

ATTACHMENT B

LED Street Lighting Performance Specifications

PART 1 – GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by their basic designation only. Versions listed shall be superseded by updated versions as they become available

A. American National Standards Institute (ANSI)

1. C78.377-2008 (or latest), Chromaticity of Solid State Lighting Products
2. C82.77-2002 (or latest), Harmonic Emission Limits – Related Power Quality Requirements for Lighting
3. C136.2-2004 (or latest), American National Standard for Roadway and Area Lighting Equipment—Luminaire Voltage Classification
4. C136.10-2010 (or latest), American National Standard for Roadway and Area Lighting Equipment - Locking-Type Photocontrol Devices and Mating Receptacle Physical and Electrical Interchangeability and Testing
5. C136.15-2011 (or latest), American National Standard for Roadway and Area Lighting Equipment – Luminaire Field Identification
6. C136.22-2004 (R2009 or latest), American National Standard for Roadway and Area Lighting Equipment – Internal Labeling of Luminaires
7. C136.25-2009 (or latest), American National Standard for Roadway and Area Lighting Equipment – Ingress Protection (Resistance to Dust, Solid Objects and Moisture) for Luminaire Enclosures
8. C136.31-2010 (or latest), American National Standard for Roadway Lighting Equipment – Luminaire Vibration
9. C136.37-2011 (or latest), American National Standard for Roadway and Area Lighting Equipment - Solid State Light Sources Used in Roadway and Area Lighting

B. American Society for Testing and Materials International (ASTM)

1. B117-09 (or latest), Standard Practice for Operating Salt Spray (Fog) Apparatus
2. D1654-08 (or latest), Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
3. D523-08 (or latest), Standard Test Method for Specular Gloss

C. Council of the European Union (EC)

1. RoHS Directive 2002/95/EC, on the restriction of the use of certain hazardous substances in electrical and electronic equipment

D. Federal Trade Commission (FTC)

1. Green Guides, 16 CFR Part 260, Guides for the Use of Environmental Marketing Claims

E. Illuminating Engineering Society of North America (IESNA or IES)

1. IESNA Lighting Handbook, 10th Edition
2. DG-4-03 (or latest), Design Guide for Roadway Lighting Maintenance
3. LM-50-99 (or latest), IESNA Guide for Photometric Measurement of Roadway Lighting Installations
4. LM-79-08 (or latest), IESNA Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products
5. LM-80-08 (or latest), IESNA Approved Method for Measuring Lumen Maintenance of LED Light Sources
6. RP-8-00 (or latest), ANSI/IESNA American National Standard Practice for Roadway Lighting

7. RP-16-10 (or latest), ANSI/IES Nomenclature and Definitions for Illuminating Engineering
 8. TM-3-95 (or latest), A Discussion of Appendix E - "Classification of Luminaire Lighting Distribution," from ANSI/IESNA RP-8-83
 9. TM-15-11 (or latest), Luminaire Classification System for Outdoor Luminaires
 10. TM-16-05 (or latest), Light Emitting Diode (LED) Sources and Systems
 11. TM-21-11 (or latest), Projecting Long Term Lumen Maintenance of LED Light Sources
- F. Institute of Electrical and Electronics Engineers (IEEE)
1. IEEE C62.41.2-2002 (or latest), IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits
 2. ANSI/IEEE C62.45-2002 (or latest), IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits
- G. National Electrical Manufacturers Association (NEMA)
1. ANSI/NEMA/ANSI C78.377-2008 (or latest), American National Standard for the Chromaticity of Solid State Lighting Products
 2. SSL-1-2010 (or latest), Electronic Drivers for LED Devices, Arrays, or Systems
 3. SSI-3-2010 (or latest), High-Power White LED Binning for General Illumination
- H. National Fire Protection Association (NFPA)
1. 70-2011 (or latest), National Electrical Code (NEC)
- I. Underwriters Laboratories (UL)
1. 1449, Surge Protective Devices
 2. 1598, Luminaires
 3. 8750, Light Emitting Diode (LED) Equipment for Use in Lighting Products

1.2 RELATED DOCUMENTS

- A. CDOT Road & Bridge Construction Specifications (2011)
- B. CDOT Roadway Lighting Design Guide (February 28, 2006)

1.3 DEFINITIONS

- A. Lighting terminology used herein is defined in IES RP-16. See referenced documents for additional definitions.
1. Exception: The term "driver" is used herein to broadly cover both drivers and power supplies, where applicable.
 2. Clarification: The term "LED light source(s)" is used herein per IES LM-80 to broadly cover LED package(s), module(s), and array(s).

1.4 QUALITY ASSURANCE

- A. Before finalizing its approval and purchase, the Department will request from a limited group of highly qualified bidders (the finalists) six (6) production line samples identical to product configuration(s) submitted for the RFP at no cost to the Department for evaluation.
1. Table Top Evaluation – Luminaire samples will be observed and evaluated indoors by the evaluation committee and/or other members of the Department.
 2. Field Demonstration – After table-top evaluation, the luminaires will be installed outdoors by the Department. The installed luminaires will remain in place for a period no more than (30) days.

- B. After installation, the Department may perform IES LM-50 field measurements to verify performance requirements outlined in HAA RFP 13-115 MM, giving consideration to measurement uncertainties outlined in IES LM-61. In addition to the lighting characteristics, the departments will evaluate other aspects of the luminaires per the operational evaluation guidelines in this attachment.

1.5 LIGHTING SYSTEM PERFORMANCE

A. General Description

- 1. This specification will provide minimum performance requirements for the LED roadway luminaire. Luminaires shall meet the general criteria provided in the body of this specification and the particular criteria for each luminaire type defined in HAA RFP 13-115 MM.

B. Luminaire Connected Load

- 1. Maximum Luminaire On-state Power Consumption
 - a. High wattage luminaire: not to exceed 220 watts
 - b. Medium wattage luminaire: not to exceed 130 watts
 - c. Low wattage luminaire: not to exceed 90 watts
- 2. Maximum Luminaire Off-state Power Consumption
 - a. The maximum off-state power consumption for the entire luminaire including photoelectric control or other control components shall be 4 watts.

C. Luminaire Delivered Lumen Output

- 1. Minimum delivered lumens shall be as follows:
 - a. High wattage luminaire: 14,000 lumens
 - b. Medium wattage luminaire: 7,500 lumens
 - c. Low wattage luminaire: 5,000 lumens

D. Luminaire Distribution

- 1. Type 2 or Type 3 distributions will be accepted.

1.6 REQUIRED SUBMITTALS FOR EACH LUMINAIRE TYPE DEFINED IN HAA RFP 13-115 MM.

A. General submittal content shall include:

- 1. Manufacturer's published specification information. The specification sheet must include:
 - a. Complete luminaire catalog number
 - b. Luminaire specification data
 - c. Dimmable LED driver(s)
 - i. Provide diagrams illustrating light output and input power as a function of control signal.
 - d. Surge protection device
- 2. Instructions for installation and maintenance
- 3. TM-21 lumen maintenance report
 - a. Lumen maintenance life value (L_{70}) shall be greater than 50,000 hours at $T_S = 55$ degrees celsius and $I_F = 350\text{mA}$.
- 4. LM-79 luminaire photometric report(s) shall be produced by the test laboratory and include:
 - a. Name of test laboratory
 - b. The test laboratory must hold National Voluntary Laboratory Accreditation Program (NVLAP) accreditation for the IES LM-79 test procedure or must be

- qualified, verified, and recognized through the U.S. Department of Energy's CALiPER program. For more information, see <http://ts.nist.gov/standards/scopes/eelit.htm> or www.ssl.energy.gov/test_labs.html.
- c. Report number
 - d. Date
 - e. Provide explanation if catalog number in test report(s) does not match catalog number of luminaire submitted and clarify whether discrepancy does not affect performance, e.g., in the case of differing luminaire housing color.
 - f. If nominal performance of submitted and tested products differs, submit additional LM-79 report(s) and derivation.
 - g. Description of luminaire, LED light source(s), and LED driver(s)
 - h. Goniophotometry (in IES format)
 - i. Colorimetry
 - j. Scotopic/photopic (S/P) ratio
5. Dimming Compatibility Letter of Assurance
 - a. Manufacturer shall submit a letter of assurance that the luminaire is compatible and fully operational with the GE Light Grid outdoor lighting dimming system, and that all of the internal wiring to the GE twist-lock receptacle will be in full compliance with the dimming system requirements.
 6. Summary of luminaire recycled content and recyclability per the FTC Green Guides, expressed by percentage of luminaire weight.
- B. Computer-generated point-by-point photometric analysis of maintained photopic luminance as per templates in Appendix A: Roadway Lighting Design Templates.
1. Calculations shall be for maintained values, i.e. Light Loss Factor (LLF) < 1.0, where $LLF = LLD \times LDD \times LATF$, and
 - a. Lamp Lumen Depreciation (LLD) shall be 0.88 for all luminaires.
 - b. Luminaire Dirt Depreciation (LDD) = 0.90 per IES DG-4 for an enclosed and gasketed roadway luminaire installed in an environment with less than $150 \mu\text{g}/\text{m}^3$ airborne particulate matter and cleaned every four years
 - c. Luminaire Ambient Temperature Factor (LATF) = 1.00
 2. Effective Lumen Factors (ELFs) shall be determined and applied per IES TM-12-2012.
 3. Calculation/measurement points shall be per IES RP-8 Luminance procedure.
- C. Summary of Joint Electron Devices Engineering Council (JEDEC) or Japan Electronics and Information Technology Industries (JEITA) reliability testing performed for LED packages
- D. Summary of reliability testing performed for LED driver(s)
- E. Written product warranty as per section 1.7 below.
- F. Buy American documentation
1. Manufacturers listed on the current NEMA Listing of Companies Offering Outdoor Luminaires Manufactured in U.S.A. for Recovery Act Projects need only provide a copy of the document (<http://www.nema.org/gov/economic-stimulus>).
 2. Other manufacturers shall submit documentation as per the DOE Guidance on Documenting Compliance with the Recovery Act Buy American Provisions (http://www1.eere.energy.gov/recovery/buy_american_provision.html).

1.7 WARRANTY

- A. The LED luminaire shall have a minimum warranty of 5 years a longer warranty (up to ten years preferred). Additional years of warranty coverage will receive favorable scoring in the evaluation. The proposer may also include in its response an annual price for additional years of

warranty coverage and any such additional pricing will also be evaluated in the scoring of the proposal. The warranty shall be for all work, materials and testing required for repairing and replacing a luminaire. An LED will be considered failed if the lighting does not meet the expected lumen requirements.

- B. Warranty period shall begin on the date of receipt by the Department.
- C. The warranty shall provide for repair or replacement of all electrical or mechanical components including:
 - 1. Luminaire housing, wiring, and connections
 - 2. LED light source(s)
 - a. Zero or nearly zero light output from more than 10 percent of the LED packages constitutes luminaire failure.
 - 3. LED driver(s)/power supplies
 - 4. Photoelectric control devices and/or control systems

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

A. General Requirements

- 1. Luminaires shall be as specified for each type in HAA RFP 13-115 MM
- 2. Luminaire shall be suitable for use in and listed for wet locations by an OSHA NRTL.
- 3. Electrically test fully assembled luminaires before shipment from factory.
- 4. Luminaire shall have an external label per ANSI C136.15
- 5. Luminaire shall have an internal label per ANSI C136.22.
- 6. Luminaires shall comply with IESNA LM-79 and LM-80, and TM-21.
- 7. Nominal luminaire input wattage shall account for nominal applied voltage and any reduction in driver efficiency due to sub-optimal driver loading.
- 8. Luminaires shall start and operate in -40°C to +50°C ambient.
- 9. IESNA Luminaire Classification (TM-15-11): B2 – U0 – G2
- 10. Effective Projected Area (EPA) : 1.2 square feet (max)
- 11. Weight: 45 pounds (max)
- 12. Minimum Color Rendering Index (CRI): 70
- 13. Correlated Color Temperature (CCT): 4000K ± 275
- 14. Luminaires shall be designed for ease of component replacement and end-of-life disassembly.
- 15. Luminaires shall be rated per ANSI C136.31 Vibration Level 3G.
- 16. Transmissive optical components shall be applied in accordance with LED manufacturer's OEM design guidelines to ensure suitability for the environment in which the luminaire is installed.

B. LED Light Source (Lamp)

- 1. The LED lamp shall be comprised of LED modules connected to a non-integrated driver and ready for connection to a production line luminaire.
- 2. Luminaires utilizing integrated LED light sources or screw-based retrofit products shall not be accepted.

C. Luminaire Housing

- 1. Housing shall be constructed of cast aluminum.
- 2. Driver must be internal and thermally separated from LED compartment.
- 3. Access to all internal parts requiring replacement shall not require tools (i.e. "tool-less entry")
- 4. Ingress Protection Rating: IP66

5. Color: Gray

D. Driver

1. All LED drivers provided with luminaires shall be the dimmable type. Approved dimming signal protocols are 0-10VDC or DALI.
2. Operating voltage: 120/240-volt at 50/60 Hz, and shall operate normally with input voltage fluctuations of ± 10 percent, consistent with NEMA SSI-1-2010, Electronic Drivers for LED Devices, Arrays or Systems.
3. Minimum Power Factor (PF): 0.90 at full input power and across specified voltage range.
4. Maximum Total Harmonic Distortion: 20% at full input power and across specified voltage range.
5. Drive Current: Factory setting shall be 530mA or below. Field selectable drive current settings are preferred.
6. Driver(s) shall be RoHS compliant.
7. Rated case temperature shall be suitable for operation in the luminaire operating in the ambient temperatures indicated in section 2.1.A above.

E. Photocontrol Receptacle

1. Luminaire to be furnished with a modified twist-lock outdoor lighting dimming receptacle for LED luminaires manufactured by General Electric (GE).
2. Connections required for the twist-lock receptacle:
 - i. Hot (or Phase 1)
 - ii. Neutral (or phase 2)
 - iii. Switched Hot (relay controlled hot/Phase 1)
 - iv. + 0-10V Dimming Control
 - v. - 0-10V Dimming Control

F. Mounting Hardware

1. 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.
2. Slipfitter shall consist of a two-piece clamp and four (4) 9/16-inch hex bolts.
3. Slipfitter shall allow for a vertical tilt adjustment of ± 5 percent.

G. 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.

H. Electrical immunity (including surge protection)

1. Luminaire shall meet the "Elevated" requirements in Appendix B – Electric Immunity. Manufacturer shall indicate whether failure of the electrical immunity system can possibly result in disconnect of power to luminaire.

I. Electromagnetic interference

1. Shall comply with FCC 47 CFR part 15 non-consumer RFI/EMI standards.

J. Painted or finished luminaire components exposed to the environment

1. Powder coat: Super TGIC polyester powder coat 2.5 mil nominal thickness.
2. Finish shall exceed a rating of six (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.

K. BUG Ratings

1. IES TM-15-11 limits for Backlight, Uplight, and Glare shall be as specified for each luminaire type as indicated in the Roadway Lighting Design templates.
2. Calculation of BUG Ratings shall be for initial (worst-case) values, i.e., Light Loss Factor (LLF) = 1.0.
3. Luminaires with U-value greater than zero shall not be accepted.

L. The following shall be in accordance with corresponding sections of ANSI C136.37

1. Wiring and grounding
 - a. All internal components shall be assembled and pre-wired using modular electrical connections.
2. Terminal blocks required for incoming AC conductors.
3. Photocontrol receptacle, if required.
4. Latching and hinging

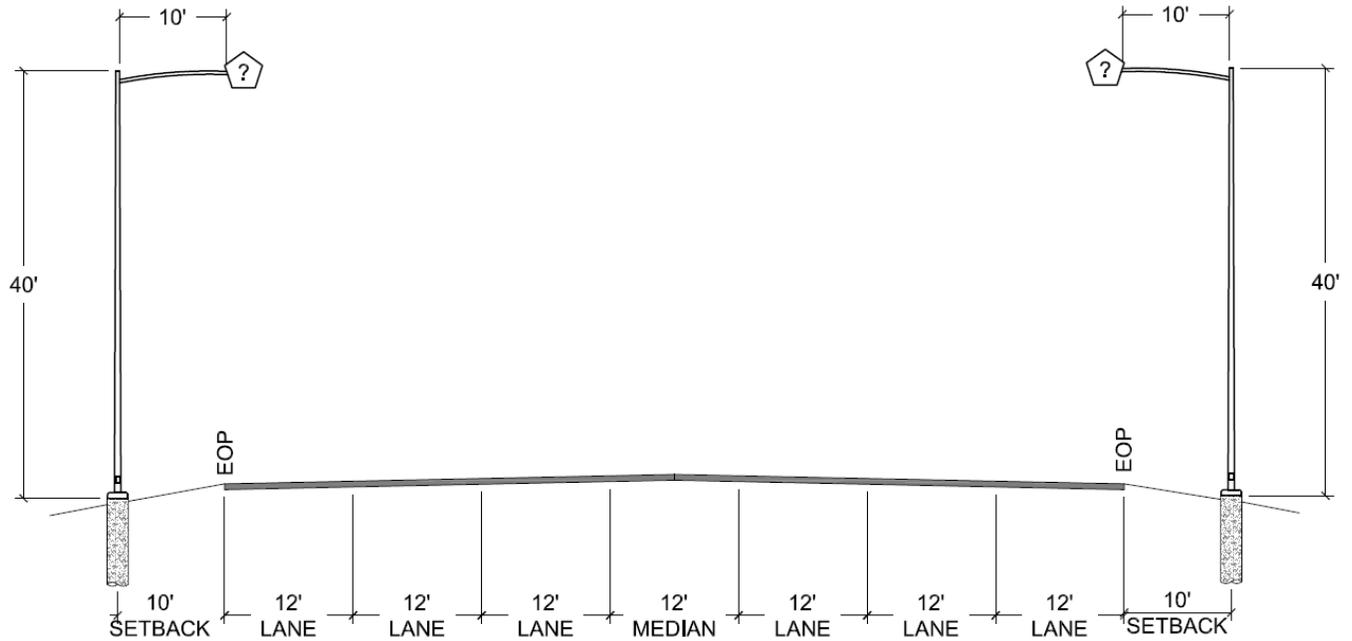
2.2 MANUFACTURER SERVICES

- A. A qualified representative of the Manufacturer shall be available in Colorado for up to two weeks during the first week of LED installation to ensure proper installation, and provide training on the installation, testing, and operation of the LED luminaire. This individual(s) may have to physically go to each of the locations listed in attachment A

END OF SECTION

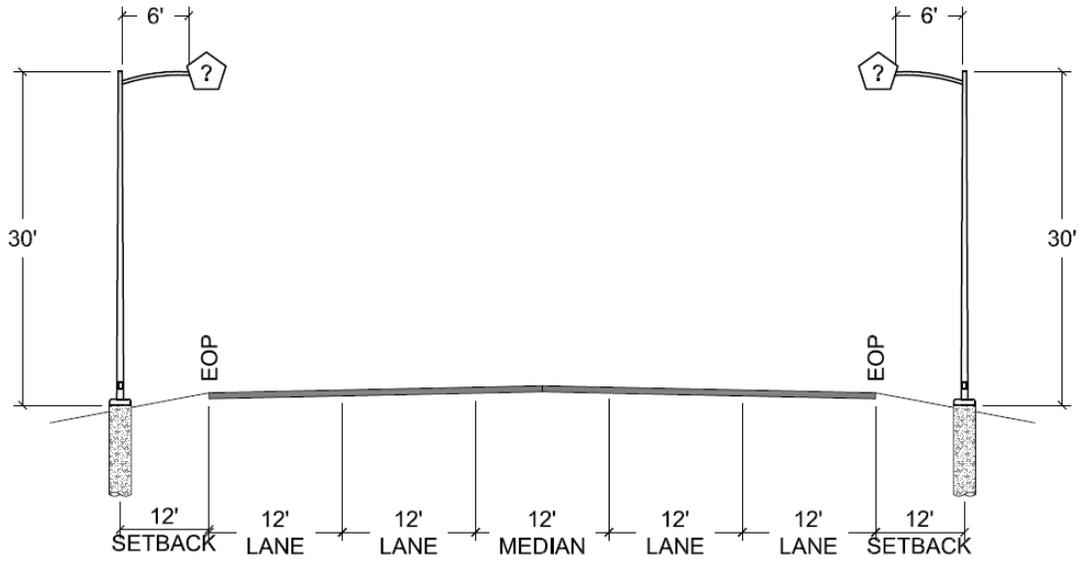
Appendix A: Roadway Lighting Design Templates

6-Lane Divided (Concrete Pavement)



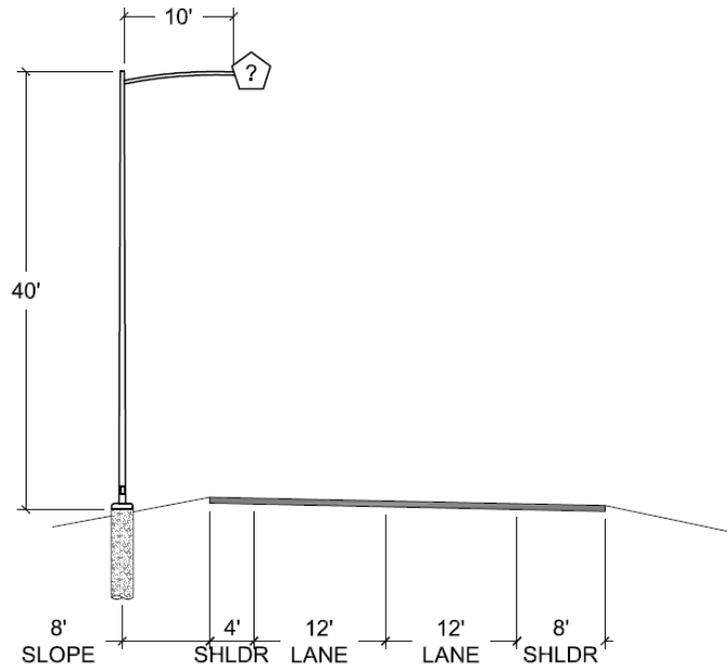
Pole Spacing	200 feet
Light Loss factors	0.88 LLD; 0.90 LDD
BUG Rating	B3-U0-G2
Target Criteria - Luminance	
Average Luminance (maintained)	.40 - .50
Avg/Min Uniformity	3 : 1
Max/Min Uniformity	6 : 1

4-Lane Divided (Concrete Pavement)



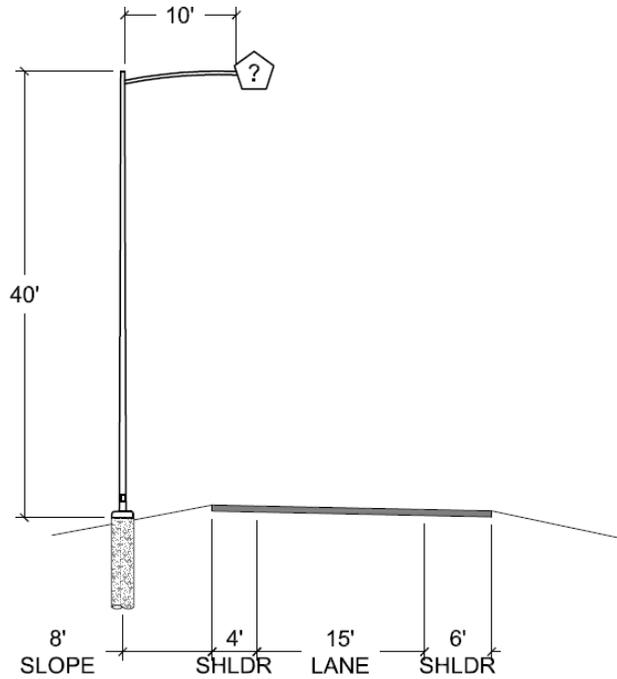
Pole Spacing	150 feet
Arrangement	Staggered
Light Loss factors	0.88 LLD; 0.90 LDD
BUG Rating	B3-U0-G2
Target Criteria - Luminance	
Average Luminance (maintained)	0.4 - 0.5
Avg/Min Uniformity	3 : 1
Max/Min Uniformity	6 : 1

2-Lane (Ramp or Frontage Road)(Concrete Pavement)



Pole Spacing	200 feet
Arrangement	One-side
Light Loss factors	0.88 LLD; 0.90 LDD
BUG Rating	B3-U0-G2
Target Criteria - Luminance	
Average Luminance (maintained)	0.3 - 0.5
Avg/Min Uniformity	3 : 1
Max/Min Uniformity	6 : 1

1-Lane (Exit or Entrance Ramp)(Concrete Pavement)



Pole Spacing	200 feet
Arrangement	One-side
Light Loss factors	0.88 LLD; 0.90 LDD
BUG Rating	B3-U0-G2
Target Criteria - Luminance	
Average Luminance (maintained)	0.4 - 0.6
Avg/Min Uniformity	3 : 1
Max/Min Uniformity	6 : 1

Appendix B: Electrical Immunity

Test Procedure

- Electrical Immunity Tests 1, 2 and 3, as defined by their Test Specifications, shall be performed on an entire powered and connected luminaire, including any control modules housed within the luminaire, but excluding any control modules mounted externally, such as a NEMA socket connected photo-control. A shorting cap should be placed across any such exterior connector.
- The luminaire shall be connected to an AC power source with a configuration appropriate for nominal operation. The AC power source shall have a minimum available short-circuit current of 200A. The luminaire shall be tested at the nominal input voltage specified in Appendix A or at the highest input voltage in the input voltage range specified in Appendix A.
- Electrical Immunity test waveforms shall be superimposed on the input AC power line at a point within 6 inches (15cm) of entry into the luminaire using appropriate high-voltage probes and a series coupler/decoupler network (CDN) appropriate for each coupling mode, as defined by ANSI/IEEE C62.45-2002. The test area for all tests shall be set up according to ANSI/IEEE C62.45-2002, as appropriate.
- Prior to electrical immunity testing a set of diagnostic measurements shall be performed, and the results recorded to note the pre-test function of the luminaire after it has reached thermal equilibrium. These measurements should include at a minimum:
 - a) For luminaires specified as dimmable, Real Power, Input RMS Current, Power Factor and THD at a minimum of 4 dimmed levels (i.e. 90%, 75%, 50%, 25%) in addition to the rated minimum dimmed level.
- Tests shall be applied in sequential order (Test 1, followed by Test 2, followed by Test 3). If a failure occurs during Test 3, then Test 3 shall be re-applied to a secondary luminaire of identical construction.
- Following the completion of Tests 1, 2, and 3, the same set of diagnostic measurements performed pre-test should be repeated for all tested luminaires, and the results recorded to note the post-test function of the luminaire(s).
- A luminaire must function normally and show no evidence of failure following the completion of Test 1 + Test 2 + Test 3 (for a single tested luminaire), or the completion of Test 1 + Test 2 on a primary luminaire and Test 3 on a secondary luminaire. Abnormal behavior during testing is acceptable.
- A luminaire failure will be deemed to have occurred if any of the following conditions exists following the completion of testing:
 - a) A hard power reset is required to return to normal operation
 - b) A noticeable reduction in full light output (e.g. one or more LEDs fail to produce light, or become unstable) is observed
 - c) Any of the post-test diagnostic measurements exceeds by $\pm 5\%$ the corresponding pre-test diagnostic measurement.
 - d) The luminaire, or any component in the luminaire (including but not limited to an electrical connector, a driver, a protection component or module) has ignited or shows evidence of melting or other heat-induced damage. Evidence of cracking, splitting, rupturing, or smoke damage on any component is acceptable.

Test Specifications

NOTE: L1 is typically "HOT", L2 is typically "NEUTRAL" and PE = Protective Earth.

Test 1) Ring Wave: The luminaire shall be subjected to repetitive strikes of a “C Low Ring Wave” as defined in IEEE C62.41.2-2002, Scenario 1, Location Category C. The test strikes shall be applied as specified by Table D.1. Prior to testing, the ring wave generator shall be calibrated to simultaneously meet BOTH the specified short circuit current peak and open circuit voltage peak MINIMUM requirements. Note that this may require that the generator charging voltage be raised above the specified level to obtain the specified current peak. Calibrated current probes/transformers designed for measuring high-frequency currents shall be used to measure test waveform currents.

Test waveform current shapes and peaks for all strikes shall be compared to ensure uniformity throughout each set (coupling mode + polarity/phase angle) of test strikes, and the average peak current shall be calculated and recorded. If any individual peak current in a set exceeds by ±10% the average, the test setup shall be checked, and the test strikes repeated.

Table D.1: 0.5 μS – 100Hz Ring Wave Specification

Parameter	Test Level/Configuration
Short Circuit Current Peak	0.5 kA
Open Circuit Voltage Peak	10 kV
Source Impedance	12 Ω
Coupling Modes	L1 to PE, L2 to PE, L1 to L2
Polarity and Phase Angle	Positive at 90° and Negative at 270°
Test Strikes	5 for each Coupling Mode and Polarity/Phase Angle combination
Time between Strikes	1 minute
Total Number of Strikes	= 5 strikes x 4 coupling modes x 2 polarity/phase angles = 40 total strikes

Test 2) Combination Wave: The luminaire shall be subjected to repetitive strikes of a “C High Combination Wave” or “C Low Combination Wave”, as defined in IEEE C62.41.2-2002, Scenario 1, Location Category C. The test strikes shall be applied as specified by Table D.2. The “Low” test level shall be used for luminaires with **Basic** Electrical Immunity requirements, while the “High” test level shall be used for luminaires with **Elevated** Electrical Immunity requirements. Prior to testing, the combination wave generator shall be calibrated to simultaneously meet BOTH the specified short circuit current peak and open circuit voltage peak MINIMUM requirements. Note that this may require that the generator charging voltage be raised above the specified level to obtain the specified current peak. Calibrated current probes/transformers designed for measuring high-frequency currents shall be used to measure test waveform currents.

Test waveform current shapes and peaks for all strikes shall be compared to ensure uniformity throughout each set (coupling mode + polarity/phase angle) of test strikes, and the average peak current shall be calculated and recorded. If any individual peak current in a set exceeds by ±10% the average, the test setup shall be checked, and the test strikes repeated.

Table D.2: 1.2/50μS – 8/20 μS Combination Wave Specification

Parameter	Test Level/ Configuration	
8/20 μS Short Circuit Current Peak	Low: 3 kA	High: 10kA
1.2/50 μS Open Circuit Voltage Peak	Low: 6 kV	High: 10kV
Source Impedance	2Ω	
Coupling Modes	L1 to PE, L2 to PE, L1 to L2	

Polarity and Phase Angle	Positive at 90° and Negative at 270°
Test Strikes	5 for each Coupling Mode and Polarity/Phase Angle combination
Time Between Strikes	1 minute
Total Number of Strikes	= 5 strikes x 4 coupling modes x 2 polarity/phase angles = 40 total strikes

Test 3) Electrical Fast Transient (EFT): The luminaire shall be subjected to “Electrical Fast Transient Bursts”, as defined in IEEE C62.41.2 -2002. The test area shall be set up according to IEEE C62.45-2002. The bursts shall be applied as specified by Table D.3. Direct coupling is required; the use of a coupling clamp is not allowed.

Table D.3: Electrical Fast Transient (EFT) Specification

Parameter	Test Level/ Configuration
Open Circuit Voltage Peak	3 kV
Burst Repetition Rate	2.5 kHz
Burst Duration	15 mS
Burst Period	300 mS
Coupling Modes	L1 to PE, L2 to PE, L1 to L2
Polarity	Positive and Negative
Test Duration	1 minute for each Coupling Mode and Polarity combination
Total Test Duration	= 1 minute x 7 coupling modes x 2 polarities = 14 minutes