
Standard Specification for Retroreflective Sheeting for Flat and Vertical Traffic Control Applications

AASHTO Designation: M 268-22

Technically Revised: 2022

Technical Subcommittee: 4d, Safety Devices



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1. SCOPE

- 1.1. This specification covers retroreflective sheeting, translucent ink, and overlay film intended for traffic control applications. The sheeting serves either as the reflectorized background for sign messages or for the legends and symbols applied to the reflectorized background. Messages may be applied in opaque black or transparent colors. This specification does not cover temporary retroreflective sheeting used during construction. Refer to other specifications for these products.
- 1.2. All material furnished under this specification shall have been manufactured within 18 months of the delivery date. All retroreflective sheeting and process components on a single sign shall be supplied by the same manufacturer or approved by that manufacturer.
- 1.3. The values stated in inch-pound units are to be regarded as the standard.
- 1.4. *This specification 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.*
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2. REFERENCED DOCUMENTS

- 2.1. *AASHTO Standard:*
- M 339M/M 339, Thermometers Used in the Testing of Construction Materials
- 2.2. *ASTM Standards:*
- B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
 - B209M, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
 - B449, Standard Specification for Chromates on Aluminum
 - D2244, Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
 - D4956, Standard Specification for Retroreflective Sheeting for Traffic Control
 - E1, Standard Specification for ASTM Liquid-in-Glass Thermometers
 - E230/E230M, Standard Specification for Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples
 - E308, Standard Practice for Computing the Colors of Objects by Using the CIE System
 - E810, Standard Test Method for Coefficient of Retroreflection of Retroreflective Sheeting Utilizing the Coplanar Geometry

- E811, Standard Practice for Measuring Colorimetric Characteristics of Retroreflectors under Nighttime Conditions
- E991, Standard Practice for Color Measurement of Fluorescent Specimens Using the One-Monochromator Method
- E1164, Standard Practice for Obtaining Spectrometric Data for Object-Color Evaluation
- E1347, Standard Test Method for Color and Color-Difference Measurement by Tristimulus Colorimetry
- E1349, Standard Test Method for Reflectance Factor and Color by Spectrophotometry Using Bidirectional (45°:0° or 0°:45°) Geometry
- E2152, Standard Practice for Computing the Colors of Fluorescent Objects from Bispectral Photometric Data
- E2153, Standard Practice for Obtaining Bispectral Photometric Data for Evaluation of Fluorescent Color
- E2301, Standard 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
- E2877, Standard Guide for Digital Contact Thermometers
- G147, Standard Practice for Conditioning and Handling of Nonmetallic Materials for Natural and Artificial Weathering Tests
- G151, Standard Practice for Exposing Nonmetallic Materials in Accelerated Test Devices that Use Laboratory Light Sources
- G155, Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials

2.3. *Federal Standards:*

- *Manual on Uniform Traffic Control Devices*
- Standard Color Tolerance Charts, Federal Highway Administration, Washington, DC

2.4. *International Electrotechnical Commission Standard:*

- IEC 60584-1: 2013 Thermocouples - Part 1: EMF Specifications and Tolerances

2.5. *Other Documents:*

- *Commission Internationale de l'Eclairage (CIE) Standard Colorimetric System*
- *Commission Internationale de l'Eclairage (CIE) Standard Illuminant D65*

3. DISCUSSION

- 3.1. The retroreflective sheeting classifications established in this specification are not intended to describe any specific materials, but are instead intended to establish meaningful minimum retroreflectivity intervals. These intervals are correlated with human performance factors by which sheeting may be classified.
- 3.2. Classifications are provided as a means for differentiating functional performance based on minimum retroreflectivity levels at standard combinations of entrance and observation angles. The combinations of entrance and observation angles shown in this specification provide a mechanism to categorize retroreflective sheeting materials into Type classifications. It should be recognized that performance characteristics outside these standard geometries cannot always be reasonably predicted, especially for retroreflective sheeting of microprismatic construction, and may vary between particular products meeting the same Type. It is the responsibility of the user of this specification to determine the suitability of any reflective sheeting material for its intended application.

- 3.3. When tested in accordance with ASTM E810, the average coefficient of retroreflection (R_A) for a set of three samples taken from the same roll must not vary more than 20 percent between R_A measured at 0, 45, 90, and 120 degrees of rotation in order to be considered rotationally insensitive. Other rotational angles can be specified for testing by the user. The test shall be conducted at an observation angle of 0.5 degrees and an entrance angle of -4.0 degrees. Other combinations of observation and entrance angle can be specified for testing by the user. Calculate the percent difference by dividing the absolute difference between $R_A(0)$ and $R_A(45)$ by $R_A(0)$. Repeat the calculation replacing $R_A(45)$ with $R_A(90)$ and $R_A(120)$. $R_A(0)$ is established with the sheeting aligned in its optimum rotation.
- 3.3.1. For sheeting not meeting the 20 percent maximum rotational sensitivity requirement, the manufacturer must provide identification marks or other features (such as a datum mark, tiles, or distinct seal pattern) in or on the sheeting face denoting the optimum orientation of the sheeting. The markings or features must be visible from a minimum distance of 2 ft and must be arrayed in such a manner that they will be readily distinguishable on cutout legends, symbols, or borders. The manufacturer must provide fabrication guidelines outlining optimum sheeting orientation upon user request.
- 3.3.2. When using sheeting that does not meet the 20 percent maximum rotational requirement, fabricate signs by applying white sheeting for cutout legends, symbols, borders, and route marker attachments within the parent sign face in the optimum rotation according to the identification markings, and apply all background sheeting uniformly oriented.
- 3.4. *Delineators*—Retroreflective sheeting materials suitable for use on delineators are typically of microprismatic construction. The type of retroreflective sheeting shall be specified by the user.

4. CLASSIFICATIONS

- 4.1. This specification establishes four types of retroreflective sheeting, with successively increasing minimum coefficients of retroreflection. Retroreflective sheeting materials shall meet all of the performance requirements in Section 5 to qualify as a particular type under this specification. Minimum coefficients of retroreflection are shown in Tables 4, 5, 6, and 7 for retroreflective sheeting Types A, B, C, and D, respectively. The designated type is exclusive to the highest specified minimum R_A satisfied at observation angle of 0.5 degrees and an entrance angle of -4.0 degrees. Using higher retroreflectivity sheeting to manufacture signs where lower retroreflectivity sheeting types are specified must be approved by the end user.
- 4.2. The following are general descriptions of the types of retroreflective sheeting established by this specification. These are provided for descriptive information only and are not intended to be limitations or recommendations.
- Note 1**—The *Manual on Uniform Traffic Control Devices* (MUTCD) requires that traffic control signs, unless illuminated, be retroreflective to show the same shape and similar color both day and night. Therefore, any retroreflective sheeting materials meeting this specification would satisfy that requirement. However, when determining the appropriateness of a particular type of sheeting for a particular application, consideration should be given to the pertinent highway characteristics where the materials will be installed, such as traffic volumes, traffic speeds, and roadway geometrics, as well as available resources. Brighter materials (meeting Type B, C, or D) should be considered for use on complex roadway environments where the driving task may be more involved.
- 4.2.1. *Type A*—Retroreflective sheeting materials meeting Type A are typically constructed of encapsulated microscopic glass bead lens construction.

- 4.2.2. *Type B*—Retroreflective sheeting materials meeting Type B are typically constructed of unmetallized microprismatic optics. These triangular microprismatic materials do not have a significant 1-degree observation angle performance.
- 4.2.3. *Type C*—Retroreflective sheeting materials meeting Type C are typically constructed of unmetallized microprismatic optics. These triangular microprismatic materials have a significant 1-degree observation angle performance.
- 4.2.4. *Type D*—Retroreflective sheeting materials meeting Type D are typically constructed of unmetallized microprismatic optics. These materials have 0.5- and 1-degree observation angle performance approximately two times greater than Type C materials.
- 4.3. *Adhesive Backing Classes*—The adhesive backing classes shall be specified by the end user and shall be classified as follows:
- 4.3.1. *Class 1*—The adhesive backing shall be pressure-sensitive and require no heat, solvent, or other preparation for adhesion to smooth, clean surfaces.
- 4.3.2. *Class 2*—The adhesive backing shall be activated by applying heat and pressure to the material. The temperature necessary to form a durable permanent bond shall be a minimum of 66°C (150°F). Reflective sheeting materials with Class 2 adhesive shall be repositionable under normal shop conditions and at substrate temperatures up to 38°C (100°F) without damage to the sheeting. Reflective sheeting materials with Class 2 adhesive may be perforated to facilitate removal of air in heat-vacuum laminators, but the perforations must be of a size and frequency such that they do not cause objectionable blemishes in the finished sign.
- 4.3.3. *Class 3*—The adhesive backing shall be a positionable low-tack pressure-sensitive adhesive that requires no heat, solvent, or other preparation for adhesion to smooth, clean surfaces. Reflective sheeting materials with Class 3 adhesive shall be repositionable up to a temperature of 38°C (100°F) without damage to the sheeting.
- 4.3.4. *Class 4*—The adhesive backing shall be a low-temperature pressure-sensitive adhesive that permits sheeting applications down to -7°C (+20°F) without the aid of heat, solvent, or other preparation for adhesion to smooth, dry, and clean surfaces.

5. SHEETING PROPERTIES

- 5.1. *Test Conditions*—Unless otherwise specified in this specification, condition all adhesively bonded and unbonded test samples and specimens at a temperature of 73 ± 3°F (23 ± 2°C) and 50 ± 5 percent relative humidity for 24 h prior to testing. The thermometer for measuring the conditioning temperature of the test samples shall meet the requirements of M 339M/M 339 with a temperature range of at least 65 to 80°F (18.3 to 26.7°C) and an accuracy of ±0.9°F (±0.5°C) (see Note 2).
- Note 2**—Thermometer types suitable for use include ASTM E1 mercury thermometers; ASTM E2877 digital metal stem thermometer; ASTM E230/E230M thermocouple thermometer, Type T, Special Class; or IEC 60584 thermocouple thermometer, Type T, Class 1.
- 5.2. *Panel Preparation*—Unless otherwise specified in this specification, when tests are to be performed using test panels, apply the specimens of retroreflective material to smooth aluminum cut from Alloy 6061-T6 or 5052-H38, in accordance with ASTM B209 or B209M. The aluminum substrate thickness shall be between 0.060 in. (1.52 mm) and 0.100 in. (2.54 mm) (see Note 3). The retroreflective sheeting area shall be a minimum of 48 in.² with a minimum dimension of 4 in. and a maximum dimension of 12 in. Prepare the aluminum in accordance with ASTM B449, Class 2, or degrease and lightly acid etch before the specimens are applied (see Note 4). Apply the