



Designation: D4383 – 18

## Standard Specification for Plowable, Raised Retroreflective Pavement Markers<sup>1</sup>

This standard is issued under the fixed designation D4383; 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 reappraisal. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reappraisal.

### 1. Scope

1.1 This specification covers a type of plowable, retroreflective, raised pavement marker for lane marking and delineation.

1.2 Retroreflective markers are intended for nighttime visibility.

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

1.4 The following precautionary caveat pertains only to the test methods portion, Section 10, of this specification: *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:<sup>2</sup>

A536 Specification for Ductile Iron Castings

C184 Test Method for Fineness of Hydraulic Cement by the 150- $\mu$ m (No. 100) and 75- $\mu$ m (No. 200) Sieves (Withdrawn 2002)<sup>3</sup>

<sup>1</sup> 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.

Current edition approved April 1, 2018. Published April 2018. Originally approved in 1984. Last previous edition approved in 2012 as D4383 – 12. DOI: 10.1520/D4383-18.

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

<sup>3</sup> The last approved version of this historical standard is referenced on [www.astm.org](http://www.astm.org).

C430 Test Method for Fineness of Hydraulic Cement by the 45- $\mu$ m (No. 325) Sieve

C778 Specification for Standard Sand

D5 Test Method for Penetration of Bituminous Materials

D36 Test Method for Softening Point of Bitumen (Ring-and-Ball Apparatus)

D70 Test Method for Density of Semi-Solid Bituminous Materials (Pycnometer Method)

D71 Test Method for Relative Density of Solid Pitch and Asphalt (Displacement Method)

D92 Test Method for Flash and Fire Points by Cleveland Open Cup Tester

D113 Test Method for Ductility of Asphalt Materials

D1754 Test Method for Effects of Heat and Air on Asphaltic Materials (Thin-Film Oven Test)

D1785 Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

D1856 Test Method for Recovery of Asphalt From Solution by Abson Method

D2171 Test Method for Viscosity of Asphalts by Vacuum Capillary Viscometer

D2172 Test Methods for Quantitative Extraction of Bitumen From Bituminous Paving Mixtures

D2669 Test Method for Apparent Viscosity of Petroleum Waxes Compounded with Additives (Hot Melts)

D3111 Test Method for Flexibility Determination of Hot-Melt Adhesives by Mandrel Bend Test Method

D4280 Specification for Extended Life Type, Nonplowable, Raised Retroreflective Pavement Markers

D4402 Test Method for Viscosity Determination of Asphalt at Elevated Temperatures Using a Rotational Viscometer

D5329 Test Methods for Sealants and Fillers, Hot-Applied, for Joints and Cracks in Asphalt Pavements and Portland Cement Concrete Pavements

E18 Test Methods for Rockwell Hardness of Metallic Materials

E284 Terminology of Appearance

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

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

E808 Practice for Describing Retroreflection

E809 Practice for Measuring Photometric Characteristics of Retroreflectors

## E811 Practice for Measuring Colorimetric Characteristics of Retroreflectors Under Nighttime Conditions

### 2.2 Federal Specification:<sup>4</sup>

**TT-T-291** Thinner, Paint, Mineral Spirits, Regular and Odorless

### 2.3 AASHTO Standard:<sup>5</sup>

**AASHTO M237** Epoxy Resin Adhesive for Bonding Traffic Markers to Hardened Concrete

## 3. Terminology

### 3.1 Definitions:

3.1.1 *cleanability*—the ability of a raised retroreflective marker to keep its optical surfaces clean under traffic and environmental conditions.

3.1.2 *coefficient of luminous intensity*,  $R_f$ —the ratio of the luminous intensity ( $I$ ) of the retroreflector in the direction of observation to the illuminance ( $E$ ) at the retroreflector on a plane perpendicular to the direction of the incident light, expressed in candelas per lux (cd/lx) (see Practice **E808** and Terminology **E284**).

3.1.2.1 *Discussion*—The values presented for the coefficient of luminous intensity are presented in SI units, which are the accepted worldwide norm for expressing this value, rather than in inch-pounds units. When values are low, the coefficient of (retroreflected) luminous intensity may be given in millicandelas per lux. In inch-pound units,  $R_f$  is given in candelas per footcandle (cd/ftc). Historically, the term “specific intensity” and symbol “SI” have been used to designate this term, but “ $R_f$ ” is preferred.

3.1.3 *color*—expressed by chromaticity coordinates according to the CIE (Commission Internationale de l’Eclairage 1931) standard colorimetric system.

3.1.4 *horizontal entrance angle*—the angle in the horizontal plane between the direction of incident light and the normal to the leading edge of the marker.

3.1.4.1 *Discussion*—This angle corresponds to the entrance angle component  $\beta_2$  when the marker is positioned for photometry. (See Practice **E808**.) The direction given in Practice **E808** should be used when designating this angle.

3.1.5 *observation angle*—the angle at the reflector between the illumination axis and the observation axis. (See Practice **E808**.)

### 3.2 Definitions of Terms Specific to This Standard:

3.2.1 *raised retroreflective pavement markers, raised retroreflective marker, retroreflective marker, and marker*—used interchangeably in this specification to refer to a molded plastic prismatic retroreflector, the reflecting area of which is covered with an abrasion-resistant lens surface. The terms do not include the metal holder sometimes used to protect markers from plow blades.

<sup>4</sup> Available from U.S. Government Printing Office Superintendent of Documents, 732 N. Capitol St., NW, Mail Stop: SDE, Washington, DC 20401, <http://www.access.gpo.gov>.

<sup>5</sup> Available from American Association of State Highway and Transportation Officials (AASHTO), 444 N. Capitol St., NW, Suite 249, Washington, DC 20001, <http://www.transportation.org>.

## 4. Classification

4.1 Markers shall be classified as to type, color, and intended application.

### 4.1.1 Types of Markers:

4.1.1.1 *Type A*—Two-way retroreflective markers, one color.

4.1.1.2 *Type B*—One-way retroreflective markers, one color.

4.1.1.3 *Type E*—Two-way retroreflective marker, two colors.

### 4.1.2 Color of Markers:

4.1.2.1 *W*—White,

4.1.2.2 *Y*—Yellow,

4.1.2.3 *R*—Red,

4.1.2.4 *B*—Blue, and

4.1.2.5 *G*—Green.

### 4.1.3 Intended Application of Markers:

4.1.3.1 Marker to be mounted in a holder.

4.1.3.2 Marker to be mounted in a recess.

4.1.4 Show classification in the order detailed in **4.1.1 – 4.1.3.2**: type, color, and application.

4.2 Holders shall be classified as to the design installed height of the holder above the pavement.

## 5. Ordering Information

5.1 Orders for markers under this specification should include the following information:

5.1.1 Quantity,

5.1.2 Type of marker—Retroreflective one-way or retroreflective two-way, and

5.1.3 Color of marker.

5.2 Orders for holders under this specification should include the following information:

5.2.1 Design installed maximum height of the holder.

## 6. Performance Requirements

### 6.1 Retroreflectivity:

6.1.1 For new markers, coefficient of luminous intensity (RI) measured in accordance with **10.1** shall be not less than the values in **Table 1**.

**TABLE 1 Coefficient of Luminous Intensity  $R_f$**

NOTE 1—The retroreflector axis and datum axis of the marker are as shown in **Figs. 2 and 3**.

NOTE 2—Entrance angle component  $\beta_1$  and rotation angle  $\epsilon$  are  $0^\circ$ .

NOTE 3—The values presented for the coefficient of luminous intensity in the table are given in SI units, which are the accepted worldwide norm for expressing this value, rather than in inch-pound units. The values in *cd/ftc* are provided for information.

Entrance Angle $\beta_2$	Observation Angle $\alpha$	Minimum Value $R_f$ , mcd/lx				
		White	Yellow	Red	Green	Blue
$0^\circ$	$0.2^\circ$	279	167	70	93	26
$+20^\circ/-20^\circ$	$0.2^\circ$	112	67	28	37	10
Entrance Angle $\beta_2$	Observation Angle $\alpha$	Minimum Value $R_f$ , cd/ftc				
		White	Yellow	Red	Green	Blue
$0^\circ$	$0.2^\circ$	3.0	1.8	0.75	1.0	0.28
$+20^\circ/-20^\circ$	$0.2^\circ$	1.2	0.72	0.30	0.40	0.11

6.1.2 After abrading the marker per 10.2, coefficient of luminous intensity at 0° entrance angle measured in accordance with 10.1 shall be not less than the values in Table 1 multiplied by 0.5.

NOTE 1—No laboratory abrasion test has been established for markers having biconvex optical elements.

NOTE 2—Some two-color markers may intentionally have only one of the retroreflective faces abrasion resistant, in which case the second face should not be abraded.

NOTE 3—No laboratory abrasion test can be expected to model the full range of surface wear of pavement markers in use.

6.2 *Color*—When the retroreflector is illuminated by a CIE Standard Source A and when measured in accordance with 10.3, the color of the retroreflected light shall fall within the color gamuts given by the following corner points and shown in Fig. 1:

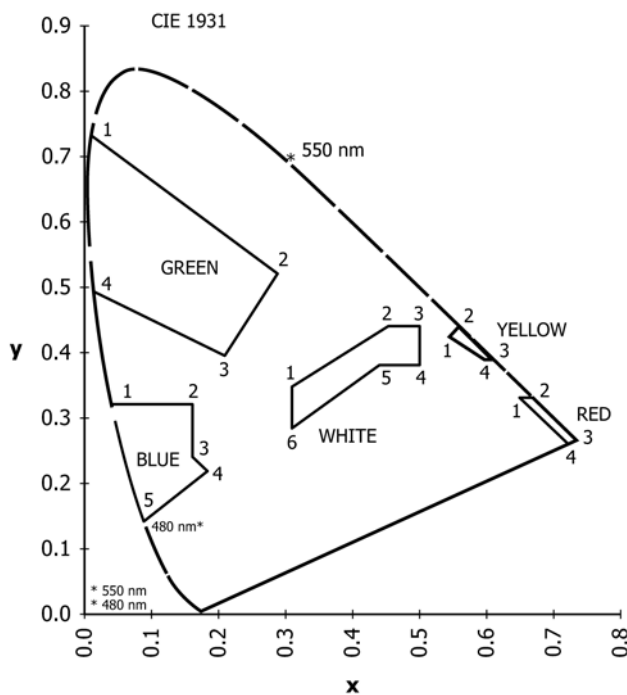


FIG. 1 Color Gamut per 6.2

#### 6.2.1 White:

Point No.	x	y
1	0.310	0.348
2	0.453	0.440
3	0.500	0.440
4	0.500	0.380
5	0.440	0.380
6	0.310	0.283

#### 6.2.2 Yellow:

Point No.	x	y
1	0.545	0.424
2	0.559	0.439
3	0.609	0.390
4	0.597	0.390

#### 6.2.3 Red:

Point No.	x	y
1	0.650	0.330
2	0.668	0.330
3	0.734	0.265
4	0.721	0.259

#### 6.2.4 Blue:

Point No.	x	y
1	0.039	0.320
2	0.160	0.320
3	0.160	0.240
4	0.183	0.218
5	0.088	0.142

#### 6.2.5 Green:

Point No.	x	y
1	0.009	0.733
2	0.288	0.520
3	0.209	0.395
4	0.012	0.494

6.3 *Lens Impact Strength*—When impacted in accordance with 10.4.2, the face of the lens shall show no more than two radial cracks longer than 0.25 in. (6.4 mm). There shall be no radial cracks extending to the edge of the abrasion-resistant area. There shall be no delamination.

6.4 *Temperature Cycling*—When subjected to temperature cycling in accordance with 10.4.3, there shall be no cracking or delamination.

6.5 *Adhesive Bond Strength*—Because no practical laboratory procedures have been determined to provide complete, reliable, and predictive information on adhesive bond strength, the user is encouraged to seek information from alternative sources such as field tests. A field test of duration twelve months is recommended. A control marker is chosen with known satisfactory adhesion. The test markers may be required to experience no more than 1.5 times as great an adhesion failure rate as the controls. The test severity should be such that between 3 % and 20 % of the controls fail during the field test. There must be adequate numbers of test markers and controls for statistical validity.

6.6 *Compressive Strength*—Tested in accordance with 10.5, a marker shall support a load of 6000 lbf (26 700 N, 2720 kgf) without breakage or significant deformation of the marker. Significant permanent deformation shall be understood to be 0.13 in. (3.2 mm). For markers laminated to an elastomeric pad, remove the pad before testing.

6.7 *Ramp Hardness of Holders*—Measured in accordance with 10.6, the hardness of the ramps shall be 51-55 HRC.

## 7. Construction Requirements for Retroreflective Markers

7.1 To withstand plowing, raised retroreflective markers are protected either by recessing within a groove below the pavement surface (see Appendix X1), mounting within a holder having metal ramps to deflect plowblades, or by other methods approved by the purchaser.

### 7.2 Retroreflective Markers:

7.2.1 The marker shall be comprised of materials with adequate chemical, water, and UV resistance for the intended use.

7.2.2 The marker width shall be approximately 4 in. (102 mm).

7.2.3 The angle between the face of the marker and the base shall be no greater than 45°.