January 30, 2014

REVISION OF SECTIONS 613 AND 715

LED ROADWAY LUMINAIRE

**NOTICE**

This is a standard special provision that revises or modifies CDOT’s *Standard Specifications for Road and Bridge Construction.* It has gone through a formal review and approval process and has been issued by CDOT’s Project Development Branch with formal instructions for its use on CDOT construction projects. It is to be used as written without change. Do not use modified versions of this special provision on CDOT construction projects, and do not use this special provision on CDOT projects in a manner other than that specified in the instructions unless such use is first approved by CDOT’s Standards and Specifications Unit. The instructions for use on CDOT construction projects appear below.

Other agencies which use the *Standard Specifications for Road and Bridge Construction* to administer construction projects may use this special provision as appropriate and at their own risk.

**Instructions for use on CDOT construction projects:**

Use in projects having light emitting diode (LED) roadway luminaires.

Sections 613 and 715 of the Standard Specifications are hereby revised for this project as follows:

In subsection 613.02, delete (e) and replace with the following:

1. *Luminaire*. A complete luminaire includes the housing, lens, Light Emitting Diode (LED) luminaire, luminaire housing, driver or power generator, slip-fitting clamp or approved manufacturer mounting, all necessary internal wiring, and photoelectric control. Luminaires shall operate at either 120 VAC, 60 Hz or 277 VAC, 60 Hz. Luminaires shall meet electrical utility company requirements.

In subsection 613.02 (i), delete (4), (6), (7) and (8) and replace with the following:

1. Luminaire manufacturer’s product information including data in Illuminating Engineering Society of North America (IESNA) format, IESNA photometric distribution type for vertical and lateral distribution (example: B2-U0-G1, Type III), and a photograph or line drawing
2. Luminaire Lumen Range
3. LED Driver or Power Supply
4. Lighting Control Centers and Photoelectric Control Devices

Subsection 613.02 shall include the following:

1. *LED Luminaire Warranty.* The Contractor shall ensure that the LED Roadway Luminaire has a minimum warranty of 10 years for all parts, materials and shipping required to repair or replace the luminaire. The Contractor shall provide the manufacturer’s warranty to the Engineer prior to installing the luminaire.

The warranty shall cover all failures including:

1. Failure in luminaire housing, wiring, connections, drivers and photoelectric control devices.
2. More than 10 percent decrease in lumen output
3. Significant change in color

The warranty shall begin upon the date the Contractor receives the luminaire. The bill of lading shall be provided to the Engineer prior to final payment of the lighting.

1. *Technical Support.* During the warranty period, technical support shall be available from the manufacturer via telephone within 24 hours of the time the call is made from the Contractor, and this support shall be made available from factory certified personnel or factory certified installers at no additional charge to the Department.

In subsection 613.06, delete the first paragraph and replace with the following:

**613.06** **Luminaires and Lamps**. Roadway Luminaires shall be mounted on the mast arm by a slip-fitter clamp or other approved device. Luminaires shall be adjusted vertically and horizontally to provide the required orientation and maximum light distribution on the roadway and to meet Illuminating Engineering Society of North America (IESNA) TM-15 uplight rating of U0.

In subsection 613.06, delete the fourth paragraph and replace with the following:

Luminaires of the specified type and lumen output shall be installed as shown on the plans. The type and lumen output shall be marked on each luminaire or pole in accordance American National Standards Institute (ANSI) specifications. ANSI approved tags shall be provided and installed by the Contractor.

Subsection 613.12 shall include the following:

**Pay Item Pay Unit**

Luminaire (LED) (\_\_ Lumens) Each

In subsection 715.04 (a), delete 2. and 4. and replace with the following:

1. Optical Chamber. The luminaire distribution shall be equal to or less than an Illuminating Engineering Society of North America (IES) TM15-11 Backlight Uplight and Glare (BUG) ratings listed below in Table 715-1 based on initial lumens or Light Loss Factor (LLF) = 1.0. Roadway luminaires with a U value greater than U0 shall not be accepted. The optical chamber shall be completely sealed from the housing, or the housing shall be completely sealed. A seamless one piece memory-retentive gasket shall seal the optical chamber or housing against the luminaire lens door. All wires entering the optical chamber shall be gasketed at their point of entry. Socket mountings, rivets used in the construction or support of the reflector system, and all other penetrations into the optical chamber shall be completely sealed. The optical chamber shall be water tight when the luminaire door is closed.

**Table 715-1  
BACKLIGHT, UPLIGHT AND GLARE (BUG) VALUES**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Luminaire Mounting Location | Minimum Initial Luminaire Lumen Range | Backlight (B) Rating Maximum | Uplight (U) Rating Maximum | Glare (G) Rating Maximum |
| Non median-mounted | Less than 5,000 | B2 | U0 | G1 |
| 5,000 – 22,000 | B3 | U0 | G2 |
| Above 22,000\* | B3 | U0 | G3 |
| Median-mounted | Less than 5,000 | B3 | U0 | G1 |
| 5,000 – 22,000 | B4 | U0 | G2 |
| Above 22,000\* | B4 | U0 | G3 |
|  | \*By special application only. | | | |

4. Electrical Components. All components shall be Underwriters Laboratory (UL) listed for wet locations or by an Occupational Safety & Health Administration Nationally Recognized Testing Laboratories (OSHA NRTL). Luminaires shall operate from 120 to 277 VAC as specified on the plans or adaptable to the type of power distribution system to be used. All internal wiring and quick disconnects shall be rated for at least 600 VAC and insulated for 302°F. The dimmable driver shall be easily removable from the luminaire housing without the use of tools. The following components shall be in accordance with corresponding sections of ANSI C136.37:

1. Wiring and grounding.
2. Terminal blocks for incoming AC lines.
3. Photocontrol receptacle.
4. Latching and hinging

In subsection 715.04, delete (b) through (e) and replace with the following:

(b) *Roadway* *Luminaires*. Roadway luminaires shall be LED type with integral driver, flat lens, aluminum housing, and be UL Listed for wet locations. All luminaires for the project shall be the same type and design unless the plans specify otherwise.

1. The luminaire and all components shall be UL or Intertek Testing Services (ETL) listed for Wet Location and shall have minimum Ingress Protection Rating of IP66.
2. Light source shall be comprised of LED modules connected to a non-integrated driver and ready for connection to a production line luminaire. Luminaires utilizing integrated driver LED light sources, screw-based or panel retrofit products shall not be accepted.
3. The luminaire shall have a Type II or III distribution for non-median mounted luminaires, and Type II, III, IV or V for median mounted luminaires.
4. Transmissive optical components shall be applied in accordance with LED manufacturer’s Original Equipment Manufacturer (OEM) design guidelines to ensure suitability for the environment in which the luminaire is installed.
5. Luminaires shall utilize an adjustable slipfitter-type mounting system for installation on 1.25-inch (1.66-inch o.d.) to 2-inch (2.375-inch o.d.) outside diameter pipe tenons. Slipfitter shall consist of a two-piece clamp and four 9/16-inch hex bolts. Slipfitter shall allow for a vertical tilt adjustment of ± 5 percent in order to mount luminaire plumb for a U0 rating. Luminaires shall be equipped with integrated leveling bubble.
6. Access to all internal parts requiring replacement shall not require tools (i.e. “tool-less entry”).
7. The luminaire housing shall be constructed of aluminum alloy.
8. Power Supply/Driver shall be provided in compliance with subsection 715.05(a). Driver must be internal and thermally separated from LED compartment.
9. Dimming photocell receptacle shall conform to (d) below.
10. Luminaire finish shall be corrosion resistant Super triglycidyl isocyanurate (TGIC) polyester powdercoat. Color shall be gray.
    1. Powder coat: Super TGIC polyester powder coat 2.5 mil nominal thickness.
    2. Finish shall exceed a rating of 6 per ASTM D1654 after 1000hrs of testing per ASTM B117.
    3. The coating shall exhibit no greater than 30% reduction of gloss per ASTM D523, after 500 hours of QUV testing at ASTM G154 Cycle 6.
11. Effective Projected Area (EPA) for wind-loading calculations shall be no greater than 1.2 square feet.
12. Luminaire weight shall not exceed 45 pounds.
13. Luminaire shall be tested in accordance with IES LM79 and TM21 certifying photometric performance and rated life, respectively. LM79 (performance) and TM21 (predicted life at 55oC) testing shall both be for the same luminaire’s operating drive current as specified.
14. Luminaire shall have a maximum Backlight rating as shown in Table 715-1, an Uplight rating of U0, and a maximum Glare rating as shown in Table 715-1.
15. Luminaire system efficacy shall be no less than 68 luminaire lumens per input watt.
16. Luminaire shall have an external label per ANSI C136.15 and internal label per ANSI C136.22.

(c) *Light* *Sources*. LED luminaires shall not be retrofit to existing luminaire housing; the Contractor shall replace housing along with the luminaire as a single unit. Light sources shall be compatible with dimmable drivers supplied with the luminaires in which they are to be installed. All light sources of a similar type shall be provided by the same manufacturer.

LED light sources shall meet or exceed the following requirements:

1. CCT, CRI and Flux:

* 1. Correlated Color Temperature (CCT) – All LED light sources shall emit white light and have a CCT no less than 2700K nominal and no greater than 4000K nominal in accordance with ANSI C78.277.
  2. Color Rendering Index (CRI) – All LED light sources shall have a minimum Color Rendering Index (CRI) of 70 per the LM79 test results.
  3. Luminous Flux – LED light sources shall not exceed the junction temperature recommended by the LED manufacturer. Luminous flux differences between LEDs shall not exceed 10 percent.

1. LEDs shall have a minimum rated life of 70,000 hours per IES TM-21 at 55oC at the normal operating driver current for the specific luminaire. The lumen output shall be maintained at 70 percent of initial rated lumens (L70) or greater at the rated life of the luminaire.
2. LEDs shall be temperature rated for operation and storage within the range of -40°C to +50°C, and shall withstand low and high frequency vibration (ANSI C136.31 Vibration Level 3G) over the rated life of the light source.
3. Cooling System
   1. Mechanical design of protruding external surfaces (e.g. heat sink fins) shall facilitate hose-down cleaning and discourage debris accumulation.
   2. The cooling system must be passive utilizing heat sinks, convection or conduction.
   3. Fans, diaphragms, pumps, or liquids shall not be acceptable.

(d) *Photocontrol* *Receptacle*.

Each roadway luminaire shall be furnished with a multi-contact twist-lock outdoor lighting dimming receptacle per ANSI C136.41.

Delete subsection 715.05 and replace with the following:

* 1. **LED** **Drivers**. Led drivers shall conform to the following:
  2. Dimming signal protocols are 0-10VDC or Digital Addressable Lighting Interface (DALI).
  3. Operating voltage shall be 120/277-volt at 50/60 Hz, and shall operate normally with input voltage fluctuations of ±10 percent, consistent with NEMA SSl-1-2010, Electronic Drivers for LED Devices, Arrays or Systems.
  4. Minimum Power Factor (PF) shall be 0.90 at full input power and across specified voltage range.
  5. Maximum Total Harmonic Distortion (THD) shall be 20 percent at full input power and across specified voltage range.
  6. Factory-set drive current shall be 530mA or less unless approved by Engineer. If higher drive currents are proposed, the submittal must be accompanied with IES LM79 and TM21 test results for higher operating drive current.
  7. Drivers shall be Restriction of Hazardous Substances (RoHS) compliant.
  8. Rated case temperature shall conform to subsection 715.04 (c) 3.
  9. All electronics of the power supply and the LEDs shall be protected from all electrical surges with an elevated electrical immunity rating, including but not limited to lightning strikes and stray current in rebar and concrete. Surge protection shall be integral to the LED power supply.
  10. Luminaire, including driver, shall consume no more than 4 watts in the off state power.
  11. Electrical immunity (including surge protection)
      + 1. Luminaire shall meet the “Elevated” requirements per IEEE C62.41.2 -2002. Manufacturer shall indicate whether failure of the electrical immunity system can possibly result in disconnect of power to luminaire.
  12. Electromagnetic interference: Shall comply with Federal Communications Commission (FCC) 47 Code of Federal Regulations (CFR) part 15 non-consumer radio frequency interference (RFI) and/or electromagnetic interference (EMI) standards.