

## SECTION 992 HIGHWAY LIGHTING MATERIALS

### 992-1 Basic Design Criteria.

**992-1.1 General:** Unless otherwise specified in the plans or the specifications, the light poles and bracket arms shall be in accordance with the requirements of the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, and with the specific requirements contained in this Section.

**992-1.2 Wall Thickness of Steel Poles:** The minimum wall thickness for galvanized steel poles shall be 0.1196 inch (11 gauge).

**992-1.3 Design Calculations:** The Contractor shall submit for approval, design calculations of the light poles (including bracket arms) and anchor bolts.

**992-1.4 Light Pole Assembly:** The light pole assembly shall conform to the applicable requirements of IES, EEI, and NEMA (Illuminating Engineering Society, Edison Electric Institute, and National Electrical Manufacturers Association).

### 992-2 Light Poles.

**992-2.1 Galvanized Steel:** Unless otherwise shown, galvanized steel light poles shall be one piece, continuous-tapered, round or octagonal poles and shall be manufactured from one length of steel sheet, formed in continuous tapered tube, with one continuous arc-welded vertical seam. They shall be galvanized in accordance with ASTM A 123.

**992-2.2 Aluminum:** Aluminum light poles shall be one piece, continuous-tapered, round or octagonal shaft, of high-strength, corrosion-resistant aluminum, and of approved alloy meeting the requirements for the design as specified in 992-1.

**992-2.3 Length:** The poles shall be of such length as to provide the approximate luminaire mounting height shown in the plans or directed by the Engineer.

**992-2.4 Bases:** Anchor base poles shall have a wiring hand hole with a weatherproof metal cover near the base, with a grounding lug located inside the pole near the hand hole. Transformer base poles shall have a grounding lug in the transformer base. A heavy cast base shall be attached to the lower end of each shaft by a continuous arc weld, inside and outside of the shaft, or by a combination of arc welding and a press fit, subject to the approval of the Engineer. The base shall be arranged for anchoring to a transformer base or a concrete foundation with four anchor bolts 1 inch (minimum size), unless otherwise shown in the plans.

**992-2.5 General:** The lighting pole assembly shall conform to the applicable requirements of IES, EEI and NEMA. The base shall be provided with the necessary anchorage, hardware, and bolt covers. An ornamental cap shall be provided to fit over the top of the pole to exclude moisture. All poles not located behind guardrail or bridge rail, or that are not wall mounted, shall be frangible, except as shown in the plans.

### 992-3 Bracket Arms.

Steel or aluminum bracket arms shall be of truss-type construction, consisting of upper and lower members with vertical struts, and shall have the luminaire end formed to accommodate a 2 inch pipe slipfitter. The bracket arms shall meet the design requirements of 992-1. Bracket arms shall be attached to either steel or aluminum poles, with machine bolts and pole adapters, unless approved otherwise.

Steel bracket arms shall be used with steel standards, and aluminum bracket arms shall be used with aluminum standards.

Steel brackets shall be galvanized in accordance with ASTM A 123.

#### **992-4 Luminaires, Ballasts, etc.**

Luminaires shall consist of a precision-cast aluminum housing and reflector holder, a refractor-holder latch on the street side, and a hinge with a safety catch on the house side of the luminaire; also a slipfitter suitable for attaching to a 2 inch mounting bracket, gasketing between the reflector and the refractor and the socket entry, an adjustable bracket capable of producing the specified IES type light distributions, and a heat-resistant, high-transmission glass prismatic refractor. Luminaires may be mercury vapor, metal halide, or high pressure sodium vapor, as indicated in the plans.

Unless otherwise indicated in the plans, the luminaires shall have internal ballasts of the regulated output (constant wattage) type, suitable for operating on the circuits shown in the plans. The ballasts shall be pre-wired to the lamp socket and terminal board, requiring only connection of the power-supply leads to the ballast primary terminals. The efficiency of the ballast shall be at least 84% and the power factor shall be at least 95%. The ballast shall provide for regulation within  $\pm 2\%$  variation in lamp watts and a primary voltage variation of  $\pm 10\%$ .

The luminaires shall meet the requirements shown in the plans.

**992-4.1 Certification:** The Contractor shall provide the Engineer a certification conforming to the requirements of Section 6 from the manufacturer of the luminaries and electrical ballasts confirming that the requirements of this Section are met. Each certification shall cover only one LOT for luminaries and/or electrical ballasts.

#### **992-5 Conductors.**

The conductors shall be color-coded and, unless otherwise shown in the plans, the conductors shall be as called for below.

Service conductors shall be stranded copper, single-conductor cable, Type RHW or THW and shall not be smaller than No. 6 AWG.

Direct-burial cable shall meet the same classification requirements as the service conductors except it shall be approved for direct burial.

Pole and bracket cable shall be a stranded cable, Type RHW or THW, and shall not be smaller than No. 10 AWG.

Roadway lighting cable shall meet the same classification requirements as the service conductors.

Underdeck structure lighting conductors shall be Type RHW or THW and shall not be smaller than No. 12 AWG.

Bonding ground conductor shall be bare (or have a green jacket) and shall be No. 6 AWG or larger.

#### **992-6 Conduit.**

**992-6.1 General:** Conduit shall, in general, be rigid steel. Polyvinyl-chloride conduit may be used in lieu of rigid steel when the conduit is embedded in concrete, and elsewhere if called for or if specifically approved by the Engineer.

**992-6.2 Rigid Steel:** Rigid steel conduit shall be hot-dip galvanized and each 10 foot length shall carry the Underwriter's seal of approval.

**992-6.3 Polyvinyl-Chloride:** Polyvinyl-chloride conduit shall be high-impact, Schedule 40, and each 10 foot length shall carry the Underwriter's seal of approval.

**992-6.4 Electrical Grounds:** The electrical ground rods shall be made of corrosion-resistant clad steel or other material as may be permitted by the plans or approved by the Engineer.

#### **992-7 Ducts.**

**992-7.1 Type I Duct:** Type I duct is a light wall duct. It shall be made by a recognized manufacturer, specifically for use in concrete-encased electrical duct work. The duct material may be asphalt-impregnated fibers or a plastic material such as styrene. The joints shall be watertight and the bore smooth. The concrete encasement shall be of Class I Concrete, at least 3 inches in thickness.

**992-7.2 Type II Duct:** Type II duct is a heavy wall duct, which shall be made by a recognized manufacturer, specifically for use as a direct-burial duct. The materials and workmanship shall be as noted for Type I duct but the walls shall be thicker to withstand the greater pressure and impact.

#### **992-8 Fittings, Pull-boxes, and Bends.**

Fittings, pull-boxes, bends and miscellaneous hardware shall be in accordance with the National Electrical Code and shall be compatible with the adjacent conduit and materials.

#### **992-9 Wooden Service Poles.**

**992-9.1 General:** Wooden service poles shall meet the requirements of ANSI (ASA) and shall be at least 35 feet in length. The pole shall be Class 5 unless otherwise specified on the plans or in the specifications.

**992-9.2 Treatment:** Poles shall be treated in accordance with ASTM D 1760, Pressure Treatment of Timber Products, with the exceptions and additions as specified herein. Pressure treatment shall be with creosote oil, pentachlorophenol solution, or salt preservative meeting the requirements of 955-4 with the restriction that poles treated with pentachlorophenol solution shall not be used in a salt water nor brackish water environment.

##### **992-9.3 Retention of Preservative:**

**992-9.3.1 Creosote Oil:** Retention shall be at least 9 lb/ft<sup>3</sup> of wood.

**992-9.3.2 Pentachlorophenol Solution:** Minimum retention shall be 0.45 pound of dry pentachlorophenol chemicals per cubic foot of wood.

**992-9.3.3 Salt Preservative (Chromated Copper Arsenate):** Minimum retention shall be 0.60 pound of CCA oxide per cubic foot of wood.

**992-9.3.4 Measuring Retention:** With all preservatives, retention shall be by assay of sample from the 0.50 to 2.00 inch zone, performed and certified to by the treating company.

##### **992-9.4 Penetration of Preservative:**

**992-9.4.1 Determination:** Penetration shall be determined as specified in 955-6.4.

**992-9.4.2 Sapwood Penetration:** Sapwood penetration shall be as specified in 955-6.2.

**992-9.5 Retreatment:** Retreatment, when necessary, shall be as specified in 955-6.3.

**992-9.6 Mounting Height:** Mounting height of all equipment and lines shall meet the requirements of the latest edition of the National Safety Code, the local ordinances, and the specifications of the connecting utility.

**992-10 Protection of Light Poles.**

Each metal pole shall be appropriately and adequately protected by “tire wrapping” with heavy paper, or by some other effective means, so that no chipping, gouging, or other significant surface damage will be incurred during transit or installation. The poles, when installed, shall be clean and uniformly free from dark streaks and discoloration.

**992-11 Concrete Foundations for Light Poles.**

The concrete foundations for the light poles shall be of Class I concrete unless otherwise shown in the plans. They may be either precast or cast-in-place. The foundation design shall be as recommended by the pole manufacturer and as approved by the Engineer.

**992-12 Pole Cable Distribution System.**

**992-12.1 Conductor Splices:** Unless otherwise authorized by the Engineer, splices shall be made with split bolt connectors. The connector shall be sealed in silicone gel that easily peels away leaving a clean connection. The gel will be contained in a closure that when snapped around the split bolt will provide a waterproof connection without the use of tools or taping. This closure will be UV resistant, impact resistant and abrasion resistant.

**992-12.2 General (Roadway Lighting):** These requirements are applicable for all systems rated up to and including 600 V.

The installed system shall be in compliance with the Design Standards, Index No. 17500, or as an alternate, shall meet the following requirements:

A modular color coded cable system consisting of rubber cords with integrally molded watertight submergible connectors, inline fuses, submergible surge arrestor and breakaway connectors shall be installed. The cables shall extend from a underground junction box near the base of the pole to the luminaires at the top of the pole. A cable system shall be required at each pole.

The cable system shall consist of the following described components:

**Distribution Block:** The red molded body shall contain a three wire female outlet integrally molded to a 24 inch length of 12/3 SOWA cable with an end molded to the body and the other end shall be spliced in the field to the distribution cable that feeds through the underground junction box near the base of the pole. The block shall be watertight and submergible when the integrally fused plug on the power cable is engaged and fully seated. Dimensions shall be approximately 2 by 3 by 3 inches. The size is important because of limited space.

**Surge Arrestor Cable:** Provide a 12 inch length of 10/2 SOWA cable with a red male plug to match the red female connector cable extending from the fused plug on the power cable. The other end of the surge arrestor cable shall be integrally molded to a MOV submergible surge arrestor. The red male plug shall make a submergible connection when mated to the red female connector on the power cable.

**Power Cable:** This cable feeds the Luminaire Cable and the Surge Arrestor Cable from the load side of its integrally fused red male plug end. The red fused plug shall contain FNQ 10 amp 600 volt fuses (13/32 by 1 1/2 inch) or equal. A solid copper slug shall be

installed on neutral side for line to neutral service. Both lines shall be fused for line to line service. The section that feeds the Luminaire Cable shall be a 10 foot section of 14/3 SOWA cable with an orange female connector molded to the end extending up into the base of the pole. This female connector shall pass easily through a standard size 35 PVC elbow and make a submergible connection when mated with the orange male plug on the Luminaire Cable. The section that feeds the Surge Arrestor Cable shall be 12 inches in length of 10/2 SOWA cable with a red female connector on the end. The red female connector shall make a submergible connection when mated to the red male plug on the Surge Arrestor Cable.

Luminaire Cable: This cable is a variable length of 14/3 SOWA cable with an orange male molded plug molded to match the orange female end of the Power Cable. The connector shall require 25 pounds of force to mate or disengage from the female end. When engaged, the connection shall be watertight and submergible. The cable strain relief shall extend approximately 2 inches from the connector. The length of the cable shall be the length of the pole and support arm plus 5 feet.

The Distribution Block and each connector shall be made of thermosetting synthetic polymer which is non-flame supporting and which remains flexible over a temperature range of -40 to 190°F. Hardness of the molded rubber shall be 65 durometer.

**992-12.2.1 Testing and Performance Criteria:** The system shall pass the following performance criteria in accordance with NEC 110.2:

Dielectric Test - No breakdown shall occur with a test potential of 1,960 volts applied between the primary conductors (tied together) and the protective ground for a period of one minute.

Leakage Current Test - Leakage current shall be measured on the mated connectors between the primary conductors and the protective ground conductor. When tested at the rated operating voltage, the leakage current shall not exceed 0.5 mA. The mated connectors shall then be wrapped in aluminum foil and the leakage current measured between the primary conductors and the foil wrap. When tested at the rated operating voltage, the leakage current shall not exceed 0.5 mA.

Flame Retardant Test - Flammability tests shall be conducted on the cable, the molded body of the connectors, and the molded protective caps. These materials shall be subjected to five flame applications on for 15 seconds and off for 15 seconds. The materials shall self-extinguish within one minute upon removal of the flame and not burn through.

Internal Temperature Test - The internal temperature rise of the contact area of the mated connectors shall not exceed a temperature rise of 54°F referenced to 73°F ambient temperature when operated at the maximum current rating.

External Temperature Test - The external temperature rise of the mated connectors and cable shall not be greater than 54°F referenced to 73°F ambient temperature when operated at the maximum current rating.

Fault Test - The mated connectors shall be fault tested by applying a test current of .1,000 amperes, 60 HZ, for a minimum of 3 cycles (50 ms). The mated connectors shall then satisfactorily pass the dielectric test.

Drop Test - The connectors shall not break, crack or suffer other damage when subjected to eight consecutive drop tests from 3 feet above the concrete floor with the connectors having been rotated 45 degrees between each drop.

Crushing Test - No breakage or deformation shall result when the mated and unmated connectors are subjected to a crushing force of 500 pounds for one minute. Following the crush test, the dielectric test shall be satisfactorily passed.

Impact Resistance Test - No breakage or deformation shall result when the connectors are subjected to an impact caused by dropping a cylindrical 10 pound weight having a flat face 2 inches in diameter from a height of 18 inches.

Flex Test - No detachment or loosening shall result when each connector is subjected to a 5,000 cycle flex test at the cable/bond area back and forth in a plane through an angle of 180 degrees. Following the flex test the dielectric test shall be satisfactorily passed.

No Load Endurance Test - No excessive wear shall result when the male and female connectors and protective cap and female connector were subjected to 2,000 cycles of complete insertion and withdrawal.

Rain Test - The mated and capped connectors shall be subjected to a continuous water spray (simulating worst case outdoor rain down pour) for at least one hour at a rate of at least 18 inches per hour at an operating pressure of 5 psi. The dielectric and leakage current tests shall be satisfactorily passed. The connectors shall be unmated and caps removed. Inspection shall indicate that water had been successfully prevented from reaching the contact areas of the connectors.

Watertight (Immersion) Tests - The mated and capped connectors shall be immersed in water for one hour in which the highest point of the test samples is at least 3 feet below the water level. Immediately following the immersion, a satisfactory dielectric and leakage current tests shall be performed. The connectors shall be unmated and caps removed. Inspection shall indicate that water had been successfully prevented from reaching the contact areas of the connectors.

Exposure to Deteriorating Liquids - The cable and connectors shall be dried at 212°F for one hour. The samples shall then be immersed in ASTM Reference Oil No. 1 and ASTM Reference Fuel C liquids for one hour. The samples shall show no evidence of bubbling, cracking or corrosion. Within one hour after being removed from the fluids, the test samples shall satisfactorily pass the flammability test.

**992-12.2.2 Qualified Products List:** Pole Cable Distribution Systems installed as alternates to the Design Standards, Index No. 17500, shall be one of the products listed on the Qualified Products List. Manufacturers seeking evaluation of their product shall submit an application in accordance with Section 6.

**992-12.3 General (Highmast Lighting):** These requirements are applicable for all systems rated up to and including 600 V.

A modular cable system consisting of rubber covered cables with watertight connectors, and surge arrestor shall be installed. The cables shall extend from an underground junction box near the base of the pole to the luminaires at the top of the pole. A cable system shall be required at each highmast pole.

Power Cable: This cable shall be a 15 foot section of 10/3 SOWA cable that is wired to the line side of the Circuit Breaker in the pole and the other end shall be spliced to the distribution cable that feeds through the underground junction box near the base of the pole.

Circuit Breaker Cable: This cable is a 8 foot length of 10/3 SOWA cable with no connector at the end that is fed from the load side of the circuit breaker and a female connector on the other end. This female connector shall mate with the male plug on the pole cable, the male flanged receptacle on the ring junction box, and also the male plug on the lowering hoist.

Pole Cable: The length of this cable is the mounting height of the pole plus 6 feet. The cable shall be 10/3 SOWA with a male plug on one end that mates with the connector on the circuit breaker cable. The other end fits under the lugs in junction box mounted on the fixture ring at the top of the pole.

Junction Box Cable: This cable is a 3 foot length of 10/3 SOWA cable with a female connector on one end that fits the male flanged receptacle on the ring mounted junction box. The other end shall fit under the same lugs as the pole cable.

Junction Box Male Flanged Receptacle: This male flanged receptacle shall mate with the junction box cable. The back of the flanged receptacle shall be wired to the fixture bus in the junction box.

The plugs, connectors and receptacles in the highmast system shall meet the requirements of NEMA 6 or IP 67.

Surge Arrestor: The surge arrestor shall be installed in the circuit breaker panel.

**992-12.4 General (Wall Mounted Lighting):** These requirements are applicable for all bridge mounted and barrier wall mounted systems rated up to and including 600V.

A cable system consisting of rubber covered cables, in-line fuses and a surge arrestor shall be installed. The cables shall extend from a junction box in the wall to the luminaire at the top of the pole.

A 14/3 SOWA cable shall be spliced to the distribution cable in the junction box and feed in-line fuses and a surge arrestor located in the junction box. The fuses shall be FNQ 10 amp 600 volt fuses. A solid copper slug shall be installed on the neutral side for line to neutral service. Both lines shall be fused for line to line service. The surge arrestor shall be connected on the load side of the fuses. The cable shall continue to the luminaire at the top of the pole.