



Standard for LED Signal Modules at Highway-Railway Grade Crossings

October 10, 2003



Railway Association
of Canada

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1. Purpose

The purpose of this standard is to provide the minimum performance requirements for 200 mm and 300 mm Light Emitting Diode (LED) signal modules for use in Highway/Railway grade crossing signal assemblies in Canada.

2. Definitions

- 2.1 **“Burn-In Process”** The procedure by which a LED signal module is energized at an ambient temperature for a specified time duration to cause any early electronic component mortality failures to occur and to detect any component reliability problems before the product is shipped to the end user for installation.
- 2.2 **“Candela (cd)”** SI unit of luminous intensity. The candela is the luminous intensity, in a given direction, of a source that emits monochromatic radiation of frequency 540 nm and that has a radiant intensity in that direction of 1683 W per steradian (1 cd = 1 lm/sr).
- 2.3 **“Chromaticity”** The colour of the light emitted by an LED signal module, specified as x-y or x and y chromaticity diagram according to the 1931 Commission Internationale d’Eclairage (CIE) standard observer and coordination system.
- 2.4 **“Duty Cycle”** The amount of time during a given unit of time that an LED signal module is actually energized, expressed as a percentage (i.e., 30 minutes per hour would be a 50 % duty cycle).
- 2.5 **“Illuminance (at a point on a surface)”** The luminous flux $d\phi_v$ incident on an element of the surface containing the point divided by the area dA of that element (footcandle, lux)
- 2.6 **“LED Light Source”** A single light emitting diode (LED) or an array of LEDs.
- 2.7 **“LED Signal Module”** An array of LEDs and a lens that together are capable of providing a circular signal indication . An LED signal module shall be capable of replacing the optical unit of an existing highway/railway grade crossing signal section.
- 2.8 **“Light Stabilization Procedure”** The procedure by which an LED signal module is energized at a given temperature for a specified time duration to cause stabilization in light output.
- 2.9 **“Long Term Luminous Intensity Degradation”** The reduction in luminous intensity that normally occurs when an LED is illuminated over an extended period of time.
- 2.10 **“Lumen (lm)”** SI unit of luminous flux. Luminous flux emitted in unit solid angle (steradian (sr)) by a uniform point source having a luminous intensity of 1 candela

- 2.11 **“Luminance”** (in a given direction, at a given point on a real or imaginary surface, L_v) – Quantity defined by the formula

$$L_v = \frac{d\Phi_v}{dA \cdot d\Omega \cdot \cos\theta}$$

where $d\Phi_v$ is the luminous flux transmitted by an elementary beam passing through the given point and propagating in the solid angle $d\Omega$ containing the given direction; dA is the area of a section of that beam containing the given point; θ is the angle between the normal to that section and the direction of the beam (footlambert, cd/m^2)

- 2.12 **“Luminous Efficacy of Radiation (K)”** The luminous flux Φ_v divided by the corresponding radiant flux Φ_e ($K = \Phi_v/\Phi_e$).
- 2.13 **“Luminous Efficacy of a Source”** The luminous flux emitted divided by the power consumed by the source.
- 2.14 **“Luminous Intensity”** (of a source in a given direction, I_v) The luminous flux $d\Phi_v$ leaving the source and propagating in the element of solid angle $d\Omega$ containing the given direction, divided by the element of solid angle ($I_v = d\Phi_v/d\Omega$ candela)
- 2.15 **“Luminous Flux (Φ_v)”** Quantity derived from radiant flux Φ_e by evaluating the radiation according to its action upon the CIE standard photometric observer (lumen).
- 2.16 **“Lux (lx)”** SI unit of illuminance. Illuminance produced on a surface of area 1 square metre by a luminous flux of 1 lumen uniformly distributed over that surface ($1 \text{ lx} = 1 \text{ lm}/\text{m}^2$).
- 2.17 **“Power Consumption”** The electrical power in watts consumed by an LED signal module when operated at nominal operating voltage and ambient operating temperature range.
- 2.18 **“Radiant Flux (Φ_e)”** The total power emitted, received, or passing in the form of electromagnetic radiation. It is measured in watts.
- 2.20 **“Rated Life”** The arithmetic average of burning hours for a sample number of signal modules operated at rated voltage and under defined operating conditions.
- 2.21 **“Rated Voltage”** The nominal or design operating voltage of the LED signal module; the voltage at which rated watts, candelas, and life are determined.
- 2.22 **“Rated Watts”** The average initial power (watts) consumed when the lamp is operated at rated voltage.
- 2.23 **“Highway/Railway Grade Crossing Signal”** That part of a Highway/Railway Grade Crossing Warning System used at the crossing to provide visual warning to highway traffic.

2.24 **“Spectral Luminous Efficiency”** Ratio of the radiant flux at wavelength λ_m to that at wavelength λ such that both radiations produce equally intense luminous sensations under specified photometric conditions and λ_m is chosen so that the maximum value of this ratio is equal to 1.

3. Photometric Requirements

3.1 Luminous Intensity

When LED signal modules are in use at a highway/railway grade crossing, they shall at all times and under all normal operational conditions meet the minimum luminous intensity values shown in Table A-1.

Table A-1 – Minimum Luminous Intensity (Candela) over Temperature and Lifetime

	0°	5° L/R	10° L/R	15° L/R	20° L/R	25° L/R	30° L/R
0°	400	375	250	150	75	40	15
5° D	350	325	250	150	75	40	15
10° D	130	125	110	85	60	35	15
15° D	45	40	35	30	25	20	15
20° D	15	15	15	15	15	15	10

3.2 Chromaticity

A signal module shall produce a uniform red light output that conforms to the *Equipment and Material Standards* of the Institute of Transportation Engineers (ITE), Chapter 2, Section 8.04, 1998.

3.3 Uniformity

The ratio of the greatest and least luminance on the signal module shall not exceed 5:1, when measured over average areas of 500 mm².

3.4 Rise/Fall Time

The maximum rise time from zero intensity to full intensity, and the maximum fall time from full intensity to zero intensity, shall be 75 ms.

4. Physical and Mechanical Requirements

4.1 LED Signal Module Design

The LED signal module shall be designed to replace the existing signal module holder, reflector, and lens in highway/railway grade crossing signal housings without requiring modification of the mechanical, structural, or electrical components of those housings, which are described in AREMA C&S Manual Part 3.2.35 (*Recommended Design Criteria for Electric Light Unit for Highway-Rail Grade Crossing Signals Including Light Emitting Arrays and Incandescent Lamps*).

The LED signal module may be either 200 mm or 300 mm in size, and may have either a clear or a red lens. Any gasket or similar sealing provisions shall be made of a material in accordance with AREMA Manual Part 15.2.10 (*Recommended Functional Guidelines for Gasket Material Suitable for Circuit Controllers, Signal Cases and Other Signal Apparatus Housings*).

4.2 Environmental Requirements

The LED signal module shall operate over an ambient temperature range of -40°C (-40°F) to 70°C (158°F) per MIL-STD-883, Test Method 1010.

The LED signal module shall be protected against dust and moisture intrusion as per the requirements of NEMA Standard 250-1991, sections 4.7.2.1 and 4.7.3.2, for Type 4 enclosures.

The LED signal module shall be meet mechanical vibration and shock requirements as per AREMA Manual Part 11.5.1 (*Recommended Environmental Requirements for Electrical and Electronic Railroad Signal System Equipment*).

The LED signal module lens shall be UV stabilized.

4.3 Identification

The LED signal module shall be clearly identified with the following information:

Highway/Railway Grade Crossing: LED, Red
Beam Deflection Classification: Universal
Operating Voltage: _____
Current Consumption at Operating Voltage: _____
Meets Transport Canada Specifications: 2002
Serial Number: _____
Date of Manufacture: _____

If the module or its components require orientation, they shall be prominently and permanently marked with an indexing arrow.

5. ELECTRICAL REQUIREMENTS

5.1 Transient Voltage Protection

LED signal module circuitry shall include voltage surge protection as specified in REMA Manual Part 11.3.3 (*Recommended Design Criteria for Surge Withstand Capability of Electronic Signal Equipment for Signal Systems*).

5.2 LED Drive Circuitry

LED signal module circuitry shall operate in accordance with AREMA C&S Manual, Part 3.2.35 (Recommended Design Criteria for Electric Light Unit for Highway-Rail Grade Crossing Signals Including Light Emitting Arrays and Incandescent Lamps).

5.3 Dielectric and Electromagnetic Interference

LED signal module circuitry shall conform to dielectric and electromagnetic interference requirements for Class B equipment in AREMA Manual Part 11.5.1 (*Recommended Environmental Requirements for Electrical and Electronic Railroad Signal System Equipment*).



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