SURFACE VEHICLE RECOMMENDED PRACTICE

J1889™ JUL2019

Issued 1988-06
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Revised 2019-07

Superseding J1889 MAR2015

(R) LED Signal and Marking Lighting Devices

RATIONALE

The 2015 revision of SAE J1889 expedited production testing, yet allowed previous methods when appropriate. The purpose of the 2019 update is twofold:

1. To allow industry to take advantages of new technologies, such as camera-based photometry (SAE J3100). This requires a better definition of photometric stability.

2. To allow shorter warm up times, when appropriate, by use of pre-determining minimum ratio. This could facilitate more frequent production quality checks.

Additional concerns are addressed related to minimum photometric values not being measured at 30 minutes per the 1999 version of SAE J1889 and the use of that version by Transport Canada when conducting compliance audit testing of LED lighting devices, as indicated in their Road Safety Bulletin published August 2004. Changes to this version will reference 30 minute photometric values by direct measurement or by a ratio method from a pre-determine ratio value.

SAE J1889 History

To understand the current ballot, it is best to understand the purpose SAE J1889 was created. The basic assumption was that the lumen output of a bulb changes very little over time, but lumen output of LEDs may considerably degrade as the device heats up. SAE J1330 states, “The light source should be allowed sufficient warm-up period for the luminous flux to stabilize.” This guideline is true for any light source, since taking photometric measurements with a stable light source minimizes drift error during the photometry test. Calling out LEDs as inferior to a bulb is not necessarily true with current day LEDs. See figure below. Luminous flux stability is needed for all light sources.

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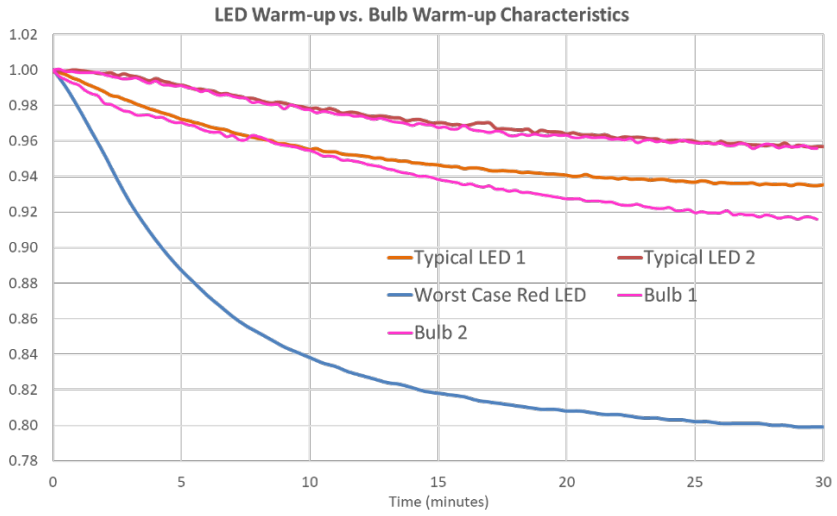

In the 1999 version of SAE J1889, there was no definition of photometric stability; instead, the rationale described what is required to obtain “stable” photometric data. See text in italics below. Remember that photometric stability is important to limit drift (error) during measurement.

Section 4.1.5.2: *Since it is not considered practical to impose routine laboratory photometric measurement requirements at temperatures other than normal laboratory ambient, the purpose of the special photometry test procedure for LED lamps is to:*

1. *Obtain reasonable inter-lab correlation by conducting measurements during relatively stable photometric output periods at laboratory room ambient temperatures, and*

2. *Obtain measurements for minimum values after some period of operation so that the self-heating of the LED device produces values which simulate initial-on photometric values at elevated ambient temperatures.*

Section 4.1.5.2 of the 1999 document contained a note regarding photometry testing:

NOTE: Other test methods which yield equivalent results may be used. Examples include eliminating the ratio calculation and directly measuring the maximum photometric value at 1 minute (for a typical LED device where photometric values decrease with on-time) or directly measuring values at the specified on-time when the photometric measurement equipment can record near simultaneous readings at all test points. ***Readings at shorter on-times may also be used when the photometric output versus time performance of the device is known.***

The term “relatively stable photometric output periods” was not defined in the 1999 version, but, in 2005, was determined to be ±5% over an arbitrary unit of time. Actual measurement error is not known with the former definitions of photometric stability (2005 to 2015 versions of SAE J1889). In this ballot, photometric stability is bounded to limit measurement error due to the light source. The definition of photometric stability should be independent of light source and be valid for any current or future light source. LED stability is something completely different. LED stability can be defined as a percentage light output change over a fixed duration (i.e., ±3% over 15 minutes).

Any photometric measurement on a goniometer has many error sources, including: calibration accuracy, detector drift, ambient light errors, positioning errors of DUT, and light source drift during the measurement duration. SAE J1889 is a recommended practice that teaches industry how to know the light source drift error is below a threshold determined by industry experts as a reasonable limit. The first four error sources mentioned describe goniometer measurement errors that are generally known to not be better than ±3%. With a ±3% goniometer error, defining light source drift error to be less than 0.01% or allowed to be greater than 3% is not reasonable. Also, goniometers are not the only way to measure the performance of lighting device. Camera-based photometry is also used and defined in SAE J3100. These devices record all data points simultaneously, and although camera-based measurements have their unique error sources, light source drift during measurement is not an error source. Therefore, SAE J1889 must re-define photometric stability to recognize methods of measurements other than goniometer. Other methods were recognized in the 1999 version of SAE J1889, “Directly measuring values at the specified on-time when the photometric measurement equipment can record near simultaneous readings at all test points.”

In conclusion, the definition of photometric stability must be: (1) Valid for all light sources, (2) Effective and not discriminating against any measurement instrument method, and (3) A reasonable requirement and a quantifiable measure of the actual error when performing a photometric test.

Photometric Stability: The point in time when the device under test (DUT) photometric value is stable to within 1% over the photometric test duration.

1. This definition is independent of light source and can be used for bulb, OLED, LED, laser, etc.

2. This definition does not descriminate against faster methods of measurement as it is specific to the duration of the test for the measurement instrument. An advantage of a faster measurement instrument is that it is more effective at reducing drift errors and should not be penalized by SAE J1889.

3. If instruments used to measure photometry are accurate to ±3% or ±5%, then a 1% drift error during a measurement seems reasonable and not unduely restrictive. It also makes the drift error known to be not more than 1%. Previous definitions do not bound the drift error.

Three definitions are being added to this document: (1) Photometric test duration is being added to the document to make the definition of photometric stability well understood, (2) Minimum ratio is added to explain how to calculate the ratio to determine minimum values, and (3) Maximum ratio is added to explain how to calculate the ratio to determine maximum values

Changed or added sections of the document:

3.6 Maximum Ratio

3.7 Minimum Ratio

3.8 Photometric Stability

3.9 Photometric Test Duration

5.1.5.2 Lamps that flash during operation may be stabilized and/or photometrically evaluated in flashing mode.

5.1.5.3 Verification Method

5.1.5.4 Pre-Determined Stability Method

5.2 Color Test

6.1.5 Photometry

7.2 Method for Pre-Determining Ratio of Photometric Stability Values to Minimum Values - split into 7.2.1 to 7.2.4

1. SCOPE

This SAE Recommended Practice applies to functions of motor vehicle signaling and marking lighting devices which use light emitting diodes (LEDs) as light sources. This report provides test methods, requirements, and guidelines applicable to the special characteristics of LED lighting devices. This Recommended Practice is in addition to those required for devices designed with incandescent light sources. This report is intended to be a guide to standard practice and is subject to change to reflect additional experience and technical advances.