

DMS-8300, Sign Face Materials

Overview

(Combining DMS-8320 with DMS-8300)

Effective Date: July 2005 - August 2006 (refer to 'Archived Versions' for previous versions).

This Specification establishes prequalification, warranty, material and testing requirements, approval procedures, and the Material Producer List (MPL) for the following sign face materials:

- ◆ reflective sheeting
- ◆ nonreflective sheeting
- ◆ screen inks
- ◆ electronically cuttable (EC) transparent films
- ◆ anti-graffiti films and coatings and
- ◆ miscellaneous sign face materials.

Units of Measurement

The values given in parentheses (if provided) are not standard and may not be exact mathematical conversions. Use each system of units separately. Combining values from the two systems may result in nonconformance with the standard.

Material Producer List

The Materials and Pavements Section of the Construction Division (CST/M&P) maintains the MPL of all materials conforming to the requirements of this Specification. Materials appearing on the list of prequalified sign face materials may require sampling and testing before use. "Tex-720-I, Sampling Reflective Sheeting, Vinyl Nonreflective Decal Sheeting, and Colored Transparent Film," describes the sampling procedures.

Only products listed by manufacturer and product code or designation shown on the MPL will be considered for purchase.

Prequalification Requests

Submit a written request for product prequalification to the Texas Department of Transportation, Construction Division, Materials and Pavements Section (CP51), 125 East 11th Street, Austin, Texas 78701-2483.

For sign sheeting, supply a test report with actual test data showing the material complies with the requirements of ASTM D 4956, "Standard Specification for Retroreflective Sheeting for Traffic Control," for the sheeting type proposed. Provide sample quantities in accordance with "Tex-720-I, Sampling Reflective Sheeting, Vinyl Nonreflective Decal Sheeting, and Colored Transparent Film." For all proposed products, supply the warranty statement required in 'Comprehensive Manufacturer's Warranty Requirements.'

Manufacturers' and Suppliers' Requirements

At the Department's request, provide satisfactory evidence of the ability to furnish the products in accordance with the terms and conditions specified. The Department reserves the right to make the final determination as to the material supplier's ability.

Prospective material supplier or bidder with unresolved pending issues may not be considered for award in connection with any advertisement unless the item being offered is significantly different.

Prequalification and Performance History

Submit all materials for prequalification tests at no cost to the Department.

The Department may grant provisional prequalification after successful completion of the accelerated weathering requirements, for material that has undergone a full evaluation by the National Transportation Product Evaluation Program, and whose test results meet the minimum durability values required by this Specification.

The Department will grant full prequalification after successful completion of the exterior exposure requirements.

Failure to successfully complete all exterior exposure requirements is grounds for cancellation of provisional prequalification. You may resubmit failing material for re-evaluation after submitting a reasonable explanation of failure and evidence that the cause has been identified and corrected.

Re-evaluation

Report changes in the composition or in the manufacturing process of any material to CST/M&P at the address shown in 'Prequalification Requests.'

The Department will review significant changes reported and the material may require a re-evaluation. The Department reserves the right to conduct whatever tests are deemed necessary to identify a prequalified material and determine if a change has been made in the composition, manufacturing process, or quality, which may affect its durability or performance.

Changes detected in the composition or in the manufacturing process and not reported by the manufacturer, may be cause for removal of that material from the MPL.

Periodic Evaluation

The Department reserves the right to periodically evaluate the performance of randomly selected materials submitted to the Department on Contracts or purchase orders.

Failure of a material to comply with the specified requirements may be cause for removal of that material from the MPL.

Comprehensive Manufacturer’s Warranty Requirements

Manufacturers must comply with all requirements of the following warranty. Failure to comply with the requirements of this warranty is cause for removal from the MPL.

Submit a statement indicating understanding and compliance with the provisions of the warranty and willingness to abide by the provisions to the address shown in 'Prequalification Requests.' Include the name, address, and telephone number of the person to contact regarding potential claims under the warranty provisions.

The warranty must include the use of one manufacturer’s sign face material directly applied to a different manufacturer’s sign face material. If a failure occurs, assignment of warranty responsibility is to the manufacturer of the sign face material that fails. (Example: If the sheeting separates from the sign substrate, the manufacturer of the sheeting attached to the substrate will be responsible. If the sheeting or film used for legend detaches from the sheeting attached to the substrate, the manufacturer of the legend material will be responsible for the failure.)

Certification

Submit a certification with each lot or shipment which states that the material supplied meets the requirements listed. Show individual lot numbers on the certification.

Field Performance Requirements

Sign face materials processed and applied according to the manufacturer’s recommendations (or as required in this Specification when there is an exception to the manufacturer’s recommendations), must perform satisfactorily for the number of years stated in 'Minimum Performance Period' under ‘Comprehensive Manufacturer’s Warranty Requirements’ for that type of sheeting or when applied to that type of sheeting.

The sign face material is unsatisfactory if:

- ◆ it deteriorates due to natural causes to the extent that the sign is ineffective for its intended purpose (for example, when the sign is viewed from a moving vehicle under normal day and night driving conditions) or
- ◆ shows any of the following defects:
 - cracks discernible with the unaided eye from the driver’s position while in an outside lane at a distance of 15 m (50 ft.) or greater from the sign
 - peeling in excess of 6.4 mm (1/4 in.)

- shrinkage in excess of 3.2 mm (1/8 in.) total per 1.2 m (48 in.) of sheeting width
- fading or loss of color to the extent that color fails to meet the requirements in ASTM D 4956 or
- loss of reflectivity to a level below 60% for Types A and B and 80% for Types C, D, and E sheeting of the minimum values specified in ASTM D 4956 or in this Specification for new sheeting when measured at the angles specified for each type.

Provide manuals, training videos, or both to the applicators describing the proper application method. Submit a copy of the current training materials provided, with any updates as they occur to the address shown in 'Prequalification Requests.' Include recommended procedures for the storage and handling of materials after application to the sign face up to final installation.

The sheeting manufacturer's warranty does not relieve the Contractor for unacceptable work or improper handling, storage, or installation. The Contractor is fully responsible for all work until final acceptance by the Engineer.

Minimum Performance Period

All signs made with the type of sheeting indicated below and any other sign face materials used on each type of sheeting, except construction and maintenance work signs and barricades, must meet the following minimum performance periods:

- ◆ Type A – 3 yr.
- ◆ Types B, C, and D – 7 yr. plus 3 additional yr. with obligation for sheeting replacement only and
- ◆ Type E – 5 yr. plus 2 additional yr. with obligation for sheeting replacement only.

Manufacturer's Replacement Obligation

Where and when shown that retroreflective traffic signs processed in conformance with the sign face material manufacturer's recommendations (or as required in this Specification when there is an exception to the manufacturer's recommendations) have not met the field performance requirements above, a manufacturer's replacement obligation exists. The manufacturer must cover the costs of replacement of the sign on the roadway or of restoring the sign surface to its original effectiveness as determined by and at no cost to the Department for materials or labor.

Replacement sign face materials must be the same type originally specified unless otherwise approved or directed by the Engineer, meet all the requirements of this Specification, and be prequalified by the Department.

Schedule with designated Department personnel, within 30 days of notification of potential replacement obligation, an on-site investigation to determine if the sign face material manufacturer's obligation exists.

Fulfill all obligations within 120 days after determination of obligations are made. The Department may replace signs where obligations are not completed within 120 days and may bill the manufacturer for all Department costs in performing the manufacturer's replacement obligation.

When in the judgment of the Department deteriorated signs present a traffic hazard, the Department reserves the right to remove the signs from the roadway and place them in storage for the manufacturer's inspection. Reimburse the Department for all costs, including labor for removal and replacement, when inspection reveals that a material manufacturer's obligation exists.

The materials manufacturer may use an independent Contractor to fulfill obligations to replace or refurbish signs on the roadway.

Terms of the Contract must be in conformance with the provisions of Contracts used by the Department for this type work, be approved by the Department, and save harmless the Department from any liability that may arise out of the Contractor's operations.

The Department can provide a sample Contract to the manufacturer upon the manufacturer's request.

The Department reserves the right to place a representative on the job to ensure that the signs are replaced or refurbished in conformance with Department standards. The Department will test all sign face materials used to fulfill the manufacturer's obligations to ensure compliance with this Specification.

The field performance obligation-period begins with the placement on the roadway or the application to the substrate date, plus 4 mo., whichever is earlier. Replacement material assumes the remaining warranty period of the material it replaces.

Sign Processors' Obligations

Submit the following with each shipment of signs or sign faces:

- ◆ Department Contract or purchase order number and
- ◆ a copy of the certification, as required in 'Certification' under 'Comprehensive Manufacturer's Warranty Requirements,' showing the lot number of all sign face materials from which the completed signs or sign faces were processed.

Sampling and Testing

The Department will sample in accordance with "Tex-720-I, Sampling Reflective Sheeting, Vinyl Nonreflective Decal Sheeting, and Colored Transparent Film," and will test in accordance the methods listed in 'Material Requirements' for the specific material.

The Department reserves the right to conduct random sampling of prequalified materials for testing and to perform random audits of test reports. Department representatives may sample material from the manufacturing plant, the project site, and the warehouse. CST/M&P reserves the right to test samples to verify compliance with this Specification.

Costs of sampling and testing are normally borne by the Department; however, the cost of sampling and testing of materials failing to conform to the requirements of this Specification is borne by the Contractor or supplier.

Costs of sampling and testing of failing material is \$250 per sample, unless otherwise indicated on a purchase order or in the Contract plans. Amounts due the Department for conducting such tests will be deducted from monthly or final estimates on Contracts or from partial or final payments on direct purchase orders by the State.

Material Requirements for Reflective Sheeting

General Requirements

This Specification covers the general and specific requirements for 5 types of reflective sheeting materials: Types A, B, C, D, and E.

Meet all the requirements of ASTM D 4956, except when other specific requirements are shown for a particular type of reflective sheeting material or exceptions are indicated in this Specification.

The Department conducts outdoor weathering at the Department’s test site in Austin, Texas or at other locations as deemed necessary by the Director of CST/M&P.

Meet the supplementary requirements specified in ASTM D 4956, Supplementary Requirement S3, 'Artificial Accelerated Weathering.'

The Department will test all nonconstruction-zone application-types, not listed in Table S3.1, for 2,200 hr. and they must meet a minimum of 80% of the minimum specified initial retroreflectivity values for that type after accelerated weathering. The Department will test all construction zone application-types, not listed in Table S3.1, for 500 hr. and they must meet a minimum of 60% of the minimum specified initial retroreflectivity values for that type after accelerated weathering.

The manufacturer may fabricate identification marks to denote type of sheeting in or on the face of sheeting. When used, place the markings inconspicuously on 100 to 300 mm (4 to 12 in.) centers visible from a distance of not more than 9 m (30 ft.), or in a manner pre-approved by the Director of CST/M&P.

The sheeting manufacturer must furnish identification codes to the Department.

Sheeting Requirements

Type	Specification	Type
A	ASTM D 4956	I
B		II
C		III or IV
D		VII, VIII, IX
E ¹	-	-
¹ Type E must meet the requirements listed in 'Fluorescent Sheeting' under 'Material Requirements for Reflective Sheeting'		

Any fluorescence specification requirements added to ASTM D 4956 supersede those contained in this Specification.

Film Characteristics

The sheeting must meet the following film characteristics.

Film Requirements	
Characteristic	Requirement
Tensile Strength (Type A & B only) Tested according to ASTM D 882	≥ 25 N (5 lbf) per 25.4 mm (1 in.) of width
Elongation (Type A & B only) Tested according to ASTM D 882	≥ 5%
Workability	The integrity of the film must be such that when the sheeting or a completed sign face is trimmed (in the normal manner) to match the sign substrate, the film must not crack, flake, nor chip on the sign panel or sign face side of the trim line.
Temperature Stability	<ul style="list-style-type: none"> ◆ At any combination of temperatures from 10 to 38°C (50 to 100°F) and relative humidity from 20% to 90%, the sheeting must be able to be cut, applied, and color processed. ◆ Unapplied sheeting must withstand heat curing of process inks at temperatures up to 93°C (200°F), unless otherwise limited by the sheeting manufacturer and so stated in their technical literature.
Chemical Resistance	The surface of the sheeting or the face of a completed sign must be chemically resistant to the extent that there will be no surface change when wiped with a soft, clean cloth dampened with mild detergents or cleaners supplied by or recommended by the sheeting manufacturer.

Adhesive

Precoat the backside of the reflective sheeting with either a heat-activated or a pressure-sensitive adhesive. No additional coats of adhesive must be required to affix the reflective sheeting to the sign blank. The adhesive and liner, when used, must meet the requirements of ASTM D 4956.

Suppliers of reflective sheeting using a porous, textured-backing paper to protect the adhesive layer which is not suitable for use as a slip-sheet for packaging of completed signs, sign panels, or both, must supply rolls of slip-sheet paper in the various widths of reflective sheeting supplied. The area of slip-sheet paper, supplied in the various widths, must be the same as the area of reflective sheeting supplied in the various widths. Supplied slip-sheet paper is considered as subsidiary to the reflective sheeting and any costs, direct or indirect, must be included in the bid price for reflective sheeting on State purchases.

The adhesive must have no staining effect on the reflective sheeting.

Reflected Night Color

The reflected night color must be:

- ◆ identifiable as the same color as the day color when observed at 15 m (50 ft.) and
- ◆ uniform and free of streaks, mars, and other imperfections.

Screened Sheeting Optical Performance

Before exterior exposure or weather-ometer exposure, sheeting reverse screened with transparent ink must have the minimum coefficient of retroreflectivity values specified in ASTM D 4956. (Note: Retroreflectivity will be determined according to "Tex-842-B, Measuring Retroreflectivity.")

Material Identification

Mark each container, carton, or box containing reflective sheeting with the information listed in ASTM D 4956. The identification numbers must also appear on the inside of the sheeting roll core. The identification number on the outside of the box and on the inside of the core must match. The mismatch of these numbers may be cause for rejection.

Fluorescent Sheeting

Type E fluorescent sheeting must meet the minimum coefficient of retroreflection values listed in 'Type E Fluorescent Sheeting' when measured according to "Tex-842-B, Measuring Retroreflectivity."

Each color must meet the International Committee on Illumination (CIE) color specification limits listed in 'Initial Daytime Fluorescent Color' table when measured in the same manner as indicated in ASTM D 4956 for nonfluorescent sheeting.

Each color must also meet the values indicated below for Fluorescent Test I or Fluorescent Test II.

- ◆ Type E Fluorescent Sheeting

Type E Fluorescent Sheeting Minimum Coefficient of Retroreflection: cd/(lx m²)			
Observation / Entrance Angle / (Degrees)	Orange	Yellow	Yellow/Green
0.2 / -4	180	220	360
0.2 / 30	85	125	205
0.5 / -4	60	145	235
0.5 / 30	30	75	110

◆ Initial Daytime Fluorescent Color

Initial Daytime Fluorescent Color Specification Limits and Minimum Luminance Factors (Y min)										
Color	1		2		3		4		Luminance	
	x	y	x	y	x	y	x	y	Y min	
Orange	0.583	0.418	0.516	0.397	0.560	0.341	0.655	0.345	20	
Yellow	0.498	0.412	0.557	0.442	0.479	0.520	0.438	0.472	40	
Yellow / Green	0.387	0.610	0.460	0.540	0.421	0.486	0.368	0.539	60	

Fluorescent Test I

The fluorescent sheeting will be measured instrumentally using a bispectral (2-monochromator) spectrophotometer employing annular 45/0 (or equivalent 0/45) illuminating and viewing geometry.

The fluorescence luminance factor (Y_f) will be calculated from the fluorescence spectral radiance factors computed for CIE Illuminant D 65 in accordance with the following 3 test methods:

- ◆ ASTM E 308
- ◆ ASTM E 2152
- ◆ ASTM E 2153.

The sheeting must meet the following minimum fluorescence luminance factor (Y_f) values for the life of the sheeting:

- ◆ Orange: 17
- ◆ Yellow: 25
- ◆ Yellow/Green: 35.

Fluorescent Test II

The fluorescence sheeting will be measured to determine the total luminance factor ($Y\%$) and the color chromaticity coordinates (x, y). The MacAdam limit luminance factor (Y_m) will be computed using the equations described below. Color measurements will be made using Illuminant D 65 and in accordance with ASTM D 4956. The luminance factor must be greater than 70% of the MacAdam limit for the life of the sheeting.

For fluorescent orange chromaticities:

$$Y_m = 70 - 164x + 175y$$

$$Y\% > 0.70 \times Y_m$$

For fluorescent yellow chromaticities:

$$Y_m = 110 - 223x + 155y$$

$$Y\% > 0.70 \times Y_m$$

For fluorescent yellow-green chromaticities:

$$\text{When } y < 0.53, Y_m = 133 - 99x + 4y$$

$$\text{When } y \geq 0.53, m = 308 - 99x - 326y$$

$$Y\% > 0.70 \times Y_m$$

Material Requirements for Screen Inks

General Requirements

Specifically formulate screen inks for screening sign faces or legends on the type of reflective sheeting required.

Color

Screen inks, when screened onto any prequalified white reflective sheeting, must produce a color within the color requirements specified for the various colors of reflective sheeting in ASTM D 4956.

Use screen inks as supplied or thinned according to the manufacturer's recommendations.

Use the type of screen recommended by the manufacturer.

Color will be determined by using ink from sealed, unopened containers as received from the manufacturer and according to manufacturer's recommendations for thinning.

Transparency

Black screen ink, when applied to white sheeting, must be completely opaque. All other colors, when screened onto white sheeting according to the manufacturer's recommendation, must meet the contrast ratio requirements as specified in 'Contrast Ratio of Sign Faces and Completed Signs.'

Durability

Screen inks, recommended by the ink manufacturer for use on any of the types of reflective sheeting, must exhibit the same durability as specified for that type of reflective sheeting.

When tested according to Federal Test Method 6301, "Adhesion (Wet) Tape Test," the results must show no process inks removed after processing a minimum of 96 hr. or after exposure of the sheeting types to durability and weathering tests specified.

Material Requirements for Colored, EC Transparent Films

General Requirements

Colored, transparent films must consist of durable, electronically cuttable films coated with a transparent, pressure-sensitive adhesive protected by a removable liner.

The films must be:

- ◆ designed to be cut on knife-over-roll (sprocket-fed or friction-fed) and flat bed electronic cutting machines;
- ◆ available in standard traffic colors;
- ◆ dimensionally stable; and
- ◆ designed to cut, weed, lift, and transfer.

The colored, transparent films must not release any volatile, organic compounds.

Color

When applied to retroreflective sheeting, the resulting color must fall within the color requirements specified for each color of reflective sheeting in ASTM D 4956.

Coefficient of Retroreflection

When applied to retroreflective sheeting, the resulting coefficient of retroreflection must meet the minimum values specified in ASTM D 4956.

Retroreflectivity will be determined in accordance with "Tex-842-B, Measuring Retroreflectivity."

Adhesion

Adhesion must meet the requirements of ASTM D 4956.

Durability

Colored, transparent films, when applied to the various types of reflective sheeting, must meet the same durability requirements as specified for that type of reflective sheeting.

Black Sheeting

Film Characteristics

The sheeting must meet the following film characteristics.

Film Requirements

Characteristic	Requirement
Tensile Strength (Type A & B only) Tested according to ASTM D 882	≥ 25 N (5 lbf) per 25.4 mm (1 in.) of width
Elongation (Type A & B only) Tested according to ASTM D 882	≥ 5%
Workability	The integrity of the film must be such that when the sheeting is cut or trimmed in a normal manner with a razor knife, the film must not crack, flake, nor chip on either side of the trim/cut line.
Temperature Stability	The sheeting must permit cutting at any combination of temperatures from 10 to 38°C (50 to 100°F) and relative humidity from 20 to 90%.
Chemical Resistance	The surface of the sheeting must be chemically resistant to the extent that there will be no surface change when wiped with a soft, clean cloth dampened with mild detergents or cleaners supplied by or recommended by the sheeting manufacturer.
Mildew Resistance	Meet ASTM D 4956, Supplementary Requirement S1, 'Fungus Resistance'

Adhesive

Precoat the sheeting with a pressure-sensitive adhesive. Use no additional coats of adhesive to affix to the applicable substrate.

- ◆ Protective Liner
 - Attach a protective liner to the adhesive to protect its adhesive qualities until the time of sheeting application.
 - The protective liner must be easily removed by peeling, without soaking in water or other solvents and after accelerated storage for 4 hr. at 66°C (150°F) with a 1.13 kg weight and with a 25 mm by 25 mm (2.5 lb. of weight per square inch).
- ◆ Stain Resistance
 - The adhesive must have no staining effect on the sheeting or the substrate.

Durability

- ◆ Resistance and Exposure
 - The sheeting must show no cracking, crazing, blistering, chalking, or dimensional change after Weather-Ometer (Atlas, Sunshine Type) exposure for 2,200 hr. and exterior exposure at 45° for 36 mo. or at 90° for 5 yr.

- Weather-ometer exposure will be in accordance with ASTM G 153, using Method 1 (18 min. for water spray in every 120 min. of light exposure), Type EH.
- Exterior exposure will be facing south at the Department's exterior exposure test site in Austin, Texas or other locations as deemed necessary by the Director of CST/M&P.

Color and Gloss

The color of the sheeting must be black with reflectance (Y) no greater than 4.0 as determined by "Tex-839-B, Determining Color in Reflective Materials."

The sheeting face must have an 85° gloss meter rating of no less than 35 both before and after Weather-Ometer and exterior exposure as determined by ASTM D 523.

Anti-Graffiti Films and Coatings

Color

When applied to retroreflective sheeting, the resulting color must fall within the color requirements specified for the various colors of reflective sheeting in ASTM D 4956.

Coefficient of Retroreflection

When applied to retroreflective sheeting, the resulting coefficient of retroreflection reading must have the minimum values as shown in ASTM D 4956.

Coefficient of retroreflection will be determined in accordance with "Tex-842-B, Measuring Retroreflectivity."

Durability

◆ Resistance and Exposure

- The sheeting must show no cracking, crazing, blistering, chalking, or dimensional change after Weather-Ometer (Atlas, Sunshine Type) exposure for 2,200 hr. and exterior exposure at 45° for 36 mo. or at 90° for 5 yr.
- Weather-ometer exposure will be in accordance with ASTM G 153, using Method 1 (18 min. for water spray in every 120 min. of light exposure), Type EH.
- Exterior exposure will be facing south at the Department's exterior exposure test site in Austin, Texas or other locations as deemed necessary by the Director of CST/M&P.

Contrast Ratio of Sign Faces and Completed Signs

For all sign faces and completed signs using transparent screen inks or transparent films, the 'Contrast Ratio' is the quotient obtained when the coefficient of retroreflection of the white is divided by the coefficient of retroreflection of the other color.

The contrast ratio will be determined at an observation angle of 0.2° and an entrance angle of -4°.

For all signs, which use white and red reflective sheeting, the contrast ratio must not be less than 4.0 or greater than 15.0. For all other signs, sign panels, sign faces, and traffic control devices, the contrast ratio must not be less than 4.0.

Packaging

Package the materials in containers that will permit normal shipping and storage without the material sustaining damage or becoming difficult to apply.

Roll material must contain no more than 3 splices per 46 m (50 yd.). The length of the roll core must not be less than the width of the material.

Pressure-Sensitive Material

The ends of the material must be cut square with an overlap splice of 9.5 ±3.2 mm (3/8 ±1/8 in. in width). Edges of the overlap splice are to be straight and square.

Heat-Activated Material

Cut the ends of the material square, but jointed closely together and held securely in place with a removable tape.

Archived Versions

The following archived versions of “DMS-8300, Flat Surface Reflective Sheeting” are available:

- [8300-0898](#) for the Specification effective August 1998 through December 2001.
- [8300-0102](#) for the Specification effective January 2002 through January 2003.
- [8300-0203](#) for the Specification effective February 2003 through April 2003.
- [8300-0503](#) for the Specification effective May 2003 through July 2004.
- 8300-0804 for the Specification effective August 2004 through June 2005.
- 8300-0705 for the Specification effective July 2005 through August 2006.