

**SECTION 26 01 00 - BASIC ELECTRICAL REQUIREMENTS-STREETSCAPE****PART 1 - GENERAL****1.1 GENERAL:**

- A. All work covered by this section of these specification shall be accomplished in accordance with the respective drawings, information or instructions to bidders, general requirements, and the general conditions of these specifications. Any supplementary conditions, special conditions, addenda, or directives which may be issued by the Architect herewith or otherwise shall be complied with in every respect.
- B. Connect new work to existing work in neat and approved manner. Restore existing work disturbed to original condition.
- C. Existing systems shall be left in perfect working order upon completion of all new work.
- D. Any equipment which is removed and not reinstalled shall be delivered on site to the Owner, or removed by the Contractor, as directed by the Owner.

**1.2 SUB-CONTRACTOR QUALIFICATIONS:**

- A. Sub-Contractor (as a company) and his job superintendent for their portion of the work shall have at least three years of satisfactory experience in completion of projects of comparable size and complexity. Evidence of this experience will be required before approval of the Architect as being acceptable for their portion of the work.

**1.3 SCOPE:**

- A. The work included under this specification consists of the furnishing of all labor, materials, tools, transportation, services, etc., which are applicable and necessary to complete the installation of the systems described in these specifications, illustrated on the accompanying drawings, or as directed by the Architect.
- B. In general, the various lines and raceways to be installed by the various trades under this specification shall be run as indicated, as specified herein, as required by particular conditions at the site, as required to conform to the generally accepted standards and as required by all governing Building Codes so as to complete the work in a neat and satisfactorily workable manner. Run work parallel or perpendicular to the lines of the paved areas unless otherwise noted.
- C. The construction details of the site are illustrated on the Architectural and Civil drawings. Be thoroughly acquainted with the details before submitting a bid as no allowances will be made because of unfamiliarity with these details. Place all sleeves or conduit to accommodate the ultimate electrical installation before concrete is poured.

- D. The Electrical Contractor shall coordinate with the General Contractor, the requirements of all trades for temporary power during the construction phase. The Electrical Contractor shall provide the installation of temporary power distribution for those requirements as part of his work and at no additional cost to the owner.

#### **1.4 INSTRUCTIONS:**

- A. When specified in other Sections, the contractor shall furnish the services of competent instructors who will give full instruction to designated personnel in the adjustment, operation, and maintenance, including pertinent safety requirements of the equipment or system specified. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Owner for regular operation.
- B. The number of man-days of instruction to be furnished shall be as specified in the various Sections of the Specification.

#### **1.5 CODE REQUIREMENTS:**

- A. All work shall comply with the provisions of these specifications, as illustrated on the accompanying drawings, or as directed by the Architect, and shall satisfy the National Electrical Code and all applicable local codes, ordinances, or regulations of the governing bodies, and all authorities having jurisdiction over the work, or services thereto. In all cases where alterations to, or deviations from, the drawings and specifications are required by the authority having jurisdiction, report the same in writing to the Architect and secure his approval before proceeding. Upon completion of the work, furnish a statement from the inspecting authority stating that the installation has been accepted and approved. Provide complete utility service connections as directed, and submit, as required, all necessary drawings; secure all permits and inspections necessary in connection with the work, and pay all legal fees on account thereof. In the absence of other applicable local codes, acceptable to the Architect, the National Electric Code shall apply to this work.

#### **1.6 MATERIALS AND WORKMANSHIP:**

- A. All materials unless otherwise specified shall be new, free from any defects, and of the best quality of their respective kinds. All like materials used shall be of the same manufacture, model, and quality unless otherwise specified.
- B. All manufactured articles, materials, and equipment shall be applied, installed, connected, erected, used, cleaned, adjusted, and conditioned as recommended by the manufacturers, or as indicated in their published literature unless specifically herein specified to the contrary.
- C. All work shall be performed by competent workmen and executed in a neat and workmanlike manner providing a thorough and complete installation. Work shall be properly protected during construction, including the shielding of soft or fragile materials, and the temporary plugging of open conduits during construction. At completion, the installation shall be thoroughly cleaned and all tools, equipment, obstructions, or debris present as a result of this portion of work shall be removed from the premises.

**1.7 COOPERATION:**

- A. All work under these specifications shall be accomplished in conjunction with other trades on this project in a manner which will allow each trade to complete his work in a timely fashion.
- B. Maintaining contact and being familiar with the progress of the general construction and timely installation shall be the responsibility of this trade to expedite this contract and avoid unnecessary delays in the progress of other trades.
- C. Should any question arise between the trades as to the placing of lines, ducts, conduits, fixtures, or equipment, or should it appear desirable to remove any general construction which would affect the appearance or strength of the structure, reference shall be made to the Architect for instructions.

**1.8 DRAWINGS AND SPECIFICATIONS:**

- A. The drawings show diagrammatically the locations of the various conduits, fixtures, and equipment, and the method of connecting and controlling them. It is not intended to show every connection in detail and all fittings required for a complete system. The systems shall include, but are not limited to, the items shown on the drawings. Exact locations of these items shall be determined by reference to the general plans and measurements at the building and in cooperation with other trades and, in all cases, shall be subject to the approval of the Architect. The Architect reserves the right to make reasonable change in the location of this work without additional cost to the Owner.
- B. Should any changes be deemed necessary in items shown on the contract drawings, the shop drawings, descriptions, and the reason for the proposed changes shall be submitted to the Architect for approval.
- C. Exceptions and inconsistencies in drawings and specifications shall be brought to the Architect's attention before bids are submitted; otherwise, the Contractor shall be responsible for the cost of any and all changes and additions that may be necessary to accommodate his particular apparatus.
- D. Lay out all work maintaining all lines, grades, and dimensions according to these drawings with due consideration for other trades and verify all dimensions at the site prior to any fabrication or installation; should any conflict develop or installation be impractical, the Architect shall be notified before any installation or fabrication and the existing conditions shall be investigated and proper changes effected without any additional cost.
- E. Titles of Sections and Paragraphs in these specifications are introduced merely for convenience and are not to be construed as a correct or complete segregation or tabulation of the various units of material and/or work.

**1.9 ARCHITECT'S APPROVAL:**

- A. In the statement under this contract where "approval" is required or requested, it is understood that such approval must be obtained from the Architect in writing before proceeding with the

proposal, and an adequate number of copies of any such proposal shall be submitted to the Architect.

- B. The approval of the Architect of any material, changes, drawings, etc., submitted will be considered as general only and to aid the Contractor in expediting his work. Such approval as may be given does not in any way relieve the Contractor from the necessity of furnishing all materials and performing all work as required by the Drawings and Specifications.

#### **1.10 LOCAL RESTRICTIONS:**

- A. Become familiar with all rules and regulations of the City, County, and State, or any other authority having jurisdiction over this project; and if any work or materials shown on the drawings or specified do not comply with these rules and regulations as to size, type, capacity, and quality, make it known prior to the submission of a bid, which shall be deemed evidence of compliance; otherwise, be responsible for the corrections required to obtain approval of all work, or material.

#### **1.11 ELECTRIC WIRING:**

- A. Except for such items as are normally wired up at the point of manufacture and so delivered, and unless specifically noted to the contrary herein, the Electrical Contractor shall do all electric wiring for power supply, including contactors, starters, etc. Individual motor starters will either be provided by the Electrical Contractor, or by the other Contractors, as scheduled or indicated on plans. The other Contractors will erect all motors in place ready for connections. The Electrical Contractor shall mount all starters, as directed, furnishing supporting structures where necessary. The other Contractors will furnish with each item requiring electrical connections, the necessary instructions and wiring diagrams to this Sub-Contractor.

#### **1.12 FOUNDATIONS:**

- A. Coordinate provision of concrete equipment pads and pole fixture bases with General Contractor. Coordinate to fit electrical equipment actually provided.
- B. Furnish templates for bolt installation, along with the anchor bolts.
- C. Provide necessary supporting steel required for the electrical systems.

#### **1.13 RESPONSIBILITY:**

- A. This Contractor will be held responsible for the satisfactory and complete execution of all work specified or indicated. He shall produce complete finished operating systems and provide all incidental items required as part of this work, regardless of whether such item is particularly specified or indicated.

**1.14 GUARANTEE:**

- A. The entire system shall be guaranteed to be complete and installed in accordance with these plans and specifications.
- B. Guarantee all new materials and workmanship for a period of one year from and after date of acceptance of installation. Replace, during the period of the guarantee, any parts found to be defective in their operation, without cost to the Owner.

**1.15 REFERENCE ABBREVIATIONS:**

- A. References are made in the various electrical sections to technical societies, codes, specifications, trade organizations, and regulatory authorities in accordance with the following abbreviations:
  - 1. FM - Factory Mutual
  - 2. FS - Federal Specification
  - 3. IEEE - Institute of Electrical and Electronics Engineers.
  - 4. IPCEA - Insulated Power Cable Engineers Association
  - 5. IRI - Industrial Risk Insurors
  - 6. ISO - Insurance Services Organization
  - 7. NEC - National Electrical Code(NFPA Pamphlet No. 70)
  - 8. NEMA - National Electrical Manufacturer's Association
  - 9. NFC - National Fire Codes
  - 10. NFPA - National Fire Protection Association
  - 11. UL - Underwriters Laboratories, Inc.

**1.16 SHOP DRAWINGS AND DATA TO BE SUBMITTED:**

- A. SUBMITTALS WHICH DO NOT MEET THE FOLLOWING REQUIREMENTS WILL BE IMMEDIATELY REJECTED WITHOUT FURTHER REVIEW!
  - 1. Catalog cutsheets and brochures will be preceded by a neatly arranged cover sheet having ample room for shopdrawing stamps and bearing the following information in a prominent, immediately visible location and size:
    - a. Equipment name or number as referenced in the contract Documents (example: "Type A" light fixture).
    - b. All options or accessories provided.
    - c. Applicable Specification section and paragraph numbers.
  - 2. Substitutions -
    - a. Cross reference individual manufacturer and catalog numbers of substitute products to those of specified material.
    - b. Provide with requests for substitution, drawings, specifications, samples, performance data and other information as may be required to assist in determination of acceptability of the product. The burden of proof is the Contractor's responsibility.

3. All similar or related items shall be submitted together under one cover sheet (i.e. fixtures, raceways, wiring, equipment). Do not piece-meal submittals!!!

**B. Submittal Items:**

1. Submit manufacturer's certified data relative to equipment required for the installation of the electrical and electronic systems.
2. Submit adequate engineering data on each piece of equipment to allow a careful check of compliance with the technical requirements of the Contract Documents. Clearly indicate on submittal data the manufacturer's name, piece number, equipment capacity, and other applicable technical data.
3. Equipment, Electrical Systems Submittals:
  - a. Power Distribution Equipment.
  - b. Wiring Devices and Cover Plates.
  - c. Sports Lighting Equipment.
  - d. Special Systems.

**1.17 OPERATING AND MAINTENANCE MANUALS:**

- A. Bind in looseleaf binders with the words, "Operating and Maintenance Manual" and the Project identification imprinted on the cover. Prepare three complete sets of records for the Owner, with table of contents, index, and tabbed Section dividers.
- B. During the construction period, accumulate the following for inclusion in the Operating and Maintenance Manuals-
  1. Copies or warranties and guarantees on each piece of equipment installed.
  2. Fixture brochures.
  3. Wiring and Control Diagrams.
  4. Approved Shop Drawings.
  5. Operating instructions.
  6. Recommended maintenance procedures.
  7. Lists of major items of equipment with name, address, and telephone number of each local representative.
- C. Submit the manuals for approval at approximately 75 percent job completion.
- D. Each manual shall consist of-
  1. Complete description of each item of equipment and apparatus furnished and installed - including ratings, capacities, and characteristics.
  2. Fully detailed parts list, including all numbered parts of each item of equipment and apparatus furnished and installed.
  3. Manufacturer's printed instructions describing operation, servicing, maintenance and repair of each item of equipment and apparatus.
  4. Typewritten record of all tests made of materials, equipment, and systems. All such records shall state the date tests were conducted, the names of all persons making and witnessing the tests, and citing any unusual conditions relevant to the tests.

**1.18 RECORD DRAWINGS:**

- A. Accumulate Record Drawings during the construction of the Project. Keep one set of blue-line Contract Drawings at the job site at all times, and mark changes, rerouting or modifications which occur, clearly on the Drawings with dimensions.
- B. At completion of the job, deliver Record Drawings to Architect. Record Drawings shall be submitted for approval prior to final payment.

**PART 2 - PRODUCTS****2.1 ACCEPTABLE MANUFACTURERS:**

- A. Manufacturer's names and catalog numbers are scheduled or specified for the purpose of establishing standard of design, quality, appearance, performance and serviceability, and not to limit competition. Scheduled products (as may be modified by detailed specifications) are those selected as the basis for system design with respect to physical size and space arrangements, required capacity and performance characteristics, and the product quality intended.
- B. The Drawings indicate specified products physically arranged in the spaces, as cataloged by specific manufacturers, generally as listed in the Equipment Schedules.
- C. Listed "Acceptable Manufacturer's" are those considered capable of manufacturing products conforming to detailed Specifications, and as such, are invited to compete on an equal basis provided the offering is comparable in every respect to scheduled or specified products and actually conforms to the detailed Specifications and Schedule requirements. Listing herein as "acceptable manufacturers" does not imply "accepted", "approved", or "prior approval", or any other such connotation.
- D. Manufacturers of materials and equipment shall be as specified, scheduled, or as listed in each respective product Specification Article.
- E. At a bidder's request, an unnamed manufacturer's equipment will be considered to determine additional "acceptable manufacturers" if a request is made in writing no later than ten days prior to the bid opening. If such requests are found acceptable, an addendum will be written listing additional acceptable manufacturers. Consideration will be given only to requests of bona fide bidders (Contractors), not to those received from vendors.
- F. Manufacturers of materials and equipment shall be as specified, scheduled, or as listed in each respective product Specification Article.

**2.2 GROUNDING:**

- A. Provide grounding of electrical system in accordance with the National Electrical Code NFPA 70, UL 467, and IEEE 837 for grounding and bonding materials and equipment.

1. Equipment grounding conductors shall be sized in accordance with the National Electrical Code Equipment Grounding Conductor Table on the basis of the circuit overcurrent protection device rating.
  2. Bond together the following items to serve as a single grounding electrode for all electric services:
    - a. Minimum 20 feet BHD copper conductor encased in concrete footing or grade beam in contact with earth.
    - b. 10'-0" X 3/4" diameter copper-clad steel ground rod(s).
      - 1) Where more than one ground rod is required to meet specified resistance, ground rods shall be located at least 10 feet apart. Interconnect with grounding electrode conductor below grade unless otherwise indicated.
    - c. Metal underground water pipe.
  3. Do not bond to building steel above grade.
  4. The grounding electrode shall be connected by a grounding electrode conductor sized in accordance with the National Electric Code Table 250-94 to the service neutral bus.
  5. Provide a main bonding jumper from the grounded service neutral bus to the main equipment ground bus or point of termination of the equipment grounding conductors.
  6. Provide bonding jumpers for attachment of each metallic water, fuel, fire suppression, steam, gas or air piping system to the building grounding electrode system. Provide connections with listed connectors applied to the piping in an approved method. The points of attachment of the bonding jumpers shall be accessible. The bonding jumper size shall match the main grounding electrode conductor.
  7. Grounding system resistance must not exceed 5 ohms. Final tests shall be conducted to ensure that this requirement is met.
- B. Provide equipment grounding conductors for all circuits. A green insulated, copper ground conductor shall be installed with all circuits so as to make an electrically continuous ground system.
- C. Ground all non-current carrying equipment, such as cable tray and equipment structures.
- D. Grounding Connectors:
1. Listed and labeled by a NRTL acceptable to the authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
  2. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.
  3. Welded Connections:
    - a. Exothermic welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
    - b. For structural steel, steel grounding stud for compression connector.
  4. Compression Connectors: Hydraulic crimped, irreversible compression type kits. Connectors shall be factory filled with oxide inhibitor. All crimps shall be made with a hydraulic tool that embosses the index number on the outside of the connector.



Compression type connections shall be allowed above and below grade where any permanent connection is required.

5. All splices and grounding electrode connections shall be made with exothermic welds or with hydraulic compression fittings.

E. Field Quality Control

1. Inspect grounding and bonding system conductors and connections for tightness and proper installation. Inspect compression type connections for proper die index number embossment.
2. Perform the following testing:
  - a. After installing grounding system, but before permanent electrical circuits have been energized, test for compliance with requirements.
  - b. Test completed grounding system as each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at ground rods. Make tests at ground rods before any conductors are connected.
  - c. Measure ground resistance no fewer than two full days after the last trace of participation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
  - d. Perform tests for fall-of-potential method according to IEEE 81. Submit test results to the Engineer.
  - e. If resistance to ground exceeds specified values, promptly notify Engineer and include recommendations for reducing ground resistance.

### 2.3 IDENTIFICATION:

- A. All cabinets for all panelboards, switchboards, disconnect switches, transformers, motor control centers, motor starters, and electrical equipment furnished (regardless of supplier) shall be provided with engraved phenolic lamacoid plastic name plates of 1/8-inch minimum thickness, with 1/2 inch block engraving. Name plates shall be attached to front of equipment with rivets or screws.
1. Name plates shall give equipment designation as scheduled on the drawings, voltage and phase of service, the source of power, conduit and wire size. Example:
    - a) PANEL 2LW
    - b) 208/120Y, 3 $\phi$ , 4 W
    - c) FED FROM MDP-3
    - d) 2" C, 4-#3/0, #6G
  2. Provide labels for fused and non-fused switches and enclosed molded case breakers indicating equipment served, the unit capacity in horse power or full load amperes, voltage and phase of service, the installed fuse rating (where applicable) the source of power, conduit and wire size.. Example:
    - a) PUMP P-5
    - b) 10 HP

- c) 480V, 3 $\phi$
- d) 20A FUSES
- e) FED FROM MDP-2
- f)  $\frac{3}{4}$ "C, 3#12, #12G

- B. After balancing branch circuits, provide each breaker panel with a clear plastic covered, neatly typed circuit directory in cardholder inside panelboard door, which identifies specifically the branch circuit loads and location, using room numbers corresponding to those finally established at the project. Coordinate room numbers with Owner before preparing directory. This requirement applies to all new panelboards and to existing panelboards that are affected in this project.
- C. Provide neatly handwritten circuit identification on every junction box cover plate, indicating the circuits within the box.
- D. Underground Warning Tapes for Buried Lines Outside of Building-
  - 1. Provide 3-inch wide metallic core brightly colored polyethylene detection tape, shallow buried in the trench above nonmetallic conduits, serving the dual purpose of line location and identification. The tape shall be easily detected by any commonly used metal detector and shall bear a printed message (continuous along entire length) describing the contents of the line beneath.
  - 2. Provide 6-inch wide brightly colored polyethylene tape, shallow buried in the trench above metallic conduits, to identify the contents of the line beneath. The tape shall bear a printed message (continuous along entire length) describing the type of the buried line and its contents.

## 2.4 WIRE AND CABLE:

- A. Provide systems of wires and cables for electric power, signalling, and control.
- B. Materials:
  - 1. Conductors shall be soft drawn annealed, conductivity of 98% pure copper. No. 10 AWG and Smaller: Solid copper. No. 8 AWG and Larger: Stranded copper.
  - 2. Other: Pull Cords - 1/8" nylon. Pulling Compound - Ideal "Yellow 77".
- C. Install Wire Types:
  - 1. THWN, XHHW for light and power branch circuits and control wiring.
  - 2. THWN, XHHW for feeders, sub-feeders, motor circuits and high ambient temperature locations.
- D. Consistently color code wiring continuous throughout the work with insulation factory color-coded by pigmentation.
  - 1. 120/208 Volt Systems:
    - a. Phase A - Black
    - b. Phase B - Red

- c. Phase C - Blue
  - d. Neutral - White
  - e. Ground - Green
2. 277/480 Volt Systems:
- a. Phase A - Brown
  - b. Phase B - Orange
  - c. Phase C - Yellow
  - d. Neutral - Gray
  - e. Ground - Green
3. Switch legs, travelers, and special systems continuous throughout the work as selected by the Contractor.
4. Where factory colors are not available, code ends of conductors with 1-1/2 inch colored tape.
- E. Circuits of multiple phases passing through enclosures shall have phases grouped to reduce the reactance effect.
- F. Minimum Sizes:
1. Light and Power Branch Circuits, 15 and 20 amperes OCP:
- a. Minimum branch circuit: No. 12 AWG
  - b. 120V longer than 80 feet first outlet to panel: No. 10 AWG.
  - c. 120V longer than 120 feet from first outlet to panel: No. 8 AWG
  - d. 277V longer than 130 feet from first outlet to panel: No. 10 AWG.
  - e. 277V longer than 220 feet from first outlet to panel: No. 8 AWG.
2. All branch circuits shall have dedicated full ampacity neutrals, or shared neutral conductors serving two or three branch circuits shall be sized at 175% of the maximum branch circuit overcurrent device, based on the 75°C ratings in Table 310-16 of the National Electrical Code. Shared neutral conductors shall be considered as current-carrying conductors for the purpose of derating conductor ampacities for installation of more than three current-carrying conductors in a raceway or cable.
3. Other circuits sized to limit voltage drop per National Electrical Code.
4. Control Wiring: No. 14 AWG, unless otherwise specified.
- G. Acceptable Manufacturers - American Insulated Wire Corp., Cablec Corp., Cerrowire, Essex, Guardian, Rome Cable, Triangle.

## 2.5 CONDUITS:

- A. Provide a mechanically and electrically complete conduit system.
- B. Rigid Metal Electrical Conduit: Hot-dipped galvanized steel with zinc coated threads and an outer coating of zinc bichromate, complete with one coupling and one end thread protector.

- C. Rigid Nonmetallic Electrical Conduit: Schedule 40 heavy wall polyvinylchloride, high impact resistant.
- D. Elbows and Bends:
  - 1. For rigid nonmetallic conduit systems, use rigid metal electrical conduits.
  - 2. For nonmetallic conduit systems, use rigid metal electrical conduits.
  - 3. Size 1-1/4 inch and larger shall be factory manufactured.
- E. Bushings:
  - 1. 1-1/4" and Smaller: Same material as the conduit with which they are installed.
  - 2. 1-1/2" and Larger: Hot-dipped galvanized with thermosetting phenolic insulation, 150 Deg.C., O-Z/Gedney Type "B".
- F. Locknuts:
  - 1. 1-1/2" and Smaller: Zinc plated heavy stock steel, O- Z/Gedney.
  - 2. 2" and Larger: Cadmium plated malleable iron, O-Z/Gedney.
- G. Hubs: Cadmium plated malleable iron, tapered threads, neoprene "O" ring, insulated throat, O-Z/Gedney.
- H. Size conduits as indicated on the drawings and as required by the NEC for the number and sizes of wires to be drawn into conduit. Do not use conduit sized less than 3/4" unless specified otherwise.
- I. Installation:
  - 1. Install all conduits at elevations and locations to avoid interference with grading of other work.
  - 2. Cap or plug conduits with standard manufactured accessories as soon as the conduits have been permanently installed in place.
  - 3. Make all conduit joints mechanically tight, electrically continuous, and watertight. Pitch conduits in a manner to avoid creating moisture traps.
  - 4. Install rigid non-metallic conduit with manufactured spacers for feeders and branch circuits run underground, Use rigid metal conduit long radius sweeps for offsets and changes in direction. Use rigid metal conduit for risers and where exposed above slab or grade.

## **PART 3 - EXECUTION**

### **3.1 PROTECTION OF EQUIPMENT:**

- A. Protect equipment from physical damage and deterioration after it is delivered to the Project, and during the installation period prior to Owner acceptance.
- B. Repair scratches, mars, or paint deterioration.

**3.2 EQUIPMENT SPACE:**

- A. The Drawings indicate specified products physically arranged in the spaces, as cataloged by specific manufacturers, generally as listed in the Equipment Schedule.
- B. Coordinate the exact physical space requirements for equipment and servicing of equipment actually purchased for each item of equipment involved.
- C. Adhere to Drawings as closely as possible in layout of work.
- D. Vary run of conduits and make offset during progress of work as required to meet structural and other interferences.

**3.3 PAINTING AND FINISHING AND CLEANING:**

- A. Provide touchup painting of prefinished electrical products.
- B. Surfaces shall be left clean and debris shall be removed.
- C. Clean all light fixture lenses, lamps and reflectors.

**3.4 TESTS AND LOAD BALANCING:**

- A. Test all circuits to assure them to be free of grounds. Prove and test energy available at the load side of disconnect switches and the final point of connection to driven equipment. Make all reasonable tests as required by the Architect to provide the integrity of the work and leave the complete electrical installation in first class condition and ready for operation.
- B. Balance the load on each phase when connecting the various branch circuits in each panel board. When all load is turned on and the system is in operation at 100% demand, the initial unbalance shall not exceed 10%.
- C. Furnish at the completion of the job, a final inspection certificate from the local inspecting authority.

**3.5 EXCAVATION AND BACKFILLING:**

- A. Provide necessary excavating and backfilling for the installation of work specified in this Division. Trenches for underground conduits shall be excavated to required depths as necessary to insure uniform bearing. Care should be taken not to excavate below depth, and any excavation below depth shall be refilled with sand or gravel firmly compacted. Where rock or hard objects are encountered, they shall be excavated to a grade six inches (6") below the lowermost part of the raceway and refilled to the raceway grade as specified. After the raceway has been installed, tested, and approved, the trenches shall be backfilled to grade with approved material, in 12 inch layers wetted and compacted to density of adjacent soil. Complete backfill to grade to result in a well compacted trench to 95% compaction by the standard Proctor test. Where streets, sidewalks, etc., are disturbed, cut, or damaged by this work, the expense of repairing same in a manner approved by the Architect shall be a part of this work.

**3.6 ELECTRICAL DISCONNECTS:**

- A. Provide disconnects where indicated and where required by the National Electrical Code. Install within sight of electrified equipment served and provide final connection to equipment served.
- B. Provide switch sizes as required by the National Electrical Code based on the equipment actually furnished under other Divisions or provided by the Owner.
- C. Provide NEMA 3R enclosures.

END OF SECTION 26 01 00

## **SECTION 26 16 00 - POWER DISTRIBUTION EQUIPMENT**

### **PART 1 - GENERAL**

#### **1.1 WORK INCLUDED:**

- A. Provide distribution panelboards, branch circuit panelboards, motor control centers, transformers and power factor correction equipment, as scheduled and specified for the electrical distribution system.

#### **1.2 QUALITY ASSURANCE:**

- A. Source Quality Control: Tests to meet applicable standards of the following:
  - 1. Underwriters' Laboratories.
  - 2. National Electrical Manufacturer's Association.
  - 3. National Electrical Code.
  - 4. American National Standards Institute.

#### **1.3 SUBMITTALS:**

- A. Submit shop drawings in accordance with other Sections. Include layouts showing cabinet dimensions, conduit entrances, electrical ratings, bussing connections, single line diagrams, device locations and ratings, and cable termination provisions.
- B. Certificates:
  - 1. Labels of Underwriters' Laboratories affixed to each item of material.
  - 2. Label of Underwriters' Laboratories approval for service entrance use, where applicable, affixed to material.
- C. See section 26 01 00.

### **PART 2 - PRODUCTS**

#### **2.1 POWER DISTRIBUTION EQUIPMENT:**

- A. Circuit Breaker Distribution Panelboard:
  - 1. Equivalent to Square D I-Line, copper bussing.
  - 2. 3 phase, 4 wire, solid neutral design with sequence bussing and full capacity neutral unless scheduled otherwise.
  - 3. Provide scheduled bolt-on panelboard circuit breakers, 22,000 Amp., R.M.S. minimum interrupting rating, or as scheduled on drawings.

4. Provide cabinets.
5. Provide feed thru lugs where extension of primary feeders is required.
6. Provide ground bus unless noted otherwise.
7. Provide isolated ground bus where scheduled.

B. Branch Circuit Panelboards:

1. Equivalent to Square D Type NQOD and NF, copper bussing.
2. Single phase, 3 wire, and 3 phase, 4 wire, solid neutral design with sequence bussing and full capacity neutral.
3. Provide scheduled circuit breakers, minimum 10,000 A.I.C. for 208 volt and 14,000 for 480 volt.
4. Provide feed thru lugs where extension of primary feeders is required.
5. Provide cabinets of NEMA type appropriate for application.

C. Circuit Breakers:

1. Resettable, quick-make, quick-break, thermal magnetic type, ambient compensated, trip free with separate trip position from on and off positions.
2. Multiple pole breakers with common trip and one operating handle. Do not provide handle ties.
3. 15 and 20 ampere, single pole circuit breakers shall be U.L. listed as switching duty rated.
4. Wire with sequence phasing.
5. Provide circuit breakers of appropriate capacity for all unscheduled circuits.
6. For panelboards rated 600 amperes or greater, provide bolt- on type circuit breakers.
7. Provide U.L listed HACR circuit breakers for compressorized equipment loads where the circuit breaker serves as the final overcurrent protection.
8. Provide arc-fault circuit breakers where scheduled on drawings and where required by the National Electrical Code.
9. Where indicated on the panel schedule, provide panel mounted power supply to provide 24 volts DC switching power for remote controlled circuit breakers.
10. Breakers marked "Remote Controlled" on the panel schedules shall be of the latching type. Circuit breaker contacts shall open when the breaker is in the "OFF" or "TRIPPED" position regardless of the remote signal.

D. Dry Type Transformers:

1. Two windings of the size and electrical characteristics as scheduled.
2. Guaranteed sound levels shall not exceed ANSI standard decibel levels. Transformers shall be rated at full load in a 40°C ambient with 30°C ultimate hot spot temperature rise allowance, with Class F insulation having a UL 185°C rating limiting system temperature to 115°C on 25 kVA and smaller units, and Class H insulation having a UL 220°C rating limiting system temperature to 150°C on 30 kVA and larger units.
3. The maximum temperature rise of the top of the enclosure shall not exceed 35°C over a 40°C ambient.
4. Transformers rated at 30 kVA and above shall have core and coil assembly completely isolated from enclosure with neoprene rubber pads, and six primary voltage taps rated (4) 2-1/2 percent normal and (2) 2-1/2 percent above normal. Transformers rated at 25 KVA and below shall have four primary voltage taps rated (2) 2-1/2 percent below normal and (2) 2-1/2 percent above normal.



5. Make necessary tap adjustments on transformers to insure that the secondary voltages at the transformer terminals will be as close as possible to 120 volts phase-to-neutral, and 208 volts phase-to-phase, when the building is in normal operation.
  6. Transformers shall have heat barriered termination compartment arranged for feeder terminations for side or bottom entrance of flexible metallic raceways.
  7. Transformers shall have a bonding jumper installed between the secondary neutral terminal and the metal case and shall include a ground terminal of proper size to receive ground conductor.
- E. Enclosed Circuit Breakers:
1. Equivalent to Square D LHL, MHL and PJJ.
  2. 3 phase, 4 wire, solid neutral design with sequence bussing, copper and full capacity neutral unless scheduled otherwise.
  3. 65,000 Amp., R.M.S. minimum interrupting rating, or as scheduled on drawings.
  4. Provide dual rated lugs for supply and load conductors.
  5. Provide cabinets of NEMA type appropriate for application. Outdoor enclosures shall be equipped with factory installed means to padlock door.
  6. Weather proof hubs and threaded conduit connections shall be used for outdoor circuitry.
  7. Provide ground bus unless noted otherwise.
- F. Acceptable Manufacturers – Eaton, General Electric, Siemens, Square D.

### **PART 3 - EXECUTION**

#### **3.1 PREPARATION:**

- A. Carefully measure and lay out exact locations of equipment in conference with the Construction Manager.
- B. Assure that equipment may be installed without adversely affecting the integrity and appearance of the building structure and with the clearances required by the National Electrical Code.

#### **3.2 INSTALLATION:**

- A. Provide panelboards of the types and ratings scheduled where indicated.
- B. Provide flush and surface mounted types where indicated and scheduled.
  1. Provide multi-section cabinets as required and scheduled; one-piece covers and doors, main and sub-feed lugs as required.
  2. Provide hinged doors with flush tumbler lock and catch, all locks keyed alike.
  3. Provide 3 keys for each panelboard.
- C. Provide supports to the building structure, independent of raceways.
- D. Install tops of panelboard cabinets at 6 feet, 6 inches, above finished floor.
- E. Install panelboards in cabinets, centered in door openings.

- F. Provide Identification:
1. For Panelboards - Engraved, lamacoid plastic name plate, giving equipment designation.
  2. For Distribution and Branch Circuit Panelboards: - Neatly typewritten circuit directory in cardholder inside panelboard door.
    - a. For Branch Circuit Panelboards: Identify rooms served using room numbers corresponding to those finally established at the project.
    - b. For Distribution Panelboards: Identify the equipment served and give circuit designation.
    - c. For motor starters identify equipment designation as scheduled on the drawings, voltage and phase of service, and the source of power.
- G. Provide Vibration Isolation for Suspended Transformers:
1. Provide spring hangers, equivalent to Mason Type PC30, 1" deflection, consisting of a rectangular steel box, coil spring, spring cups, neoprene impregnated fabric washer, and steel washer, with an elastomeric element at the top of the box for acoustic isolation. The design shall be such as to prevent metal-to-metal contact between the hanger rod and the top of the hanger box. The elastomeric element shall be designed for approximately 1/4-inch deflection and loaded so that deflection does not exceed 15 percent of the free height of the element.
  2. Install the isolators with the isolator hanger box as close as possible to the structure.
  3. Suspend the isolators from the building structure, never from slab diaphragms between beams.

### 3.3 FIELD QUALITY CONTROL:

- A. Perform manufacturer's recommended field tests prior to energization.
- B. Provide copies of test results to the Owner's representative.

END OF SECTION 26 16 00

## **SECTION 26 17 00 - MOTOR AND CIRCUIT DISCONNECTS**

### **PART 1 - GENERAL**

#### **1.1 SCOPE**

- A. Provide disconnect switches for branch circuit, motor circuits, and all items of equipment in conformance with the National Electric Code.

#### **1.2 QUALITY ASSURANCE**

- A. Source Quality Control: Tests to meet applicable Underwriters' Laboratories, Inc. Standards, the National Electrical Manufacturer's Association and the National Electrical Code.

#### **1.3 SUBMITTALS**

- A. Submit shop drawings in accordance with other Sections. Include enclosure dimensions, type, electrical ratings, fuse provision, installation instructions, and name plate nomenclature.
- B. Certificates:
  - 1. Labels of Underwriters' Laboratories, Inc. affixed to each item of materials.
- C. See Section 26 01 00.

#### **1.4 JOB CONDITIONS:**

- A. Provide switch sizes as required by the National Electrical Code based on the equipment actually furnished under other Divisions or provided by the Owner.

### **PART 2 - PRODUCTS**

#### **2.1 EQUIPMENT**

- A. For single phase motors under 1/2 horsepower: Equivalent to Square D Class 2510 Fractional Horsepower single phase two pole manual starter with toggle type switch, locking attachment, neon pilot light, thermal overload elements sized per motor name plate rating and NEMA 1 enclosure indoors, NEMA 4 enclosure exterior, in damp or wet locations and in crawl spaces, flush and surface as specified for outlet boxes.

- B. For single and three phase motors, 120, 230, 480 volts, 1/2 to 3 horsepower, requiring manual starters: Equivalent to Square D Class 2510 Integral Horsepower manual starter with toggle type switch, low voltage protection, pilot light, thermal overload elements sized per motor name plate rating with number of poles required for specific application and NEMA 1 enclosure indoors, NEMA 3R enclosure exterior, in damp or wet locations and in crawl spaces, flush and surface as specified for outlet boxes.
- C. For Other 250 Volt Equipment: Equivalent to Square D Class 3130 NEMA Type GD Safety Switches, fusible and non-fusible as required by NEC with cover interlocks, with NEMA cabinet required for application, with threaded hubs.
- D. Acceptable Manufacturers - Cutler Hammer, General Electric, Siemens ITE, Square D.

### **PART 3 - EXECUTION**

#### **3.1 INSPECTION**

- A. Inspect building structure to which disconnects are to be secured for defects which affect the execution and quality of work.
- B. Do not start work until defects are corrected.

#### **3.2 PREPARATION**

- A. Carefully measure and lay out exact locations maintaining working clearances required by the National Electrical Code.

#### **3.3 INSTALLATION**

- A. Provide disconnects where indicated and where required by the National Electrical Code.
- B. Install within sight of equipment served.
- C. Provide final connection to equipment served.
- D. Provide name plate secured to cabinet with designation of equipment served, operating voltage, and circuit designation.

#### **3.4 EQUIPMENT CONNECTIONS**

- A. Provide wiring for the connection of motors and control equipment and control wiring as indicated on the Electrical Drawings.

1. Equipment installed under Other Sections - wiring shall be extended to the equipment, and proper connections made thereto.
2. Flexible connections of short lengths - shall be provided for equipment subject to vibration or movement and for motorized and compressor equipment. Liquid-tight conduit shall be used in wet locations. A separate ground conductor shall be provided across flexible connections.
  - a. Length of flexible connections for motors shall be at least 11-inches plus 1/4-inch per horsepower up to 100 hp, and need not be longer than 36-inches unless otherwise indicated.
  - b. Length of flexible connections for transformers shall be at least 11-inches plus 1/4-inch per KVA up to 100 KVA, and need not be longer than 36-inches unless otherwise indicated.
3. Power connections to any vibration isolated equipment shall be made with a length of flexible conduit having a 90 degree bend in it between the junction box on the equipment and any non-flexible conduit.
4. Owner furnished equipment - wiring shall be extended to the equipment, and proper connections made thereto.

END OF SECTION 26 17 00

## SECTION 26 50 01 – SPORTS LIGHTING

**PART 1 - GENERAL****1.1 WORK INCLUDED**

- A. Conditions of the Contract and General Requirements are hereby made a part of this section.
- B. Provide a comprehensive lighting performance analysis for existing field lighting components to remain combined with new field lighting components.
- C. Provide lighting fixtures, lamps, and accessories for exterior illumination.
  - 1. Scope of work includes complete turnkey installation of new galvanized steel pole sports lighting system.
  - 2. All electrical installation must meet Local and National Electrical Code requirements.
  - 3. Successful bidder to perform final light tests with Owner and make any adjustments necessary to meet specifications. A typed photometric report of actual light levels on each field must then be submitted prior to final payment being released.

**1.2 REFERENCES**

- A. IES RP-6-2015, Current Recommended Practice for Sports Lighting, current edition

**1.3 DEFINITIONS**

- A. Coefficient of variance (CV): A measure of uniformity. The formula for calculating CV values is given in IES RP-6, section 2.2.2 (page 3).
- B. Uniformity gradient (UG): A measure of uniformity. UG is a measure of the rate of change of illuminance expressed as a ratio between the illuminance level of adjacent measuring points on a uniform grid
- C. Primary playing area: An area including the playing field and extending 15 feet beyond the boundaries of the playing field in all directions.

**1.4 QUALITY ASSURANCE**

- A. Manufacturers: Exceptions to manufacturers listed with each item shall be made in accordance with the General Requirements.
- B. Laboratory Testing: Photometric testing shall be by Independent Testing Laboratories, Inc., based on Illuminating Engineering Society published procedures, and shall include candlepower distribution tabulation and zonal cavity coefficient of utilization tabulation.

- C. Fixtures shall be provided possessing Underwriters' Laboratories location duty listings as required by the specific application.
1. Exposed Outdoors - Wet Location
  2. Sheltered Outdoors - Damp location
- D. Lighting calculations shall be accordance with current IES Standards and recommendations.
- E. The Sports Lighting Supplier shall be dedicated to sports lighting with in-house engineering, sales and support personnel. Supplier shall maintain inventory and personnel who are qualified to supervise the installation, to be responsible that the system is installed as submitted, to conduct system start up, instruct the Owners representatives in the proper operation of the system and provide service throughout the warranty period.
- F. The contractor that installs the sports lighting system shall have been in business at least five consecutive years under the same name and shall have installed, under that name, at least five sports lighting systems similar to this project.
1. The contractor shall be fully experienced in the installation of the lighting systems as herein specified, and shall furnish with the bid an itemized list of the installations of this type. The list shall include the name of the project, date of completion, the amount of the contract, the name, and telephone number of the person to contact for reference.
  2. The Owner may make such investigations as he deems necessary to determine the ability of the bidder to perform the work, and the bidder shall furnish to the Owner all such information and data for this purpose as the Owner may request. The Owner reserves the right to reject any bid if the evidence submitted by, or investigation of, such bidder fails to satisfy the Owner that such bidder is properly qualified to carry out the obligations of the contract and to complete the work contemplated therein. Conditional bids will not be accepted.
  3. Bidders who do not currently possess the necessary qualifications, trained and experienced personnel, financial capacity, and meet the other requirements herein described will be disqualified.
- G. Regulatory Requirements: All materials furnished under this Contract shall be new, free from defects of any kind, of the quality and design hereinafter specified, and shall conform to the standards of Underwriter's Laboratories Inc., except for equipment which U.L. does not list or provide label service.

## 1.5 WARRANTY

- A. Light System Maintenance Free Warranty: Lighting Manufacturer must repair or replace any part of the sports lighting fixture or wiring that proves to be defective for a period of 10 years. Warranty must cover the cost for both labor and material. Warranty also guarantees light levels, aiming and energy consumption. Energy consumption will not increase as the system ages.
- B. Structural Warranty: Lighting Manufacturer must repair or replace any structural component that proves to be defective for a period of 10 years. Warranty must cover both parts and labor.
- C. Manufacturer's Warranty: Lighting Manufacturer must maintain specifically funded financial reserves to assure fulfillment of the warranty for the full term. Warranty excludes fuses, storm damage, vandalism, abuse and unauthorized repairs or alterations

## 1.6 LIGHTING SYSTEM DESIGN REQUIREMENTS

- A. The maintained illuminance level shall be calculated using a (LLF) Light Loss Factor of 0.95.
- B. Structural Strength: The luminaire assembly as shown in the manufacturer's submittal shall be capable of withstanding forces equal to 90 MPH wind speeds based on AASHTO structural design criteria for this region, without damage or misalignment of the luminaire assembly.

## 1.7 LIGHTING SYSTEM PERFORMANCE REQUIREMENTS

- A. The calculated horizontal average maintained illuminance level for each primary playing area shall be as follows:
  - 1. Football Field 50 footcandles maintained
  - 2. Track 10 footcandles maintained
- B. The maximum-to-minimum uniformity ratio for all lighting on the primary playing area shall not exceed 1.35.
- C. The coefficient of variance for the primary playing area shall be per IES RP-6-15.
- D. The uniformity gradient of the primary playing area shall be per IES RP-6-15.
- E. The lighting design is to be based on a minimum of 4 poles. Mounting Heights shall be minimum 70' to bottom row of fixtures on all poles based on setbacks from the playing surface.

## 1.8 SUBMITTALS

- A. Product Data: The submittal package shall include product data on the following:
  - 1. Controls
  - 2. Luminaires
  - 3. Pole assemblies
  - 4. Engineered foundation
  - 5. Waveform Corrector
  - 6. Wireless Control System
- B. Shop Drawing submittal shall include the following shop drawings before construction:
  - 1. The supplier shall supply drawings for each pole foundation. Drawings shall be sealed and signed by a professional engineer licensed in the State of Kansas. Drawings shall include depth, diameter and reinforcement.
  - 2. The manufacturer shall submit a computer derived lighting plan showing the point-by-point horizontal maintained illuminance levels.
  - 3. The manufacturer shall submit a computer derived lighting plan showing the point-by-point horizontal initial illuminance levels.
  - 4. The two above shop drawings shall indicate illuminance levels on a 30 foot by 30 foot square grid. The grid shall be oriented such that one of the calculation points is offset fifteen feet in each direction from a point at the midpoint of the playing field.
    - a. A minimum of 72 grid points shall be calculated for the football field.
      - 1) The target points shall be those that fall on a plane 3' above the football field surface within the field edges including the end zones.



- b. A minimum of 45 grid points shall be calculated for the track.
    - 1) The target points shall be those that fall on a plane 3' above the track surface within the edges of the track.
  - 5. In addition to the point-by-point illuminance levels, each of the two above shop drawings shall indicate the following:
    - a. The maximum to minimum ratio of the primary playing area.
    - b. The coefficient of variance of the primary playing area.
    - c. The greatest uniformity gradient in the primary playing area.
    - d. The mounting height to the lowest row of the luminaires.
    - e. The number of luminaires used at each pole or location.
    - f. The kilowatt consumption of the lighting system.
    - g. The lamp lumens used in the calculations.
  - 6. Light aiming point plan: The contractor shall submit an aiming plan indicating the horizontal degree setting and the vertical degree setting of each fixture on each of the pole assemblies.
  - 7. A drawing or cut sheet of the luminaire assembly and its interface with the required poles.
- C. See Section 26 01 00.

## 1.9 CERTIFICATES

- A. Labels of Underwriters' Laboratories, Inc.; Certified Ballasts Manufacturers, and Electrical Testing Laboratories affixed to each item of material.

## PART 2 - PRODUCTS

### 2.1 SPORTS LIGHTING FIXTURES

- A. LED Luminaire Requirements
  - 1. Product Requirements:
    - a. LED Luminaire must be an integral unit with maximum distance of 18 inches between power supply, driver and LED's to minimize power loss and EMI (electromagnetic interference). Entire fixture must be factory assembled and vacuum sealed.
    - b. Luminaire must be UL Certified for wet locations at an operating temperature range rating between -40°C and +65°C.
    - c. Luminaire must be 3rd party NEMA 4X certified based on NEMA 250 standards for external icing, hose-down, and 200-hours salt spray test.
    - d. Luminaire must be 3rd party tested and certified to UL 844 vibration requirements.
    - e. Luminaire must be 3rd party tested and certified to ANSI C136.31, 3G vibration requirements.
    - f. Luminaire must be IP66 certified tested to IEC 60598-1 standards to meet dust-tight and powerful water jet-proof test.
    - g. Luminaire shall have a Correlated Color Temperature (CCT) of 5600K with a tolerance of  $\pm 300K$ , and a CRI of  $>68$ .

- h. Luminaire shall be third-party verified to be flicker free at super slow motion speeds up to 2400 FPS and use pulse width modulation greater than 18 Khz with a flicker index rating <.06.
  - i. Luminaire shall have lumen depreciation, L70 rating, greater than 100,000 hrs certified through CREE Tempo-24 Testing or equivalent.
  - j. Luminaire shall include an integrated and thermal isolated power supply with wide input range 240VAC-480VAC, remote power supply's or drivers shall be located within 24" of the LED board to eliminate Electromagnetic interference and higher Total Harmonic Distortion which will generate heat on power lines and components connected to the distribution system and cause premature failures of those components.
2. Integrated power supply shall have the following features:
  - a. Efficiency - Greater than 95% from 240VAC to 480VAC with full load applied
  - b. Hold Up Time – Greater than 25msec
  - c. Restrike Time - Less than 3.0sec to meet UL924 Emergency Lighting requirements
  - d. Thermal Sensors – Monitor temperature readings of critical components, and self-protect when conditions exceeded, and report conditions wirelessly to remote site
  - e. Ultra Low Standby Power – Less than 0.20% Standby power consumed with primary output disabled
  - f. In-field Upgradable – remote wireless interface to program and update firmware/software.
3. Luminaire must have a fully integrated health telemetry capability. The following metrics at a minimum must be continuously monitored and reported on a remote computer with the ability to print out reports.
  - a. Life Time Run Hours
  - b. Life Time Power Consumed
  - c. Power Supply Temp
  - d. Peak Power Supply Temp
  - e. Average Current
  - f. Peak Current
  - g. Input Voltage
  - h. Peak Input Voltage
  - i. Average Power
  - j. Life Time Watt Hours
4. Luminaire shall weigh less than 50lbs, including power supply, shade, bracket, and RF system.
5. Luminaire shall have an EPA of 1.4 square feet or less.
6. Luminaire shall have a power factor greater than 0.98 @ 277VAC and 0.97 @480AVC
7. Luminaire shall have a THD (Total Harmonic Distortion) Less than 10% at 240VAC with full load and less than 14% at 480VAC at full load.
8. Luminaire must have an integrated pressure and humidity sensor.
9. Luminaire must have an integrated accelerator for aiming, commissioning, and feedback on light positioning.
10. Luminaire shall include custom lensing injection molded from optical grade, impact resistant lens with a UV additive to provide more than 25 years of long-term sunlight exposure.
11. Luminaire lensing shall be TIR (Total Internal Reflection) based.
12. Luminaire shall be constructed as a single pressure cavity vessel system. Enclosure shall include a breathable vent for pressure fluctuation reduction and increased seal life.

13. Aluminum shall be chromate conversion coated and then two-stage architectural grade powder coated for long term resistance to corrosion and UV exposure.
14. Luminaire shall include separate control cards to current balance each LED array into no less than 5 strings for effective lifetime management

B. Sports Lighting Poles

1. Pole Foundations: The pole foundations shall be designed for allowable stresses in accordance with latest AASHTO standards. Foundation must be designed by Structural Engineer Licensed in the State of Kansas. Installation based on wind speed criteria of these specifications.
2. Poles:
  - a. The sports lighting pole system shall consist of concrete encased galvanized steel poles with a factory pre-wired crossarm assembly. All wiring/connections should be factory assembled from the fixture mounting location to the base of the pole. Strain relief device(s) must be factory installed in pre-wired crossarm assembly to ensure no weight or tension is placed on electrical connections.
  - b. The sports lighting pole structure shall consist of a modular pole assembly. This shall consist of no more than two shaft components.
  - c. The entire sports lighting system (pole structure, wiring and fixtures) must be supplied by a single Company who underwrites warranty. Combining components of various Manufacturers is not acceptable.
  - d. Wind Speed & Design Criteria:
    - 1) Wind velocities of 90-Mph and AASHTO 2001 design parameters shall be utilized for design purposes, with a 1.3 gust factor without damage or misalignment of the luminaire assembly.
  - e. Pole Shaft:
    - 1) The Structure shall be designed for the combined effective projected area (EPA) and weight of all applicable appurtenances (i.e. mounting brackets) and fixtures. Concrete poles or pole sections are not acceptable due to excessive weight.
    - 2) Each section of the pole shaft shall be of single-ply material and be made from a single sheet of steel with no circumferential welded splices.
    - 3) The pole shafts cross-section shall be round. The pole shaft sections shall be high-strength steel meeting the requirements of ASTM A570 GR65(65 ksi yield) and/or ASTM A595 GR55(55 ksi yield).
    - 4) Each slip joint shall be assembled in the field by telescoping the upper female section over the lower male section by a minimum lap of 1.5 times the inside diameter of the "female" section. The female, telescoped area must be welded both inside and out to insure 100% weld penetration in an area equal to the minimum slip distance plus 10".
  - f. Embedment Shaft Section:
    - 1) The shaft section of the pole structure shall be a single piece round tapered shaft section. The taper rate and material cross section properties shall match the adjoining section.
    - 2) The lower shaft section shall be embedded into the earth a minimum distance of 10% of the free standing height of the structure plus 2' or as recommended by Engineer.
    - 3) The shaft section shall be galvanized in accordance with ASTM A123 specifications. The entire embedded shaft portion shall also be externally

coated with Corrocote II epoxy coating up to 6" above the ground line. Concrete stub pole sections are not acceptable due to excessive weight.

- 4) Foundation shall be 3000 psi concrete.
- g. Galvanizing: Pole shaft sections shall be hot dip galvanized in accordance with the requirements of ASTM A123 specifications. Each shaft assembly must be completely coated, inside and out, in a single dip. Double dipping will not be permitted in compliance to USGA (United States Galvanizing Association) recommended practices and procedures to prevent acid entrapment. All miscellaneous connecting hardware shall be galvanized in accordance with ASTM A153 specifications.
- h. Crossarms:
  - 1) All crossarms shall be factory pre-wired and assembled. The sports lighting pole system shall consist of concrete encased galvanized steel poles with a factory pre-wired crossarm assembly. All wiring/connections should be factory assembled from the fixture mounting location to the base of the pole. No field connections, plugs or Brad-Harrison type connectors are allowed. Strain relief device(s) must be factory installed in pre-wired crossarm assembly to ensure no weight or tension is placed on electrical connections.
  - 2) All factory pre-wiring must be done in a manner that requires no electrical connections inside the pole or crossarm assembly to be made in the field. Sports lighting supplier must provide warranty as outlined in these specifications.
3. Lightning protection shall be provided for each pole. A grounding lug fastened to the metallic portion of the pole shall be provided at the pole bottom hand hole. This grounding lug shall be electrically and mechanically connected to all metal portions of the pole.

#### C. Wireless Control System

1. Wireless control system shall provide local control and monitoring of the LED fixtures via a secure, self-forming, self-healing mesh network.
2. Wireless control system shall be utilized to switch lights on/off as well as dimming the system to specified levels with the Wireless control Hub.
3. Wireless control system shall have the capability to link to external devices such as smartphones and tablets as well as desktop and laptop systems via Bluetooth, wifi, LAN or cellular connection.
4. System shall be FCC/IC certified
5. System shall be capable of storing power data, behaviors, alarms and critical events locally for maintenance and troubleshooting.

#### D. ACCEPTABLE FIXTURE MANUFACTURERS: Musco, Qualite, Universal Sports Lighting.

## PART 3 - EXECUTION

### 3.1 INSPECTION

- A. Inspect drawings and specifications.

- B. Inspect site and existing construction for defects affecting the quality and execution of work.

### 3.2 PREPARATION

- A. Layout exact locations of poles and fixtures in accordance with plans.

### 3.3 DELIVERY

- A. The entire sports lighting system shall be delivered to the jobsite by the sports lighting supplier. All material (poles, fixtures, crossarm assemblies, etc) shall arrive the same day. The supplier shall off-load all material and stage required material at each pole location to eliminate possibility of lost or damaged material.

### 3.4 INSTALLATION

- A. Plumb poles to within 2" of vertical. Provide transit for inspection of poles by Engineer if requested.
- B. Install in accordance with manufacturer's instructions, submittal data, and details on the drawings.
- C. Aim fixtures according to the manufacturer's aiming plan.

### 3.5 SPORTS LIGHTING POLE INSTALLATION

- A. Excavation:
  - 1. The Contractor may excavate by any means he prefers, insofar as these methods conform to these specifications. Holes shall be excavated with diameters not less than 8" greater than the largest dimension of the poles being installed. Required depth of pole embedment holes shall be 10% of overall pole length plus not less than 2' nor more than 5'.
  - 2. The bottom of the pole holes shall be on undisturbed earth. If a pole hole is excavated to a depth greater than required, it shall be backfilled with graded crushed rock, placed in 6" layers, and thoroughly machine tamped to density of surrounding soil.
  - 3. Backfill pole bore holes with 3000 PSI strength concrete.
- B. Soil Conditions:
  - 1. The design criteria for these specifications are based on soil conditions with 1500 PSF or greater lateral load. It shall be the Contractor's responsibility to notify the Owner of soil conditions other than the design criteria.
- C. Grounding: Each pole shall be grounded. The ground resistance shall be no less than 2.5 ohms. Ground terminals shall be located not less than 2 feet from the pole.

**3.6 FIELD QUALITY CONTROL**

- A. Testing for acceptance shall be by the Sports Lighting Supplier.
- B. Test methods, instruments, and test intervals shall meet the approval of the Owners representative prior to testing.
- C. Testing Equipment: Testing equipment for measurement of footcandle levels shall be performed using a Konica Minolta T-10 Illuminance Meter. Supplier must show proof of calibration prior to testing as required by the manufacturer. Accuracy shall be  $\pm 4\%$  or less of recording. Measuring functions shall be in footcandles.
- D. Readings shall be recorded for each of the 30-foot grid points, and the results confirmed by Owner and/or Engineer.
- E. Horizontal illuminance readings shall be taken in accordance with "IES Standard for Photometric Measurement of Area and Sports Lighting Installations".
- F. Measurements shall be taken at 36" inches above grade, with meter held horizontally. Dark clothing shall be worn by individuals performing test.
- G. The contractor shall take voltage and current readings at each pole base during the time of the test for the purpose of ascertaining the approximate fixture operating condition. Voltage at the pole base shall be adjusted within  $\pm 5\%$  of rated ballast voltage.
- H. The contractor shall provide stakes or other identifiable markings at all test points on the field at the time of the test.
- I. The measured values shall be within plus or minus ten percent of the calculated values indicated on the computer derived lighting plan of the initial illuminance levels.
- J. Failure to meet criteria shall require that the fixtures be re-aimed and retested and added to until satisfactory results are obtained. Any expense of re-aiming, subsequent retesting additional fixtures and installation, if any, shall be borne by the supplier with no additional cost to the Owner, Architect or Engineer.

END OF SECTION 26 50 01

**SECTION 26 51 00 – SITE LIGHTING****PART 1 - GENERAL****1.1 WORK INCLUDED:**

- A. Conditions of the Contract and General Requirements are hereby made a part of this section.
- B. Provide lighting fixtures, lamps, and accessories for exterior site illumination.

**1.2 QUALITY ASSURANCE:**

- A. Manufacturers: Exceptions to manufacturers listed with each item shall be made in accordance with the General Requirements.
- B. Laboratory Testing: Photometric testing shall be by Independent Testing Laboratories, Inc., based on Illuminating Engineering Society published procedures, and shall include candlepower distribution tabulation and zonal cavity coefficient of utilization tabulation.
- C. Pole Lighting performance shall meet the criteria established for the design of this project. The supplier shall provide calculated performance information in this work. The manufacturer shall supply photometric data for the supplied fixture in a standard IES format so that the calculations for this project may be independently verified.
- D. Standards:
  - 1. All lighting fixtures shall meet Underwriters' Laboratories, Inc., applicable standards.
  - 2. Fixtures shall be provided possessing Underwriters' Laboratories location duty listings as required by the specific application.
    - a. Exposed Outdoors - Wet Location
    - b. Sheltered Outdoors - Damp location
- E. NEC Compliance: Comply with the NEC as applicable to the installation and construction of lighting fixtures.
- F. NEMA Compliance: Comply with applicable requirements of NEMA Standard Pub. Nos. LE-1 and LE-2 pertaining to lighting equipment.
- G. ANSI/UL Compliance: Comply with ANSI/UL Standards pertaining to exterior lighting fixtures.
- H. UL Compliance: Provide light fixtures that have been UL listed and labeled.

**1.3 SUBMITTALS:**

- A. Submit manufacturer's literature giving materials, finishes, dimensions, coefficients of utilization, and light source types for each fixture which is the product of one of the listed acceptable manufacturers. Include complete shop drawings of the fixture.
- B. Submit samples of fixtures upon specific request.
- C. See Section 26 01 00.
- D. Submit shop drawings for each ground and pole mounted site lighting assembly to include fixture and driver arrangement, maximum EPA per pole, total electrical loads and pole construction details, pole fixture lighting layout showing recommended pole locations, fixture types, aiming points and mounting heights.
  1. Submit IES format photometric data on standard digital data media for the submitted fixtures.
- E. Manufacturer shall submit for approval a computer calculation derived lighting layout showing point by point footcandle levels of the parking and sidewalk surfaces, maximum to minimum ratio and total energy consumption in KW per hour required for proposed layout. Point by point lighting level calculations shall identify maintained horizontal footcandle levels for comparison to the design.
  1. For LED fixtures, calculations to determine the maintained lighting levels shall be based on the following:
    - a. A 0.9 light loss factor.
    - b. Absolute fixture lumens.
    - c. Minimum illuminance for the paved parking and sidewalk areas of 1.0 footcandle.
  2. Submit IES format photometric data on standard digital data media for the submitted fixtures.

**1.4 CERTIFICATES:**

- A. Labels of Underwriters' Laboratories, Inc.; Certified Ballasts Manufacturers, and Electrical Testing Laboratories affixed to each item of material.

**PART 2 - PRODUCTS****2.1 ACCEPTABLE FIXTURE MANUFACTURERS:**

- A. Listed in schedule and with materials.

**2.2 POLE LIGHTING FIXTURES:**

- A. Luminaire Assembly/Hardware -
  1. Luminaires shall be fully assembled and individually tested prior to shipment.



2. Luminaire housing and door shall be one piece die cast aluminum construction. The housing shall be designed to prevent the buildup of water and debris on the top of the housing. Access to the internal housing and electrical components shall be toolless by use of two recessed stainless steel latches. Door frame shall swing down and be retained by two catch hinges. Drivers and surge module shall be separated from the optical chamber by a cast in wall to allow for cooler operation. Luminaire shall include an extruded aluminum bolt on arm bracket for mounting to round or square poles.
  3. The maximum weight of the luminaire shall be 45 pounds and the maximum effective projected area shall not exceed 1.30 with mounting bracket.
  4. Manufacturers of LED luminaires shall demonstrate a suitable testing program incorporating high heat, high humidity and thermal shock test regimes to ensure system reliability and to substantiate lifetime claims.
  5. The sole use of IESNA LM-80 data to predict luminaire lifetime is not acceptable.
  6. At time of manufacture, electrical and light technical properties shall be recorded for each luminaire. At a minimum, this should include lumen output, CCT, and CRI. Each luminaire shall utilize a unique serial numbering scheme. Technical properties must be made available for a minimum of 5 years after the date of manufacture.
  7. Luminaires shall be provided with a 5 year warranty covering LEDs, drivers, 10kV surge module, paint finish and electrical connectivity.
  8. Each luminaire shall consist of an assembly that utilizes LEDs as the light source. In addition, a complete luminaire shall consist of a housing, LED array, and electronic driver.
  9. Each luminaire shall be rated for a minimum operational life of 50,000 hours at an average operating time of 11.5 hours per night at 40°C (104°F).
  10. The rated luminaire operating temperature range shall be -30°C (-22°F) to +40°C (104°F).
  11. Each luminaire shall be capable of operating above 104° F (40°C), but not expected to comply with photometric requirements at elevated temperatures.
  12. Each luminaire shall be listed with Underwriters Laboratory, Inc. under UL1598 for luminaires, or approved equivalent standard from a nationally recognized testing laboratory.
  13. Luminaire housing shall be UL wet location listed.
  14. The optical assembly of the luminaire shall be protected against dust and moisture intrusion per the requirements of IP-66 (minimum) to protect the optical components.
  15. Housing and door frame shall be die cast aluminum with a nominal 2.5 mil thick paint finish able to withstand a 3,000 hour salt spray test as specified in ASTM Designation B117.
  16. Each refractor or lens shall be made from UV inhibited high impact optical grade acrylic and be resistant to scratching.
  17. Luminaire shall have a minimum initial efficacy of 84 lumens per watt and shall consume no more than 146 watts. The luminaire shall not consume power in the off state.
- B. LEDs and Drivers:
1. As specified below.
- C. Aluminum or steel lighting poles, as scheduled (base mounted):
- a. All poles with concrete base shall be designed to withstand the bending and overturning moment created by the wind loading of the entire pole and mounted

assemblies (EPA) and eccentricity caused by deflections under design wind loads. The design wind loading shall utilize an 80 MPH wind with a 1.3 gust factor. All portions of concrete pole bases shall be constructed in accordance with other specification sections.

- b. Poles shall be fabricated from aluminum or steel, as scheduled, and shall have an electrical cable passageway through the center. Poles shall receive a baked, electrostatically applied powder paint finish with a primer coat and a finish coat.
- c. Poles shall be provided with base access hole with cover above the pole base.
- d. Lightning protection shall be provided for each pole. A dual rated grounding lug shall be provided at the pole bottom hand hole. This grounding lug shall be electrically and mechanically connected to the pole metal.
- e. Pole accessories:
  - 1) A handhole frame shall be centered above the pole base. Cover in round poles shall be curved.
  - 2) A UL grounding lug shall be bonded to the inside of the pole across from the pole base handhole.
  - 3) Factory installed vibration dampener.
- f. Grounding: A #6 stranded copper ground wire shall be attached to an internal lug and connect a 5/8" x 10' UL listed ground rod unless diagrammed or scheduled otherwise.
- g. Pole Handling and Erection:
  - 1) Transportation, site handling and erection shall be performed by qualified personnel with equipment and methods that are in accordance with standard industry practices.
  - 2) Prior to unloading the pole, shop drawings shall be reviewed to identify proper pick-up points for unloading, storage and erection procedures.
  - 3) Internal wiring may be installed while pole is in horizontal position on the ground.

D. Acceptable Manufacturers:

1. Eaton-Lumark, Hubbell, Lithonia Architectural.

## 2.3 LEDs AND DRIVERS:

A. LEDs and Thermal Management:

1. Luminaire shall be manufactured with LED's provided by Philips Lumileds, Cree, Nichia or Citizen. LEDs shall have a Correlated Color Temperature (CCT) of 4,000K +/-275K. The color rendition index (CRI) shall be a nominal 70. Binning of the LEDs shall conform to ANSI/G, NEMA SSL 3-2010. Drive current to the LEDs shall not exceed 350mA.
2. The individual LEDs shall be constructed such that a catastrophic loss or the failure of one LED will not result in the loss of the entire luminaire.
3. The luminaire shall be constructed such that LED modules may be replaced or repaired without replacement of the whole luminaire.

4. The thermal management (of the heat generated by the LEDs) shall be of sufficient capacity to assure proper operation of the luminaire over the expected useful life.
5. The LED manufacturer's maximum thermal pad temperature for the expected life shall not be exceeded.
6. Thermal management shall be passive by design. The use of fans or other mechanical devices shall not be allowed.
7. The luminaire shall have a minimum heat sink surface such that the LED manufacturer's maximum junction temperature is not exceeded at the maximum rated operating temperature.
8. The heat sink material shall be aluminum.

B. Drivers:

1. LED Drivers and Surge Supression :
  - a. The driver shall operate from 60 HZ+/-3HZ AC line over a voltage ranging from 108 VAC to 305 VAC. The fluctuations of line voltage shall have no visible effect on the luminous output. Power factor shall be .90 or greater. Total harmonic distortion (current and voltage) induced into the AC power line shall not exceed 20 percent. Drivers must meet Class A emission limits referred in Federal Communications Commission Title 47, Subpart B, Section 15 regulations concerning the emission of electronic noise. Drivers shall be an IP66 rated UL class 2 power unit as per UL 1310.
  - b. Surge Suppression: The luminaire on-board circuitry shall include surge protection devices (SPD) to withstand high repetition noise transients as a result of utility line switching, nearby lightning strikes, and other interference. The SPD shall protect the luminaire from damage and failure for common and differential mode transient peak currents up to 10 kA (minimum). SPD conforms to UL 1449. SPD performance has been tested per procedures in ANSI/IEEE C62.41-2:2002 category C high exposure and ANSI C136.2 10kV BIL. The SPD shall fail in such a way as the Luminaire will no longer operate. The SPD shall be field replaceable.

## **PART 3 - EXECUTION**

### **3.1 INSPECTION:**

- A. Inspect drawings and specifications.
- B. Inspect site and existing construction for defects affecting the quality and execution of work.

### **3.2 PREPARATION:**

- A. Layout exact locations of poles and fixtures in accordance with plans, fixture details and supports. Obtain approval from Architect for layout locations.

**3.3 LIGHTING POLE INSTALLATION:**

- A. Excavation:
  - 1. The Contractor may excavate by any means he prefers, insofar as these methods conform to these specifications.
  - 2. The bottom of the pole base holes shall be on undisturbed earth. If a pole hole is excavated to a depth greater than required, it shall be backfilled with graded crushed rock, placed in 6" layers, and thoroughly machine tamped to density of surrounding soil.
  - 3. The Contractor shall immediately notify the Architect of any abnormal conditions discovered during excavation that may affect the installation.
- B. Plumb poles to vertical.
- C. Provide lighting fixtures, switches, and control systems, and wiring.
- D. Install in accordance with manufacturer's instructions, submittal data, and details on the drawings.

**3.4 ADJUSTMENT AND CLEANING:**

- A. Adjustment: Adjust internal reflectors and/or lamp positions for desired effects. Align fixtures with layout or building walls.
- B. Cleaning: Remove dirt, grease, and foreign materials from interior and exposed of all fixtures.
- C. Touchup marred finishes with manufacturer supplied paint or coating material to the satisfaction of the Architect. Poles with excessive damage to finish shall be replaced.
- D. The Contractor shall be responsible and bear all costs for remedy of deficient performance or installation.

**3.5 LIGHTING FIXTURE SCHEDULE: Refer to drawings for fixture schedule.**

END OF SECTION 26 51 00