



Standard Test Method for Photopic Luminance of Photoluminescent (Phosphorescent) Markings¹

This standard is issued under the fixed designation E2073; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 This test method covers a procedure for determining the photopic luminance of photoluminescent (phosphorescent) markings. It does not cover scotopic or mesopic measurements.

1.2 When reference is made regarding photoluminescence in the text of this test method, it implies phosphorescence.

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered 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

E284 Terminology of Appearance

E308 Practice for Computing the Colors of Objects by Using the CIE System

E1316 Terminology for Nondestructive Examinations

E2072 Specification for Photoluminescent (Phosphorescent) Safety Markings

2.2 *Other Standards:*

Publication CIE No. 69 (1987) Methods of characterizing illuminance meters and luminance meters; Performance, characteristics and specifications³

3. Terminology

3.1 Definitions of terms in Terminology E284 and Terminology E1316 are applicable to this specification.

4. Significance and Use

4.1 To assess how photoluminescent markings perform under identical test conditions, the luminance shall be measured in accordance with this test method (see Specification E2072).

5. Apparatus

5.1 *Illuminance Meter*—To measure the illumination of the activating light source on the surface of the photoluminescent marking, use an illuminance meter calibrated to measure illuminance in fc (lux), with the following features: spectral error, f_1' , $\leq 5\%$; UV response, u , $\leq 0.5\%$; resolution 1.0 lux; and linearity error, f_3 , $\leq 0.5\%$ (see Publication CIE No. 69).

5.2 *Luminance Meter*—To measure the photopic luminance of photoluminescent markings, use a luminance meter with the following minimum features (see Publication CIE No. 69): spectral error, f_1' , $\leq 5\%$; UV response, u , $\leq 0.5\%$; resolution at least 0.1 mcd/m²; linearity error, f_3 , $\leq 0.5\%$; signal-to-noise-ratio: at least 10:1 for all measurements. The instrument shall have been calibrated within the preceding 12 months using photometric standards traceable to a national standards institute.

6. Sampling, Test Specimens, and Test Units

6.1 *Method of Sampling*—Take a minimum of three samples. Each sample shall be of a minimum size of at least 1¼ in. (45 mm) in diameter.

¹ This test method is under the jurisdiction of ASTM Committee E12 on Color and Appearance and is the direct responsibility of Subcommittee E12.13 on Photoluminescent Safety Markings.

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

³ Available from U.S. National Committee of the CIE (International Commission on Illumination), C/o Thomas M. Lemons, TLA-Lighting Consultants, Inc., 7 Pond St., Salem, MA 01970, <http://www.cie-usnc.org>.

6.2 *Firm/solid Photoluminescent markings*—Select samples at random. If a manufacturer, samples shall be representative of the production lot, coded, and identified to correspond to production batch codes, and shall be numbered consecutively.

6.3 Field-mixed/field applied paints/coatings are submitted to the testing laboratory in their non-solid form (for example, liquid, powder) with the manufacturer's preparation and application instructions. If a manufacturer, the non-solid samples shall be representative of the production lot, and their packaging be coded and identified to correspond to production batch codes and shall be numbered consecutively. Field-mixed/field-applied paints/coatings shall be applied by the testing laboratory in compliance with the manufacturer's preparation and application instructions, which have to include, but shall not be limited to, primers if required, layers needed, and wet (if required) and dry coat thicknesses, as luminance of the photoluminescent paint/coating is dependent on these factors.

7. Conditioning

7.1 Precondition all test specimens by placing them in complete darkness until their residual luminance has fallen to 0.3 mcd/m² or less, tested utilizing the luminance meter specified under 5.2.

7.2 Remove one test specimen at a time immediately before performing the procedure described in 8.3. No ambient or stray light shall be present.

7.3 Report the start and end of conditioning for each test specimen and the verified luminance that must be 0.3 mcd/m² or less, following the reporting required in Section 9.

7.4 If luminance of 0.31 mcd/m² or higher is measured, continue with the preconditioning process until residual luminance of each test specimen has fallen to 0.3 mcd/m² or less.

8. Procedure

8.1 *Ambient Conditions*—The ambient temperature during darkness preconditioning of specimens, activation and luminance testing shall be 77 °F ± 5 °F (25 °C ± 3 °C). The relative humidity shall not exceed 60 %. All luminance testing shall be performed in a room whose ambient light level is such that the luminance of a white diffuse reflectance standard is at least one decade lower than the lowest test specimen luminance measurement to be recorded.

8.2 *Preparation of Apparatus*—The luminance meter shall be zeroed prior to every measurement, then checked immediately after the measurement and the measurement shall be rejected if the zero drifted by more than 5 % of the measured value. The distance between the luminance meter and the measured test specimen, and also the aperture angle of the luminance meter, shall be chosen in such a way that 1⁵/₁₆ in. (30 mm) diameter of the photoluminescent test specimen, which is of at least 1³/₄ in. (45 mm) diameter, is evaluated.

8.3 *Activation*—Activate the photoluminescent marking specimens for 60 min (±10 s), providing an illumination of 1 fc (10.8 lux) ±1 % on the marking surface. Use one of the following light sources:

(1) An unfiltered fluorescent cool white source of light having a spectral power distribution similar to cool white F2 as

described in Practice E308 Table 4, of 40 W or less, with a correlated color temperature ranging from 4000 K to 4500 K.

(2) LED – any lamp configuration, 4000 K – 4500 K color temperature, seasoned for minimum 2 hr.

8.4 *Luminance*—Measure the photopic luminance of all specimens of the photoluminescent marking with a luminance meter as described in 5.2 after 10 min ±10 s and 60 min ±10 s and 90 min ±10 s.

9. Report

9.1 Report the following information per each individual test specimen:

9.1.1 Tested in accordance with ASTM Standard E2073 Edition: ____ (insert Year of Test Method publication, for example, for E2073-24 insert Edition: 24).

9.1.2 Manufacturer of tested photoluminescent marking: (company name, address, phone, email),

9.1.3 Specimen description: (clear item identification to make specimens traceable to manufacturer's data sheets). For field-mixed/field-applied paints/coatings describe sample preparation requirements based on manufacturer's preparation and application instructions (primer if any was applied, number of paint/coating layers applied, wet (if required)/dry coat thickness accomplished),

9.1.4 Beginning and end of conditioning: (fill in days and time),

9.1.5 Luminance determined (must be 0.3 mcd/m² or less),

9.1.6 Date of measurement,

9.1.7 Instrument parameters and photometer serial number,

9.1.8 Activation: (fill in minutes, type of activating light source, illuminance in fc (lux)),

9.1.9 Ambient temperature and relative humidity,

9.1.10 Photopic luminance measurement results in reference to 8.4,

9.1.11 List separately for all test specimens,

9.1.12 Luminance in mcd/m² 10 min after activation has ceased,

9.1.13 Luminance in mcd/m² 60 min after activation has ceased,

9.1.14 Luminance in mcd/m² 90 min after activation has ceased,

9.1.15 Test performed by: (person's name, title), and

9.1.16 Signature: ____; at: (describe test location) and company performing test: (company, full name of personnel responsible for the test, address, phone, email).

10. Precision and Bias

10.1 *Precision: Interlaboratory Test Program*—An interlaboratory round robin testing was conducted in 2005 and 2006, using three photoluminescent product samples. Eight laboratories participated by taking one measurement each of samples A and B, and by taking two measurements of sample C.

10.1.1 The samples were activated using an unfiltered fluorescent cool white source of light, 40 W or less, in the 4000 to 4500 K range, providing an illumination of 21.6 lux (2 fc) for 60 min at the sample surface.