



Designation: ~~D6628~~—~~16~~ D6628 – 23

Standard Specification for Color of Retroreflective Pavement Marking Materials¹

This standard is issued under the fixed designation D6628; 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 specification covers the daytime and nighttime color of retroreflective pavement marking materials used for traffic control lane markings and symbols on road surfaces. ~~It is intended to apply throughout the service life of the material.~~

1.2 This specification applies to ~~both painted and tape lines, including thermoplastic, epoxy and other types.~~ all retroreflective pavement markings (markings that include retroreflective optics residing on the surface) except structured pavement markings as defined in 3.2.5.

1.3 This specification is not applicable to the testing, for quality control purposes, of marking material without added drop-on beads. ~~pavement markings that do not include retroreflective optics on the surface.~~

1.4 ~~In addition, it does not describe.~~ This specification does not address any requirements other than color such as retroreflectance. ~~the color of retroreflective pavement markings.~~

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

1.5.1 *Exception*—This specification is noted to be an SI document, where angles are generally expressed in radians. However, as angles used in retroreflection have historically been identified in degrees, the International Committee for Weights and Measures (CIPM, Comité International des Poids et Mesures) accepts the use of degrees with SI units, and European Normatives and documents from the International Commission on Illumination (CIE) use degrees for retroreflection geometry.

1.6 *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

[D4061 Test Method for Retroreflectance of Horizontal Coatings](#)

[D4505 Specification for Preformed Retroreflective Pavement Marking Tape for Extended Service Life](#)

[D4592 Specification for Preformed Retroreflective Pavement Marking Tape for Limited Service Life](#)

[D7585/D7585M Practice for Evaluating Retroreflective Pavement Markings Using Portable Hand-Operated Instruments](#)

¹ This specification is under the jurisdiction of ASTM Committee D04 on Road and Paving Materials and is the direct responsibility of Subcommittee D04.38 on Highway Traffic Control Materials.

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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.

[E284 Terminology of Appearance](#)

[E308 Practice for Computing the Colors of Objects by Using the CIE System](#)

[E811 Practice for Measuring Colorimetric Characteristics of Retroreflectors Under Nighttime Conditions](#)

[E1349 Test Method for Reflectance Factor and Color by Spectrophotometry Using Bidirectional \(45°:0° or 0°:45°\) Geometry](#)

[E2367 Test Method for Measurement of Nighttime Chromaticity of Pavement Marking Materials Using a Portable Retro-reflection Colorimeter](#)

2.2 *CIE Publications*:³

No. 15.2 Colorimetry

No. 39.2 Recommendations for Surface Colours for Visual Signalling

2.3 *Federal Register*:⁴

[23 CFR Chapter 1, Subchapter G, Part 655, Subpart F Traffic Control Devices on Federal-Aid and Other Streets and Highways](#)

3. Terminology

3.1 Definitions:

3.1.1 Definitions in Practice [E308](#) and of appearance terms in Terminology [E284](#) are applicable to this specification.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *in-service pavement markings*—pavement markings that have been applied in the field longer than 30 days.

3.2.1.1 Discussion—

This specification does not promote or condone the requirements of holding these requirements to in-service pavement markings. If this specification is planned to be required for longer than 30 days, some precautions are to be considered. Those are discussed in [Appendix X2](#).

3.2.2 *luminance factor (daytime luminance, Y)*, *n*—ratio of the luminance of a specimen to that of a perfect diffuser when illuminated and viewed under specified geometric conditions.

3.2.2.1 Discussion—

In the CIE 1931 system this quantity is tristimulus value Y (1991a). For fluorescent media, the luminance factor is the sum of two quantities, the reflection luminance factor Y_r and the fluorescence luminance factor Y_f . ($Y = Y_r + Y_f$). Such usage may be assumed unless the above definition is specifically required by the context. [CIE]

3.2.3 *newly applied pavement markings*—newly applied pavement markings are those that have been applied and tested after 24 h and before 30 days and from which all excess retroreflective optics or aggregates have been removed.

3.2.3.1 Discussion—

Excess retroreflective optics and aggregates contribute to erroneous readings directly after application and are generally not present a few days after application. They should be removed by strong brushing or by air pressure or other methods that do not remove the drop-on materials that are correctly embedded.

3.2.4 retroreflective optics—

(1) *glass beads*—spherical glass with a typical refractive index between 1.5 and 1.95, manufactured for use with pavement marking materials to provide retroreflective properties to the marking, allowing them to be visible when viewed at night under automobile headlights.

(2) *composite optics*—a multi-component retroreflective particle comprised of a pigmented core (typically white or yellow) covered with very small glass or ceramic beads typically having a refractive index of between 1.90 and 2.4.

3.2.5 *pavement marking structured materials—structured pavement markings*—a structured road pavement marking has raised faces or edges in a regular or random pattern that are tilted towards the direction of traffic in order to enhance retroreflection in wet or rainy conditions or to produce acoustic or vibrational effects by the passage of wheels, or both. The pattern can be produced by non-uniform application of the material in the liquid state, by reworking the surface of applied material while still liquid, or by other suitable means. Pavement markings that are installed in a rumble strip pattern are considered to be structured markings and therefore not applicable to this specification. For visual examples of structured pavement markings, see [Appendix X1](#). Road marking tapes with a surface pattern, as defined in Specifications [D4505](#) and [D4592](#), are not considered to be structured pavement markings for the intent of this specification.

³ Available from USNC-CIE Publications Office, TLA Lighting Consultants, Inc., 7 Pond Street, Salem, MA 01970.

⁴ Available from U.S. Government Publishing Office (GPO), 732 N. Capitol St., NW, Washington, DC 20401, <http://www.gpo.gov>.

3.2.5.1 Discussion—

When measuring color, daytime, or nighttime on non-flat pavement markings, care should be taken to minimize the introduction of any stray light into the viewing area. The introduction of stray light may provide measured values and results that are different from those under visual viewing conditions. The geometry of the instrument illumination, with respect to the profiles, can also cause misleading results. The small illumination field in this type of instrumentation makes the reading sensitive to the positioning of the instrument.

4. Significance and Use

4.1 This specification is intended for use during the lifetime of the retroreflective pavement marking on the road surface. Specifications identifies the color performance requirements for retroreflective pavement markings under daytime and nighttime lighting conditions. Requirements for characteristics other than retroreflective color are found in other ASTM documents/standards.

4.2 Newly applied pavement markings, as defined in 3.2.3, shall meet the requirements of this specification for both daytime and nighttime color.

5. Performance Requirements

5.1 Chromaticity Limits—The material must plot within the boundaries described by the four corner points listed in Tables 1 and 2 when measured in accordance with the test methods in Section 7.

5.1.1 Table 1—Table 1—Daytime (x,y) chromaticity coordinates of the corners of the regions for the colors of white, yellow, blue, purple, and red pavement markings. See Fig. 1.

5.1.2 Table 2—Table 2—Nighttime (x,y) chromaticity coordinates of the corners of the regions for the colors of white and yellow/white, yellow, and purple pavement markings. See Fig. 2.

5.1.3 Chromaticity and Retroreflectance—The third dimension of the perceived appearance of the road retroreflective pavement marking at night is the retroreflectance. This quantity is specified in other ASTM documents/standards on pavement markings and is not part of this pavement marking nighttime color specification. Research has shown that the nighttime color as specified by chromaticity is sufficient and adequate for the color naming of the material as viewed under nighttime conditions./ chromaticity specification.

5.2 Daytime Lightness Limits—Luminance (Y Tristimulus Coordinate)—Value—The lightness—daytime luminance limits shall conform to Table 3. (The 45/0 and 0/45 geometry is the current standard practice for these measurements. Table 3. Measurements shall be taken using 45/0 (0/45) geometry, CIE illuminant D65, and the 1931 CIE 2° standard observer. Also known as “luminance factor.”

NOTE 1—Daytime luminance factor testing of pavement markings excludes structured materials. They pavement materials because of the difficulty of reading color on non-flat surfaces that may potentially allow stray light into the viewing area. Structured pavement markings should be tested at the viewing angle encountered in usage using diffuse illumination and 87.71° viewing angle, which is not covered in this standard.

NOTE 2—Historically, the term “daytime reflectance” has been used to describe the luminance factor measured under mid-day daylight conditions (D65) using the pre-1964 observer function (1931, 2°). For the purpose of this standard, we consider daytime reflectance to be an equivalent reference to the

TABLE 1 Daytime Color^A

NOTE 1—Daytime, Geometry—45/0 (0/45), CIE illuminant D65 and the CIE 1931 (2°) standard observer.

Color	Daytime Chromaticity Coordinates (Corner Points)							
	1		2		3		4	
	x	y	x	y	x	y	x	y
White	0.355	0.355	0.305	0.305	0.285	0.325	0.335	0.375
Yellow	0.560	0.440	0.490	0.510	0.420	0.440	0.460	0.400
Red	0.480	0.300	0.690	0.315	0.620	0.380	0.480	0.360
Blue	0.105	0.100	0.220	0.180	0.200	0.260	0.060	0.220
Purple	0.300	0.064	0.309	0.260	0.362	0.295	0.475	0.144

^A These chromaticity coordinates are also referenced in 23 CFR Chapter 1, Subchapter G, Table 5 to Appendix to Part 655, Subpart F—Daytime Color Specification Limits for Retroreflective Pavement Marking Material.

Daytime Chromaticity Coordinates of Pavement Marking Retroreflective Materials

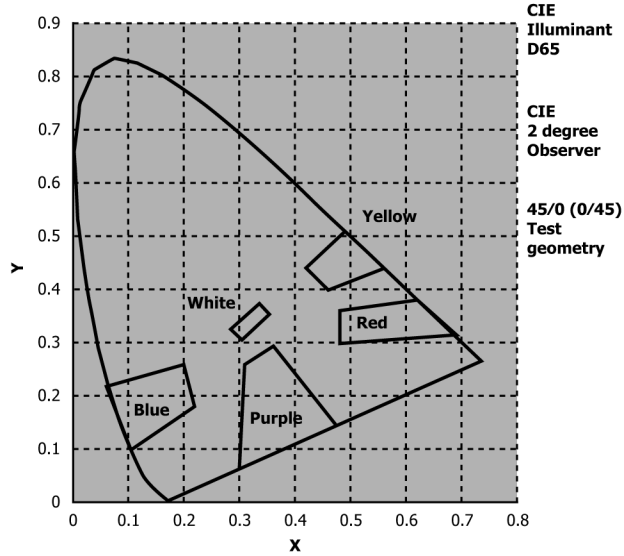


FIG. 1 Daytime Chromaticity of Pavement Markings

Nighttime Chromaticity Coordinates of Pavement Marking Retroreflective Materials

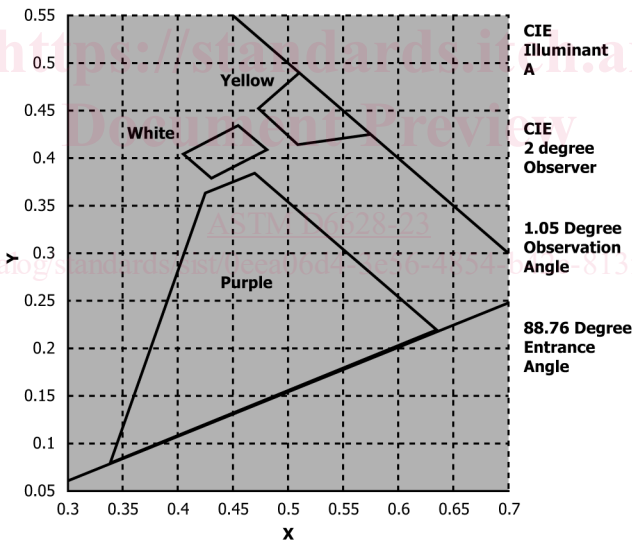


FIG. 2 Nighttime Chromaticity of Pavement Markings

TABLE 2 Nighttime Color^A

NOTE 1—Nighttime, Geometry—observationGeometry—Observation angle of 1.05° and entrance angle of 88.76°. CIE illuminant A and the CIE 1931 (2°) standard observer.

Color	Nighttime Chromaticity Coordinates (Corner Points)							
	1		2		3		4	
	x	y	x	y	x	y	x	y
White	0.480	0.410	0.430	0.380	0.405	0.405	0.455	0.435
Yellow	0.575	0.425	0.508	0.415	0.473	0.453	0.510	0.490
Purple	0.338	0.080	0.425	0.365	0.470	0.385	0.635	0.221

^A These chromaticity coordinates are also referenced in 23 CFR Chapter 1, Subchapter G, Table 6 to Appendix to Part 655, Subpart F—Nighttime Color Specification Limits for Retroreflective Pavement Marking Material.