DIVISION II
CONSTRUCTION AND MATERIAL SPECIFICATIONS SEWERS
SECTION 2800 – STREET LIGHTS

APPROVED AND ADOPTED THIS 15th DAY OF FEBRUARY, 2017

KANSAS CITY METROPOLITAN CHAPTER
OF THE AMERICAN PUBLIC WORKS ASSOCIATION

TABLE OF CONTENTS

SECTION 2801 GENERAL

2801.1 Scope

This section governs the furnishing of all labor, materials and equipment for the installation and testing of a complete, operational street light system as shown on the Plans and in accordance with the Standard Drawings, the specifications and the Special Provisions.

2801.2 Referenced Standards

The following standards are referenced directly in this section. The latest version of these standards shall be used. If conflicting standards are referenced, the more stringent standard shall apply.

APWA

Section 2100 Grading and Site Preparation
Section 2150 Erosion and Sediment Control
Section 2200 Paving
Section 2300 Incidental Construction
Section 2400 Seeding and Sodding

AASHTO

A307 Portland Bolt
LTS-6 Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals
M 133 Standard Specification for Preservatives and Pressure Treatment Processes for Timber
M 284 Standard Specification for Epoxy-Coated Reinforcing Bars
M-31 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
T-12 Structural Support Signs, Luminaries, and Traffic Signals
T-65 Standard Method of Test for Mass [Weight] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings

ACI 301 Specifications for Structural Concrete

ANSI

B18.2 Fasteners
C1 Specification of General Requirements for a Quality Program
C2 National Electrical Safety Code
C136.10 Locking-Type Photocontrol Devices and Mating Receptacles—Physical and Electrical Interchangeability and Testing
C80.1 Electrical Rigid Steel Conduit
C80.4 Fittings for Rigid Metal Conduit & Electrical Metal
05.1 Stand Specifications for Wood Poles

ASTM

A 36 Standard Specification for Carbon Structural Steel
A 53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
A 123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A 153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
A 252 Standard Specification for Welded and Seamless Steel Pipe Piles
A 307 Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength

A 615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
A 775 Standard Specification for Epoxy-Coated Steel Reinforcing Bars
B 695 Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel
D 2683 Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing
D 3035 Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR)
F 436 Standard Specification for Hardened Steel Washers Inch and Metric Dimensions

GSA
A-A-1923 A Shield Expansion (Lag, Machine and Externally Threaded Wedge Bolt Anchors)

ICEA
S-95-658 Power Cables Rated 2000 Volts or less for the Distribution of Electrical Energy

NEMA
TC-2 Electrical Polyvinyl Chloride (PVC) Conduit
TC-3 Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing
TC-7 Smooth-Wall Coilable Electrical Polyethylene Conduit

UL
508A Standard for Industrial Control Panels
514 Metallic Outlet Boxes, Conduit, Tubing, and Cable Fittings

MCIB Mid-West Concrete Industry Board Concrete Specifications - Concrete Pavement
The current editions of the "Bulletins" and Approved Sections of the "Standard Concrete Specifications" issued by the Mid-West Concrete Industry Board, Inc. (MCIB) are made a part hereof by reference. However, when the provisions of this Specification differ from the provisions of such "Bulletins" and "Sections" the provisions of this Specification shall govern. Reference December 2000 Specifications if most recent version does not contain specified mix designs.

KCMMB Kansas City Metro Materials Board Specifications

2801.3 Appurtenances

All appurtenances shall be installed as shown on the Plans, specifications, Standard Drawings, or the Special Provisions. Any deviations must be established by the Contractor and authorized by the Owner. No additional payments will be made for appurtenances.

2801.4 Incidental Work and Parts

Work incidental to the installation of a street lighting system that is not covered in these specifications shall be performed in accordance with the Special Provisions and Standard Drawings. All incidental parts, which are not shown on the Plans or specified in the specifications and which are necessary to complete the street lighting system, shall be supplied and installed by the Contractor to the satisfaction of the Owner. No additional payments will be made for incidental work or parts.

2801.5 Existing Lighting

Existing lighting shall be maintained in effective operation by the Contractor except for shutdowns with approval from the Owner for alterations or final removal. The Contractor shall take all precautions necessary to minimize the

downtime of the existing street lighting systems to be modified.

2801.6 Electrical Service

The Contractor is responsible for contacting the electrical utility company in advance to schedule delivery of service to each power supply. Unless otherwise specified, the Contractor shall pay the electrical utility company's fees to deliver electrical service and shall be billed for all electrical utility service charges until the entire project is substantially complete and the burn test is successfully completed. After those milestones the electrical service can be transferred to the Owner.

2801.7 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 light system, regardless of the cause or responsible party, until the work is determined by the Owner to be substantially complete.

SECTION 2802 MATERIALS AND EQUIPMENT

2802.1 Scope

This section governs the furnishing all labor, materials, and equipment necessary for all work required to complete the street lighting system as shown on the Plans and in accordance with the specifications, Standard Drawings, and the Special Provisions.

2802.2 General

All lighting equipment shall be of new stock unless the Contract provides for relocation of existing units or use of units furnished by others. New equipment and material shall be in accordance with ICEA, NEMA, and NESC, as applicable, and shall meet the approval of the Owner.

2802.3 Concrete

All concrete for bases and pads, whether reinforced or non-reinforced, shall be a KCMMB 4K mix, unless otherwise specified in the Special Provisions or Plans. Concrete construction shall be in accordance with ACI 301 Standard Specifications for Structural Concrete.

2802.4 Flowable Backfill (CLSM)

All flowable backfill (CLSM) shall comply with Section 2100 Grading and Site Preparation.

2802.5 Reinforcing Steel

Grade 40 or 60 deformed reinforcing steel shall be placed as shown on the Plans or on the Standard Drawings and shall conform to ASTM A 615 or AASHTO M 31 for plain or ASTM A 775 or AASHTO M 284 for epoxy coated.

Upon request, Contractor shall provide documentation of reinforcing steel that shall include the steel manufacturer's certified mill test report showing complete chemical and physical test results for each heat.

2802.6 Conduit

The location and type of conduit shall be as shown on the Plans or Standard Drawings. The Contractor may furnish and install polyvinyl chloride (PVC), or high-density polyethylene (HDPE) conduit for the distribution system. Galvanized Rigid Steel (GRS) conduit shall be used where conduit is to be installed externally on a structure.

A. Polyvinyl Chloride (PVC): Rigid non-metallic conduit shall be polyvinyl chloride (PVC), Schedule 40, and shall conform to NEMA Standard TC-2 and NEMA TC-3. The conduit shall bear an Underwriters' Laboratories (U.L.) label and be clearly and durably marked at least every 10 feet with the material designation, nominal duct size, and the name and/or trademark of the manufacturer. Fittings for PVC conduit shall be in accordance with U.L. 514. Cement used for the fittings shall be in accordance with the conduit manufacturer's recommendations.

B. High Density Polyethylene (HDPE): Flexible non-metallic conduit shall be high-density polyethylene conduit (HDPE), Schedule 80. The conduit shall be smooth walled inside and out, and shall be gray in color. The conduit shall be a plastic duct which is intended for underground use and which can be manufactured and coiled or reeled in continuous transportable lengths and uncoiled for further processing and/or installation without adversely affecting its properties of performance. The conduit shall be manufactured to NEMA Standard TC-7 and ASTM D 3035 SDR11 specifications. The conduit shall be clearly and durably marked at least every 10 feet with the material designation, nominal duct size, and the name and/or trademark of the manufacturer. Fittings for HDPE conduit shall be in accordance with ASTM D 2683. Epoxy used for the fittings shall be in accordance with the conduit manufacturer's recommendations. An approved factory coupling 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 material. The coupling shall provide an airtight and watertight lock connection.

C. Galvanized Rigid Steel (GRS): Galvanized rigid steel conduit shall be shall be in accordance with ANSI C80.1. GRS conduit shall be galvanized on both the inside and the outside surfaces. The weight (mass) of zinc coating shall be no less than 0.5 ounce per square foot of coated surface, as determined in accordance with AASHTO T 65. The interior or exterior surface, or both, may be given a coating of suitable material to facilitate installation of wires and cables and to permit the conduit to be readily distinguished from pipe used for purposes other than electrical. All metal conduit ends shall be provided with a bushing to protect the cable from abrasion. Fittings shall be in accordance with ANSI C80.4. A sufficient number of conduit hangers shall be supplied to attach the GRS conduit to the structure, as recommended by the manufacturer. One (1) No. 6 AWG, bare copper ground wire shall be attached to each end of the GRS conduit with a grounding bushing. The ground wire shall be connected to a ground rod at each end of a GRS conduit run, or extended to an adjacent GRS conduit or ground rod.

2802.7 Anchor Bolts

Anchor bolts shall be of size, length and deformation as shown on the Plans, the Standard Drawings or in the Special Provisions and shall conform to ASTM A 307. Nuts, washers and no less than the top eight inches of the bolts shall be galvanized (2.02 ounces per square foot) as specified by ASTM A 153. Nut dimensions shall conform to requirements of ANSI B18.2 for heavy semi-finished hex nuts. Washer dimensions shall conform to ASTM F 436.

2802.8 Screw Anchor Foundations

Screw anchor foundations shall be fabricated of new steel. The length and diameter shall be as shown on the Standard Drawings, the Plans or in the Special Provisions. The shaft shall be steel pipe conforming to ASTM A 252, Grade 2 with minimum wall thickness per ASTM A 53, Schedule 40. The edges of the conduit access slot shall be

smooth and clean to prevent damage to the conduit. The conduit access slot shall be large enough for entry of three, two inch diameter ducts. The base plate steel shall conform to ASTM A 36, shall telescope the shaft and shall be fastened to the shaft with continuous circumferential welds, top and bottom. Mounting holes shall be radially elongated. After fabrication, the foundation shall be hot dip galvanized conforming to ASTM A 123. Mounting bolts shall be one inch diameter. Bolts, nuts and washers shall conform to Section 2802.7.

2802.9 Breakaway Supports

All poles, except 14-foot poles, shall be attached to a cast aluminum breakaway base sized according to the Standard Drawings, the Plans or the Special Provisions. Breakaway supports shall conform to AASHTO LTS-6.

2802.10 Cable

The types and lengths of cables shall be supplied as shown on the Plans, Standard Drawings, or as specified in the Special Provisions. All cable shall be stranded annealed soft drawn copper wire, and shall be the AWG size as listed on the Plans. Cable shall be 600-volt and be thermoplastic or thermosetting polyethylene insulated. All cable shall be plainly marked on the outside with the manufacturer's name and identification in accordance with industry practice.

A. Distribution Cable: Distribution cables shall be insulated three-conductor cables (3c), type RHH, RHW-2 or USE-2, meeting the requirements of ICEA S-95-658. Average thickness of insulation shall be no less than 60 mils. The conductors should be no larger than No. 4 AWG and no smaller than No. 8 AWG.

B. Pole and Bracket Cable: Pole wiring above handhole, inside the pole to luminaire(s) shall be insulated two-conductor No. 10 AWG cables (2c #10), type THHN/THWN. For poles with dual luminaires separate cables will be required for each luminaire, which will extend up from the break-away fused connectors.

C. Cable-In-Duct: Cable-In-Duct shall consist of three insulated power cables, factory installed in conduit intended for direct burial. The duct shall meet all the specifications for high density polyethylene, as described in Section 2802.6.B. The duct shall be clearly and durably marked at least every 10 feet with the material designation, nominal duct size, and the name and/or trademark of the manufacturer. The cables shall meet all the specifications for distribution cable, as described in Section 2802.10.A.

2802.11 Enclosures

Enclosures shall be as specified on the Plans, the Standard Drawings, or in the Special Provisions. The construction and installation shall be according to the NEC, NESC, and local applicable utility standards.

2802.12 Splices

Splices shall be made with copper type K split bolt connectors. All splices shall be protected with a waterproof resin splice kit installed in accordance with the manufacturer's recommendations.

2802.13 Cabinets

Cabinets shall be as specified on the Plans, the Standard Drawings, or in the Special Provisions.

2802.14 Lighting Contactors, Relays, and Terminal Blocks

Lighting contactors, relays and terminal blocks shall be as specified on the Plans, the Standard Drawings, or in the

Special Provisions. The lighting contactor panel shall be labeled per UL 508A.

2802.15 Circuit Breakers

Circuit breakers shall be as specified on the Plans, the Standard Drawings, or in the Special Provisions.

2802.16 Lightning Arrestors

Lightning arrestors shall be as specified on the Plans, the Standard Drawings, or in the Special Provisions.

2802.17 Fuses

Fuses and fuseholders shall be as specified on the Plans, the Standard Drawings, or in the Special Provisions.

2802.18 Photoelectric Controls

The photoelectric control shall meet the requirements of ANSI C136.10. The control shall be adjusted to operate at a footcandle level designated by the Owner, as measured in accordance with the standard. The control shall be designed so that if it fails, the system is energized. Photoelectric cells shall sense light levels with a non-drifting phototransistor. The photoelectric cell shall have a time delay to avoid turn off due to lightning and transient light.

2802.19 Pull and Junction Boxes

Pull and junction boxes shall be as specified on the Plans, the Standard Drawings, or in the Special Provisions.

2802.20 Poles

The type and length of pole and arm will be specified in Plans or Special Provisions. New installations shall match with existing equipment (luminaire type, pole type, etc.). All poles shall have ID plates with the following information:

1) Manufacturer's name
2) Date of manufacture
3) Part/order number

A. Aluminum Poles: The pole shaft shall be a seamless, round, tapered tube of aluminum alloy 6063-T6. The pole base flange shall be a one piece casting of aluminum alloy 356. It shall telescope the shaft and be attached to the shaft by a continuous circumferential weld. The pole shall be furnished with an internally mounted dampener to damp wind induced harmonic vibration. Anchor bolt covers of aluminum alloy 356 and hex socket attachment screws of 300 series stainless steel shall be provided. The shaft, base, anchor bolt covers and arm shall have a natural color satin finish, unless otherwise specified on the Plans or in the Special Provisions. A handhole shall be provided near the base for wiring access. The handhole shall be positioned as specified on the Plans. The handhole cover shall be secured with hex socket attachment screws of 300 series stainless steel. Handhole minimum size shall be clear 4"x6". A ground connector capable of accepting 6 AWG wire shall be provided inside the pole, convenient to the handhole. The pole shall mount on the bolt circle diameter specified on the Standard Drawings, the Plans or in the Special Provisions. The top of the pole shall be equipped with a removable cap. The pole and arm, when equipped with the specified luminaire, shall meet load requirements per AASHTO T-12.

B. Steel Poles: The shaft shall be round or octagonal, tapered, and fabricated from cold rolled open hearth,

basic oxygen or electric furnace steel. The shaft shall be one piece for lengths to 40 feet and may be two-piece for lengths exceeding 40 feet. The two piece shaft shall be field assembled by a slip joint, the minimum length of which is one and one half times the diameter of the shaft at the joint. The field assembled pole must not require a weld to develop full strength. All welds in the fabrication of the shaft shall be continuous and longitudinal. The pole base flange shall be of cast steel or fabricated steel plate. It shall telescope the shaft and be secured top and bottom, by continuous circumferential welds. It shall be designed to avoid stress risers under dynamic loading. The anchor bolt covers shall be formed, forged or cast, and shall be attached to the base with hex socket threaded fasteners. A handhole shall be provided near the base for wiring access. The handhole shall be positioned 90 degrees away from the mounting arm. The handhole cover shall be secured with hex socket threaded fasteners. Handhole minimum size shall be clear 4"x6". A ground connector capable of accepting 6 AWG wire shall be provided inside the pole convenient to the handhole. The steel pole, arm, and all incidental parts shall be finished with hot dip galvanizing in accordance with ASTM A 123. All fasteners shall be of 300 series stainless steel or of carbon steel galvanized in accordance with ASTM A 153. The pole shall mount on the bolt circle diameter specified on the Standard Drawings, the Plans, or in the Special Provisions. The top of the pole shall be equipped with a removable cap. The pole and arm, when equipped with the specified luminaire, shall meet load requirements per AASHTO T-12.

C. Wood poles: New wood poles shall be preservative-treated in conformance with AASHTO M-133. Wood poles shall be fabricated in conformance with the ANSI Standard Specifications and Dimensions for Wood Poles, ANSI Publication 05.1. Poles shall be marked or have other documentation to confirm compliance with this requirement as well as the class designation. Poles shall be in good condition as acceptable by the Engineer and shall be in conformance with the applicable ANSI requirements for sweep, crook, defects and mechanical damage. Poles deemed unacceptable by the Engineer should be removed from the job site. Hardware shall include cable hardware as well as pole hardware including insulators, cable supports, guy anchors, guy wires and the like. Hardware shall be indicated on the drawing, or as specified herein. Hardware shall also be made available for inspection by the Engineer, and hardware deemed defective by the Engineer shall be removed from the job site. As a minimum, pole guying shall be provided where indicated on the Plans and at every dead-end pole and at any pole having non-offsetting cable support stresses, i.e. non-symmetrical cable attachments.

2802.21 Bracket Arms

The bracket arm assembly shall be a one piece welded assembly with a connector or weld at the outboard end, unless otherwise specified in the Plans, Standard Drawings, or Special Provisions. The bracket arm shall be of the same material and finish as the pole and to the length specified. For wood poles, the bracket arm shall be of 6063-T6 alloy. The outboard end of the bracket arm shall be sized to fit the specified luminaire. If applicable, any open outboard end of an arm shall be covered with an end cap. Small holes shall be drilled at the ends of both arms on the bottom side to allow for drainage of condensation.

2802.22 Luminaires

The manufacturer, type and model of approved, acceptable luminaires will be specified on the Plans or in the Special Provisions.

A. Rectilinear Luminaire: The housing shall be aluminum or steel and shall provide a moisture proof and dust proof light chamber and weather protection for the ballast. The lens shall be a single piece of optically clear, flat, heat resistant, impact resistant glass. The lens shall be enclosed in a frame which is hinged to the underside of the luminaire housing. The frame shall be securely retained in the open or closed position and shall be readily opened, closed, or removed. The luminaire shall mount to the pole with a rectilinear

mounting arm. Aluminum shall be finished as specified on the Plans or in the Special Provisions. Steel shall be finished as specified on the Plans or in the Special Provisions. The luminaire shall be prewired, requiring only connection of service wires to a terminal. The luminaire shall be equipped with a regulator type ballast capable of operating the specified lamp. The ballast shall operate at 240 vac, have a power factor of 0.90 or better, shall provide reliable lamp starting at -20 degrees F or higher, and shall provide 10% or better lamp power regulation with a 10% input voltage variation. The ballast assembly shall be separated from the lamp compartment by a metal heat barrier.

The lamp socket shall be preset at the factory to meet the requirements of the IESNA classification for Type III cutoff light distribution unless otherwise specified on the Plans. The illuminance on the roadway surface shall be the required level and uniformity without hot spots, dark spots or striations as determined by the Engineer.

The luminaire shall not be provided with a photocell receptacle unless otherwise noted on the Plans or Special Provisions.

Luminaires shall be pre-wired, requiring only connection of service wires to a terminal board. 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 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. The ballast assembly shall be separated from the lamp compartment by a metal heat barrier.

B. Cobrahead 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 one-piece or 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 luminaire 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 person 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. The luminaire shall provide a moisture proof and dust proof chamber and weather protection for the ballast. A removable power-pad/module with quickconnect 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 fully shielded (emitting no direct uplight). 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 meet the requirements of the IESNA classification for Type III cutoff light distribution unless otherwise specified on the Plans or Special Provisions. The illuminance on the roadway surface shall be the required level and uniformity without hot spots, dark spots or striations as determined by the Engineer.

The luminaire shall not be provided with a photocell receptacle unless otherwise noted on the Plans or Special Provisions.

Luminaires shall be pre-wired, requiring only connection of service wires to a terminal board. 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 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. The ballast assembly shall be separated from the lamp compartment by a metal heat barrier.

C. Post Top Luminare: The luminaire housing shall be constructed of cast aluminum and shall be as specified on the Plans or Special Provisions. 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 IESNA Type III distribution, unless otherwise specified on the Plans or Special Provisions.

The lamp socket shall be preset at the factory to meet the requirements of the IESNA classification for Type III cutoff light distribution unless otherwise specified on the Plans or Special Provisions. The illuminance on the roadway surface shall be the required level and uniformity without hot spots, dark spots or striations as determined by the Engineer.

The luminaire shall not be provided with a photocell receptacle unless otherwise noted on the Plans or Special Provisions.

Luminaires shall be pre-wired, requiring only connection of service wires to a terminal board. 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 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. The ballast assembly shall be separated from the lamp compartment by a metal heat barrier.

D. LED Luminaire: LED luminaires shall be a power door or drop driver type and be constructed of a die-cast aluminum upper housing and one-piece or 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 luminaire 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 person 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 provide a moisture proof and dust proof chamber and weather protection for the ballast. A removable power-pad/module with quickconnect electrical hookup for easy installation of the electrical system and easy access to the driver 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 fully shielded (emitting no direct uplight). The light from the LED's shall be reflected to the roadway to minimize glare. The reflector shall be secured to the top housing.

The lamp socket shall be preset at the factory to meet the requirements of the IESNA classification for Type III cutoff light distribution unless otherwise specified on the Plans or Special Provisions. The illuminance on the roadway surface shall be the required level and uniformity without hot spots, dark spots or striations as determined by the Engineer.

The luminaire shall not be provided with a photocell receptacle unless otherwise noted on the Plans or Special Provisions.

Luminaires shall be pre-wired, requiring only connection of service wires to a terminal board. 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 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. The ballast assembly shall be separated from the lamp compartment by a metal heat barrier.

2802.23 Lamps

Luminaires equipped with high pressure sodium vapor or LED lamps. Lamp life for high pressure sodium lamps shall not be less than 24,000 hours. Burnout for high pressure sodium lamps at 20,000 hours shall not exceed 20%. Rated initial lumen output for high pressure sodium lamps shall be:

1) 70 watt: 6,300 lumens
2) 100 watt: 9,800 lumens
3) 150 watt: 16,000 lumens
4) 250 watt: 29,000 lumens
5) 400 watt: 54,000 lumens
6) 1000 watt: 140,000 lumens

LED lamp guidelines shall be defined in the Plans or Special Provisions and in conformance with IESNA.

2802.24 Shop Drawings

Shop drawings for manufactured equipment shall be submitted to the Engineer. Manufacturer's bulletins, leaflets and other descriptive data which 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 which item is to be used and which paragraph of the contract specification it is to satisfy. Orders for equipment shall not be placed until written approval is obtained from the Engineer.

2802.25 Spare Equipment

If spare equipment is included in the Contract Documents, it shall conform to these specifications, the Standard Drawings, and the Special Provisions. All spare equipment shall be from the same manufacturer and of the same style, model, etc. as equipment installed on the project. The items shall be delivered new and undamaged to a place and time mutually agreed on by the Contractor and the Owner, unless otherwise specified in the Contract Documents.

SECTION 2803 POLE FOUNDATION CONSTRUCTION

2803.1 Scope

This section governs the furnishing all labor, materials, and equipment necessary for the performance of all work required to construct pole foundations as shown on the Plans and in accordance with the specifications, the Standard Drawings, and the Special Provisions.

2803.2 Conduit Bends

Conduit bends shall be installed in concrete foundations as shown on the Plans or Special Provisions and positioned

in the direction of the duct or cable run.

2803.3 Anchor Bolts

Anchor bolts shall be installed in concrete foundations as shown on the Plans, Special Provisions, or the Standard Drawings. All portions of the anchor bolts extending above the foundation shall be threaded. Anchor bolts shall align with the bolt holes on the shoe base. Anchor bolts shall be provided with two (2) hex head nuts, flat washer, and lock washer. When the concrete foundation requires a concrete cap, one nut shall be installed on each anchor bolt to be embedded in the concrete foundation with the top of the nut approximately 1/8" above the top of the foundation.

2803.4 Concrete Foundations

All concrete foundations shall be of the size and type and materials as shown on the Plans, Special Provisions, or Standard Drawings.

A. Location: The Contractor is responsible for verifying the correct line and elevations of all concrete bases prior to installation. The Contractor shall stake the location of all street lighting poles to be installed. The Engineer shall inspect the staking prior to any excavation and/or construction. Minor relocation of equipment to avoid conflicts may be allowed with the approval of the Owner.

B. Reinforcing Steel: Reinforcing steel for concrete bases shall be accurately cut and bent to the dimensions and shapes shown on the Plans or Standard Drawings. Cutting and bending tolerances for reinforcing steel shall be in accordance with the Concrete Reinforcing Steel Institute's Manual of Standard Practice. When placed in the work and before concrete is placed, reinforcing steel shall be free from dirt, oil, paint, grease, loose mill scale, thick rust, any dried mortar and other foreign substances. Reinforcing bars shall be positively secured against displacement. The bars shall be firmly tied at alternate crossings or closer. The steel shall be spot welded or tied in the correct position with proper clearance maintained between the bare earth or forms and the reinforcement. Measurements to reinforcing steel will be made to the centerline of bar, except where the clear distance from face of concrete is shown on the Plans or Standard Drawings. Splicing of bars shall not be allowed.

C. Conduits: PVC conduits and conduit bends should be set in the forms for concrete bases. Pole foundations shall have separate conduits for exiting/entering cables and a separate one inch (1") conduit for the ground wire. The direction of the exiting conduits shall be as shown on the Plans or Standard Drawings. Conduit set in concrete bases shall extend approximately three inches (3") above the base vertically and a minimum of three inches (3") outside the base horizontally underground.

D. Construction: The bottom of all concrete bases shall rest on firm ground. Forms shall be true to line and grade. The top of the foundation for street light poles, except raised foundations, shall be finished to curb or sidewalk grade, or as directed by the Engineer. Forms shall be rigid and securely braced in place. Conduits 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. Conduits shall be covered before concrete is poured to prevent concrete from entering the conduits. Both forms and ground which will contact the concrete shall be thoroughly moistened before placing concrete.

   Pole foundations shall be poured monolithic. Foundations 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. Prior to installing the pole, the positioning jig shall be removed and loose concrete cleaned from around the anchor bolts and conduits.

Cinders, broken concrete, broken rock or other hard or undesirable material shall not be used for backfilling around the finished foundation. The earthen backfill material shall be placed in layers not to exceed six inches (6") deep, and each layer shall be thoroughly compacted to the approximate density of the adjacent material before the next layer is placed.

E. Expansion Joints: Expansion joints shall be provided where a concrete pole foundation is adjacent to concrete. After concrete has cured a minimum of seven days, the joint shall be cleaned, filled and sealed as shown on the Plans or Standard Drawings.

2803.5 Screw Anchor Foundations

The Contractor is responsible for verifying the correct line and grade of all screw anchor foundations prior to installation. The Contractor shall stake the location of all street lighting poles to be installed. The Engineer shall inspect the staking prior to any excavation and/or construction. Minor relocation of equipment to avoid conflicts may be allowed with the approval of the Engineer.

Screw anchor foundations shall be of the size and type required as indicated on the Plans or Standard Drawings.

Pre-drilling of holes for the screw anchor foundation is not allowed except for a depression to improve location accuracy. If screw anchor foundations are not able to be used for any reason, concrete foundations shall be installed at the Contractor's expense.

The screw anchor foundation shall be screwed straight into the ground and the steel base plate shall be at the proper elevation and properly oriented to receive the shoe base. During installation the anchor shall be plumbed with a level. The base plate shall be flush with the finished grade. 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 one-quarter inch (0.25") thick. Only one shim or washer will be allowed at any one anchor bolt. The installing torque for screw anchor foundations shall be between the maximum and minimum torque ratings per the manufacturer's recommendations.

Conduit bends shall be installed into all screw anchor foundations through the slots in the base of the anchors. After conduit bends are installed and capped, the internal cavity of the screw anchor foundation shall be backfilled with sand or other fine aggregate material, as approved by the Engineer.

SECTION 2804 UNDERGROUND CABLE

2804.1 Scope

This section governs the furnishing all labor, materials, and equipment necessary for the performance of all work required to install underground cable in duct or cable in conduit where shown on the Plans or where directed by the Engineer. The work shall be done in accordance with these specifications, the Standard Drawings, and the Special Provisions.

2804.2 Location

The underground cable in duct or cable in conduit shall be installed at the location indicated on the Plans. Deviations required due to the terrain or underground obstructions shall be in accordance with the National Electrical Code, ANSI C1, the National Electrical Safety Code, ANSI C2, and have prior concurrence of the Engineer. All duct and conduit shall be routed to avoid root damage.

2804.3 Conduit Installation

Conduit shall be installed as shown in the Plans or Standard Drawings. The size of the conduit used shall be as shown on the Plans or Standard Drawings. It shall be the privilege of the Contractor, at his own expense, to use larger size conduit if desired, as approved by the Engineer. 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.

Wherever a conduit passes beneath a curbed street, aluminum conduit markers shall be installed in the curb immediately over the conduit location. Conduit markers shall be furnished by the Contractor and are subsidiary to the installation of conduit. The conduit marker shall be inscribed as approved by the Owner. The conduit marker shall be installed in the top of the curb by drilling the curb and epoxying the conduit marker in place.

The ends of all conduits shall be well reamed to remove burrs and rough edges. All conduits shall be cleaned and swabbed prior to installation of cable. Field cuts shall be made square and true so that the ends will butt or come together for the full diameter thereof. The end of each conduit run shall be covered to prevent water or debris from entering the conduit while the system is being constructed.

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

An approved factory coupling shall be used for connection of the HDPE conduit to a 90° factory PVC elbow or between two lengths of HDPE conduit. No couplings or joints will be allowed in HDPE conduits at intermediate points unless approved by the Engineer.

Conduit bends, except factory bends, shall have a radius of not less than six times the inside diameter of the conduit. Where factory bends are not used, conduit bends shall be made without crimping or flattening, using the longest radius practicable and utilizing an appropriate conduit bending tool.

The conduit shall be installed continuous from outlet to outlet or as otherwise shown on the Plans. The conduit may be directional bored to minimize disruption to the existing improvements or may be plowed or trenched. Unless otherwise specified, conduit shall be installed under roadway pavement sections at a depth not less than 36 inches below top of pavement. In all other areas, conduit shall be placed to a depth of 24 to 36 inches below finish grade.

At all outlets, conduit shall enter from the direction of the run. PVC conduit bends shall enter all junction or pull boxes from below the box and shall extend into the box a minimum of 2 inches unless otherwise specified. GRS conduits may enter a pull or junction box from the side. The side of the box shall be drilled per the manufacturer's recommendations. The hole shall be no more than one-half inch (½") larger than the conduit. The gap between the box and conduit shall be filled with sealing compound.

2804.4 Trenching

Trenches shall be excavated to a maximum width of six inches (6") and deep enough to provide the minimum cover for conduits not less than 24 inches or greater than 36 inches or as shown in the Plans. 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. Trenches shall be backfilled as soon as practical after the installation of conduit, but after inspection of the trench by the Engineer. Backfill material installed within six inches (6") of the conduit shall be free of rock or other solid material

that might cause mechanical damage to conduit. The backfill material shall be placed in layers not to exceed 6 inches (6") deep, and each layer shall be thoroughly compacted to the approximate density of the adjacent material before the next layer is placed. In lieu of tamped backfill material, Contractor may at his privilege use flowable backfill (CLSM) as specified in Section 2802.4. Four to six inches of backfill material directly below finished grade shall be topsoil. All disturbed areas shall be restored to the satisfaction of the Owner.

2804.5 Alternate Methods

Pushing, plowing, auguring, or boring may be used instead of trenching. Cable duct shall be plowed in. It shall be done by plow feeding the cable duct and the operation shall be non-injurious to the cables or duct. Where cable duct is plowed in, it shall be done by plow feeding the cable duct and the operation shall be non-injurious to the cables or duct. The cable duct shall be round and free of kinks as it is fed into the plow to ensure unrestricted movement of the wires and cables inside the duct. Pavement shall not be disturbed without the written permission of the Owner and then only in the event insurmountable obstructions are encountered. Conduit shall be placed under existing pavement by pushing, augering or boring. All disturbed areas shall be restored to the satisfaction of the Owner. Boring may be used instead of trenching at all other locations.

2804.6 Duct Joints

Duct shall be joined using materials and method recommended by the manufacturer. The interior shall be sufficiently smooth to prevent cable damage during pulling.

2804.7 Cable Splices

Distribution cables shall be continuous and unspliced from the control panel to the first light pole and between light poles. Cable shall be pulled with minimal dragging on the ground or pavement. Frame mounted pulleys or other suitable devices shall be used for pulling cables out of conduits into pull boxes. Powdered soapstone, talc or other approved lubricant shall be used to facilitate pulling cable in conduits. 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. Electrical tape shall be UL listed all weather vinyl plastic tape that is resistant to abrasion, puncture, flame, oil, alkalis and weathering. After cables are installed all conduit ends shall be sealed around the cables with a readily workable, soft, sealing compound. The compound shall be workable at 30° F and shall not melt or run at temperatures up to 175° F.

Underground cable splices shall be made in a pull or junction box. Splices in the distribution cable will only be permitted where circuits branch or tee. Tee splices shall be made with split bolt connectors or an approved equivalent. All splices shall be protected with a waterproof resin splice kit installed in accordance with the manufacturer's recommendations. All cables passing through a pull or junction box shall be coiled once around the inside of the box to allow for splicing and connecting wires in the future. Wiring within power supplies and boxes shall be neatly arranged and laced up.

2804.8 Pull or Junction Boxes

Pull or junction boxes shall be installed as shown on the Plans, Standard Drawings, or as directed by the Engineer. Pull or junction boxes shall not be installed in sidewalk ramps. In joint use boxes, cables shall be clearly identified as street light cables with permanent plastic tags. Additional pull boxes may be installed at the Contractor's expense when approved by the Engineer.

The top surface of all pull or junction boxes shall be flush with surfaced areas. For non-surfaced areas, the top surface of all pull or junction boxes shall be flush or a maximum of 1" above finish grade. All boxes shall have one-

half inch (½") clean crushed aggregate or other porous material for a minimum depth of twelve inches (12") below the box for drainage. The excavated opening outside the junction box shall be wide enough to allow compaction of the backfill material. Cinders, broken concrete, broken rock or other hard or undesirable material shall not be used for backfilling. The backfill material shall be placed in layers not to exceed six inches (6") deep, and each layer shall be thoroughly compacted before the next layer is placed. All disturbed areas shall be restored to the satisfaction of the Engineer.

If shown on the Plans or Standard Drawings, the cable hooks for pull or junction boxes shall be galvanized steel or brass with a minimum diameter of 3/8 inch and a minimum length of five inches (5").

2804.9 Surface Restoration

Disturbed areas shall be restored to a condition equal to or better than that existing prior to construction. Sidewalk and street cuts shall be restored in accordance with APWA Sections 2100, 2200, and 2300 or as directed by the Engineer.

SECTION 2805 OVERHEAD CABLE INSTALLATION

2805.1 Scope

This section governs the furnishing all labor, materials, and equipment necessary for the performance of all work required to install overhead cable where shown on the Plans or where directed by the Engineer. It includes installation of the cable, pole line hardware, anchors, guys, grounds, and connections. The work shall be done in accordance with these specifications, the Standard Drawings, the Special Provisions, the National Electrical Safety Code, and Utility Company requirements.

2805.2 Cable Installation

All terminations shall be by wedge clamp. Connections shall be made with bolted type connectors. When cut, the insulated conductors shall be secured to the messenger with aluminum tie straps.

SECTION 2806 EXTERNAL CONDUIT ON STRUCTURE

2806.1 Scope

This section governs the furnishing of labor, materials, and equipment necessary for the performance of all work required to install Galvanized Rigid Steel (GRS) conduit externally on structures. Conduit on structures will include conduit on bridges, retaining walls or other structures, and shall be installed as shown on the Plans, Standard Drawings, or as directed by the Engineer.

2806.2 Installation

The final location of all conduit and junction boxes shall be approved by the Engineer before installation begins. Conduit shall not be attached to prestressed concrete girders or prestressed, precast concrete deck panels. The conduit shall be secured to the concrete with clamps at no more than 5-foot intervals. Concrete anchors shall be in accordance with U.S. Government G.S.A. specification A-A-1923A, Type 4, and shall be galvanized in accordance with ASTM A 153, B 695-91 Class 50, or constructed of stainless steel. The minimum embedment in concrete shall be 1 3/4 inches. If it is necessary to anchor the conduit to steel bridge members, the attachment method shall not involve drilling, grinding or welding. Attachment method to steel members shall be approved by the Engineer. Expansion fittings shall be installed at each end of a bridge and each location where the conduit crosses a bridge

expansion joint. The expansion fitting shall provide a minimum movement in either direction as shown on the Plans, Standard Drawings, or as specified by the Engineer. Clamps, concrete anchors, expansion fittings, and any hardware or material required for conduit installation on structures shall be at the Contractor's expense.

SECTION 2807 FEED POINT INSTALLATION

2807.1 Scope

This section governs the furnishing of labor, materials, and equipment necessary for the performance of all work required to install the enclosure, cabinet, circuit breakers, fuses, contactor, photoelectric control, control cable, mounting pad, meter socket, and entrance cable, where shown on the Plans or where directed by the Engineer. The feed point shall be in accordance with the Plans, utility company requirements, the specifications, the Standard Drawings, and the Special Provisions.

2807.2 Coordination

The Contractor shall coordinate his activities with the utility company to insure delivery of power to the feed point when and where required.

2807.3 Installation

The cabinet shall be cleaned of wrapping, shipping material, dirt, grease, etc. Scratches, abrasions or other surface damage shall be repaired to like new condition. The photoelectric cell shall be oriented to the North or to the East.

2807.4 Wiring

Installation of wiring shall be in accordance with the Plans, Standard Drawings, and appropriate articles of the NEC. All circuits shall be properly labeled in all power supplies and boxes by means of permanent plastic identification tags appropriately attached to the cables by plastic ties or electrical tape. The ends of the copper wire should be wrapped with electrical tape. Circuits shall be labeled with the power supply ID number and the circuit number.

SECTION 2808 POLE AND LUMINAIRE INSTALLATION

2808.1 Scope

This section governs the furnishing of labor, materials, and equipment necessary for the performance of all work required to install the street lighting poles and luminaires and to connect the luminaires to the distribution system. Poles and luminaires shall be installed where shown on the Plans or where directed by the Engineer. Poles and luminaires shall be installed in accordance with the specifications, the Standard Drawings, and the Special Provisions.

2808.2 Wiring

The luminaire shall be connected to the distribution system through in-line, waterproof, breakaway fuse holders installed in the pole wiring, and fused as shown on the Plans or Standard Drawings. Sufficient slack shall be left in the pole wire so that the fuseholder can be brought out of the pole through the handhole for fuse replacement or disconnection. The wire shall be without splices from the fuse holder to the connection at the luminaire. In joint use poles, cables shall be clearly identified as street light cables with permanent plastic identification tags appropriately attached to the cables by plastic ties or electrical tape. The neutral shall not be fused.

2808.3 Pole and Luminaire Erection on a Concrete Foundation

No sooner than five days after construction of the foundation, a nut and washer shall be installed on each anchor bolt. The pole base shall be fastened to the foundation with a break-away base using galvanized hardware, except the 14-foot pole which does not require a break-away base. Using the break-away hardware or the lower nuts, the pole shall be brought into vertical alignment (plumb), the top nuts tightened, and the anchor bolt covers installed. The luminaire and arm 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 as shown on the Plans or Standard Drawings.

2808.4 Pole and Luminaire Erection on a Screw Anchor Foundation

The pole shall be fastened to the foundation with a break-away base using galvanized hardware except the 14-foot pole which does not require a break-away base. The pole shall be checked for plumb, minor corrections made using the break-away hardware or galvanized or cadmium plated steel shim stock, the nuts tightened and the anchor bolt covers installed. The luminaire and arm shall project from the street side of the pole and be perpendicular to the curb line.

2808.5 Bracket Arm Installation

Bracket arms for luminaires shall project from the street side of the pole and be perpendicular to the roadway. Install a rubber grommet around the hole at the top of the light pole for the cable entrance. Sufficient lengths of pole and bracket cable shall be run inside the length of the street light pole shaft, out through the grommet at the top of the pole, and through the bracket arm. The bracket arm is to be attached to the pole with clamp-on style or other approved supports using stainless steel hardware. Cables shall not be pinched when bracket arms are attached to poles.

For poles with dual luminaires, pole and bracket cables shall be identified by means of permanent plastic identification tags appropriately attached to the cables by plastic ties or electrical tape to indicate the directional orientation of each luminaire, unless otherwise specified by the Owner.

2808.6 Cover Skirt

If shown on the Plans or Standard Drawings, an aluminum cover skirt shall be installed around all sides of the base plate if a gap of more than one inch (1") is visible between the bottom face of the base plate and the finished grade. The cover skirt is to be field cut and shaped to fit flush against the base plate and extend down to the finished grade or top of base.

2808.7 Luminaire on Wood Pole

The luminaire and arm shall be installed on the wood pole as shown on the Plans or on the Standard Drawings. The luminaire and arm shall project from the street side of the pole and be perpendicular to the roadway unless shown otherwise on the Plans.

2808.8 Luminaire on Mast Arm Pole

The luminaire slipfitter shall be installed on the davit supplied with the mast arm pole. Internal wiring shall be as specified in Section 2808.2. The luminaire and davit shall project from the street side of the pole and be perpendicular to the roadway unless shown otherwise on the Plans or Standard Drawings.

2808.9 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, unless shown otherwise on the Plans or Standard Drawings.

2808.10 Lamp Installation

The installation date shall be marked on the base of the lamp prior to installing it in the luminaire housing.

2808.11 Clean Up

Poles and luminaires shall be cleaned of wrapping, shipping material, dirt, grease, etc. Scratches, abrasions or other surface damage shall be repaired to like new condition.

SECTION 2809 GROUNDING

2809.1 Scope

This section governs the furnishing all labor, materials, and equipment necessary for the performance of all work required to install grounding for the street lighting system. Grounding shall be installed where shown on the Plans, Standard Drawings, or where directed by the Engineer. Grounding shall be installed in accordance with the specifications, the Standard Drawings, and the Special Provisions.

2809.2 Individual Ground

All electrical systems, equipment and appurtenances, including poles and feed points, shall be properly grounded in accordance with NEC requirements. A minimum ½-inch by 10-foot copper grounding rod shall be driven into the bottom of the trench adjacent to the pole or feed point foundation so that top of the rod is a minimum of twelve inches (12") below finished grade. All connections to ground rods shall be a minimum No. 6 AWG copper wire made with exothermic welds or compression clamps as directed by the Engineer. The ground wire is to be run through a one inch (1") diameter conduit in the base. At the feed point, the grounding wire shall connect to the neutral bus and the enclosure.

On a wood pole, the grounding wire shall go up the pole and fasten to the luminaire or the arm. The lower eight feet (8') of the grounding wire on a wood pole shall be covered with standard molding. If an existing utility ground is available, the grounding wire should connect to it instead of another ground rod.

If subsurface conditions exist which prohibit the placement of the ground rod in a vertical position, the rod may be driven at an oblique angle, not to exceed 45-degrees from vertical, or when authorized by the Engineer, buried in a trench a minimum of twenty-four inches (24") below finished grade.

2809.3 System Ground

A minimum ½-inch by 10 foot copper grounding rod shall be driven into the bottom of the trench adjacent to the feed point foundation so that the top of the rod is a minimum of twelve inches (12") below finished grade. All connections to ground rods shall be a minimum No. 6 AWG copper wire made with exothermic welds or compression clamps as directed by the Engineer. The ground wire is to be run through a one inch (1") diameter conduit in the base. At the feed point, the grounding wire shall connect to the neutral bus and the enclosure.

A neutral conductor is required for each branch circuit. At each pole, the neutral conductor shall be connected to the ground connector inside the pole shaft.

SECTION 2810 SYSTEM TESTING AND ACCEPTANCE

2810.1 Scope

This section governs the furnishing all labor, materials, and equipment necessary for the performance of all work required for system testing and acceptance in accordance with the specifications, the Standard Drawings, and the Special Provisions.

2810.2 Cable Testing

Prior to final inspection, the Contractor shall test all cables for unscheduled grounds. Each conductor shall be tested to ground with a megohmeter at 500 volts. Readings in each case shall be infinity. The resistance test shall be performed by the Contractor in the presence of and documented by the Engineer. The ground rod shall have a resistance to ground of 25 ohms or less. If the resistance is more than 25 ohms, the Contractor shall install additional ground rods which are bonded to the first ground rod, until the required resistance is achieved. No payments will be made for additional ground rods.

2810.3 Operational Testing

The Contractor is responsible for testing the completed street lighting system. Prior to acceptance, the Contractor shall notify the Engineer for an inspection as soon as the system is ready. All street lighting system elements shall function properly as a complete system for a minimum period of fifteen (15) days before acceptance is granted. The fifteen (15) day period shall be cyclical and initiated by the Engineer. Any malfunction observed or recorded shall stop the test period for the entire system as of the time of the malfunction. A period shall start when the malfunction has been repaired to the satisfaction of the Engineer. After the burn test is completed, the street light system must remain in operation if the street is open to vehicle traffic.

2810.4 Maintenance Information

Before acceptance of the work, the Contractor shall furnish the Owner four (4) copies of the manufacturers' written instructions for maintenance and operation of all lighting equipment and wiring diagrams of the installation or system. At a minimum, the manufacturer's instructions shall include documented, organized instructions, wiring and component layout diagrams, and parts lists with part numbers.

2810.5 As-Built Plans

Prior to acceptance of the work, the Contractor shall submit marked-up or corrected Plans showing in detail all construction changes, especially the location and depth of conduit.

2810.6 Final Clean Up

Before final acceptance, the Contractor shall restore to a condition equal to or better than that existing prior to construction, for all property, both public and private, within, adjacent to and beyond the limits of construction that have been disturbed or damaged while executing the work. This includes, but not limited to, existing curb and gutter, sidewalk, pavement, drainage structures, irrigation systems, street lighting and traffic signal equipment. All unpaved areas damaged during construction shall be restored to the original condition. Unless otherwise directed, grassy

areas which were originally sodded shall be re-sodded. Restoration work shall be at the Contractor's expense. All restoration work shall be acceptable to the Engineer.

SECTION 2811 REMOVALS AND RELOCATIONS

2811.1 Scope

This section governs the furnishing all labor, materials, and equipment necessary for the performance of all work required for the removal and/or relocation of the street lighting system as shown on the Plans and in accordance with the specifications, the Standard Drawings, and the Special Provisions.

2811.2 Removals and Relocations

All removals and/or relocations shall be noted and identified on the Plans. An itemized removal schedule and/or relocation plan shall be submitted. Any damage sustained to the lighting unit during the removal or relocation operation shall be repaired, or replaced in kind, to the satisfaction of the Engineer at the Contractor's expense. Site restoration shall conform to these specifications.

A. Removals: This item shall consist of the disconnection and removal of poles, aerial and underground cables, luminaires, all associated apparatus, connections and backfilling the pole holes and other associated work specified herein. Abandoned section of buried cable shall be de-energized at its power source, taped and labeled “abandoned”. All equipment and materials, except for luminaires and bracket/mast arms, shall become property of the Contractor and shall be removed from the site, unless otherwise specified on the Plans.

B. Relocations: The re-use of existing poles and appurtenant items will be acceptable under this item, upon physical inspection and approval by the Engineer. Any additional cable, splices and other materials required to make the relocated pole operational shall be at the Contractor’s expense.

SECTION 2812 MEASUREMENT AND PAYMENT

2812.1 General

There shall be no measurement or separate payment for any items of work, appurtenances, incidental work or parts not specifically identified or listed in the Contract Documents and all costs pertaining thereto shall be included in the Contract unit prices for other items which are listed in the Contract Documents.

2812.2 Method of Measurement

The quantities of accepted work will be measured or determined as follows:

A. Pole Foundations: Pole foundations will be measured per each for each type listed in the Contract Documents.

B. Trenching: Trenching will be measured along the trench from center of facility to center of facility to the nearest 0.1 linear foot.

C. Conduit: Conduit will be measured along the conduit from center of facility to center of facility to the nearest 0.1 linear foot.

D. Underground Cable: Underground cable will be measured along the trench line from center of facility to center of facility to the nearest 0.1 linear foot for each size of cable installed. Five (5) feet shall be added to the measured length for each entry into and for each exit from foundation, service entrance and junction box. Twenty-five (25) feet shall be added to the measured length for each connection to the overhead cable system. The measured ground length, plus additions, multiplied by the number of cables in the trench equals the number of cable feet. For measurement purposes, a cable is defined as the group of conductors required to complete a circuit. A cable will normally consist of two conductors plus, if specified, a neutral conductor. If preassembled "cable in duct" is specified. The cable will consist of the duct and all conductors contained therein.

E. Overhead Cable: Overhead cable will be measured on the ground along the pole line from center of facility to center of facility, to the nearest 0.1 linear foot.

F. Feed Points: Feed points will be measured per each for each type listed in the Contract Documents.

G. Poles and/or Luminaires: Poles and/or luminaires will be measured per each for each type listed in the Contract Documents.

H. Pull or Junction Boxes: Pull or junction boxes will be measured per each for each type listed in the Contract Documents.

I. Spare Equipment: Spare equipment will be measured per each for each type listed in the Contract Documents.

J. Removals: Removals will be measured as one per Contract.

K. Relocations: Relocations will be measured as one per Contract.

L. Street Lighting System: Street Lighting System will be measured as one per Contract.

2812.3 Basis of Payment

Payment for quantities of accepted work will be made as follows when included in the Contract Bid Items:

A. Pole Foundations: Pole foundations will be paid for by one of the following:

1. Contract unit bid price.

2. Contract lump sum bid price.

B. Trenching: Trenching will be paid for by one of the following:

1. Contract unit bid price.

2. Contract lump sum bid price.

C. Conduit: Conduit will be paid for by one of the following:

1. Contract unit bid price.

2. Contract lump sum bid price.

D. Underground Cable: Underground cable will be paid for by one of the following:

1. Contract unit bid price.

2. Contract lump sum bid price.

E. Overhead Cable: Overhead cable will be paid for by one of the following:

1. Contract unit bid price.

2. Contract lump sum bid price.

F. Feed Points: Feed points will be paid for by one of the following:

1. Contract unit bid price.

2. Contract lump sum bid price.

G. Poles and/or Luminaires: Poles and/or luminaires will be paid for by one of the following:

1. Contract unit bid price.

2. Contract lump sum bid price.

H. Pull or Junction Boxes: Pull or junction boxes will be paid for by one of the following:

1. Contract unit bid price.

2. Contract lump sum bid price.

I. Spare Equipment: Spare equipment will be paid for by one of the following:

1. Contract unit bid price.

2. Contract lump sum bid price.

J. Removal: Removal will be paid for at the Contract lump sum bid price.

K. Relocation: Relocation will be paid for at the Contract lump sum bid price.

L. Street Lighting System: The complete, functioning street lighting system including all equipment, materials, labor, supervision, and other ancillary requirements to construct the street lighting system depicted on the Plans will be paid at the Contract lump sum bid price.

END OF SECTION