

## SECTION 116833 – OUTDOOR SPORTS EQUIPMENT

### PART 1 – GENERAL

#### 1.1 WORK INCLUDED

- A. Provide equipment and materials and do work necessary and construct or provide the following as indicated on the Drawings and as specified. Work shall include but shall not be limited to:
  - 1. Tennis Equipment:
    - a. Pickleball posts, nets, and anchors
    - b. Netting system.

#### 1.2 SUBMITTALS

- A. Shop Drawings:
  - 1. Show application to project.
- B. Product Data: Submit manufacturer’s product data and samples as noted for the following:
  - 1. Pickleball Net, posts, anchor.

#### 1.3 QUALITY ASSURANCE

- A. Installer of outdoor sports equipment the playing field shall be the same Contractor. All installed equipment shall be under the supervision of Owner’s groundskeeper.
- B. Welding: Qualify procedures and personnel according to AWS D1.1, “Structural Welding Code-Steel,” and AWS D1.3, “Structural Welding Code – Sheet Steel.”

#### 1.4 WARRANTY

- A. General Warranty: Special warranties specified in this Section shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Warranties:
  - 1. Equipment: Written warranties, executed by the manufacturer of each piece of equipment specified agreeing to repair or replace equipment or components that fail in materials or workmanship with specified warranty period.
  - 2. Windscreen Warranty: Minimum of three (3) years.

### PART 2 – PRODUCTS

#### 2.1 PICKLEBALL EQUIPMENT

- A. Pickleball Posts and ground sleeve: 3-inch OD Posts with net tightener, top pulley and ground sleeve by the following or approved equal. Removable or folding winder handle.

1. Model No. RD-36 Douglas Premier QuickStart/Pickleball post with brass gears.
  2. Finish: Black, Powder Coated.
- B. Pickleball Net: Douglas PN-30, Weather resistant vinyl topped binding, vinyl coated cable, Nylon bindings on sides and bottom by the following or approved equal.
1. Hercules Athletic.
  2. Douglas.
  3. Color: Black.
- C. Net Anchor Pin to be galvanized steel ground staple, bent.
- D. Center Strap: Nylon, adjustable with snap hook.
- E. Supplier:
1. PW Athletic Mfg. Co (800) 687-5768, [www.pwathletic.com](http://www.pwathletic.com).
  2. Douglas Sport Nets and Equipment, (800) 553-8907, [www.douglas-sports.com](http://www.douglas-sports.com).
  3. Palos Sports, (800) 233-5484, [www.palossports.com](http://www.palossports.com).
  4. Or approved equal.

## PART 3 – EXECUTION

### 3.1 INSTALLATION

- A. General: Install in accordance with manufacturers recommendations and approved shop drawings.
- B. Pickleball Equipment:
1. Net System:
    - a. Install per instructions of the manufacturer.
    - b. Footing installation included. Review drawings for location and layout.
    - c. Install one complete set for each tennis court.

END OF SECTION

SECTION 260500 – ELECTRICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide all materials, labor, and equipment required to furnish and install a complete electrical system as indicated on the Drawings and as specified herein.
- B. Electrical work includes, but is not limited to, the following:
  - 1. Complete distribution system for lighting and power including the electrical service and necessary feeders, panelboards, branch circuits, conduit, lighting fixtures, control switches, and receptacles.
  - 2. Excavation, trenching, and backfilling for conduit and/or cable.
  - 3. Grounding
  - 4. Data and Telephone system raceways, boxes.



1.2 RELATED WORK

- A. The following work shall be furnished under other Divisions of these Specifications, but shall be coordinated with said Divisions by Division 26 tradesman prior to bid.
  - 1. Flashing of conduits into roofing and outside walls.
  - 2. Painting.
  - 3. Cutting and patching.
  - 4. Heating, ventilating, air conditioning, and plumbing equipment.
- B. Commissioning
  - 1. Complete lighting controls check-list for pickleball courts.

1.3 DEFINITIONS

- A. Provide: Shall mean "furnish, install, connect, and put in good working order."
- B. Wiring: Shall mean "wire and cable, installed in raceway with all required boxes, fittings, connectors, etc. completely installed."
- C. Engineer: Shall mean "Engineer of Record" whose seal is affixed to the contract specifications and drawings of Division 26.

#### 1.4 CODES AND STANDARDS

- A. Comply with applicable local, state, and federal codes.
- B. Electrical work shall be installed in accordance with the Drawings and Specifications, the 2023 NEC, 2018 IBC and applicable accessibility code.
- C. In event of conflict between Drawings, Specifications and such codes, Engineer shall be notified in writing prior to bid. A ruling will then be made by the Engineer in writing. All work shall be installed in strict accordance with applicable codes without additional cost to Owner.
- D. Contractor shall submit and/or file all necessary specifications and drawings as required by governing authorities.

#### 1.5 SUBMITTALS

- A. Provide submittals on materials and equipment identified in the Specifications and Drawings prior to manufacturer, order, or installation in accordance with Shop Drawings, Product Data, and Samples.
- B. Submittals shall include but not be limited to the following:  
Lighting fixtures                      Over Current Protection                      Conduit & Wire

#### PART 2 - PRODUCTS (Not used)

#### PART 3 - EXECUTION

##### 3.1 SITE VISIT

- A. Visit job site prior to bid date to determine actual conditions under which work shall be done, to become familiar with project, and to verify total scope of work required. Failure to do so shall not constitute a reason for an extra charge.

END OF SECTION

## SECTION 260501 – BASIC ELECTRICAL MATERIALS AND METHODS

### PART 1 - GENERAL

#### 1.1 QUALITY ASSURANCE

- A. Qualifications of Manufacturer: All materials and equipment used in work of Division 26 shall be produced by manufacturers regularly engaged in manufacturer of similar items and with history of successful production acceptable to the Engineer. They shall be new and be UL listed and labeled or listed and labeled by other recognized testing laboratory where such label is available.
- B. Qualifications of Installers: Use adequate numbers of skilled workmen who are thoroughly trained and experienced in necessary crafts and who are completely familiar with specified requirements and methods needed for proper performance of work of this Section.

#### 1.2 GUARANTEE-WARRANTY

- A. Guarantee work to be free of material and workmanship defects for a period of one year, from date of final acceptance for the project. Repair and replace defective work and other work damaged thereby which becomes defective during term of Guarantee-Warranty. Furnish Owner with three written copies of Guarantee-Warranty.

### PART 2 - PRODUCTS

#### 2.1 SUBSTITUTIONS

- A. Reference in Specifications to any article, device, product, material, fixture, form and type of construction, by name, make, or catalog number shall be interpreted as established standard of quality and shall not be construed as limiting competition. Any article, device, product, material, fixture, form and type of construction which in the judgment of Engineer, expressed in writing, is equal to that specified, may be used.
- B. Substitution shall be approved by Engineer before purchase and/or installation. If unapproved materials are installed, work required to remove and replace unapproved items shall be done at the Contractor's expense.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Electrical drawings are diagrammatic and shall not be scaled for exact sizes or locations. They are not intended to disclose absolute or unconditional knowledge of actual field conditions.

- B. Equipment shall be installed according to manufacturer's recommendations.
- C. Protect work and materials from damage by weather, entrance of water, and dirt. Cap conduit during installation. Avoid damage to materials and equipment in place.
- D. Satisfactorily repair or remove and replace damaged work with new materials.
- E. Trenching and backfilling shall comply with Site Work of these Specifications and provide sheathing, shoring, dewatering and cleaning necessary to keep trenches and their grades in proper condition for work to be carried on. Trenches shall be excavated 6" below elevation of bottom of conduit. Backfill shall be per Site Grading and Filling.
- F. Failure to route conduit through building without interfering with other equipment and construction shall not constitute a reason for an extra charge. Equipment, conduit and fixtures shall fit into available space in building and shall not be introduced into building at such times and manner as to cause damage to structure. Equipment requiring services shall be readily accessible.
- G. Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements:
  - 1. Coordinate electrical systems, equipment, and materials installation with other building components.
  - 2. Verify all dimensions by field measurements.
  - 3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for electrical installations.
  - 4. Coordinate the installation of required supporting devices and sleeves to be set in poured in-place concrete and other structural components, as they are constructed.
  - 5. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
  - 6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
  - 7. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
  - 8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Engineer.
  - 9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, whether exposed or concealed.
  - 10. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
  - 11. Install access panels or doors where units are concealed behind finished surfaces.
  - 12. Insulate dissimilar metals so they are not installed in direct contact.

- H. Conduits which pass through floor slabs (except ground floor) shall be sealed with Fire Stop Sealant. Seal around conduits or other wiring materials passing through partitions, floors, and fire rated walls. Use UL approved Fire Stop Sealant as detailed on the drawings.
- I. Coordinate electrical power connection requirements with all equipment suppliers. Where power requirements differ from drawing design requirements, Engineer shall be notified for clarification and installation requirements prior to installing that portion of work. Cost for equipment and labor for improperly installed electrical connections not coordinated and approved by other trades and the Engineer shall be incurred by the Electrical Contractor and shall not constitute a reason for an extra charge because of rework.

### 3.2 CUTTING AND PATCHING

- A. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

### 3.3 TESTING AND EQUIPMENT SERVICING

- A. Entire installation shall be free from improper grounds and short or open circuits. Conductors shall be tested before energizing circuit. Test to insure that entire system is in proper operating condition, and that adjustments and settings of circuit breakers, fuses, control equipment, and apparatus have been made. Correct defects discovered during tests.

### 3.4 REMOVAL OF DEBRIS

- A. Remove surplus materials and debris caused by, or incidental to electrical work. Remove such debris at frequent intervals. Keep job site clean during construction.

### 3.5 IDENTIFICATION OF EQUIPMENT

- A. Equipment shall be identified in accordance with Section 26.05.53, “Electrical Identification.”

### 3.6 AS-BUILT DRAWINGS

- A. Maintain one set of blue line electrical prints on site, marked to show as-built conditions and installations, prints to be turned over to Owner after job is complete.

### 3.7 TEMPORARY LIGHTING AND POWER

- A. Provide, maintain and remove after construction is completed, temporary lighting adequate for workman safety and temporary power for all trades including any 1 phase power required.

### 3.8 POWER OUTAGES

- A. Coordinate all power outages with Owner and submit for approval proposed schedule of work indicating extent, number, and length of outages required to perform work. Contractor shall include in bid cost of overtime labor required for power outage to occur after Owner's normal hours of operation.

### 3.9 OTHER MATERIALS

- A. Work of this Division shall also include those items not specifically mentioned or described, but which are obviously necessary to conform to the design intent, applicable codes and to produce complete electrical system that functions properly. These materials shall be as selected by Contractor but subject to approval of the Engineer.

### 3.10 OTHER COORDINATION

- A. Contractor shall obtain and pay for all necessary permits and inspection fees required for the electrical installation.
- B. Contractor shall coordinate electrical service requirements with the local electric utility company, and provide any required fee, conduit, transformer pad, metering equipment, etc. that is required.

END OF SECTION

## SECTION 260516 – CONDUIT

### PART 1 - GENERAL

#### 1.1 WORK INCLUDED

- A. Provide a complete conduit system to support all electrical equipment and systems. Conduit system includes conduit, couplers, connectors, fittings, boxes, covers and supports.
- B. No conduit serving branch circuits shall be installed in or below concrete slabs unless required for branch circuits serving loads located in the center of a room.

#### 1.2 QUALITY ASSURANCE

- A. Listing and Labeling: Provide conduit that is listed and labeled.
  - 1. The term "listed and labeled": As defined in the National Electrical Code, Article 100.
  - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- B. Conduit and its installation shall comply with requirements of the National Electrical Code.

### PART 2 - PRODUCTS

#### 2.1 CONDUIT

- A. Electric Metallic Tubing (EMT): Allied, Wheatland, LTV Copperweld, or approved equal.
- B. Rigid Metal Conduit (RMC): Allied, Wheatland, Republic, or approved equal.
- C. Flexible Steel Conduit (Greenfield): Alfex, Electroflex, or approved equal.
- D. Rigid Non-Metallic Conduit (PVC): Carlon Schedule 40, Cantex, Southern Pipe, Schedule 80 or approved equal.
- E. Liquidtight Flexible Nonmetallic Conduit (LFNC): Aflex, Electroflex, or approved equal.

#### 2.2 CONDUIT FITTINGS

- A. Couplings and connectors: Appleton, T&B, Arlington, or O.Z. Gedney.
- B. Bushings: Appleton, T&B, O.Z., or Gedney
- C. Straps and Hangers: Appleton, T&B, Steel City, or Minerallac.

- D. Group Pipe supports: Unistrut, Kindorf, B-Line, or approved equal.
- E. Expansion Fittings: O.Z. Gedney Type AX, or equal by Appleton, or approved equal.
- F. Exposed Conduit Fittings: Appleton, Crouse-Hinds, or O.Z. Gedney.

### PART 3 - EXECUTION

#### 3.1 CONDUIT

- A. In general, conduit installation shall follow layout shown on drawings. However, this layout is diagrammatic only and where changes are necessary due to structural conditions, other apparatus or other causes, such changes shall be made without cost to Owner. Offsets in conduits are not indicated and must be furnished as required.
- B. Conduit shall be installed in accordance with the National Electrical Code.
- C. Provide bushings on the open ends of conduit containing conductors. Insulated bushings shall be provided for conduits containing conductors #4 AWG or larger with an insulating ring an integral part of the bushing.
- D. Use EMT where Drawings call for conduit to be concealed in walls or above ceilings or when cast in concrete slabs not on grade. Do not use EMT exposed lower than 4' above floor, in wet locations, or in exterior applications.
- E. Use Schedule 40 PVC encased in concrete or when installed underground. Use Schedule 80 PVC when exposed.
- F. When PVC conduit is used, turn up perpendicular to slab.
- G. Support conduit and secure to forms when cast in concrete so that conduit will not be displaced during pouring of concrete. Stuff boxes and cork fittings to prevent entrance of water during concrete pouring and at other times during construction, prior to completion of conduit installation.
- H. Route all conduit at right angles or parallel to walls of building.
- I. Use proper sized tools for bending. Do not heat metal conduit. Dents and flat spots will be rejected. Cut and thread conduit so ends will butt in couplings. Make threads no longer than necessary and ream pipe free of burrs.
- J. Minimum conduit size 1/2" unless otherwise required.
- K. Leave one #10 AWG or equivalent nylon pull wire in empty conduits.
- L. Use short pieces, approximately five (5') feet of flexible conduit to connect motors and other devices subject to motion and vibration. Use liquid tight flexible conduit where outside or subject to water spray.

### 3.2 CONDUIT FITTINGS

- A. When EMT is installed concealed in walls or above ceilings use steel double set screw connectors. All connectors shall have throated insulating bushing.
- B. Support conduit vertically and horizontally by straps or hangers. Do not exceed intervals as described in the National Electrical Code.
- C. Use expansion fittings, properly bonded to assure ground continuity, across expansion joints in floors and ceilings. Use double lock nuts and bushings on panel feeders at panel cans.
- D. When connections are made to motors or other equipment, not near walls or columns, provide a vertical conduit, minimum 3/4", attached to floor with a floor flange, bring wiring out of this conduit by means of a condulet and flexible conduit extending to equipment junction box.

END OF SECTION

## SECTION 260519 – WIRE AND CABLE

### PART 1 - GENERAL

#### 1.1 WORK INCLUDED

- A. Wire and cable for all service, feeders, branch circuits, and instrument and control wiring rated 600 volts and below.

#### 1.2 QUALITY ASSURANCE

- A. Listing and Labeling: Provide wire and cable that is listed and labeled.
  - 1. The term "listed and labeled": As defined in the National Electrical Code, Article 100.
  - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- B. Wire and cable and its installation shall comply with requirements of the National Electrical Code.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Wires and cables shall meet applicable requirements of the National Electrical Code and UL for the type of insulation, jacket, and conductor specified or indicated.
- B. All conductors shall be copper with 600 volt insulation unless otherwise indicated.
- C. Wire and cable shall be manufactured by Belden, General Cable, Essex, Encore, Rome Cable, Southwire, or approved equal.
- D. Use solid copper type THHN/THWN for branch circuit wiring #10 AWG and smaller. No conductor for branch circuit wiring shall be smaller than #12 AWG.
- E. Use stranded copper, type THHN/THWN for feeder and power circuits #8 AWG and larger.
- F. Provide color coded wire and with a different color for each phase and neutral and ground as follows: 208/120 volt circuits - phases A, B, and C: black, red, and blue respectively; neutral: white; ground: green, 480/277 volt circuits – phases A, B, and C: brown, orange, and yellow, respectively, neutral: gray; ground: green. Approved color tape is acceptable for feeders. Also provide color coded wire for control circuits.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Complete conduit system before pulling any wire or cable. Use cable lubricants recommended by cable manufacturer as necessary.
- B. Conductors shall be continuous from outlet to outlet or to branch circuit over-current devices. Make splices only in junction boxes. Splices shall not be made in panelboards. Control wiring shall be continuous between components and/or terminal boards.
- C. A minimum of eight (8") inches of slack conductor shall be left in every outlet or junction box. There should also be enough slack so three (3") inches extends outside the outlet or junction box.
- D. Make splices in conductors #10 AWG and smaller diameter with insulated, pressure-type connector. Use Scotchlok, Ideal, or equal wire connectors.
- E. Make splices in conductors #8 AWG and larger diameter with solderless connectors and cover with insulation material equivalent to conductor insulation. Use Burndy compression connectors with crimp cover, type CC, or equal.

#### 3.2 TESTING

- A. After completion of the installation and splicing and prior to energizing the conductors, wire and cable shall be given continuity and insulation tests as herein specified.
- B. Test wiring to verify that no short circuits, open circuits, or accidental grounds exist. Continuity tests shall be conducted using a dc device with bell or buzzer.
- C. Perform Megger tests on wiring #4 AWG and larger.

END OF SECTION

## SECTION 260526 – GROUNDING AND BONDING

### PART 1 - GENERAL

#### 1.1 WORK INCLUDED

- A. Grounding electrodes and conductors.
- B. Equipment grounding conductors.
- C. Bonding.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. The grounding system to earth resistance shall be less than 15 ohms.

#### 1.3 QUALITY ASSURANCE

- A. Listing and Labeling: Provide grounding and bonding materials that are listed and labeled.
  - 1. The term "listed and labeled": As defined in the National Electrical Code, Article 100.
  - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- B. Components and installation shall comply with the requirements of the National Electrical Code (NEC).
- C. Materials shall comply with UL 467, "Grounding and Bonding Equipment."

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers shall be Burndy, T&B, or approved equal.

#### 2.2 GROUNDING ELECTRODES

- A. Ground rods shall be copper clad steel with minimum dimensions of  $\frac{3}{4}$  inch diameter by 10 feet long.

## 2.3 CONNECTORS

- A. Exothermic welded connections shall be provided in kit form and selected for the specific types, sizes, and combinations of conductors and other items to be connected.
- B. Pressure connectors shall be high-conductivity-plated units.
- C. Bolted clamps shall be heavy-duty units listed for the application.

## 2.4 WIRE AND CABLE

- A. All grounding conductors shall be copper.
- B. The grounding electrode conductor shall be stranded.
- C. Equipment grounding conductors shall have green insulation.
- D. Bare copper conductors shall conform to the following:
  - 1. Solid conductors: ASTM B-3
  - 2. Assembly of stranded conductors: ASTM B-8
  - 3. Tinned Conductors: ASTM B-33

## 2.5 MISCELLANEOUS CONDUCTORS

- A. Ground bus shall be bare annealed copper bars.
- B. Braided bonding jumpers shall be copper tape, braided number 30 gauge bare copper wire, and terminated with copper ferrules.
- C. Bonding strap conductor/connectors shall be soft copper, 0.05 inch thick and two (2") inches wide, unless otherwise noted.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Grounding system shall be in accordance with Article 250 of the NEC except where the Drawings or Specifications exceed NEC requirements.
- B. Install code size green grounding conductors in all feeder and branch circuits. Bond conductors to chassis or fixed equipment.
- C. All grounding conductors shall be bonded to multi-terminal ground bus at panelboard or other distribution equipment. Grouping of grounding conductors under a single lug is not acceptable.
- D. Bond interior metal piping systems and metal air ducts to equipment ground conductors of pumps, fans, electric heaters, and air cleaners serving individual systems.

- E. Bond structural steel and reinforcing steel in foundation footing to grounding electrode conductor. Bond steel together. Every corner column and every other column in between shall be connected to the ground ring.
- F. Locate all grounding attachments away from areas subject to physical damage. Provide protective covering as required.
- G. All separate grounding electrodes shall be bonded together to limit potential differences between them and between their associated wiring systems. This includes the power system, TVSS, telephone system, and system grounding electrodes.

### 3.2 CONNECTIONS

- A. Make connections in such a manner as to minimize possibility of galvanic action or electrolysis. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
  - 1. Use electroplated or hot-tin-coated materials to assure high conductivity and make contact points closer in order of galvanic series.
  - 2. Make connections with clean bare metal at points of contact.
  - 3. Aluminum to steel connections shall be with stainless steel separators and mechanical clamps.
  - 4. Aluminum to galvanized steel connections shall be with tin-plated copper jumpers and mechanical clamps.
  - 5. Coat and seal connections involving dissimilar metals with inert material such as red lead paint to prevent future penetration of moisture to contact surfaces.
- B. Use exothermic welded connections for connections to structural steel and for underground connections. Comply with manufacturer's written recommendations. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
- C. For compression-type connections, use hydraulic compression tools to provide the correct circumferential pressure for compression connectors. Use tools and dies recommended by the manufacturer of the connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on the ground conductor.
- D. Terminate insulated equipment grounding conductors for feeders and branch circuits with pressure-type grounding lugs. Where metallic raceways terminate at metallic housings without mechanical and electrical connection to the housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to the ground bus in the housing. Bond electrically noncontinuous conduits at both entrances and exits with grounding bushings and bare grounding conductors.
- E. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A and UL 486B.
- F. Where insulated ground conductors are connected to ground rods or ground buses, insulate the entire area of the connection and seal against moisture penetration of the insulation and cable.

- G. Do not use flexible metal conduit and fittings as a grounding means. Pull a green wire in each piece of flexible conduit, and screw to conduit system with lugs at both ends.

### 3.3 FIELD QUALITY CONTROL

- A. Use the fall-of-potential method as described in IEEE Standard 81 to measure the resistance of the following. Record the measurements and provide to the Engineer.
  - 1. The resistance between earth and each ground rod prior to interconnection with other ground rods.
  - 2. The resistance between earth and the counterpoise.
  - 3. The resistance of the grounding system at the grounding electrode connection to earth.
    - a. Measure the ground resistance when there has been no precipitation for 5 days, without the soil being moistened by any means other than natural precipitation or natural drainage or seepage, and without chemical treatment or other artificial means of reducing natural ground resistance.
  - 4. Resistance shall be less than 15 ohms.
- B. Perform continuity tests at all power receptacles to ensure the ground terminals are properly grounded to the facility ground network.

END OF SECTION

## SECTION 260529 – SUPPORTING DEVICES

### PART 1 - GENERAL

#### 1.1 WORK INCLUDED

- A. This Section includes secure support from the building structure for electrical items by means of hangers, supports, anchors, sleeves, inserts, seals, and associated fasteners.

#### 1.2 QUALITY ASSURANCE

- A. Electrical Component Standard: Components and installation shall comply with the National Electrical Code.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Subject to compliance with requirements, Slotted Metal Angle and U-Channel Systems shall be provided by Allied Tube & Conduit, American Electric, B-Line Systems, Inc., Unistrut Diversified Products, or approved equal.
- B. Subject to compliance with requirements, Conduit Sealing Bushings shall be provided by Bridgeport Fittings, Inc., Cooper Industries, Inc., Killark Electric Mfg. Co., O-Z/Gedney, Raco, Inc., Spring City Electrical Mfg. Co., Thomas & Betts Corp., or approved equal.

#### 2.2 COATINGS

- A. Coating: Supports, support hardware, and fasteners shall be protected with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish, or inherent material characteristic. Products for use outdoors shall be aluminum or hot-dip galvanized.

#### 2.3 MANUFACTURED SUPPORTING DEVICES

- A. Raceway Supports: Raceways shall be supported with clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps.
- B. Fasteners: Types, materials, and construction features as follows:
  - 1. Expansion Anchors: Carbon steel wedge or sleeve type.
  - 2. Toggle Bolts: All steel springhead type.
  - 3. Powder-Driven Threaded Studs: Heat-treated steel, designed specifically for the intended service.

- C. Conduit Sealing Bushings: Factory-fabricated watertight conduit sealing bushing assemblies suitable for sealing around conduit, or tubing passing through concrete floors and walls. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps, and cap screws.
- D. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Provide plugs with number and size of conductor gripping holes as required to suit individual risers. Construct body of malleable-iron casting with hot-dip galvanized finish.
- E. U-Channel Systems: 16-gauge steel channels, with 9/16-inch-diameter holes, at a minimum of 8 inches on center, in top surface. Provide fittings and accessories that mate and match with U-channel and are of the same manufacturer.

## 2.4 FABRICATED SUPPORTING DEVICES

- A. General: Shop- or field-fabricated supports or manufactured supports assembled from U-channel components.
- B. Steel Brackets: Fabricated of angles, channels, and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.
- C. Pipe Sleeves: Provide pipe sleeves of one of the following:
  - 1. Sheet Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate sleeves from the following gage metal for sleeve diameter noted:
    - a. 3-inch and smaller: 20-gauge.
    - b. 4-inch to 6-inch: 16-gauge.
    - c. over 6-inch: 14-gauge.
  - 2. Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe.
  - 3. Plastic Pipe: Fabricate from Schedule 80 PVC plastic pipe.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install supporting devices to fasten electrical components securely and permanently in accordance with NEC requirements.
- B. Coordinate with the building structural system and with other electrical installation.
- C. Raceway Supports: Comply with the NEC and the following requirements:
  - 1. Conform to manufacturer's recommendations for selection and installation of supports.
  - 2. Strength of each support shall be adequate to carry present and future load multiplied by a safety factor of at least four. Where this determination results in a safety allowance of less

- than 200 lbs., provide additional strength until there is a minimum of 200 lbs. safety allowance in the strength of each support.
3. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.
  4. Support parallel runs of horizontal raceways together on trapeze-type hangers.
  5. Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for 1-1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings only. For hanger rods with spring steel fasteners, use 1/4-inch-diameter or larger threaded steel. Use spring steel fasteners that are specifically designed for supporting single conduits or tubing.
  6. Space supports for raceway types not covered by the above in accordance with NEC.
  7. Support exposed and concealed raceway within 1 foot of an unsupported box and access fittings. In horizontal runs, support at the box and access fittings may be omitted where box or access fittings are independently supported and raceway terminals are not made with chase nipples or threadless box connectors.
  8. In vertical runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports with no weight load on raceway terminals.
- D. Vertical Conductor Supports: Install simultaneously with installation of conductors.
- E. Miscellaneous Supports: Support miscellaneous electrical components as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices.
- F. In open overhead spaces, cast boxes threaded to raceways need not be supported separately except where used for fixture support; support sheet metal boxes directly from the building structure or by bar hangers. Where bar hangers are used, attach the bar to raceways on opposite sides of the box and support the raceway with an approved type of fastener not more than 24 inches from the box.
- G. Sleeves: Install in concrete slabs and walls and all other fire rated floors and walls for raceways and cable installations. For sleeves through fire rated wall or floor construction, apply UL listed firestopping sealant in gaps between sleeves and enclosed conduits and cables in accordance with manufacturer's recommendations.
- H. Conduit Seals: Install seals for conduit penetrations of slabs on grade and exterior walls below grade and where indicated. Tighten sleeve seal screws until sealing grommets have expanded to form watertight seal.
- I. Fastening: Unless otherwise indicated, fasten electrical items and their supporting hardware securely to the building structure, including but not limited to conduits, raceways, cables, cable trays, busways, cabinets, panelboards, transformers, boxes, disconnect switches, and control components in accordance with the following:
1. Fasten by means of wood screws or screw-type nails on wood; toggle bolts on hollow masonry units; concrete inserts or expansion bolts on concrete or solid masonry; and machine screws, welded threaded studs, or spring-tension clamps on steel. Threaded studs driven by a powder charge and provided with lock washers and nuts may be used instead

of expansion bolts and machine or wood screws. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures. In partitions of light steel construction, use sheet metal screws.

2. Holes cut to depth of more than 1-1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete shall not cut the main reinforcing bars. Fill holes that are not used.
3. Ensure that the load applied to any fastener does not exceed 25 percent of the proof test load. Use vibration- and shock- resistant fasteners for attachments to concrete slabs.

END OF SECTION

## SECTION 260533 – OUTLET AND JUNCTION BOXES

### PART 1 - GENERAL

#### 1.1 WORK INCLUDED

- A. Wall and ceiling outlet boxes.
- B. Pull and junction boxes.

#### 1.2 QUALITY ASSURANCE

- A. Listing and Labeling: Provide outlet and junction boxes that are listed and labeled.
  - 1. The term "listed and labeled": As defined in the National Electrical Code, Article 100.
  - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- B. Outlet and junction boxes and their installation shall comply with the requirements of the National Electrical Code.

### PART 2 - PRODUCTS

#### 2.1 OUTLET AND JUNCTION BOXES

- A. Outlet and junction boxes shall be galvanized steel, 1-1/2" deep minimum by Raco, T&B/Steel City, Crouse Hinds or approved equal.
- B. Boxes for interior areas with exposed conduit shall be pressed steel and in exterior areas with exposed conduit shall be cast metal with threaded hubs, "FS" type. Use galvanized steel for concealed boxes.

### PART 3 - EXECUTION

#### 3.1 GENERAL

- A. Outlet and junction boxes in inaccessible ceiling areas shall be located no more than 6 inches from ceiling access panel or from removable recessed luminaire.
- B. Install boxes to preserve fire resistance rating of partitions and other elements, using UL listed fire stop materials and methods.
- C. Do not install flush mounted boxes back-to-back in walls; provide minimum six (6") inches separation. Provide minimum twenty-four (24") inches separation in fire rated walls.

- D. Do not fasten boxes to ceiling support wires.
- E. Support boxes independently of conduit.
- F. Bonding jumpers shall be used around knockouts.

### 3.2 OUTLET BOXES

- A. Outlet boxes shall be securely anchored, set true, and plumb and no part of box shall extend beyond finished wall or ceiling. Flush mounted boxes shall be set to within 1/8" of finished wall and a plaster ring used to make cover flush with wall.
- B. Select boxes according to intended use and type of outlet. Ceiling outlet boxes shall be four (4") inches octagon and 2-1/2" deep minimum. Use four (4") inches square boxes where required. All ceiling outlet boxes shall have a fixture stud of the no bolt, self-locking type if required to hang the fixture specified at the outlet.
- C. Receptacle and switch boxes installed in concrete block walls not plastered shall be Steel City, Appleton, Raco Series No. 690 through No. 699, or approved equal masonry boxes of proper depth and gang required and specifically designed for this purpose. If more than two conduits enter box from one direction, 4" square boxes with square-cut device covers not less than one (1") inch deep specifically designed for this purpose, shall be used. Round edge plaster rings will not be acceptable for block walls. Sectional or gangable type outlet boxes will not be acceptable except in drywall construction.
- D. Mount outlet boxes worked to nearest block course. Confirm ADA compliance.
- E. Install blank device plates on outlet boxes left for future use.
- F. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices. Confirm accessibility code compliance.

### 3.3 JUNCTION BOXES

- A. Pull and junction boxes shall be sized in accordance with the National Electrical Code according to number of conductors in box or type of service to be provided. Minimum size is 4-11/16" square and 2-1/2" deep.
- B. Pull boxes shall be provided where necessary in the conduit system to facilitate conductor installation. Conduit runs longer than 100 feet or with bends exceeding 270 degrees shall have a pull box installed at a convenient intermediate location.
- C. Install in locations as shown on Drawings and as required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements.
- D. Install pull and junction boxes above accessible ceilings and in unfinished areas only.

3.4 ADJUSTING

- A. Adjust flush-mounting outlets to make front flush with finished wall material.
- B. Install knockout closures in unused box openings.

3.5 CLEANING

- A. Clean interior of boxes to remove dust, debris, and other material.
- B. Clean exposed surfaces and restore finish.

END OF SECTION

## SECTION 260548 – SEISMIC BRACING FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Seismic Requirements for single rod hanger supports for conduit, pipe and other similar systems.
- B. Seismic Requirements for trapeze type supports for cable tray, conduit, pipe and other similar systems.

#### 1.2 REFERENCES

- A. International Building Code (IBC), latest edition.
- B. NFPA 70/NEC – National Fire Protection Association (National Electrical Code)

#### 1.3 QUALITY ASSURANCE

- A. General:
  - 1. The contractor shall provide pre-engineered seismic restraint systems to meet total design lateral force requirements for support and restraint of piping, conduit, cable trays and other similar systems and equipment where required by the applicable building code.
- B. Manufacturer:
  - 1. System Supports/Restraints: Firms regularly engaged in the manufacture of products of the types specified in this section, whose products have been in satisfactory use in similar service for not less than 5 years.
  - 2. Bolted framing channels and fittings shall have the manufacturers name, part number, and material heat code identification number stamped in the part itself for identification. Material certification sheets and test reports must be made available by the manufacturer upon request.
- C. Installer: Company experienced in performing the work of this Section.

#### 1.4 SUBMITTALS

- A. Submit seismic force level ( $F_p$ ) calculations from applicable building code. Submit pre-approved restraint selections and installation details.
- B. Restraint selection and installation details shall be pre-approved by a professionally licensed engineer experienced in seismic restraint design.

- C. Submit manufacturer's product data on strut channels including, but not limited to, types, materials, finishes, gauge thickness, and hole patterns. For each different strut cross-section, submit cross sectional properties including Section Modulus (Sx) and Moment of Inertia (Ix).

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver strut systems, pipe hangers and components carefully to avoid breakage, denting, and scoring finishes. Do not install damaged equipment.
- B. Store strut systems, pipe hangers and components in original cartons and in clean dry space; protect from weather and construction traffic.

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturer: Subject to compliance with these specifications, strut systems, pipe hangers, and accessories to be installed shall be as manufactured by Cooper B-Line, Inc. or approved equal.

### 2.2 SEISMIC BRACING COMPONENTS

- A. Steel strut shall be 1-5/8 wide in varying heights and mig-welded combinations as required to meet load capacities and designs indicated. A material heat code, part number, and manufacturer's name shall be stamped on all strut and fittings to maintain traceability to material test reports.
  - 1. Material for epoxy painted strut: ASTM A1011, SS, Grade 33
  - 2. Material for pre-galvanized strut: ASTM A653, SS, Gr. 33
  - 3. Material for Hot-Dip Galvanized strut: ASTM A1011, SS, Grade 33 and hot-dip galvanized after fabrication in accordance with ASTM A123.
  - 4. Material for fittings and accessories: ASTM A907 Gr. 33, Structural Quality or ASTM A1011, SS, Gr.33.
  - 5. Fittings and accessories: Products shall be of the same manufacturer as strut and designed for use with that product.

### 2.3 CODE INFORMATION

- A. This project is subject to the seismic bracing requirements of the International Building Code, 2012 edition. The following criteria are applicable to this project.
  - 1. Seismic Category: C; SDS = 0.316; SD1 = 0.165; Site Class = D; Importance Factor = 1.25; Risk Category III, Ss=0.304; S1=0.104..
  - 2. The total height of the structure (hr) and the height of the system to be restrained within the structure (hx) shall be determined in coordination with architectural plans and the General Contractor.
  - 3. Refer to Structural Drawings for additional seismic information.

4. Confirm Seismic Category data in item No. 1 prior to commencing rough-in.
- B. Forces shall be calculated for individual supports using the above information.

## 2.4 SEISMIC BRACING AND SUPPORT OF SYSTEMS AND COMPONENTS

### A. General:

1. Seismic restraint designer shall coordinate all attachments with the structural engineer of record.
2. Design analysis shall include calculated dead loads, static seismic loads, and capacity of materials utilized for the connection of the equipment or system to the structure.
3. Analysis shall detail anchoring methods, bolt diameter, and embedment depth.
4. All seismic restraint devices shall be designed to accept without failure the forces calculated per the applicable building code and as summarized in Section 3.01.

- B. Friction from gravity loads shall not be considered resistance to seismic forces.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

#### A. Seismic Restraint of Electrical Services

1. All seismic restraint systems shall be installed in strict accordance with the manufacturer's seismic restraint guidelines manual and all certified submittal data.
2. Installation of seismic restraints shall not cause any change in position of equipment or conduit, resulting in stresses or misalignment.
3. No rigid connections between equipment and the building structure shall be made that degrade the noise and vibration-isolation system specified.
4. Do not install any equipment, piping, duct, or conduit that makes rigid connections with the building unless isolation is not specified.
5. Prior to installation, bring to the architect's/engineer's attention any discrepancies between the specifications and the field conditions, or changes required due to specific equipment selection.
6. Bracing may occur from flanges of structural beams, upper truss cords of bar joists, cast in place inserts, or wedge-type concrete anchors. Consult structural engineer of record.
7. Overstressing of the building structure shall not occur from overhead support of equipment. Bracing attached to structural members may present additional stresses. The contractor shall submit loads to the structural engineer of record for approval in this event.
8. Brace support rods when necessary to accept compressive loads. Welding of compressive braces to the vertical support rods is not acceptable.
9. Provide reinforced clevis bolts where required.
10. Seismic restraints shall be mechanically attached to the system. Looping restraints around the system is not acceptable.
11. Do not brace a system to two independent structures such as a ceiling and wall.
12. Provide appropriately sized openings in walls, floors, and ceilings for anticipated seismic movement. Provide fire seal systems in fire-rated walls.

13. Provide Seismic Code and Category information to Switchgear manufacturer for factory seismic construction criteria.
14. Provide seismic restraints for all lighting fixtures where installed pendant or in acoustical grid ceilings.

END OF SECTION

## SECTION 260553 – ELECTRICAL IDENTIFICATION

### PART 1 - GENERAL

#### 1.1 WORK INCLUDED

- A. Extent and types of electrical identification are indicated herein and as follows:
1. Operational instructions and warnings.
  2. Danger signs.
  3. Equipment/system identification signs.
  4. Conduit identification.
  5. Power and control wiring identification.
  6. Terminal marking.
  7. Arc-flash warning.
  8. Panelboard Legends.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Subject to compliance with requirements, identification products shall be provided by W.H. Brady Co., Ideal Industries, Inc., Panduit, T&B, or approved equal.

#### 2.2 MATERIALS

- A. General: Except as otherwise indicated, provide manufacturer's standard products of categories and types required for each application. Where more than single type is specified for an application, selection is Installer's option, but provide single selection for each application.
- B. Cable/Conductor Identification Bands: Provide manufacturer's standard wrap-around type, vinyl-cloth, self-adhesive cable/conductor markers with either pre-numbered plastic coated type or write-on type with clear plastic self-adhesive cover flap, numbered to show circuit identification. Provide markers for all field control wiring.
- C. Self-Adhesive Plastic Signs: Provide manufacturer's standard, self-adhesive or pressure-sensitive, pre-printed, flexible vinyl signs for operational instructions or warnings. Signs shall be of sizes suitable for application areas and adequate for visibility, with proper wording for each application (as examples: 208V, EXHAUST FAN or DANGER – HIGH VOLTAGE).
1. Colors: Unless otherwise indicated or required by governing regulations, provide orange signs with black lettering.
- D. Engraved Plastic-Laminate Signs: Provide three-layer engraving stock in sizes and thickness indicated, engraved with engraver's standard letter style of sizes and wording indicated, black and

white core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.

1. Thickness: 1/16", for units up to 20 sq. in. or eight (8") length; 1/8" for larger units.
2. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate substrate.

- E. Underground Warning Tape: Provide four (4") inch wide detectable type, plastic, yellow warning tape with suitable warning describing type of cable/circuit over buried electrical lines.

## 2.3 LETTERING AND GRAPHICS

- A. General: Coordinate names, abbreviations, and other designations used in electrical identification work, with corresponding designations shown, specified, or scheduled. Provide numbers, lettering, and working as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of electrical systems and equipment.

## PART 3 - EXECUTION

### 3.1 APPLICATION AND INSTALLATION

- A. General Installation Requirements:

1. Coordination: Where identification is to be applied to surfaces, which require finish, install identification after completion of painting.
2. Regulations: Comply with governing regulations and requests of governing authorities for identification of electrical work.
3. Conduit Identification: Where electrical conduit is exposed in spaces with exposed mechanical piping which is identified by a color-coded method, apply color-coded identification on electrical conduit in a manner similar to piping identification. Except as otherwise indicated use orange as coded color for conduit.
4. Equipment/System Identifications: Install engraved plastic-laminate sign on each disconnect and control cabinets. Except as otherwise indicated, provide single line of text, 1/2" high lettering on 1-1/2" high sign (2" high where 2 lines are required), white lettering in black field. Provide text matching terminology and numbering of the contract documents and shop drawings. Provide identification and warning signs for each unit of the following categories of electrical work.
  - a. Electrical cabinets and enclosures.
  - b. Panelboards
  - c. Access panel/doors to electrical cabinets.
  - d. Control stations.
  - e. Disconnect switches.

- B. Install signs at locations indicated or, where not otherwise indicated, at locations for best convenience of viewing without interference with operation and maintenance of equipment. Secure to substrate with stainless steel tamperproof fasteners.

- C. Install danger signs on all disconnect and control cabinet exteriors.
- D. Install danger and notice to disconnect power before removing or opening on all inner panels.
- E. Install underground warning tape in accordance with the National Electrical Code.
- F. Install vinyl stick on labels (Burndy or similar) with panel and circuit numbers for all receptacle faceplates.

END OF SECTION

## SECTION 260573 – OVERCURRENT PROTECTIVE DEVICES

### PART 1 - GENERAL

#### 1.1 WORK INCLUDED

- A. This section includes circuit breakers and fuses.

#### 1.2 SUBMITTALS

- A. Provide manufacturer's product data for the following:
  - 1. Circuit breakers
  - 2. Enclosures
  - 3. Fuses (Provide complete list of all fuses and the equipment where they are used.)
  - 4. Shunt trips
- B. Provide maintenance data for products for inclusion in the Operating and Maintenance Manual.
  - 1. Include a load current and overload relay heater list compiled by Contractor after motors have been installed. Arrange list to demonstrate selection of heaters to suit actual motor nameplate full load currents.

#### 1.3 QUALITY ASSURANCE

- A. Listing and Labeling: Provide overcurrent protective devices that are listed and labeled.
  - 1. The term "listed and labeled": As defined in the National Electrical Code, Article 100.
  - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- B. Overcurrent protective devices and their installation shall comply with the requirements of the National Electrical Code.
- C. Circuit breakers shall comply with UL 489, NEMA AB 1, and NEMA AB 3.
- D. Fuses shall conform to NEMA FU 1.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Circuit Breakers: Subject to compliance with requirements, provide products by Cutler-Hammer; General Electric Co.; Siemens Energy & Automation, Inc.; Square D Co.; or approved equal.

- B. Fuses: Subject to compliance with requirements, provide products by Bussmann Mfg. Co., Littlefuse Co, Ferraz Shawmut, or approved equal.

## 2.2 MOLDED-CASE CIRCUIT BREAKERS

- A. Circuit breakers shall be bolt-on only. Plug-in type circuit breakers are not permitted.
- B. Circuit breakers shall be molded case, manually operated, trip-free, with inverse-time, thermal-overload protection, and instantaneous magnetic, short-circuit protection, as required. Circuit breakers shall be completely enclosed in a molded case, with the calibrated sensing element factory-sealed to prevent tampering.
- C. Thermal-magnetic tripping elements shall be located in each pole of the circuit breaker and shall provide inverse-time-delay thermal overload protection and instantaneous magnetic short-circuit protection. On frame sizes larger than 100 amperes, the instantaneous magnetic tripping element shall be adjustable and accessible from the front of the breaker.
- D. Breaker size shall be as required for the continuous current rating of the circuit. Breaker class shall be as required.
- E. Interrupting capacity of the branch circuit breakers shall be sufficient to successfully interrupt the maximum short-circuit current imposed on the circuit at the breaker terminals. Circuit breaker minimum interrupting capacities shall be as shown on drawings and shall conform to NEMA AB 3.
- F. Multipole circuit breakers shall be of the common-trip type having a single operating handle and shall have a two-position on/off indication. Circuit breakers shall have temperature compensation for operation in an ambient temperature of 104 degrees F. Circuit breakers shall have root mean square (rms) symmetrical interrupting rating sufficient to protect the circuit being supplied. Interrupting ratings may have selective type tripping (time delay, magnetic, thermal, or ground fault).
- G. Breaker body shall be of phenolic composition. Breakers shall be capable of having such accessories as handle-extension, handle-locking, and padlocking devices attached where required.
- H. Provide UL listed service entrance equipment when used for service disconnect.
- I. Circuit breakers used for switching high intensity discharge lights or fluorescent lights shall be rated for that type of service.

## 2.3 ENCLOSED MOLDED-CASE CIRCUIT BREAKERS

- A. Enclosed circuit breakers shall be thermal-magnetic, molded-case circuit breakers in surface-mounted, non-ventilated enclosures, conforming to the appropriate articles of NEMA 250 and NEMA AB 1.

## 2.4 FUSES

- A. A complete set of fuses for all switches shall be provided. Fuses shall have a voltage rating not less than the circuit voltage.
- B. Provide Class RK5 fuses for motor branch circuits.
- C. Fuses shall be labeled showing UL class, interrupting rating, and time-delay characteristics, when applicable.
- D. Fuse holders field-mounted in a cabinet or box shall be porcelain. Field installation of fuse holders made of such materials as ebony asbestos, Bakelite, or pressed fiber shall not be used.
- E. Provide a minimum of three (3) spare fuses of each size and type fuse installed.
- F. Provide a complete list of all fuses and the equipment where they are used.

## 2.5 EQUIPMENT ENCLOSURES

- A. Enclosures for equipment shall be in accordance with NEMA 250.
- B. Equipment installed inside, clean, dry locations shall be contained in NEMA Type 1, general-purpose sheet-steel enclosures.
- C. Equipment installed in wet locations shall be contained in NEMA Type 3R, rainproof, sheet-steel enclosures, constructed for outdoor use to protect against falling rain, sleet, and ice.
- D. Ferrous-metal surfaces of electrical enclosures shall be cleaned, phosphatized, and painted with the manufacturer's standard finish.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install overcurrent protective devices as indicated or required, in accordance with the manufacturer's written instructions and with recognized industry practices to ensure that protective devices comply with requirements.
- B. Coordinate with other work, including electrical wiring work, as necessary to interface installation of overcurrent protective devices.
- C. Fasten circuit breakers without mechanical stresses, twisting or misalignment being exerted by clamps, supports, or cables.
- D. Install enclosed circuit breakers plumb with operating handle at five (5') feet above finished elevation.
- E. Set field-adjustable circuit breakers for trip settings as indicated, subsequent to installation of devices.

- F. Provide engraved plastic-laminate identification under the provisions of Section 26.05.53, "Electrical Identification" for enclosed circuit breakers and motor controllers.

### 3.2 FIELD QUALITY CONTROL

- A. Prior to energization of overcurrent protective devices, test devices for continuity of circuitry and for short-circuits. Correct malfunctioning units, and then demonstrate compliance with requirements.
- B. In the presence of the Owner or Owner's Representative, test each device and demonstrate its working as specified.

END OF SECTION

## SECTION 262726 – WIRING DEVICES AND PLATES

### PART 1 - GENERAL

#### 1.1 WORK INCLUDED

- A. Switches
- B. Receptacles
- C. Plates

#### 1.2 QUALITY ASSURANCE

- A. Listing and Labeling: Provide wiring devices and plates that are listed and labeled.
  - 1. The term "listed and labeled": As defined in the National Electrical Code, Article 100.
  - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- B. Wiring devices and plates and their installation shall comply with the requirements of the National Electrical Code.

### PART 2 - PRODUCTS

#### 2.1 SWITCHES

- A. Switches shall be toggle, quiet-type with totally enclosed with bodies of thermo-plastic and mounting strap.
- B. Switches shall be rated for 20 amps, 277 volts AC. Switches shall be specification grade Hubbell, P&S, Leviton, Cooper Wiring Devices, or approved equal.

#### 2.2 RECEPTACLES

- A. Receptacles shall be general purpose, heavy duty, duplex receptacles made of thermoplastic supported on a metal mounting strap in accordance with NEMA WD 1. Receptacles shall be 20 amp, 125 volt, specification grade Cooper Wiring Devices, Hubbell, Leviton, P&S.
- B. Ground fault circuit interrupter receptacles shall be the “feed-through” type rated to protect 20 amps. Receptacles shall be specification grade duplex receptacles with almond impact-resistant nylon face with test and reset buttons.
  - 1. 20 Amp, 125 Volt: Cooper Wiring Devices, Hubbell, Leviton, P&S, or approved equal.

- C. Special Receptacles: As indicated on Drawings, and including USB Charging type receptacles in public areas, corridors, and conference rooms.

### 2.3 PLATES

- A. Provide UL listed, one-piece device plates to suit the devices installed.
- B. For metal outlet boxes, plates on unfinished walls shall be of zinc-coated sheet steel or cast-metal having round or beveled edges.
- C. Plates on finished walls shall be nylon or thermoplastic, mid-size, unless noted otherwise. Plates in the kitchens/food service areas shall be stainless steel.
- D. Plates shall be same color as receptacle or toggle switch with which they are mounted. Screws shall be machine-type with countersunk heads in color to match finish of plate.
- E. Plates installed in wet locations shall be gasketed and UL listed for “wet locations” as per NEC 406.8 (B).

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Provide proper size outlet boxes for all wiring devices in accordance with Section 26.05.33, “Outlet and Junction Boxes.”
- B. Install switches forty-eight (48") inches above finished floor on lock side and clear of door frame a minimum of three (3") inches unless otherwise noted. Prior to rough-in, coordinate with architectural drawings to determine lock side of door.
- C. All switches shall be made by the same manufacturer.
- D. Where two or more snap switches are to be installed at the same location, they shall be mounted in one-piece ganged switch boxes, with at gang cover plate.
- E. Combination snap switch and single or duplex receptacles shall be mounted in two-gang switch box with one-piece device plate.
- F. Receptacles shall be mounted 18" above finished floor unless otherwise noted.
- G. All wiring devices shall be mounted in accordance with accessibility code requirements.
- H. The color of all devices and plates shall be selected by the architect.

END OF SECTION

## SECTION 26 56 68 – EXTERIOR ATHLETIC LIGHTING

### Lighting System with LED Light Source

#### PART 1 – GENERAL

##### 1.1 SUMMARY

- A. Work covered by this section of the specifications shall conform to the contract documents, engineering plans as well as state and local codes.
- B. The purpose of these specifications is to define the lighting system performance and design standards for East Tennessee State University Pickleball using an LED Lighting source. The manufacturer / contractor shall supply lighting equipment to meet or exceed the standards set forth in these specifications.
- C. The sports lighting will be for the following venues:
  - 1. Pickleball 1
  - 2. Pickleball 2
- D. The primary goals of this sports lighting project are:
  - 1. Guaranteed Light Levels: Selection of appropriate light levels impacts the safety of players and the enjoyment of spectators. Therefore, light levels are guaranteed to not drop below specified target values for a period of 25 years.
  - 2. Environmental Light Control: It is the primary goal of this project to minimize spill light to adjoining properties and glare to players, spectators, and neighbors.
  - 3. Cost of Ownership: To reduce the operating budget, the preferred lighting system shall be energy efficient and cost effective to operate. All maintenance costs shall be eliminated for the duration of the warranty.
  - 4. Control and Monitoring – To allow for optimized use of labor resources and avoid unneeded operation of the facility, customer requires a remote on/off control system for the lighting system. Fields should be proactively monitored to detect luminaire outages over a 25-year life cycle. All communication and monitoring costs for 25-year period shall be included in the bid.
    - a. Control and monitoring system shall provide contactor control of all existing circuits. Key switches shall be provided to provide field-level control of existing circuit groups.

##### 1.2 ONFIELD LIGHTING PERFORMANCE

- A. Illumination Levels and Design Factors: Playing surfaces shall be lit to an average target illumination level and uniformity as specified in the chart below. Lighting manufacturers will provide a guarantee that light levels will be sustained over the life of the warranty period. Lighting

calculations shall be developed, and field measurements taken on the grid spacing with the minimum number of grid points specified below.

Manufacturers will provide lumen maintenance data of the LED luminaires used per TM-21-11 and will incorporate the lumen maintenance projections into the lighting designs to ensure target light levels are achieved throughout the guaranteed period of the system. Per IES guidelines, lumen maintenance hours should be reported based on the 6x multiplier of testing hours.

Area of Lighting	Average Target Illumination Levels	Maximum to Minimum Uniformity Ratio	Grid Points	Grid Spacing
Pickleball 1	50 FC	2.5:1.0	21	10' X 10'
Pickleball 2	50 FC	2.5:1.0	21	10' X 10'

- B. Color Temperature: The lighting system shall have a minimum color temperature of 5700KK and a CRI of 75.
- C. Playability: Lighting design and luminaire selection should be optimized for playability by reducing glare onfield and providing sufficient uplift.
  - 1. Aiming Angles: To reduce glare, luminaire aiming should ensure the top of the luminaire field angle (based on sample photometric reports) is a minimum of 10 degrees below horizontal.
  - 2. Glare Control Technology – Luminaires selected should have glare control technology including, but not limited to: external visors, internal shields and louvers. No symmetrical beam patterns are acceptable.
  - 3. Mounting Heights: To ensure proper aiming angles, minimum mountings heights shall be as described below. Higher mounting heights may be necessary for luminaire with lesser glare control to meet field angle requirements of section 1.2.C.1.

# of Poles	Pole Designation	Pole Height
3	P1-3	30'

1.3 ENVIRONMENTAL LIGHT CONTROL

- A. Light Control Luminaires: All luminaires shall utilize spill light and glare control devices including, but not limited to, internal shields, louvers, and external shields. No symmetrical beam patterns are accepted.
- B. Spill Light and Glare Control: To minimize impact on adjacent properties, spill light and candela values must not exceed the following levels taken at 3 feet above grade.

	Average	Maximum
150' Specified Spill Line Horizontal Footcandles	.01 fc	.1 fc
150' Specified Spill Line Max Vertical Footcandles	.01 fc	.1 fc
150' Specified Spill Line Max Candela (taken at 5 ft above grade)		1000 cd

- C. Spill Scans: Spill scans must be submitted indicating the amount of horizontal and vertical footcandles along the specified lines. Light levels shall be provided in 30-foot intervals along the boundary line at 3 ft above grade.
- D. Sample Photometry: The first page of a photometric report for all luminaire types proposed showing horizontal and vertical axial candle power shall be provided to demonstrate the capability of achieving the specified performance. Reports shall be certified by a qualified testing laboratory with a minimum of five years experience or by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products. A summary of the horizontal and vertical aiming angles for each luminaire shall be included with the photometric report.
- E. Field Verification: Lighting manufacturer shall supply field verification of environmental light control using a meter calibrated within the last 12 months:
  - 1. Spill verification: Illumination levels shall be taken in accordance with IESNA RP-6-22. The light sensing surface of the light meter should be held 36 inches above the playing surface with the sensing surface horizontal (for horizontal readings) or vertically pointed at the brightest light bank (for max vertical readings)

#### 1.4 COST OF OWNERSHIP

- A. Manufacturer shall submit a 25 year Cost of Ownership summary that includes energy consumption, anticipated maintenance costs, and control costs. All costs associated with faulty luminaire replacement - equipment rentals, removal and installation labor, and shipping - are to be included in the maintenance costs.

### PART 2 – PRODUCT

#### 2.1 SPORTS LIGHTING SYSTEM CONSTRUCTION

- A. Manufacturing Requirements: All components shall be designed and manufactured as a system. All luminaires, wire harnesses, drivers and other enclosures shall be factory assembled, aimed, wired and tested.
- B. Durability: All exposed components shall be constructed of corrosion resistant material and/or coated to help prevent corrosion. All exposed carbon steel shall be hot dip galvanized per ASTM A123. All exposed aluminum shall be powder coated with high performance polyester or anodized. All exterior reflective inserts shall be anodized, coated, and protected from direct environmental exposure to prevent reflective degradation or corrosion. All exposed hardware and fasteners shall be stainless steel, passivated and coated with aluminum-based thermosetting epoxy resin for protection against corrosion and stress corrosion cracking. Structural fasteners may be carbon steel and galvanized meeting ASTM A153 and ISO/EN 1461 (for hot dipped galvanizing), or ASTM B695 (for mechanical galvanizing). All wiring shall be enclosed within the cross-arms, pole, or electrical components enclosure.
- C. System Description: Lighting system shall consist of the following:

1. Galvanized steel poles and cross-arm assembly.
2. Non-approved pole technology:
  - a. Square static cast concrete poles will not be accepted.
  - b. Direct bury steel poles which utilize the extended portion of the steel shaft for their foundation will not be accepted due to potential for internal and external corrosive reaction to the soils and long term performance concerns.
3. Lighting systems shall use concrete foundations. See Section 2.4 for details.
  - a. For a foundation using a pre-stressed concrete base embedded in concrete backfill the concrete shall be air-entrained and have a minimum compressive design strength at 28 days of 3,000 PSI. 3,000 PSI concrete specified for early pole erection, actual required minimum allowable concrete strength is 1,000 PSI. All piers and concrete backfill must bear on and against firm undisturbed soil.
  - b. For anchor bolt foundations or foundations using a pre-stressed concrete base in a suspended pier or re-enforced pier design pole erection may occur after 7 days. Or after a concrete sample from the same batch achieves a certain strength.
4. Manufacturer will supply all drivers and supporting electrical equipment.
  - a. Remote drivers and supporting electrical equipment shall be mounted approximately 10 feet above grade in aluminum enclosures. The enclosures shall be touch-safe and include drivers and fusing with indicator lights on fuses to notify when a fuse is to be replaced for each luminaire. Disconnect per circuit for each pole structure will be located in the enclosure. Integral drivers are not allowed.
  - b. Manufacturer shall provide surge protection at the pole equal to or greater than 40 kA for each line to ground (Common Mode) as recommended by IEEE C62.41.2\_2002.
5. Wire harness complete with an abrasion protection sleeve, strain relief and plug-in connections for fast, trouble-free installation.
6. All luminaires, visors, and cross-arm assemblies shall withstand 150 mi/h winds and maintain luminaire aiming alignment.
7. Control cabinet to provide remote on-off control and monitoring of the lighting system. See Section 2.3 for further details.
8. Manufacturer shall provide lightning grounding as defined by NFPA 780 and be UL Listed per UL 96 and UL 96A.
  - a. Integrated grounding via concrete encased electrode grounding system.
  - b. If grounding is not integrated into the structure, the manufacturer shall supply grounding electrodes, copper down conductors, and exothermic weld kits. Electrodes and conductors shall be sized as required by NFPA 780. The grounding electrode shall be minimum size of 5/8 inch diameter and 8 feet long, with a minimum of 10 feet embedment. Grounding electrode shall be connected to the structure by a grounding electrode conductor with a minimum size of 2 AWG for poles with 75 feet mounting height or less, and 2/0 AWG for poles with more than 75 feet mounting height.

D. Safety: All system components shall be UL listed for the appropriate application.

## 2.2 ELECTRICAL

A. Electric Power Requirements for the Sports Lighting Equipment:

1. Electric power: 480 Volt, 3 Phase

2. Maximum total voltage drop: Voltage drop to the disconnect switch located on the poles shall not exceed three (3) percent of the rated voltage.

B. Energy Consumption: The kW consumption for the field lighting system shall be 5 kW.

### 2.3 CONTROL

- A. Instant On/Off Capabilities: System shall provide for instant on/off of luminaires.
- B. Lighting contactor cabinet(s) constructed of NEMA Type 4 aluminum, designed for easy installation with contactors, labeled to match field diagrams and electrical design. Manual off-on-auto selector switches shall be provided.
- C. Contactor control of lights: To minimize wear on drivers and other electrical components and prevent lights from turning on due to communication loss, circuits must be controlled via contactor switching, not dimming driver output to zero.
- D. Dimming: System shall provide for 3-stage dimming (high-medium-low). Dimming will be set via scheduling options (Website, app, phone, email)
- E. Remote Lighting Control System: System shall allow owner and users with a security code to schedule on/off system operation via a web site, phone, or email up to ten years in advance. Manufacturer shall provide and maintain a two-way TCP/IP communication link. Trained staff shall be available 24/7 to provide scheduling support and assist with reporting needs.

The owner may assign various security levels to schedulers by function and/or fields. This function must be flexible to allow a range of privileges such as full scheduling capabilities for all fields to only having permission to execute “early off” commands by phone. Scheduling tool shall be capable of setting curfew limits.

Controller shall accept and store 7-day schedules, be protected against memory loss during power outages, and shall reboot once power is regained and execute any commands that would have occurred during outage.

- F. Remote Monitoring System: System shall monitor lighting performance and notify manufacturer if individual luminaire outage is detected so that appropriate maintenance can be scheduled. The controller shall determine switch position (manual or auto) and contactor status (open or closed).
- G. Management Tools: Manufacturer shall provide a web-based database and dashboard tool of actual field usage and provide reports by facility and user group. Dashboard shall also show current status of luminaire outages, control operation and service. Mobile application will be provided suitable for IOS and Android devices.

Hours of Usage: Manufacturer shall provide a means of tracking actual hours of usage for the field lighting system that is readily accessible to the owner.

1. Cumulative hours: shall be tracked to show the total hours used by the facility.
2. Report hours saved by using early off and push buttons by users.

- H. Communication Costs: Manufacturer shall include communication costs for operating the control and monitoring system for a period of 25 years.
- I. Communication with luminaire drivers: Control system shall interface with drivers in electrical components enclosures by means of powerline communication.

#### 2.4 STRUCTURAL PARAMETERS

- A. Wind Loads: Wind loads shall be based on the 2021 International Building Code. Wind loads to be calculated using ASCE 7-16, an ultimate design wind speed of 115 mph and exposure category C.
- B. Pole Structural Design: The stress analysis and safety factor of the poles shall conform to 2013 AASHTO Standard Specification for Structural Supports for Highway Signs, Luminaires, and Traffic Signals (LTS-6).
- C. Foundation Design: The foundation design shall be based on soils that meet or exceed those of a Class 5 material as defined by 2021 IBC Table 1806.2.

### PART 3 – EXECUTION

#### 3.1 SOIL QUALITY CONTROL

- A. It shall be the Contractor's responsibility to notify the Owner if soil conditions exist other than those on which the foundation design is based, or if the soil cannot be readily excavated. Contractor may issue a change order request / estimate for the Owner's approval / payment for additional costs associated with:
  - 1. Providing engineered foundation embedment design by a registered engineer in the State of Tennessee for soils other than specified soil conditions;
  - 2. Additional materials required to achieve alternate foundation;
  - 3. Excavation and removal of materials other than normal soils, such as rock, caliche, etc.

#### 3.2 DELIVERY TIMING

- A. Delivery Timing Equipment On-Site: The equipment must be on-site 10 – 12 weeks from receipt of approved submittals and receipt of complete order information.

#### 3.3 FIELD QUALITY CONTROL

- A. Illumination Measurements: Upon substantial completion of the project and in the presence of the Contractor, Project Engineer, Owner's Representative, and Manufacturer's Representative, illumination measurements shall be taken and verified. The illumination measurements shall be conducted in accordance with IESNA RP-6-22.
- B. Field Light Level Accountability

1. Light levels are guaranteed not to fall below the target maintained light levels for the entire warranty period of 25 years. These levels will be specifically stated as “guaranteed” on the illumination summary provided by the manufacturer.
  2. The contractor/manufacturer shall be responsible for conducting initial light level testing and an additional inspection of the system, in the presence of the owner, one year from the date of commissioning of the lighting.
  3. The contractor/manufacturer will be held responsible for any and all changes needed to bring these fields back to compliance for light levels and uniformities. Contractor/Manufacturer will be held responsible for any damage to the fields during these repairs.
- C. Correcting Non-Conformance: If, in the opinion of the Owner or his appointed Representative, the actual performance levels including footcandles, uniformity ratios, and offsite candela readings are not in conformance with the requirements of the performance specifications and submitted information, the Manufacturer shall be required to make adjustments to meet specifications and satisfy Owner.

### 3.4 WARRANTY AND GUARANTEE

- A. 25-Year Warranty: Each manufacturer shall supply a signed warranty covering the entire system for 25 years from the date of shipment. Warranty shall guarantee specified light levels. Manufacturer shall maintain specifically funded financial reserves to assure fulfillment of the warranty for the full term. Warranty does not cover weather conditions events such as lightning or hail damage, improper installation, vandalism or abuse, unauthorized repairs or alterations, or product made by other manufacturers.
- B. Maintenance: Manufacturer shall monitor the performance of the lighting system, including on/off status, hours of usage and luminaire outage for 25 years from the date of equipment shipment. Parts and labor shall be covered such that individual luminaire outages will be repaired when the usage of any field is materially impacted. Manufacturer is responsible for removal and replacement of failed luminaires, including all parts, labor, shipping, and equipment rental associated with maintenance. Owner agrees to check fuses in the event of a luminaire outage.

## PART 4 – DESIGN APPROVAL

### 4.1 PRE-BID SUBMITTAL REQUIREMENTS (Non-Musco)

- A. Design Approval: The owner / engineer will review pre-bid submittals per section 4.1.B from all the manufacturers to ensure compliance to the specification 10 days prior to bid. If the design meets the design requirements of the specifications, a letter and/or addendum will be issued to the manufacturer indicating approval for the specific design submitted.
- B. Approved Product: Musco’s Light-Structure System™ with TLC for LED® is the approved product. All substitutions must provide a complete submittal package for approval as outlined in Submittal Information at the end of this section at least 10 days prior to bid. Special manufacturing to meet the standards of this specification may be required. An addendum will be issued prior to bid listing any other approved lighting manufacturers and designs.

- C. All listed manufacturers not pre-approved shall submit the information at the end of this section at least 10 days prior to bid. An addendum will be issued prior to bid; listing approved lighting manufacturers and the design method to be used.
- D. Bidders are required to bid only products that have been approved by this specification or addendum by the owner or owner's representative. Bids received that do not utilize an approved system/design, will be rejected.

**REQUIRED SUBMITTAL INFORMATION FOR ALL MANUFACTURERS (NOT PRE-APPROVED) 10 DAYS PRIOR TO BID**

*All items listed below are mandatory, shall comply with the specification and be submitted according to pre-bid submittal requirements. Complete the Yes/No column to indicate compliance (Y) or noncompliance (N) for each item. **Submit checklist below with submittal.***

Yes / No	Tab	Item	Description
	<b>A</b>	Letter/ Checklist	Listing of all information being submitted must be included on the table of contents. List the name of the manufacturer’s local representative and his/her phone number. Signed submittal checklist to be included.
	<b>B</b>	Equipment Layout	Drawing(s) showing field layouts with pole locations
	<b>C</b>	On Field Lighting Design	Lighting design drawing(s) showing: <ul style="list-style-type: none"> <li>a. Field Name, date, file number, prepared by</li> <li>b. Outline of field(s) being lighted, as well as pole locations referenced to the center of the field (x &amp; y), Illuminance levels at grid spacing specified</li> <li>c. Pole height, number of fixtures per pole, horizontal and vertical aiming angles, as well as luminaire information including wattage, lumens and optics</li> <li>d. Height of light test meter above field surface.</li> <li>e. Summary table showing the number and spacing of grid points; average, minimum and maximum illuminance levels in foot candles (fc); uniformity including maximum to minimum ratio, coefficient of variance (CV), coefficient of utilization (CU) uniformity gradient; number of luminaires, total kilowatts, average tilt factor; light loss factor.</li> </ul>
	<b>D</b>	Off Field Lighting Design	Lighting design drawing showing initial spill light levels along the boundary line (defined on bid drawings) in footcandles. Lighting design showing glare along the boundary line in candela. Light levels shall be taken at 30-foot intervals along the boundary line. Readings shall be taken with the meter orientation at both horizontal and aimed towards the most intense bank of lights.
	<b>E</b>	Photometric Report	Provide first page of photometric report for all luminaire types being proposed showing candela tabulations as defined by IESNA Publication LM-35-02. Photometric data shall be certified by laboratory with current National Voluntary Laboratory Accreditation Program or an independent testing facility with over 5 years experience.
	<b>F</b>	Performance Guarantee	Provide performance guarantee including a written commitment to undertake all corrections required to meet the performance requirements noted in these specifications at no expense to the owner. Light levels must be guaranteed to not fall below target levels for warranty period.
	<b>G</b>	Structural Calculations	Pole structural calculations and foundation design showing foundation shape, depth backfill requirements, rebar and anchor bolts (if required). Pole base reaction forces shall be shown on the foundation drawing along with soil bearing pressures. Design must be stamped by a structural engineer in the state of Tennessee, if required by owner.
	<b>H</b>	Control & Monitoring System	Manufacturer of the control and monitoring system shall provide written definition and schematics for automated control system. They will also provide ten (10) references of customers currently using proposed system in the state of Tennessee.
	<b>I</b>	Electrical Distribution	Manufacturer bidding an alternate product must include a revised electrical distribution plan including changes to service entrance, panels and wire sizing, signed by a licensed

		Plans	Electrical Engineer in the state of Tennessee.
	<b>J</b>	Warranty	Provide written warranty information including all terms and conditions. Provide ten (10) references of customers currently under specified warranty in the state of Tennessee.
	<b>K</b>	Project References	Manufacturer to provide a list of ten (10) projects where the technology and specific fixture proposed for this project has been installed in the state of Tennessee. Reference list will include project name, project city, installation date, and if requested, contact name and contact phone number.
	<b>L</b>	Product Information	Complete bill of material and current brochures/cut sheets for all products being provided.
	<b>M</b>	Delivery	Manufacturer shall supply an expected delivery timeframe from receipt of approved submittals and complete order information.
	<b>N</b>	Non-Compliance	Manufacturer shall list all items that do not comply with the specifications. If in full compliance, tab may be omitted.
	<b>O</b>	Cost of Ownership	Document cost of ownership as defined in the specification. Identify energy costs for operating the luminaires. Maintenance cost for the system must be included. All costs should be based on 25 Years

The information supplied herein shall be used for the purpose of complying with the specifications for for East Tennessee State University Pickleball. By signing below, I agree that all requirements of the specifications have been met and that the manufacturer will be responsible for any future costs incurred to bring their equipment into compliance for all items not meeting specifications and not listed in the Non-Compliance section.

**Manufacturer:** \_\_\_\_\_

**Signature:** \_\_\_\_\_

**Contact Name:** \_\_\_\_\_

**Date:** \_\_\_\_/\_\_\_\_/\_\_\_\_

**Contractor:** \_\_\_\_\_

**Signature:**

END OF SECTION

## SECTION 321613.16 – CAST-IN-PLACE CONCRETE

### PART 1 – GENERAL

#### 1.1 SUMMARY

- A. This Section includes the installation of concrete curbing as shown on the Drawings or as specified herein.
- B. The materials and methods specified herein are directly intended for placement of “new” concrete curbing. Where existing curbing is removed and replaced during construction, modifications to these specifications to match existing conditions shall be made as directed by the Engineer.

#### 1.2 QUALITY ASSURANCE

- A. Reference Standards:
  - 1. The latest edition of the following standards, as referenced herein, shall be applicable.
    - a. “Standard Specifications, Construction and Materials, TennDOT.”
    - b. American Society of Testing and Materials (ASTM).
    - c. American Concrete Institute. (ACI).
- B. The Contractor shall provide and pay for all costs in connection with an approved independent testing facility to determine conformance of materials with the specifications, if at any time during the Work, materials appear unsuitable in the opinion of the Engineer.

#### 1.3 SUBMITTALS

- A. Concrete:
  - 1. The Contractor shall furnish the name and location of the concrete supplier.
  - 2. Submit the design mix for each class of concrete prior to use in the Work.
- B. Product Data:
  - 1. Submit manufacturer’s catalog cuts, specifications, and installation instructions.
- C. Test Results:
  - 1. The testing laboratory shall submit written reports of all tests, investigations, and recommendations to the Contractor and Engineer.

### PART 2 – PRODUCTS

#### 2.1 MATERIALS

- A. Concrete:
  - 1. All cast-in-place concrete shall be ready mixed concrete meeting the following criteria:
    - a. 28-day compressive strength: 4000 psi.
    - b. Air entrainment: 4% to 8%.
    - c. Slump: 2 to 4 inches.
  - 2. Concrete shall be proportioned using methods 1 or 2 as outlined in ACI-301.
  - 3. The approved mix design shall be used throughout this project unless changes are ordered or approved by the Engineer.

- B. Pre-moulded Expansion Joint Filler:
  - 1. Concrete curbing shall be provided with a 1/2-inch pre-moulded expansion joint filler conforming to ASTM D1751.
  - 2. The pre-moulded expansion joint filler shall be “pre-cut” to match the concrete curbing cross-sectioned dimensions as detailed on the Drawings.
  
- C. Curing Materials:
  - 1. Impervious Sheeting: ASTM C171.
  - 2. Liquid Membrane Curing Compound: ASTM C309, compound shall be free of paraffin or petroleum.
  - 3. Manufacturers:
    - a. “Kure-N-Seal 0800” by Sonneborn.
    - b. “Cure & Seal” by Symons.
    - c. Or approved equal.
  
- D. Sealants:
  - 1. Joint Sealers: ASTM D1850.
  
- E. Forms:
  - 1. Forms shall be of wood or steel, straight, and of sufficient strength to resist springing during depositing and consolidating the concrete. The forms shall have a height equal to the full depth of the concrete.
  - 2. Straight forms of wood shall be surfaced plank, 2-inch nominal thickness, straight and free from warp, twist, loose knots, splits, or other defects. Wood forms shall have a nominal length of 10 feet, with a minimum of three stakes per form, at maximum spacing of 4 feet. Corners, deep sections, and radius bends shall have additional stakes and braces, as required. Radius bends may be formed with 3/4-inch boards, laminated to the required thickness.
  - 3. Steel forms shall be channel-formed sections with a flat top surface and with welded braces at each end and at not less than two intermediate points. Form ends shall be interlocked and self-aligning. Forms shall include flexible forms for radius forming, corner forms, form spreaders, and fillers. Forms shall have a nominal length of 10 feet, with minimum of two welded stake pockets per form. Stake pins shall be solid steel rods with chamfered heads and pointed tips, designed for use with steel forms.
  - 4. Rigid forms shall be provided for curb returns, except that benders of thin plank forms may be used for curb or curb returns with a radius of 10 feet or more, where grade changes occur in the return, or where the central angle is such that a rigid form with a central angle of 90 degrees cannot be used. Back forms for curb returns may be made of 1-1/2 inch benders, for the full height of the curb, cleated together.

## PART 3 – EXECUTION

### 3.1 INSPECTION

- A. The Contractor shall notify the Engineer 24 hours before placing concrete in order to give the Engineer an opportunity to inspect the formwork and related items prior to placement of the concrete.

- B. Delivery tickets shall show the amount of cement, brand, and amount of all admixtures, in addition to information required by ASTM C94, Section 14. Water added on the job shall be approved and the amount noted on the delivery ticket and initialed by the Contractor.

### 3.2 SUBBASE PREPARATION

- A. Concrete curbing shall be constructed on a compacted granular subbase as shown on the Drawings.
- B. The subbase shall be maintained in a smooth, compacted condition in conformity with the required section and established grade, until the concrete is placed.
- C. The subbase shall be in a moist condition when concrete is placed.
- D. The subbase shall be prepared and protected so as to produce a subbase free from frost when the concrete is deposited.

### 3.3 FORMWORK

- A. Earth cuts may not be used as forms for vertical surfaces.
- B. All forms shall be built mortar tight and of materials sufficient in strength to hold concrete without bulging between supports. Forms shall be maintained to eliminate the formation of joints due to shrinkage of the forms. Concrete, mis-shapen by bulges or deformations caused by inadequate forms, shall be removed or corrected as ordered by the Engineer. All replacements or corrections shall be made at the Contractor's expense.
- C. All surfaces of wooden forms that will be in contact with exposed concrete shall be thoroughly treated with an approved lacquer in the procedure recommended by the manufacturer. Forms so treated shall be protected from being damaged or dirtied prior to placing of the concrete.
- D. Metal forms shall be treated with an approved form lacquer or may be treated with an approved form oil. The metal used for forms shall be of sufficient thickness to remain true to shape. All bolt and rivet heads shall be designed to hold the forms rigidly together and to allow removal, without injury to the concrete. Metal forms which do not have smooth surfaces, correct alignment and clean surfaces shall not be used.
- E. The forms shall be removed not less than 2 hours nor more than 6 hours after the concrete has been placed.

### 3.4 CONCRETE PLACEMENT AND FINISHING

- A. Preparation:
  - 1. Set approved forms true to line and grade.
  - 2. Provide cut to size joint filler between 20-foot sections and where concrete abuts existing concrete paving and fixed structures or appurtenances. Protect the top edge of the joint filler during concrete placement with a temporary cap and remove after concrete has been placed.
  - 3. Expansion joints shall be constructed at right angles to the line of the curb.

- B. Concrete Placement:
1. Concrete shall be placed in layers not to exceed 6 inches. For slipform concrete, refer to maximum placement depth as recommended by machine manufacturer,
  2. Concrete shall be thoroughly consolidated by tamping and spading or with approved mechanical vibrators, eliminating all air pockets, stone pockets and honeycombing.
  3. Place concrete in accordance with ACI 301 unless otherwise specified herein.
  4. Cold Weather Concreting: Comply with ACI 306 for placement at temperatures of, or expected to be, below 40 DegF.
  5. Hot Weather Concreting: Comply with ACI 305 for placement at temperatures of, or expected to be, above 90 DegF.
  6. For slipform concrete, any concrete placed outside the tolerance of 1/2 inch of the established line or 1/4 inch outside of the established grade shall be removed and replaced by the contractor.
- C. Concrete Finishing:
1. The concrete shall be rounded with an edging tool to a radius of 1/2 inch and the surfaces shall be floated and finished with a smooth wood float until true to grade and section and uniform in texture. Floated surfaces shall then be brushed with a fine-hair brush with longitudinal strokes.
  2. Visible surfaces shall be free of blemishes and form and tool marks, and shall be uniform in color, shape, and appearance.
  3. No plastering shall be permitted.
  4. Forms shall be left in place at least 24 hours, or until the concrete has sufficiently set so that, in the opinion of the Engineer, the forms can be removed without injury to the curbing.

### 3.5 CURING

- A. Impervious Sheeting Method:
1. The entire exposed surface shall be wetted with a fine spray of water and then covered with impervious sheeting material. Sheets shall be laid directly on the concrete surface with the light-colored side up and overlapped 12 inches when a continuous sheet is not used.
  2. The curing medium shall not be less than 18 inches wider than the concrete surface to be cured and shall be securely weighted down by heavy wood planks, or by placing a bank of moist earth along edges and laps in the sheets.
  3. Sheets shall be satisfactorily repaired or replaced if torn or otherwise damaged during curing. The curing medium shall remain on the concrete surface to be cured for not less than 7 days.
- or -
- B. Membrane Curing Method:
1. The entire exposed surface shall be covered with a membrane forming curing compound.
  2. Curing compound shall be applied in two (2) coats by hand operated pressure sprayers at a coverage of approximately 200 square feet per gallon for both coats, unless otherwise approved by the Engineer based upon manufacturer's data.
  3. The second coat shall be applied in a direction approximately at right angles to the direction of application of the first coat. The compound shall form a uniform, continuous, coherent film that will not check, crack, or peel and shall be free from pinholes or other imperfections. Apply an additional coat to all surfaces showing discontinuity, pinholes, or other defects.
  4. Concrete surfaces that are subjected to heavy rainfall within 3 hours after curing compound has been applied shall be resprayed by the above method and at the above coverage at no additional cost to the Owner.
  5. Expansion-joint openings shall be sealed at the top by inserting moistened paper or fiber rope or covering with strips of waterproof paper prior to application of the curing compound, in a

manner to prevent the curing compound entering the joint.

6. Concrete surfaces to which membrane-curing compounds have been applied shall be adequately protected for 7 days from pedestrian and vehicular traffic and from any other action that might disrupt the continuity of the membrane. Any area covered with curing compound and damaged by subsequent construction operations within the 7-day curing period shall be resprayed as specified above at no additional expense to the Owner.

### 3.6 SEALING JOINTS

- A. The approximately horizontal sections of expansion joints shall be sealed with joint sealer. The joint opening shall be thoroughly cleaned before the sealing material is placed. Sealing shall be done so that the material will not be spilled on exposed surfaces of the concrete.
- B. Concrete at the joint shall be surface dry and atmospheric and concrete temperatures shall be above 50°F at the time of application of joint-sealing materials. Excess material on exposed surfaces of the concrete shall be removed immediately and exposed concrete surfaces cleaned.

### 3.7 BACKFILLING AND RESTORATION

- A. After curing, debris shall be removed, and the area adjoining the concrete shall be backfilled, graded, and compacted to conform to the surrounding area in accordance with lines and grades indicated.
- B. All lawns, pavements, driveways, shrubs, or other improvements affected by curbing placement shall be restored to their original condition.

### 3.8 PROTECTION

- A. The Contractor shall protect the concrete and keep it in alignment and “first class” condition until the completion of the Contract. Any concrete, which is damaged prior to final acceptance of the Work, shall be removed and replaced at the Contractor’s expense.

END OF SECTION

## SECTION 321823.59 - COURT SURFACING

### PART 1 - GENERAL

#### 1.1 DESCRIPTION OF WORK

- A. The Contractor shall provide all labor, materials, equipment, and services necessary for and incidental to, the repair and resurfacing of an acrylic tennis court playing system, as shown on the Drawings and as specified, including:
  - 1. Inspection of existing court pavement and surfacing
  - 2. Cleaning of court surfacing
  - 3. Repair of bird baths
  - 4. Placing athletic color coat material
  - 5. Line and graphics painting
  - 6. Clean Up
  - 7. Warranty

#### 1.2 ENVIRONMENTAL CONDITIONS

- A. Weather Limitations: Surface temperature is 50°F (10°C) and rising to allow for proper application and curing. Do not apply if surface temperature is in excess of 140°F (60°C).
- B. Materials are water based acrylic and are to be kept from freezing during storage, transit, and installation.

#### 1.3 SUBMITTALS

- A. Submit manufacturer's technical data, specifications, and application instructions for the tennis playing surface system.
- B. Submit color samples for court surfacing. Final colors to be selected by Owner.
- C. Certified installer documentation by the manufacturer.

#### 1.4 QUALITY ASSURANCE

- A. Installer shall be certified as an approved installer by the manufacturer and have a minimum of 5 years direct project related experience installing one of the products specified in this section. Installer shall also have completed a minimum of 15 successful court installations with one of four materials specified, within the last 5 years.
- B. Unless otherwise indicated, all court playing lines shall abide by the following Rules of Pickleball:
  - 1. USAPA (USA Pickleball Association)

#### 1.5 DELIVERY

- A. Materials shall be delivered to the site in sealed, properly labeled containers and stenciled with the proper batch code numbers. Products packaged or labeled in any other manner will not be accepted. Mixing with clean fresh water shall only be done at the job site. Coverage rates are based upon material type, prior to mixing with water as directed by the manufacturer.

## 1.6 COORDINATION

- A. Court surfacing system shall be applied to existing acrylic surface or cured Concrete:
  - 1. Concrete shall cure for a minimum of 30 days.

## 1.7 WARRANTY

- A. Provide manufacturer's warranty for all materials incorporated into the tennis court surface system.
- B. Contractor shall warrant the completed tennis court crack repair system against defect in workmanship and materials for a period of one year after the date of substantial completion.
- C. Contractor shall warrant the completed tennis court surface system against defects in workmanship and materials for a period of three years after the date of substantial completion.
- D. Defective materials and workmanship may be defined as, but not necessarily limited to the following: lack of system coalescence, loss of adhesion, and cohesion in any surfacing components which covers the surfacing system to not serve its intended purposes. Surface failures in the form of tears, delamination, blistering, bubbling or splits not caused by the owner or any other causes are indications of defective material or workmanship.
- E. Manufacturer and contractor shall warrant the completed tennis playing surface against chalking, checking, fading, discoloration, or other adverse effects from ultraviolet rays of the sun, from weather moisture, or from weather temperatures.
- F. Materials shall be delivered to the construction site in their original unused and unopened containers clearly labeled with trade name and name of manufacturer.

## PART 2 – PRODUCTS

### 2.1 COURT SURFACING

- A. Surfacing system to be an exterior acrylic surface system for application onto an asphalt pavement base. Acceptable product manufacturers include the following or an approved equal:
  - 1. Nova Sports, USA, [www.novasports.com](http://www.novasports.com), Framingham Mass., (800) 872-6682
    - a. Novacoat Surface System.
  - 2. Laykold by APT, [laykold.com](http://laykold.com), Harmony, PA, (866) 664-9917
    - a. Laykold ColorFlex
  - 3. California Products Corp., [www.calprocorp.com](http://www.calprocorp.com), Deco Surfacing Systems, Andover, Mass., (800) 225-1141.
    - a. Plexipave Color Finish System.
  - 4. Acrytech, by Stegas Inc., [www.tennispaint.com](http://www.tennispaint.com), Austell, GA 30106, (770)734-3000.
    - a. Acrytech with UV-15 colorguard
  - 5. Approved equivalent.
- B. The court surfacing system shall be a 100% acrylic, latex surface system desired by the owner to produce the playing characteristics required for the intended use of the tennis facility.
- C. Obtain all court surfacing materials and components including leveling materials from a single manufacturer. Provide secondary materials as recommended and approved only in writing by manufacturer of primary surfacing materials.

- D. If the surfacing contractor desires to use a surface system other than the surface system set forth above, complete manufacturer's literature, product data sheets and a description of the surface system must be submitted to the Engineer for review a minimum of 15 days prior to commencement of the surface system application. The Engineer at its discretion may approve or disapprove the substitute system if in its sole judgment the proposed system does not satisfy the system design criteria set forth by the Engineer.

## PART 3 – EXECUTION

### 3.1 COURT SURFACING

- A. Preparation
  - 1. The surface shall be flooded with water and allowed to drain for 1 hour at 70 degrees Fahrenheit ambient temperatures. Any remaining ponded areas shall be checked for depth using a US five cent piece (US Nickel). Any ponded areas in excess of the thickness of a US five cent piece shall be deemed patchable and shall be marked out with a pavement marking crayon.
- B. Repair Bird Baths
  - 1. After all low spots (bird baths) have been identified, patch and level with a metal straight edge application of acrylic crack and leveling binder patch. Installation shall be per manufacturer's recommendations.
- C. Structural Crack Repair
  - 1. All structural cracks shall be power routed and thoroughly cleaned by forced air.
  - 2. Fill all structural cracks to refusal with ACRYLIC CRACK AND LEVELING BINDER PATCH per manufacturer's recommendations. Multiple applications may be required.
  - 3. After thorough curing of all crack fill materials the cracks shall be scraped smooth with hand scrapers and disc sanders if necessary. The resulting repair shall be neat, smooth and flush with the existing surface.
  - 4. To prevent the possibility of chalking, all CURED ACRYLIC CRACK AND LEVELING BINDER patchwork (birdbaths/cracks) shall be thoroughly wetted with clean potable water and allowed to dry. This "bleeding" process shall be completed prior to the application of the ACRYLIC COLOR SURFACE.
  - 5. The CRACK REPAIR SYSTEM shall be installed over all previously filled structural cracks. Installation shall be per manufacturer's specification. All completed Crack Repairs shall then be coated with one squeegee applied application of ACRYLIC RESURFACER.
- D. Curing
  - 1. Allow crack repair system to cure properly before tennis surface coats are applied.
- E. Pavement Surface Planarity Observation.
  - 1. Prior to application of the court surface system the concrete surface shall be flooded with water and allowed to drain. Any depressions holding water deeper than 1/16 in. shall be patched and leveled in accordance with recommendations of the manufacturer of the court surfacing material specified herein.
- F. Pavement Surface Preparation.
  - 1. Preparation of the existing acrylic surface shall include all work necessary to provide a clean, uniform, and sound surface free from any extraneous materials that could affect the tennis surface system. The surface shall be thoroughly cleaned by the use of a power broom or power wash. All oil spots or oily residue, and loose surfacing material shall be removed.

Subsequent to the cleaning of the surface, a prime coat of dilute acrylic primer shall be applied to any areas of the concrete that are not clean or where the bond to the surface of the concrete is in question. The entire surface shall be checked for minor depressions or irregularities or areas not meeting the surface tolerance specified. Depressed areas and surface irregularities shall be corrected using an acrylic based patching material.

G. Weather Conditions.

- 3.2 Water emulsion systems set forth in this specification shall be applied in dry weather and only when the pavement and atmospheric temperature is 50°F. or above. Application shall not be permitted when precipitation is anticipated before the film dries to a rain-resistant condition, or when temperature and humidity conditions are such that the emulsion systems could not dry thoroughly before a minimum pavement temperature of 45°F occurs. Each application shall be thoroughly dry and cured prior to the application of succeeding applications

3.3 COURT SURFACE SYSTEM

A. Surface System Application.

1. Application of the court surface system shall commence after any patches have thoroughly cured for a minimum of 30 days. The court surface system shall be applied in multiple applications. Individual surface system applications shall be made perpendicular to each other (alternated lengthwise and crosswise of the court) with the final application being applied parallel with the net line.

B. Court Surface System.

1. The court surface system shall consist of the following applications after the patching has been completed. There are a total of 4 applications minimum in the surface system specified plus the playing lines. It is the intent of this specification to provide a smooth playing surface. The surface shall be observed after the acrylic filler coat has been applied to ensure that this intent has been accomplished.
  - a. Thoroughly scrape and clean the entire area to be surfaced with hand scrapers and forced air.
  - b. Phosphoric Acid etch the concrete surface
  - c. Apply concrete primer – Nova CP761 or equal from coating manufacturer. Apply per manufacturer's recommendations.
  - d. Apply, by hand squeegee, 2 coats ACRYLIC SURFACER. Apply per manufacturer's recommendations.
  - e. Apply by hand squeegee, 1 coat ACRYLIC FILLER (fully pigmented) and 1 coat ACRYLIC FINISH (fully pigmented). Apply per manufacturer's recommendations. Color(s) shall be determined by owner.
  - f. Layout, mask and hand paint all tennis court line markings per USTA specification using 100% ACRYLIC LINE PAINT. Apply per manufacturer's recommendations.
2. Prior to the application of the color courses, the Owner and Engineer shall observe the surface to ensure that it is free from ridges, loose or foreign materials or other surface irregularities.

C. Court Surface Color.

1. The court surface colors (up to two colors) shall be as approved by the Owner.

D. Finished Court Surface Tolerance.

1. The finished court surface when flooded with water and allowed to drain shall have no depressions holding water deeper than 1/16", the thickness of a 5-cent piece (American coin). This depth is considered to be the allowable depth that will evaporate in a reasonable

period of time after the remainder of the surface is dry, the time required for evaporation being dependent upon temperature, humidity, and wind velocity.

E. Playing Lines

1. The playing lines shall be 2" in width and shall be applied straight, true, and accurate. Allow a minimum of 24 hours for the color surfacing to dry before painting the lines. All lines shall be taped and hand painted. The lines area after taping shall be coated with clear acrylic to seal the edges of the tape and produce a clean, crisp edge of the finished line. Mechanical painting of the lines shall be unacceptable. No fuzzy edges or wavy lines will be acceptable.

F. Curing Time

1. The court surface shall be allowed to cure for a minimum of 4 days before being opened to play.

3.4 PROTECTION

- A. Erect temporary barriers to protect coatings during drying and curing.
- B. Lock gates to prevent use until acceptance by the owner's representative.

3.5 CLEAN UP

- A. Remove all containers, surplus materials and debris. Dispose of materials in accordance with local, state and Federal regulations.
- B. Leave site in a clean and orderly condition.

END OF SECTION