & Covenants shall be excluded and not applicable to any specification referred here in, or otherwise listed in this document.

1.2 DESCRIPTION OF WORK

- A. The work under this section includes the removal and reinstallation of standard and special traffic signs (warning, regulatory, and guide). The Contractor shall furnish all labor, materials, post, tools, supplies, equipment, and machinery necessary to fully complete the work shown in the plans and in these specifications.

1.3 PRODUCTS

- A. MATERIALS

- All materials shall be new and of good quality unless otherwise specified. The Contractor, at his own expense and if requested by owner Contract Administrator, shall furnish samples of material and/or shall certify that the material meets all FDOT requirements. All material or work that has been rejected shall be remedied by the Contractor at his own expense and without delay. If the Contractor fails to promptly remove and/or dispose of rejected material and replace the same, the Engineer may remove and replace the same and deduct the cost of the work from the contract amount.
- If the Contractor chooses to use material other than specified herein, a sample of the material with supporting manufacturer's literature and specifications must be submitted to the owner's Contract Administrator for prior approval.

1.4 EXECUTION

A. UTILITY SPOTS

- All street name signs shall be fabricated and installed in accordance with the plans and related documents. Contractor shall contact Sunshine State One Call of Florida at least two working days prior to digging or driving posts.

B. SIGN INSTALLATION

- Signs shall be placed at the locations illustrated and/or specified in the plans or related documents. The soil around the post shall be solidly tamped so that the sign will stand vertically.
- If a sign cannot be placed where indicated due to a conflict, the Contractor shall immediately notify the owner's Contract Administrator. The owner's Contract Administrator will specify an alternate location.
- The date when each sign is installed shall be marked in permanent ink on the rear side of each sign.

1.5 MEASUREMENT

A. METHOD OF MEASUREMENT

- The quantity to be paid for will be plan quantity, unless otherwise provided.

B. BASIS OF PAYEMNT

- Price and payment will constitute full compensation for all work specified in this section. Payment for all items relating to traffic signs will be a lump sum quantity.

END OF SECTION 01400

SECTION 01500
CONCRETE SIDEWALKS, CURB AND CUTTER

PART 1 GENERAL

1.1 SCOPE

- A. The work specified in this section consists of the construction of sidewalks, curbing, curb and gutter, ribbon curb, or valley gutter, of Portland cement concrete. Such work is to be constructed in accordance with the specs, lines, grades, dimensions, and notes as shown on the plans.

1.2 COMPRESSIVE STRENGTH

- A. All concrete in sidewalks, curbing, valley gutter, and standard curb and gutter shall contain cement, coarse aggregate, and fine aggregate with a minimum of 3,000 pounds compressive strength per square inch at 28 days. Sidewalks shall be fiber reinforced.

1.3 GRADING

- A. Grading shall include the removing and disposing of the existing curb, gutter and sidewalks and the excavation or fill necessary to bring the subgrade to the proper line, grade and contour after compacting and consolidating same by rolling, tamping and watering. Subgrade or base upon which the curb, curb and gutter or valley gutter is to be set shall meet compaction requirements. All roots, loam or other objectionable material shall be removed to a depth of at least two (2) feet below the top of the finished subgrade and the resultant holes filled with a suitable material and compacted by tamping.
- B. Excess material not used in constructing fills shall be removed and deposited at a location to be provided by the Contractor.

1.4 FORMS

- A. Forms for this work shall be made of either 2" surfaced lumber or of metal of approved section with a flat surface on top. They shall be straight, free from warp or bends and of sufficient strength, when staked, to resist the pressure of the concrete without deforming. Forms shall have a depth equal to the plan dimensions for the depth of the concrete being deposited against them. Forms for combination curb and gutter shall be so constructed as to insure fastening of the forms to each other.

1.5 PLACING CONCRETE

- A. No concrete shall be placed prior to the approval of the subgrade and form work by the Engineer or his duly authorized representative. No concrete shall be placed in inclement weather. Concrete proportioned as previously specified shall immediately be placed between the forms on the prepared subgrade. It shall, with a minimum amount of handling, be deposited evenly and slightly in excess of the required finished depth. It shall then be screeded to its proper elevation using suitable tools so as to produce a dense homogeneous concrete free from voids and stone pockets (honeycombing).

1.6 FINISHING CONCRETE

- A. All surplus water, laitance or inert material shall be worked off the surface of the concrete with a straight edge.

B. SIDEWALKS

- The concrete shall be given a float finish with tools approved by the inspector. When so finished, surface variations shall not exceed 1/8 inch under a ten (10) foot straight edge, and not more than 1/16 inch on the four (4) foot transverse section. The edges of the sidewalk shall be carefully finished with an edging tool having a radius of 1/2 inch. When the concrete has sufficiently set, the float finish shall be brushed with a broom to the final finish grade. The sidewalk shall be marked into five (5) foot sections with an approved tool that will give a 1/2-inch-deep marking. Expansion joints shall be provided at thirty (30) foot intervals.

C. CURB, VALLEY GUTTER, CURB AND GUTTER

- The top of the curbing or gutter shall be floated smooth and the edges rounded to the radius shown on the plans. Unless otherwise shown on the plans, curb, curb and gutter and valley gutter shall be constructed in uniform ten (10) foot intervals.

1.7 CURING

- A. Cure the concrete as specified in FDOT Specification 520-8.

1.8 OPENING SIDEWALK TO PEDESTRIAN TRAFFIC

- A. Install detectable warnings, when shown in the Plans, in accordance with FDOT Specification Section 527 on completed sections of sidewalk before opening to pedestrian traffic.

1.9 MEASUREMENT

- A. The quantity to be paid will be plan quantity, in square yards, completed and accepted.

1.10 PAYMENT

- A. Price and payment will be full compensation for all work specified in this Section and any other material necessary to construction sidewalk and pad per plans.

END OF SECTION 01500

SECTION 01540
PLANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

- 1. Plants.
- 2. Tree stabilization.
- 3. Erosion-control material(s).

B. Related Requirements:

- 1. Section 328400 FL "Planting Irrigation

C. Backfill: The earth used to replace or the act of replacing earth in an excavation.

D. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with a ball size not less than diameter and depth recommended by ANSI Z60.1; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.

E. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.

F. Finish Grade: Elevation of finished surface of planting soil.

G. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant. Some sources classify herbicides separately from pesticides.

H. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

I. Planting Area: Areas to be planted.

J. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

- K. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.
- L. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.
- M. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.
- N. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
 - 2. Plant Photographs: Include color photographs in digital format of each required species and size of plant material as it will be furnished to Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.
- B. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:
 - 1. Manufacturer's certified analysis of standard products.
 - 2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
- C. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.
- D. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before expiration of required maintenance periods.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.

1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
 2. Experience: Five years' experience in landscape installation in addition to requirements in Section 014000 "Quality Requirements."
 3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
 4. Pesticide Applicator: State licensed, commercial.
- B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.
1. Selection of plants purchased under allowances is made by Landscape Architect, who tags plants at their place of growth before they are prepared for transplanting.
- C. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.
1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container-grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.
 2. Other Plants: Measure with stems, petioles, and foliage in their normal position.
- D. Plant Material Observation: Landscape Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Landscape Architect may also observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and may reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.
1. Notify Landscape Architect of sources of planting materials seven days in advance of delivery to site.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws if applicable.
- B. Bulk Materials:
1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
 3. Accompany each delivery of bulk materials with appropriate certificates.
- C. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

- D. Handle planting stock by root ball.
- E. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.
 - 1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.
- F. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.
- G. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.
 - 1. Heel-in bare-root stock. Soak roots that are in less than moist condition in water for two hours. Reject plants with dry roots.
 - 2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
 - 3. Do not remove container-grown stock from containers before time of planting.
 - 4. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly wet condition.

1.8 FIELD CONDITIONS

- A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.
- B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

1.9 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner.
 - b. Structural failures including plantings falling or blowing over.
 - 2. Warranty Periods: From date of acceptance from County.
 - a. Trees, Shrubs, Vines, and Ornamental Grasses: 12 months.
 - b. Ground Covers, Biennials, Perennials, and Other Plants: 12 months.
 - 3. Include the following remedial actions as a minimum:

- a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
- b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
- c. A limit of one replacement of each plant is required except for losses or replacements due to failure to comply with requirements.
- d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

- A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
 1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch in diameter; or with stem girdling roots are unacceptable.
- B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Landscape Architect, with a proportionate increase in size of roots or balls.
- C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare according to ANSI Z60.1. Root flare shall be visible before planting.
- D. Biennials: Provide healthy, disease-free plants of species and variety shown or listed, with well-established root systems reaching to sides of the container to maintain a firm ball, but not with excessive root growth encircling the container. Provide only plants that are acclimated to outdoor conditions before delivery.

2.2 FERTILIZERS

- A. Planting Tablets: Tightly compressed chip-type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.
 1. See plan specifications.

2.3 MULCHES

- A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:
 1. See plan specifications.

2.4 EROSION -CONTROL BARRIERS

- A. Erosion control blanket shall provide a temporary, biodegradable cover material to reduce slope and/or channel erosion and enhance revegetation. Erosion control blanket performance capabilities shall be determined by ASTM D 6459, "Determination of Erosion Control Blanket (ECB) Performance in Protecting Hillslopes from Rainfall-Induced Erosion", and ASTM D 6460,
- B. Erosion control blanket shall be furnished in rolls and wrapped with suitable material to protect against moisture intrusion and extended ultraviolet exposure prior to placement. Each roll shall be labeled with a date code identification, which allows for sufficient tracking of the product back to date of manufacturing and for quality control purposes.
- C. Erosion control blanket shall be of consistent thickness with fibers distributed evenly over the entire area of the blanket.
- D. Erosion control blanket shall be free of defects and voids that would interfere with proper installation or impair performance.
- E. Erosion control blanket shall be stored by the Contractor in a manner that protects them from damage by construction activities.
- F. Site Preparation:
 - 1. Before placing erosion control blanket, the Contractor shall certify that the subgrade has been properly compacted, graded smooth, has no depressions, voids, soft or uncompacted areas, is free from obstructions such as tree roots, protruding stones or other foreign matter, and is seeded and fertilized according to project specifications.
 - 2. The Contractor shall not proceed until all unsatisfactory conditions have been remedied. By beginning construction, the Contractor signifies that the preceding work is in conformance with this specification.
 - 3. Contractor shall fine grade the subgrade by hand dressing where necessary to remove local deviations
- G. Slope Installation
 - 1. Erosion control blanket shall be installed as directed by the owner's representative in accordance with manufacturer's Installation Guidelines, Staple Pattern Guides, and Plan details. The extent of erosion control blanket shall be as shown on the project drawings.
 - 2. Erosion control blanket shall be orientated in vertical strips and anchored with staples, as identified in the Staple Pattern Guide. Adjacent strips shall be abutted or overlapped to allow for installation of a common row of staples that anchor through the nettings of both blankets. Horizontal joints between erosion control blankets shall be sufficiently overlapped with the uphill end on top for a common row of staples so that the staples anchor through the nettings of both blankets.
 - 3. Where exposed to overland sheet flow, a trench shall be located at the uphill termination. Erosion control blanket shall be stapled to the bottom of the trench. The trench shall be backfilled and compacted. Where feasible, the uphill end of the blanket shall be extended three feet over the crest of the slope

2.5 PESTICIDES

- A. General: Pesticide registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Pre-Emergent Herbicide Selective: Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
- C. Post-Emergent Herbicide Selective: Effective for controlling weed growth that has already germinated.

2.6 TREE-STABILIZATION MATERIALS

- A. Trunk-Stabilization Materials:
 - 1. See plan specifications.

2.7 MISCELLANEOUS PRODUCTS

- A. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.
- B. Mycorrhizal Fungi: Dry, granular inoculant containing at least 5300 spores per lb of vesicular-arbuscular mycorrhizal fungi and 95 million spores per lb of ectomycorrhizal fungi, 33 percent hydrogel, and a maximum of 5.5 percent inert material.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive plants, with Installer present, for compliance with requirements and conditions affecting installation and performance of the Work.
 - 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
 - 2. Verify that plants and vehicles loaded with plants can travel to planting locations with adequate overhead clearance.
 - 3. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
 - 4. Uniformly moisten excessively dry soil that is not workable or which is dusty.
- B. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

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

3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Architect's acceptance of layout before excavating or planting. Make minor adjustments as required.
- D. Lay out plants at locations directed by Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings.

3.3 PLANTING AREA ESTABLISHMENT

- A. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.
- B. Application of Mycorrhizal Fungi: At time directed by Architect, broadcast dry product uniformly over prepared soil at application rate according to manufacturer's written recommendations.

3.4 EXCAVATION FOR TREES AND SHRUBS

- A. See plan specifications.

3.5 TREE, SHRUB, AND VINE PLANTING

- A. See plan specifications.

3.6 TREE, SHRUB, AND VINE PRUNING

- A. Remove only dead, dying, or broken branches. Do not prune for shape.
- B. Prune, thin, and shape trees, shrubs, and vines as directed by Landscape Architect.
- C. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.
- D. Do not apply pruning paint to wounds.

3.7 TREE AND PALM STABILIZATION

- A. See plan specifications.

3.8 GROUND COVER AND PLANT PLANTING

- A. See plan specifications.

3.9 PLANTING AREA MULCHING

- A. Mulch backfilled surfaces of planting areas and other areas indicated.
 - 1. Trees and Treelike Shrubs in Turf Areas: Apply organic mulch ring of 3-inch average thickness, with 36-inch radius around trunks or stems. Do not place mulch within 3 inches of trunks or stems.
 - 2. Organic Mulch in Planting Areas: Apply 3-inch average thickness of organic mulch extending 12 inches beyond edge of individual planting pit or trench and over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 3 inches of trunks or stems.

3.10 PLANT MAINTENANCE

- A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.
- B. Fill in, as necessary, soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.
- C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices when possible to minimize use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

3.11 PESTICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents according to authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- B. Pre-Emergent Herbicides (Selective and Nonselective): Apply to tree, shrub, and ground-cover areas according to manufacturer's written recommendations. Do not apply to seeded areas.
- C. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.12 REPAIR AND REPLACEMENT

- A. General: Repair or replace existing or new trees and other plants that are damaged by construction operations, in a manner approved by Architect.
 - 1. Submit details of proposed pruning and repairs.
 - 2. Perform repairs of damaged trunks, branches, and roots within 24 hours, if approved.
 - 3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Landscape Architect.
- B. Remove and replace trees that are more than 25 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Landscape Architect determines are incapable of restoring to normal growth pattern.
 - 1. Provide new trees of same size as those being replaced for each tree of 6 inches or smaller in caliper size.

3.13 CLEANING AND PROTECTION

- A. During planting, keep adjacent paving and construction clean and work area in an orderly condition. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.
- C. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.
- D. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.
- E. At time of Substantial Completion, verify that tree-watering devices are in good working order and leave them in place. Replace improperly functioning devices.

3.14 MAINTENANCE SERVICE

- A. Maintenance Service for Trees and Shrubs: Provide maintenance by skilled employees of landscape Installer. Maintain as required in "Plant Maintenance" Article. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:
- B. Maintenance Service for Ground Cover and Other Plants: Provide maintenance by skilled employees of landscape Installer. Maintain as required in "Plant Maintenance" Article. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:

END OF SECTION 01540

SECTION 01550
PLANTING IRRIGATION

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. Piping.
 - 2. Manual valves.
 - 3. Automatic control valves.
 - 4. Miscellaneous piping specialties.
 - 5. Sprinklers.
 - 6. Drip irrigation specialties.
 - 7. Controllers.
 - 8. Boxes for automatic control valves.

1.3 DEFINITIONS

- A. Circuit Piping: Downstream from control valves to sprinklers, specialties, and drain valves. Piping is under pressure during flow.
- B. Drain Piping: Downstream from circuit-piping drain valves. Piping is not under pressure.
- C. Main Piping: Downstream from point of connection to water distribution piping to and including control valves. Piping is under water-distribution-system pressure.
- D. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.4 PERFORMANCE REQUIREMENTS

- A. Irrigation zone control shall be automatic operation with controller valves.
- B. Location of Sprinklers and Specialties: Design location is approximate. Make minor adjustments necessary to avoid plantings and obstructions such as signs and light standards. Maintain 100 percent irrigation coverage of areas indicated.
- C. Minimum Working Pressures: The following are minimum pressure requirements for piping, valves, and specialties unless otherwise indicated:

1. Irrigation Main Piping: **200 psig**
2. Circuit Piping: **150 psig**

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics and furnished specialties and accessories.
- B. Wiring Diagrams: for power, signal, and control wiring.
- C. Delegated-Design Submittal: For irrigation systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Irrigation systems, drawn to scale, on which components are shown and coordinated with each other, using input from Installers of the items involved. Also include adjustments necessary to avoid plantings and obstructions such as signs and light standards.
- B. Qualification Data: For qualified Installer.
- C. Zoning Chart: Show each irrigation zone and its control valve.
- D. Controller Timing Schedule: Indicate timing settings for each automatic controller zone.
- E. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For sprinklers, drip, controllers, and automatic control valves to include in operation and maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers that include a certified irrigation designer qualified by The Irrigation Association or Professional Class member of the American Society of Irrigation Consultants
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

- B. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.10 PROJECT 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 according to requirements indicated:
 - 1. Notify Owner no fewer than two days in advance of proposed interruption of water service.
 - 2. Do not proceed with interruption of water service without Owner's written permission.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

- A. Comply with requirements in the piping schedule for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.
- B. PVC Pipe: ASTM D 1785, PVC 1120 compound, Schedules 40 and 80.
 - 1. PVC Socket Fittings: ASTM D 2466, Schedules 40 and 80.
 - 2. PVC Threaded Fittings: ASTM D 2464, Schedule 80.
 - 3. PVC Socket Unions: Construction similar to MSS SP-107, except both headpiece and tailpiece shall be PVC with socket ends.
- C. PVC Pipe, Pressure Rated: ASTM D 2241, PVC 1120 compound, SDR 21 and SDR 26.
 - 1. PVC Socket Fittings: ASTM D 2467, Schedule 80.
 - 2. PVC Socket Unions: Construction similar to MSS SP-107, except both headpiece and tailpiece shall be PVC with socket or threaded ends.

2.2 PIPING JOINING MATERIALS

- A. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 6q56.
- B. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.3 ENCASEMENT FOR PIPING

- A. Standard: ASTM A 674 or AWWA C105.

2.4 MANUAL VALVES

A. Plastic Threaded Ball Valves:

1. Description:
 - a. Standard: MSS SP-122.
 - b. Pressure Rating: 150 psig
 - c. Body Material: PVC.
 - d. Type: Union.
 - e. End Connections: Socket or threaded.
 - f. Port: Full.

2.5 AUTOMATIC CONTROL VALVES

A. Plastic Automatic Control Valve

1. General Information
 - a. Provide valve as per the specification.
2. Valve
 - a. Irrigation valve specifications include but are not limited to:
 - 1) The valve body and bonnet shall be constructed of heavy-duty and ultra-violet resistant plastic.
 - 2) The bonnet shall be assembled to the body using multi-drive screws for use with flathead, Phillips, or hexagonal tools.
 - 3) Shall possess a water tight seal between the body and bonnet.
 - 4) Shall be a normally closed, forward flow design.
 - 5) Shall have a filtered pilot flow to resist debris and clogging.
 - 6) Shall be slow closing to prevent water hammer from causing subsequent system damage.
 - 7) Shall have a Ø1 inch NPT globe and angle inlet as well as a Ø1 inch NPT outlet.
 - 8) Shall have a manual internal bleed capability to operate the valve without allowing water into the valve box.
 - 9) Shall have a non-rising flow control handle to adjust water flow as needed.
 - 10) Shall include a 24 VAC 50/60 Hz solenoid capable of 2-wire operation.
 - a) Inrush current: 0.41A (9.9VA) at 60Hz
 - b) Holding current: 0.14A (3.43 VA) at 60Hz
 - 11) Operating flow rate of 2-40 gpm (7.6-151.4 l/min).
 - 12) Operating pressure range of 15-150 psi (1.04-10.4 bar).
 - 13) Water temperature: Up to 110°F (43°C).
 - 14) Ambient temperature: Up to 125°F (52°C).
 - 15) Shall accommodate an optional field-installed pressure regulating dial.
 - 16) Shall accept an optional latching solenoid for use with battery operated controllers.
 - 17) Shall be available with an optional purple flow control handle for use with non-potable water applications.
 - 18) Shall have a heavy-duty stainless steel spring for positive diaphragm closure.

2.6 SPRINKLERS

1. Rotors
 - a. designed to provide uniform coverage over entire area of spray shown on drawings at available water pressure or as follows:
 - 1) Rotor for shrub or groundcover (8-25 feet) spacing: maximum 30 psi.
2. Pop-Up Spray
 - a. Rotor for shrub or small turf areas (8-25 feet) spacing: maximum 30 psi. Irrigation rotor specifications include but are not limited to:
 - 1) The rotor body, stem and nozzle, shall be constructed of heavy-duty and ultra-violet resistant plastic.
 - a) Shall have a heavy-duty stainless steel retract spring for positive pop-down.
 - 2) Shall have integrated seals and method for clearing debris.
 - a) Oversized pressure activated wiper seal prevents leaks and protects internals from debris.
 - b) Precision controlled flush at pop-down to clear debris from the unit, to assure positive stem retraction in all soil types.
 - c) Ported arc adjustment screw to clear debris from unit at pop-down
 - 3) Shall have a slip clutch installation feature to allow easy arc alignment.
 - 4) Non-reversing 360° full arc rotation.
 - 5) 7.38 inch body height; 4.0 inch and 12 inch pop-up height (measured to center of nozzle).
 - 6) Operating range of 8 to 25 feet.
 - 7) Operating pressure range of 5 to 55 psi.
 - 8) Shall have a precipitation rate of 0.20 to 1.50 in/hr.
 - 9) Shall include a green cover and a flow shut-off valve in the rotor head.
 - 10) Exposed surface diameter shall measure 1.5 inch.
 - 11) Shall include Ø3/4 inch NPT female threaded bottom inlet.
 - 12) Shall include a nozzle tree containing twelve nozzles with indicated flow rates from 0.76 to 9.63 gpm and an exit trajectory of 10-25°.
 - 13) All rotor body components shall be removable from the top without special tools in order to provide quick and easy flushing and maintenance of the sprinkler.
 - 14) Shall include slot in cover for use of a pull up tool for ease of nozzle installation and replacement.
 - 15) Shall include nozzle retention screw that may also be used to reduce spray radius by 25%.
 - 16) Shall have a filter screen in the stem to protect the drive from clogging and to simplify removal for cleaning and flushing the system.
 - 17) Shall utilize nozzles designed to deliver even distribution over the entire radius including large wind resistant droplets and gentle close-in-watering.

2.7 CONTROLLERS

A. Description:

1. The controller shall be a full-featured, commercial-industrial product for the purpose of irrigation operation, management, and monitoring of control valves and sensors. The

controller shall be of a modular design that is provided with a standard 8-station output module. The controller shall be expandable to 12-station decoder output module controller Stations for Automatic Control Valves: Each station is variable from approximately 5 to 60 minutes. Include switch for manual or automatic operation of each station.

2. Exterior Control Enclosures: NEMA 250, Type 4, weatherproof, with locking cover and two matching keys; include provision for grounding.
 - a. Body Material: Molded plastic.
 - b. Mounting: Pole mounted.
3. Control Transformer: 24-V secondary, with primary fuse.
4. Depending on requirements, transformer input shall be 120 VAC, 60 Hz or 230 VAC, 50 Hz. Maximum output per station shall be 24 VAC, up to 0.56 A. Maximum output per P/MV terminal shall be 24 VAC, up to 0.56 A.
5. The controller transformer shall be equipped with an internal, self-resetting thermal circuit breaker to protect against overheating.
6. The controller transformer shall also be equipped with a ground lug for connecting to proper earth-ground hardware.
7. Station Modules
 - a. Controller shall provide 12 (plastic enclosure) station output module slots Timing Device: Adjustable, 24-hour, 14-day clock, with automatic operations to skip operation any day in timer period, to operate every other day, or to operate two or more times daily.
 - b. Station modules shall be secured against field wiring tension by locking levers.
 - c. Using 2 wire only, the controller shall be expandable from 8 to 38 stations (plastic) and 8 to 54 stations (metal and pedestals).
 - d. Using conventional station modules in conjunction with one decoder output module (model: EZ-DM), all controller configurations (plastic, metal, pedestal) shall expand up to 54 stations.
 - e. Using only one decoder output module (model: EZ-DM) all controller configurations (plastic, pedestal) shall expand up to 54 stations.
 - f. The controller shall have a base model capacity of 12 stations, consisting of one 8-station output module.
 - g. Each station output shall supply 24 VAC, up to 0.56 A current for solenoid activation.
 - h. The controller shall have self-diagnostic, electronic short circuit protection that detects a faulty circuit, continues watering the remainder of the program, and reports the faulty station via alert/notification to the user's smartphone, tablet, or computer. The built-in milliamp sensor shall constantly be measuring the current draw of each individual station.
 - i. Module hardware
 1. The controller output modules shall have metal oxide varistors (MOVs) and copper induction coils on each station output circuit to help protect the micro-circuitry from power surges
 - i. Sensor inputs - The controller shall be equipped with two dedicated general-purpose sensor ports.
 2. The sensor inputs shall be compatible with any standard normally closed or normally open "Clik-type" sensors for automatic shutdown during rain, freeze, soil moisture, and/or wind events.

3. The sensor inputs shall also be compatible with the Rainbird Flow Meter for flow monitoring, alerts, and reporting.
- k. P/MV outputs
 1. The controller shall have one built-in P/MV (24 VAC) output with a capacity of up to 0.56 A.
 2. The P/MV output shall be selectable as active or disabled per each individual station.
 3. A common wire terminal is provided on the controller's power module, and additional commons are provided on each station output module.
 - a. SmartPort®
 - 1) The controller shall be pre-wired with a SmartPort connector for easy connection of optional wireless remote controls.
 - 2) For international or short-range uses, the wireless remote control shall be the Rainbird model with a useful range of up to 1,000' (330 m).
 - 3) For use in the United States or long-range uses, where permitted, the wireless remote shall be Rainbird model with a useful range of up to 2 mi. (3.2 km).
 4. 3.10 Wi-Fi information
 - a. The controller shall be equipped with built-in Wi-Fi.
 - b. Wi-Fi operation shall be 802.11 b/g/n.
 - c. Wi-Fi frequency is 2.4 GHz.
 - d. Security shall have the ability to auto detect and offer the following security settings: WPA2, WPA Personal, and WPA Auto.
8. Moisture Sensor: Adjustable from one to seven days, to shut off water flow during rain.
9. Wiring: UL 493, Type UF multiconductor, with solid-copper conductors; insulated cable; suitable for direct burial.
 - a. Feeder-Circuit Cables: No. 12 AWG minimum, between building and controllers.
 - b. Low-Voltage, Branch-Circuit Cables: No. 14 AWG minimum, between controllers and automatic control valves; color-coded different from feeder-circuit-cable jacket color; with jackets of different colors for multiple-cable installation in same trench.
 - c. Splicing Materials: Manufacturer's packaged kit consisting of insulating, spring-type connector or crimped joint and epoxy resin moisture seal; suitable for direct burial.

2.8 BOXES FOR AUTOMATIC CONTROL VALVES

- A. Plastic Boxes:
 1. Description: Box and cover, with open bottom and openings for piping; designed for installing flush with grade.
 - a. Size: As required for valves and service.
 - b. Shape: Round (for gate valves) and Rectangular for control valves.
 - c. Sidewall Material: PE.
 - d. Cover Material: PE
- B. Drainage Backfill: Cleaned gravel or crushed stone, graded from 3/4 inch minimum to 3 inches maximum.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."
- B. Install warning tape directly above pressure piping, 12 inches below finished grades, except 6 inches below subgrade under pavement and slabs.
- C. Drain Pockets: Excavate to sizes indicated. Backfill with cleaned gravel or crushed stone, graded from 3/4 to 3 inches to 12 inches below grade. Cover gravel or crushed stone with sheet of asphalt-saturated felt and backfill remainder with excavated material.
- D. Provide minimum cover over top of underground piping according to the following:
 - 1. Irrigation Main Piping: Minimum depth of 36 inches below finished grade, or not less than 18 inches below average local frost depth, whichever is deeper.
 - 2. Circuit Piping: 12 inches.
 - 3. Drain Piping: 12 inches.
 - 4. Sleeves: 24 inches.

3.2 PREPARATION

- A. Set stakes to identify locations of proposed irrigation system. Obtain Architect's approval before excavation.

3.3 PIPING INSTALLATION

- A. Location and Arrangement: Drawings indicate location and arrangement of piping systems. Install piping as indicated unless deviations are approved on Coordination Drawings.
- B. Install piping at minimum uniform slope of 0.5 percent down toward drain valves.
- C. Install piping free of sags and bends.
- D. Install groups of pipes parallel to each other, spaced to permit valve servicing.
- E. Install fittings for changes in direction and branch connections.
- F. Install unions adjacent to valves and to final connections to other components with NPS 2 or smaller pipe connection.
- G. Install underground thermoplastic piping according to ASTM D 2774 and ASTM F 690.
- H. Install expansion loops in control-valve boxes for plastic piping.
- I. Lay piping on solid subbase, uniformly sloped without humps or depressions.
- J. Install ductile-iron piping according to AWWA C600.

- K. Install PVC piping in dry weather when temperature is above 40 deg F. Allow joints to cure at least 24 hours at temperatures above 40 deg F before testing.
- L. Install water regulators with shutoff valve and strainer on inlet and pressure gage on outlet. Install shutoff valve on outlet. Install aboveground or in control-valve boxes.
- M. Water Hammer Arresters: Install between connection to building main and circuit valves aboveground or in control-valve boxes.
- N. Install piping in sleeves under parking lots, roadways, and sidewalks.
- O. Install sleeves made of Schedule 40 PVC pipe and socket fittings, and solvent-cemented joints.
- P. Install transition fittings for plastic-to-metal pipe connections according to the following:
 - 1. Underground Piping:
 - a. NPS 1-1/2 and Smaller: Plastic-to-metal transition fittings.
 - b. NPS 2 and Larger: AWWA transition couplings.
 - 2. Aboveground Piping:
 - a. NPS 2 and Smaller: Plastic-to-metal transition fittings.
 - b. NPS 2 and Larger: Use dielectric flange kits with one plastic flange.
- Q. Install dielectric fittings for dissimilar-metal pipe connections according to the following:
 - 1. Underground Piping:
 - a. NPS 2 and Smaller: Dielectric coupling or dielectric nipple.
 - b. NPS 2-1/2 and Larger: Prohibited except in control-valve box.
 - 2. Aboveground Piping:
 - a. NPS 2 and Smaller: Dielectric union.
 - b. NPS 2-1/2 to NPS 4: Dielectric flange.
 - c. NPS 5 and Larger: Dielectric flange kit.
 - 3. Piping in Control-Valve Boxes:
 - a. NPS 2 and Smaller: Dielectric union.
 - b. NPS 2-1/2 to NPS 4: Dielectric flange.
 - c. NPS 5 and Larger: Dielectric flange kit.

3.4 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 pipe and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

- D. Flanged Joints: Select rubber gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- E. Ductile-Iron Piping Gasketed Joints: Comply with AWWA C600 and AWWA M41.
- F. Copper-Tubing Brazed Joints: Construct joints according to CDA's "Copper Tube Handbook," using copper-phosphorus brazing filler metal.
- G. Copper-Tubing Soldered Joints: Apply ASTM B 813 water-flushable flux to tube end unless otherwise indicated. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy (0.20 percent maximum lead content) complying with ASTM B 32.
- H. PE Piping Fastener Joints: Join with insert fittings and bands or fasteners according to piping manufacturer's written instructions.
- I. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End PE Pipe and Fittings: Use butt fusion.
 - 2. Plain-End PE Pipe and Socket Fittings: Use socket fusion.
- J. PVC Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. PVC Pressure Piping: Join schedule number, ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.

3.5 VALVE INSTALLATION

- A. Valves: Install in boxes for automatic control valves or aboveground between shutoff valves.

3.6 SPRINKLER INSTALLATION

- A. Install sprinklers after hydrostatic test is completed.
- B. Install sprinklers at manufacturer's recommended heights.
- C. Locate part-circle sprinklers to maintain a minimum distance of 6 inches from walls and 2 inches from other boundaries unless otherwise indicated.

3.7 AUTOMATIC IRRIGATION-CONTROL SYSTEM INSTALLATION

- A. Equipment Mounting: Install exterior freestanding controllers within manufacturer plastic cabinet.

1. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished by manufacturer.
 2. Install anchor bolts to elevations required for proper attachment to supported equipment per manufacturer.
- B. Install control cable in same trench as irrigation piping and at least 2 inches below piping. Provide conductors of size not smaller than recommended by controller manufacturer. Install cable in separate sleeve under paved areas.

3.8 CONNECTIONS

- A. Comply with requirements for piping specified for irrigation water supply as directed by local permitting requirements and Chapter 62-524, F.A.C., rules of Florida Department of Environmental Protection for piping, fittings, and specialties.
- B. Install piping adjacent to equipment, valves, and devices to allow service and maintenance.
- C. Connect wiring between controllers and automatic control valves.

3.9 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."
- B. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplates and signs on each automatic controller.
 1. Text: In addition to identifying unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
- C. Warning Tapes: Arrange for installation of continuous, underground, detectable warning tapes over underground piping during backfilling of trenches. See Section 312000 "Earth Moving" for warning tapes.

3.10 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. 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.
- C. Tests and Inspections:
 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 2. Operational Test: After electrical circuitry has been energized, operate controllers and automatic control valves to confirm proper system operation.

3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Any irrigation product will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.11 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

2. Verify that controllers are installed and connected according to the Contract Documents.

3. Verify that electrical wiring installation complies with manufacturer's submittal.

3.12 ADJUSTING

A. Adjust settings of controllers.

B. Adjust automatic control valves to provide flow rate at rated operating pressure required for each sprinkler circuit.

C. Adjust sprinklers and devices, except those intended to be mounted aboveground, so they will be flush with finish grade.

3.13 CLEANING

A. Flush dirt and debris from piping before installing sprinklers and other devices.

3.14 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain automatic control valves and controllers.

3.15 PIPING SCHEDULE

A. Install components having pressure rating equal to or greater than system operating pressure.

B. Piping in control-valve boxes and aboveground may be joined with flanges or unions instead of joints indicated.

C. Underground irrigation main piping NPS 4 shall be one of the following:

1. Class 200 PVC pipe and socket fittings, and solvent-cemented joints.

D. Underground irrigation main piping, NPS 5 and larger, shall be the following:

1. Class 200 PVC pipe and socket fittings; and solvent-cemented joints.

E. Circuit piping, NPS 2 the following:

1. Schedule 40, PVC pipe and socket fittings; and solvent-cemented joints.

F. Circuit piping, NPS 2-1/2 to NPS 4 shall be the following:

1. Schedule 40, PVC pipe and socket fittings; and solvent-cemented joints.

- G. Underground Branches and Offsets at Sprinklers and Devices: Schedule 80, PVC pipe; threaded PVC fittings; and threaded joints.
 - 1. Option: Plastic swing-joint assemblies, with offsets for flexible joints, manufactured for this application.

END OF SECTION 01550

SECTION 01560
INTEGRALLY COLORED CONCRETE

PART 1 GENERAL

1.1 SUMMARY

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to Work of this Section.
- B. Section Includes:
- Integrally colored concrete.
 - Curing of integrally colored concrete.
- C. Related Sections:
- Division 3 Section "Cast-In-Place Concrete" for general applications of concrete and coordination of sample submittal and color selection.
 - Division 7 Section "Joint Sealants" for colored sealant for joints.

1.2 REFERENCES

- A. PCA PA124 - Finishing Concrete Slabs/Wall with Color and Texture.
- B. PCA SP021 - Color and Texture in Architectural Concrete.
- C. American Concrete Institute (ACI):
- ACI 301 "Specification for Structural Concrete for Buildings."
 - ACI 302 IR "Recommended Practice for Concrete Floor and Slab Construction."
 - ACI 303.1 "Standard Specification for Cast-In-Place Architectural Concrete."
 - ACI 304 "Recommended Practice for Measuring, Mixing, Transporting and Placing of Concrete."
 - "Recommended Practice for Hot Weather Concreting."
 - ACI 306R "Recommended Practice for Cold Weather Concreting."
- D. American Society for Testing and Materials (ASTM):
- ASTM C309 "Liquid Membrane-Forming Compounds for Curing Concrete."
 - ASTM C494 "Standard Specification for Chemical Admixtures for Concrete."

- ASTM C979 "Standard Specification for Pigments for Integrally Colored Concrete."

E. American Association of State Highway and Transportation Officials (AASHTO):

- AASHTO M194 "Chemical Admixtures."

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's complete technical data sheets for the following:

- Colored admixture.
- Curing compound.
- Design Mixes: For each type of integrally colored concrete.
- Samples for Initial Selection: Manufacturer's color charts showing full range of colors available.
- Qualification Data: For firms indicated in "Quality Assurance" Article, including list of completed projects.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer with 10-years' experience in the production of specified products.
- B. Installer Qualifications: An installer with 5 years' experience with work of similar scope and quality.
- C. Comply with the requirements of ACI 301.
- D. Obtain each specified material from same source and maintain high degree of consistency in workmanship throughout Project.
- E. Notification of manufacturer's authorized representative shall be given at least 1-week before start of Work.
- F. Integrally Colored Concrete Mockups and Field Samples REQUIRED:
- Provide under provisions of Division 1 Section "Quality Control."
 - At location on Project selected by Landscape Architect, place and finish area.

- For accurate color, the quantity of concrete mixed to produce the sample should not be less than 3 cubic yards (or not less than 1/3 the capacity of the mixing drum on the ready-mix truck) and should always be in full cubic yard increments. Excess material shall be discarded according to local regulations.
- Construct sample panel using processes and techniques intended for use on permanent work, including curing procedures. Include samples of control, construction, and expansion joints in sample panels. Field sample shall be produced by the individual workers who will perform the work for the Project.
- Retain samples of cements, sands, aggregates and color additives used in mockup for comparison with materials used in remaining work.
- Accepted field sample provides visual standard for work of Section.
- Field sample shall remain through completion of work for use as a quality standard for finished work.
- Remove mockup and field samples when directed.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Colored Admixture: Comply with manufacturer's instructions. Deliver colored admixtures in original, unopened packaging. Store in dry conditions.

1.6 PROJECT CONDITIONS

- A. Integrally Colored Concrete Environmental Requirements:
- Schedule placement to minimize exposure to wind and hot sun before curing materials are applied.
 - Avoid placing concrete if rain, frost is forecast within 24-hours. Protect fresh concrete from moisture and freezing.
 - Comply with professional practices described in ACI 305R and ACI 306R.
- B. Schedule delivery of concrete to provide consistent mix times from batching until discharge. Mix times shall meet manufacturer's written recommendations.

1.7 PRE-JOB CONFERENCE

- A. 03360-7.1 One week prior to placement of integrally colored concrete a meeting will be held to discuss the Project and application materials.

- B. It is suggested that the Landscape Architect, General Contractor, Engineer, Subcontractor, Ready-Mix Concrete Representative, and a Manufacturer's Representative be present.

1.8 ACCEPTABLE MANUFACTURERS

- A. 03360-8.1 L.M. SCOFIELD COMPANY, Douglasville, Georgia and Los Angeles, California. (800) 800-9900 or the appropriate local contact: Eastern Division – 201-672-9050; Western Division – 714-568-1870; Central Division Office – 630-377-5959. www.scofield.com
- B. Solomon Colors, Inc., 4050 Color Plant Road, Springfield, IL 62702. (800)624-0261, or the appropriate local contact. www.solomoncolors.com
- C. Or approved equal, approved by the Landscape Architect or project owner's representative.
- D. Below materials are representative of the materials provided by L.M. Scofield Company, and are provided as examples.

1.9 MATERIALS

- A. 03360-9.1 Colored Admixture for Integrally Colored Concrete: CHROMIX P® Admixture and CHROMIX GL®; L.M. SCOFIELD COMPANY.
- Admixture shall be a colored, water-reducing, admixture containing no calcium chloride with coloring agents that are lime proof and ultra-violet resistant.
 - Colored admixture shall conform to the requirements of ACI 303.1, ASTM C979, ASTM C494 and ASSHTO M194.
- B. Curing Compound for Integrally Colored Concrete: Curing compound shall comply with ASTM C309 and be of same manufacturer as colored admixture, for use with integrally colored concrete.
- Exterior Integrally Colored Concrete: LITHOCHROME® COLORWAX; L.M. SCOFIELD COMPANY. Use to cure exterior flatwork that will be allowed to cure naturally with only occasional maintenance.
 - Interior Integrally Colored Concrete: COLORCURE® (Pigmented) or CEMENTONE® (Clear); L.M. SCOFIELD COMPANY. Use to cure interior flatwork that will receive regular maintenance.
- C. Curing and Sealing Compound (if required based on recommendation of local concrete supplier): Cureseal-W™ or Cureseal-S™; L.M. SCOFIELD COMPANY. Curing and sealing compound shall comply with ASTM C309 and be of same manufacturer as colored admixture, for use with integrally colored concrete.

D. **SUBSTITUTIONS:** The use of products other than those specified will be considered providing that the Contractor requests its use in writing within 14-days prior to bid date. This request shall be accompanied by the following:

- A certificate of compliance from material manufacturer stating that proposed products meet or exceed requirements of this Section, including standards ACI 303.1, ASTM C979, ASTM C494 and AASHTO M194.
- Documented proof that proposed materials have a 10-year proven record of performance, confirmed by at least 5 local projects that the Project Landscape Architect, Engineer, or project owner's representative can examine.

1.10 COLORS

A. **Concrete Color:**

- **Cement:** Color shall be determined as gray or white as determined in the pre-construction conference.
- **Sand:** Color shall be locally available natural sand. The Contractor shall supply a sand sample representative of the sand to be used in the mix.
- **Aggregate:** Sample to be provided by the local concrete producer's standard aggregate for integral color concrete.
- **Colored Admixture:** As selected by Project Landscape Architect, Engineer, or project owner, from Scofield or Solomon color charts, or other approved supplier color charts.

1.11 CONCRETE MIX DESIGN

- A. Mix must meet requirements in technical specification for sidewalks and details provided in construction plans.
- B. Do not add calcium chloride to mix as it causes mottling and surface discoloration.
- C. Supplemental admixtures shall not be used unless approved by manufacturer.
- D. Do not add water to the mix in the field.
- E. Add colored admixture to concrete mix according to manufacturer's written instructions.

1.12 INSTALLATION

- A. Install concrete according to requirements of Division 3 Section "Cast-In-Place Concrete."
- B. Do not add water to concrete mix in the field.
- C. Surfaces shall be finished uniformly with the following finish:
 - Broomed: Pull broom across freshly floated troweled concrete to produce fine texture in straight lines perpendicular to main line of traffic. Do not dampen brooms.
 - Trowel: Precautions should be taken to ensure that the surface is uniformly troweled so that it will not be slippery. Do not over-trowel or burnish the surface

1.13 CURING

- A. Integrally Colored Concrete: Apply curing or curing and sealing compound for integrally colored concrete according to manufacturer's instructions using manufacturer's recommended application techniques, or as recommended by the local concrete producer/supplier. Apply curing or curing and sealing compound at consistent times for each pour to maintain close color consistency.
- B. Colored Curing compound shall be same color as the colored concrete and supplied by same manufacturer of the colored admixture.
- C. Precautions shall be taken in hot weather to prevent plastic cracking resulting from excessively rapid drying at surface as described in CIP 5 Plastic Shrinkage Cracking published by the National Ready Mixed Concrete Association.
- D. Do not cover concrete with plastic sheeting.

1.14 TOLERANCES

- A. Minor variations in appearance of integrally colored concrete, which are similar to natural variations in color and appearance of uncolored concrete, are acceptable.

END OF SECTION 01560

SECTION 01660
MAINTENANCE OF TRAFFIC

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Specifications Sections, apply to work of this section.
- B. Unless otherwise specified on the plan sheets or in other sections of the specifications, all materials and work shall conform to the applicable requirements in the following documents:
 - Florida Department of Transportation Design Standards, Latest Edition.
 - Florida Department of Transportation Standard Specifications for Road and Bridge Construction, Latest Edition.
 - USDOT, Federal Highway Administration Manual on Uniform Traffic Control Devices for Streets and Highways, Latest Edition, Part 6 Temporary Traffic Controls.
 - FDOT Minimum Specifications for Traffic control and Devices, Latest Edition.
 - Okaloosa County standards.

1.2 SUMMARY OF WORK

- A. The work under this section includes the maintenance of traffic within the limits of, and adjacent to the project for the duration of construction.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.1 RESPONSIBILITIES OF CONTRACTOR

- A. Provide the owner with a maintenance of traffic plan which shall be approved prior to starting work.
- B. Control and maintain traffic and provide for the safety of the work area in accordance with Maintenance of Traffic (MOT) Plan that is to be submitted to the owner or its representative for approval. Contractor shall comply with all aspects of said plan. Conduct operations in a manner that will not interrupt pedestrian and vehicle traffic except as approved by the Engineer/Traffic Division. Confine the work area to the smallest area practical to allow the maximum use of the street and sidewalk and to reduce any hazard to vehicles and pedestrians to a minimum.

- C. Maintain access to properties that adjoin the work. Contact property owners and assure that access is coordinated prior to commencing work that may block access.
- D. Furnish all labor, materials, tools, supplies, equipment, and machinery needed to fully comply with the specifications described on the plan sheets and in this Section. At all times, the Contractor shall use workers and traffic control devices necessary to comply with all applicable provisions contained in the reference documents listed in Section 1.1.

3.2 PENALTIES AND SUSPENSION OF WORK

- A. The owner may verbally direct the Contractor to immediately suspend work if appearance of violation of safety regulations is found. In such an event, Contractor shall immediately stop work and secure any potential hazards from the public until the potential violation is confirmed and/or corrected to satisfaction of the owner. Law enforcement officers may be called to assist the owner in suspending work if the Contractor is not responsive. Suspension of work for violation of safety regulations shall not be grounds for a contract time-extension or additional payment.

END OF SECTION 01660

SECTION 03300
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Description of scope and intent
1. CONTRACTOR shall provide all material, labor, and tools required to complete the installation of specified system.
 2. Any omission of reference to items required to complete the full operational and functional system specified in the section does not relieve the CONTRACTOR of the obligation to provide same.
 3. To provide installation of all items, including delivery, dispersing to the proper locations within the building, and affixing in place.
 4. Installation shall be accomplished by workers skilled in their craft that will perform their work in a professional manner and will leave the premises safe, orderly and clean.
 5. Drawings and general provisions of Contract, including General and Supplemental Conditions and Division 1 Specification Sections, apply to this Section.
 6. CONTRACTOR is responsible for coordination of work included in this specification with all other specification sections related to furnishing of all materials, labor, permits, fees and services necessary for completion of work in this section.
- B. Section Includes:
1. Formwork for cast in place concrete, with shoring, bracing, and anchorage.
 2. Formwork accessories.
 3. Form stripping.
 4. Reinforcing steel for cast in place concrete.
 5. Grout.
 6. Cast in place concrete, including concrete for the following:
 - a. Foundations, footings.
 - b. Slabs on grade.
 - c. Supported slabs.
 - d. Foundation and structural walls.
 - e. Equipment pads and bases.
 7. Concrete curing.
 8. Shoring and reshoring.

1.02 REFERENCES

All referenced standards refer to the edition in force at the time these plans and Specifications are issued for bidding.

- A. AASHTO M 182 Standard Specification for Burlap Cloth Made from Jute or Kenaf; American Association of State Highway and Transportation Officials.
- B. ACI 117 Standard Tolerances for Concrete Construction and Materials; American Concrete Institute.
- C. ACI 201.2R Guide to Durable Concrete; American Concrete Institute.
- D. ACI 211.1 Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass

Concrete; American Concrete Institute.

- E. ACI 214 Recommended Practice for Evaluation of Compression Test Results of Field Concrete.
- F. ACI 301 Specifications for Structural Concrete for Buildings; American Concrete Institute.
- G. ACI 302.1R Guide for Concrete Floor and Slab Construction; American Concrete Institute.
- H. ACI 304R Guide for Measuring, Mixing, Transporting, and Placing Concrete; American Concrete Institute.
- I. ACI 305R Hot Weather Concreting; American Concrete Institute.
- J. ACI 306R Cold Weather Concreting; American Concrete Institute.
- K. ACI 318 Building Code Requirements for Reinforced Concrete; American Concrete Institute.
- L. ACI 347R Guide to Formwork for Concrete; American Concrete Institute.
- M. ACI 350 Code Requirements for Environmental Engineering Concrete Structures.
- N. ACI 350.1 Specification for Tightness Testing of Environmental Engineering Concrete Containment Structures & Commentary
- O. ACI 372 Guide to Design and Construction of Circular Wire-and-Strand-Wrapped Prestressed Concrete Structures
- P. ACI SP 66 ACI Detailing Manual; American Concrete Institute.
- Q. ASTM A 185 Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
- R. ASTM A 615 Standard Specification for Deformed and Plain Billet Steel Bars for Concrete Reinforcement.
- S. ASTM C 31 Standard Practice for Making and Curing Concrete Test Specimens in the Field.
- T. ASTM C 33 Standard Specification for Concrete Aggregates.
- U. ASTM C 39 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- V. ASTM C 42 Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
- W. ASTM C 94 Standard Specification for Ready Mixed Concrete.
- X. ASTM C 143 Standard Test Method for Slump of Hydraulic Cement Concrete.

- Y. ASTM C 150 Standard Specification for Portland Cement.
- Z. ASTM C 171 Standard Specifications for Sheet Materials for Curing Concrete.
- AA. ASTM C 172 Standard Practice for Sampling Freshly Mixed Concrete.
- BB. ASTM C 173 Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
- CC. ASTM C 231 Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
- DD. ASTM C 260 Standard Specifications for Air Entraining Admixtures for Concrete.
- EE. ASTM C 494 Standard Specifications for Chemical Admixtures for Concrete.
- FF. ASTM C 618 Standard Specifications for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.
- GG. ASTM C 685 Standard Specifications for Concrete Made by Volumetric Batching and Continuous Mixing.
- HH. ASTM C 881 Standard Specification for Epoxy Resin Base Bonding Systems for Concrete.
- II. ASTM C 1059 Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete.
- JJ. ASTM C 1107 Standard Specification for Packaged Dry, Hydraulic Cement Grout (Nonshrink).
- KK. ASTM D 1751 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
- LL. ASTM D 1752 Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
- MM. ASTM E 154 Standard Test Methods for Water Vapor Retarders Used in Contact with Earth under Concrete Slabs, on Walls, or as Ground Cover.
- NN. ASTM E 329 Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.
- OO. CRSI Manual of Standard Practice; Concrete Reinforcing Steel Institute.
- PP. Florida Building Code – FBC

1.03 DEFINITIONS

- A. Unexposed Finish: A general use finish, with no appearance criteria, applicable to all formed concrete concealed from view after completion of construction.
- B. Exposed Finish: A general use finish applicable to all formed concrete exposed to view except those indicated to receive textured finish and including surfaces which may receive a paint coating (if

any).

1.04 SUBMITTALS

- A. All submittals shall be submitted in accordance with Section 01300.
- B. Product Data: Submit manufacturer's product data for the following:
 - 1. Formwork accessories.
 - 2. Form liners.
 - 3. Concrete admixtures.
 - 4. Grout.
 - 5. Bonding compound.
 - 6. Epoxy bonding system
- C. Aggregates: Submit test reports showing compliance with specified quality and gradation.
- D. Shop Drawings: Submit shop drawings for fabrication and placement of the following:
 - 1. Reinforcement: Comply with ACI SP 66. Include bar schedules, diagrams of bent bars, arrangement of concrete reinforcement, and splices.
 - a. Show construction joints.
 - b. Include details of reinforcement at openings through concrete structures.
 - c. Include elevations of reinforcement in walls.
 - d. Show stirrup spacing.
 - e. Concrete embedment's.
 - 2. Shoring and reshoring for elevated concrete placement shall include:
 - a. Location, size, and type of all shoring members.
 - b. Location, size, and type of all reshoring members.
 - c. Location, size, and type of all mud sills, blocking, temporary lateral bracing and other accessories necessary to safely support and brace the structure during construction.
 - d. Prepare shop drawings under seal of professional structural ENGINEER registered in the state of Florida.
- E. Quality Control Submittals
 - 1. Submit the following information related to quality assurance requirements specified:
 - 2. Design data: Submit proposed mix designs and test data before concrete operations begin. Identify for each mix submitted the method by which proportions have been selected.
 - a. For mix designs based on trial mixtures, include trial mix proportions, test results, and graphical analysis and show required average compressive strength $f'(cr)$.
 - b. Indicate quantity of each ingredient per cubic yard of concrete.
 - c. Indicate type and quantity of admixtures proposed or required.
 - 3. Test reports: Submit laboratory test reports for all testing specified.
 - 4. Certifications: Submit affidavits from an independent testing agency certifying that all materials furnished under this section conform to specifications.
 - 5. Certifications: Provide certification from manufacturers of concrete admixtures that chloride content complies with specified requirements.
 - 6. Certifications: Submit mill test certificates for all reinforcing steel furnished under this section, showing physical and chemical analysis.
 - 7. Placement schedule: Submit concrete placement schedule prior to start of any concrete placement operations. Include location of all joints indicated on drawings, plus anticipated construction joints.
 - 8. Submit batch tickets complying with ASTM C 685 or delivery tickets complying with ASTM C 94, as applicable, for each load of concrete used in the work.
 - a. Include on the tickets the additional information specified in the ASTM document.
 - 9. Cold weather concreting: Submit description of planned protective measures.

10. Hot weather concreting: Submit description of planned protective measures.
11. Mass Concrete: Submit description of planned protective measures.

1.05 QUALITY ASSURANCE

- A. Codes and Standards: Comply with the following documents, except where requirements of the contract documents or of governing codes and governing authorities are more stringent:
 1. ACI 301
 2. ACI 318
 3. ACI 350
 4. CRSI Manual of Standard Practice.
- B. Testing Agency Services:
 1. Employ, at CONTRACTOR's expense, an independent testing agency acceptable to the ENGINEER to perform specified tests and other services required for quality assurance.
 - a. Testing agency shall meet ASTM E 329 requirements.
- C. Source of Materials: Obtain materials of each type from same source for the entire project.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver reinforcement to project site bundled and tagged with metal tags indicating bar size, lengths, and other data corresponding to information shown on placement drawings.
 1. Concrete reinforcement materials stored on the site shall be kept on concrete blocks and supported off the ground to prevent damage and accumulation of water, dirt, or rust.
- B. Store cementitious materials in a dry, weather tight location. Maintain accurate records of shipment and use.
- C. Store aggregates to permit free drainage and to avoid contamination with deleterious matter or other aggregates. When stockpiled on ground, discard bottom 6 inches of pile.
- D. Handle aggregates to avoid segregation.

1.07 PROJECT CONDITIONS

- A. Cold Weather Concreting: Comply fully with the recommendations of ACI 306.
 1. Well in advance of proposed concreting operations, advise the ENGINEER of planned protective measures including but not limited to heating of materials, heated enclosures, and insulating blankets.
- B. Hot Weather Concreting: Comply fully with the recommendations of ACI 05R.
 1. Well in advance of proposed concreting operations, advise the ENGINEER of planned protective measures including but not limited to cooling of materials before or during mixing, placement during evening to dawn hours, fogging during finishing and curing, shading, and windbreaks.
- C. Mass Concrete: Comply fully with the recommendations of ACI 207.1R.
 1. Well in advance of proposed concreting operations, advise the ENGINEER of planned protective measures including but not limited to cooling of materials before or during mixing, placement, curing, forms, height of lifts (max 8ft), and monitoring.

PART 2- PRODUCTS

2.01 FORMWORK

- A. Facing Materials:
 - 1. Unexposed finish concrete: Any standard form materials that produce structurally sound concrete.
 - 2. Exposed finish concrete: Materials selected to offer optimum smooth, stain free final appearance and minimum number of joints. Provide materials with sufficient strength to resist hydrostatic head without bow or deflection in excess of allowable tolerances.
 - 3. Textured finish concrete: Materials or linings as indicated on the drawings, or as required to match ENGINEER's control sample.
- B. Formwork Accessories:
 - 1. Form coating: Form release agent that will not adversely affect concrete surfaces or prevent subsequent application of concrete coatings.
 - 2. Metal ties: Commercially manufactured types; cone snap ties, taper removable bolt, or other type which will leave no metal closer than 1-1/2 inches from surface of concrete when forms are removed, leaving not more than a 1 inch diameter hole in concrete surface.
 - 3. Fillets: Wood or plastic fillets for chamfered corners, in maximum lengths possible.

2.02 REINFORCING MATERIALS

- A. Reinforcing Bars: Provide deformed bars complying with the following, except where otherwise indicated:
 - 1. ASTM A 615, Grade 60.
- B. Welded Wire Fabric: ASTM A 185, cold drawn steel, plain.
- C. Reinforcing Accessories:
 - 1. Tie wire: Black annealed type, 16-1/2 gage or heavier.
 - 2. Supports: Bar supports conforming to specifications of CRSI "Manual of Standard Practice."
 - a. Class 1 (plastic protected) at all formed surfaces which will be exposed to weather.
 - b. Class 1 (plastic protected) or Class 2 (stainless steel protected) at all formed surfaces which will be exposed to view but not to weather.
 - c. Precast concrete blocks of strength equal to or greater than specified strength of concrete or Class 3 supports equipped with sand plates, where concrete will be cast against earth. Concrete masonry units will not be accepted.

2.03 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, and as follows:
 - 1. Type I, except where other type is specifically permitted or required.
 - 2. Type II shall be used for moderate sulfate resistance conditions, retaining walls and exposed concrete not included in Type V below and when hot weather concreting is required.
 - 3. Type III shall be used for high early strength and when cold weather concreting is required.
 - 4. Type IV shall be used for low heat of hydration when mass concreting is required.
 - 5. Type V shall be used for high sulfate resistance conditions, all environmental and all water or wastewater liquid retaining structures (includes all wet well surfaces). (An alternate Type V cement mixture shall be a Type I/II. The CONTRACTOR shall submit the Type I/II cement for review, concrete mix design where the Type I/II was utilized and 30 concrete break test results of where the Type I/II cement was implemented).
- B. Fly Ash: ASTM C 618, Type C or F.
- C. Water: Potable.
- D. Aggregates:

1. Normal weight concrete: ASTM C 33.
 - a. Class 5M.
 - b. Gradation as specified below under mix design.

- E. Admixtures General: Admixtures which result in more than 0.1 percent of soluble chloride ions by weight of cement are prohibited.

- F. Air Entraining Admixture: ASTM C 260 and certified by manufacturer for compatibility with other mix components.
 1. Products: The following products, provided they comply with requirements of the contract documents, will be among those considered acceptable:
 - a. "Air Mix"; The Euclid Chemical Company.
 - b. "Sika Aer"; Sika Corporation.
 - c. "Micro Air"; Master Builders, Inc.
 - d. "Darex AEA"; W. R. Grace & Co.

- G. Water Reducing, Retarding Admixture: ASTM C 494, Type D.
 1. Products: The following products, provided they comply with requirements of the contract documents, will be among those considered acceptable:
 - a. "Pozzolith Retarder"; Master Builders, Inc.
 - b. "Eucon Retarder 75"; The Euclid Chemical Company.
 - c. "Daratard 17"; W. R. Grace & Co.
 - d. "PSI R Plus"; Cormix Construction Chemicals.
 - e. "Plastiment"; Sika Corporation.
 - f. "Protard"; Master Builders, Inc. (former Conchem product).

- H. Water Reducing and Accelerating Admixtures: ASTM C 494, Type E.
 1. Products: The following products, provided they comply with requirements of the contract documents, will be among those considered acceptable:
 - a. "Accelguard 80"; The Euclid Chemical Company.
 - b. "Pozzutec 20"; Master Builders, Inc.
 - c. "Gilco Accelerator"; Cormix Construction Chemicals.

- I. High Range Water Reducing Admixture (Superplasticizer): ASTM C 494, Type F or G.
 1. Products: The following products, provided they comply with requirements of the contract documents, will be among those considered acceptable:
 - a. "WRDA 19" or "Daracem 100"; W. R. Grace & Co.
 - b. "PSP Superplasticizer"; Master Builders, Inc. (former Conchem product).
 - c. "Sikament 300"; Sika Corporation.
 - d. "Eucon 37"; The Euclid Chemical Company.
 - e. "PSI Super"; Cormix Construction Chemicals.
 - f. "Rheobuild"; Master Builders, Inc.

2.04 MISCELLANEOUS MATERIALS AND ACCESSORIES

- A. Vapor Retarder: Membrane for installation beneath building slabs on grade, resistant to decay when tested in accordance with ASTM E 154, and as follows:
 1. Polyethylene sheet, not less than 8 mils thick.

- B. Nonshrink Grout: ASTM C 1107.
 1. Minimum 4000 psi grout compressive strength
 2. Type: Provide nonmetallic type only.
 3. Products: The following products, provided they comply with requirements of the contract documents, will be among those considered acceptable:

- a. Nonmetallic type:
 - 1) "Masterflow 928"; Master Builders, Inc.
 - 2) "SonogROUT 14k"; Sonneborn Building Products Division ChemRex, Inc.
 - 3) "Euco N S Grout"; The Euclid Chemical Company.
 - 4) "Supreme"; Cormix Construction Chemicals.
 - 5) "Five Star Grout"; Five Star Products, Inc.
- C. Burlap: AASHTO M 182, Class 2 jute or kenaf cloth.
- D. Moisture Retaining Cover: ASTM C 171, and as follows:
 1. Curing paper.
 2. Polyethylene film.
 3. White burlap polyethylene sheeting.
- E. Bonding Compound: Non redispersible acrylic bonding admixture, ASTM C 1059, Type II.
 1. Products: The following products, provided they comply with requirements of the contract documents, will be among those considered acceptable:
 - a. "Everbond"; L & M Construction Chemicals, Inc.
 - b. "Flex Con"; The Euclid Chemical Company.
- F. Epoxy Bonding Systems: Epoxy adhesive for bonding fresh concrete to hardened concrete and for grouting wall pipes, bolts and reinforcing dowels. ASTM C 881; type, grade, and class as required for project conditions.
 1. Products: The following products, provided they comply with requirements of the contract documents, will be among those considered acceptable:
 - a. "Concresive LPL"; Master Builders, Inc.
 - b. "Sikadur 32 Hi Mod"; Sika Corporation.
 - c. "Euco #452 Epoxy System"; The Euclid Chemical Company.
 - d. "Sikastix 390".
 - e. "EucoEpoxy 461".
 - f. "Five Star Epoxy Grout".
 - g. "Sikstix 370".
 - h. "EucoEpoxy 463".
- G. Expansion Joint Filler
 1. Expansion Joint Filler shall be performed non-extruding and resilient type meeting the Specifications of ASTM D1751, or D1752, unless otherwise specified.
 2. All expansion joints in base slabs on grade other than hydraulic structures shall be fiber expansion joints of required slab depth meeting the requirement of ASTM D1751, Type I and AASHTO M213. Exposed joints shall be sealed as specified below.
 3. All expansion joints in hydraulic structures shall be ¾ inch sponge rubber expansion joints of required wall thickness meeting the requirements of ASTM D1752, Type I and AASHTO M153, Type I. Joints shall be sealed on both sides as specified below.
 - a. Nonextruding bituminous type: ASTM D 1751.
 - b. Sponge rubber type: ASTM D 1752, Type I.
- H. Expansion Joint Sealer
 1. Joint sealants for hydraulic structures shall be one of the following, or approved equal:
 - a. "CM-60" two-part gray tone, as manufactured by W. R. Meadows, Inc., applied over a backer rod sized for the joint. Underwater primer shall be used on all joints subject to immersion. Standard "CM-60" primer shall be applied to all other joints. Sealant depth shall be one-half the width of the joint.
 - b. The sealant shall be a two-part, polyurethane sealant "Eucolastic I" by the Euclid Chemical Company or "Sikaflex 1a" by Sika Chemical Company. Joint width should

be 4 times the expected joint movement, but not less than ¼ inch. All joints shall be primed with "Eucolastic Primer" by the Euclid Chemical Company or "Sikaflex 429" by Sika Chemical Company.

- I. PVC Waterstops
Waterstops: Made of Polyvinyl Chloride (PVC) and of subzero grade, Plastigrip, Type W-6 as manufactured by Progress Unlimited, Inc. or approved equivalent.
 1. Minimum 4" x 3/16" or as specified on the drawings.
 2. Produced from a compound, the base resin of which shall be virgin PVC.
 3. Minimum Properties:
 - a. 2000 psi minimum tensile strength, ASTM D412-51T
 - b. 350% minimum elongation, ASTM D412-51T
 - c. -35 degrees F minimum low temperature brittleness, ASTM D746-57T
 - d. 65-75 shore 'A' durometer hardness, ASTM D676-59T
 - e. 0.15 maximum water absorption, ASTM D570-59T
 4. Field Splicing:
 - a. Butt splices shall be fused welded using a thermostatically controlled Teflon PVC Waterstop iron at the Manufacturer's recommended temperature
 - b. Lapping, gluing or use of adhesives shall not be permitted.
 - c. Provide factory made waterstop fabrications for all changes of directions, intersections, and transitions leaving only butt joint splicing for the field.
 5. Center waterstop in the joint and secure in correct position.
 6. Use ribbed center bulb for all moving joints. Use dumbbell for all non-movement joints.
 7. Always place the center bulb in the center of the expansion joint. Do not embed the center bulb in concrete.
 8. Vibrate concrete around waterstops thoroughly to prevent honeycombing and to ensure contact between concrete and waterstop.

2.05 CONCRETE MIX DESIGN

- A. Review: Do not begin concrete operations until proposed mix has been reviewed by the ENGINEER.
- B. Proportioning of Normal Weight Concrete: Comply with recommendations of ACI 211.1.
- C. Required Average Strength: Establish the required average strength $f'(cr)$ of the design mix on the basis of trial mixtures as specified in ACI 301, and proportion mixes accordingly. Employ an independent testing agency acceptable to the ENGINEER for preparing and reporting proposed mix design.
- D. Proportion normal-weight concrete mix to produce an average strength at 28 day as follows unless otherwise indicated on the drawings:
 1. Columns, beams, walls, footings, pile caps and slabs: 4000 psi
 2. Masonry Filled Grout: 3000 psi
 3. Prestressed Elements: 5000 psi
- E. Fly Ash:
 1. The CONTRACTOR may elect to replace a portion of the Portland cement with fly ash up to a maximum of 25 percent by weight of cement plus fly ash.
- F. Admixtures:
 1. Air entraining admixture: Add at rate to achieve specified air content.
 - a. Do not use in slabs on grade scheduled to receive topping, unless manufacturer of topping recommends use over air entrained concrete.

2. Water reducing and retarding admixture: Add as required in concrete mixes to be placed at ambient temperatures above 90 degrees F.
 3. Water reducing and accelerating admixture: Add as required in concrete mixes to be placed at ambient temperatures below 50 degrees F.
 4. High range water reducing admixture (superplasticizer): Add as required for placement and workability.
 5. Do not use admixtures not specified or approved.
- G. Design mix to meet or exceed each requirement specified. Where more than one criterion is specified, the most stringent shall apply. For example, a minimum cement content or maximum water cement ratio might result in strengths greater than the minimum specified; likewise, a greater cement content or lower water cement ratio may be required in order to achieve the required strength.
1. Specified compressive strength $f(c)$ (ASTM C 39): As noted
 2. Maximum water cement ratio by weight:
 - a. 0.4 for concrete toppings subject to traffic
 - b. 0.45 for all other concrete
 3. Maximum slump: As recommended in ACI 211.1. and ACI 350 as applicable.
 4. Gradation of coarse aggregate: ASTM C 33 standard gradation with maximum nominal size of 3/4 inches.
 5. Total air content (ASTM C 173 or ASTM C 231): 5 percent.
- H. Mix Adjustments: Provided that no additional expense to OWNER is involved, CONTRACTOR may submit for ENGINEER's approval requests for adjustment to approved concrete mixes when circumstances such as changed project conditions, weather, or unfavorable test results occur. Include laboratory test data substantiating specified properties with mix adjustment requests.

2.06 CONTROL OF MIX IN THE FIELD

- A. Slump: A tolerance of up to 1 inch above that specified will be permitted for 1 batch in 5 consecutive batches tested. Concrete of lower slump than that specified may be used, provided proper placing and consolidation is obtained.
1. If slump upon arrival at the site is lower than 1 inch below the value specified, one addition of water in accordance with ASTM C 94 will be permitted to bring slump within tolerance, provided that:
 - a. A positive means is available to measure the amount of water added at the site.
 - b. The specified (or approved) maximum water cement ratio is not exceeded.
 - c. Not more than 45 minutes have elapsed since batching.
- B. Total Air Content: A tolerance of plus or minus 1 1/2 percent of that specified will be allowed for field measurements.
- C. Do not use batches that exceed tolerances.

2.07 CONCRETE MIXING

- A. On Site Equipment: Mix concrete materials in appropriate drum type batch machine mixer, in compliance with ASTM C 685. Mix each batch minimum of 1 1/2 minutes and maximum of 5 minutes before discharging concrete. Clean thoroughly at end of day and before changing concrete type.
- B. Transit Mixers: Mix concrete materials in transit mixers, complying with requirements of ASTM C 94.
1. At ambient temperatures of 85 to 90 degrees F, reduce mixing and delivery time to 75

- minutes.
2. At ambient temperatures above 90 degrees F, reduce mixing and delivery time to 60 minutes.

PART 3- EXECUTION

3.01 CONCRETE FORM PREPARATION

- A. General: Comply with requirements of ACI 301 for formwork, and as herein specified. The CONTRACTOR is responsible for design, ENGINEER, and construction of formwork, and for its timely removal.
- B. Earth Forms: Hand trim bottoms and sides of earth forms to profiles indicated on the drawings. Remove loose dirt before placing concrete.
- C. Design: Design and fabricate forms for easy removal, without impact, shock, or damage to concrete surfaces or other portions of the work. Design to support all applied loads until concrete is adequately cured, within allowable tolerances and deflection limits.
- D. Construction: Construct and brace formwork to accurately achieve end results required by contract documents, with all elements properly located and free of distortion. Provide for necessary openings, inserts, anchorages, and other features shown or otherwise required.
 1. Joints: Minimize form joints and make watertight to prevent leakage of concrete.
 - a. Align joints symmetrically at exposed conditions.
 2. Chamfers: Provide chamfered edges and corners at exposed locations, unless specifically indicated otherwise on the drawings.
 3. Permanent openings: Provide openings to accommodate work of other trades, sized and located accurately. Securely support items built into forms; provide additional bracing at openings and discontinuities in formwork.
 4. Temporary openings: Provide temporary openings for cleaning and inspection in most inconspicuous locations at base of forms, closed with tight fitting panels designed to minimize appearance of joints in finished concrete work.
- E. Tolerances for Formed Surfaces: Comply with minimum tolerances established in ACI 117, unless more stringent requirements are indicated on the drawings.
- F. Release Agent: Provide either form materials with factory applied non-absorptive liner or field applied form coating. If field applied coating is employed, thoroughly clean and recondition formwork and reapply coating before each use. Rust on form surfaces is unacceptable.

3.02 VAPOR RETARDER INSTALLATION

- A. General: Place vapor retarder sheet over prepared base material, aligning longer dimension parallel to direction of pour and lapped 6 inches. Seal joints with appropriate tape.

3.03 PLACING REINFORCEMENT

- A. General: Comply with requirements of ACI 301 and as herein specified.
- B. Preparation: Clean reinforcement of loose rust and mill scale, soil, and other materials which adversely affect bond with concrete.
- C. Placement: Place reinforcement to achieve not less than minimum concrete coverages required for protection. Accurately position, support, and secure reinforcement against displacement. Provide Class C tension lap splices complying with ACI 318 unless otherwise indicated. Do not field bend partially embedded bars unless otherwise indicated or approved.

1. Use approved bar supports and tie wire, as required. Set wire ties to avoid contact with or penetration of exposed concrete surfaces. Tack welding of reinforcing is not permitted.
2. Wire fabric: Install in maximum lengths possible, lapping adjoining pieces not less than one full mesh. Offset end laps to prevent continuous laps in either direction, and splice laps with tie wire.

D. Welding: Welding of reinforcement is not permitted.

3.04 JOINT CONSTRUCTION

- A. Construction Joints: Locate and install construction joints as indicated on drawings. If construction joints are not indicated, locate in manner which will not impair strength and will have least impact on appearance, as acceptable to the ENGINEER. Construction joints in retaining walls and walls of concrete tanks or structures subject to hydrostatic pressure shall be intentionally roughened to a full amplitude of approximately ¼ inch.
1. Keyways: Provide keyways not less than 1 1/2 inches deep.
 2. Reinforcement: Continue reinforcement across and perpendicular to construction joints, unless details specifically indicate otherwise.
- B. Isolation Joints: Construct isolation joints in slabs poured on grade at points of contact with vertical components, such as foundation walls and column pedestals. Install expansion joint filler to full concrete depth. Recess top edge of filler 1/8 inch where joints are unsealed.
- C. Expansion Joints: Construct expansion joints where indicated. Install expansion joint filler to full depth of concrete. Recess edge of filler to depth indicated to receive joint sealant and backer rod as specified herein and detailed on drawings.
- D. Control Joints: Construct contraction joints in building slabs poured on grade to form panels of sizes indicated on drawings, but not more than 20 feet apart in either direction.
1. Saw cuts: Form control joints by means of saw cuts one fourth the depth of the slab, performed as soon as possible after slab finishing without dislodging aggregate.

3.05 INSTALLATION OF EMBEDDED ITEMS

- A. General: Set anchorage devices and other items required for other work connected to or supported by cast in place concrete, using templates, setting drawings, and instructions from suppliers of items to be embedded.
1. Edge Forms and Screeds: Set edge forms and intermediate screeds as necessary to achieve final elevations indicated for finished slab surfaces.

3.06 WATERSTOPS

- A. Waterstops shall be provided at all joints to seal off leakage of liquid from or into concrete tanks or structures subject to hydrostatic pressures. The type of water stops used shall be as shown on the Drawings and as specified herein. The CONTRACTOR shall submit to the ENGINEER for approval the proposed procedure and schedule of concrete placing operations along with a detailed layout of the waterstop materials required showing sizes, lengths and types of joints.
- B. Where required for proper location of waterstops, whether shown on the Drawings or not, starter walls of up to 1-1/2 inches in height and monolithic with slabs shall be provided at all wall construction joints. Reinforcing steel shall not be depressed at waterstops but shall have only the amount of concrete covering shown or specified. Starter walls as specified shall be required whether shown on the Drawings or not, unless specified concrete cover over reinforcing steel is 3 inches or greater.

3.07 CONCRETE PLACEMENT

- A. Preparation: Provide materials necessary to ensure adequate protection of concrete during inclement weather before beginning installation of concrete.
- B. Inspection: Before beginning concrete placement, inspect formwork, reinforcing steel, and items to be embedded, verifying that all such work has been completed.
 - 1. Wood forms: Moisten immediately before placing concrete in locations where form coatings are not used.
- C. Placement General: Comply with requirements of ACI 304 and as follows:
 - 1. Concreting should be carried on at such a rate that the concrete is at all times plastic and flows readily into spaces between reinforcement.
 - 2. Schedule continuous placement of concrete to prevent the formation of cold joints.
 - 3. Provide construction joints if concrete for a particular element or component cannot be placed in a continuous operation.
 - 4. Deposit concrete as close as possible to its final location, to avoid segregation.
 - 5. Concrete shall be worked around reinforcement and embedded fixtures and into corners of forms.
 - 6. The following shall be prohibited from use:
 - a. Partially hardened concrete.
 - b. Contaminated concrete.
 - c. Re-tempered concrete.
 - d. Re-mixed concrete after initial set has occurred.
- D. Placement in Forms: Limit horizontal layers to depths which can be properly consolidated, but in no event greater than 24 inches.
 - 1. Consolidate concrete by means of mechanical vibrators, inserted vertically in freshly placed concrete in a systematic pattern at close intervals. Penetrate previously placed concrete to ensure that separate concrete layers are knitted together.
 - 2. Vibrate concrete sufficiently to achieve consistent consolidation without segregation of coarse aggregates.
 - 3. Do not use vibrators to move concrete laterally.
- E. Slab Placement: Schedule continuous placement and consolidation of concrete within planned construction joints.
 - 1. Thoroughly consolidate concrete without displacing reinforcement or embedded items, using internal vibrators, vibrating screeds, roller pipe screeds, or other means acceptable to ENGINEER.
 - 2. Strike off and level concrete slab surfaces, using highway straightedges, darbies, or bull floats before bleed water can collect on surface. Do not work concrete further until finishing operations are commenced.
- F. Cold Weather Placement: Comply with recommendations of ACI 306 when air temperatures are expected to drop below 40 degrees F either during concrete placement operations or before concrete has cured.
 - 1. Do not use frozen or ice laden materials.
 - 2. Do not place concrete on frozen substrates.
- G. Hot Weather Placement: Comply with recommendations of ACI 305R when ambient temperature before, during, or after concrete placement is expected to exceed 90 degrees F or when combinations of high air temperature, low relative humidity, and wind speed are such that the rate of evaporation from freshly poured concrete would otherwise exceed 0.2 pounds per square foot per hour.

1. Do not add water to approved concrete mixes under hot weather conditions.
 2. Provide mixing water at lowest feasible temperature and provide adequate protection of poured concrete to reduce rate of evaporation.
 3. Use fog nozzle to cool formwork and reinforcing steel immediately prior to placing concrete.
- H. Mass Concrete Placement: Comply with recommendations of ACI 207.1R when any volume of concrete with dimensions large enough to require that measures be taken to cope with generation of heat from hydration of the cement and attendant volume change to minimize cracking.
1. When the minimum dimension of the concrete exceeds 36 inches and the ratio of volume of concrete to the surface area is greater than 12 inches, provide for mass concrete.
 2. Lifts shall not exceed 8ft.

3.08 FINISHING FORMED SURFACES

- A. Repairs, General: Repair surface defects, including tie holes, immediately after removing formwork.
1. Remove honeycombed areas and other defective concrete down to sound concrete, cutting perpendicular to surface or slightly undercutting. Dampen patch location and area immediately surrounding it prior to applying bonding compound or patching mortar.
 2. Before bonding compound has dried, apply patching mixture matching original concrete in materials and mix except for omission of coarse aggregate, and using a blend of white and normal Portland cement as necessary to achieve color match. Consolidate thoroughly and strike off slightly higher than surrounding surface.
- B. Textured Form Finish: Repair tie holes and patch defective areas to match pattern created by form construction or form liners.
- C. Unexposed Form Finish: Repair tie holes and patch defective areas. Rub down or chip off fins or other raised areas exceeding ¼-inch height.
- D. Exposed Form Finish: Repair and patch defective areas, with fins or other projections completely removed and smoothed.
1. Smooth rubbed finish: Apply to surfaces indicated no later than 24 hours after form removal.
 - a. Wet concrete surfaces to be finished and rub with Carborundum brick or other abrasive until uniform color and texture are achieved.
 - b. Do not apply separate grout mixture.
 2. Contiguous unformed surfaces: Strike smooth and float to a similar texture tops of walls, horizontal offsets, and other unformed surfaces adjacent to or contiguous with formed surfaces. Continue final finish of formed surfaces across unformed surfaces, unless otherwise specifically indicated.

3.09 FINISHING SLABS

- A. Finishing Operations
1. Do not directly apply water to slab surface or dust with cement.
 2. Use hand or powered equipment only as recommended in ACI 302.1R.
 3. Screeding: Strike off to required grade and within surface tolerances indicated. Verify conformance to surface tolerances. Correct deficiencies while concrete is still plastic.
 4. Bull Floating: Immediately following screeding, bull float or darby before bleed water appears to eliminate ridges, fill in voids, and embed coarse aggregate. Recheck and correct surface tolerances.
 5. Do not perform subsequent finishing until excess moisture or bleed water has disappeared and concrete will support either foot pressure with less than ¼-inch indentation or weight of power floats without damaging flatness.
 6. Final floating: Float to embed coarse aggregate, to eliminate ridges, to compact concrete, to

consolidate mortar at surface, and to achieve uniform, sandy texture. Recheck and correct surface tolerances.

- B. Coordinate appearance and texture of required final finishes with the ENGINEER before application.
 - 1. Apply final finishes in the locations indicated on the drawings.
- C. Float Finish: As specified above.
- D. Broomed Float Finish: After floating and when water sheen has practically disappeared, apply uniform transverse corrugations approximately 1/16-inch deep, without tearing surface.
- E. Slab Surface Tolerances:
 - 1. Achieve flat, level planes except where grades are indicated. Slope uniformly to drains.
 - 2. Floated finishes: Depressions between high spots shall not exceed 5/16 inch under a 10-foot straightedge.
- F. Repair of Slab Surfaces: Test slab surfaces for smoothness and to verify surface plane to tolerance specified. Repair defects as follows:
 - 1. High areas: Correct by grinding after concrete has cured for not less than 14 days.
 - 2. Low areas: Immediately after completion of surface finishing operations, cut out low areas and replace with fresh concrete. Finish repaired areas to blend with adjacent concrete. Proprietary patching compounds may be used when approved by the ENGINEER.
 - 3. Craze or cracked areas: Cut out defective areas, except random cracks and single holes not exceeding 1 inch in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts. Dampen exposed concrete and apply bonding compound. Mix, place, compact, and finish patching concrete to match adjacent concrete.
 - 4. Isolated cracks and holes: Groove top of cracks and cut out holes not over 1 inch in diameter. Dampen cleaned concrete surfaces and apply bonding compound; place dry pack or proprietary repair compound acceptable to ENGINEER while bonding compound is still active:
 - a. Dry pack mix: One part Portland cement to 2-1/2 parts fine aggregate and enough water as required for handling and placing.
 - b. Install patching mixture and consolidate thoroughly, striking off level with and matching surrounding surface. Do not allow patched areas to dry out prematurely.

3.10 CONCRETE CURING AND PROTECTION

- A. General
 - 1. Prevent premature drying of freshly placed concrete and protect from excessively cold or hot temperatures until concrete has cured.
 - 2. Provide curing of concrete by one of the methods listed and as appropriate to service conditions and type of applied finish in each case.
- B. Curing Period
 - 1. Not less than 7 days for standard cements and mixes.
 - 2. Not less than 4 days for high early strength concrete using Type III cement.
- C. Curing Temperature
 - 1. Concrete shall be maintained above 50 degrees F and in moist condition during the entire curing period.

- D. Formed Surfaces: Cure formed concrete surfaces by moist curing with forms in place for full curing period.
 - 1. Keep wooden or metal forms moist when exposed to heat of the sun.
 - 2. If forms are removed prior to completion of curing process, continue curing by one of the applicable methods specified.

- E. Surfaces Not in Contact with Forms
 - 1. Start initial curing as soon as free water has disappeared, but before surface is dry.
 - 2. Keep continuously moist for not less than 3 days by uninterrupted use of any of the following:
 - a. Water ponding.
 - b. Water saturated sand.
 - c. Water fog spray.
 - d. Saturated burlap: Provide 4-inch minimum overlap at joints.
 - 3. Begin final curing procedures immediately following initial curing and before concrete has dried.
 - a. Moisture retaining cover: Lap not less than 3-inches at edges and ends, and seal with waterproof tape or adhesive. Repair holes or tears during curing period with same tape or adhesive. Maintain covering in intimate contact with concrete surface. Secure to avoid displacement.
 - 1) Extend covering past slab edges at least twice the thickness of slab.
 - 2) Do not use plastic sheeting on surfaces which will be exposed to view when in service.
 - 3) Continue final curing to end of curing period.

- F. Avoid rapid drying at end of curing period.

- G. During and following curing period, protect concrete from temperature changes of adjacent air in excess of 5 degrees F per hour and 50 degrees F per 24 hours. Progressively adjust protective measures to provide uniform temperature changes over entire concrete surface.

3.11 SHORES AND SUPPORTS

- A. General: Comply with recommendations of ACI 347 for shoring and reshoring in multistory construction.

- B. Low Rise Construction: Extend shoring from ground to roof for structures 4 stories or less in height.

- C. Reshoring: Remove shores and reshore in a planned sequence, to avoid damage to partly cured concrete. Locate and provide adequate reshoring to safely support work without excessive stress or deflection.

- D. Provide as a package, shoring and reshoring drawings prepared by or under the direct supervision of a specialty ENGINEER registered in the State of Florida.

3.12 REMOVAL OF FORMS AND SUPPORTS

- A. Non Load Bearing Formwork: Provided that concrete has hardened sufficiently that it will not be damaged, forms not actually supporting weight of concrete or weight of soffit forms may be removed after concrete has cured at not less than 50 degrees F for 24 hours. Maintain curing and protection operations after form removal.

- B. Load Bearing Formwork: Do not remove shoring and forms supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements, until concrete has attained at least the

specified compressive strength $f(c)$ and until the CONTRACTOR has determined that the actual compressive strength attained is adequate to support the weight of the concrete and superimposed loads.

- C. Keep reshores in place a minimum of 15 days after placing upper tier, and longer if required, until concrete has attained at least the specified compressive strength $f(c)$ and until the CONTRACTOR has determined that the actual compressive strength attained is adequate to support the weight of the concrete and superimposed loads.
- D. Keep supports in place until heavy loads due to construction operations have been removed.
- E. Test field cured specimens to determine potential compressive strength of concrete for specific locations.

3.13 MISCELLANEOUS CONCRETE ITEMS

- A. Fill in: Fill in holes and openings left in concrete structures for passage of work by other trades after such work is in place. Place such fill in concrete to blend with existing construction, using same mix and curing methods.
- B. Equipment Bases and Foundations: Provide machine and equipment bases and foundations, as indicated on Drawings. Set anchor bolts at correct elevations, complying with diagrams or templates of equipment manufacturer.
 - 1. Grout base plates and foundations as indicated with non-shrink grout.
 - 2. Use nonmetallic grout for exposed conditions, unless otherwise indicated.
 - 3. Equipment bases shall be sized to provide a minimum of 1.5" between the edge of the equipment bases and the edge of the equipment being served.
 - 4. Provide conduit windows through equipment bases of electrical equipment sized no larger than the conduit windows of the equipment being served.
 - 5. Equipment bases for electrical equipment shall be a minimum of 4" thick with chamfered edges.
- C. Reinforced Masonry: Provide concrete grout for reinforced masonry where indicated on Drawings and as scheduled.

3.14 CONCRETE REPAIRS

- A. General: Repairs due to poor workmanship shall be made by the CONTRACTOR at the CONTRACTOR's expense and shall be approved by the ENGINEER prior to repair procedure being implicated.
- B. Perform cosmetic repairs of concrete surfaces as specified under concrete application.
- C. Perform structural repairs with prior approval of the ENGINEER for method and procedure, using epoxy bonding systems. The ENGINEER's approval is required for repair methods using materials other than those specified.

3.15 QUALITY CONTROL TESTING DURING CONSTRUCTION

- A. Refer to Section 01410 for additional concrete testing requirements for the project.
- B. Composite Sampling and Making and Curing of Specimens: ASTM C 172 and ASTM C 31.
 - 1. Take samples at point of discharge.

2. For pumped concrete, perform sampling and testing at the frequencies specified herein at point of delivery to pump, and perform additional sampling and testing at the same frequency at discharge from line.
3. Results obtained at discharge from line shall be used for acceptance of concrete.
- C. Slump: ASTM C 143. One test per strength test and additional tests if concrete consistency changes.
 1. Modify sampling to comply with ASTM C 94.
- D. Air Content of Normal Weight Concrete: ASTM C 173 or ASTM C 231. One test per strength test performed on air entrained concrete.
- E. Concrete Temperature:
 1. Test hourly when air temperature is 40 degrees F or below.
 2. Test hourly when air temperature is 90 degrees F or above.
 3. Test each time a set of strength test specimens is made.
- F. Compressive Strength Tests: ASTM C 39.
 1. Compression test specimens: Mold and cure one set of 4 standard cylinders for each compressive strength test required.
 2. Testing for acceptance of potential strength of as delivered concrete:
 - a. Obtain samples on a statistically sound, random basis.
 - b. Minimum frequency:
 - 1) One set per 100 cubic yards or fraction thereof for each day's pour of each concrete class.
 - 2) One set per 3500 square feet of slab or wall area or fraction thereof for each day's pour of each concrete class.
 - 3) When the above testing frequency would provide fewer than 5 strength tests for a given class of concrete during the project, conduct testing from not less than 5 randomly selected batches, or from each batch if fewer than 5.
 - c. Test one specimen per set at 7 days for information unless an earlier age is required.
 - d. Test 2 specimens per set for acceptance of strength potential; test at 28 days unless other age is specified. The test result shall be the average of the two specimens. If one specimen shows evidence of improper sampling, molding, or testing, the test result shall be the result of the remaining specimen; if both show such evidence, discard the test result and inform the ENGINEER.
 - e. Retain one specimen from each set for later testing, if required.
 - f. Strength potential of as delivered concrete will be considered acceptable if all of the following criteria are met:
 - 1) No individual test result falls below specified compressive strength by more than 500 psi.
 - 2) Average of any 3 consecutive strength test results equals or exceeds specified compressive strength f'_c .
 - 3) Testing for evaluation of field curing:
 - a) Frequency: 1 field set of specimens per strength acceptance test.
 - b) Mold specimens from same sample used for strength acceptance tests. Field cure, and test at same age as for strength acceptance tests.
 - c) Evaluate construction and curing procedures and implement corrective action when strength results for field cured specimens are less than 85 percent of test values for companion laboratory cured specimens.
 3. Removal of forms or supports: Mold additional specimens and field cure with concrete represented; test to determine strength of concrete at proposed time of form or support removal.
- G. Test Results: Testing agency shall report test results in writing to ENGINEER and CONTRACTOR within 24 hours of test.
 1. Test reports shall contain the following data:

- a. Project name, number, and other identification.
 - b. Name of concrete testing agency.
 - c. Date and time of sampling.
 - d. Concrete type and class.
 - e. Location of concrete batch in the completed work.
 - f. All information required by respective ASTM test methods.
2. Nondestructive testing devices such as impact hammer or sonoscope may be used at ENGINEER's option for assistance in determining probable concrete strength at various locations or for selecting areas to be cored, but such tests shall not be the sole basis for acceptance or rejection.
 3. The testing agency shall make additional tests of in place concrete as directed by the ENGINEER when test results indicate that specified strength and other concrete characteristics have not been attained.
 - a. Testing agency may conduct tests of cored cylinders complying with ASTM C 42, or tests as directed.
 - b. Cost of additional testing shall be borne by the CONTRACTOR when unacceptable concrete has been verified.

END OF SECTION 03300

SECTION 05120
STRUCTURAL STEEL

PART 1 – GENERAL

1.01 SCOPE

A. Description of Work

1. Provide all labor, material and equipment to furnish, fabricate, deliver, unload, store, distribute and erect all structural steel required by the Drawings and specified herein.

B. Related Work Specified Elsewhere

1. Loose Lintels, Loose Shelf-Angles, Steel Floor Plates, Ladders, Hand Rails, and Steel Grating, Section 05500, MISCELLANEOUS METALS.
2. Field Touch-Up Painting of bolt heads, nuts, field welds and abrasions in shop coat after erection.

1.02 FURNISHED BUT INSTALLED ELSEWHERE

- A. Anchor Bolts and Loose Bearing plates which will be installed under Section 03300, CAST-IN-PLACE CONCRETE.
- B. All fasteners and structural steel shapes shall be 316 stainless steel.

1.03 FURNISHED BY THE OWNER

- A. No items will be provided by the Owner.

1.04 REQUIREMENTS OF REGULATORY AGENCIES

- A. Building Code shall mean State and Local building codes together with applicable State and Local laws.
- B. AISC Specification Structural Steel for Buildings shall mean "Specification For Structural Steel Buildings" of the American Institute of Steel Construction.
- C. Specification for Structural Joints shall mean "Specification For Structural Joints Using ASTM A325 or A490 Bolts", approved by the Research Council on Structural Connections of the Engineering Foundation.
- D. AWS Building Code shall mean "Structural Welding Code, D1.1, of the American Welding Society.
- E. AISC Specification Architecturally Exposed Steel shall mean "Specification for Architecturally Exposed Structural Steel", of the American Institute of Steel Construction.

1.05 WORKMANSHIP AND QUALIFICATIONS

A. General

1. All steel work shall conform with the applicable requirements of the hereinbefore referenced "Codes and Standards". All details shown are typical. Similar details apply to similar conditions. Structural Drawings shall be checked with the Architectural Drawings for dimensions, elevations, size and locations of all installations. All dimensions shall be verified at the job. Built-in or cast in items shall be supplied in ample time for incorporation in the work. Include all reinforcing angles, plates, straps, brackets, hangers, clips, lugs, holes, shim, etc., as shown or required for erection of structural steel work and as required to complete the work as shown on the Drawings.

B. Design of Members and Connections

1. Design of members and connections for any portion of the structure not indicated on the Drawings shall be completed by the fabricator and indicated on the shop drawings. Riveted connections will not be permitted. Proportion items to meet the applicable building code and to support any live loads which may normally be imposed unless specific live loads are indicated on the Drawings. Connections and members designed by the Fabricator are subject to review of the Engineer.

C. Responsibility for Errors

1. The Contractor shall be responsible for all errors of detailing, fabrication, and for the correct fitting of all structural members.

D. Bases, Bearing Plates, and Anchors

1. For items bearing on concrete, provide steel bearing plates and anchors as indicated. Bases or bearing plates shall be leveled by the use of leveling plates. Leveling plates shall be steel wedged to a true and level position and then grouted with a full bed of non-shrink grout. Anchor bolts shall not be used for leveling. After grout has set at least 3 days, wedges shall be cleanly and neatly removed and voids grouted. Templates shall be furnished, together with instructions for setting of anchors, anchor bolts, and bearing plates. The Contractor shall supervise and ascertain that anchors and related items are properly set in concrete during the progress of the work.

E. Qualification of Welders

1. Before assigning any welder to work covered by this section, the Contractor shall provide the Engineer with the names of the welders to be employed on the work, together with certification that each of these welders has passed qualification tests using procedures covered in the American Welding Society Standard. Qualification tests shall have been administered within the past two years.
2. If required by the Engineer, the Contractor shall submit identifying stenciled test coupons made by an operator whose workmanship is subject to question. The

Contractor shall require any welder to retake the test when, in the opinion of the Engineer, the work of the welder creates a reasonable doubt as to the proficiency of the welder.

3. Tests, when required, shall be conducted at no additional expense to the Owner. Recertification of the welder shall be made to the Engineer only after the welder has taken and passed the required retest.
4. The Engineer may require coupons to be cut from any location in any joint for testing. All sections of welds found defective shall be chipped or cut out to base metal and properly rewelded before proceeding with the work. Should any two coupons cut from the work of any welder show strengths, under test, less than that of the base metal, it will be considered evidence of negligence or incompetence, and such welder shall be permanently removed from the work.
5. When coupons are removed from any part of a structure, the members cut shall be repaired at no additional cost to the Owner, in a neat and workmanlike manner with joints of proper type to develop the full strength of the members and joints cut, with peening as necessary or directed to relieve residual stress.

F. Steel Fabricator

1. Fabricator shall have not less than five (5) years experience in the fabrication of Structural Steel.
2. Submit a written description of fabrication ability including facilities, personnel and list of similar completed Projects.

G. Steel Erection

1. Erector shall have not less than five (5) years experience in the erection of structural steel.
2. Submit a written description of structural steel erection ability including equipment, personnel and a list of similar completed projects.

H. Welding procedures, welders, welding operations and tackers shall be qualified in accordance with AWS Building Code.

1.06 SUBMITTALS

A. General

1. All submittals shall be made in accordance with Section 01300, SUBMITTALS.

B. Shop Drawings

1. Submit shop drawings indicating all shop and erection details, including cuts, copes, connection, holes, threaded fasteners and welds.

2. All welds, both shop and field, shall be indicated by AWS A2.0 "Welding Symbols".
 3. Except as permitted by the Drawings, no substitutions of steel members shall be made unless authorized in writing by the Engineer.
 4. Provide all holes required for the attachment of other work indicated on the Drawings.
 5. Approval of shop drawings when given shall be for design and general construction only and not for dimensions and field fit. The Engineer reserves the right to review all design and layout work done by the fabricator and revise same when in his opinion the design is not adequate or does not represent good engineering practice.
- C. Erection Procedure
1. Submit descriptive data to illustrate the structural steel erection procedure, including the sequence of erection and temporary staying and bracing.
- D. Welding Procedure
1. Only prequalified welding procedures in accordance with AWS Paragraph 1.3.1 of the 1972 AWS Code shall be used.
- E. Field Welding Equipment
1. Submit descriptive data for field welding equipment, including type, voltage and amperage.
- F. Submit the following proofs of compliance for materials:
1. Reports of ladle analysis for all steel.
 2. Reports of tensile properties and bend tests for:
 - a. Steel Shapes
 - b. Steel Bars
 - c. Steel Plates
 3. Certificates of conformance for:
 - a. Structural Steel Tubing
 - b. Crane Rails
 - c. Raised Pattern Rolled Steel Floor Plates

- d. Steel Bar Grating
- e. Fire-rated Prefabricated Building Columns
- f. Base Studs in accordance with Article 434 of AWS Building Code
- g. Filler Metals For Welding
- h. Shop Paint Primer
- 4. Reports of tensile properties for:
 - a. Steel castings
 - b. Steel forgings
- 5. Reports of mechanical properties of headed stud type shear connectors.
- 6. Reports of mechanical tests for:
 - a. High strength threaded fasteners
- G. Manufacturer's Literature:
 - 1. Submit description of each type of welding stud and arc shield.
- H. Inspection Reports:
 - 1. Submit reports for the inspection tests specified in Paragraphs 2.3 "Source Quality Control" and 3.2, "Field Quality Control" of this Section.

1.07 PRODUCT HANDLING

- A. Delivery of materials to be installed under other sections
 - 1. Anchor bolts and other anchorage devices which are embedded in cast-in-place concrete or masonry construction shall be delivered to the project site in time to be installed before the start of cast-in-place concrete operations or masonry work.
 - 2. Provide setting Drawings, templates, and direction for the installation of the anchor bolts and other devices.
- B. Storage of Materials
 - 1. Structural steel members which are stored at the project site shall be above ground on platforms, skids or other supports.
 - 2. Steel shall be protected from corrosion. Anchor bolts shall be oiled and capped.

3. Other materials shall be stored in a weathertight and dry place, until ready for use in the work.
4. Packaged materials shall be stored in their original unbroken package or container.

1.08 INSPECTION AND TESTS

A. Inspection and Tests

1. Materials are subject to inspection and tests in the mill, shop and field, conducted by a Testing Laboratory, selected by the Engineer and paid by the Contractor. Such inspection and tests, however, shall not relieve the Contractor of responsibility for furnishing satisfactory materials. The right is reserved to reject any material at any time before final acceptance, if the Engineer finds material and workmanship that do not conform to specification requirements. Acceptance of any materials shall not prevent its rejection later if defects are discovered. Contractor shall remove and replace any installed materials which are rejected by the Engineer at no additional cost to the Owner, and to the satisfaction of the Engineer. Standards for tests will be as set forth in the applicable ASTM Specifications.

B. Costs of Tests (Not Required for this Project)

PART 2 – PRODUCTS

2.01 MATERIALS

A. Steel Shapes, Bars and Plates

1. 316 Stainless Steel: ASTM A484, ASTM A276, Fy=30 ksi

B. Threaded rods, Bolts and Nuts:

1. Stainless Steel: ASTM F593, ASTM F594
2. 316 stainless steel plain washers shall conform to "Plain Washers", (ANSI B27.2) Type A.
3. 316 stainless steel beveled washers shall conform to "Beveled Washers", (ANSI B27.4).

D. High Strength Threaded Fasteners shall conform to "Specification For High Strength Steel Bolts for Structural Steel Joints Including Suitable Nuts and Plain Hardened Washers", (316 stainless steel).

E. Filler Metals For Welding:

1. Filler materials to match base metal in accordance with AWS.

2.02 FABRICATION

- A. Fabricate structural steel in accordance with the Building Code and the AISC Specification, Structural Steel for Building, with the modifications and additional requirements specified in this section.
 1. Where a conflict occurs between the standards specified above, the Building Code shall govern.
 2. Fabrication of architecturally exposed structural steel shall be in accordance with the AISC Specification Architecturally Exposed Structural Steel.
- B. The design of all connections for any part of the structure not indicated on the design Drawings shall be completed by the fabricator. All end connections and splices shall develop the full strength of the member or the stated reaction if shown. Minimum requirements shall be based on 3/4 inch H.S. bolts and 1/4 inch welds.
- C. Shop Connections shall be bolted or welded as required by the Project.
- D. Field Connections
 1. Provide bolted, except where welded connections are indicated.
 2. High strength threaded fasteners shall be used for bolted connections, except where standard fasteners are permitted.
- E. High Strength Bolted Construction Assembly
 1. Tightening shall be done in accordance with Part 8 of AISC "Specifications for Structural Joints".
- F. Welded Construction
 1. Welding process shall be limited to one or a combination of the following:
 - a. Manual shield-arc
 - b. Submerged-arc
 2. Welded connections shall be made where and as indicated on the approved shop drawings. Welded construction shall conform to the applicable requirements of AISC "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings". Do all welding indicated or required to make exposed joints water and weather tight. The welding rod used shall be uniformly and heavily coated (not washed) and shall be of such a nature that the coating will not chip or peel while being used with the maximum amperage specified by the manufacturer. All welds shall be clean and smooth.

3. Details of welded joints shall comply with all requirements for joints which are exempt from qualification tests under the "Code for Arc and Gas Welding in Building Construction" of the Americal Welding Society.
4. Surfaces to be welded shall be cleaned of loose scale, slag, rust, grease, paint, and other foreign material. Grind burned edges to be welded.
5. All defective welds or unsatisfactory work shall be cut out and replaced at no additional cost to the Owner.

G. Bearing Plates

1. Bearing plates shall be provided under beams, girders and trusses resting on footings, piers and walls.
2. Bearing plates shall be either attached or loose.

H. Holes

1. Holes shall be cut, drilled, or punched at right angles to the surface of the metal and shall not be made or enlarged by burning. Holes in base or bearing plates shall be drilled. Holes shall be provided in members to permit connecting the work of other trades. Holes shall be clean cut without torn or ragged edges. Outside burrs resulting from drilling or reaming operation shall be removed with a tool making a 1/16 inch bevel. Bolt holes shall be 1/16 inch oversize.

I. Shop Painting

1. Shop paint all steel work with rust inhibiting primer, except steel to be encased in concrete, surfaces to be welded, contact surfaces to be high strength friction-type bolt connected.
2. All steel work shall be sand blasted. The degree of sand blast shall be as required by the appropriate paint system.

2.03 SOURCE QUALITY CONTROL

A. Testing Agency shall perform the following:

1. Supply certified copies of the chemical composition of each heat of steel used on project.
2. Supply certified copies of mechanical properties of each heat, in accordance with "Methods and Definitions for Mechanical Testing of Steel Products", (ASTM A370) of the following materials:
 - a. Steel shapes
 - b. Bars and plates

- c. Structural steel tubing
 - d. Anchor bolts
 - e. High Strength Threaded Fasteners
 - f. Filler Metals For Welding
 - g. Headed stud type shear connectors
 - h. Crane Rails
 - i. Steel Castings
 - j. Steel forgings
- 3. Qualification of shop for high-strength bolting, welding and studwelding procedure and personnel as required by the project.
 - 4. Inspection of shop fabricated structural steel members and assemblies for conformance with the requirements specified.
 - 5. Inspection of shop assembled high strength bolted construction.
 - 6. Inspection of shop welds shall be in accordance with Section 6 of AWS Building Code and as follows:
 - a. Visual inspection of all shop welds in accordance with Article 6.5.
 - 7. Inspection of shop painting
 - a. Surface preparation prior to painting shall be visually evaluated for degree of cleaning by comparison with SSPC pictorial standards.
 - b. Measurement of dry film thickness of each coat of shop applied paint shall be in accordance with "Measurement of Dry Film Thickness of Organic Coatings", (ASTM D1005).

PART 3 – EXECUTION

3.01 ERECTION

A. General

- 1. Erect structural steel in accordance with the Building Code and the AISC Specification for "Structural Steel Buildings" with modifications and additional requirements of this section:
- 2. Structural steel shall be erected as rapidly as the progress of other work will permit. A sufficient number of skilled mechanics shall be furnished to handle the

work expeditiously and all work shall be erected at such time and in such a manner as to be completed within the shortest period of time practicable. Splices and field connections shall be made with bolts, except where welding is indicated or approved on the shop drawings. Erecting equipment shall be suitable and safe for the workmen. Errors in shop fabrication or deformation resulting from handling and transportation that prevent the proper assembly and fitting of parts shall be reported immediately to the Engineer and approval of the method of correction shall be obtained. Approved corrections shall be made at no additional cost to the Owner. Field welding shall conform to the requirements hereinbefore specified under "Fabrication".

B. Erection Tolerances

1. Individual pieces except architecturally exposed structural steel shall be erected so that the deviation from plumb, level and alignment shall not exceed 1 to 500.
2. Architecturally exposed structural steel erection tolerances shall be as indicated.

C. Field Assembly

1. Structural steel frames shall be accurately assembled to the lines and elevations indicated, within the specified erection tolerances.
2. The various members forming parts of a complete frame or structure after being assembled shall be aligned and adjusted accurately before being fastened.
3. Fastening of splices of compression members shall be done after the abutting surfaces have been brought completely into contact.
4. Bearing surfaces and surfaces which will be in permanent contact shall be cleaned before the members are assembled.
5. Splices shall be permitted only where indicated.
6. Field connections of bolted construction, welded construction and shear connectors shall be as specified in "Fabrication" of this section.
7. Erection bolts used in welded construction may be either tightened securely and left in place or removed and the holes filled with plug welds.
8. Poor matching of holes shall be corrected by drilling to the next larger size. Welding for redrilling will not be permitted.
9. Driftpins may be used only to bring together the several parts, and shall not be used in such manner as to distort or damage the metal.

D. Gas Cutting

1. Field correcting of fabrication by gas cutting shall not be permitted on any major member in the structural framing without prior written approval of the Engineer.

E. Temporary Bracing

1. Temporary bracing shall be provided as required and must be kept in position until final completion. Shop fabricated items subject to damage shall be braced and carefully handled to prevent distortions or other damage. All items installed before concrete is placed shall be properly braced to prevent distortion by pressure of concrete. Bracing must be watched and maintained by the Contractor during all construction operations.

3.02 FIELD QUALITY CONTROL

A. Engineer's Representative shall perform the following:

1. Qualification of field for high-strength bolting and welding procedure and personnel as required by the project.
2. Inspection of erected structural steel work for conformance with the requirements specified hereinafter.

B. Inspection of Field Assembled High Strength Bolted Construction shall be in accordance with Part 5, AISC "Specification for Structural Joints".

C. Inspection of Field Welds shall be in accordance with Section 8 of AWS Building Code and as follows:

1. Visual inspection of all field welds in accordance with Article 6.5.

END OF SECTION 05120

SECTION 05500
MISCELLANEOUS METALS

PART 1 – GENERAL

1.01 SCOPE

A. Description Of Work

1. The work consists of furnishing all labor, materials, equipment, tools and services necessary to furnish and install all miscellaneous metal items as shown on the Drawings and/or specified herein.

B. Miscellaneous Metal Items

Miscellaneous metal items (include, but are not limited to:)

1. Floor (and trench) grating, including frames
2. Metal connectors requiring special fabrication
3. Metal railings and brackets (including both fixed and removable type)
4. Jamb, corner and miscellaneous guards, and metal nosings
5. Structural steel frames, bucks, and sub-frames
6. Mounting plates for dock bumpers
7. Abrasive nosing for poured concrete stairs
8. Expansion bolts
9. Anchor bolts
10. Adhesive anchors

C. Related Work In Other Sections:

1. The following items of associated work are included in other sections of these specifications;
 - a. Structural steel
 - b. Painting
 - c. Gratings for site drainage structures

1.02 REFERENCES AND STANDARDS

- A. The following references and standards are hereby made a part of this Section and miscellaneous metal work shall conform to the applicable requirements therein except as otherwise specified herein or shown on the Drawings. Nothing contained herein shall be construed as permitting work that is contrary to code requirements or governing rules and regulations.
1. "Code For Arc And Gas Welding In Building Construction" of American Welding Society, AWS D1.0, latest edition with current supplements and addenda.
 2. "Specification For The Design, Fabrication, And Erection of Structural Steel For Buildings" of the AISC
 3. "Metal Finishes Manual", published by National Assn. of Architectural Metal Manufacturers (NAAMM)
 4. Steel Structures Painting Council (SSPC) Surface Preparation Specification (Vol. 2)
 5. Aluminum Association Publications:
 - a. Aluminum Standards and Data
 - b. Designation System For Aluminum Finishes
 - c. Standards For Aluminum Sand and Permanent Mold Castings
 - d. Standards For Anodized Architectural Aluminum
 - e. Welding Aluminum
 - f. Care of Aluminum

1.03 SUBMITTALS

- A. All submittals shall be made in accordance with Section 01300, SUBMITTALS.
- B. Shop Drawings:
1. Shop drawings shall show dimensions, sizes, thicknesses, gauges, finishes, joining, attachments, and relationship of work to adjoining construction. Where items must fit and coordinate with finished surfaces and/or constructed spaces, take measurements at site and not from Drawings. Where concrete, masonry or other materials must be set to exact locations to receive work, furnish assistance and direction necessary to permit other trades to properly locate their work. Where welded connectors, concrete, or masonry inserts are required to receive work, shop drawings shall show exact locations required, and all such drawings shall be furnished to the trades responsible for installing the connectors or inserts. Catalog work sheets showing illustrated cuts of item to be furnished, scale details and dimensions may be submitted for standard manufactured items.

- C. Samples
 - 1. Submit samples of color anodized aluminum work which shall show proposed nominal colors and maximum color ranges as well as texture intended for the project. Such ranges are subject to review of the Engineer.
 - 2. Identify all samples as to pretreatment, anodizing process, alloy, color, and portion of the work to which sample applies.
 - 3. Do not proceed with processing of anodized aluminum until Engineer's review has been obtained.

PART 2 – PRODUCTS

2.01 BASIC MATERIALS AND ACCESSORIES

- A. Standard Structural Steel Shapes and Plates: 316 Stainless Steel
- B. Architectural and Miscellaneous Steel Items: ASTM A283, grade optional
- C. Anchor bolts shall conform to "Specification for Stainless Steel Steel Externally and Internally Threaded Standard Fasteners". (316 Stainless Steel).
- D. Steel Tubing: ASTM A501 (hot formed), welded or seamless
- E. Steel Pipe: ASTM A53, Type E or S, Grade A or B
- F. Aluminum Items:
 - 1. Aluminum Extrusions:
 - a. Color anodized finish. Alloys specially produced to best achieve the color anodized finish specified
 - b. Clear anodized finish: 6061 alloy
 - c. Structural shapes, anchors and clips: 6061 alloy
 - 2. Aluminum Sheet and Plate
 - a. Color anodized finish: Alloys specially produced to best achieve the color anodized finish specified
 - b. Clear anodized finish: 6061 alloy
 - c. Sheet for corrugated roofing and siding Alclad 3004
 - d. Plate used in all process units: Alclad 3003

- e. Miscellaneous Plate: 6061
- 3. Aluminum Castings:
 - a. Anodized finish: 214 alloy
 - b. Structural castings: 214 or 356 alloy as per strength requirements
- G. Stainless Steel Items: (unless noted otherwise)
 - 1. AISI Type 316
 - 2. Type 316 shall be provided where indicated.
- H. Bronze Items:
 - 1. Extrusions
 - 2. Rods and bars
 - 3. Cast fittings: Match color and finish of adjacent components as closely as possible.
- I. Cast Iron: ASTM A48, Class 30 unless otherwise indicated
- J. Fastenings (General): Furnish all bolts, nuts, screws, clips, washers, and any other fastenings necessary for proper erection of items specified herein.
 - 1. For ferrous metal: Use 316 stainless steel on exterior. On interior, match adjacent material.
 - 2. For aluminum: Exposed fasteners shall match adjacent material in color and appearance.
 - a. Color anodized finish: 6061-T6 alloy
 - b. Clear anodized finish: 2024 alloy
 - c. All other fastenings not otherwise specified or noted. 2024 or 6061 alloy except AISI Type 316 stainless steel shall be used for concealed fasteners and may be used for exposed fasteners if heat tempered to match color of anodized surface.
 - d. Where exposed screws are required in architectural aluminum, they shall be Phillips flat head, countersunk unless otherwise noted.
 - 3. For stainless steel: AISI Type 316 stainless steel. Unless noted otherwise, exposed screws shall be Phillips flat head, countersunk.

4. For bronze: Use brass or bronze. Match adjacent surface where exposed. Unless noted otherwise, exposed screws shall be Phillips flat head, countersunk.
- K. Welding Electrodes: As permitted by AWS Code D1.0
- L. Paint: All painting shall be in accordance with Section 09900 PAINTING.

2.02 SPECIALTY FABRICATED AND CATALOG ITEMS

A. Railings

1. Pickets shall be ½" 316 stainless steel spaced at 4" on-center max.
2. Handrails shall be 1.5" schedule 40 316 stainless steel.
3. Handrail brackets shall be 316 stainless steel.
4. All joints shall be coped, mitered, etc; butt welded and ground smooth.
5. Railings shall be designed to meet requirements of OSHA regulations.
6. Slip joints in handrail shall be provided every 20 feet and at structure expansion joints.

E. Expansion Bolts

1. Expansion bolts shall be that type requiring a drilled hole diameter equal to the bolt diameter such as Hilti Inc. "Kwik-Bolt", or equal.
2. All expansion bolts shall be stainless steel, Type 316.
3. As a condition for approval, certified test results shall be submitted to the Engineer for approval. Tests shall have been conducted on concrete of strength equal to specified strength and a minimum of 4 tests for each diameter anchor shall be submitted. Ultimate loads in shear and tension shall be in excess of 4 times the allowable working loads shown on the Contract Drawings.

F. Anchor Bolts

1. Anchor bolts shall be as detailed on the Drawings. Bolts, nuts and washers shall be stainless steel, Type 316.

G. Adhesive Anchors

1. Adhesive anchors shall be a non-expansion anchor using a stress free chemical bond, such as Hilti HVA anchor, or equal.
2. The resin shall be contained in a premeasured, manufactured cartridge, for field installation. The resin shall be a two component, chemically resistant adhesive that will not deteriorate or loose strength with age.
3. All anchor rods shall be stainless steel Type 316 with a double chisel pointed end.
4. As a condition for acceptance, certified test results shall be submitted to the Engineer for review. Tests shall have been conducted on concrete of strength equal

to specified strength and a minimum of 4 tests for each diameter anchor shall be submitted. Ultimate loads in shear and tension shall be in excess of 4 times the allowable working loads shown on the Drawings.

2.03 FINISHES (Except as otherwise noted on the Drawings or Specified)

- A. Ferrous metals shall be painted in accordance with Section 09900 PAINTING.
- B. Interior Ferrous Metal: Welds, burrs, and rough surfaces ground smooth and completed assembly cleaned, hot phosphate treated, and given one (1) shop prime coat of paint.
- C. Exposed Aluminum Items:
 - 1. All aluminum finishing shall conform to requirements and recommendations of the References and Standards previously listed. Where color anodized finishes are required, all finishing shall be done in strict accordance with procedures established by the manufacturer of the alloy.
 - 2. Where more than one (1) color anodized process is utilized on the project for the same desired color and finish, such processes shall be coordinated by the Contractor to achieve matching finishes within the approved range.
 - 3. Commence no finishing operations until all fabrication and forming operations have been completed.
 - 4. Take all precautions necessary to prevent "rack" marks on exposed aluminum surfaces caused by the anodizing process. Where edges of aluminum items are exposed, the finish shall be uniform from face onto such edges.
 - 5. Required finishes are as specified below. Finish designations are those of the Aluminum Association. Pre-anodic finishes (mechanical and/or chemical) shall be applied before application of any anodic treatment.
 - a. Stair nosings, process items, misc. structural shall have mill finish, Aluminum Assoc. Designation M10.
- D. All Exposed Fastenings: To match color and finish of adjacent material.

PART 3 – EXECUTION

3.01 CONDITION OF SURFACES

- A. Inspect all surfaces to receive miscellaneous metal work and report all defects which would interfere with this installation. Starting work implies acceptance of surfaces as satisfactory.

3.02 WORKMANSHIP

- A. General Requirements:

1. Verify all measurements at job.
2. Coordinate all metal work with adjoining work for details of attachment, fittings, etc. Do all cutting, shearing, drilling, punching, threading, tapping, etc., required for miscellaneous metal or for attachment of adjacent work. Drill or punch holes; do not use cutting torch. Shearing and punching shall leave true lines and surfaces.
3. Conceal all fastenings where practical. Thickness of metal and details of assembly and supports shall give ample strength and stiffness. Form joints exposed to weather to exclude water.
4. Make all permanent connections in ferrous metal surfaces using welds where at all possible; do not use bolts or screws where they can be avoided.
5. The self-tapping screws or nuts for steel studs holding removable grating shall be snug tight only.
6. Provide all lugs, clips, anchors, and miscellaneous fastenings necessary for the complete assembly and installation.
7. Set all work plumb, true, rigid, and neatly trimmed out. Miter corners and angles of exposed moldings and frames unless otherwise noted.
8. Do all grouting of frames, plates, sills, bolts, and similar items with non-shrink grout.
9. Set all railings and similar items shown or required to be set in sleeves or cans with epoxy grout. Unless otherwise noted, size sleeves for a minimum 1/4 inch clearance all around.
10. All forming operations on aluminum except on painted sheet products, shall be done prior to finishing or anodizing.
11. For expansion and contraction the work shall be so designed and anchored that there will be no objectionable distortion or serious stress of fastenings as the metal expands and contracts.
12. Make all trim in longest lengths possible. Where joints are not otherwise shown, make pieces of equal length or locate joints symmetrically. Fit adjacent pieces with hairline joints and aligned surfaces. Where exposed screws are required, space evenly and symmetrically.
13. Castings subject to foot or street traffic shall have bearing surfaces machined to prevent rocking and rattling.
14. Where items must be incorporated or built into adjacent work, deliver to trade responsible for such work in sufficient time that progress of work is not delayed. Be responsible for proper location of such items.

15. Protect all dissimilar metals from galvanic corrosion by pressure tapes, coatings or isolators as specified herein.

B. Welding:

1. Ferrous Metals

- a. Perform all welding in accordance with AWS Code D1.0.
- b. Only prequalified welding procedures in accordance with AWS Paragraph 103(a) shall be used.
- c. Welds shall be made only by operators experienced in performing the type of work indicated.
- d. Welds normally exposed to view in the finished work shall be uniformly made and shall be ground smooth.
- e. Where welding is done in proximity to glass or finished surfaces, such surfaces shall be protected from damage due to weld sparks, spatter, or tramp metal.

2. Aluminum

- a. All aluminum welding shall be done by the inert gas shielded arc of fluxless resistance techniques.
- b. Welded assemblies to be anodized shall be designed so that laying surfaces are free-rinsing and will not trap anodizing solutions.
- c. Where at all possible, welds in assemblies to be anodized shall be located so as to conceal visible discoloration in the heat-affected zone.
- d. Where weld metal must be exposed after anodizing, filler alloys shall be selected to closely match the composition of the base metal. Follow parent metal manufacturer's recommendations for such filler alloys.
- e. Where weldments are to be made on materials that have been previously anodized, the area of fusion shall be free of the anodic film prior to welding. Parts to be so welded shall be masked during anodizing, or sanded clean in the weld areas. Only weldments that will be concealed may be so made. Cracking or discoloring of the anodic coating in the weld area will not be acceptable in exposed areas.
- f. Weldments on exposed finished surfaces shall be ground and/or polished to match and blend with finish of adjacent parent metal.
- g. Structural welds shall be made by qualified welders and shall conform to the general recommendations and regulations of the referenced Aluminum Association Publications.

- (1) Dirt, grease, lubricant, or other organic material shall be removed by vapor degreasing or suitable solvent.
 - (2) Joints rejected because of welding defects may be repaired only by rewelding. Defective welds shall be removed by chipping or machining. Flame cutting shall not be used.
- h. Where welding is done in proximity to glass or finished surfaces, such surfaces shall be protected from damage due to weld sparks, spatter, or tramp metal.
- C. Bolted, Screwed, and Riveted Connections:
1. In general, use bolts for field connections only and then only as detailed. Provide washers under all heads and nuts bearing on wood. Draw all nuts tight and nick threads of permanent connections to prevent loosening. Use beveled washers where bearing is on sloped surfaces.
 2. Where screws must be used for permanent connections in ferrous metal, use flat head type, countersunk, with screw slots filled and finished smooth and flush.
 3. Where rivets are used, they shall be machine driven, tight, heads centered, countersunk and finished flush and smooth.
- D. Surface Treatment and Protective Coatings:
1. Cleaning
 - a. Thoroughly clean all mill scale, rust, dirt, grease and other foreign matter from ferrous metal prior to any galvanizing, hot phosphate treatment or painting. Conditions which are too severe to be removed by hand cleaning methods shall be cleaned as per SSPC "Surface Preparation Specifications", "Solvent Cleaning, SSPC-SP 1-63", "Power Tool Cleaning, SSPC-SP-63", or "Brush-Off Blast Cleaning, SSPC-SP 7-63; as required.
 2. Hot phosphate treatment
 - a. Conform to SSPC-PT-4.
 3. Painting
 - a. After material has been properly cleaned and treated, apply shop prime coat of paint to all surfaces except those encased in concrete or masonry. Apply all paint as per manufacturer's directions. Spot paint all abrasions and field connections after assembly. Shop coat shall be dry prior to shipment to job site. Unless otherwise specified or directed, do not apply shop prime coats or any stenciled or painted identification markings to any surfaces.

4. Galvanizing

- a. Conform to ASTM A123 for rolled, pressed and forged shapes, plates, bar and strip; A153 for hardware items and A386 for assembled steel products. Conform to ASTM A384 and A385 (Recommended Practices) pertaining to galvanizing assembled steel products. Unless otherwise permitted, do all galvanizing after fabrication, in largest sections practicable. Where galvanizing is removed by welding or other assembly procedure, touch-up abraded areas with molten zinc or zinc-rich paint.

5. Dissimilar Materials:

a. Protective Materials:

- (1) Primer: Section 09900, PAINTING - System "1"
- (2) Finish Coat: Section 09900, PAINTING - System "1".
- (3) Alkali-Resistant Lacquer: Conform to Aluminum Association Standards for Anodized Architectural Aluminum.

- b. Dissimilar Metals: Where aluminum is placed in contact with or fastened to dissimilar metals (excepting 316 stainless steel), treat the contact surfaces by one of the following methods. If drainage from dissimilar metals passes over aluminum work, paint the dissimilar metal as specified in paragraph (1) below.

- (1) Apply prime coat of zinc chromate primer to the dissimilar metal followed by one or two coats of aluminum metal and masonry paint.
- (2) Apply a coat of bituminous paint to the dissimilar metal.
- (3) Separate contact surfaces with pressure tape or approved non-absorptive gaskets.

c. Concrete, masonry, and plaster

- (1) Where aluminum is placed in contact with, or built with, or will receive drainage from masonry, including lime mortar, concrete, or plaster, apply a clear coat of alkali-resistant lacquer or a heavy coat of bituminous paint, to the aluminum areas affected.

d. Moisture-absorbent materials

- (1) Where aluminum is placed in contact with wood or other absorptive materials subject to repeated wetting, or wood treated with a preservative which is not compatible with aluminum, apply two coats of approved aluminum house paint to such materials.

Seal joints with non-drying, non-skinning polyisobutylene caulking compound.

- e. Uncoated Steel
 - (1) Paint all uncoated steel items provided as accessories to aluminum work with one heavy coat of rust inhibitive primer.
- f. Protection materials applied to architecturally exposed surfaces are subject to review of Engineer.

E. Protection of Surfaces

- 1. Protection of work and initial cleaning shall be the responsibility of each installer or erector until the installation is finally completed, whereupon the responsibility for subsequent protection and final cleaning shall pass to the Contractor for the entire project.
- 2. Protection shall be provided by strippable coating, protective sleeves, polyethylene sheets, boarding, or other suitable means during fabrication, shipment, site storage, and erection to prevent damage to the finished work due to stains, discolorations, scratches, or any other cause. Damaged elements shall be replaced as damages occur.
- 3. After installation, and after danger of subsequent damage has passed, remove all protective coverings from all exposed surfaces, and clean those surfaces of all soil and discoloration, ready for acceptance.

END OF SECTION 05500

SECTION 02 45 9

TIMBER PILES

PART 1—GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes specifications for furnishing, installing, and testing of driven piles for structures. Piles shall be end-bearing piles, friction load-bearing piles or both as indicated.
- B. Supply piles of the following types as indicated:
 - 1. Timber piles, peeled and treated, driven.
- C. Related Sections:
For bracing, pile caps and framing, see Division 6, Rough Carpentry, or Heavy Timber Construction.

1.03 DEFINITIONS

- A. Test Pile: An individual pile which is observed to determine its behavior during driving and under static axial compression load.
- B. Reaction Pile: An individual pile which provides the reaction load required to perform the load test on a test pile. During this process the reaction pile can be subjected to either an axial compression load or an axial tension load.

1.04 REFERENCE STANDARDS

- A. American Association of State Highway and Transportation Officials (AASHTO).
AASHTO M-133. Specification for Preservative and Pressure Treatment Process for Timber.
- B. American Society for Testing and Materials (ASTM).
ASTM D25 Specification for Round Timber Piles
ASTM D1143 Method of Testing Piles Under Static Axial Compressive Load
ASTM D3689 Method of Testing Individual Piles Under Static Axial Tension Load
- C. American Wood Preservers' Association (AWPA)
AWPA C3. Piles - Preservative Treatment by Pressure Processes.
AWPA C14. Wood for Highway Construction - Preservative Treatment by Pressure Processes.
AWPA C18. Standard for Pressure treated Material in Marine Construction. AWPA M4. Standard for the Care of Preservative Treated Wood Products.

1.05 SUBMITTALS

- A. General: Refer to Contract Requirements for Submittals, Shop Drawings, Product Data and Samples.
 - B. Shop Drawings: Submit shop drawings of pile types as follows:
 - 1. Show any structural connections such as for uplift loads.
 - C. Pile Driving Sequential Layout:
 - 1. Submit layout drawings showing the proposed sequence of driving the piles.
 - 2. On the sequential layout, show each pile identification as indicated on the Contract Drawings, its driving sequence number, type, size, load bearing capacity and pile tip elevation planned.
 - D. Pile Driving Record: Maintain a pile driving record during pile driving and submit it to the Project Engineer upon completion of pile driving. On the record indicate, for each pile driven, the information specified in C above, and the following: type and rating of driving equipment, overall blow count per foot, number of blows per inch penetration for the last 12 inches, and any unusual conditions encountered during driving.
 - E. Equipment Review and Drawings:
 - 1. Submit complete list of the equipment proposed for use, including a description of the characteristics of each piece of driving equipment.
 - a. The Project Engineer will review the proposed driving equipment, accessories, and methods of adequacy for the conditions expected to be encountered. However, the adequacy of the equipment and accessories shall remain the responsibility of the Contractor. Should the equipment used by the Contractor prove inadequate to drive the scheduled types of piles in the locations indicated, or should the use rate of accessories show damage to the piles, or should the Progress Schedule not be maintained, the Contractor shall replace, or use different types of equipment.
 - 2. Submit shop drawings of driving accessories showing compatibility with the size configuration, handling, and driving requirements of each type of pile indicated on the Contract Drawings.
 - 3. Submit shop drawings showing the methods and equipment proposed for loading test piles.
 - F. Submit data on round timber pile treatment data, including certification by treating plant stating type of preservative solution and pressure process used, net amount of preservative retained, and compliance with applicable standards.
- 1.06 DELIVERY, STORAGE, AND HANDLING
- A. Handling, storage and field fabrication, including treating of cut ends, shall be in accordance with AWPA M4.
- 2.0 PART 2 – PRODUCTS
- 2.01 TIMBER PILES
- A. Round Timber Piles: Piles shall be Southern Pine and shall conform to ASTM D 25, unused, clean peeled, uniformly tapered, one piece from butt to tip.
 - B. Piles sizes shall be as indicated on the Contract Drawings.

- C. Pressure treatment shall be in accordance with the following Use Category Standards:
 - Foundation piles. AWPA C3.
 - Land and freshwater piles. AWPA C3. Marine piles. AWPA C3 and C18.
 - Highway bridge piles. AWPA C14.
 - Marine, dual treatment. AWPA C3.
 - Field treatment of cut ends and holes. AWPA M4.
- D. All wood attached directly to concrete or exposed to weather shall be pressure treated with alkaline copper quat (ACQ) at the rate of 0.8 pcf.
- E. All piles shall be pressure treated with CCA at a rate of 2.5 pcf for marine use.
- F. Fabrication
 - 1. Field-Applied Wood Preservative: Treat field cuts, holes, and other penetrations in accordance with AWPA M4.

PART 3 - EXECUTION

3.01 PILE TYPES

Piles shall be end-bearing type or friction type as indicated. Drive end-bearing piles to the required bearing value. The bearing value for each pile shall be as determined in Article 3.04. Drive friction piles to the required penetration, as indicated.

3.02 DETERMINATION OF LENGTH

- A. Provide piles of such length as required to develop the specified bearing value, to obtain the specified penetration, and to extend into the cap or footing block as indicated.
- B. Assume responsibility for furnishing piles of sufficient length to obtain the penetration and bearing value indicated.

3.03 TEST PILES

- A. The Contract Drawings indicate the required type of piling, the required bearing value, the minimum penetration, and the estimated pile tip elevation. Estimated tip elevations are approximate, based upon subsurface explorations, and are given only to show the basis for the estimated quantities indicated in the Bid Schedule and to indicate the required lengths of test piles.
- B. Order and drive the test piles. Safe bearing capacities of the test piles will be determined by methods herein specified.
- C. From the test pile data and behavior and the subsurface exploration data, the Design Engineer will determine the penetration required. The Design engineer may also determine the required penetration based upon settlement criteria or any other factors which in the opinion of the Design Engineer are applicable to the work. Submit the final data to the Project Manager for evaluation.

3.04 DRIVEN PILE CAPACITY

- A. Design
 - 1. The ultimate pile capacity will be determined by the Design Engineer. Drive piles with approved driving equipment to the ordered length or other lengths necessary to obtain the required ultimate pile capacity. Jetting, predrilling or other methods to facilitate pile

penetration shall not be used unless specifically permitted by the Design Engineer.

2. Penetration per blow may be measured either during initial driving or during re-driving following a set period of time as determined by the Design Engineer.

- B. Practical Refusal: Practical refusal will be determined by the Design Engineer, and will be a condition where the blow count exceeds either two times the number of blows required in 1 foot or three times the number of blows required in 3 inches to achieve the required bearing value, not to exceed 5 blows per inch. Piles reaching practical refusal shall not be driven further.

3.05 PILE LOAD TESTS FOR PILES UNDER AXIAL COMPRESSION LOAD

- A. Install test piles and reaction piles, of the same type and kind as permanent piles, in the locations indicated by the Design Engineer. Install test piles vertically.
- B. Test piles which pass the load test in an undamaged condition, may be utilized as permanent piles in the work. Reaction piles which were used to perform the pile load test may be utilized as permanent piles in the work, provided they are not damaged and that they are not moved upward.
- C. Either extract damaged test piles and reaction piles and remove from the site or cut them off 3 feet below any structure to be installed above.
- D. Comply with ASTM D1143 for pile load test apparatus, for applying load and measuring movements, and for standard measuring procedures. Perform loading procedures as follows:
 1. Apply the load in load increments of 10-15% of the design load to a maximum load of 300% or failure, whichever occurs first. Maintain each test load for 2.5 minutes.
 2. Measure the settlement and rebound of the test pile to the nearest 0.01 inch.
- E. Do not subject reaction piles which are to become permanent piles to uplift loads greater than 70 percent of the required bearing capacity. Test reaction piles in accordance with ASTM D3689.
- F. Safe bearing capacity of the test pile shall be defined as 50% of the failure load. The failure load shall be defined as the load that produces a movement of the pile butt (S_f) equal to:

$$S_f = S + (0.15 + 0.008D)$$

Where:

- S_f = Settlement at failure in inches
 D = Pile diameter or width in inches
 S = Elastic deformation of total unsupported pile length in inches

- G. The Design Engineer may require additional load tests in the event that the behavior of the test pile or any other pile shows any peculiarity, erratic action, or otherwise causes suspicion as to the reliability of the safe bearing capacity.
- H. Immediately following completion of load testing, submit two copies of the test report for each test pile to the Project Manager. Include in the test report the data required by ASTM D1143.
- I. Following the completion of load tests, the Design Engineer will make a determination of the required penetration.

3.06 INSTALLATION OF PILES

- A. General: Provide piles of the type indicated and of the length and configuration necessary to:
1. Achieve the required penetration determined by the Design Engineer.
 2. Extend into the pile cap or structure footing to the location directed by the Design Engineer; and
 3. Attain indicated bearing capacity.
- B. Penetration and Bearing: Install piles to the required penetration, or to the required bearing, as indicated, except as specified in Article 3.04, C and D. Jetting will not be permitted unless specifically approved by the Design Engineer for the location.
- C. Predrilled Holes:
1. When necessary to achieve the required penetration, drill holes of diameter not greater than 90 percent of the average cross-sectional dimension of the pile at the depth being drilled and drive the pile therein to practical refusal.
- D. Pile Driving:
1. Complete backfill to the required elevations in the area which piles are to occupy before starting to drive piles.
 2. Do not drive piles within 20 feet of concrete less than seven days old.
 3. Drive piles at interior of bases of footings before driving perimeter piles.
 4. If necessary, provide adequate lateral support for installed individual piles to prevent excessive temporary flexural stresses or movement of the pile top out of tolerance.
 5. Maintain the hammer coaxial with the pile during the driving operation by using a combination of driving cap and leads.
 6. Investigate any sudden decrease in driving resistance for possible breakage of the pile. If sudden decrease in driving resistance cannot be correlated to boring data or some incident in the driving, and if the pile cannot be inspected, such decrease in driving resistance may be cause for rejection of the pile.
 7. Re-drive any pile which is raised during driving of adjacent piles, to the original tip elevation.
 8. Cut off piles at top elevation directed by the Design Engineer. Replace or repair piles which are damaged when cut off.
- E. Installation Tolerances:
1. Deviation from plumb and angle of batter: $\frac{1}{4}$ inch per foot of pile length, but not more than 6 inches overall.
 2. Deviation from location of pile top: 3 inches.
- F. Piles not meeting ASTM D25 requirements will be rejected. Remove such piles from the site and replace with sound piles. Piles broken under driving stresses may be cut off and left in place if approved

by the Design Engineer for the location. Otherwise they shall be extracted and removed from the site.

- G. Fit timber piles with metal shoes on the tip as shown on the Contract Drawings (when specified). When the area of the head of a timber pile is greater than that of the face of the hammer, use a suitable cap to distribute the blows throughout the cross section of the pile.
- H. After timber piles are cut off, treat cut surfaces in accordance with AWPA M4. Remove cut off sections of the piles from the site and legally dispose.

END OF SECTION 02459

SECTION 06 10 00

ROUGH CARPENTRY

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Roofing nailers.
- B. Preservative treated wood materials.
- C. Fire retardant treated wood materials.
- D. Miscellaneous framing and sheathing.
- E. Communications and electrical room mounting boards.
- F. Concealed wood blocking, nailers, and supports.

1.2 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- B. ASTM D2898 - Standard Test Methods for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing; 2010.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- D. AWPA U1 - Use Category System: User Specification for Treated Wood; American Wood Protection Association; 2012.
- E. PS 1 - Structural Plywood; 2009.
- F. PS 20 - American Softwood Lumber Standard; National Institute of Standards and Technology, Department of Commerce; 2010.
- G. SPIB (GR) - Grading Rules; Southern Pine Inspection Bureau, Inc.; 2014.

1.3 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide technical data on wood preservative materials and application instructions.
- C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.
- B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, or installation.

1.5 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a one year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
 - 1. Species: Southern Pine, unless otherwise indicated.
 - 2. If no species is specified, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.
 - 3. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
 - 4. Lumber of other species or grades is acceptable provided structural and appearance characteristics are equivalent to or better than products specified.
- B. Lumber fabricated from old growth timber is not permitted.

2.2 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

- A. Grading Agency: Southern Pine Inspection Bureau, Inc. (SPIB).
- B. Sizes: Nominal sizes as indicated on drawings, S4S.
- C. Moisture Content: S-dry or MC19.
- D. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
 - 1. Lumber: S4S, No. 2 or Standard Grade.
 - 2. Boards: Standard or No. 3.

2.3 CONSTRUCTION PANELS

- A. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

2.4 ACCESSORIES

- A. Fasteners and Anchors:
 - 1. Metal and Finish: Stainless Steel, Type 316
 - 2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.
 - 3. Anchors: Toggle bolt type for anchorage to hollow masonry.

2.5 FACTORY WOOD TREATMENT

- A. Treated Lumber and Plywood: Comply with requirements of AWWA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
 - 1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.
 - 2. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWWA standards.
- B. Fire Retardant Treatment:
 - 1. Manufacturers:

- a. Arch Wood Protection, Inc: www.wolmanizedwood.com.
 - b. Hoover Treated Wood Products, Inc: www.frtw.com.
 - c. Substitutions: See Section 016000 - Product Requirements.
2. Exterior Type: AWWPA U1, Category UCFB, Commodity Specification H, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes both before and after accelerated weathering test performed in accordance with ASTM D2898.
 - a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
 - b. Treat all exterior rough carpentry items.
 - c. Do not use treated wood in direct contact with the ground.
 3. Interior Type A: AWWPA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
 - a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
 - b. Treat rough carpentry items as indicated.
 - c. Do not use treated wood in applications exposed to weather or where the wood may become wet.
- C. Preservative Treatment:
1. Manufacturers:
 - a. Arch Wood Protection, Inc: www.wolmanizedwood.com.
 - b. Koppers Performance Chemicals, Inc: www.koppersperformancechemicals.com.
 - c. Viance, LLC: www.treatedwood.com.
 - d. Substitutions: See Section 016000 - Product Requirements.
- D. Preservative Pressure Treatment of Lumber Above Grade: AWWPA U1, Use Category UC3B, Commodity Specification A using waterborne preservative to 0.25 lb/cu ft retention.
1. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
 2. Treat lumber exposed to weather.
 3. Treat lumber in contact with roofing, flashing, or waterproofing.
 4. Treat lumber in contact with masonry or concrete.
 5. Treat lumber less than 18 inches above grade.
 6. Preservative Pressure Treatment of Plywood Above Grade: AWWPA U1, Use Category UC2 and UC3B, Commodity Specification F using waterborne preservative to 0.25 lb/cu ft retention.
 - a. Kiln dry plywood after treatment to maximum moisture content of 19 percent.
 - b. Treat plywood in contact with roofing, flashing, or waterproofing.
 - c. Treat plywood in contact with masonry or concrete.
 - d. Treat plywood less than 18 inches above grade.

PART 3 EXECUTION

3.1 PREPARATION

- A. Coordinate installation of rough carpentry members specified in other sections.

3.2 INSTALLATION - GENERAL

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
- C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.3 BLOCKING, NAILERS, AND SUPPORTS

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
- B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to code authorities may be used in lieu of solid wood blocking.
- C. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.
- D. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
- E. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.
- F. Provide the following specific non-structural framing and blocking:
 - 1. Cabinets, casework and shelf supports.
 - 2. Wall brackets and hardware.
 - 3. Handrails.
 - 4. Grab bars.
 - 5. Towel and bath accessories.
 - 6. Wall-mounted door stops.
 - 7. Chalkboards and marker boards.
 - 8. Wall paneling and trim.
 - 9. Joints of rigid wall coverings that occur between studs.
 - 10. Projection screens, curtain tracks, draperies, blinds and other fixtures and equipment.
 - 11. Exterior equipment, fixture, bases and support elements.

3.4 ROOF-RELATED CARPENTRY

- A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.
- B. Provide wood curb at all roof openings except where specifically indicated otherwise. Form corners by alternating lapping side members.

3.5 INSTALLATION OF CONSTRUCTION PANELS

- A. Communications and Electrical Room Mounting Boards: Secure with screws to

studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.

1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
3. Install adjacent boards without gaps.
4. Size: 48 by 96 inches, installed horizontally at ceiling height.

3.6 SITE APPLIED WOOD TREATMENT

- A. Apply preservative treatment compatible with factory applied treatment at site-sawn cuts, complying with manufacturer's instructions.
- B. Allow preservative to dry prior to erecting members.

3.7 TOLERANCES

- A. Framing Members: 1/4 inch from true position, maximum.
- B. Surface Flatness of Floor: 1/8 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.
- C. Variation from Plane (Other than Floors): 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.8 CLEANING

- A. Waste Disposal: Comply with the requirements of Section 017419 - Construction Waste Management and Disposal.
 1. Comply with applicable regulations.
 2. Do not burn scrap on project site.
 3. Do not burn scraps that have been pressure treated.
 4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or "waste-to-energy" facilities.
- B. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.
- C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION 06 10 00

SECTION 06531
HDPE DECK BOARDS

PART 1—GENERAL

1.01 RELATED DOCUMENTS

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

1.02 PRODUCT COMPOSITION

- A. High Density Polyethylene (HDPE) resin and a proprietary blend of additives including pigments, UV inhibitors, and AO stabilizers.
- B. WearDeck or Moisture Shield are the basis of designs for the project.
- C. **Wear Deck and Moisture Shield shall have a wood grain texture on both sides so as to provide a textured surface.**
- D. **All Wear Deck or Moisture Shield fasteners shall be stainless steel.**
- E. Engineer approved equivalent may be substituted only if CONTRACTOR provides technical data and specifications which illustrate the proposed products exceeds the WearDeck or Moisture Shield technical characteristics.

1.03 PRODUCT FEATURES AND BENEFITS

- A. Heat Reflective
- B. Reduces boards surface temperatures by 30 percent
- C. New Barefoot colors stay cool for bare feet
- D. 8 vibrant colors in a bold wood grain, slip-resistant finish:
 - 1. Cool Gray, Sand, Cedar, Weatherwood, Saddle, White, Barefoot Grey, Barefoot Sand
- E. Maximum color retention with 25-year UV package
- F. 25-year Commercial Warranty and Lifetime Residential Warranty
- G. Custom cut-to-order program reduces waste, cost and labor
- H. Minimal thermal expansion & contraction
 - 1. Maximum of 1/32" on a 20' board
- I. Clean with soap and water or a pressure cleaner at a safe distance
- J. Weatherproof and Waterproof
- K. Withstands harsh heat, hurricanes and saltwater
- L. Rated for ground contact and underwater installation
- M. No mold or mildew

1.04 STANDARD DECKING SIZES

- A. 5/4" X 6"
 - 1. Actual Dimensions: 1.05x5.5"
 - 2. Standard Lengths: 12' 16' 20'
 - 3. Custom Lengths: Up to 28'
 - 4. Woodgrain: One Side
 - 5. Colors Available: All
 - 6. 1.90 PLF
- B. 5/4" X 8"
 - 1. Actual Dimensions: 1.05x7.25"
 - 2. Standard Lengths: 12' 16' 20'
 - 3. Custom Lengths: Up to 28'

4. Woodgrain: One Side
5. Colors Available: All
6. 2.56 PLF
- C. 2"X6"
 1. Actual Dimensions: 1.35x5.5"
 2. Standard Lengths: 12' 16' 20'
 3. Custom Lengths: Up to 28'
 4. Woodgrain: One Side
 5. Colors Available: All
 6. 2.42 PLF
- D. 2"X4"
 1. Actual Dimensions: 1.5x3.5"
 2. Standard Lengths: 16' 20'
 3. Custom Lengths: Not available
 4. Woodgrain: Both Sides
 5. Colors Available: All
 6. 1.68 PLF
- E. 2"X8"
 1. Actual Dimensions: 1.5x7.25"
 2. Standard Lengths: 12' 16' 20'
 3. Custom Lengths: Not Available
 4. Woodgrain: Both Sides
 5. Colors Available: All colors at 12' and 16'.
 6. White, Cedar, and Saddle at 20'.
 7. 3.60 PLF
- F. 2"X10"
 1. Actual Dimensions: 1.5x9.25"
 2. Standard Lengths: 12' 20'
 3. Custom Lengths: Not Available
 4. Woodgrain: Both Sides
 5. Colors Available: All colors at 12'.
 6. White, Cedar, and Saddle at 20'.
 7. 4.60 PLF
- G. ½" X 6"
 1. Actual Dimensions: 0.5x5.5"
 2. Standard Lengths: 18'
 3. Custom Lengths: Not Available
 4. Woodgrain: Both SidesColors Available: All
 5. 0.90 PLF
- H. ½" X 10"
 1. Actual Dimensions: 0.5x9.5"
 2. Standard Lengths: 12'
 3. Custom Lengths: Not Available
 4. Woodgrain: Both Sides
 5. Colors Available: All
 6. 1.60 PLF

1.05 INSTALLATION INFORMATION

- A. Reinforced Polymeric Lumber in all profiles produces decking that easily exceeds generally accepted standards for application.
- B. 5/4" decking spans 24 inches on center (O.C.) for deck and dock applications.
 1. 266 PSF load capacity @ 16" O.C.

2. 120 PSF load capacity @ 24" O.C.
 - C. 2"X6" decking spans 24 inches on center (O.C.) for deck and dock applications.
 1. 306 PSF load capacity @ 24" O.C.
- 1.06 JOISTS/STRINGERS
- A. All joists must be level to each other in order to attain a proper quality installation.
 - B. Joists may require blocking/bridging in order to maintain straight and level joists based on material used to construct deck.
- 1.07 CANTILEVERED DECK CAPACITY
- A. For cantilevering; 5/4" x 6" maximum of 2" & 2 x 6" maximum of 4".
- 1.08 LONGITUDINAL GAP BETWEEN DECKING AND WALLS/PILING/POSTS
- A. Provide a minimum of a 1/8" to 1/4" inch gap between exterior walls, pilings, posts, & retaining walls or any solid fixed structure when installing all decking.
- 1.09 FASTENING AND WORKABILITY
- A. **Stainless steel deck screws shall be utilized.**
 - B. Stainless Steel Composite Deck Screws offer exceptional longevity and appearance as they capture surface material.
- 1.10 ACCEPTABLE FASTENERS
- A. Starborn, Simpson Strong-Tie, Deckmate, TrapEase by Fasten Master, Tiger Claw
 - B. CAMO for excellent for drive tools and concealed fastening applications.
- 1.11 FASTENING RECOMMENDATIONS
- A. When face fastening a 5/4" board, use at a minimum, a #9 x 2 1/2" exterior rated composite type screw.
 - B. When face fastening a 2" board, use at a minimum, a #10 x 2 1/2" minimum exterior rated composite type screw.
 - C. Predrilling is NOT GENERALLY REQUIRED, however in the extreme cold of winter, testing to determine best method of application is recommended.
 - D. A MINIMUM of 2 fasteners should be placed from 1/2 to 1 inch from ends & edges of decking at a minimum of every 24 inches or every joist for proper standard decking applications. Your particular application may require a more fasteners based on needs of your structure. Applications for other than standard decking use, example 2x8s or 2x10s, may require special bolts or screws based on your particular application or structures needs.
 - E. 1/2" x 6" or 1/2" x 10" Fascia is designed for use as trim over a completely solid, level boardto board, surface.
 - F. 1/2" x 6" should be fastened with a minimum of 2 screws every 12 inches starting at 1" from ends and edges of each board, allowing 1/16th inch gap between ends / butt joints of each board, screw should be at least a #8 x 1 5/8" long. Example of cap capture screw would be;
 - G. Deckmate #8 x 1 5/8" T20 star drive composite.
 - H. 1/2" x 10" should be fastened with a minimum of 2 screws every 12 inches applied vertically starting at 1" from ends and edges of each board, allowing 1/16th inch gap between ends of each board, screw should be at least a #8 x 1 5/8 inches long. Example of cap capture screw would be; Deckmate #8 x 1 5/8" T20 star drive composite.
 - I. Screws can be composite deck type screw with cap capture threads or standard style threads, cap capture style screws provide the best appearance.
- 1.12 DECK SPACING GUIDELINES
- A. Thermal Expansion = 1/32" in the length of a 20' 5/4 x 6" or 2 x 6" deck board
 - B. End to end spacing minimum of 1/16 inch.
 - C. Side to side spacing minimum of 1/16 inch.

- D. General building practices call for wider side to side spacing to allow for proper drainage, debris removal and/or air circulation, PLEASE consider these factors when installing any decking material. Deck shall be rated for ground contact and can be installed underwater.
- 1.13 FACE FASTENING GUIDELINES
- A. Straight at 90° to deck board.
 - B. When face fastening place screws NO closer than ½ inch from the end and ½ inch from the side from side edge of deck board, using 2 screws at each joist connection. Builders most often find that installing screws approximately 1" from end and edges of boards provides a better look and overall optimal application.
 - C. A MINIMUM of 2 fasteners should be placed from ½ to 1 inch from ends & edges of decking at a minimum of every 24 inches or every joist for proper standard decking applications. Your particular application may require a more fasteners based on needs of your structure. Applications for other than standard decking use, example 2x8s or 2x10s, may require special bolts or screws based on your particular structures needs.
 - D. MINIMUM requirements are stated but ALL Fastening & fastener decisions are the responsibility of the homeowner, builder or contractor.
- 1.14 CLEANING
- A. Generally keeping the decking surface rinsed to remove excess dirt and debris will keep surface in excellent condition. We recommend periodic cleaning for the best overall appearance.
 - B. Promptly clean any stain with a good household cleaner and a natural bristle brush
 - C. However, if dirt is allowed to build up on the surface for a prolonged time tougher buildup may occur which could require extra effort to remove.
 - D. Deck shall have NO organic compounds and deck shall not support mildew or mold growth but if allowed to become and stay dirty the dirt, soil, debris will grow mold or mildew, requiring extra effort to clean.
 - E. Cleaning solutions such as DAWN dishwashing solution, 409, Simple Green, Fantastik, etc. should work well for general cleaning needs.
 - F. IF there is a grill on the deck, a non-rubber backed mat is recommended to protect against grease drops. If grease stains or any stain occurs, they should be cleaned as soon as possible. The longer they remain the harder they are to remove from any surface / any product. DAWN dishwashing solution generally does an excellent job removing most
 - G. grease stains.
 - H. Pressure Washing is NOT RECOMMENDED. However, if pressure washer is used always keep spray tip from 12 to 18 inches away from deck material with a wide fan spray setting at medium pressure. NEVER use a fine point spray setting when cleaning any plastic,
 - I. composite or wood decking material, as fine point spray on a pressure washer can and will most often damage any decking material regardless of type.
- 1.15 ASTM TESTING DATA AND SPANS
- | | |
|------------------------------------|--------------|
| A. Property | Requirement |
| B. Weight | ASTM D6111 |
| C. Modulus of Elasticity | ASTM D6109 |
| D. Flexural Strength ASTM | D6109 |
| E. Temperature/Moisture Effect | ICC-ES AC174 |
| F. Creep Relaxation | ICC-ES AC174 |
| G. UV Resistance | ICC-ES AC174 |
| H. Compressive Modulus | ASTM D6108 |
| I. Specific Gravity | ASTM D2395 |
| J. Screw Withdrawal | ASTM D1761 |
| K. COF Slip Resistance | ASTM F1679 |
| L. COF of Linear Thermal Expansion | ASTM D696 |

END OF SECTION 06531

SECTION 260500

BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Basic Electrical Requirements specifically applicable to Division 26 Sections, in addition to Division 1 General Requirements.

1.02 SCOPE

- A. This scope covers the furnishing, installation, testing, adjusting and placing in operation all electrical equipment, devices, facilities, materials, and auxiliary items necessary for the complete and successful operation of all electrical equipment as herein described, shown on the plans, or deemed necessary for the completion of the electrical portion of the project. It is the intent of DIVISION 26 to outline the electrical requirements of the contract in order to provide the information necessary for the construction of a fully operational system as shown on the plans and as herein described. A comprehensive electrical scope of work is as follows:
 - 1. High Voltage Electrical
 - 2. Power/Electrical System
 - 3. Generator Systems
 - 4. Lighting System
 - 5. Utility Work
 - 6. Connection of Electrically Powered Mechanical Equipment
 - 7. Temporary Construction Power
 - 8. All Incidentals Necessary for a Complete and Fully Operational Electrical System.

1.03 WORKING CLEARANCES

- A. Working clearances around equipment requiring electrical services shall be verified by Contractor to comply with Code requirements. Should there be apparent violations of clearances; the Contractor shall notify the Engineer before proceeding with connection or placing of equipment.
- B. In the case of panelboards, safety switches and other equipment requiring wire and cable terminations, the Contractor shall ascertain that lug sizes and wiring gutters, or space allowed for proper accommodation and termination of the wires and cables are adequate.

SECTION 260519

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

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. Wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.
- B. Related Requirements:
 - 1. Division 26 and 27.

1.3 DEFINITIONS

- A. VFD: Variable frequency drive.

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.
- C. Standard Test Record Sheet/s per NETA ATS Inspection and Test Procedures.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

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

1. Alpha Wire.
 2. Belden Inc.
 3. Encore Wire Corporation.
 4. General Cable Technologies Corporation.
 5. 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, RHW-2 Low Smoke, SOW and Type SO.
- D. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for metal-clad cable, Type MC, Type SO with ground wire.
- E. VFD 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, 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 Classes I and II, Division 2 hazardous location applications.
 4. Cable shall be rated for 1000V unless otherwise indicated

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 Barden 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; stranded for No. 8 AWG and larger.
- B. General Branch Circuits in building for lighting and receptacles: Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger, except VFD cable, which shall be extra flexible stranded.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Non- Industrial Facilities
 1. Service Entrance: Type THHN-THWN, single conductors in raceway.
 2. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-THWN, single conductors in raceway Metal-clad cable, Type MC.
 3. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
 4. Feeders in Cable Tray: Type THHN-THWN, single conductors in raceway Metal-clad cable, Type MC.
 5. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway Metal-clad cable, Type MC.
 6. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
 7. Branch Circuits in Cable Tray: Type THHN-THWN, single conductors in raceway Metal-clad cable, Type MC.
 8. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
 9. Class 1 Control Circuits: Type THHN-THWN, in raceway.
 10. Class 2 Control Circuits: Type THHN-THWN, in raceway.
- B. Industrial Facilities (including but not limited to: Water / Wastewater, Aviation Fueling, Roadway Lighting, Airports, etc.)
 1. Service Entrance: Type XHHW-2, single conductors in raceway.
 2. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type XHHW-2, single conductors in raceway
 3. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.
 4. Feeders in Cable Tray: Type XHHW-2, single conductors in raceway
 5. Branch Circuits Concealed in Ceilings, Walls, and Partitions of an air-conditioned space: Type THHN-THWN, single conductors in raceway Metal-clad cable, Type MC.
 6. Branch Circuits Concealed in Ceilings, Walls, and Partitions of non-air-conditioned space: Type XHHW-2, single conductors in raceway
 7. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.
 8. Branch Circuits in Cable Tray: Type XHHW-2, single conductors in raceway
 9. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

10. Class 1 Control Circuits: Type XHHW-2, in raceway.
11. Class 2 Control Circuits: Type XHHW-2, in raceway

C. Road and Rail Tunnels

1. All conductors installed in the Road and Rail Tunnel shall be type Low Smoke Zero Halogen.
2. Service Entrance: Type RHW-2, single conductors in raceway.
3. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type RHW-2, single conductors in raceway
4. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.
5. Feeders in Cable Tray: Type XHHW-2, single conductors in raceway
6. Branch Circuits Concealed in Ceilings, Walls, and Partitions of an air-conditioned space: Type RHW-2, single conductors in raceway Metal-clad cable, Type MC.
7. Branch Circuits Concealed in Ceilings, Walls, and Partitions of non-air-conditioned space: Type RHW-2, single conductors in raceway
8. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THW-2, single conductors in raceway.
9. Branch Circuits in Cable Tray: Type RHW-2, single conductors in raceway
10. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
11. Branch Circuits: Type RHW-2.
12. Tunnel lighting final tap circuits: Type RHW-2.
13. Class 1 Control Circuits: Type XHHW-2, in raceway.
14. Class 2 Control Circuits: Type XHHW-2, in raceway.

D. VFD Output Circuits: Type TC-ER cable with dual tape shield.

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 Division 26 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."
- G. Complete cable tray systems installation according to Section 260536 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

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. All torque tightening equipment shall be calibrated before use with calibration records available for inspection.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than un-spliced conductors.
 - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum 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 the project specifications.

3.8 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Record all results and submit to engineer for approval. Certify compliance with manufacturer's test parameters, in the absence of Manufacturer's published data, certify compliance with the table listed in NETA Acceptance Testing Specification.
 - 2. All testing must be carried out by competent persons.
 - 3. NETA Acceptance Testing Specification is the minimum level of testing that will be required on all projects with the most relevant inspection and test procedures extracted as listed below. The following list includes additional tests that will be required unless stated otherwise.

Pre-connection:

- a. Visual and Mechanical inspection.
- b. Perform resistance measurements through bolted connections with a low resistance DC Ohmmeter or an insulation resistance test meter.
- c. Continuity of all protective conductors to be recorded using a low resistance DC Ohmmeter or an insulation resistance test meter.
- d. Check continuity of all conductors and verify correct cable connections.
- e. Check polarity of all conductors.
- f. Perform insulation-resistance test on each conductor with respect to ground and all adjacent conductors using an insulation resistance test meter. Each conductor must be tested for 1 minute.
- g. Verify uniform resistance of all parallel conductors.

Post-connection

- h. Test and record the impedance at the supply origin.
 - i. Test and record the Ground fault loop impedance between all live conductors and ground at the furthest extents of each final circuit. This test is to be completed using a Fault Loop Impedance tester and all results must be in compliance with the Circuit Protective Device (CPD) limits from the Manufacturer.
 - j. Test and record the operating trip time of all GFI and GFCI's devices to ensure compliance with NEC and Manufacturer's published data. This test is to be completed using a GFCI test meter.
 - k. Other functional testing may be listed here if required.
4. 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. List of testing personnel with Resumes.
3. Submit all test results on the enclosed test form, see Appendix A.
4. 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

1.01 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.

1.02 SUMMARY

- A. Section includes grounding and bonding systems and equipment.
 - 1. Underground distribution grounding.
 - 2. Ground bonding common with lightning protection system.
 - 3. Foundation steel electrodes.

1.03 ACTION SUBMITTALS

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

1.04 INFORMATIONAL SUBMITTALS

- A. As-Built Data: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:
 - 1. Test wells.
 - 2. Ground rods.
 - 3. Ground rings.
 - 4. Grounding arrangements and connections for separately derived systems.
- B. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section "Operation and Maintenance Data," include the following:

- a. Instructions for periodic testing and inspection of grounding features at test wells ground rings grounding connections for separately derived systems based on NETA MTS
 - 1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
 - 2) Include recommended testing intervals.

1.06 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

2.01 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.

2.02 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.

2.03 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 Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches (6.3 by 100 mm) in cross section, with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.
- D. 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. All Service Entrance Equipment shall be provided with a Grounding Electrode Conductor between the Service Entrance Ground and the Grounding Electrode System as shown on the drawings. When the Grounding Electrode Conductor is not shown on the drawing, provide a Grounding Electrode Conductor per Table 250.66 of the NEC.
 3. Main Bonding Jumper installed between the Service Entrance Ground and Neutral and shall be sized per Table 250.66 of the NEC.
 4. System Bonding Jumper installed between the Separately Derived System Ground and Neutral and shall be sized per Table 250.66 of the NEC.

2.04 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.

2.05 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel, sectional type; 3/4 inch by 10 feet (19 mm by 3 m) min
- B. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with nonhazardous electrolytic chemical salts.
 1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches (1200 mm) long.
 2. Backfill Material: Electrode manufacturers recommended material.

PART 3 - EXECUTION

3.01 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.
 - 1. Bury at least 24 inches (600 mm) below grade.
 - 2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus horizontally, on insulated spacers 2 inches (50 mm) minimum from wall, 6 inches (150 mm) above finished floor unless otherwise indicated.
 - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.
- E. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.

3.02 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.

3.03 GROUNDING SEPARATELY DERIVED SYSTEMS

- A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

3.04 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.

- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, no shrink grout.
- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors' level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.
- D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches (150 mm) from the foundation.

3.05 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- C. Water Heater, Heat-Tracing, and Ant frost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- D. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. 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.
- E. 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.
- F. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

- G. Metallic Fences: Comply with requirements of IEEE C2.
 - 1. Grounding Conductor: Bare copper, not less than No. 8AWG.
 - 2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.
 - 3. Barbed Wire: Strands shall be bonded to the grounding conductor.

3.06 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. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 - 2. When service grounding is not detailed on the drawings, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260543 "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches (300 mm) deep, with cover.
 - 1. Test Wells: Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- E. 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.
- F. 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. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.
- H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart.
- I. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of area.
1. Install copper conductor not less than No. 2/0 AWG or as shown on the drawing for ground ring and for taps to building steel.
 2. Bury ground ring not less than 24 inches (600 mm) from building's foundation.
- J. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; using electrically conductive coated steel reinforcing bars or rods, at least 20 feet (6.0 m) long. If reinforcing is in multiple pieces, connect together by the usual steel tie wires or exothermic welding to create the required length.

3.07 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.

4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- B. Grounding system will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.
- D. Report measured ground resistances that exceed the following values:
1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: **5** ohms.
 2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: **5** ohms.
 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: **3** ohms.
 4. Power Distribution Units or Panelboards Serving Electronic Equipment: **3** ohm(s).
 5. Substations and Pad-Mounted Equipment: **5** ohms.
 6. Manhole Grounds: **10** ohms.
- 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 260529

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.
- B. Related Sections include the following:

1.03 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.04 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.05 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel slotted support systems.
 - 2. Nonmetallic slotted support systems.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze hangers. Include Product Data for components.
 - 2. Steel slotted channel systems. Include Product Data for components.
 - 3. Nonmetallic slotted channel systems. Include Product Data for components.
 - 4. Equipment supports.

1.06 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.07 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

1.08 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified together with concrete Specifications.
- B. Coordinate installation of roof mounted electrical with structural and architectural specification and drawings.

PART 2 - PRODUCTS

2.01 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; Atkore International.
 - g. Wesanco, Inc.
 - h. or Approved Equal
2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 3. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 4. Channel Dimensions: Selected for applicable load criteria.
- B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels, and angles with 9/16-inch- (14-mm-) diameter holes at a maximum of 8 inches (200 mm) on center, in at least 1 surface.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.
 - c. Fabco Plastics Wholesale Limited.
 - d. Seasafe, Inc.
 - e. or Approved Equal
 2. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
 3. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.
 4. Rated Strength: Selected to suit applicable load criteria.
- C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- D. Conduit and Cable Support Devices shall be as indicated below:
1. PVC Conduit – PVC, Fiberglass, or Stainless Steel (unless atmosphere is corrosive to Stainless Steel)
 2. RGS Conduit – Galvanized Steel
 3. Aluminum Conduit – Stainless Steel
 4. PVC Coated RGS – Stainless Steel (unless atmosphere is corrosive to Stainless Steel); if atmosphere is corrosive to Stainless Steel, then use Fiberglass.
 5. EMT – Painted or Galvanized Steel
 - 6.
- E. Cable Tray Supports shall be as indicated below:
1. Galvanized Steel – Galvanized or Stainless Steel
 2. Fiberglass – Stainless Steel or a combination of Fiberglass and Stainless Steel
 3. Aluminum – Stainless Steel

- F. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- G. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- H. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened Portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Hilti, Inc.
 - 2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.
 - 5) or Approved Equal
 2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened Portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Cooper B-Line, Inc.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti, Inc.
 - 4) ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
 - 6) or Approved Equal
 3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 6. Toggle Bolts: All-steel springhead type.
 7. Hanger Rods: Threaded steel.

2.02 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

PART 3 - EXECUTION

3.01 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with single-bolt conduit clamps].

3.02 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb. (90 kg).
- C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
 - 6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
 - 7. To Light Steel: Sheet metal screws.

8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

- D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.03 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- B. Field Welding: Comply with AWS D1.1/D1.1M.

3.04 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements as specified in the contract documents.
- C. Anchor equipment to concrete base.
 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.05 PAINTING

- A. 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 minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533

RACEWAYS AND BOXES 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.

1.2 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Surface raceways.
6. Boxes, enclosures, and cabinets.
7. Handholes and boxes for exterior underground cabling.

B. Related Requirements:

1. Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

1.3 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
 - 1. Structural members in paths of conduit groups with common supports.
 - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- B. Seismic Qualification Certificates: For enclosures, cabinets, and conduit racks and their mounting provisions, include those for internal 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.
 - 4. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.
- C. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Allied Tube & Conduit.
 - 3. Anamet Electrical, Inc.
 - 4. Electri-Flex Company.
 - 5. O-Z/Gedney.
 - 6. Picoma Industries.
 - 7. Republic Conduit.
 - 8. Robroy Industries.
 - 9. Southwire Company.
 - 10. Thomas & Betts Corporation.
 - 11. Western Tube and Conduit Corporation.
 - 12. Wheatland Tube Company.
 - 13. or Approved Equal.
- B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. GRC: Comply with ANSI C80.1 and UL 6.

- D. ARC: Comply with ANSI C80.5 and UL 6A.
- E. IMC: Comply with ANSI C80.6 and UL 1242.
- F. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
 - 1. Comply with NEMA RN 1.
 - 2. Coating Thickness: 0.040 inch (1 mm), minimum.
- G. EMT: Comply with ANSI C80.3 and UL 797.
- H. FMC: Comply with UL 1; zinc-coated steel or aluminum.
- I. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- J. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
 - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
 - 2. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: compression.
 - 3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
 - 4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.
- K. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Anamet Electrical, Inc.
 - 3. Arneo Corporation.
 - 4. CANTEX Inc.
 - 5. CertainTeed Corporation.
 - 6. Condux International, Inc.
 - 7. Electri-Flex Company.
 - 8. Kraloy.
 - 9. <http://www.specagent.com/LookUp/?uid=123456895856&mf=&src=wd>Carlton Electrical Products.
 - 10. Niedax-Kleinhuis USA, Inc.

11. RACO; Hubbell.
 12. Thomas & Betts Corporation.
 13. or Approved Equal.
- B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. ENT: Comply with NEMA TC 13 and UL 1653.
- D. RNC: Type EPC-40-PVC, or EPC-80-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- E. LFNC: Comply with UL 1660.
- F. Rigid HDPE: Comply with UL 651A.
- G. Continuous HDPE: Comply with UL 651B.
- H. Coilable HDPE: Preassembled with conductors or cables and complying with ASTM D 3485.
- I. RTRC: Comply with UL 1684A and NEMA TC 14.
- J. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
- K. Fittings for LFNC: Comply with UL 514B.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper B-Line, Inc.
 2. Hoffman.
 3. Mono-Systems, Inc.
 4. Square D.
 5. or Approved Equal.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 for interior or Type 4X stainless steel for exterior unless otherwise indicated, and sized according to NFPA 70.
1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

- D. Wireway Covers: Hinged type for NEMA 1 and hinged, flanged-and-gasketed type for NEMA 4X unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

2.4 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Allied Moulded Products, Inc.
 - 2. Hoffman.
 - 3. <http://www.specagent.com/LookUp/?uid=123456895864&mf=&src=wd>Carlton Electrical Products.
 - 4. Niedax-Kleinhuis USA, Inc.
 - 5. or Approved Equal.
- B. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Description: Fiberglass polyester or PVC, extruded and fabricated to required size and shape, and having hinged cover with captive screws.
- D. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.

2.5 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Surface Metal Raceways: Galvanized steel with Snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Mono-Systems, Inc.
 - b. Panduit Corp.
 - c. Wiremold / Legrand.
 - d. or Approved Equal.
- C. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell Incorporated.
 - b. Mono-Systems, Inc.
 - c. Panduit Corp.
 - d. Wiremold / Legrand.
 - e. or Approved Equal.

D. Tele-Power Poles:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Mono-Systems, Inc.
 - b. Panduit Corp.
 - c. Wiremold / Legrand.
 - d. or Approved Equal.
2. Material: Galvanized steel with baked-enamel finish in Architect choice of colors.
3. Fittings and Accessories: Dividers, end caps, covers, cutouts, wiring harnesses, devices, mounting materials, and other fittings shall match and mate with tele-power pole as required for complete system.

2.6 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Adalet.
 2. Cooper Technologies Company; Cooper Crouse-Hinds.
 3. EGS/Appleton Electric.
 4. Erickson Electrical Equipment Company.
 5. FSR Inc.
 6. Hoffman.
 7. Hubbell Incorporated.
 8. Kraloy.
 9. Milbank Manufacturing Co.
 10. Mono-Systems, Inc.
 11. O-Z/Gedney.
 12. RACO; Hubbell.
 13. Robroy Industries.
 14. Spring City Electrical Manufacturing Company.
 15. Stahlin Non-Metallic Enclosures.
 16. Thomas & Betts Corporation.
 17. Wiremold / Legrand.
 18. or Approved Equal.

- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy or aluminum to match raceway type, Type FD, with gasketed cover.
- E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- F. Metal Floor Boxes:
 - 1. Material: sheet metal.
 - 2. Type: Fully adjustable.
 - 3. Shape: Rectangular.
 - 4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Nonmetallic Floor Boxes: Nonadjustable, round.
 - 1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- H. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.
- I. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb (32 kg).
 - 1. Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- J. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- K. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover, unless otherwise noted.
- L. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- M. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep), unless otherwise noted.
- N. Gangable boxes are prohibited, unless specifically noted.
- O. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 4X Stainless Steel for outdoor locations, Type 12 for indoor locations, with continuous-hinge cover with flush latch unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

2. Nonmetallic Enclosures: Fiberglass.
3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

P. Cabinets:

1. NEMA 250, Type 4X Stainless Steel for outdoor locations, Type 12 for indoor locations, with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.7 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. NewBasis.
 - d. Oldcastle Precast, Inc.
 - e. Quazite: Hubbell Power System, Inc.
 - f. Synertech Moulded Products.
 - g. Or approved equal.
2. Standard: Comply with SCTE 77.
3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, as required to identify system indicated on the drawings.
7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes 12 Inches Wide by 24 Inches Long (300 mm Wide by 600 mm Long) and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

- C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of fiberglass unless otherwise noted.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. NewBasis.
 - d. Nordic Fiberglass, Inc.
 - e. Oldcastle Precast, Inc; Christy Concrete Products.
 - f. Quazite; Hubbell Power System, Inc; Hubbell Power Systems.
 - g. Synertech Moulded Products.
 - h. Or Approved Equal.
 2. Standard: Comply with SCTE 77.
 3. Color of Frame and Cover: Gray.
 4. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
 5. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
 6. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 7. Cover Legend: Molded lettering, as required to identify system indicated on the drawings
 8. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
 9. Handholes 12 Inches Wide by 24 Inches Long (300 mm Wide by 600 mm Long) and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.8 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
1. Tests of materials shall be performed by an independent testing agency.
 2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
 3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed Conduit: GRC.

2. Concealed Conduit, Aboveground: RNC, Type EPC-40-PVC, unless otherwise indicated on drawings.
 3. Underground Conduit: RNC, Type EPC-40-PVC when concrete encased, Type EPC-80-PVC when direct buried,
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC unless otherwise indicated on drawings
 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 4X Stainless steel unless otherwise indicated on drawings.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT.
 2. Exposed, Not Subject to Severe Physical Damage: EMT.
 3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 - d. Gymnasiums.
 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 6. Damp or Wet Locations: GRC unless otherwise noted.
 7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4X stainless steel in institutional and commercial kitchens and damp or wet locations, unless otherwise noted.
- C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
 3. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.
 4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- G. Install surface raceways only where indicated on Drawings.

- H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C) .

3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 12 inches (300 mm) of enclosures to which attached.
- I. Raceways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot (3-m) intervals.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 3. Arrange raceways to keep a minimum of 3 inches of concrete cover in all directions.
 - 4. Do not embed threadless fittings in concrete unless specifically approved by Engineer for each specific location.
 - 5. Change from ENT to GRC before rising above floor.
- J. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT, IMC, or RMC for raceways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

- L. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- N. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- O. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- P. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- Q. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- R. Surface Raceways:
 - 1. Install surface raceway with a minimum 2-inch (50-mm) radius control at bend points.
 - 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- S. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- T. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where an underground raceway enters a building or structure.
 - 3. Where otherwise required by NFPA 70.
- U. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- V. Expansion-Joint Fittings:
 - 1. Provide expansion joint fitting any time conduit systems cross building expansion joints or structural expansion joints.
 - 2. Provide expansion fittings as recommended by the manufacturer of the conduit.
 - 3. Provide expansion fittings per NFPA 70.

4. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- W. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for recessed and semi-recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
 3. Provide a separate ground for all flex conduits.
- X. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- Y. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between boxes and cover plate or supported equipment and box.
- Z. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.
- AA. Locate boxes so that cover or plate will not span different building finishes.
- BB. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- CC. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- DD. Set metal floor boxes level and flush with finished floor surface.
- EE. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:
1. Excavate trench bottom to provide firm and uniform support for conduit.
 2. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction per 95% modified proctor density.
 3. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor. Wrap conduit with 2 coats of 3M Scotch Wrap or Approved Equal.

- a. Couple steel conduits to ducts with adapters designed for this purpose and encase coupling with 3 inches (75 mm) of concrete for a minimum of 12 inches (300 mm) on each side of the coupling.
 - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
4. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.4 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."

3.5 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping." If Section 078413 is not included as part of the project specifications, provide fire rated penetrations based on the fire proofing material being supplied. All penetrations through fire rated walls shall be fire proofed.

3.6 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 260543

UNDERGROUND DUCTS AND RACEWAYS 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.

1.2 SUMMARY

- A. Section Includes:
 - 1. Direct-buried conduit, ducts, and duct accessories.
 - 2. Concrete-encased conduit, ducts, and duct accessories.
 - 3. Handholes and boxes.
 - 4. Manholes.

1.3 DEFINITIONS

- A. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include duct-bank materials, including separators and miscellaneous components.
 - 2. Include ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
 - 3. Include accessories for manholes, handholes, and boxes.
 - 4. Include warning tape.

- B. Shop Drawings:
 - 1. Precast manholes and handholes:
 - a. Include plans, elevations, sections, details, attachments to other work, and accessories.
 - b. Include duct entry provisions, including locations and duct sizes.
 - c. Include reinforcement details.
 - d. Include frame and cover design and manhole frame support rings.
 - e. Include Step details.

- f. Include grounding details.
 - g. Include dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
 - h. Include joint details.
2. Factory-Fabricated Handholes and Boxes Other Than Precast Concrete:
- a. Include dimensioned plans, sections, and elevations, and fabrication and installation details.
 - b. Include duct entry provisions, including locations and duct sizes.
 - c. Include cover design.
 - d. Include grounding details.
 - e. Include dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

1.5 INFORMATIONAL SUBMITTALS

- A. Duct-Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures.
 - 1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.
- B. Product Certificates: For concrete and steel used in precast concrete manholes and handholes, as required by ASTM C 858.
- C. Qualification Data: For professional engineer and testing agency responsible for testing nonconcrete handholes and boxes.
- D. Source quality-control reports.
- E. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

1.7 FIELD CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions, and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify Engineer and Owner no fewer than two days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Engineer and Owner's written permission.

- B. Ground Water: Assume ground-water level is at grade level unless a lower water table is noted in the contract documents.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR DUCTS AND RACEWAYS

- A. Comply with ANSI C2.

2.2 CONDUIT

- A. Rigid Steel Conduit: Galvanized. Comply with ANSI C80.1.
- B. RNC: NEMA TC 2, Type EPC-40-PVC and Type EPC-80-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.3 NONMETALLIC DUCTS AND DUCT ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. ARNCO Corp.
 2. Beck Manufacturing.
 3. Cantex, Inc.
 4. CertainTeed Corporation.
 5. Condux International, Inc.
 6. ElecSys, Inc.
 7. Electri-Flex Company.
 8. IPEX Inc.
 9. Lamson & Sessions; Carlon Electrical Products.
 10. Spiraduct/AFC Cable Systems, Inc.
 11. or Approved Equal.
- B. Underground Plastic Utilities Duct: NEMA TC 2, UL 651, ASTM F 512, Type EPC-80 (only when specifically called out on the drawings) and Type EPC-40, with matching fittings complying with NEMA TC 3 by same manufacturer as the duct.
- C. Duct Accessories:
 1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and size of ducts with which used, and selected to provide minimum duct spacing indicated while supporting ducts during concreting or backfilling.
 2. Warning Tape: Underground-line warning tape specified in Section 260553 "Identification for Electrical Systems."

- 2.4 PRECAST CONCRETE HANDHOLES AND BOXES (All Handholes and Boxes larger than 4 sq. ft. shall be precast)
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Christy Concrete Products.
 2. Elmhurst-Chicago Stone Co.
 3. Oldcastle Precast Group.
 4. Rinker Group, Ltd.
 5. Riverton Concrete Products.
 6. Utility Concrete Products, LLC.
 7. Utility Vault Co.
 8. Wausau Tile Inc.
 9. or Approved Equal
- B. Comply with ASTM C 858 for design and manufacturing processes.
- C. Top of handhole to be located 6" above finished grade (handhole cover is not traffic rated).
- D. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box.
1. Frame and Cover: Galvanized steel frame, with hinged galvanized steel access door assembly with tamper-resistant, captive, cover-securing bolts.
 - a. Cover Hinges: Concealed, with hold-open ratchet assembly.
 - b. Cover Handle: Recessed.
 2. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 3. Cover Legend: Molded lettering, as required to identify system indicated on the drawings.
 4. Configuration: Units shall be designed for raised burial and have open bottom unless otherwise indicated. (Install handholes on a minimum of 12" of clean crushed stone.)
 5. Extensions and Slabs: Designed to mate with bottom of enclosure. Same material as enclosure.
 - a. Extension shall provide increased depth of 12 inches (300 mm).
 - b. Slab: Same dimensions as bottom of enclosure and arranged to provide closure.
 6. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.
 7. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks, plus an additional 12 inches (300 mm) vertically and horizontally to accommodate alignment variations.
 - a. Windows shall be located no less than 6 inches (150 mm) from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.
 - b. Window opening shall have cast-in-place, welded-wire fabric reinforcement for field cutting and bending to tie to concrete envelopes of duct banks.

- c. Window openings shall be framed with at least two additional No. 3 steel reinforcing bars in concrete around each opening.
 8. Handholes shall have inserts for cable racks and pulling-in irons installed before concrete is poured.
- 2.5 HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE (for area less than 4 sq. ft.)
- A. General Requirements for Handholes and Boxes: Comply with SCTE 77. Comply with tier requirements in "Underground Enclosure Application" Article.
 1. Color: Gray.
 2. Configuration: Units shall be designed for flush burial and have open bottom unless otherwise indicated. (Install on 12" of clean crushed stone)
 3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
 4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 5. Cover Legend: Molded lettering, as required to identify system indicated on the drawing.
 6. All conduits shall enter the handholes and other boxes from the bottom. All 90-degree bends shall be long radius.
 - B. Polymer Concrete Handholes and Boxes with Polymer Concrete Cover: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two. Boxes shall be rated for Tier 22 or Tier 15 based on location.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. NewBasis.
 - d. Quazite: Hubbell Power System, Inc.
 - e. or Approved Equal.

2.6 PRECAST MANHOLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Christy Concrete Products.
 2. Elmhurst-Chicago Stone Co.
 3. Oldcastle Precast Group.
 4. Rinker Group, Ltd.
 5. Riverton Concrete Products.
 6. Utility Concrete Products, LLC.
 7. Utility Vault Co.
 8. Wausau Tile Inc.
 9. or Approved Equal

- B. Comply with ASTM C 858.
- C. Precast Manholes: One-piece units and units with interlocking mating sections, complete with accessories, hardware, and features.
- D. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks, plus an additional 12 inches (300 mm) vertically and horizontally to accommodate alignment variations.
 - 1. Windows shall be located no less than 6 inches (150 mm) from interior surfaces of walls, floors, or roofs of manholes, but close enough to corners to facilitate racking of cables on walls.
 - 2. Window opening shall have cast-in-place, welded-wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
 - 3. Window openings shall be framed with at least two additional No. 3 steel reinforcing bars in concrete around each opening.
- E. Concrete Knockout Panels: 1-1/2 to 2 inches (38 to 50 mm) thick, for future conduit entrance and sleeve for ground rod.
- F. Ground Rod Sleeve: Provide a 3-inch (75-mm) PVC conduit sleeve in manhole floors 2 inches (50 mm) from the wall adjacent to, but not underneath, the ducts routed from the facility.
- G. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.
- H. Manhole Frames, Covers, and Chimney Components: Comply with structural design loading specified for manhole.
 - 1. Frame and Cover: Weatherproof, gray cast iron complying with ASTM A 48/A 48M, Class 30B with milled cover-to-frame bearing surfaces; diameter, 29 inches (725 mm).
 - a. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 - b. Special Covers: Recess in face of cover designed to accept finish material in paved areas.
 - 2. Cover Legend: Cast in. Selected to suit system.
 - a. Legend: "ELECTRIC-LV" for duct systems with power wires and cables for systems operating at 600 V and less.
 - b. Legend: "ELECTRIC-HV" for duct systems with medium-voltage cables.
 - 3. Manhole Chimney Components: Precast concrete rings with dimensions matched to those of roof opening.
 - a. Mortar for Chimney Ring and Frame and Cover Joints: Comply with ASTM C 270, Type M, except for quantities less than 2.0 cu. ft. (60 L) where packaged mix complying with ASTM C 387, Type M, may be used.
- I. Manhole Sump Frame and Grate: ASTM A 48/A 48M, Class 30B, gray cast iron.

- J. Pulling Eyes in Concrete Walls: Eyebolt with reinforcing-bar fastening insert, 2-inch- (50-mm-) diameter eye, and 1-by-4-inch (25-by-100-mm) bolt.
 - 1. Working Load Embedded in 6-Inch (150-mm), 4000-psi (27.6-MPa) Concrete: 13,000-lbf (58-kN) minimum tension.
- K. Pulling-In and Lifting Irons in Concrete Floors: 7/8-inch- (22-mm-) diameter, hot-dip galvanized, bent steel rod; stress relieved after forming; and fastened to reinforcing rod. Exposed triangular opening.
 - 1. Ultimate Yield Strength: 40,000-lbf (180-kN) shear and 60,000-lbf (270-kN) tension.
- L. Expansion Anchors for Installation after Concrete Is Cast: Zinc-plated, carbon-steel-wedge type with stainless-steel expander clip with 1/2-inch (13-mm) bolt, 5300-lbf (24-kN) rated pullout strength, and minimum 6800-lbf (30-kN) rated shear strength.
- M. Cable Rack Assembly: hot-dip galvanized, except insulators.
 - 1. Stanchions: T-section or channel; 2-1/4-inch (56-mm) nominal size; punched with 14 holes on 1-1/2-inch (38-mm) centers for cable-arm attachment.
 - 2. Arms: 1-1/2 inches (38 mm) wide, lengths ranging from 3 inches (75 mm) with 450-lb (204-kg) minimum capacity to 18 inches (450 mm) with 250-lb (114-kg) minimum capacity. Arms shall have slots along full length for cable ties and be arranged for secure mounting in horizontal position at any vertical location on stanchions.
 - 3. Insulators: High-glaze, wet-process porcelain arranged for mounting on cable arms.
- N. Duct-Sealing Compound: Nonhardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F (2 deg C). Capable of withstanding temperature of 300 deg F (150 deg C) without slump and adhering to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.
- O. Cover Hooks: Heavy duty, designed for lifts 60 lbf (270 N) and greater, Two required.

2.7 SOURCE QUALITY CONTROL

- A. Test and inspect precast concrete utility structures according to ASTM C 1037.
- B. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of manholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
 - 1. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
 - 2. Testing machine pressure gages shall have current calibration certification, complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field. Notify Engineer if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.

3.2 UNDERGROUND DUCT APPLICATION

- A. Ducts for Electrical Cables More than 600 V: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank unless otherwise indicated.
- B. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-40 -PVC, in concrete-encased duct bank unless otherwise indicated.
- C. Ducts for Electrical Branch Circuits: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank unless otherwise indicated.
- D. Underground Ducts Crossing Roadways and Paved Areas: RNC, NEMA Type EPC-40-PVC, encased in reinforced concrete.

3.3 UNDERGROUND ENCLOSURE APPLICATION

- A. Handholes and Boxes for 600 V and Less:
 - 1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, H-20 structural load rating.
 - 2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Precast concrete, AASHTO HB 17, H-20 or Polymer concrete, SCTE 77, Tier 22 structural load rating.
 - 3. Units in Sidewalk, Similar Applications, and Non-Paved Areas with a Safety Factor for Nondeliberate Loading by Vehicles: Precast concrete, AASHTO HB 17, H-10 or Polymer concrete units, SCTE 77, Tier 15
- B. Manholes: Precast concrete.
 - 1. H-20 structural load rating according to AASHTO HB 17.

3.4 EARTHWORK

- A. Excavation and Backfill: Comply with the provisions of the contract documents and the manufacturer's recommendations. Compact gravel under manholes and handholes to 95% modified proctor.
 - 1. Provide 12" of crushed stone for placement of all manholes and handholes.

- B. Restore surface features at areas disturbed by excavation and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
- C. Cut and patch existing pavement in the path of underground ducts and utility structures according to the general provisions of the contract.

3.5 DUCT INSTALLATION

- A. Install ducts according to NEMA TCB 2.
- B. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes, to drain in both directions.
- C. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches (1200 mm), both horizontally and vertically, at other locations unless otherwise indicated.
- D. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.
- E. Installation Adjacent to High-Temperature Steam Lines: Where duct banks are installed parallel to underground steam lines, perform calculations showing the duct bank will not be subject to environmental temperatures above 40 deg C. Where environmental temperatures are calculated to rise above 40 deg C, and anywhere the duct bank crosses above an underground steam line, install insulation blankets listed for direct burial to isolate the duct bank from the steam line.
- F. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches (250 mm) over center for 5-inch (125-mm) ducts, and vary proportionately for other duct sizes.
 - 1. Begin change from regular spacing to end-bell spacing 10 feet (3 m) from the end bell without reducing duct line slope and without forming a trap in the line.
 - 2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole. Install an expansion fitting near the center of all straight line direct-buried duct banks with calculated expansion of more than 3/4 inch (19 mm).
 - 3. Grout end bells into structure walls from both sides to provide watertight entrances.
- G. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 feet (3 m) outside the building wall, without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."
- H. Building Conduit Entry Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig (1.03-MPa) hydrostatic pressure.

- I. Pulling Cord: Install 100-lbf- (445-N-) test nylon cord in empty ducts.
- J. Concrete-Encased Ducts: Support ducts on duct separators.
 1. Excavate trench bottom to provide firm and uniform support for duct bank.
 2. Width: Excavate trench 12 inches (300 mm) wider than duct bank on each side.
 3. Depth: Install top of duct bank at least 24 inches (600 mm) below finished grade in areas not subject to deliberate traffic, and at least 30 inches (750 mm) below finished grade in deliberate traffic paths for vehicles unless otherwise indicated.
 4. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
 5. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than four spacers per 20 feet (6 m) of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches (150 mm) between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
 6. Minimum Space between Ducts: 3 inches (75 mm) between ducts and exterior envelope wall, 2 inches (50 mm) between ducts for like services, and 4 inches (100 mm) between power and signal ducts.
 7. Elbows: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment, at building entrances through floor, and at changes of direction in duct run.
 - a. Couple steel conduits to ducts with adapters designed for this purpose and encase coupling with 3 inches (75 mm) of concrete.
 - b. Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of base. Install insulated grounding bushings on terminations at equipment.
 8. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
 9. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
 10. Concrete Cover: Install a minimum of 3 inches (75 mm) of concrete cover at top and bottom, and a minimum of 2 inches (50 mm) on each side of duct bank.
 11. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
 - a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations or use other specific measures to prevent expansion-contraction damage.
 - b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch (15-mm) reinforcing-rod dowels extending a minimum of 18 inches (450 mm) into concrete on both sides of joint near corners of envelope.
 12. Pouring Concrete: Comply with requirements in accordance with the general conditions of the contract. Place concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Allow concrete to flow to center of bank and rise up in middle,

uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.

K. Direct-Buried Duct Banks:

1. Excavate trench bottom to provide firm and uniform support for duct bank.
2. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
3. Space separators close enough to prevent sagging and deforming of ducts, with not less than four spacers per 20 feet (6 m) of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches (150 mm) between tiers.
4. Depth: Install top of duct bank at least 24" below finished grade unless otherwise indicated.
5. Set elevation of bottom of duct bank below frost line.
6. Install ducts with a minimum of 3 inches (75 mm) between ducts for like services and 6 inches (150 mm) between power and signal ducts.
7. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment, at building entrances through floor, and at changes of direction in duct run.
 - a. Couple steel conduits to ducts with adapters designed for this purpose and encase coupling with 3 inches (75 mm) of concrete.
 - b. For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
8. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfill to 4 inches (100 mm) over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction. Comply to 95% modified Proctor.
 - a. Place minimum 3 inches (75 mm) of sand as a bed for duct bank. Place sand to a minimum of 6 inches (150 mm) above top level of duct bank.

- L. Warning Tape: Bury warning tape approximately 12 inches (300 mm) above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches (75 mm) of centerline of duct bank. Provide an additional warning tape for each 12-inch (300-mm) increment of duct-bank width over a nominal 18 inches (450 mm). Space additional tapes 12 inches (300 mm) apart, horizontally.

3.6 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

A. Precast Concrete Handhole and Manhole Installation:

1. Comply with ASTM C 891 unless otherwise indicated.
2. Install units level and plumb and with orientation and depth coordinated with connecting ducts, to minimize bends and deflections required for proper entrances.

3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch (25-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

B. Elevations:

1. Manhole Roof: Install with rooftop at least 15 inches (375 mm) below finished grade.
2. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames 1 inch (25 mm) above finished grade.
3. Install handholes with bottom below frost line.
4. Traffic Rated Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.
5. Install precast handholes without traffic rated lids 6" above grade.
6. Where indicated, cast handhole cover frame integrally with handhole structure.

C. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.

D. Manhole Access: Circular opening in manhole roof; sized to match cover size.

1. Install chimney, constructed of precast concrete collars and rings, to support cast-iron frame to connect cover with manhole roof opening. Provide moisture-tight masonry joints and waterproof grouting for frame to chimney.

E. Waterproofing: Apply waterproofing to exterior surfaces of manholes and precast concrete handholes after concrete has cured at least three days. After ducts have been connected and grouted, and before backfilling, waterproof joints, and connections, and touch up abrasions and scars. Waterproof exterior of manhole chimneys after mortar has cured at least three days.

F. Hardware: Install removable hardware, including pulling eyes, cable stanchions, and cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.

G. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inches (97 mm) for manholes and 2 inches (50 mm) for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

3.7 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting ducts, to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by manufacturer.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas and trafficways, set cover flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.

D. Install handholes and boxes with bottom below frost line.

- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.
- F. Field cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.
- G. For enclosures subject to occasional, nondeliberate, heavy vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth.
 - 1. Concrete: 3000 psi (20 kPa), 28-day strength, complying with the provisions of the general contract. Finish with a trowel.
 - 2. Dimensions: in accordance with the manufacturer's recommendations but no less than 10 inches wide by 12 inches deep.

3.8 GROUNDING

- A. Ground underground ducts and utility structures according to Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Install a 10' x 3/4" copper clad steel ground rod in each manhole and handhole. Bond ground rod to grounding electrode in duct bank or duct counterpoise if provided. Bond ground rod to all metal parts inside the manhole or handhole.

3.9 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
 - 1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
 - 2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide a minimum 6-inch- (150-mm-) long mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
 - 3. Test manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.10 CLEANING

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

- B. Clean internal surfaces of manholes, including sump. Remove foreign material.

END OF SECTION 260543

SECTION 260554

SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

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. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
 - 2. Sleeve-seal systems.
 - 3. Sleeve-seal fittings.
 - 4. Grout.
 - 5. Silicone sealants.
- B. Related Requirements:
 - 1. For penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items, use UL listed assemblies for the type and installation applied.

1.3 ACTION SUBMITTALS

- A. Submit in accordance with Section 01300:
 - 1. Product data: for each type of product

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Wall Sleeves:
 - 1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.
- C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40. (For use with grounding electrode conductors only.)
- D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

- E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- F. Sleeves for Rectangular Openings:
 - 1. Material: Galvanized sheet steel.
 - 2. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
 - b. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. CALPICO, Inc.
 - c. Metraflex Company (The).
 - d. Pipeline Seal and Insulator, Inc.
 - e. Proco Products, Inc.
 - f. or Approved Equal.
 - 2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Stainless steel.
 - 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Presealed Systems.
 - b. or Approved Equal.

2.4 GROUT

- A. Description: Non-shrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

- D. Packaging: Premixed and factory packaged.
- 2.5 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 07900 "Joint Sealants."
 - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level. Install sleeves during erection of floors.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- G. Underground, Exterior-Wall and Floor Penetrations: Install steel pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 260554

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 and metal-clad cable.
 2. Identification for conductors and communication and control cable.
 3. Underground-line warning tape.
 4. Warning labels and signs.
 5. Instruction signs.
 6. Equipment identification labels.
 7. 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.
- C. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

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 identifying devices before installing acoustical ceilings and similar concealment.
- E. Install all signs and labels horizontal (level) and consistent for similar equipment and panels.

PART 2 - PRODUCTS

2.1 RACEWAY AND METAL-CLAD CABLE 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. 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.
- D. 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 Metal-Clad 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. Fire Alarm System: Red.
 - 3. Fire-Suppression Supervisory and Control System: Red and yellow.
 - 4. Combined Fire Alarm and Security System: Red and blue.
 - 5. Security System: Blue and yellow.
 - 6. Mechanical and Electrical Supervisory System: Green and blue.
 - 7. Telecommunication System: Green and yellow.
 - 8. Control Wiring: Green and red.

- C. Power-Circuit Conductor Identification: For primary and secondary conductors No. 1/0 AWG and larger in vaults, pull and junction boxes, manholes, and hand holes use metal tags. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.
 - 1. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking nylon tie fastener.

- D. 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.

- E. 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.

- F. 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.

- G. 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.
- H. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install underground-line warning tape for both direct-buried cables and cables in raceway. During backfilling of trenches install continuous underground-line warning tape directly above line at 12 inches above duct. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
1. Description:
 - a. Permanent, bright-colored, continuous-printed, polyethylene tape.
 - b. Not less than 6 inches wide by 4 mils thick.
 - c. Compounded for permanent direct-burial service.
 - d. Embedded continuous metallic strip or core.
 - e. Printed legend shall indicate type of underground line.
- I. 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.
 4. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 7 by 10 inches.
 5. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 10 by 14 inches.
 6. Warning label and sign shall include, but are not limited to, the following legends:
 - a. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 - b. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

- J. **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.
 2. **Emergency Operating Instructions:** Install emergency operating instruction signs at equipment used for power transfer, safety shutdown, or any other locations requiring operation in an emergency.
 - 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 Red face and punched or drilled for mechanical fasteners.
 - c. The signs shall be installed with stainless hardware.
- K. **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, lighting, control, 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.
 - b. **Elevated Components:** Increase the size of the labels and letters to those appropriate for viewing from the floor.
 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. Electrical switchgear and switchboards.
 - e. Transformers.
 - f. Electrical substations.
 - g. Emergency system boxes and enclosures.
 - h. Motor-control centers.
 - i. Disconnect switches.
 - j. Enclosed circuit breakers.
 - k. Motor starters.
 - l. Push-button stations.
 - m. Power transfer equipment.
 - n. Contactors.
 - o. Battery inverter units.

- p. Battery racks.
- q. Power-generating units.
- r. Voice and data cable terminal equipment.
- s. Television/audio components, racks, and controls.
- t. Fire-alarm control panel and annunciators.
- u. Security and intrusion-detection control stations, control panels, terminal cabinets, and racks.
- v. Monitoring and control equipment.
- w. Uninterruptible power supply equipment.
- x. Terminals, racks, and patch panels for voice and data communication and for signal and control functions.
- y. Control systems
- z. Field mounted control devices
- aa. 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.

F. Painted Identification: Prepare surface and apply paint according to Division 9 painting Sections.

END OF SECTION 260553

SECTION 262416

PANELBOARDS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.
 - 3. Electronic-grade panelboards.

1.03 DEFINITIONS

- A. SVR: Suppressed voltage rating.
- B. SPD: Surge Protection Device

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 6. Include wiring diagrams for power, signal, and control wiring.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field Quality-Control Reports:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- D. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing indicating the connected load for each breaker in accordance with the NEC. Schedule to be typed and dated.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.07 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Keys: Two spares for each type of panelboard cabinet lock.
 - 2. Circuit Breakers Including GFCI and Ground Fault Equipment Protection (GFEP) Types: Provide spare breakers as shown in the schedules on the drawings.
 - 3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 - 4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.08 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- 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. Comply with NEMA PB 1.
- E. Comply with NFPA 70.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Store in accordance with the manufacturer's recommendations.
- B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.10 PROJECT CONDITIONS

- A. Environmental Limitations:
 - 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding minus 22 deg F (minus 30 deg C) to plus 104 deg F (plus 40 deg C).
 - b. Altitude: Not exceeding 6600 feet (2000 m).
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude not exceeding 6600 feet (2000 m).
- C. 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 Engineer and Owner no fewer than 10 working days in advance of proposed interruption of electric service.

2. Do not proceed with interruption of electric service without Engineer and Owner's written permission.
3. Comply with NFPA 70E.

1.11 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.12 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."
- B. Enclosures: See Plan Sheet Panel Schedule for Enclosure Types and Mounting.
 1. Provide rated enclosures as shown below unless otherwise indicated on plans:
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - b. Indoor Damp or Wet Locations: NEMA 250, Type 4X.
 - c. Indoor Corrosive Locations: NEMA 250, Type 4X Fiberglass
 - d. Outdoor Locations: NEMA 250, Type 4X
 - e. Wash-Down Areas: NEMA 250, Type 4X 316 stainless steel
 - f. Other Wet or Damp Indoor Locations: NEMA 250, Type 4X.
 - g. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
 - h. For conditions not addressed above, provide rated enclosures for environmental conditions at installed locations.

2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
 4. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
 5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
 6. Finishes:
 - a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Galvanized steel unless indicated otherwise on panel schedule.
 - c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components. (Only required with the relative humidity is above 90% and the electrical room or space is not conditioned.)
 7. Directory Card: Inside panelboard door, mounted in transparent card holder. All breaker text to be typed and dated. Directory card shall include the source of supply to the panelboard. Directory card shall include typed contact information for the electrical contractor.
- C. Incoming Mains Location: Top or bottom per contractors' installation method unless specifically indicated on the drawings.
- D. Phase, Neutral, and Ground Buses:
1. Material: Hard-drawn copper, 98 percent conductivity.
 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
 3. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
 4. Neutral Bus: 100% of the phase bus capacity unless otherwise indicated.
 5. Extra-Capacity Neutral Bus (when shown on the drawings): Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
 6. Split Bus: Vertical buses divided into individual vertical sections.
- E. Conductor Connectors: Suitable for use with conductor material and sizes.
1. Material: Hard-drawn copper, 98 percent conductivity.
 2. Main and Neutral Lugs Mechanical type.
 3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
 4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
 5. Sub feed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
 6. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

7. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.
 8. >.
- F. Service Equipment Label: NRTL labeled for use as service equipment for panelboards with one or more main service disconnecting and overcurrent protective devices.
- G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- H. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.02 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 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."
- B. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 2]. Provide SPD devices per section 264313 of the project documents.

2.03 DISTRIBUTION PANELBOARDS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.
- D. Mains: As shown on the drawings
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
- G. Branch Overcurrent Protective Devices: Fused switches.

2.04 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains as shown on the drawings.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Provide Door-in-Door Construction with concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- F. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

2.05 ELECTRONIC-GRADE PANELBOARDS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Current Technology; a subsidiary of Danahar Corporation.
 - 2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 4. Liebert Corporation.
 - 5. Siemens Energy & Automation, Inc.
 - 6. Square D; a brand of Schneider Electric.
 - 7.
- B. Panelboards: NEMA PB 1; with factory-installed, integral SPD; labeled by an NRTL for compliance with UL 67 after installing SPD.
- C. Doors: Provide Door-in-Door Construction with Secured with vault-type latch with tumbler lock; keyed alike.

- D. Main Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.
- E. Branch Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.
- F. Buses:
 - 1. Copper phase and neutral buses; 200 percent capacity neutral bus and lugs.
 - 2. Copper equipment and isolated ground buses.

2.06 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
 - 5. >.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replaceable electronic trip; and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I squared x t response.
 - 3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 - 4. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
 - 5. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
 - 6. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
 - 7. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.

- c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - d. Ground-Fault Protection: Integrally mounted or Remote-mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - e. Communication Capability: as shown on the controls drawings when specifically indicated.
 - f. Shunt Trip: as shown on the drawings.
 - g. Undervoltage Trip, as shown on the drawings.
 - h. Auxiliary Contacts: Where shown on the drawings, two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
 - i. Alarm Switch: Where shown on the drawings, single-pole, normally open contact that actuates only when circuit breaker trips.
 - j. Key Interlock Kit: Where shown on the drawings, externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
 - k. Zone-Selective Interlocking: Where shown on the drawings, integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.
 - l. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
 - m. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in off position.
 - n. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
- C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
- 1. Fuses, and Spare-Fuse Cabinet: Comply with requirements specified in Section 262813 "Fuses."
 - 2. Fused Switch Features and Accessories: Standard ampere ratings and number of poles.
 - 3. Auxiliary Contacts: When shown on the drawings provide Two normally open and normally closed contact(s) that operate with switch handle operation.
- 2.07 ACCESSORY COMPONENTS AND FEATURES (if call for on the contract drawings)
- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
 - B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Equipment Mounting:
- C. Floor Mounted panelboards on concrete bases, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete in the project specifications. If no concrete is specified use 3000 psi.
 - a. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.
 - b. For panelboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - c. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - d. Install anchor bolts to elevations required for proper attachment to panelboards.
 - e. Attach panelboard to the vertical finished or structural surface behind the panelboard.
- 2. Wall/Rack Mounted:
 - a. Mount to wall/rack using unistrut with bolts/mounting hardware approved by the structural engineer or architect.
- D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- E. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- F. Mount panelboards such that the highest operator is less than 78" above finished floor.
- G. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- H. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
- I. Install filler plates in unused spaces.

- J. Stub a minimum of four 1-inch (27-GRC) empty conduits but not less than 25% of the combined cross-sectional area of all other live conduit from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub a minimum of four 1-inch (27-GRC) empty conduits but not less than 25% of the combined cross-sectional area of all other live conduit into raised floor space or below slab not on grade. This is for recessed panelboards only.
- K. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- L. Comply with NECA 1.

3.03 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.04 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. 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.
- C. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- D. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
 - c. Instruments and Equipment:
 - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- E. Panelboards will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.05 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in the "Overcurrent Protective Device Coordination Study."
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
 1. Measure as directed during period of normal system loading.
 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.06 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 262416

SECTION 265613

LIGHTING POLES AND STANDARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 DEFINITIONS

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each pole, accessory, and luminaire-supporting and -lowering device, arranged as indicated.
 - 1. Include data on construction details, profiles, EPA, cable entrances, materials, dimensions, weight, rated design load, and ultimate strength of individual components.
 - 2. Include finishes for lighting poles and luminaire-supporting devices.
 - 3. Anchor bolts.
 - 4. Manufactured pole foundations.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, **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.
- C. Samples: For each exposed lighting pole, standard, and luminaire-supporting device and for each color and texture specified.

1.5 INFORMATIONAL SUBMITTALS

- A. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements according to AASHTO LTS-6-M and that load imposed by luminaire and attachments has been included in design. The certification shall be based on design calculations signed and sealed by a professional engineer.
- B. Qualification Data: For **Installer**.
- C. Seismic Qualification Data: For 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.
- D. Material Test Reports:
1. For each foundation component, by a qualified testing agency.
 2. For each pole, by a qualified testing agency.
- E. Source quality-control reports.
- F. Field quality-control reports.
- G. Sample Warranty: Manufacturer's standard warranty.
- H. Soil test reports

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For **poles and luminaire-lowering devices** to include in emergency, operation, and maintenance manuals.
1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include pole inspection and repair procedures.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Pole repair materials.

1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM C1093 for foundation testing.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Package aluminum poles for shipping according to ASTM B660.
- B. Store poles on decay-resistant skids at least **12 inches (300 mm)** above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- C. Handle wood poles so they will not be damaged. Do not use pointed tools that can indent pole surface more than **1/4 inch (6 mm)** deep. Do not apply tools to section of pole to be installed below finished grade.
- D. Retain factory-applied pole wrappings on fiberglass and laminated wood poles until right before pole installation. Handle poles with web fabric straps.
- E. Retain factory-applied pole wrappings on metal poles until right before pole installation. Handle poles with web fabric straps.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of [**pole(s)**] [**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. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs from special warranty period.
 - 1. Warranty Period: **Five** years from date of Substantial Completion.
 - 2. Warranty Period for Corrosion Resistance: **Five** years from date of Substantial Completion.
 - 3. Warranty Period for Color Retention: **Five** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design pole foundation and pole power system.
- B. 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."
 2. Component Importance Factor: **1.5** **1.0**.
- 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 (2200 N)** distributed according to AASHTO LTS-6-M.
- F. Ice Load: Load of **3 lbf/sq. ft. (145 Pa)**, 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. Wind Importance Factor: refer to AASHTO LTS-6-M.
 2. Minimum Design Life: refer to AASHTO LTS-6-M.
 3. Velocity Conversion Factor: refer to 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: 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.
- B. Poles: Comply with ASTM A500/A500M, Grade B carbon steel with a minimum yield of **46,000 psig (317 MPa)**; one-piece construction up to **40 feet (12 m)** in height with access handhole in pole wall.
1. Shape: **[Round, tapered]** **[Round, straight]** **[Square, tapered]** **[Square, straight]**.
 2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
- C. Poles: Comply with **[ASTM A240/A240M]** **[ASTM A666]**, stainless steel with a minimum yield of **55,000 psig (379 MPa)**; one-piece construction up to **40 feet (12 m)** in height with access handhole in pole wall.
1. Shape: **[Round, tapered]** **[Round, straight]** **[Square, tapered]** **[Square, straight]**.
 2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
- D. Steel Mast Arms: **[Single-arm]** **[Truss]** **[Davit]** type, continuously welded to pole attachment plate. Material and finish same as plate.

- E. Brackets for Luminaires: Detachable, cantilever, without underbrace.
 - 1. Adaptor fitting welded to pole, allowing the bracket to be bolted to the pole-mounted adapter, then bolted together with [**stainless**] [**galvanized**]-steel bolts.
 - 2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire. Match pole material and finish.
- F. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.
- G. Fasteners: [**Stainless steel**] [**Galvanized steel**] <Insert finish or grade>, 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.
- H. Grounding and Bonding Lugs: Welded **1/2-inch (13-mm)** 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.
- I. Steps: Fixed steel, with nonslip treads.
 - 1. For climbing positions, install at **15-inch (381-mm)** vertical spacing, alternating on opposite sides of pole, oriented 180 degrees from each other; first step shall be at an elevation **10 feet (3 m)** above finished grade.
 - 2. For working positions, install steps on opposite side of pole, oriented 180 degrees from each other at the same elevation.
- J. Handhole: Oval shaped, with minimum clear opening of **2-1/2 by 5 inches (65 by 130 mm)**, with cover secured by stainless-steel captive screws.
- K. Intermediate Handhole and Cable Support: Weatherproof, **3-by-5-inch (76-by-130-mm)** 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. Platform for Lamp and Ballast Servicing: Factory fabricated of steel, with finish matching that of pole.
- N. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.
- O. Galvanized Finish: After fabrication, hot-dip galvanize according to ASTM A123/A123M.
- P. 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]** **[Match Architect's sample]** **[As selected by Architect from manufacturer's full range]**.

Q. 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 (64- to 89-um)** dry film thickness. Coat interior and exterior of pole for equal corrosion protection.
 - b. Color: **[As indicated by manufacturer's designations]** **[Match Architect's sample]** **[As selected by Architect from manufacturer's full range]**.

2.3 ALUMINUM POLES

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Poles: **[Seamed]** **[Seamless]**, extruded structural tube complying with ASTM B221, Alloy 6063-T6, with access handhole in pole wall.
- C. Poles: **[Seamed]** **[Seamless]**, extruded structural tube complying with ASTM B221, Alloy 6061-T6, with access handhole in in pole wall.
 1. Shape: **[Round, tapered]** **[Round, straight]** **[Square, tapered]** **[Square, straight]**.
 2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
- D. Mast Arms: **[Aluminum]** **[Steel]** **[Single-arm]** **[Truss]** **[Davit]** type, continuously welded to pole attachment plate. Material and finish same as plate.
- E. Brackets for Luminaires: Detachable, cantilever, without underbrace.
 1. Adaptor fitting welded to pole, allowing the bracket to be bolted to the pole-mounted adapter, then bolted together with **[stainless]** **[galvanized]**-steel bolts.
 2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire. Match pole material and finish.

- F. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.
- G. Grounding and Bonding Lugs: Bolted **1/2-inch (13-mm)** threaded lug, complying with requirements in Section 260526 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.
- H. Fasteners: [**Stainless steel**] [**Galvanized steel**] <Insert finish or grade>, size and type as determined by manufacturer. Corrosion-resistant items compatible with support components.
 - 1. Materials: Compatible with poles and standards as well as to substrates to which poles and standards are fastened and shall not cause galvanic action at contact points.
 - 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.
- I. Handhole: Oval shaped, with minimum clear opening of **2-1/2 by 5 inches (65 by 130 mm)**, with cover secured by stainless-steel captive screws.
- J. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.
- K. Aluminum Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
 - 1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 - 2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.
 - 3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I clear coating of 0.018 mm or thicker), complying with AAMA 611.
 - 4. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.
- L. 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**] [**Match Architect's sample**] [**As selected by Architect from manufacturer's full range**].

- M. 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 (64- to 89-um)** 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**] [**Match Architect's sample**] [**As selected by Architect from manufacturer's full range**].

2.4 FIBERGLASS POLES

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Poles:
1. Designed specifically for supporting luminaires, with factory-formed cable entrance and handhole.
 2. Not less than 65 percent by weight of fiberglass roving, with resin and pigment making up the remainder.
 3. Roving shall be continuously applied with uniform tension, with multiple layers placed to meet axial and compressive strength requirements.
 4. Shape: [**Round, tapered**] [**Round, straight**] [**Square, tapered**] [**Square, straight**].
 5. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
 6. Resin Color: [**Black**] [**Dark**] [**Bronze**] **<Insert Color>**; uniform coloration throughout entire wall thickness.
 7. Surface Finish: Smooth and uniform along surface of pole.
 8. Paint Finish: Pigmented polyurethane, with a minimum dry film thickness of **1.5 mils (0.04 mm)**. Polyurethane may be omitted if the surface layer of the pole is inherently UV inhibited.
- C. Mast Arms: [**Aluminum**] [**Steel**] [**Fiberglass**] [**Single-arm**] [**Truss**] [**Davit**] type, continuously welded to pole attachment plate. Material and finish same as plate. Adaptor plate shall be steel hot-dip galvanized according to ASTM A153 or 6061-T6 aluminum encased within fiberglass roving, allowing the mast arm adaptor to be bolted to the pole.
- D. Brackets for Luminaires: Detachable, cantilever, without underbrace.
1. Adaptor fitting: Steel, hot-dip galvanized according to ASTM A153, or 6061-T6 aluminum, permanently bonded within fiberglass roving, allowing the bracket to be bolted to the pole-mounted adapter. Bolt together with [**stainless**] [**galvanized**]-steel bolts; use anti-seize compound when bolting dissimilar metals.
 2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire. Match pole material and finish.

- E. Pole-Top Tenons: Steel, hot-dip galvanized according to ASTM A153, or 6061-T6 aluminum, permanently bonded to the fiberglass shaft. Fabricated to support luminaire or luminaires and brackets indicated.
- F. Fasteners: [**Stainless steel**] [**Galvanized steel**] <Insert finish or grade>, 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.
- G. Handhole: Oval shaped, with minimum clear opening of **2-1/2 by 5 inches (65 by 130 mm)**, with cover secured by stainless-steel captive screws.
- H. Grounding: Bare, stranded copper, #6 AWG, [**suspended inside of pole**] [**inside a 3/4-inch (18-mm) conduit fastened to the interior of the pole**], connected to luminaire(s), ground lug near handhole and ground rod.
- I. Grounding and Bonding Lugs: Bolted **1/2-inch (13-mm)** threaded lug, complying with requirements in Section 260526 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.
- J. Anchor Base: Integral galvanized steel or aluminum casting, enclosing and permanently bonded to the exterior of the fiberglass shaft.

2.5 LAMINATED WOOD POLES

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Species and Grades for Structural Laminated Timber: Complying with ANSI A190.1. Use [**Southern pine**] [**Douglas fir**] [**Alaska cedar**] [**any species listed in AITC 117**], engineered and fabricated to withstand indicated structural loads without exceeding allowable design working stresses according to [**AITC 117**] [**ANSI O5.2**].
- C. Features include [**wood bracket**] [**wood crossarm**] [**pole-top adaptor**] <Insert items> for mounting luminaire(s), metal pole cap, and concealed raceway path connected to access handhole.
- D. Mounting Provisions: [**Embedded**] <Insert description of other mounting unless detailed on **Drawings**>.
- E. Fasteners: [**Stainless steel**] [**Galvanized steel**] <Insert finish or grade>, 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.

- F. Appearance Grade: Architectural appearance grade complying with AITC 110.
- G. Preservative Treatment:
 - 1. Exposure: Comply with [AWPA UC4A] [AWPA UC4B] [AWPA UC4C].
 - 2. Treatment after Dressing and End Cutting: Comply with AWPA M4 for surface cuts to a depth of more than **1/16 inch (1.6 mm)**.
- H. Adhesive: Wet-use type complying with ASTM D2559.
- I. End Sealer: Manufacturer's standard, transparent, colorless wood sealer that is effective in retarding the transmission of moisture at cross-grain cuts and is compatible with indicated finish.
- J. Penetrating Sealer: Manufacturer's standard, transparent, penetrating wood sealer that is compatible with indicated finish.
- K. Finish: [**Natural, unstained wood**] [**Semitransparent stain applied after erection**] [**Factory-applied semitransparent stain**], color as selected by Architect.

2.6 WOOD POLES

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Poles: [**Douglas fir**] [**Southern yellow pine**], [**machine trimmed by turning**], for wood species used; and bored, roofed, and grained before treatment.
 - 1. Pole Brand: Brand the manufacturer's trademark and date of treatment, height and class of pole, wood species, preservation code, and retention. Brand shall be placed so that the bottom of the brand is minimum **10 feet (3 m)** from pole butt.
 - 2. Mounting Provisions: Embedded.
- C. Fasteners: [**Stainless steel**] [**Galvanized steel**] **<Insert finish or grade>**, 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.
- D. Preservative Treatment: Treat according to [AWPA UC4A] [AWPA UC4B] [AWPA UC4C].
- E. Luminaire Brackets: Comply with ANSI C136.13.

2.7 PRESTRESSED CONCRETE POLES

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)

- B. Poles: Comply with ASTM C1089[**and manufactured by centrifugal spin-casting process**] [**and manufactured by static-casting method**].
 - 1. Shape: [**Round, tapered**] [**Round, straight**] [**Square, tapered**] [**Square, straight**].
 - 2. Mounting Provisions: [**Steel butt flange for bolted mounting to foundation or breakaway support**] [**Embedded**].
 - 3. Finishing: Capped at top and plugged at bottom. Seat each reinforcing strand with epoxy adhesive.
 - 4. Grounding: Continuous copper ground wire cast into pole. Terminate at top of pole[**and attach to 24-inch (610-mm) lighting rod**].
 - 5. Raceway: Smooth, internal, and not less than **3 inches (76 mm)** in diameter.
- C. Concrete: Minimum 28-day compressive strength of **7000 psi (48 265 kPa)** <Insert value>.
- D. Cured with wet steam and aged for a minimum of 15 days prior to installation.
- E. Reinforcement: [**Reinforcing bars complying with ASTM A615/A615M**] [**Cold drawn spiral wire complying with ASTM A82**] [**Pre-stressing strand, 270 K, complying with ASTM A416/A416M**].
- F. Surface Treatment: Hard, nonporous, and resistant to water, frost, and road and soil chemicals; and shall have a maximum water-absorption rate of 3 percent.
- G. Finish Texture: [**Standard form**] [**Polished exposed aggregate**] [**Etched exposed aggregate**].
 - 1. Exposed aggregate shall be of <Insert aggregate type selected from manufacturers' lists> type.
- H. Fasteners: [**Stainless steel**] [**Galvanized steel**] <Insert finish or grade>, size and type as determined by manufacturer. 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.
- I. Nameplate: Aluminum cast into pole wall at approximately **5 feet (1.5 m)** above ground line, listing name of manufacturer, Project identifier, overall height, and approximate weight.
- J. Pole Brackets: Comply with ANSI C136.31.

2.8 POLE ACCESSORIES

- A. Duplex Receptacle: Ground-fault circuit interrupter type, 120 V ac, 20 A in a weatherproof assembly. Comply with requirements in Section 262726 "Wiring Devices."
 - 1. [**Surface mounted**] [**Recessed**] **12 inches (300 mm)** <Insert dimensions> above finished grade.
 - a. NEMA 250, [**Type 3R**] [**Type 4X**], nonmetallic polycarbonate plastic or reinforced fiberglass, enclosure with cover; color to match pole.
 - b. Lockable hasp and latch complying with OSHA lockout and tag-out requirements.
- B. Minimum 1800-W transformer, protected by replaceable fuses, mounted behind access cover.

- C. Base Covers: Manufacturers' standard metal units, finished same as pole, and arranged to cover pole's mounting bolts and nuts.
- D. Transformer-Type Base: Same material and color as pole. Coordinate dimensions to suit pole's base flange and to accept [**ballast(s)**] [**indicated accessories**]. Include removable flanged access cover secured with bolts or screws.
- E. Decorative accessories, supplied by decorative pole manufacturer, include the following:
 - 1. Banner Arms: <**Insert material**>.
 - 2. Flag Holders: <**Insert material**>.
 - 3. Ladder Rests: <**Insert material**>.

2.9 LOWERING SYSTEM FOR LUMINAIRES

- A. System Description: Capable of lowering luminaire [**assembly**] to a service position within **36 inches (900 mm)** of finished grade in winds up to **30 mph (49 km/h)**. Provide manual plug connection to electrical power accessible in lowered position. Assembled system of pole, luminaire, and lowering device shall be capable of loads specified in "Performance Requirements" Article.
- B. Compatibility of Material: Materials for attachment and connection of luminaire-mounting assembly, lowering device, lowering cable, and portable winch shall be compatible to avoid corrosion and electrolysis.
- C. Structural and Mechanical Design Safety Factor: 5.0, minimum, for static and dynamic loads of load-bearing components, including cable.
- D. Luminaire-Mounting and Disconnect Arrangement: Multiple [**ring**] [**carriage**]-mounted luminaires, arranged for lowering and rising as a group.
 - 1. Electrical cable for normal operating power to luminaires shall manually disconnect inside pole base, using weatherproof multi-pin connector, and shall be arranged to move within the pole during lowering and rising of luminaire assembly.
 - 2. Electrical cable for normal operating power to luminaires shall automatically disconnect at weatherproof multi-pin connector within the pole-top lowering head at the beginning of the lowering cycle and reconnect when luminaire or luminaire assembly is raised to the operating position.
- E. Lowering Device: Weatherproof, cast-aluminum housing, and multiple mechanical latches. Moving parts of latching assembly shall be located in the portion of the unit that is lowered to servicing position. Positive latching in the operating position shall be indicated to the operator at the base of the pole by a clear visual signal or by other means acceptable to Owner or authorities having jurisdiction.
- F. Lowering Cable: [**Zinc-electroplated-**] [**or**] [**stainless-**] steel aircraft cable.
- G. Portable Winch: [**Manual**] [**120-V electric**] type. [**One**] <**Insert number**> required.
 - 1. Winch Power Connection: Cord and plug.

2. Winch Raise-Lower Control: Remote-control station with [**15 feet (5 m)**] <Insert **dimension**> of cable.

2.10 MOUNTING HARDWARE

- A. Anchor Bolts: Manufactured to [**ASTM F1554, Grade 55,**] with a minimum yield strength of **55,000 psi (380 000 kPa)**.
 1. Galvanizing: [**Hot dip galvanized according to ASTM A153, Class C**] [**Mechanically deposited galvanization according to ASTM B695, Class 50**].
 2. [**Bent**] [**Headed**] rods <Insert **inches (mm)**> in diameter by <Insert **inches (mm)**> in length.
 3. Threading: [**Uniform National Coarse**] [**Uniform National 8**], Class 2A.
- B. Nuts: ASTM A563, Grade A, Heavy-Hex.
 1. Galvanizing: [**Hot dip galvanized according to ASTM A153, Class C**] [**Mechanically deposited galvanization according to ASTM B695, Class 50**].
 2. [**Two**] [**Four**] <Insert number> 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**] [**Mechanically deposited galvanization according to ASTM B695, Class 50**].
 2. [**One**] [**Two**] <Insert number> washer(s) provided per anchor bolt.

2.11 GENERAL FINISH REQUIREMENTS

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

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine poles, luminaire-mounting devices, lowering devices, and pole accessories before installation. Components that are scratched, dented, marred, wet, moisture damaged, or visibly damaged are considered defective.

- C. Examine roughing-in for foundation and conduit to verify actual locations of installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 POLE FOUNDATION

- A. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Structural steel complying with ASTM A36/A36M and hot-dip galvanized according to ASTM A123/A123M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."
- 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 [**one-sixth of pole height**] [as indicated]. Add backfill [in **6-inch (150-mm) to 9-inch (230-mm) layers, tamping each layer before adding the next**] [as shown on Drawings] <Insert requirement>. 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 [**one-sixth of pole height**] [as indicated]. To ensure a plumb installation, continuously check pole orientation with plumb bob while tamping.
 - 1. Make holes **6 inches (150 mm)** in diameter larger than pole diameter.
 - 2. Fill augered hole around pole with air-entrained concrete having a minimum compressive strength of **3000 psi (20 MPa)** at 28 days and finish in a dome above finished grade.
 - 3. Use a short piece of **1/2-inch (13-mm)** 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**] [**plywood**] template, uniformly spaced.

3.3 POLE INSTALLATION

- A. Alignment: [**Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on pole**] [**Align poles as indicated**].

- B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features unless otherwise indicated on drawing.
 - 1. Fire Hydrants and Water Piping: [60 inches (1520 mm)] <Insert dimension>.
 - 2. Water, Gas, Electric, Communications, and Sewer Lines: [10 feet (3 m)] <Insert dimension>.
 - 3. Trees: 15 feet (5 m) from tree trunk.
 - 4. <Insert features and clearance dimensions>.
- C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Section 033000 "Cast-in-Place Concrete."
- D. Foundation-Mounted Poles: Mount pole with leveling nuts and tighten top nuts to torque level according to pole manufacturer's written instructions.
 - 1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.
 - 2. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
 - 3. Install base covers unless otherwise indicated.
 - 4. Use a short piece of 1/2 -inch (13-mm) diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.
- E. Poles and Pole Foundations Set in Concrete-Paved Areas: Install poles with a minimum 6-inch- (150-mm-) 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 (25 mm) below top of concrete slab.
- F. Raise and set pole using web fabric slings (not chain or cable) at locations indicated by manufacturer.

3.4 CORROSION PREVENTION

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

3.5 GROUNDING

- A. Ground Metal Poles and Support Structures: Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."
 - 1. Install grounding electrode for each pole unless otherwise indicated.
 - 2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

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.

3.6 IDENTIFICATION

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

3.7 FIELD QUALITY CONTROL

A. Special Inspections: [**Owner will engage**] [**Engage**] a qualified special inspector to perform the following special inspections:

1. Inspect poles for nicks, mars, dents, scratches, and other damage.
2. System function tests.
3. <**Insert special inspections**>.

END OF SECTION 265613

SECTION 265619

LED EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Luminaire-mounted photoelectric relays.
 - 2. Luminaire types.
 - 3. Materials.
 - 4. Finishes.
 - 5. Luminaire support components.

1.3 DEFINITIONS

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of luminaire.
 - 1. Arrange in order of luminaire designation.
 - 2. Include data on features, accessories, and finishes.
 - 3. Include physical description and dimensions of luminaire.
 - 4. Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.
 - 5. Photometric data and adjustment factors based on laboratory tests, complying with **IES Lighting Measurements Testing and Calculation Guides, of each luminaire type.**

The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project.

- a. Manufacturer's Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.
 - b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
6. Wiring diagrams for power, control, and signal wiring.
 7. Photoelectric relays.
 8. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.
- B. Shop Drawings: For nonstandard or custom luminaires.
1. Include plans, elevations, sections, and mounting and attachment details.
 2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 3. Include diagrams for power, signal, and control wiring.
- C. Samples: For each luminaire and for each color and texture indicated with factory-applied finish.
- D. Product Schedule: For luminaires and lamps. **Use same designations indicated on Drawings.**
- E. Delegated-Design Submittal: For luminaire supports.
1. Include design calculations for luminaire supports **and seismic restraints.**
- 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Luminaires.
 2. Structural members to which **equipment and** luminaires will be attached.
 3. Underground utilities and structures.
 4. Existing underground utilities and structures.
 5. Above-grade utilities and structures.
 6. Existing above-grade utilities and structures.
 7. Building features.
 8. Vertical and horizontal information.
- B. Qualification Data: For testing laboratory providing photometric data for luminaires.
- C. Seismic Qualification Data: For luminaires, 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.

D. Product Certificates: For each type of the following:

1. Luminaire.
2. Photoelectric relay.

E. Product Test Reports: For each luminaire, for tests performed by **manufacturer and witnessed by a qualified testing agency**.

F. Source quality-control reports.

G. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires **and photoelectric relays** to include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.
2. Provide a list of all photoelectric relay types used on Project; use manufacturers' codes.

1.7 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. Lamps: **Ten for every 100** of each type and rating installed. Furnish at least one of each type.
2. Glass, Acrylic, and Plastic Lenses, Covers, and Other Optical Parts: **One for every 100** of each type and rating installed. Furnish at least one of each type.
3. Diffusers and Lenses: **One for every 100** of each type and rating installed. Furnish at least one of each type.
4. Globes and Guards: **One for every 20** of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications:

1. Luminaire manufacturers' laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

2. Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products and complying with applicable IES testing standards.
- B. Provide luminaires from a single manufacturer for each luminaire type.
- C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.
- D. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- E. Mockups: For exterior luminaires, complete with power and control connections.
 1. Obtain Architect's approval of luminaires in mockups before starting installations.
 2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed work.
 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.10 FIELD CONDITIONS

- A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.
- B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.11 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Structural failures, including luminaire support components.
 - b. Faulty operation of luminaires and accessories.

- c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
2. Warranty Period: **2** year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance:

1. Luminaires shall withstand the effects of earthquake motions determined according to **ASCE/SEI 7**].
2. Luminaires and lamps shall be labeled vibration and shock resistant.
3. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified."

2.2 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- D. UL Compliance: Comply with UL 1598[**and listed for wet location**].
- E. Lamp base complying with **ANSI C81.61**.
- F. Bulb shape complying with ANSI C79.1.
- G. CRI and CCT shall match that of the luminaire specified in the schedule provided on the drawings.
- H. L70 lamp life of shall match that of the luminaire specified in the schedule provided on the drawings..
- I. Lamps dimmable where indicated on the drawings.
- J. Internal driver.
- K. Nominal Operating Voltage: shall match that of the luminaire specified in the schedule provided on the drawings.

- L. In-line Fusing: shall match that of the luminaire specified in the schedule provided on the drawings.
- M. Lamp Rating: Lamp marked for [**outdoor use**] [**and**] [**in enclosed locations**].
- N. Source Limitations:
 - 1. Obtain luminaires of the same label from single source from a single manufacturer.
 - 2. For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.3 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

- A. Comply with UL 773 or UL 773A.
- B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at **1.5 to 3 fc (16 to 32 lx)** and off at **4.5 to 10 fc (48 to 108 lx)** with 15-second minimum time delay. **Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.**
 - 1. Relay with locking-type receptacle shall comply with ANSI C136.10.
 - 2. Adjustable window slide for adjusting on-off set points.

2.4 LUMINAIRE TYPES

- A. Refer to Luminaire schedule on drawings.

2.5 MATERIALS

- A. Metal Parts: Free of burrs and sharp corners and edges.
- B. Sheet Metal Components: [**Corrosion-resistant aluminum**] [**Stainless steel**] [**Epoxy-coated steel**] <Insert material>. 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. Glass: Annealed crystal glass unless otherwise indicated.
 - 3. 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. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 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.
- H. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 - 1. Label shall include the following lamp characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage and coating.
 - c. CCT and CRI for all luminaires.

2.6 FINISHES

- A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.
- C. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 - 2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.
 - 3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
 - 4. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I,

integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.

a. Color: [**Light bronze**] [**Medium bronze**] [**Dark bronze**] [**Black**] <Insert color>.

D. 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.

2.7 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 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.
- C. Examine walls, roofs, **canopy ceilings and overhang ceilings** as applicable for suitable conditions where luminaires will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

- A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is substantially complete, clean luminaires used for temporary lighting and install new lamps.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Comply with NECA 1.
- B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- C. Install lamps in each luminaire.
- D. Fasten luminaire to structural support.
- E. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Support luminaires without causing deflection of finished surface.
 - 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.
- F. Wall-Mounted Luminaire Support:
 - 1. **Attached to structural members in walls**
- G. Wiring Method: Install cables in raceways. Conceal raceways and cables.
- H. **Install luminaires level, plumb, and square with finished grade unless otherwise indicated. Install luminaires at height and aiming angle as indicated on Drawings.**
- I. Coordinate layout and installation of luminaires with other construction.
- J. 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.**
- K. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.4 INSTALLATION OF BOLLARD LUMINAIRES

- A. Align units for optimum directional alignment of light distribution.
 - 1. Install on concrete base with top [**4 inches (100 mm)**] <Insert dimension> above finished grade or surface at luminaire location. Cast conduit into base, and shape base to match shape of bollard base. Finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 033000 "Cast-in-Place Concrete."

3.5 INSTALLATION OF INDIVIDUAL GROUND-MOUNTED LUMINAIRES

- A. Aim as indicated on Drawings.
- B. Install on concrete base with top [**4 inches (100 mm)**] <Insert dimension> above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 033000 "Cast-in-Place Concrete."

3.6 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.

3.7 IDENTIFICATION

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

3.8 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.
- C. Illumination Tests:
 - 1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IES testing guide(s):
 - a. IES LM-5.
 - b. IES LM-50.
 - c. IES LM-52.
 - d. IES LM-64.
 - e. IES LM-72.
 - 2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

- D. Luminaire will be considered defective if it does not pass tests and inspections.
- E. 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.

3.9 DEMONSTRATION

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

3.10 ADJUSTING

- A. Occupancy Adjustments: When requested within **12** months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to **two** visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
 - 1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
 - 2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 265619

1.04 WORKMANSHIP

- A. Workmanship under this Division shall be accomplished by persons skilled in the performance of the required task. All work shall be done in keeping with conventions of the trade. Work of this Division shall be closely coordinated with work of other trades to avoid conflict and interference.

1.05 PROTECTION OF ELECTRICAL EQUIPMENT

- A. Electrical equipment shall be protected by the weather, especially from water dripping or splashing upon it, always during shipment, storage and after installation. Should any apparatus be subjected to possible injury by water, it shall be thoroughly dried out and put through a dielectric test, at the expense of the contractor, to ascertain the suitability of this apparatus. The results of the test shall be submitted to the Engineer and if the apparatus is found to be unsuitable, the contractor shall replace it without additional cost to the Owner.

1.06 UTILITIES

- A. The electrical contractor shall install a fully operational electrical service as described in the plans.
- B. Arrange with the utility company for the services and install the services in accordance with their requirements, regulations, and recommendations.

1.07 GUARANTEE

- A. Contractor shall guarantee all light bulbs. They shall be guaranteed for a period of one (1) year after the building is occupied. Guarantee shall include material and labor for repair.
- B. The Contractor shall guarantee all other electrical systems, materials and workmanship to be free from defects for a period of one (1) year from the date of final acceptance. He shall correct all defects arising within this period upon notification by the Owner or Engineer, without additional compensation.
- C. It is understood that the rights and benefits given the Owner by the guarantees found in the technical specifications are in addition to and not in derogation of any rights or benefits found in the special and general provisions of the contract.

1.08 TEMPORARY POWER AND LIGHTS DURING CONSTRUCTION

- A. It shall always be the responsibility of the Contractor to provide and maintain adequate temporary power and lighting during construction, so that the various other trades can accomplish their work in a flawless manner. Particular attention will be given to power and lighting for masonry, drywall, painting, tile work and any other finish work.

1.09 MATERIAL STANDARDS

- A. Material shall be new and comply with standards of Underwriters' Laboratories, Inc., where standards have been established for the particular product and the various NEMA, ANSI, ASTM, IEEE, AEIC, IPCEA or other publications referenced.

1.10 TEST EQUIPMENT

- A. The contractor shall provide all test equipment and supplies deemed necessary by the Engineer at no extra cost to the Owner. These supplies shall include but not be limited to the following: volt meters, amp meters, clamp-on ground rod test meter, light meters, generator load banks & temporary cables, watt meters, harmonic distortion test equipment, thermal image camera, megger tester, high pot test equipment, power quality analyzers, recording power meter, and oscilloscopes.

1.11 REFERENCES

- A. ANSI/NFPA 70 – National Electrical Code.
- B. ANSIC2 – National Electrical Safety Code.
- C. NEMA – National Electrical Manufacturer's Assoc.
- D. UL – Underwriters Laboratories
- E. NFPA – National Fire Protection Assoc.
- F. IEEE – The Institute of Electrical and Electronics Engineers
- G. IESNA – The Illuminating Engineering Society of North America
- H. NETA – International Electrical Testing Association
- I. API – American Petroleum Institute
- J. AGA – American Gas Association
- K. Recommended Standards for Water Works and Wastewater Facilities as published by Great Lakes – Upper Mississippi River Board of State Public Health and Environmental Managers.

1.12 SUBMITTAL

- A. Submit under provisions of the General Provisions.
 - 1. The Contractor installing all Electrical work shall review and approve all electrical shop drawings prior to submittal to the Engineer for review. As part of the review, the installer shall certify the following:
 - a. I hereby certify that the (equipment) (material) (article) shown and marked in this submittal is in compliance with the contract drawing and specifications, can be

installed in the allocated space, will be stored in accordance with the manufacturer's recommendation, will be installed per NEC, and is submitted for approval.

Certified by: _____ Date: _____

B. Submit shop drawings and product data grouped to include complete submittal of related systems, products, and accessories in a single submittal. No electrical work may be performed until shop drawings are approved. Submit Shop Drawings on the Following Systems as Grouped Below:

1. High Voltage Distribution System
 - a. Transformers
 - b. Switches
 - c. Distribution Equipment
 - d. High Voltage Cable
 - e. Equipment Pads
 - f. Utility Conduit
 - g. Miscellaneous Materials
 - h. Utility Work
2. Low Voltage Power/Electrical System
 - a. Conduit and Conduit Fittings
 - b. Wire
 - c. Pull Boxes
 - d. Panelboards
 - e. Panelboard Layouts
 - f. Circuit Breakers
 - g. Disconnects
 - h. Fuses
 - i. Conduit Support Systems
 - j. Wiring Devices
 - k. Switchboards
 - l. Motor Control Centers
 - m. Transformers
 - n. Surge Protection Equipment
 - o. Intelligent Motor Control Centers
 - p. Breaker Coordination Study
3. Generator Equipment
 - a. Generator
 - b. Fuel System
 - c. Generator Paralleling/ATS Equipment
 - d. Generator Enclosure
 - e. Power Correction Equipment
4. Lighting System
 - a. All Light Fixtures
 - 1) Computer Printout of Lighting Layout
 - 2) Sample Fixture (as directed by Engineer)
 - 3) IES Photometric Files
 - b. Poles & Foundations
5. Miscellaneous Electrical Equipment
 - a. Miscellaneous Electrical Parts

6. Drawings
 - a. Coordination drawing of All Electrical Room
 - b. Conduit layout drawings
 - c. Duct drawings
 - d. As-Built Drawings

C. Mark dimensions and values in units to match those specified.

1.13 REGULATORY REQUIREMENTS

1. Conform to applicable sections of the Building Code and all local rules, regulations, and ordinances.
2. Electrical: Conform to NFPA 70 & National Electric Safety Code
3. Obtain permits, and request inspections from authority having jurisdiction.
4. References listed in Paragraph 1.11, this section.

1.14 FINAL INSPECTION AND TESTING

- A. After the electrical installation is complete, the Contractor shall deliver to the Engineer the following information with his request for final inspection.
 1. One set of contract drawings marked to show all significant changes in equipment ratings and locations, alterations in locations of conduit runs, or of any data differing from the contract drawings. This shall include revised or changed panelboard and switchgear schedules.
 2. Certificates of final inspection from local authority.
 3. A tabulation of all motors listing their respective manufacturer, horsepower, nameplate voltage and current, actual running current after installation and overload heater rating.
- B. The electrical work shall be thoroughly tested to demonstrate that the entire system is in proper working order and in accordance with the plans and specifications. Each motor with its control shall be run as nearly as possible under operating conditions for a sufficient length of time to demonstrate correct alignment, wiring capacity, speed and satisfactory operation. All main switches and circuit breakers shall be operated, but not necessarily at full load. Contractor may be required during final inspection, at the request of the Engineer to furnish test instruments for use during the testing.
- C. All wiring shall be given a megger test using a 1000 Volt megger. This test shall be performed after conductors are pulled, but before final connections are made. The Engineer shall be given two (2) days' written notice of the anticipated test date so that he may witness the test if so desired. In any event, the Contractor shall record the circuit designation and the megger reading on each phase. This written record shall be submitted to the Engineer. The cost of this test or any retest caused by insufficient megger readings shall be the responsibility of the Contractor (All tests shall be done in accordance with NETA Standards).

1.15 STAFFING

- A. The electrical contractor shall provide a "Master Electrician" who has been deemed a "Master Electrician" by exam through the State, or any other Local Permitting Authority as the

Electrical Superintendent for the project. The Electrical Superintendent shall be on the project site any time any electrical work is performed by the contractor.

- B. In addition, the contractor shall provide one Journeyman electrician for every four electrical helpers used on the project site.

1.16 AS-BUILT DRAWINGS

- A. The contractor shall provide detailed as-built drawings for the project indicating all power wiring. (All Drawings shall be delivered to the Owner in an AutoCAD Format same version as the CD containing the bid set.)
- B. The As-Built drawings shall include detailed drawings of all duct banks, underground conduit, above ground conduit, motor control centers, PLC control panels, control drawings. These drawings shall indicate exact location of all underground electrical wiring and fiber optic cable.
 - 1. The location shall indicate the following:
 - a. Centerline location
 - b. Width / Cross section
 - c. Depth
- C. The Engineer will provide electronic copies of all drawings in the bid plans set on a CD for use by the contractor.

END OF SECTION 26500

