



Designation: D8514/D8514M – 23

Standard Specification for Flexible, Retroreflective Sheeting for Use in High Visibility Vehicle Markings¹

This standard is issued under the fixed designation D8514/D8514M; 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 flexible, retroreflective sheeting for use in high visibility markings to provide enhanced daytime and/or nighttime visibility for use on emergency response vehicles, utility vehicles, and similar vehicles.

1.2 *Units*—The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the standard.

1.3 *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.*

1.4 *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

- B117 Practice for Operating Salt Spray (Fog) Apparatus
- B209/B209M Specification for Aluminum and Aluminum-Alloy Sheet and Plate
- B449 Specification for Chromates on Aluminum
- D2794 Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
- D4956 Specification for Retroreflective Sheeting for Traffic Control

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.

Current edition approved June 1, 2023. Published June 2023. DOI: 10.1520/D8514_D8514M-23.

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

E808 Practice for Describing Retroreflection

E810 Test Method for Coefficient of Retroreflection of Retroreflective Sheeting Utilizing the Coplanar Geometry

E811 Practice for Measuring Colorimetric Characteristics of Retroreflectors Under Nighttime Conditions

E991 Practice for Color Measurement of Fluorescent Specimens Using the One-Monochromator Method

E1247 Practice for Detecting Fluorescence in Object-Color Specimens by Spectrophotometry

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

E2301 Test Method for Daytime Colorimetric Properties of Fluorescent Retroreflective Sheeting and Marking Materials for High Visibility Traffic Control and Personal Safety Applications Using 45°:Normal Geometry

E3165 Test Method for Nighttime Retroreflected Chromaticity of Retroreflective Sheeting

G7/G7M Practice for Natural Weathering of Materials

G147 Practice for Conditioning and Handling of Nonmetallic Materials for Natural and Artificial Weathering Tests

G151 Practice for Exposing Nonmetallic Materials in Accelerated Test Devices that Use Laboratory Light Sources

G155 Practice for Operating Xenon Arc Lamp Apparatus for Exposure of Materials

2.2 Other Standards and References:

Publication No. 14/04 High Conspicuity Livery for Police Vehicles, by Paul Harrison, Published by Police Scientific Development Branch, UK Home Office, 2004

NFPA 1901 Standard for Automotive Fire Apparatus, 2016 49 CFR 571.108, Standard No. 108 Lamps, Reflective Devices, and Associated Equipment

Report FA-336 / December 2013 Emergency Vehicle Safety Initiative, U.S. Fire Administration, Federal Emergency Management Administration, 2013

Report FA-323 / August 2009 Emergency Vehicle Visibility and Conspicuity Study, Federal Emergency Management Administration, 2009



Study of Protecting Emergency Responders on the Highways and Operation of Emergency Vehicles: A Review of Responder Agencies Who Have Adopted Emergency Lighting and Vehicle Conspicuity Technology, Cumberland Valley Volunteer Fireman's Association – Emergency Responder Safety Institute, June 2018

NFPA 1917 Standard for Automotive Ambulances, 2019

Olson, Paul L. et al., Performance Requirements for Large Truck Conspicuity Enhancements, University of Michigan Traffic Research Institute, Report UMTRI-92-8, February 1992

3. Terminology

3.1 Definitions:

3.1.1 Definitions of terms are as described in Terminology E284 (Appearance), and Practice E808 (Practice for Describing Retroreflection).

3.1.2 *Battenburg markings*, *n*—an alternating pattern of large, contrasting color blocks. See X1.15.1 and Fig. X1.2 for additional details.

3.1.3 *chevron markings*, *n*—an inverted V-shaped mark of an alternating pattern positioned at a 45° angle of two contrasting colors. See X1.15.2 and Fig. X1.3 for additional details.

3.1.4 *fluorescent material*, *n*—a material that absorbs light energy of visible and/or ultraviolet wavelengths, and which, in turn, radiates some portion of that light energy, typically at longer wavelengths.

3.1.4.1 *Discussion*—This reradiation allows fluorescent colors to be brighter during the daytime than non-fluorescent colors having a similar chromaticity.

3.1.5 *perimeter markings*, *n*—retroreflective striping, typically 25 mm wide, used to outline the contours of a vehicle.

4. Significance and Use

4.1 High visibility markings are utilized on emergency response vehicles, utility vehicles, and similar vehicles that may be required to stop alongside an active roadway. Such high visibility markings are utilized in order to capture the attention of motorists to warn of potentially hazardous roadside activity or to alert of the possible presence of individuals working outside their vehicle. Chevron markings and Battenburg markings are two examples of such high visibility markings.

4.2 This document establishes a specification for a flexible, retroreflective sheeting with substantially higher coefficients of

retroreflection than that provided by engineer grade sheeting, which is commonly defined by Specification D4956, Type I.

4.3 This specification only defines the minimum properties for a flexible, retroreflective sheeting for use in high visibility vehicle markings. The application guidelines provided in the appendixes are for reference purposes only. It is the responsibility of the user of this document to determine the appropriate choice of materials, coverage areas, colors, and application patterns to meet their specific needs.

4.4 This specification does not cover conspicuity tape as commonly applied to the contours of heavy trucks, trailers, buses, or similar large vehicles. Such conspicuity tape is covered by other industry standards and regulations, such as 49 CFR 571.108. Similarly, this specification does not cover retroreflective tape utilized to outline the edges of slow-moving vehicle warning triangles.

4.5 This specification does not address inks, overlays, or other imaging methods that may be applied to the retroreflective sheeting.

4.6 This specification provides minimum requirements for photometric and colorimetric properties for the retroreflective sheeting prior to its installation and in-service use on vehicles. Retroreflective sheeting, once installed as vehicle markings, are outside the scope of this document.

5. Description of Materials

5.1 Retroreflective sheeting shall consist of a white or colored sheeting having a smooth outer surface and essentially have the property of a retroreflector over its entire surface. The sheeting is supplied with a pressure-sensitive adhesive to allow application to a vehicle surface.

6. Ordering Information

6.1 The purchaser using this specification shall include the following information:

6.1.1 Reference to required conformance of this standard specification,

6.1.2 Color, and

6.1.3 Roll size.

7. Required Properties

7.1 Conformance of the retroreflective sheeting shall be evaluated using the corresponding test methods defined in Section 8.

TABLE 1 Minimum Coefficient of Retroreflection^A

Observation Angle (α)	Entrance Angle (β)	White	Yellow	Orange	Red	Blue	Green	Fluor. Yellow-Green	Fluor. Yellow	Fluor. Orange
0.2°	—4°	350	255	150	66	25	56	290	225	120
0.2°	30°	150	110	62	28	12	24	120	95	50
0.2°	45°	60	44	25	11	4	9	49	38	20
0.5°	—4°	70	50	30	13	5	11	58	45	22
0.5°	30°	40	28	16	7	2.5	6	32	26	14
0.5°	45°	15	11	6	3	1	2	12	9	5

^A Minimum coefficient of retroreflection (R_A) cd/ft² [cd·lx⁻¹·m⁻²].