

LED Roadway Lighting Product Evaluation Process

Background

WSDOT started evaluating Light Emitting Diode (LED) lighting products several years ago. In the beginning there was not an established way to compare LED luminaire fixtures to the standard High Pressure Sodium (HPS) luminaires because LEDs were still new to the roadway lighting industry and still undergoing significant product development. WSDOT has evaluated numerous LED manufacturers' products over the past 5-7 years and until recently there were no available LED fixtures that met the required light requirements with the same number of poles as a HPS system. WSDOT received LED submittals from a multitude of manufacturers, both experienced and new to the industry. Given the number of requests for product evaluation it was clear that WSDOT needed to establish a more formal evaluation process. As of today there are only a handful of products out of the 75+ products we have evaluated have successfully met these requirements and approved for continued field testing and evaluation.

Evaluation Process

The following evaluation process was established to guide WSDOT and the manufacturer from the initial submittal through final product acceptance and field testing. Every manufacturer that approaches WSDOT with a LED fixture is offered this evaluation process since WSDOT terminated the new products evaluation program previously offered through the materials laboratory.

Step 1 – Manufacturer submits product technical information and photometric data for review.

Technical and photometric data are reviewed using the product evaluation criteria and LED specifications outlined below. Since the technical specifications for LED roadway lighting is a moving target this information is used as a guide rather than a rigid standard.

AGi32 – Illumination Software Analysis (Photometric Data Evaluation)

The computer evaluation looks at a 500' section of roadway, with two 12' lanes in each direction, which are continuously illuminated. Typically a two-way-two-lane state highway is classified as a Principal Arterial. We typically use a low pedestrian classification, which has lighting requirements of: 0.2fc for a minimum light level; 0.6fc for an average light level; an average/minimum uniformity ratio of 3:1 or better; and a maximum veiling luminance of 0.3:1 or better.

WSDOT Design Policy uses an end of useful life approach. What this means is we take into account the dirt depreciation and lamp lumen depreciation factors into our calculations. With a HPS lighting system the initial lumen output of the fixtures is reduced by 38% to account for the dirt depreciation factor and lamp lumen depreciation. This closely represents the light levels on the roadway right before we clean and re-lamp the system. With LED lighting fixtures, WSDOT has established a Lamp Lumen Depreciation factor of 23.5%. ($LLF = .85(LLD) \times .9(LDF) = .765$)

Two different scenarios of typical luminaire layouts are evaluated. The first is where the lights are installed on opposite sides of the roadway, and another where the lights were installed on the same side of the roadway. (*Note: We often run into situations where we cannot install luminaires on both sides of the roadway and we are limited to installing the luminaires on only one side of the roadway.*)

WSDOT uses AGi32 lighting design software to determine how many luminaires it would take to light that section of roadway to the required levels with standard 250W and 400W HPS luminaires mounted at 40' and 50' respectively. If the LED products come close to matching the light levels required without requiring any additional poles then the manufacturer moved on to Step 2.

Step 2 – Hands-On Product Demonstration and Evaluation

After successful completion of step 1, the manufacturer is invited to a hands-on demonstration of their product(s). This demonstration includes a significant amount of unscripted questions from the following technical expert representatives including but not limited to: company background and references, previous projects, supply chain, economic viability, gross annual sales, product failure history, etc. WSDOT Maintenance, Design Engineers, Materials Lab, and HQ Traffic personnel serve as the technical experts.

Step 3 –Field testing

If the manufacturer successfully completes Step 2, then their product(s) is approved for continued field testing and evaluation. During field testing and evaluation, WSDOT evaluates the cost of the fixture, the ease of installation, craftsmanship of the fixture and components, and the durability of the fixture. Depending upon the outcome of Step 3, the manufacturer maybe required to revisit any of the previous steps.

Manufacturers and products approved by WSDOT will be installed through proprietary approval and state supplied material in an effort to ensure all approved products have an opportunity to be field tested and evaluated over an extended period of time. During this time WSDOT will continue to evaluate the feasibility of a standalone performance specification that leads to products that meet the initial physical performance specifications with the long term durability needed for effective life cycle cost recovery.

Step 4 – Pre-Approved / Qualified Products

Once a WSDOT Standard Specification or General Special Provision (GSP) is created it is expected that all manufactures will need to be re-approved to ensure compliance with the final specification. Once this step is completed all pre-approved / Qualified products will be available for use on all WSDOT Contracts.

Product Evaluation Criteria and LED Specifications

Basic Product Evaluation Criteria for LED Luminaires:

- ON the Approved list of one of the following; Energy Star, Design Light Consortium, Municipal Solid-State Street Light Consortium (MSSLC)
- Input Power for 400W HPS replacement= 225W max
- Input Power for 310W HPS replacement= 180W max
- Input Power for 250W HPS replacement= 125W max
- Drive Current= 525mA or 700mA (Higher drive currents need additional discussion and evaluation to ensure the manufacturer isn't over driving.)
- Type III lighting pattern
- BUG= 2,0,3
- CCT= 4000K (+/- 300)
- CRI= >60
- Input power= 120V/240V/277V/480V
- Dimming Capable
- 10K surge protection
- 10year warranty preferable, 5 year minimum
- 4 Bolt Mounting
- In accordance with IESNA TM-21-11, "Projected Values" represent interpolated value based on time durations that are within six times (6X) the IESNA LM-80-08 total test duration (in hours) for the device under testing ((DUT) i.e. the packaged LED chip). Use manufacturers and models that publish "Projected Values" LLD (LMF in the CREE Document) values at an operating temperature of 25 degree C where the "Projected Values" for LLD at 50,000hrs. We don't want to see products that can't meet at least 0.85 under these conditions. (See the attached CREE LMF TD13 .pdf document.)



CREE LMF TD13.pdf

Light Loss Factor Calculation

$$LLF = .85(LLD) \times .9(LDF) = .765$$

Performance Specifications - Municipal Solid-State Street Light Consortium ([MSSLC](#))

(Note: The documents below are to be used as a guide, not a rigid standard)



msslc-model-spec_active-control_led-ro:



2011-10model-spec-led-roadway-luminaire



2011-10model-spec-appendixa-material.d