

Performance Requirements for Light Emitting Diode (LED) Road Illumination Devices

RATIONALE

Revisions to this document were made to improve the consistence and clarity. The lumen maintenance test and requirement have been revised to reflect newly establish document SAE J2938. Specific changes are detailed below:

- Road illumination device system is changed to road illumination devices for clarity.
- Referenced document lists are updated to reflect new or updated documents.
- Removed unrelated definitions and updated the definitions to be consistent with J387.
- All forward lighting devices applicable tests in SAE J575 are listed in Section 5.
- All forward lighting devices applicable requirements in SAE J575 are listed in Section 6.
- Removed life cycle test because it did not provide clear specification. Incorporated LED lumen maintenance test (SAE J2938) in its place.

1. SCOPE

This SAE Recommended Practice is intended as a guide toward standard practice and is subject to change to keep pace with experience and technical advances. This document establishes additional performance requirements specifically for light emitting diode road illumination device systems.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org

SAE J575 Test Methods and Equipment for Lighting Devices for Use on Vehicles Less than 2032 mm in Overall Width

SAE J759 Lighting Identification Code

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on this Technical Report, please visit
http://www.sae.org/technical/standards/J2650_201305**

SAE J2938 LED Light Source Testing and Requirements: LED Lumen Maintenance Part II

2.2 Related Documents

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

2.2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org

SAE J387 Terminology – Motor Vehicle Lighting

SAE J578 Color Specification

SAE J1383 Performance Requirements for Motor Vehicle Headlamps

SAE J2357 Application Guidelines for Electronically Driven and/or Controlled Exterior Automotive Lighting Equipment

SAE J1889 LED Signal and Marking Lighting Devices

2.2.2 Federal Publications

Available from the Superintendent of Documents, U.S. Government Printing Office, Mail Stop: SSOP, Washington, DC 20402-9320, <http://www.gpo.gov/fdsys/>

CFR Title 49 Part 571.108; Lamps, Reflective Devices and Associated Equipment (FMVSS 108)

Available from Transport Canada, Roads Safety and Motor Vehicle Regulation, Ottawa, Ontario K1A 0N5, Canada, www.tc.gc.ca, or <http://www.tc.gc.ca/eng/acts-regulations/acts-1993c16.htm>

CMVSS 108 Lighting Systems and Retroreflective Devices

2.2.3 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org

ASTM E 308-66 Recommended Practices for Spectrophotometry and Description Color in CIE 1931 System

3. DEFINITIONS

3.1 LED Road Illumination Device

A device functioning as a forward illumination device (e.g., low beam, high beam, fog, cornering, or auxiliary high beam) and contains LEDs.

4. IDENTIFICATION CODES, MARKINGS AND NOTICES

- 4.1 The device shall be marked in accordance with SAE J759. Headlamps using LED devices shall be identified by the code "HL". Refer to specific device standards for possible additional marking requirements.
- 4.2 Permanent identification markings may be located on any component of the lamp assembly.
- 4.3 The design voltage shall be permanently marked on the lamp unless a control module is used to supply power to the lamp. Where a control module is used, the wording "Control Module Required" shall be indicated on the exterior of the lamp assembly.

5. TESTS

- 5.1 Each device shall be tested in accordance with the test section of each applicable SAE standard appropriate for the device and subsystem.
- 5.2 Tests per SAE J575 with the modifications as indicated.

5.2.1 Photometry

Also test per applicable SAE standard except as noted.

5.2.1.1 Adjustments to Test Points Due to Temperature

- 5.2.1.2 A photometric measurement shall be made for each specific function at the specified test point with the device at room temperature ($23\text{ }^{\circ}\text{C} \pm 4\text{ }^{\circ}\text{C}$) after 1 min of operation. Other test methods which yield equivalent results may be used. For these measurements, the aim can be approximate, but must be maintained for the before and after ratio measurements. Once stability of photometry has been achieved (see 5.2.1.3), aiming of the device for complete photometry shall be performed in accordance with the requirements of each specific function.

TABLE 1 – TEST POINTS FOR ROAD ILLUMINATION DEVICES

Function	Point to Measure
Low Beam	1.5D – 2R
High Beam	H – V
Front Fog Lamp	2D – V
Auxiliary High Beam	H – V
Front Cornering Lamp	2.5D – 45R(L)

- 5.2.1.3 The lamp shall continue operation until photometric stability has occurred; when the photometry is stable within $\pm 3\%$ of any 15 min period. Photometer the lamp at all test points required for the specific device.
- 5.2.1.4 Calculate the ratio between the photometric test point determined in 5.2.1.2 and the same point determined in 5.2.2.3.
- 5.2.1.5 Apply the ratio calculated above to each of the remainder of the test points to create a new photometric table that describes the complete photometry based on 1 min of operation.
- 5.2.2 Vibration Test
- 5.2.3 Impact Test
- 5.2.4 Abrasion Test of Plastic Headlamp or Fog Lamp Lens Material
- 5.2.5 Thermal Cycle Test
- 5.2.6 Internal Heat Test

5.2.7 Humidity Test

5.2.8 Dust Test

Integral beam headlamps are not subject to the dust test

5.2.9 Corrosion Test

5.2.10 Corrosion Resistance Test of Reflectors of Replaceable Lens Headlamps or Fog Lamps

5.2.11 Chemical Resistance Test

5.2.12 Chemical Resistance Test of Reflectors of Replaceable Lens Headlamps or Fog Lamps

5.3 Luminous Flux Maintenance Test

5.3.1 The LED packages used in the device shall be tested according to SAE J2938.

5.4 Color Test

The color for the emitted light from the device shall be measured per the test method specified in SAE J578. It shall also be measured before and after the luminous flux maintenance test (5.3).

5.5 Red Spectral Content

A spectrophotometric method shall be used to check the "red" spectral content, k_{red} , of the light from the light source for compliance with minimum red content specifications. Refer to ASTM E 308-66 for more details on spectrophotometric measurement.

$$k_{\text{red}} = \frac{\int_{\lambda=610\text{nm}}^{780\text{nm}} E_e(\lambda)V(\lambda)d\lambda}{\int_{\lambda=380\text{nm}}^{780\text{nm}} E_e(\lambda)V(\lambda)d\lambda}$$

(Eq. 1)

where:

$E_e(\lambda)$ [W/nm] is the spectral distribution of radiant flux
 $V(\lambda)$ is the spectral luminous efficiency
 λ [nm] is the wavelength

6. REQUIREMENTS

6.1 The device shall meet the requirements as specified in the "Requirements" section of the standard applicable to the device being tested.

6.2 Meet requirements per SAE J575

6.2.1 Photometry

6.2.1.1 Photometric Affects Due to Temperature

All photometry test point requirements as specified in the applicable standard shall be met after the photometric stabilization period, and with the applied 1 min/photometric stability ratio.