

ORIGINATION FORM

Date: December 5, 2011
Originator: Chester A. Henson
Contact Information: 414-4117

Specification Title: Highway Lighting Materials
Specification Section, Article, or Subarticle Number: Section 992

Why does the existing language need to be changed? Specification was difficult to apply and not up to date.

Summary of the changes: Moved all specification information on Design Standards to specification. Reorganized specification to indicate general requirements and specific requirements for different highway lighting categories.

Are these changes applicable to all Department jobs? If not, what are the restrictions? Yes

Will these changes result in an increase or decrease in project costs? If yes, what is the estimated change in costs? Nominal

With who have you discussed these changes? Specifications, LESS Committee, Industry.

What other offices will be impacted by these changes?

Are changes needed to the PPM, Design Standards, SDG, CPAM or other manual? Yes changes were made to the Design Standards.

Is a Design Bulletin, Construction Memo, or Estimates Bulletin needed? No

Contact the State Specifications Office for assistance in completing this form.
Rudy Powell 850-414-42820 rudy.powell@dot.state.fl.us
Frances Thomas 850-414-4101 frances.thomas@dot.state.fl.us
Debbie Toole 850-414-4114 deborah.toole@dot.state.fl.us
Andy Harper 850-414-4127 clifton.harper@dot.state.fl.us



Florida Department of Transportation

RICK SCOTT
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

ANANTH PRASAD, P.E.
SECRETARY

M E M O R A N D U M

DATE: December 14, 2011

TO: Specification Review Distribution List

FROM: Rudy Powell, State Specifications Engineer

SUBJECT: Proposed Specification: **9920000 Highway Lighting Materials.**

In accordance with Specification Development Procedures, we are sending you a copy of a proposed specification change.

This change was proposed by Chester Henson to move all specification information on Design Standards to the specification and to reorganize the specification to indicate general and specific requirements for the different highway lighting categories.

Please share this proposal with others within your responsibility. Review comments are due within four weeks and should be sent to Mail Station 75 or to my attention via e-mail at SP965RP or rudy.powell@dot.state.fl.us. Comments received after **January 11, 2011**, may not be considered. Your input is encouraged.

RP/cah
Attachment

HIGHWAY LIGHTING MATERIALS.
(REV 12-5-11)

SECTION 992 (Pages 966 – 973) is deleted and the following substituted:

SECTION 992
HIGHWAY LIGHTING MATERIALS

992-1 ~~Design Criteria~~ *General*.

992-1.1 *Pole Design Criteria* ~~General~~: 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, the FDOT Structures Manual and with the specific requirements contained in this Section.

992-1.2 *Luminaires* ~~Wall Thickness of Steel High Mast Poles~~: *Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by a Nationally Recognized Testing Laboratory acceptable to the Department.* ~~The minimum wall thickness for galvanized steel poles shall be 0.1793 inch (7 gauge).~~

992-1.3 *Conductors* ~~Light Pole Assembly~~: *All conductors shall be color-coded stranded copper meeting the requirements of NEMA WC 70.* ~~The light pole assembly shall conform to the applicable requirements of IES, EEL, and NEMA (Illuminating Engineering Society, Edison Electric Institute, and National Electrical Manufacturers Association).~~

Service and circuit conductors shall be single-conductor cable Type THWN-2 and shall not be smaller than No. 6 AWG.

~~_____ Pole and bracket cable shall be multi-conductor Type XHHW-2 XLP TC with three No. 10 AWG.~~

~~_____ 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 not be smaller than No. 6 AWG.

992-1.4 *Conduit*: ~~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.~~ *Conduit shall be used in accordance with the National Electrical Code and as specified in the plans. All conduit shall be UL listed and meet the following material requirements:-*

992-1.4.1 *Rigid Metal Conduit* ~~Steel~~: *Rigid steel conduit shall meet the requirements of UL 6. The steel conduit shall be hot-dip galvanized with a minimum coating of 1.24 oz/ft² on both the inside and outside of the conduit. The weight of the zinc coating shall be determined using ASTM A 90.* ~~and each 10 foot length shall carry the underwriter's seal of approval.~~

992-1.4.2 *Polyvinyl-Chloride*: *Polyvinyl-chloride conduit shall be high impact, Schedule 40 or Schedule 80 conduit meeting the requirements of UL 651.* ~~and each 10 foot length shall carry the Underwriter's seal of approval.~~

992-1.4.3 *Rigid Aluminum*: *Rigid aluminum conduit shall meet the requirements of UL 6A.*

992-1.4.4 High Density Polyethylene (HDPE): HDPE conduit shall meet the requirements of UL65 651A.

992-1.4.5 Liquid tight Flexible Metal: The conduit shall meet the requirements of UL 360.

992-1.5 Electrical Ground Rod: The electrical ground rods shall be 5/8 inch copper clad steel. Electrical ground rods shall be sectional type where length exceeds 10 feet.

~~**992-1.6 Ducts:**~~

~~**992-1.6.1 Type I Ducts:** 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 1 Concrete, at least 3 inch in thickness.~~

~~**992-1.6.2 Type II Ducts:** 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 wall shall be thicker to withstand the greater pressure and impact.~~

992-1.6.7 Fittings and Bends: Fittings, bends and miscellaneous hardware shall be in accordance with the National Electrical Code (NEC) and shall be compatible with the adjacent conduit and materials.

992-1.7 Conductor Splices: Unless otherwise shown in the Design Standards or authorized by the Engineer, splices shall be made with compression sleeves or 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.

992-1.8 Pull Boxes: Pull boxes shall meet the requirements of Section 635, except that the minimum size for highway lighting shall be 13 inches wide, 24 inches long and 12 inches deep. The cover shall be marked light "lighting" and shall be bonded to the ground rod if of metal construction.

992-1.9 Distribution Service Point Equipment: All electrical equipment shall provided with 75° C terminal lug connectors.

992-1.9.1 Service Main: Two pole 480 V, 25,000 A/C, solid neutral, NEMA 4X stainless steel, enclosed circuit breaker rated for service entrance.

992-1.9.2 Control Panel Enclosure: NEMA 4X stainless steel enclosure ground mounted per Design Standards No. 17736. Dimensions shall be as necessary for equipment inside.

992-1.9.3 Control Panel Main Disconnect: Single phase, 480V, 2-wire with ground bus in NEMA 1 enclosure, with two pole, 18,000 A/C branch circuit breakers. Number and rating of branch circuit breakers shall be as indicated in plans.

992-1.9.4 Lighting Contactor: Two pole, 120V electrical contactor in NEMA 1 enclosure.

992-1.9.5 Electrical Panel: Two pole, 480V, 25,000 A/C with solid neutral in NEMA 1 enclosure.

992-1.9.6 Surge Protection Device: Surge protective device shall be Type 1, UL listed to 1449, 3rd Edition. Surge current rating on per phase basis shall equal or exceed 50KA.

I-nominal rating shall be 10KA or 20KA. Modes of protection shall include L-G and N-G having UL 1449-3 Voltage Protection Ratings of 2000V or lower.

992-2 Conventional Lighting Light Poles.

992-2.1 Poles Galvanized Steel: *Poles for conventional lighting shall be aluminum or an alternative pole approved on the Qualified Products List (QPL) unless otherwise shown in the plans. Aluminum light poles shall be round, one piece, continuous-tapered high-strength aluminum, and of an approved alloy meeting the requirements of the Design Standards. The poles shall be of such length as to provide the approximate luminaire mounting height shown in the plans. Poles installed on bridges, walls and concrete median barriers shall be equipped with internal vibration damping devices.*

Alternate pole materials to aluminum such as stainless steel may be used when listed on the QPL. Manufacturers seeking evaluation of their product shall submit an application in accordance with Section 6, accompanied by drawings and calculation indicating their product meets the requirements of 992-1. Galvanized steel high mast poles shall be continuous tapered, round or minimum of 12 sided poles. Each section 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.

992-2.1.12 Concrete Poles Aluminum: *Concrete poles may be used only when specified in the plans. When specified, concrete poles shall meet the requirements of Section 641 and Design Standards Index No. 17725 for a Type P-III pole. Aluminum light poles shall be round, one piece, continuous tapered, high-strength aluminum, and of an approved alloy meeting the requirements of the Design Standards.*

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: *Aluminum poles shall be installed on transformer bases with the exception of lights installed on bridge pilasters or on top of median barrier. 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.*

992-2.3 Bracket Arms: *Bracket arms shall be aluminum, 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 992-1.1 and 992-1.3. Bracket arms shall be attached to aluminum poles, with machine bolts and pole adapters, unless approved otherwise.*

992-2.4 Luminaires, Ballasts, etc.: *Luminaires shall consist of a precision-cast aluminum housing and reflector holder, and a heat resistant, high-transmission glass prismatic refractor. Luminaire housing shall have a refractor-holder latch on the street side, and a hinge*

with a safety catch on the house side of the luminaire; ~~also~~ *and* a slipfitter suitable for attaching to a 2 inch mounting bracket. *Pole top mounted luminaires which shall have a 2 inch tenon. Housing shall have*; 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 induction, metal halide, or~~ *shall be* high pressure sodium vapor; ~~as~~ *unless otherwise* indicated in the plans.

High-pressure sodium lamps shall meet the following requirements: NEMA C78.42, CRI 21 (Min.), CCT 2100 K and average rated life of 24,000 hours minimum.

~~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 ballast shall have a power factor of at least 90%. The ballast shall provide for regulation within ~~±~~ *plus or minus* 6% variation in lamp watts at a primary voltage variation of ~~±~~ *plus or minus* 10% for lamps of 400w or less ~~and provide for regulation within ± plus or minus 13% variation in lamp watts at a primary voltage variation of ± plus or minus 10% for lamps of 750w or greater.~~

The luminaires shall meet the requirements shown in the plans.

92-2.5 Luminaire Cable: *Pole and bracket cable shall be multi-conductor Type XHHW-2 XLP TC with three No. 10AWG.*

92-2.6 In Line Fuse Holders: *In line fuse holders shall provide a breakaway connection and be UL recognized per Guide IZLT2 and rated for 600V. The wire connections in the fuse holders shall be of the copper setscrew type. Fused connections shall utilize and ATQ or FNQ 10 amp time delay fuse rated for 500V. Fuses shall be UL listed to Standard 248-14. The rating for the fuse holders shall be water resistant or submersible rated.*

92-2.7 Surge Protection Devices: *The MOV based SPD shall be spotted in a manner to be waterproof. UL listing is not required. SPD's per mode surge current rating shall be 20KA for 480V to ground and 40KA for neutral to ground. Maximum Continuous Operation Voltage (MCOV) shall be not less than 550Vrms and not greater than 600Vrms. All wires and internal spacings shall be insulated for 600Vrms.*

92-2.85 Pole Cable Distribution System.

92-2.85.1 General: *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. Systems installed as alternates to the Design Standards shall be one of the products listed on the QPL. Manufacturers seeking evaluation of their product shall submit an application in accordance with Section 6.*

Alternate Systems shall meet the following requirements:

a. A modular color coded cable system consisting of rubber cords with integrally molded watertight submersible connectors, inline fuses, submersible surge arrester and breakaway connectors shall be installed. The cables shall extend from an underground ~~junction~~ pull 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:

a. Distribution Block: The red molded body shall contain a three wire female outlet integrally molded to a 24 inch length of 10/3 SOOW 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~~ pull box near the base of the pole. The block shall be

watertight and submersible 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.

b. *Surge Arrestor Cable:* Provide a 12 inch length of 10/2 SOOW 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 waterproof ~~submersible~~ surge arrestor. The red male plug shall make a submersible connection when mated to the red female connector on the power cable. A separate 12 inch length of no. 10 THWN green ground wire shall be provided from the surge arrestor to attach to the ground system in the pull box.

c. *Power Cable:* This cable feeds the ~~L~~uminaire 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 ~~L~~uminaire Cable shall be a 10 ft section of 10/3 SOOW 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~~1.25 inch- PVC elbow and make a submersible connection when mated with the orange male plug on the ~~L~~uminaire Cable. The section that feeds the Surge Arrestor Cable shall be 12 inches in length of 10/2 SOOW cable with a red female connector on the end. The red female connector shall make a submersible connection when mated to the red male plug on the Surge Arrestor Cable.

d. *Luminaire Cable:* This cable is ~~a variable length of~~ ~~14/3 SOOW~~Type XHHW-2 XLP-TC with three No. 10AWG ~~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 submersible. 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 ft.~~

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 minus 40° to plus 190°F. Hardness of the molded rubber shall be 65 durometer.

992-2.85.2 Testing and Performance Criteria: The system shall pass the following performance criteria in accordance with NEC 110.2.

a. *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.

b. *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 operation voltage the leakage current shall not exceed 0.5 mA.

c. *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 application, 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.

d. 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.

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

f. 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.

g. 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.

h. 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.

i. Impact 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.

j. 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.

k. 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.

l. 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.

m. Watertight (Immersion) Test: The mated and capped connectors shall be immersed in water for one hour in which the highest point of the test samples in 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.

n. 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.

992-3 High Mast Lighting.

992-3.1 Poles: Poles for high mast lighting shall be galvanized steel or an alternative pole approved on the QPL, unless otherwise shown in the plans. Steel high mast poles shall be

~~continuous-tapered, round or minimum of 12 sided poles and meet the requirements of the Design Standards. Each section 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.~~

~~Alternate pole materials to galvanized steel may be used when listed on the QPL. Manufacturers seeking evaluation of their product shall submit an application in accordance with Section 6 accompanied by drawings and calculations, indicating their product meets the requirements of 992-1.~~

~~Each pole shall include a galvanized steel wench plate of sufficient size to mount the winch, portable drive unit mounting tube, circuit breaker panel and surge arrestor.~~

~~**992-3.2 Luminaires and Ballasts:** The reflector with its aluminum cover shall be firmly attached to a cast ring. This ring shall have keyhole slots in its upper surface such that the reflector/refractor assembly may be readily attached to, or detached from, the luminaire bracket entry and lamp support assembly without completely removing the support bolts.~~

~~High pressure sodium lamps shall meet the following requirements:
NEMA C78.42, CRI 21(min), CCT 2100 K and average rated life of 24,000 hours (min).~~

~~Each luminaire shall contain an integral auto-regulator type ballast ~~connected for 480 volts input plus 10% and a power factor of more than 90%.~~ The luminaire ballast shall be enclosed within an aluminum housing which integrally attaches to the luminaire bracket entry and lamp support assembly. It shall be readily removable without removing the luminaire from the bracket arm. 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 ballast shall have a power factor of at least 90%. The ballast shall provide for regulation within plus or minus 6% variation in lamp watts at a primary voltage variation of plus or minus 13% for lamps of 750w or greater.~~

~~The luminaire shall be attached to the bracket arm by means of a bracket entry and lamp support assembly. The assembly shall include a side entry slipfitter designed for 2 inch pipe with provision for 3 adjustments for leveling the luminaire. An enclosed terminal block shall be included such that all electrical connections shall be protected from exposure to weather.~~

~~All electrical connections shall be made waterproof or be made inside a weather resistant enclosure. All luminaires shall be ANSI/IES light distribution as indicated in the plans. Each luminaire shall be labeled with a permanent label which states the type of lamp, voltage input, power input, power factor, ballast type, socket position, ANSI/IES light distribution, and such other catalog information that a complete replacement can be readily ordered.~~

~~**992-3.3 Surge Protective Devices:** Surge Protective Devices (SPD) shall be Type 1 or Type 2. UL listed to UL 1449 3rd Edition. Surge current rating on a per phase basis shall be equal or exceed 50KA. I-nominal rating shall be 10KA or 20KA. Modes of protection shall include L-G and N-G having UL 1449-3 Voltage Protection Ratings (VPR's) of 2000V or lower.~~

~~**992-3.43 Lowering System:** The lowering system may be either a top latch or bottom latch system. The lowering system shall consist of the following.~~

~~**992-3.43.1 Head frame and Covers:** The head frame unit shall rigidly mate the top of the pole to the head frame platform. The platform with its associated sheaves shall be covered to prevent water from entering the top of the pole. The head frame structure shall be stainless steel and attach to the pole by stainless steel bolts or by means of a galvanized steel slipfitter. The head frame shall utilize two stainless steel cable sheaves for each lowering cable. The cable sheaves shall be a minimum of 5 inches in diameter and grooved to the exact cable~~

diameter, for 180 cable bearing surface. The power cord shall travel on sheave (s) or a combination of rollers providing a radius for the cord of 6 inches or larger. Each end of the sheave (s) or rollers shall have a keeper to prevent the cable from jumping out of the roller track or sheave cover that will act as a keeper. Bearings ~~and cable keepers~~ shall have permanent lubrication. For top latch systems the head frame shall include latch mechanisms which support the luminaire ring in the latched position and prevent the luminaire ring from rotation. For bottom latch systems the head frame shall include centering guides which center the luminaire ring and prevent the ring from rotation.

992-3.43.2 Luminaire Ring: The luminaire ring assembly shall consist of the luminaire ring, hoisting cable terminator tubes, and weather proof junction box. The luminaire ring and the junction box shall be fabricated of stainless steel. The ring shall be supplied with bolt on 2 inch stainless steel pipe tenons for the required number of luminaires. Two of the stainless steel tenons shall have a 1 inch half coupling welded to the tenon for the possible installation of FAA approved obstruction lights. The inner portion of the ring shall be equipped with a PVC shock absorbing tubes or shall utilize roller contact spring-loaded centering arms which center the luminaire ring and protect the pole and luminaire ring during raising or lowering operations. A 600 volt terminal block, completely prewired shall be included in the junction box. The luminaire ring shall be prewired with ~~Type W or specially reinforced Type SO power cable with~~ distribution wiring suitable ~~conductor quantity and size~~ for proper application and operation of the luminaires ~~and Type ST distribution wiring with insulation suitable for a least 105°C~~. A male flanged receptacle shall be mounted on the luminaire ring to allow testing of the luminaire while in the lowered position. The receptacle shall face away from the pole for easy access.

992-3.43.3 Lowering Cables: For bottom latch lowering systems, a minimum of two cables shall be used to lower the luminaire ring. Lowering cables for bottom latch systems shall be stainless steel aircraft cables of 1/4 inch or greater diameter. Where the wire cables bend over sheaves or the winch drum, the maximum working stress in the outer fibers of wire cable shall not exceed 20% of the cable manufacture's rated ultimate stress. The hoisting cable shall manually latch at the base of the pole and shall remove the load from the winch system. Each latch point shall be capable of supporting the entire weight of the luminaire ring assembly including luminaires. All moving parts of the latch mechanism shall be within reach from the ground level.

For top latch lowering systems, three stainless steel aircraft cables of 3/16 inch or greater diameter shall be provided. The transition yoke, hardware connecting the lowering cables to the transition yoke and hardware connecting the winch cable to the transition yoke shall be stainless steel. Where the wire cables bend over sheaves or the winch drum, the maximum working stress in the outer fibers of wire cable shall not exceed 20% of the cable manufacturer's rated ultimate stress. All latching systems shall remove the load from the winch system. Each latch point shall be capable of supporting the entire weight of the luminaire ring assembly including luminaires.

992-3.43.4 Modular Power Cable System: The modular cable system shall consist of ~~rubber covered~~ cables with weathertight connectors. All ~~P~~portions of the cable system shall be rated up to and including 600 V. ~~The receptacles shall be of dead front construction. The female receptacle shall have a push button pawl which attaches the receptacle to the male plug and when secure shall provide a NEMA 4X rating. The plug and receptacle shall be Meltric UL/CSA switch rated.~~ The plugs and connectors shall be UL 498 listed twist-lock type devices

with a NEMA L16-30R configuration for 480V line to neutral systems or for 480V line to line systems. The X designated prong shall be the hot leg for 480V line to neutral systems. The X and Z designated prongs shall be the hot legs for 480V line to line systems. The Z designated prong shall always be treated as a neutral leg. The plugs and connectors shall be equipped with watertight safety shrouds meeting UL 4X enclosure rating. Plugs and connectors when used on cord sets shall be equipped with IP 55 rated waterproof boots.

The power cable shall be a minimum of ~~8~~10/34 SOOW cable that is wired from distribution cable in the pull box near the base of the pole to the line side of the circuit breaker panel.

The circuit breaker cable shall be an 8 foot length of ~~8~~10/34 SOOW (minimum) cable that is connected to the load side of the circuit breaker panel and a female receptacle on the other end. This female receptacle shall mate with the male plug on the pole cable, the male flanged receptacle on the luminaire ring and the male plug ~~flanged inlet~~ on the portable step-down transformer.

The pole cable shall be the length of the mounting height of the pole plus 6 feet. The cable shall be a minimum of 10/3 SOOW with a male plug on one end that mates with the female receptacle on the circuit breaker cable. The other end fits under the lugs in the junction box on the luminaire ring. The power cable shall be attached to the luminaire ring with a ~~waterproof~~ stainless steel strain relief Kellem's grip ~~connector~~ capable of withstanding the pull of the weight of the cable. All power cables should be attached to the stainless steel weathertight wiring chamber with weathertight cable connectors

992-3.43.5 Winch Drum: The drum shall be constructed of stainless steel and be designed to provide a level wind of wire cable. The winch shall be a reversible worm gear self locking type with an integral friction drag brake to prevent free spooling. Raising speed of the luminaire ring shall be a minimum of 12 feet per minute. Stainless steel 7 x 19 aircraft cables of 1/4 inch or greater diameter ~~equal to MIL-W83420C~~ shall be supplied on the winch. The winch drums shall be designed to provide smooth winding of the winch cables on the drum and to prevent cable slippage on the drum.

992-3.43.6 External Portable Winch Motor (One per Project): The winch shall be designed for hand operation or for operation by means of a 1/2 inch heavy duty reversing electric drill motor or a portable ~~motor power unit consisting of a TEFC, one horsepower, continuous duty, 120/240 volt, 60 Hertz,~~ reversible AC motor with a magnetic brake. ~~The~~Both portable ~~motor~~power units shall be mounted to the winch by a stainless steel mounting bracket and ~~shall utilize a V belt to power the winch input or drive pulley. Both power units shall be~~ remote controlled to enable the operator to stand 25 feet from the pole. One portable drill motor or portable motor power unit shall be provided for each project.

9923.43.7 Portable Step-Down Transformer (One per Project): A portable 1.5 KVA dry type transformer shall be provided for each project. The transformer shall step-down the high mast distribution voltage to 120/240 volts. The transformer shall be mounted in a NEMA 3R enclosure and have a male plug or receptacle which mates to circuit power cable. The transformer shall also have a 120 volt grounded receptacle for use by electric drill motor or portable motor power unit.

992-4 Sign Lighting.

992-4.1 Induction Sign Fixtures Luminaires and Ballasts: ~~The fixture shall be rated for 100,000 hours with a minimum lamp efficiency of 70% of lumen output at 60,000 hours. The luminaire housing shall consist of a~~ precision cast aluminum with a corrosive resistant polyester powder coat finish. The standard color shall be gray. The cover shall be attached to the housing utilizing stainless steel bolts, and the housing shall be sealed to provide an IP 55 rating or greater. The mounting assembly for a sign light shall be a slipfitter type to accommodate a 1 1/2 inches schedule 40 steel pipe connection. The luminaire manufacturer shall place a permanent tag on the luminaire housing on which the following is imprinted: the luminaire voltage, lamp wattage and a blank area for the Contractor to inscribe the installation date. The refractor shall be tempered clear or microprismatic glass.

Induction lamps shall meet the following requirements: CRI 80, CCT 5000 K and average rated life of 100,000 hours.

The generator/ballast may be internal or external to the fixture. If the generator is internal to the fixture, the maximum operating temperature shall not exceed 130°F when measured at the base point. If the fixture is not compatible with the circuit voltage, step-down transformers or other equivalent circuitry shall be provided by the fixture manufacturer to provide for a complete installation. The manufacturer shall provide a five year non-prorated warranty to the Department. The warranty shall begin on the installation date.

992-5 Underdeck Lighting.

992-5.1 Luminaires and Ballasts: *Luminaires shall consist of a die-cast aluminum housing and reflector holder and a heat-resistant, high-transmission glass prismatic refractor. Housing shall have gasketing between the reflector and the refractor and the socket entry. Luminaires shall be high pressure sodium vapor unless otherwise indicated in the plans.*

High pressure sodium lamps shall meet the following requirements: NEMA C78.42, CRI 21 (Min), CCT 2100 K and average rated life of 24,000 hours (min).

Underdeck fixtures may be wall mounted or pendant mounted fixtures. Pendant mounted fixtures shall be vibration tested in accordance with NEMA C136.31.

992-2.5.2 Conductors: *Underdeck structure lighting conductors shall be Type RHW or THW and shall not be smaller than No. 10 AWG.*

~~992-4.2 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.~~

992-96 Wooden Service Poles.

992-69.1 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.

992-69.2 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.

992-69.3 Retention of Preservative:

992-69.3.1 Creosote Oil: Retention shall be at least 9 lb/ft³ of wood.

992-69.3.2 Pentachlorophenol Solution: Minimum retention shall be 0.45 pound of dry pentachlorophenol chemicals per cubic foot of wood.

992-69.3.3 Salt Preservative (Chromated Copper Arsenate): Minimum retention shall be 0.60 pound of CCA oxide per cubic foot of wood.

992-69.3.4 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.

992-69.4 Penetration of Preservative:

992-69.4.1 Determination: Penetration shall be determined as specified in 955-6.4.

992-69.4.2 Sapwood Penetration: Sapwood penetration shall be as specified in 955-6.2.

992-69.5 Retreatment: Retreatment, when necessary, shall be as specified in 955-6.3.

992-69.6 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.

992-710 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 arrester 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 Arrester 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 arrester cable shall be integrally molded to a MOV submergible surge arrester. 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 Arrester 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 3/4" 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 QPL. 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 arrester 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 Arrester: The surge arrester 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 arrester 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 arrester 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 arrester shall be connected on the load side of the fuses. The cable shall continue to the luminaire at the top of the pole.~~