



Designation: E2366 – 05

# Standard Test Method for Measurement of Daytime Chromaticity of Pavement Marking Materials Using a Portable Reflection Colorimeter<sup>1</sup>

This standard is issued under the fixed designation E2366; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This test method covers measurement of the daytime chromaticity coordinates ( $x$ ,  $y$ ) of horizontal pavement markings, such as traffic stripes and surface symbols, and pavement surfaces under diffuse illumination, using a portable reflection colorimeter that can be placed on the surface to measure the chromaticity in a particular viewing direction.

1.2 The co-viewing angle of the reflection colorimeter affects the readings. As specified by the European Committee for Standardization (CEN EN 1436), the co-viewing angle shall be  $2.29^\circ$ .

1.3 This test method is intended to be used for field measurement of pavement markings but may be used to measure the chromaticity and the luminance coefficient under diffuse illumination of materials on sample panels before placing the marking material in the field.

1.4 The portable reflection colorimeter may integrate measurement of the luminance coefficient under diffuse illumination Qd according to Test Method E2302 and thus be an integrated reflectometer/reflection colorimeter.

1.5 *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. Referenced Documents

2.1 *ASTM Standards:*<sup>2</sup>

D6628 Specification for Color of Pavement Marking Materials

E284 Terminology of Appearance

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

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee E12 on Color and Appearance and is the direct responsibility of Subcommittee E12.10 on Retroreflection.

Current edition approved Jan. 1, 2005. Published February 2005. DOI: 10.1520/E2366-05.

<sup>2</sup> 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.

E811 Practice for Measuring Colorimetric Characteristics of Retroreflectors Under Nighttime Conditions

E2302 Test Method for Measurement of the Luminance Coefficient Under Diffuse Illumination of Pavement Marking Materials Using a Portable Reflectometer

2.2 *Other Standard:*

CEN EN 1436 Road Marking Materials—Road Marking Performance for Road Users<sup>3</sup>

## 3. Terminology

3.1 The terminology used in this test method generally agrees with that used in Terminology E284. The definitions given in Test Method E2302 and Practice E811 apply in this test method as well.

3.2 *Definitions:*

3.2.1 *reflection colorimeter, n*—an instrument that illuminates a specimen and applies a colorimeter to the light reflected.

## 4. Summary of Test Method

4.1 This test method involves the use of portable reflection colorimeters for determining the chromaticity coordinates ( $x$ ,  $y$ ) of horizontal coatings materials used in pavement markings, and of pavement surfaces.

4.2 Illumination is diffuse and the co-viewing angle is fixed at  $2.29^\circ$ .

4.3 The reflection colorimeters use one or more external panels or other instrument standards of known chromaticity coordinates ( $x$ ,  $y$ ), or known spectral reflectance factor.

4.4 The portable reflection colorimeter's illuminator is placed directly over the pavement marking to be measured, ensuring that the measurement area of the reflection colorimeter fits within the width of the stripe, and the readings displayed by the reflection colorimeter are recorded.

4.5 Readings shall be taken for the direction of traffic. Readings shall be taken for each direction of traffic separately for centerlines.

<sup>3</sup> Available from European Committee for Standardization, Central Secretariat (CEN), rue de Stassart 36, B1050 Brussels, Belgium.

## 5. Significance and Use

5.1 The chromaticity of the stripe is determined by means of the tristimulus values  $X$ ,  $Y$  and  $Z$  for the CIE 1931 ( $2^\circ$ ) standard observer for CIE Standard Illuminant D65, which are converted to the chromaticity coordinates  $(x, y)$  and shown in the CIE 1931  $(x, y)$ -chromaticity diagram. Refer to Practice E308.

5.2 Under the same conditions of illumination and viewing, the chromaticity coordinates  $(x, y)$  represent the daytime color of pavement markings in daylight illumination as seen by drivers of the vehicles.

5.3 The chromaticity of pavement (road) markings may change with traffic wear and require periodic measurement to ensure that the chromaticity is maintained within boundaries (see Specification D6628 for examples of color boundaries).

5.4 As specified by CEN, the measurement geometry of the instrument is based on a viewing distance of 30 m and an eye height of 1.2 m.

5.5 It shall be the responsibility of the user to employ an instrument having the specified illumination and co-viewing angle.

## 6. Apparatus

### 6.1 Portable Reflection Colorimeter :

6.1.1 The reflection colorimeter shall be portable, with the capability to be placed on various horizontal pavement markings in different locations.

6.1.2 The reflection colorimeter shall be constructed so that placement on the highway pavement markings will preclude any stray light entering the measurement area of the instrument and affecting the reading. This may be done by shielding against stray light, or by subtraction of the stray light reading, or both.

6.1.3 For the convenience of the user, a marking shall be placed on the instrument to permit it to be aligned with the direction of traffic, or the instrument design shall itself indicate the measuring direction in an obvious manner.

### 6.2 Illumination System Requirements :

6.2.1 The illumination system shall comply with requirements of Test Method E2302, section on Illumination System Requirements.

### 6.3 Colorimeter Requirements:

6.3.1 The colorimeter shall have sufficient sensitivity and range to accommodate values expected in use, such as presented by a range of the luminance coefficient under diffuse illumination Qd from 80 to 300  $\text{mcd}\cdot\text{m}^{-2}\cdot\text{lx}^{-1}$  (the theoretical maximum is  $1000/\pi = 318 \text{ mcd}\cdot\text{m}^{-2}\cdot\text{lx}^{-1}$ ).

6.3.2 The colorimeter shall provide  $X$ ,  $Y$  and  $Z$  tristimulus values according to the CIE 1931 ( $2^\circ$ ) color matching functions. The reflection colorimeter must be able to apply illumination condition correction for CIE Standard Illuminant D65, and may either be a tristimulus colorimeter or a spectrophotometer.

6.3.2.1 A tristimulus colorimeter may have filters that can be inserted individually in front of a receiver to provide matches of the combined spectral distribution of the illumination and the spectral responsivity of the receiver to the

combined spectral distribution of CIE Standard Illuminant D65 and the CIE 1931 ( $2^\circ$ )  $x(\lambda)$ ,  $y(\lambda)$  and  $z(\lambda)$  color-matching functions, respectively. The  $x(\lambda)$  function has two distinct lobes. This may be dealt with by splitting  $x(\lambda)$  into  $x_{\text{short}}(\lambda)$  and  $x_{\text{long}}(\lambda)$ , each with a separate filter. The filters may be manually or automatically operated.

6.3.2.2 A spectrophotometer may measure the spectral reflectance in equal wavelength steps covering at least the wavelength range from 400 to 700 nm, with a maximum half power bandwidth of 10 nm in maximum step increment of 10 nm and from these data derive  $X$ ,  $Y$  and  $Z$  tristimulus values.

NOTE 1—Use of filters provides larger signals than measurement of the spectral distribution.

6.3.3 The colorimeter shall be able to determine the chromaticity coordinates  $(x, y)$  for CIE D65 and the CIE 1931 Observer of white and yellow pavement markings with a value of the luminance coefficient under diffuse illumination Qd of 80  $\text{mcd}\cdot\text{m}^{-2}\cdot\text{lx}^{-1}$ , or higher, with a minimum reproducibility 0.005, when calibrated and used according to the instrument manufacturers instructions.

6.3.4 The colorimeter shall comply with requirements of Test Method E2302, Receiver Requirements sections concerning respectively receiver aperture, combined stability of the output of the light source and receiver, and linearity.

### 6.4 Measurement Geometry:

6.4.1 The measurement geometry shall comply with requirements of Test Method E2302, Measurement Geometry section.

## 7. Standardization and Procedure

7.1 The instrument will either require an external black standard or it will incorporate an internal black standard or some other internal means of zeroing.

7.1.1 If the instrument standardization requires a black standard then the black standard shall have virtually no reflection over the range of wavelengths for the visible part of the spectrum. The black standard may be a light trap formed as a wedge of two black acrylic plates. For some instruments, the black standard may be an unobstructed free path obtained by a lift or a tilt of the instrument.

7.2 A portable instrument with a tristimulus colorimeter, refer to 6.3.2, can be calibrated using a black standard (if required) and one, two, three or more instrument standards consisting of separate panels or other instruments standards.

7.2.1 The instrument standard(s) shall have known and reproducible  $X_S$ ,  $Y_S$  and  $Z_S$  tristimulus values measured at the same geometry as used in the portable instrument. Alternatively, the values of  $Y_S$  and the  $(x, y)$  chromaticity coordinates may be known instead of the tristimulus values.

NOTE 2—Some instruments measure Qd in addition to the chromaticity coordinates  $(x, y)$ , and for these instruments  $Y_S$  should be in the scale of Qd.

7.2.2 The producer of the instrument shall provide the software needed to guide the user through the calibration procedure and to obtain the chromaticity values  $(x, y)$  from the measurements.