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Standard Test Method for Determining Luminance of a Membrane Switch Backlit with Diffuse Light Source[1]

This standard is issued under the fixed designation F2360; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

ε[1] NOTE—The spelling of interlaboratory in 8.1 was corrected editorially in June 2015.

1. Scope

1.1 This test method covers procedures for determining the luminance of a backlit membrane switch. As written, it applies to a fully assembled switch. For specific purposes, it can be applied to partially assembled switches with the understanding that the results pertain only to the partial assembly and will be modified as the further assembly proceeds.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Terminology

2.1 *Definitions:*

2.1.1 *graphic overlay*—a graphically illustrated layer often attached to the topside (or first surface) of the switch assembly for protection, cosmetic purposes, or to indicate the location and function of the switch keys.

2.1.2 *illumination layer*—a layer in the construction of a membrane switch, which may or may not be a physically distinct layer which contains or supports the source of illumination for the membrane switch. Examples are a flexible layer containing light emitting diodes (LEDs), often either the top or bottom layer of the switch, or a flexible layer of electroluminescent (EL) material, often a distinct and separate layer added at assembly.

2.1.3 *membrane switch*—a momentary switching device, in which at least one contact is on, or made of, a flexible substrate.

2.1.4 *UUT*—unit under test.

3. Significance and Use

3.1 Illumination of a switch or of certain features of a switch often has a functional purpose and must meet specification to satisfy the functional requirements of the switch.

3.2 Illumination of the switch can be affected by variations in the quality and design of the overlay and its application.

3.3 This test method addresses only the optical and visual appearance of the switch and not its electrical function.

3.4 This test method is non-destructive.

3.5 If this test method is applied to the entire switch assembly, the results can be applied to the whole device. However, it may be sufficient and practical to apply the test either to a subassembly only, or to the illumination layer only, in which case the results apply to that layer only and the net effect on the fully assembled device must be calculated, extrapolated, or otherwise inferred.

4. Interferences

4.1 Tests on incomplete assemblies give results appropriate to that state of assembly. Specifically, later application of a graphic overlay may alter the results.

4.2 Failure to fill the sampling aperture of the photometer will bias the results in a way which is not necessarily predictable.

4.3 Since every system of illumination changes characteristics as it ages, it must be recognized that the results apply to a particular interval in the lifetime of the system. Characterization of the aging properties may be addressed in a separate test method.

4.4 *Perpendicularity*—Since the angular distribution of emitted light can be altered by any material through which it passes, it is important that the photometer be held perpendicular to the area to be sampled.

4.5 *Temperature*—Since the performance of many light sources can vary with temperature, it is important to allow the

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UUT to thermally stabilize, if necessary, and then record the ambient temperature at which the measurements are made.

4.6 *Ambient Light*—Stray light sources will be detected by the photometer and will affect the UUT luminance measurement. It is important to measure the ambient light before illuminating the UUT. This ambient light reading should be zero or as close to zero as possible.

5. Apparatus

5.1 A working or mounting surface to hold and support the UUT assembly, providing electrical access to the termination region from which the illumination is to be powered and visible access to the regions at which the luminance is to be measured.

5.2 A power supply providing appropriate and adequate power to drive the illumination device(s) with appropriate connector(s). This should be specified as dc or ac, with voltage and power level given, and ideally should be switched.

5.3 A calibrated device to measure surface luminance (or radiance). This is typically a spot photometer, with a fairly compact sampling aperture (<1-cm diameter at the minimum working distance). Output should be in foot lamberts (candela per meter squared). Alternatively, a radiometer may be used, or even a video photometer, but cognizance must be maintained of the output units and calibration.

5.4 A means to support the luminance measuring instrument at a fixed distance and orientation to the UUT.

5.5 A means to control stray light and prevent it from entering the aperture of the photometer.

6. Procedure

6.1 Mount UUT on the working surface with the illuminated surface visible.

6.2 Attach a switched power source as appropriate to the illumination device set to the design operating point.

6.3 Mount the photometer or luminance meter so that the axis of its field of view is perpendicular to the area of the UUT to be measured. Ensure that the sampling aperture is filled by the area to be measured on the UUT.

6.4 Measure the stray light level by taking a photometer reading while the UUT luminous source is not powered. If this value is not zero or very close to it, do not proceed, but take steps to reduce the stray light present. This may be as simple as reducing the ambient room light or switching the overhead lights off altogether.

6.5 Switch on the luminous source in the UUT.

6.6 Measure the luminance of the sample area of the UUT.

7. Report

7.1 Report the following information:

7.1.1 State of UUT (assembled or not),

7.1.2 Stray light level,

7.1.3 Luminance measured,

7.1.4 Power conditions for the illumination device,

7.1.5 Location and size of the sample area or areas,

7.1.6 Photometer used, sample settings, calibration status, and the size of the sampling aperture,

7.1.7 Ambient temperature, and

7.1.8 Date of test.

8. Precision and Bias

8.1 The precision of this test method is based on an interlaboratory study of F2360-04, conducted in 2006. Each of six laboratories tested three different types of lamps. A single "test result" represents an individual determination. Every laboratory produced twelve test results for each material.[2]

8.1.1 *Repeatability*— Two test results obtained within one laboratory shall be judged not equivalent if they differ by more than the "*r*" value for that material; "*r*" is the interval representing the critical difference between two test results for the same material, obtained by the same operator using the same equipment on the same day in the same laboratory.

8.1.2 *Reproducibilty*— Two test results shall be judged not equivalent if they differ by more than the "*R*" value for that material; "*R*" is the interval representing the difference between two test results for the same material, obtained by different operators using different equipment in different laboratories.

8.1.3 Any judgment in accordance with these two statements would have an approximate 95 % probability of being correct.

8.2 *Bias*—At the time of the study, there was no accepted reference material suitable for determining the bias for this test method, therefore no statement on bias is being made.

8.3 The precision statement was determined through statistical examination of 216 results, from six laboratories, on three types of lamps. The three types of lamps used are described below:

Lamp 1: manufactured by Metromark: color: amber (X = 0.521, Y = 0.462)

Lamp 2: manufactured by Nelson Nameplate: color: green (X = 0.186, Y = 0.449)

Lamp 3: manufactured by Durel: color: blue (X = 0.155, Y = 0.204)

8.3.1 To judge the equivalency of two test results, it is recommended to choose the lamp closest in characteristics to the test lamp.

9. Keywords

9.1 backlit; colorimeter; diffuse light; electroluminescent material; light emitting diodes; luminance; membrane switch; photometer; radiometer; video photometer

[2] Supporting data are available from ASTM International Headquarters. Request RR:F01-1019.

TABLE 1 Luminance (foot lamberts)

Lamp	Average $\bar{x}$	Repeatability Standard Deviation sr	Reproducibility Standard Deviation sR	Repeatability Limit r	Reproducibility Limit R
1	2.6140	0.0996	0.4386	0.28	1.23
2	16.0102	0.3321	1.9016	0.93	5.32
3	4.4033	0.1878	0.5747	0.53	1.61