

1 Make this section a part of the Standard Specifications:
2

3 **SECTION 761 – LIGHT EMITTING DIODE (LED) ROADWAY**
4 **LIGHTING SYSTEMS MATERIALS**
5
6

7 **761.01 Lighting Poles.** Light poles shall be made of aluminum, conforming
8 to requirements of AASHTO publication *Standard Specifications for Structural*
9 *Supports for Highway Signs, Luminaires, and Traffic Signals*, and this
10 subsection. Drawings for proposed poles shall be submitted in accordance with
11 Subsection 622.03(A) - Equipment List and Drawings.
12

13 **(A) Aluminum Poles.** Aluminum poles shall be spun tapered from
14 seamless aluminum tubing, alloy 6063-T6, conforming to ASTM B 221,
15 with minimum thickness of 0.250 inch. Circumferential or longitudinal
16 welds will be allowed only at lower end of pole where pole is joined to
17 anchor base.
18

19 Poles shall have anchor base consisting of permanent mold cast
20 aluminum, alloy 356.0, conforming to ASTM B 108. Anchor bolts shall be
21 stainless steel conforming to Subsection 718.01 - Standard Fasteners,
22 and shall be of quantity and grade indicated in the contract documents.
23 Poles mounted on walls and structures shall have anchor bases and side
24 entry handholes. Poles mounted on bridge structures shall be equipped
25 with vibration damper recommended by pole manufacturer and accepted
26 by the Engineer.
27

28 Grounding nut or screw on inner portion of pole shall be placed
29 opposite handhole.
30

31 Each pole shall be furnished complete with mast arm, base,
32 ornamental pole top, base cover, and anchor bolts. Unless otherwise
33 indicated in the contract documents, aluminum poles shall have polished
34 natural aluminum finish and stainless steel hardware.
35

36 Aluminum poles shall be protected during shipment with protective
37 paper.
38

39 **761.02 Luminaire Mast Arms.** Mast arms shall be made of seamless
40 aluminum tubing conforming to ASTM B 221, and shall be of type, size, length,
41 and rise, as indicated in the contract documents. Mast arms 8 feet long or
42 shorter shall be tapered elliptical, self-supporting mast arms. Mast arms greater
43 than 8 feet long shall be truss-type mast arms. Ends of mast arms shall be
44 completed in two-inch slip fitter with inner-wired-type pole plates.
45

761.03 Luminaires for Roadway Lighting. Luminaires shall conform to the provisions in Section 761.03, "Luminaires for Roadway Lighting", of Section 761 Light Emitting Diode (LED) Roadway Lighting Systems Materials.

Luminaires shall conform to the following Standards and Special Provisions:

Standards

- ANSI/NFPA 70, National Electrical Code
- FCC 47 CFR Part 15, Federal Code Of Regulation (CFR) testing standard for electronic equipment
- IEEE C62.41, Guide on the Surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits
- IESNA LM-79, Electrical and Photometric Measurements of Solid-State Lighting Products
- IESNA LM-80, Approved Method for Measuring Lumen Maintenance of LED Light Sources
- IESNA TM-15, Luminaire Classification System for Outdoor Luminaires
- NEMA SSL 3-2010, High-Power White LED Binning for General Illumination
- UL1598, Standard for Safety of Luminaires

(A) Luminaires for Roadway Lighting. Luminaires for roadway lighting shall be nominal 4000K Light Emitting Diode (LED) type, suitable for wet locations per UL 1598. Luminaire shall have a BUG rating with U to be zero and produce zero light at or above 90 degrees. Each luminaire shall be listed with Underwriters Laboratory, Inc. under UL1598 for luminaires in wet locations

(1) Housing. Housing shall conform to the following:

(a) Housing shall be rear-entry with horizontal slipfitter for inner wiring, die-cast aluminum with integral heat sinks. The cast aluminum electrical compartment shall be separate from the LED array to ensure cooler operating temperatures of the driver. Access to the electrical compartment shall be tool-less by use of stainless steel latches. Driver and surge module shall be secured to the swing down door which can easily be removed and exchanged without the use of tools by separating a quick disconnect electrical connection. Housing shall be designed to prevent the buildup of water on the top of the housing.

I. The thermal management (of the heat generated by the LEDs) shall be of sufficient capacity

91 to assure proper operation of the luminaire over the
92 expected useful life.

93
94 II. The LED manufacturer's maximum thermal
95 pad temperature for the expected life shall not be
96 exceeded.

97
98 III. Thermal management shall be passive by
99 design. The use of fans or other mechanical devices
100 shall not be allowed.

101
102 IV. The luminaire shall have a minimum heat sink
103 surface such that LED manufacturer's maximum
104 junction temperature is not exceeded at maximum
105 rated ambient temperature.

106
107 **(b)** Luminaire shall include cast in pipe stops, leveling
108 steps and a four bolt mounting system capable of
109 accommodating 1¼" to 2" ID pipe (1 5/8" to 2 3/8" OD).

110
111 **(c)** The assembly and manufacturing process for the LED
112 luminaire shall be designed to assure all internal
113 components are adequately supported to withstand
114 mechanical shock and vibration. Luminaire shall withstand
115 vibration, meeting ANSI C136.31 American Standard for
116 Roadway and Area Lighting Equipment – Luminaire
117 Vibration for normal and bridge operation (3G minimum).

118
119 **(d)** Housing and door frame shall be aluminum with a
120 nominal 2.0 mil thick paint finish able to withstand a
121 3000-hour salt spray test as specified in ASTM Designation:
122 B117. Housing shall have a minimum IP rating of IP-65.

123
124 **(e)** The housing shall meet the requirements for
125 NEMA/UL wet location, be UL listed and gray in color with a
126 flat or semi-gloss sheen.

127
128 **(f)** Each LED luminaire shall have the manufacture's
129 name, trademark, model number, serial number, date of
130 manufacture (month-year), and lot number as identification
131 permanently marked inside each unit and the outside of
132 each packaging box. The operation characteristics such as
133 rated voltage and rated power in watts and Volt-Ampere
134 shall be permanently marked inside each LED luminaire unit.

136 **(2) Driver.** Driver shall conform to the following:
137

138 **(a)** Operation Voltage: The luminaire shall operate from a
139 60 HZ ± 3 HZ AC line over a voltage ranging from 108 VAC
140 to 305 VAC. The fluctuations of line voltage shall have no
141 visible effect on the luminous output.
142

143 **(b)** Power Factor: The luminaire shall have a power factor
144 of 0.9 or greater.
145

146 **(c)** Operational Performance: The LED circuitry shall
147 prevent visible flicker to the unaided eye over the voltage
148 range specified above.
149

150 **(d)** Surge Suppression: The luminaire onboard circuitry
151 shall include surge protection devices (SPD) to withstand
152 high repetition noise transients as a result of utility line
153 switching, nearby lightning strikes, and other interference.
154 The SPD protects the luminaire from damage and failure for
155 common (Line-to-Ground) and differential (Line-to-Line)
156 mode transient peak currents up to 10 kA (minimum). SPD
157 conforms to UL 1449. SPD performance has been tested
158 per procedures in ANSI/IEEE C62.41-2:2002 category C
159 high exposure and ANSI C136.2 10kV BIL. The SPD shall
160 fail in such a way as the Luminaire will no longer operate.
161 The SPD shall be field replaceable and IP66 rated.
162

163 **(e)** RF Interference: LED Drivers must meet Class A
164 emission limits referred in Federal Communications
165 Commission (FCC) Title 47, Subpart B, Section 15
166 regulations concerning the emission of electronic noise.
167

168 **(f)** The rated operating temperature range shall be -40°C
169 (-40°F) to $+40^{\circ}\text{C}$ (104°F).
170

171 **(g)** The power supply shall be contained inside the
172 luminaire and a minimum IP rating of IP-65.
173

174 **(h)** Driver shall be IP66 rated and capable of dimming for
175 future controllability.
176

177 **(i)** THD: Total harmonic distortion (current and voltage)
178 induced into an AC power line by a luminaire shall not
179 exceed 20 percent.
180

181 **(3) LED Array(s).** LED arrays shall be high brightness, nominal
182 70 CRI at CCT 4000K. The design life of the LED array(s) shall be
183 defined as L70 at 50,000 hours at 40°C.
184

185 (a) Each luminaire is capable of operating above 40°C
186 (104°F), but not expected to comply with photometric
187 requirements at elevated temperatures.
188

189 (b) The rated operating temperature range shall be -40°C
190 (-40°F) to +40°C (104°F).
191

192 (c) The individual LEDs shall be constructed such that a
193 catastrophic loss or the failure of one LED will not result in
194 the loss of the entire luminaire.
195

196 (d) The optical assembly of the luminaire shall be
197 protected against dust and moisture intrusion.
198

199 (e) Each refractor or lens shall be made from UV
200 inhibited high impact optical grade material and be resistant
201 to scratching.
202

203 **(4) Illumination.** Luminaires shall provide roadway with
204 minimum average maintained illumination value in accordance with
205 manufacturer's specifications and IES light distribution type
206 indicated in the contract documents. Photometric data with
207 certification of conformance shall be submitted.
208

209 (a) Photometry must be compliant with IESNA LM-79.
210

211 (b) Luminaire shall have a minimum efficacy of 90
212 lumens per watt and shall not consume power in the off
213 state.
214

215 (c) BUG rating shall not exceed U0.
216

217 (d) Luminaire manufacturer shall provide the LED
218 manufacturers LM-80 report.
219

220 **(5) Photoelectric Control Receptacle.** Luminaires shall be
221 furnished with or without photoelectric control receptacles, as
222 indicated in the contract documents. When photoelectric control
223 receptacle is included, rain tight shorting cap shall be installed.
224

(a) When a photo control receptacle is required, it shall be compliant with ANSI C136.41-2013, 7-pin photocontrol receptacle. This shall provide a standard method of light level control between external PCR and a dimmable driver for future use.

(6) **Warranty.** Luminaires shall be warranted to be free from manufacturing defects for a period of 5 years.

(a) LED luminaire manufacturer shall provide 5-year warranty on LED luminaires that includes LEDs, housing, drivers and finish.

(b) Technical properties must be made available for a minimum of 5 years after the date of manufacture.

(c) Luminaires shall be fully assembled and individually electrically tested prior to shipment.

(7) **Manufacturer.** The luminaire manufacturer shall have a minimum of 15 years of experience in the manufacture, assembly, and sale of roadway luminaires in the United States of America. The roadway luminaire shall comply with the Buy America Act and the American Recovery and Reinvestment Act of 2009 (ARRA). The manufacturer shall have a minimum of 10,000 roadway luminaires installed within the United States of America prior to bid opening.

(8) **Submittals.** Product data submitted for approvals shall include, but not limited to materials, finishes, photometric performance, photometric layouts, dimensional information and LM-79 report for each luminaire.

(9) **Delivery, Storage and Handling.** Deliver luminaires and components carefully to avoid breakage, bending and scoring finishes. Do not install damaged equipment. Store luminaires and accessories in original cartons and in clean dry space; protect from weather and construction traffic.

761.04 Cables and Wires for Roadway Lighting System

(A) Cables and Wires.

(1) **Circuit Cable.** Cable for 120/240 volt or 240/480 volt roadway lighting circuits shall conform to the following

requirements: single conductor, 600 volt, AWG sizes as indicated in the contract documents; stranded copper, Type XHHW suitable for use at 167 degrees F, with 2/32-inch-thick rubber insulation, and 3/64-inch thick neoprene jacket. Rubber insulation and neoprene jacket shall conform to NEC, RHW/USE standards, and ICEA S-105 692 standard.

(2) Pole Fixture Cable. Connection of circuit cables from base of light pole or pull box to each luminaire shall conform to the following requirements: single conductor, 600 volt, No. 10 AWG, stranded copper, and Type XHHW or RHW. Unless otherwise indicated in the contract documents, ground conductors shall conform to the following requirements: single conductor, 600 volt, No. 6 AWG, stranded copper, Type XHHW or RHW. Ground conductors shall be installed in conduits.

(B) Luminaire and Cable and Wire Identification. Tags of rigid, non-ferrous material shall be affixed, with machine embossed legend on two sides with non-ferrous wire to feeder, branch feeders, and sub-branch cables and wires in pullboxes and light standard bases. Legend with 1/4-inch-high letters shall indicate feeder designation.

761.05 Disconnect and Protective Devices.

(A) General. Splices and taps shall be limited to minimum number. Conductor-to-conductor connections shall be made with hydraulically indented lugs.

(B) Taps. Taps from feeders to highway lighting luminaires shall be made at lighting standards, with standard connector kits that provide quick-disconnect, fused branch connection to feeder conductors. Waterproof taps shall have dielectric value equal to that of the insulation of conductors joined. Fuses shall be standard midget, ferrule-type, with ampere ratings an indicated in the contract documents.

(C) Splicing. Feeders shall be spliced with standard splicing kits of type recommended by cable manufacturer. Splices shall be waterproof and shall have dielectric value equal to that of the insulation of conductors joined.

761.06 Waterproof Connectors for Roadway Lighting. Where indicated in the contract documents, connector kits shall be of waterproof, molded rubber. Connectors shall be 600-volt, quick disconnect, in-line connectors, fused for ungrounded conductor and non-fused for neutral at each pole. Opening in line conductor connectors shall be suitable for cables furnished. Lubrication and

taping shall be as recommended by manufacturer of connectors. Fused connectors shall accommodate standard midget, ferrule-type fuses with ampere rating as indicated in the contract documents.

761.07 Photoelectric Control. Photoelectric control unit shall have inrush current rating of 120 amperes. Photoelectric control shall withstand surge current up to 1,000 amperes. Chassis shall withstand hi-pot test of 5,000 volts. Cadmium-sulfide cells shall have 300 to 500 milliwatts maximum dissipation operating voltage range between 105 volts to 285 volts, and mounting features that conform to EEL Publication No. 148, NEMA Publication No. SH18-1959. Photoelectric control unit shall be UL listed for wet locations.

Light level setting shall be adjustable from 0.5 to 3.0 foot-candles with time delay of up to three minutes. Light level setting shall be adjusted for turn on at 0.7 ± 0.2 foot-candles.

END OF SECTION 761