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.

Designation: D4383 – 21

Standard Specification for Plowable, Raised Retroreflective Pavement Markers[1]

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 reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers several types of plowable, retroreflective pavement markers for lane marking and delineation.

1.2 Retroreflective markers are intended for nighttime visibility under both wet and dry conditions.

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 text of this standard references notes and footnotes which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the standard.

1.5 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.*

1.6 *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]

A536 Specification for Ductile Iron Castings
C778 Specification for Standard Sand
D5/D5M Test Method for Penetration of Bituminous Materials
D36/D36M Test Method for Softening Point of Bitumen (Ring-and-Ball Apparatus)
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
D1785 Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
D3111 Practice for Flexibility Determination of Hot-Melt Adhesives by Mandrel Bend Test
D4280 Specification for Extended Life Type, Nonplowable, Raised Retroreflective Pavement Markers
D4402/D4402M Test Method for Viscosity Determination of Asphalt at Elevated Temperatures Using a Rotational Viscometer
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:*[3]

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

2.3 *AASHTO Standard:*[4]

AASHTO M 237 Epoxy Resin Adhesive for Bonding Traffic Markers to Hardened Concrete

[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.

[3] 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.

[4] 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.

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3. Terminology

3.1 *Definitions:*

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

3.1.2 *coefficient of luminous intensity, R_I*—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_I is given in candelas per foot-candle (cd/fc). Historically, the term "specific intensity" and symbol "SI" have been used to designate this term, but "R_I" 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 β2 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 *retroreflective pavement markers, 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 holder sometimes used to protect markers from plow blades where the lens is positioned above the pavement surface or used to hold the lens when positioned below the pavement surface (inlaid). The holder may be metallic, nonmetallic, or a combination of both metallic and nonmetallic components.

4. Classification

4.1 Markers shall be classified as to type, color, and category (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 Category 1: Marker mounted in a metallic holder and installed in a plunge cut in the pavement in such a manner that the marker protrudes above the pavement surface.

4.1.3.2 Category 2: Marker mounted in a holder consisting of a nonmetallic body with metallic rails that provide the marker protection from the plows and installed in a plunge cut in the pavement in such a manner that the marker protrudes above the pavement surface.

4.1.3.3 Category 3: Marker mounted in a nonmetallic holder and installed in a plunge cut groove in the pavement in such a manner that the marker is recessed below the pavement surface.

4.1.3.4 Category 4: Conventional, nonplowable marker installed in a recess below the pavement surface.

4.1.4 Show classification in the order detailed in 4.1.1 – 4.1.3: type, color, and category.

4.2 Category 1 and 2 holders shall be classified as to the design installed height of the holder above the pavement surface.

4.3 Category 3 holders shall be classified as to the designed depth of both the groove and the plunge cut for marker placement that would allow the marker residing in the holder to be positioned below the surface of the pavement at a minimum of 0.12 in. (3.0 mm).

4.4 Category 4 markers shall be classified as to the designed depth of the cut for placement that would allow the marker to be positioned below the surface of the pavement at a minimum of 0.06 in. (1.5 mm).

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 for Category 1 and 2 markers.

5.2.2 Design installed length and minimum depth of the groove and placement and minimum depth of the plunge cut for Category 3 markers.

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.

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.

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TABLE 1 Coefficient of Luminous Intensity R_I

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

NOTE 2—Entrance angle component β1 and rotation angle ε are 0°.

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/fc* are provided for information.

Entrance Angle β2	Observation Angle α	Minimum Value R_I, *mcd/lx*				
		White	Yellow	Red	Green	Blue
0°	0.2°	279	167	70	93	26
+20°/–20°	0.2°	112	67	28	37	10
Entrance Angle β2	Observation Angle α	Minimum Value R_I, *cd/fc*				
		White	Yellow	Red	Green	Blue
0°	0.2°	3.0	1.8	0.75	1.0	0.28
+20°/–20°	0.2°	1.2	0.72	0.30	0.40	0.11

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:

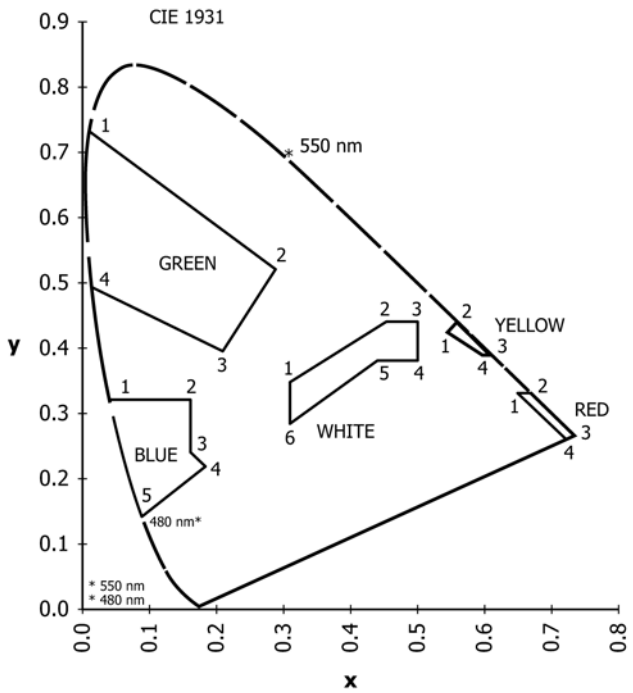

FIG. 1 Color Gamut per 6.2

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× 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 Category 1 and 2 Holders*—Measured in accordance with 10.6, the hardness of the ramps shall be 51-55 HRC.

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