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SURFACE VEHICLE RECOMMENDED PRACTICE

Submitted for recognition as an American National Standard

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L.E.D. LIGHTING DEVICES

1. *Scope*—This SAE Recommended Practice applies to motor vehicle signalling and marking lighting devices which use light emitting diodes (L.E.D.) as light sources. This report provides test methods, requirements, and guidelines applicable to the special characteristics of L.E.D. lighting devices. These are in addition to those required for devices designed with incandescent light sources. This report is intended as a guide to standard practice and is subject to change to reflect additional experience and technical advances.

(R) 2. *References*

2.1 **Applicable Documents**—The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J387—Terminology—Motor Vehicle Lighting
SAE J575—Test Methods and Equipment for Lighting Devices and Components for Use on Vehicles Less than 2032 mm in Overall Width
SAE J576—Plastic Materials for Use in Optical Parts Such as Lenses and Reflex Reflectors of Motor Vehicle Lighting Devices
SAE J578—Color Specification
SAE J1330—Photometry Laboratory Accuracy Guidelines

2.2 **Definitions**

2.2.1 SEMICONDUCTOR—A material whose resistivity lies in the broad range between conductors and insulators.

2.2.2 L.E.D.—An indivisible, discrete light source unit containing a semiconductor junction in which visible light is nonthermally produced when a forward current flows as a result of applied voltage.

2.2.3 L.E.D. LIGHTING DEVICE—A lighting device in which light is produced by an array of L.E.D. light sources.

2.2.4 INCANDESCENCE—The generation of light caused by heating a body to a high temperature. Generally this heating is obtained by passing an electric current through a wire filament. The resistance of the filament to the current causes the filament to heat up and emit radiant energy, some of which is in the visible range. Ordinary automotive bulbs have incandescent light sources.

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2.2.5 L.E.D. LIGHT SOURCE CENTER—For a single L.E.D., the point that is located at the geometric center of the junction where the luminescence takes place.

2.2.6 LIGHTING DEVICE LIGHT CENTER—The geometric center of all the single L.E.D. light source centers within the L.E.D. array(s) used to illuminate the device function, or the geometric center of the illuminated area if the light output is produced indirectly.

3. Tests—The following section describes individual tests which need not be performed in any particular sequence. Testing may be expedited by performing two or more tests simultaneously on separate samples.

3.1 SAE J575 is a part of this report. Unless otherwise specified, the following tests are applicable with modifications as indicated.

3.1.1 VIBRATION TEST—The evaluation of the sample at the completion of the test shall also include a functional lighting check. If a partial outage is observed, a photometry test (see 3.1.5) shall be performed and the results recorded.

3.1.2 MOISTURE TEST

3.1.3 DUST TEST—If dust is found, the change in the maximum photometric luminous intensity of the sample shall be determined by using the photometric measurement procedures in 3.1.5.

3.1.4 CORROSION TEST

(R) 3.1.5 PHOTOMETRY TEST—Due to the near monochromatic nature of the color emitted by most L.E.D. light sources, the color response of the photometer detector shall be accurately calibrated in the spectral range of the L.E.D. device being measured. The photometric output (luminous intensity) of a L.E.D. lighting device typically decreases as the temperature of the L.E.D. light sources increases. In addition to the test procedures in SAE J575, the following shall apply:

3.1.5.1 Design Voltage—The device shall be operated at its design voltage during all photometric tests.

3.1.5.2 Photometric Maximums—For measurements to photometric maximum requirements, first allow the test device to stabilize at laboratory ambient temperature (23 °C ± 5 °C) unenergized. After all the device components are at laboratory ambient temperature, energize the test device and record the maximum photometric value(s) within 60 s of the initial on-time.

3.1.5.3 Photometric Minimums—For measurements to photometric minimum requirements, the test device light output shall first be stabilized by energizing the device at laboratory ambient temperature (23 °C ± 5 °C) until either internal heat buildup saturation has occurred or 30 min has elapsed, whichever occurs first.

3.1.6 WARPAGE TEST ON DEVICES WITH PLASTIC COMPONENTS—Not required.

3.2 Color Test—SAE J578 is a part of this report.

3.3 Thermal Cycle Test

3.3.1 SCOPE—This test evaluates the ability of the sample device to resist optical, electrical, or physical malfunctions due to exposures to repeated changes from hot to cold temperature extremes. Devices installed in vehicle locations that could produce temperatures outside the test range specified may necessitate special test requirements.

3.3.2 TEST EQUIPMENT—A thermal cycle chamber capable of providing the temperature extremes and rates of change of temperature in the temperature-time profile specified in Figure 1.

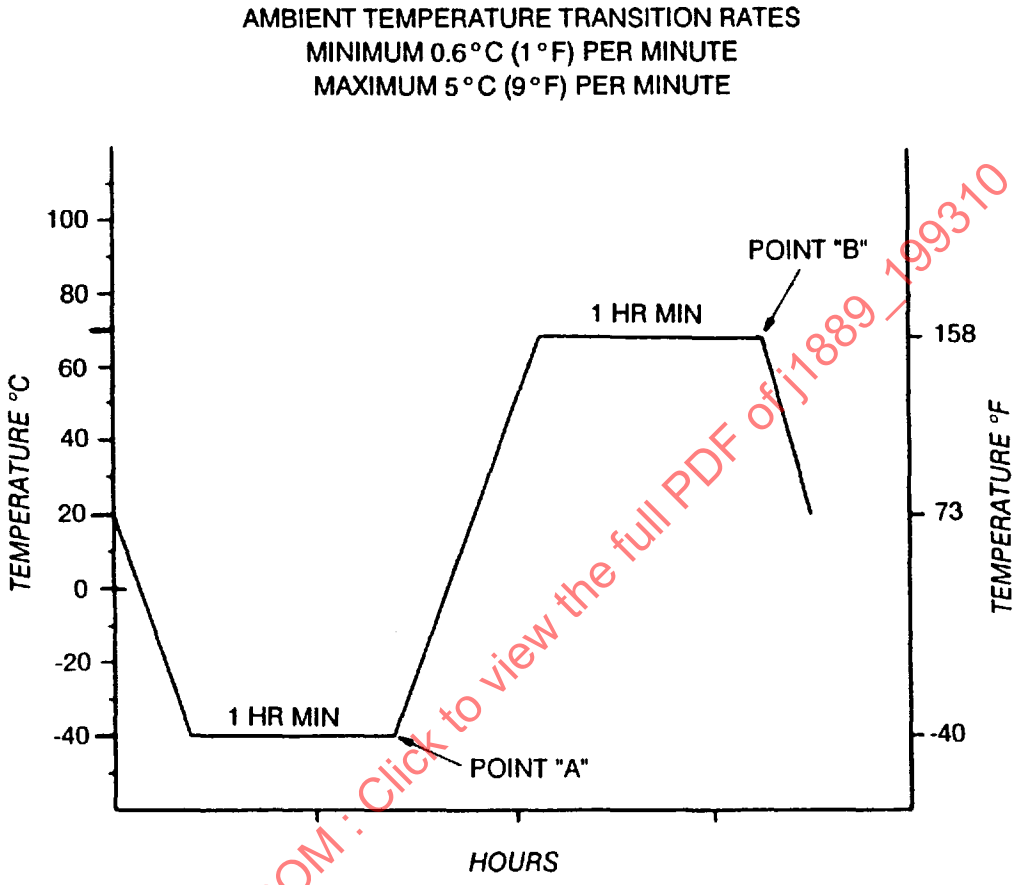

FIGURE 1—THERMAL CYCLE PROFILE

3.3.3 TEST PROCEDURE—The sample device, mounted on a test fixture shall be subjected to thermal cycles as follows:

3.3.3.1 Thermal Cycle—The device shall be exposed to the thermal cycle profile shown in Figure 1.

3.3.3.2 Device Operation—The device shall be energized at design voltage commencing at point "A" of Figure 1 and de-energized at point "B" of each cycle. When energized, the lighting function(s) shall be cycled as specified in SAE J575, Table 1.

3.3.3.3 Test Duration—The test shall consist of 25 complete cycles of the thermal cycle profile shown in Figure 1.

3.3.3.4 Sample Evaluation—During the final thermal cycle, the sample lighting function(s) shall be continuously checked for permanent or intermittent outages while energized from Point "A" (cold temperature) to Point "B" (hot temperature) on Figure 1 and the results recorded. If partial outage is observed, a photometry test (see 3.1.5) with the remaining functional L.E.D. segments lighted shall be performed and the results recorded. Upon completion of the thermal cycle exposure the sample device shall be visually examined for any cracking, rupture, or warpage of parts and the results recorded. If any of the previous changes are observed that could result in failure of the other tests contained in Section 3, these test(s) shall be performed on the same sample used for the thermal cycle test and the results recorded.

4. Requirements

4.1 Performance Requirements—A L.E.D. lighting device when tested in accordance with the test procedures specified in Section 3 shall meet the following requirements.

4.1.1 VIBRATION—SAE J575. The following requirements also apply:

4.1.1.1 After completion of test procedure 3.1.1, all L.E.D. light sources contained within the device shall function or the device shall comply with the photometric requirements in 4.1.5 of this report.

4.1.2 MOISTURE—SAE J575.

4.1.3 DUST—SAE J575.

4.1.4 CORROSION—SAE J575.

4.1.5 PHOTOMETRY—SAE J575. The photometric performance requirements in the applicable SAE technical report for the lighting function being tested shall also apply. Specified photometric maximum and minimum test points shall be determined as specified in 3.1.5.2 and 3.1.5.3 of this report. The following requirements shall also apply:

4.1.5.1 Lighted Sections—Applicable photometric requirements specified in other SAE technical reports which are based on the number of lighted sections shall instead be applied based on the dimensions of the L.E.D. lighting device function being tested. The maximum horizontal or vertical projected lighted linear dimension of the function shall be equivalent to the number of lighted sections in Table 1:

TABLE 1

Maximum Projected Linear Dimension	Equivalent Number of Lighted Sections
150 mm or less	1
151 to 300 mm	2
301 mm or greater	3

4.1.6 WARPAGE—SAE J575. Not required.

4.1.7 COLOR—The color of light shall be as specified in SAE J578 and in the SAE report of the applicable device function.