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Standard Test Method for Determining the Uniformity of the Luminance of an Electroluminescent Lamp or Other Diffuse Lighting Device[1]

This standard is issued under the fixed designation F2964; 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.

1. Scope

1.1 This test method covers procedures for determining the uniformity of the luminance of an electroluminescent (EL) lamp. While written specifically for the purpose of evaluating EL devices, which are intrinsically very uniform, it can be applied (judiciously) to the measurement of any diffuse, essentially planar, light source. For specific purposes, it can be applied to partially assembled devices into which the illumination is installed (such as a membrane switch) as a diagnostic for the performance of the entire device. In such a case it must be understood that the results pertain only to the partial assembly and will be modified as the further assembly proceeds.

1.2 The method is to take a 2-dimensional set of measurements, sampling the surface of the unit under test with appropriate density. The method is restricted to measuring luminance only, since variations in color will also show as luminance non-uniformity especially in any photoptically calibrated measuring device.

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

1.4 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

F2360 Test Method for Determining Luminance of a Membrane Switch Backlit with Diffuse Light Source

F2771 Test Method for Determining the Luminance Curve of an Electroluminescent Lamp at Ambient Conditions

3. Terminology

3.1 *Definitions:*

3.1.1 *luminance, n*—measure of the brightness or luminous intensity of light, usually expressed in units of candelas per square metre (cd/m^2) or foot lamberts. 1 fL = 3.426 cd/m^2.

3.1.2 *luminance curve, n*—a graphical representation of the variation of luminance with time (implicitly under unvarying operating conditions).

3.1.3 *electroluminescent lamp (EL lamp), n*—essentially a capacitor structure with phosphor and a dielectric sandwiched between electrodes, one of which is transparent to allow light to escape. Application of an ac voltage across the electrodes generates a charging field within the phosphor, which causes it to emit light.

3.1.4 *time to half luminance (THL), n*—the elapsed operating time over which the luminance of a lamp maintained under constant power will be reduced to half of its initial value.

3.1.5 *UUT, n*—unit under test.

4. Significance and Use

4.1 Application of an EL lamp (or other diffuse lighting source) to illuminate a device has a functional purpose and must meet specifications to satisfy the functional requirements of the device.

4.2 Illumination of the device or application can be affected by variations in the quality, efficiency, and design of the lamp and any attendant mounting or shading fixtures.

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

[1] This test method is under the jurisdiction of ASTM Committee F01 on Electronics and is the direct responsibility of Subcommittee F01.18 on Printed Electronics.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

4.4 This test method is non-destructive.

4.5 This test method is described for application to the illumination layer in which case the results apply to that layer only. However, it may be desirable and practical to apply the test to a further assembly or to a fully assembled device with built in illumination. In such a case, the results refer specifically to the subassembly or the entire device respectively.

5. Interferences

5.1 *State of Assembly*—Tests on incomplete assemblies give results appropriate to that state of assembly. Specifically, later application of mounting hardware, baffling, or fixtures may alter the results.

5.2 *Filling of Aperture*—Failure to fill the sampling aperture of the photometer will bias the results in a way which is not necessarily predictable.

5.3 *Age of Device*—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. (See for example Test Method F2771.)

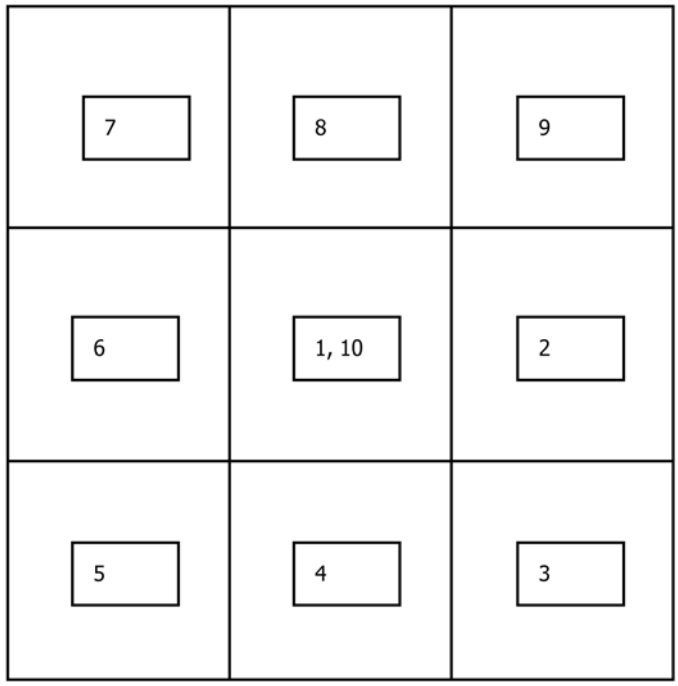
5.4 *Perpendicularity*—Since the angular distribution of emitted light can be altered by any material through which it passes, it is important that the photometer be held perpendicular to the area to be sampled.

5.5 *Temperature*—Since the performance of many light sources can vary with temperature, it is important to allow the UUT to stabilize thermally, if necessary, and then record the ambient temperature at which the measurements are made.

5.6 *Power*—Since the performance of many power sources can vary with temperature, it is important to allow the power supply for the UUT to stabilize thermally, if necessary, and then record the warm-up time at which the measurements are made.

5.7 *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.

5.8 *Sampling Aperture*—The sampling aperture (area of the UUT sample and over which luminance values are averaged by the measuring instrument) should be large enough to average over any intrinsic granularity of the UUT. This area should also be small enough compared with the overall size of the UUT to allow multiple measurements to be made without the sampling apertures of adjacent measurements overlapping (at least nine measurements are recommended). If areas overlap, the individual samples may no longer be considered as independent samples. The decision to allow individual samples to overlap or to remain physically distinct is one the experimenter must make and be conscious of. Use of a preplanned sequence of measurements is recommended. See Fig. 1 for example of a sample sequence and distribution.



NOTE 1—A sequence of nine, non-overlapping measurements which will reveal side-to-side, center to edge, and top to bottom non-uniformities of luminance. The order of sampling is suggested by the numbers. See 5.8.

NOTE 2—Size for the sampling area (shown here as small rectangles) can be chosen to maximize significance by taking it to be large enough to average over any intrinsic granularity of the lamp (such as phosphor crystal size) and small enough to avoid overlap with its neighbor (and thus remain independent).

FIG. 1 Suggested Organization of Sampling Points for Uniformity Measurement

6. Apparatus

6.1 A working or mounting surface to hold and support the UUT and any supporting fixtures, providing electrical access to the termination region from which the EL lamp illumination is to be powered and visible access to all regions of interest on the lamp at which the luminance is to be measured.

6.2 A power supply providing appropriate, stable 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.

6.3 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. Hereinafter we refer to this as the photometer.

6.4 A means to support the photometer at a fixed distance and orientation to the emitting surface of the UUT.

6.5 A means to move the lamp and photometer relative to each other with enough travel to allow the instrument controlled and stable visual access to all regions of the UUT. The apparatus or set up should allow the experimenter to collect