

SECTION D – SPECIFICATIONS/SCOPE OF WORK

SPECIFICATION FOR ASTM SHEETING FOR PERMANENT SIGNING Type IV, and Type XI

1. Scope

This specification covers flexible white or colored, wide angle retroreflective sheeting (hereinafter called sheeting), tape and related processing materials designed to enhance nighttime visibility of traffic control signs and objects. Type IV Sheeting shall consist of High Intensity Prismatic lens elements encapsulated by a flexible transparent plastic that has a smooth outer surface. Type XI Sheeting shall consist of Full Cube Prismatic, or Full Cubed Prismatic Florescent Yellow and Florescent Yellow Green lens elements visible from the face of a smooth surface. The sheeting shall have a precoated adhesive protected by an easily removable liner.

Materials shall be new, shall be on Maryland State Highway Administration's (MSHA) Qualified Product List (QPL), and shall be covered under manufacturers' warranty (field performance guarantee), see table I below.

TABLE I
FIELD PERFORMANCE/WARRANTY REPLACEMENT REQUIREMENTS

Minimum coefficient of retro- reflectivity (R_A) cd/fc/ft² (cd•lx⁻¹•m⁻²)
(at -2 degrees observance angle and -4 entrance)

Sheeting Type	Sheeting Colors							Years of Effective Performance Life	Replacement Requirement
	White	Yellow	Red	Blue	Green	Brown	Orange		
High Intensity Prismatic (ASTM Type IV)	448	336	67	24	45	14	116	0-7 years	A
	392	294	59	21	39	13	102	8-10 years	B
Diamond Grade (3) Cubed (ASTM Type XI)	464	348	70	21	46	14	160	0-3 years	A
	406	304	61	18	41	12	140	4-7 years	B

*NOTE: All measurements shall be taken after sign cleaning in accordance with sheeting manufacturer's recommendations. For screen printed transparent colored areas on white sheeting, the coefficient of retro-reflection shall not be less than 50% of the values for the corresponding color in Table I.

Warranty Replacement Requirement "A": The Contractor shall reimburse the County for the cost of the sheeting, faces, process colors, and labor of restoring sign to new condition.

Warranty Replacement Requirement "B": The Contractor shall provide to the County the sheeting or faces required to restore sign face to new condition, at no cost to the Country.

ASTM 04956 reference in this document is to its latest version.

2. Prequalification and Performance History

Materials (sheeting, process colors, overlay films) shall be considered for use only when, in the opinion of Contract Administrator, enough evidence exists to ensure that the materials and services offered can reliably conform to this specification. The sheeting manufacturer shall provide evidence of performance and suitability for use in accordance with MDSHA Qualified Products Procedures.

2.1 Prequalification

All prospective bidders are hereby notified that the material (sheeting, process colors, overlay films) proposed for submission or for use in production of finished traffic control devices shall be a material of manufacture and product code or designation shown on the list of approved manufacturers of materials maintained by MDSHA, or material shall be approved by MDSHA's Office of Traffic and Safety (OOTS) and listed on MDSHA's Qualified Product List (QPL).

2.2 Performance History

Upon request and within two weeks, the sheeting manufacturer shall provide test data showing that representative production materials (sheeting and film) of the type to be supplied have met the requirements for 36 months of accelerated outdoor weathering described under "Requirements", or in lieu of outdoor weathering, artificial weathering in accordance with ASTM D 4956.

This data shall be gathered by an independent agency, such as AASHTO's National Transportation Product Evaluation Program (NTPEP) in accordance with ASTM D 4956.

3. Classification and Conformance

The sheeting shall conform to ASTM D 4956 backing class 1. The sheeting is intended for shop production of new stationary traffic control signs or objects, exclusive of those used along County roadways. The sheeting shall have a precoated pressure sensitive adhesive (Class I) protected by an easily removable liner.

4. Items to be provided, if requested by the Contract Administrator

4.1 Process Colors

- 4.1.1 The manufacturer of the sheeting shall manufacture and offer process colors in standard traffic colors recommended for the sheeting to meet the performance requirements of this specification at no charge.
- 4.1.2 The process colors shall be a single line of traffic colors which may be applied before and after sheeting is applied to a substrate, require no component premixing, and will air dry for packing in 3 hours or less and requires no clear coating.

4.2 **Overlay Films:** The sheeting manufacturer shall also manufacture colored acrylic imaging films and clear protective overlays, which are compatible with the sheeting's, and when used in accordance with the sheeting manufacturer's instructions, shall not lessen the warranty term as described in section 7.2. These films are often used with Computer Aided Sign Manufacturing (CASM) equipment and required in both pre-punched for sprocket feed cutters and unpunched for flatbed or friction fed cutters.

4.3 **Slip sheets.** The sheeting manufacturer shall supply to the County roll or cut slip sheets at no charge. Rolls will be provided in 48" widths and cut slip sheets in all standard highway sign sizes.

4.4 **Application Tape:** The sheeting manufacturer shall also manufacture or supply pre-masking and pre-spacing tape for graphic films and computer cut text and symbols. These tapes shall be available in clear and translucent white or tan and available in widths from 24" to 48".

5. **Test Panels and Test Conditions:** Unless otherwise specified herein, sheeting shall be applied to test panels in accordance with ASTM D 4956 section 7.2 and test conditions shall conform to ASTM D 4956 section 7.1.
6. **Requirements:**
 - 6.1 **Color Requirements:** Conformance to color requirements shall be determined spectrophotometrically in accordance with ASTM E 1164, with instruments utilizing either 45/0, or 0/45 illumination/viewing conditions and tolerances as described in ASTM E 1164 for retroreflective materials. CIE Tristimulus values for the 2° observer and illuminant 065 shall be calculated in accordance with ASTM E 308.
 - 6.1.1 Daytime and Nighttime Color: Daytime and nighttime color shall conform to ASTM 04956.
 - 6.1.2 Daytime Luminance Factor: Daytime Luminance Factor shall comply with ASTM0 4956.
 - 6.1.3 Fluorescence Requirements: Daytime fluorescence luminance factor shall conform to ASTM 04956 Tables II and testing shall be determined instrumentally, on sheeting applied to aluminum test panels, using a 2-monochromator spectrophotometer employing annular 45/0 (or equivalent 0/45) illuminating and viewing geometry. The fluorescence luminance factor shall be calculated from the fluorescence spectral radiance factors computed for CIE illuminant D65 in accordance with ASTM E-308 "Practice e for Computing the Colors of Objects by Using the CIE System" for the CIE 1931 (2°) standard colorimetric observer. The measurements shall be made on a Labsphere BFC-450 Bispectral Fluorescence Colorimeter or equivalent.
 - 6.2 **Coefficient of Retroreflection:** The coefficients of retroreflection shall be determined in accordance with ASTM E-810, for the minimum requirements of ASTMD4956.
 - 6.2.1 Units: Coefficients of retroreflection shall be specified in units of candelas per foot-candle per square foot.
 - 6.2.2 The observation angles for IV and XI shall be 0.2°, 0.5° and 1 .0°.
 - 6.2.3 The entrance angles for all sheeting shall be -4°, 30°.
 - 6.2.4 For screen printed transparent colored areas or transparent colored overlay films on white sheeting, the coefficients of retroreflection shall not be less than 70% of the values for corresponding color in ASTM D4956.
 - 6.3 **Specular Gloss:** The retroreflective sheeting shall have an 85° specular gloss of not less than 40 when tested in accordance with ASTM D 523.
 - 6.4 **Color Processing:** The retroreflective sheeting shall be designed to work in concert with recommended imaging systems. Color processing with compatible transparent and opaque process colors shall be possible in accordance with the sheeting manufacturer's recommendation at temperatures of 60° to 100°F (16° to 38°C) and relative humidity of 20% to 80%. The sheeting shall be heat resistant and permit force curing without staining of applied or unapplied sheeting at temperatures recommended by the sheeting manufacturer.
 - 6.5 **Shrinkage:** The retroreflective sheeting shall comply with the shrinkage requirements contained in ASTM D 4956 section 6.6.

6.6 Adhesive: The retroreflective sheeting shall comply with the liner removal and adhesion requirements contained in ASTM D 4956-09 sections 6.8 and 6.9.

6.7 Impact Resistance: The retroreflective sheeting shall comply with the impact resistance requirements contained in ASTM D 4956-09 Section 6.10.

6.8 Resistance to Accelerated Weathering: The retroreflective surface of the sheeting shall be weather resistant and show no appreciable cracking, blistering, pitting, edge lifting, curling, or dimensional change after three years and 1 year (Orange, Fluorescent Orange) unprotected outdoor exposure conducted according to ASTM G7 and inclined at 45° from the horizontal facing the equator. After cleaning in accordance with ASTM D 4956 Section 7.6.2, the coefficient of retroreflection shall not be less than 80% of the values in ASTM D4956. Following weather exposure, gently wash panels using a soft cloth or sponge and clean water or a dilute solution (1% by weight in water, maximum concentration) of a mild detergent. After washing, rinse thoroughly with clean water and blot dry with a soft clean cloth. After washing and drying, condition the panels at room temperature for at least two hours prior to conducting any property measurements.

6.8.1 Shows no appreciable evidence of cracking, scaling, pitting, blistering, edge lifting or curling or more than 1 /32-inch (0.08 cm) shrinkage or expansion. Retroreflective performance measurements after weather exposure shall be made at 0.2° observation and -4° and 30° entrance angles in accordance with ASTM E 810. Where more than one panel of a color is measured, the coefficient of retroreflection shall be the average of all the determinations.

6.8.2 Not to be removable from the aluminum panels without damage.

6.9 Optical Stability: Three pieces of retroreflective sheeting applied to test panels and conditioned as in Section 5.0 shall each first have their photometric properties characterized by measuring the coefficients of retroreflection according to the provisions in Section 6.2 at all test geometries shown in ASTM D4956 retro tables. These panels shall then be exposed in an air circulating oven at 160 ± 5°F (71± 3°C) for a period of 24 hours. After exposure the panels shall be allowed to condition according to the provisions of Section 5.0. These panels will again be characterized for photometric properties by measuring the coefficients of retroreflection according to the provisions of Section 6.2 at all test geometries measured before exposure.

6.10 Fungus resistance: The retroreflective sheeting shall comply with the supplementary requirements contained in section S1 of ASTM D 4956.

6.11 Resistance to Corrosion: The retroreflective sheeting applied to a test panel and conditioned as in 5.0 shall show no loss of adhesion, appreciable discoloration, or corrosion and after cleaning shall retain a minimum of 80% of the original coefficient of retroreflection when measured at 0.2° observation angle, -4° entrance angle, and 0° rotation angles after 1000 hours exposure to a 5% concentration salt spray at 35°C (95°F) when tested in accordance with ASTM B 117.

6.12 General Characteristics and Packaging: The retroreflective sheeting as supplied shall be of good appearance, free from ragged edges, cracks and extraneous materials and shall be furnished in either rolls or sheets. When furnished in continuous rolls, the number of splices shall

not be more than two per 50 yards (45.7 m) of material, With a maximum of three pieces in any 50-yard (45.7 m) length. Splices shall be butted or overlapped and shall be suitable for continuous application as furnished. The sheeting shall be packaged in accordance with commercially accepted standards. Each carton shall clearly stipulate the brand, quantity, size, lot or run number, color and type adhesive. Stored properly per manufacturer's recommendations the retroreflective sheeting as furnished shall be suitable for use for a period of one year.

7. Performance Requirements and Obligations

- 7.1 Certification** - The sheeting manufacturer shall submit with each lot or shipment, a certification that states the material supplied will meet all the requirements listed herein.
- 7.2 Field Performance Requirements:** Sheeting processed and applied to sign blank materials in accordance with sheeting manufacturer's recommendations, shall perform effectively for the number of years stated in **Table1** of this specification. The retroreflective sheeting will be considered unsatisfactory if it has deteriorated due to natural causes to the extent that: (1) the sign is ineffective for its intended purpose when viewed from a moving vehicle under normal day and night driving conditions; or (2) the coefficient of retroreflection is less than the minimum specified for that sheeting during that period listed.

7.3 Sheeting Manufacturer's Replacement Obligation

For standard colors where it can be shown that retroreflective signs, supplied and used according to the sheeting manufacturer's recommendations, have not met the performance requirements of Section 7.2, the sheeting manufacturer shall cover restoration costs as follows for sheeting's shown to be unsatisfactory during:

Type IV: 80% of values listed in ASTM D4956, years 1-7and 70%, years 8-10

Type XI: 80% of values listed in ASTM D4956, years 1-7and 70%, years 8-10

Failure of process colors or overlay films provided and/or sold for use on recommended sheeting shall constitute a failure of entire sign and shall be replaced under manufacturer's replacement obligations (7.3).

For screen printed transparent colored areas or transparent colored overlay films on white sheeting, the coefficients of retroreflection shall not be less than 70% of the values for the corresponding color in the retro value charts of ASTM 04956.

In addition, during the first 7 years, the sheeting manufacturer will cover the cost of restoring the sign surface to its original effectiveness at no cost to the County for materials and labor. For fluorescent colors where it can be shown that retroreflective signs, supplied and used according to the sheeting manufacturer's recommendations, have not met the performance requirements of Section 7.2, the Sheeting manufacturer shall cover restoration costs as follows for sheeting's shown to be unsatisfactory during:

The entire 10 years: the sheeting manufacturer will replace the Sheeting required to restore the sign surface to its original effectiveness.

In addition, during the first 7 years: the Sheeting manufacturer will cover the cost of restoring the sign surface to its original effectiveness at no cost to Montgomery County for materials and labor.

7.4 County Obligation:

County will install stickers with dating on all signs at the time of installation. That date constitutes the start of the field performance obligation period.

8. Reflective Vehicle Conspicuity Markings

Vehicle Conspicuity Markings shall be prismatic, wide angle, colored retroreflective sheeting designed to enhance both day and night visibility and detection of vehicles. This highly reflective sheeting shall consist of prismatic lenses formed in a durable transparent resin and backed with an aggressive pressure sensitive adhesive and protective liner. Retroreflectance of Markings shall conform to the following table.

Minimum Coefficient of Retroreflection (Candelas per lux per meter squared) (0 and 90° Orientation)			
Observation Angle (°)	Entrance Angle (°)	White	Red
0.2	-4	600	120
0.2	+30	300	70
0.2	+45	90	20
0.2	+65	20	5
0.5	-4	250	50
0.5	+30	120	20
0.5	+45	45	10
0.5	+65	10	2

Color Specification Limits (Daytime)

Color	1		2		3		4		Reflectance	
	X	y	X	y	X	y	X	y	Min.	Max.
White	0.305	0.305	0.355	0.355	0.335	0.375	0.285	0.325	40	-
Red	0.690	0.310	0.595	0.315	0.569	0.341	0.655	0.345	3	15

DELIVERY TIME

Failure to deliver the materials within 30 business days after the receipt of a delivery order and a purchase order may result in assessment of liquidated damages as described below. Deliveries shall be made to County’s Sign Shop, located at 1283 Seven Locks Road, Rockville, MD 20854, between 7:30 AM and 3:00 PM EST any day except Saturday, Sunday, and County holidays. The County will notify the Contractor if the location of the Sign Shop changes during the course of the contract.

NOTIFICATION OF DELIVERY

A notification of delivery and estimated time of arrival must be provided to Mr. James Clinton, the Stock Clerk, or designee, at 240-773-7330 at least two business days prior to the expected delivery date. Failure to provide proper notification may result in a lengthy unloading delay, which will be at no additional cost to the County.

LIQUIDATED DAMAGES

Material delivery shall be made within 30 business days after the receipt of a delivery order and a purchase order. With the understanding that Traffic Signs provide positive guidance for traffic safety, and that the County has a responsibility to the traveling public to ensure that the necessary Traffic Signs are present at all times, it follows that late deliveries of Traffic Sign Sheeting could indirectly result in traffic safety issues for the motorists and pedestrians alike. Inasmuch as such safety issues could potentially cause liability concerns for the County, the County will deduct the sum of \$100 per business day from moneys due the Vendor, not as a penalty, but as liquidated damages for each scheduled shipment not delivered within the time specified. In addition, the County may assess Liquidated damages in the amount of \$100 per business day for Traffic Sign Sheeting rejected by the County which will be calculated from the original due date of the order until the County’s receipt and acceptance of a new Traffic Sign Sheeting order, provided the Vendor is notified of the rejection by facsimile transmission within 24 hours of delivery. Traffic Sign Sheeting determined by the County to be defective at a later date, must be replaced by the Vendor within 30 business days of notification. Liquidated Damages will continue until such time as the Traffic Sign Sheeting is received and rejected Traffic Sign Sheeting has been replaced with Traffic Sign Sheeting that is acceptable to the County. County holidays will be excluded from the computations for the assessment of Liquidated Damages.