

## TECHNICAL SPECIFICATIONS

### DIVISION 2800 STREET LIGHTING

**2801 GENERAL:** This Division of the Technical Specifications, and the sections herein, governs the furnishing of all material, equipment, and labor for the installation and testing of a complete, operational street lighting system. All material and equipment supplied and all work performed shall be in accordance with these Specifications and Standard Drawings, and as shown on the Plans, and as specified in the Special Provisions.

A complete list of pre-approved street lighting materials is available at the office of the Traffic Engineer or can be found on the City of Shawnee's Internet website at [www.cityofshawnee.org](http://www.cityofshawnee.org).

- .1 Codes and Standards:** In addition to the requirements of these Specifications, the Plans and the Special Provisions, all material and work shall conform to the requirements of the National Electrical Code (ANSI C1), the National Electrical Safety Code (ANSI C2), and the standards of the American Society for Testing Materials (ASTM) and the American Standards Associations (ASA), and local ordinances. All electrical equipment shall conform to the standards of the National Electrical Manufacturers Association (NEMA).
- .2 Revision of Standard Specifications:** When reference is made to a standard specification (NEMA, ASTM, ASA, ANSI, IES, IPCEA, UL, AASHTO, FSS, etc.), the standard specification referred to shall be construed to mean the latest revision of said standard specification, as amended, that is in effect on the date the Plans are approved, except as otherwise shown on the Plans or specified in the Special Provisions.
- .3 Other Applicable Specifications:** Work incidental to the installation of a street lighting system shall be performed in accordance with the following Technical Specifications:

Division 2100	Grading and Site Preparation
Division 2200	Erosion and Sediment Control
Division 2300	Paving
Division 2500	Incidental Construction
Division 2700	Site Restoration
- .4 Modification of Specifications:** These Specifications may be modified or deleted by notes on the Plans, by appropriate items in the Special Provisions, or by written authorization of the City Project Engineer.

- .5 Plans:** These Specifications and the Standard Drawings shall be considered a part of the approved Plans.
- A. Conflicts: Whenever any part of the Plans shall conflict with any other part of the Plans, or whenever any part of these Specifications shall conflict with any other part of these Specifications, or whenever any of the items proposed to be constructed shall seem impracticable, or impossible to construct, then the matter shall be immediately reported to the Project Engineer. The Engineer's decision in the matter shall be final, and the Contractor shall follow the Engineer's directions to avoid any such conflict in the Plans or Specifications.
  - B. Incidental Parts: All incidental parts, which are not shown on the Plans or specified herein and which are necessary to complete the street lighting system, shall be supplied and installed as though such parts were shown on the Plans or specified herein. All systems shall be complete and in operation to the satisfaction of the Engineer at the time of acceptance of the work.
  - C. Appurtenances: All appurtenances shall be installed as shown on the Plans and the Standard Drawings, or as specified in the Special Provisions. Any deviations must be established and authorized by the Engineer in the field.
  - D. Plans Available: The Contractor shall always have a copy of the approved Plans at the work site accessible to the Engineer.
  - E. As-Built Plans: Prior to the acceptance of the work, the Contractor shall submit an "As-Built" or corrected plan showing in detail all construction changes, especially the location and depth of the conduit.
- .6 Shop Drawings:** Before commencing the installation of any material or equipment, the Contractor shall submit two (2) copies of complete shop drawings for manufactured materials and equipment to the Engineer for approval. Manufacturers' bulletins, leaflets and other descriptive data that contain cuts, dimensions, specifications and wiring diagrams will be acceptable for standard cataloged equipment. Such bulletins, leaflets and other descriptive data shall be clearly marked to show the item to be used to satisfy a required item in the schedule of materials shown on the Plans, or as specified in the Special Provisions. The Engineer may require other descriptive data, drawings, and diagrams for non-cataloged equipment or materials. In the event any items of material or equipment contained on the shop drawings fail to comply with the specification requirements, such items may be rejected by the Engineer. Orders for material and equipment shall not be placed until written approval is obtained from the Engineer.

- .7 Electrical Permits and Inspections:** The Contractor is responsible for obtaining an electrical building permit from the City's Codes Administration Division before any excavation for the control center foundation or the service feed takes place. The Contractor shall contact the City's Codes Administration Division for an electrical inspection when the control center is ready.

The Contractor is responsible for obtaining such permits and approvals as may be required by the appropriate electrical utility company and is responsible for all costs associated with extending electrical power from the service point to the control center whatever the distance. The Contractor shall notify the appropriate electrical utility company ahead of when the system needs to be energized.

The Engineer will assign an address for the control center, which the Contractor shall use when obtaining permits and when dealing with the electrical utility company.

The Contractor shall contact the Public Works Traffic Division once project work begins including; trenching and pole installations and to request final project inspections.

- .8 System Testing:** The Contractor is responsible for testing the completed street lighting system. Prior to acceptance by the City, the Contractor shall notify the Traffic Division inspector for an inspection as soon as the system(s) is (are) ready.

All street lighting system elements shall function properly as a complete system for a minimum period of fifteen (15) days before acceptance by the City. The fifteen (15) day period shall be continuous and initiated by the inspector. Any malfunction observed or recorded shall stop the test period as of the time of the malfunction. A period shall start when the malfunction has been repaired to the satisfaction of the inspector.

- .9 Maintenance Work:** The Contractor is responsible for making all repairs and replacements, including, downed poles, damaged or cut cables, and burnt out lamps, to the street lighting system, regardless of the cause or responsible party, until the entire system is completed, inspected and accepted by the City.

**2802 MATERIALS AND EQUIPMENT:** This section governs all luminaires, poles, conduits, cables and other material and equipment supplied by the Contractor as required to complete the street lighting system as shown on the Plans, the Standard Drawings, and as specified in the Special Provisions. All lighting equipment shall be new and of the best grade and shall be approved by the Engineer.

All material used in the fabrication or assembly of the items below shall comply with the applicable articles of Section 801, "Electrical Lighting and Traffic Signals" and Section 1703, "Electrical Lighting and Traffic Signal Equipment" in the Kansas Department of Transportation Standard Specifications for State Road and Bridge Construction, with the additions stated herein.

Insofar as practical, major items of electrical equipment supplied under a single contract or tied contracts shall be of the same type and consist of products of the same manufacturer to secure uniformity and satisfactory service. Unless otherwise indicated on the Plans all material shall be new and of the best grade.

If spare equipment is included in the Bid Proposal, such equipment shall conform to these Specifications. The items shall be delivered new and undamaged at the place and time specified by the Engineer. All existing equipment in excess of the requirements of this project shall be completely removed from the project site by the Contractor and delivered at the place and time specified by the Engineer.

- .1 Aluminum Standards:** The type of pole and length of luminaire arm (if any) shall be as specified on the plans. This pole specification is in addition to the pole detail sheet included in the plans – refer to pole detail sheet, which describes the material specifications and pertinent design details. The manufacturer, supplier and Contractor shall guarantee that the shafts and arms provided on this project shall remain without defect for a period of five (5) years.

A. 30' and 40' Poles:

- (1) Shaft: The aluminum lighting shaft assembly shall be spun from one piece of seamless tubing and after fabrication, it shall have mechanical strength of not less than T6 temper. The cross section of the pole shall be round, and the shaft shall be fabricated in a continuous true taper from at least 6" above the handhole to the top of the shaft. The shaft shall have no longitudinal or circumferential welds, except at the lower end joining the shaft to the base. To protect the shaft during shipping, the assembly shall be tire wrapped with a non-staining paper.

Pole dimensions shall be as specified on the pole detail sheet - Table 1. It is the responsibility of the fabricator to verify and attest that the material sizes proposed are structurally adequate and in full compliance with this specification and the pole detail sheet.

- (2) Shoe Base: The shoe base shall be a permanent mold casting. The base shall be free of cracks, pits, and blow holes and of sufficient size and strength to withstand full design loads. The base shall telescope the shaft; and the one weld shall be on the inside of the base at the end of the shaft, while the other weld shall be on the outside at the top of the base. The shoe base and the two (2) welds shall develop the full strength of the pole assembly.
- (3) Luminaire Arm:
  - (a) The single member arm shall be tapered by cold working from round tubing. After tapering, the member shall be flattened to produce an elliptical cross-section with the major diameter in the vertical plane, perpendicular to the wind. The outboard end of the arm shall remain

round with a two-inch (2") slipfitter for mounting the luminaire. The single member arm shall be designed to meet given design factors and mounting dimensions.

- (b) The truss type member arm assembly shall be a one piece welded assembly consisting of an upper arm and lower arm (brace) securely joined by a vertical strut and a connector or weld at the outboard end of the arm assembly. The upper arm shall be tapered by cold working from round tubing. After tapering, the upper arm shall then be flattened to produce an elliptical cross-section with the major diameter in the horizontal plane, parallel to the wind. The outboard end of the upper arm shall remain round with a two-inch (2") slipfitter for mounting the luminaire. The outboard end of the lower arm (brace) shall be covered by an end cap.

B. 14' Pole:

- (1) Shaft: The 14' aluminum lighting shaft shall be spun from one piece of seamless tubing and after fabrication; it shall have mechanical strength of not less than T6 temper. The cross section of the pole shall be round, and the shaft shall be fabricated in a continuous true taper from at least 6" above the handhole to the top of the shaft. The shaft shall have no longitudinal or circumferential welds, except at the lower end joining the shaft to the base. To protect the shaft during shipping, the shaft shall be tire wrapped with a non-staining paper.

Pole dimensions shall be as specified on the pole detail sheet - Table 1. It is the responsibility of the fabricator to verify and attest that the material sizes proposed are structurally adequate and in full compliance with this specification and pole detail sheet.

The pole shall have a 3" O.D. slipfitter end, without a tenon, for mounting the post-top luminaire.

- (2) Shoe Base: The aluminum shoe base shall be a permanent mold casting. The base shall be free of cracks, pits, and blow holes and of sufficient size and strength to withstand full design loads. The base shall telescope the shaft; and the one weld shall be on the inside of the base at the end of the shaft while the other weld shall be on the outside at the top of the base. The shoe base and the two (2) welds shall develop the full strength of the pole assembly.

The base shall be cast with four (4) slotted holes to receive the anchor bolts-threaded studs and tapped holes for attaching the four (4) cast aluminum alloy removable bolt covers provided for each pole. The bolt covers shall attach to the upright portion of the body of the base. The bolt circle is provided in Table 1 of the pole detail sheet.

**.2 Breakaway Supports:** Breakaway Supports shall be supplied as shown on the plans and Standard Drawings, or as specified in the Special Provisions. Breakaway supports shall conform to the AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals*.

**.3 Foundations:** Screw-in foundations may be used, as shown on the plans. The foundations shall be of the size and type required in the details based on the pole mounting height. The anchors shall be screwed into the ground. Pre-drilling of holes for the anchor is prohibited, unless otherwise approved by the Engineer.

The foundation shall be screwed straight into the ground and the baseplate shall be level. Minor leveling adjustments may be made with the use of leveling shims or washers. Shims and washers shall be galvanized or cadmium-plated steel no more than 0.25" (6.35 mm) thick. Only one shim or washer will be allowed at any one anchor bolt with a maximum of two on any pole.

If screw-in foundations cannot be used for any reason, concrete foundations shall be installed at the contractor's expense.

**.4 Illumination Equipment:** The manufacturer, type and model of approved, acceptable luminaires shall be supplied as shown on the Plans or Standard Drawings, or as specified in the Special Provisions.

A. **Cobra Head Luminaire:** Cobra Head style luminaires shall be a power door or drop ballast type and be constructed of a single piece die-cast aluminum upper housing and two-piece bottom door, hinged at the back and latched on the street side. The luminaire shall be equipped with an integral slipfitter for 2-inch luminaire arm mounting. The mounting device shall allow the luminary to be mounted absolutely level and shall have no more than four (4) fasteners serving both the leveling and clamping functions. It shall allow one man to install the luminaire by simultaneously holding it in position and tightening the fasteners, such that the luminaire will be properly level at the first attempt. The luminaire shall be equipped with a 'trigger latch' for easy, one-hand, no-tools opening of the fixture for installation and servicing. A factory installed bird guard shall fit snugly around the mounting device. The luminaire shall provide a moisture proof and dust proof chamber and weather protection for the ballast.

A removable power-pad/module with quick-connect electrical hookup for easy installation of the electrical system and easy access to the ballast compartment shall be mounted on the door. Top housing mounting or a bridge assembly configuration will not be accepted.

The lens shall be a single piece of optically clear, flat, heat-resistant, impact resistant glass.

The sealed optical assembly shall be a true 90° cutoff. The reflector shall be natural unpainted alzak aluminum and shall be secured to the top housing.

The lamp socket shall be preset at the factory to provide I.E.S. Type III Medium Cutoff light distribution.

The luminaire shall not be provided with a photocell receptacle unless otherwise noted on the plans or special provisions. See approved material listing.

(1) Luminaires, 250 Watt and Above:

The luminaire shall be pre-wired, requiring only connection of service wires to a terminal board. The luminaire shall be equipped with a regulator, high power factor of 0.90 or better, ballast for high-pressure sodium at a voltage of 120/208/240/277 volts. The ballast shall be capable of reliably operating the lamp with a line voltage varying plus or minus 10 percent from normal. The entire ballast, including condensers, shall be mounted on a power door or drop assembly and be easily removable and replaceable with gloved hands and without tools through the use of quick disconnecting mechanical devices and electrical plugs.

(2) Luminaries, 150 Watt:

The luminaire shall be pre-wired, requiring only connection of service wires to a terminal board. The luminaire shall be equipped with a HPF reactor, high power factor of 0.90 or better, ballast for high-pressure sodium at a voltage of 120/208/240/277 volts. The ballast shall be capable of reliably operating the lamp with a line voltage varying plus or minus 5 percent from normal. The entire ballast, including condensers, shall be mounted on a power door or drop assembly and be easily removable and replaceable with gloved hands and without tools through the use of quick disconnecting mechanical devices and electrical plugs.

- B. Post-Top Luminaire: The luminaire housing shall be constructed of cast aluminum and painted black. The ballast shall be a regulator type, high power factor, for high-pressure sodium at a voltage of 120/208/240/277 volts. The ballast components shall be housed in a totally enclosed integral compartment, and the optical section of the unit shall be completely sealed and gasketed. The pressed prismatic refractor shall be one piece polycarbonate plastic. The refractor shall be for I.E.S. Type III distribution or Type V if specified on the plans. See approved material listing.
- C. Lamps: Lamp life shall be rated not less than twenty-four thousand (24,000) hours. Burnout at twenty thousand (20,000) hours shall not exceed twenty percent (20%).
- (1) 400 watt lamps shall be high pressure sodium (HPS), rated 50,000 lumens.
  - (2) 250 watt lamps shall be HPS, rated 30,000 lumens.
  - (3) 150 watt lamps shall be HPS, rated 16,000 lumens.
  - (4) 100 watt lamps shall be HPS, rated 9,500 lumens. (Existing luminaires only).

- .5 Electrical Material:** The types and lengths of cables shall be supplied as shown on the Plans or Standard Drawings, or as specified in the Special Provisions.
- A. Secondary Cable and Power Lead-In Cable: Power lead-in cable shall be #2 A.W.G. and secondary cable shall be #4 A.W.G. stranded annealed copper, single conductor cables for operation at 600 volts maximum. Material shall meet the applicable requirements of I.P.C.E.A. Standard S-19-81, with thermoplastic insulation of GRS-Rubber base meeting Appendix K (A) of I.P.C.E.A. and listed by U.L. as Type U.S.E. for direct burial; or material shall meet the applicable requirements of I.P.C.E.A. Standard S-66-524, interim standard #2, with thermo setting insulation of cross link polyethylene meeting requirements of Column "A" of I.P.C.E.A. and listed by U.L. as Type U.S.E. RHW-75°C.
  - B. Pole Wiring: Pole wiring above handhole in pole to luminaire(s) shall be single conductor cable with minimum 600 volt rating, No. 10 A.W.G. Type THHN/THWN. Conductor shall be stranded annealed copper. The pole wiring cables for twin luminaire poles shall be colored red for the north or west oriented luminaire and colored black for the south or east oriented luminaire. A grounding conductor shall be #4 AWG solid copper wire.
- .6 Control Center Pedestal:** Control center shall be an underground service type, rated for 100 amperes or 200 amperes (as specified on the plans), 240 volts, unless otherwise noted. Pedestal shall be 0.125 Aluminum rain tight construction with individual meter, panel, contactor, and rear service pull "compartments". Meter and panel/contactor compartments shall have piano hinged doors with padlocking provisions. The panel and contactor compartments shall have an inside panel door. The outer front and inside panel doors shall be equipped with an approved doorstop. Meter base shall be of the type used by the local utility. Panelboard shall have silver plated copper buss and shall accept 12 - 1 inch plug-in breakers manufactured by GE or Westinghouse. Panelboard compartment shall contain photocell, convenience receptacle, and test switch. All factory installed wire shall be copper. Control center shall be U.L. listed. Pedestal finish shall be painted Shawnee Green. See approved material listing.
- .7 Conduit:** The type, size and length of conduit and fittings shall be supplied as shown on the Plans or Standard Drawings, or as specified in the Special Provisions.
- A. PVC Conduit Material: Rigid nonmetallic conduit shall be 2" Schedule 40 polyvinyl chloride (PVC) conduit. The conduit shall bear an Underwriters' Laboratories label and shall conform to Federal Specification WC-1094A (latest version). Fittings shall be fabricated from PVS and have the same chemical and physical properties as the conduit with which it is being used.
- 2" Schedule 80 polyvinyl chloride (PVC) conduit is required under all road and commercial driveway crossings.



B. HDPE Conduit Material: Flexible nonmetallic conduit shall be 2” Schedule 40, high-density polyethylene conduit (HDPE). The conduit shall be smooth walled inside and out. The conduit shall be gray in color, and equipped with a polypropylene pull rope. The conduit shall be manufactured to ASTM D2447 specifications and shall meet the following applicable requirements:

Minimum Wall Thickness:	2” Schedule 40 – 0.154”	
Tensile Strength:	3,300 psi	ASTM D-638
Elongation:	800 %	ASTM D-638
Density:	60 lbs/cu. ft.	ASTM D-1505
Melt Index:	0.011 oz./10 min.	ASTM D-1238(E)
Brittle Temp.:	<-103° F	ASTM D-746
ESCR (Bell Test):	>1500 F50 hrs.	ASTM D-1693(C)
Rockwell Hardness L:	49	ASTM D-785
Shore Hardness D:	61	ASTM D-2240

C. HDPE Conduit Fittings: An approved factory coupling (PNA E-Loc or approved equal) shall be used for connection of the HDPE conduit to a 90° factory PVC elbow or between two lengths of HDPE conduit. The coupling shall be of high-density polyethylene. The coupling shall have individual reverse-locking threads with a built-in center stop.

**.8 Service and Junction Boxes:** The type and size of service and junction boxes shall be supplied as shown on the Plans. The Contractor may also use precast concrete junction boxes with cast iron covers, reinforced plastic mortar junction boxes, or cast-iron service boxes as may be shown on the plans..

**2803 CONSTRUCTION REQUIRMENTS:** This section governs the construction of all foundations and the installation of all luminaires, poles, conduits, cables and other material and equipment as required to complete the street lighting system as shown on the Plans, the Standard Drawings, and as specified in the Special Provisions. The Contractor is responsible for verifying the correct line and grade of all screw anchor and concrete foundations and conduits prior to installation.

The Contractor shall contact the Public Works – Traffic Division prior to construction to set up a pre-construction meeting in the field.

**.1 Pole and Luminaire Installation:** Street light poles and luminaires shall be installed as shown on the Plans and Standard Drawings, and as specified in the Special Provisions or as directed by the Engineer.

A. Pole Wiring: The luminaire shall be connected to the secondary cables through in-line, waterproof, breakaway fuseholders. All secondary cable connections inside a pole base shall be made with Fargo #GO-32 multiple tap connectors with slipover rubber boots. The Contractor shall install in-line waterproof, breakaway fused and non-fused disconnects in each pole base. Two (2) fused disconnects for each hot lead shall be Buchanan 65, and one (1) non-fused "dummy fuse" disconnect for the ground shall be Buchanan 20. Type KTK 8-amp high

interrupting fuses, or approved equal, shall be installed. The multiple tap connectors and fuseholders shall be installed convenient to the handhole at the base of the pole. One foot of surplus cable shall be coiled at the line side of the multiple tap connector, between the multiple tap connector and the fused disconnect, and on the load side of the fused disconnect. The connectors for the ground shall be installed with the male end of the connector on the line side.

The ground wire shall be fastened to the factory-installed grounding lug in the base of the pole by a three-eighths inch (d") ring terminal and d" - 16 x ¾" long hex bolt.

The pole wiring shall be color coded (black = hot, white = neutral, green = ground) and without splices from the fuseholder to the connection at the luminaire. Luminaires (post-top) not equipped with terminal blocks shall be connected to the pole wiring with approved butt connectors.

All cable re-connections at existing light poles shall be made with new connector kits.

- B. Pole and Luminaire Erection on a Screw Anchor Foundation: The pole shall be fastened to the foundation with a breakaway transformer base using bolts and nuts. The nut shall be on top. A washer shall be installed under the bolt head and another under the nut. The pole shall be checked for plumb, minor corrections made using galvanized or cadmium plated steel shim stock, the nuts tightened and the anchor bolt covers installed. A luminaire on a mast arm pole shall project from the street side of the pole and be perpendicular to the curb line. Hand hole covers shall be situated so that they are on the house side or away from oncoming traffic.
- C. Pole and Luminaire Erection on a Concrete Foundation: No sooner than five (5) days after construction of the foundation, a nut and washer shall be installed on each anchor bolt. The pole will be mounted to a breakaway transformer base using nuts, bolts, and washers. Using the lower nuts, the pole shall be brought into vertical alignment (plumb), the top nuts tightened, and the anchor bolt covers installed. A luminaire on a mast arm pole shall project from the street side of the pole and be perpendicular to the curb line. The opening between the pole base and the foundation shall be taped and grouted. Hand hole covers shall be situated so that they are on the house side or away from oncoming traffic.
- D. Luminaire on Mast Arm: The luminaire slipfitter shall be installed on the davit supplied with the mast arm. The luminaire and davit shall project from the street side of the pole and be perpendicular to the curb line.
- E. Luminaire Adjustment: The luminaire shall be adjusted and leveled in accordance with the manufacturer's instructions, to place the nadir directly below the light center.

- F. Lamp Installation: The installation date shall be marked on the base of the lamp prior to installing it in the luminaire.
- G. Storage and Protection: Poles and mast arms shall be kept dry and out of the weather until time for erection. The manufacturer's protective paper wrapper may be removed for inspection upon receipt from the manufacturer.
- H. Clean Up: Poles and luminaires shall be cleaned of dirt, grease, etc. Scratches, abrasions or other surface damage shall be repaired to like new condition.

**.2 Foundations:** Foundation anchors shall be of the size and type required for the pole.

- A. Screw-In Foundations: The anchors shall be screwed into the ground. Pre-drilling of holes for the anchor is not allowed. During installation the foundation shall be plumbed with a level. The foundation shall be screwed straight into the ground and the base plate shall be level.

Minor leveling adjustments may be made with the use of leveling shims or washers. Shims and washers shall be galvanized or cadmium-plated steel no more than 1/4 inch thick. Only one shim or washer will be allowed at any one anchor bolt with a maximum of two on any pole.

If screw-in foundation anchors are not able to be used for any reason, concrete foundations shall be installed at the contractor's expense

- B. Concrete Foundations: The bottom of the concrete foundations shall rest on firm ground; foundations shall be poured monolithic. The exposed portions shall be formed to present a neat appearance. Forms shall be true to line and grade. Top of footing for standards, except special foundations, shall be finished to curb, or sidewalk grade or as directed by the Engineer. Forms shall be rigid and securely braced in place. Conduit ends and anchor bolts shall be placed in proper position, to proper heights, and held in place by means of a template until the concrete sets. Anchor bolts shall be provided with hex head nut, flat washer and lock washer. Both forms and ground which will contact the concrete shall be thoroughly moistened before placing concrete.

Pole base and control center foundations shall be 4,000 psi, air entrained, 28-day compressive strength Portland Cement Concrete. Aggregate shall be Kansas Class 1 or Class 6.

Concrete pole bases shall be consolidated by an internal type vibrator. The vibrator shall operate at frequencies of vibration not less than 4,500 cycles per minute under load. The amplitude of vibration shall be adequate to consolidate concrete properly. The concrete shall be cured with an approved moisture barrier such as wet burlap, polyethylene, etc., for a period of seventy-two (72) hours. Cold weather curing shall be such that the concrete temperature shall be maintained above freezing for the entire curing period. Forms shall not be

removed until the concrete is thoroughly set.

The exposed portions of the foundation shall be finished to present a neat appearance. Finishing should be done with the positioning jig in place. If the jig must be removed for finishing, it shall be re-installed immediately after finishing and left in place throughout the cure period. A safety device (traffic cone, Type I barricade, etc.) shall be installed and secured firmly in place over each foundation immediately after finishing and remain in place until the pole or pedestal is installed. Prior to installing the pole or pedestal, the positioning jig shall be removed, loose concrete cleaned from around the anchor bolts and conduits, and the conduits trimmed to provide proper clearance for the pole or pedestal.

- .3 Wiring:** The roadway lighting conductor system shall be installed in HDPE or 2" SCH 40 or 80 PVC conduit, wired and installed as a 240 volt system where indicated, required and shown on the plans. Wiring shall conform to the appropriate articles of the National Electric Code. Wiring shall be continuous from street lighting appurtenance to street lighting appurtenance. No splices of cable will be permitted in conduit or outside of service boxes, junction boxes or pole bases.

Powdered soapstone, talc or other approved lubricant shall be used when inserting conductors in conduit. All cable to be installed in one conduit shall be pulled by the Contractor in one operation, and all ends shall be taped to exclude moisture and shall be so kept until the splices are made or terminal appliances attached. Ends of spare conductors shall be taped.

All splices in junction boxes and service boxes shall be made with appropriate split bolt connectors and/or 4 AWG copper crimp butt connectors. Such splices shall be carefully wrapped with three successive layers of Scotch (3M) No. 130C, "Linerless Rubber Splicing Tape" and then wrapped with three layers of Scotch (3M) No. 33+ "Electrical Tape". The total diameter of the taped splice shall be approximately 1 ½ times the diameter of the spliced conductor covering. 3M Scotchkote electrical coating shall be "Painted" over the splice.

Two feet of slack shall be left at all control centers, junction boxes and service boxes for splicing and connecting wires. Wiring within boxes shall be neatly arranged and laced up. Wires shall be color-coded (black = hot, white = neutral, green = ground) and circuits permanently identified in accordance with designations used on the plans.

All circuit runs shall be marked with colored tape whenever they come into a pole, junction or service box, or a control center.

Circuits coming from the North shall be marked with "Blue" tape.  
Circuits coming from the South shall be marked with "Purple" tape.  
Circuits coming from the East shall be marked with "Yellow" tape.  
Circuits coming from the West shall be marked with "Red" tape.

All distribution cable connections inside the base of the light pole shall be made with Fargo No. GO-32 multiple tap connectors provided with a slipover plastic boot. In-line waterproof, breakaway fused and non-fused disconnects shall be installed in each light pole base. Two disconnects for each hot lead (fused) shall be Buchanan 65, and one disconnect for the ground ("dummy fuse") shall be Buchanan 20. Two additional disconnects for the hot leads shall be provided for twin luminaire poles (ground disconnect is shared). Fuses shall be KTK, or approved equal, high interrupting fuses 8-amp. The multiple tap connectors and fuseholders shall be installed convenient to the handhole at the base of the pole.

One foot of surplus cable shall be coiled at the line side of the multiple tap connector, between the multiple tap connector and the fused disconnect, and on the load side of the fused disconnect. The connectors for the ground shall be installed with the male end of the connector on the line side. The ground wire shall be fastened to the factory installed ground lug in the base of the light pole by a 3/8" ring terminal and 3/8" - 16 x 3/4" long hex bolt.

Luminaires not equipped with terminal blocks (post-top) shall be connected to the pole wiring with approved butt connectors.

All poles shall be bonded to form a continuous system. At each multiple service point, a ground electrode shall be installed. The electrode shall be a copper rod not less than one-half (1/2) inch in diameter and ten (10) feet in length, unless otherwise noted on the plans, driven to a depth so the top is six (6) inches below the surface of the ground. The service equipment shall be bonded to the driven ground rod by a No. 4 A.W.G. copper wire enclosed in a one (1) inch diameter conduit.

- .4 Control Center Pedestal and Foundation:** The control center assembly, including the pedestal, circuit breakers, fuses, contactors, photoelectric control, control wiring, meter socket, service feed, and foundation, shall be constructed and installed as shown on the Plans and Standard Drawings, and as specified in the Special Provisions or as directed by the Engineer. The Contractor shall coordinate his activities with the appropriate electrical utility company to insure delivery of power to the control center when and where required. The control center pedestal shall be cleaned of wrapping, shipping material, dirt, grease, etc. Scratches, abrasions or other surface damage shall be repaired to like new condition. The photo cell shall be directed North unless southbound traffic may impact photo cell operation.
- .5 Conduit:** All conductors shall be run in conduit between all lighting equipment locations. Conduit shall be installed as shown on the Plans and Standard Drawings, and as specified in the Special Provisions or as directed by the Engineer to avoid underground obstructions. The size of the conduit used shall be as shown on the Plans, and as specified in the Special Provisions. Schedule 80 PVC conduit shall be used under existing and proposed street pavement and commercial driveway approaches. Schedule 40 or schedule 80 PVC or HDPE conduit may be used at all other locations. It shall be the privilege of the Contractor at his own expense to use larger size conduit if desired; and where larger size conduit is used, it shall be for the

entire length of the run from outlet to outlet. No reducing couplings will be permitted.

- A. Installation: The conduit installed under all roadway surfaces shall be placed a minimum of forty-eight (48) inches below the top of curb elevation; under drives and within shoulders at a minimum depth of twenty-four (24) inches below finished grade. Street lighting conduit may be installed in the same trench with traffic signal or fiber optic conduit as long as the minimum depth requirements are met and a minimum of twelve (12) inches of vertical separation between the top of one conduit and the bottom of the other is maintained.

Conduit set in standard bases shall extend approximately three (3) inches above the foundation vertically. Conduit entering through the bottom of a junction box shall be located near the ends to leave the major portion of the box clear. Conduit entering service boxes shall terminate two (2) inches inside the box wall and shall be sloped to facilitate pulling of cable. At all outlets, conduit shall enter from the direction of the run.

Existing underground conduit to be incorporated into a new system shall be cleaned with a mandrel and blown out with compressed air.

- B. Trenching: A trench crossing a proposed street shall be backfilled with clean one-half inch ( $\frac{1}{2}$ " ) crushed rock (CA-5) to two feet (2') behind the future curb. If the bottom of the trench is in rock or rocky soil, the conduit shall be placed on a six-inch (6") protective layer of clean, tamped backfill material. Backfill within six inches (6") of the conduit shall be free of rock or other solid material likely to cause damage. All backfill material shall be compacted to a density at least ninety percent (90%) of the maximum density for the material used as determined by ASTM D-698.

The six inches (6") of backfill nearest the conduit shall not be machine compacted.

- C. Boring: Conduit for a power lead-in cable to be placed under an existing developed area outside a street right-of-way shall be installed using approved boring methods. Also, where a conduit is to be placed under an existing paved surface, it shall be installed using approved boring methods. No existing developed property outside a street right-of-way or existing paved surface shall be cut or otherwise disturbed without the written permission of the Engineer and then only in the event insurmountable obstructions are encountered.

The conduit shall be bored at a depth of between twenty-four inches (24") and thirty-six inches (36") below the final grade. Boring pits shall be kept two feet (2') clear of the edge of any type of pavement wherever possible. Excessive use of water, such that the paved surface might be undermined or the subgrade softened, will not be permitted. Boring may be used instead of trenching at all other locations.

- .6 Boxes:** Junction boxes shall be installed at the locations shown on the plans. However, boxes shall not be located in sidewalks and driveways. In the unlikely event that a box is placed in a sidewalk or a driveway, a traffic-rated box shall be used.

A junction box shall also be installed at each end of a conduit run that crosses the road where direct buried cable begins and ends. The Contractor may install, at his own expense, additional boxes as may be desired to facilitate the work upon approval of the Engineer.

Junction boxes shall be installed on 12 inches (0.3 meters) of crushed rock as shown on the plans or as directed by the Engineer. Unless otherwise directed by the Engineer, boxes shall be installed level to 1 inch (25 mm) above the finish grade.

- .7 Excavations:** The Contractor shall perform all excavations for installing underground conduits, cable, boxes and pole bases in whatever substances encountered, to the depths indicated on the drawings or as otherwise approved. During excavation, material suitable for backfilling shall be piled in an orderly manner a sufficient distance from the excavation to avoid slides. All excavated materials not required or unsuitable for backfill shall be removed and wasted on site obtained by the Contractor.

- .8 Backfilling:** All areas excavated shall be backfilled and compacted in accordance with the Standard Specifications. Backfill shall be deposited in not over 6-inch layers and tamped to 95 percent density  $\pm$ 3 percent moisture. The top 6 inches of backfill shall be select soil suitable for sodding. After backfilling, all disturbed areas shall be kept well filled and maintained in a smooth and well-drained condition until permanent repairs are made.

- .9 Sodding:** All disturbed grass areas shall be sodded. The type of sod to be used will be the same as was in place prior to construction. This will be either Kentucky Bluegrass and/or Zoysia sod. The areas to be sodded shall be prepared prior to placing the sod by thorough cultivation, smoothing, removal of clods, surface stones one inch (1") in diameter or larger and weeds. The soil shall be thoroughly watered immediately prior to placing the sod. After placing, all sod shall be firmed by use of an approved roller, a tamper or other approved methods. Sod shall be of good quality Bluegrass or Zoysia, well rooted and reasonably free from weeds.

The Contractor shall water all sod immediately after placing. All sodded areas shall be kept thoroughly watered by the Contractor for a period of ten (10) days after laying and as often as required thereafter, until completion of other items of work in the contract. If sodding is the last item of work to be performed, the Contractor shall continue watering until all sod is growing and accepted.

Water used in this work shall be furnished by the Contractor and will be suitable for irrigation and free from ingredients harmful to plant life. All watering equipment required for the work shall be furnished by the Contractor.

**.10 Decorative Lighting:** With approval of the City Project Engineer, pole modifications may be approved or requested for decorative lighting. Poles shall be modified to accept a weatherproof Festoon box containing a ground fault receptacle. Three #10 THHN wires may be used to provide power.

**.11 Location:** Unless otherwise noted on the plans, or physical obstructions exist, equipment installed on this project shall be located as follows:

- A. Conduit shall be kept a minimum of one foot behind the back of curb.
- B. Street light poles shall be installed on property lines at least three feet behind the back of curb (to center of pole). Hand hole covers shall be situated so that they are on the house side or away from oncoming traffic.
- C. Junction boxes shall be installed at least two feet behind the back of curb (to center of box) and no closer than two feet to any street light pole.
- D. Control centers shall be located in accordance with the applicable City Ordinances

**2804 MEASUREMENTS AND PAYMENTS:** This section governs the method of measurement and basis for payment for all labor, tools, material and equipment and for the performance of all work necessary to construct and install a complete and operational street lighting system.

**.1 Method of Measurement:** The street light installation as indicated on the plans, complete-in-place and accepted, will be measured as a unit lump sum quantity for all work necessary.

**.2 Basis of Payment:** The street light installation measured as provided above will be paid for at the contract lump sum price bid.

**.3 Payment for Incidental Items:** No measurement or separate payment shall be made for any incidental item of work not specifically identified or listed as a bid item. The cost for all incidental items shall be included in the contract unit prices for other items listed in the Bid Proposal.