Scotchlite™ Reflective Sheeting Engineer Grade

Product Bulletin - Engineer Grade Sheeting

February 1996
Replaces Engineer Grade PB dated March 1992

Health and Safety Information

Read all health hazard, precautionary, and first aid statements found in the Material Safety Data Sheeting and/or product label of chemicals prior to handling or use.

Description

The product bulletin describes physical and optical properties of Scotchlite™ Reflective Sheeting Engineer Grade. The individual series of sheetings are further described in the following Product Bulletins:

Product Bulletin	Sheeting Series Description
2200/3200	2200 Heat Activated Adhesive and 3200 Pressure Sensitive Adhesive
5200	5200 High Tack, Low Temperature Adhesive
3260	3260 Edge Perforated for Electronic Cutting

Engineer Grade sheetings for construction work zone signs and devices are described in Product Bulletin CW 80.

Scotchlite reflective sheetings are durable, retroreflective sheetings designed for the production of traffic control devices. The reflective sheetings consist of optical lens elements enclosed within a transparent resin that has a smooth, flat outer surface. They are available with a variety of adhesives, in all traffic signing colors and are produced in rolls or sheets.

Properties

A. Photometric - Coefficients of Retroreflection

The values in Table A are minimum coefficients of retroreflection expressed in candelas per foot candle per square foot (candelas per lux per square meter).

Measurements are made in accordance with ASTM E810 “Standard Test Method for Coefficient of Retroreflection of Retroreflective Sheeting”. The sheeting maintains at least 90% of the values in Table A with water falling on the surface, when measured in accordance with the standard rainfall test of FP-85, Section 718.02(a) and Section 7.10.0 of AASHTO M 268.

Table A - Minimum Coefficient of Retroreflection
Candelas/Foot Candle/Square Foot
Candelas/Lux/Square Meter

Obs.[1] Angle	Ent.[2] Angle	White	Parkway White[3]	Yellow	Red	Green	Blue	Brown
0.2	-4	70	80	50	14.5	9.0	4.0	2.0
0.2	+30	30	35	22	6.0	3.5	1.7	1.0
0.5	-4	30	41	25	7.5	4.5	2.0	1.0
0.5	+30	15	21	13	3.0	2.2	0.8	0.5

Reflectivity conforms to Federal Specification FP-85 Table 718-1 and ASTM D 4956.

[1]Observation (Divergence) Angle - The angle between the illumination axis and the observation axis.

[2]Entrance (Incidence) Angle - The angle from the illumination axis to the retroreflector axis. The retroreflector axis is an axis perpendicular to the retroreflective surface.

[3]Parkway White should be used for all sign copy, including letters, numerals, symbols, borders and route markers to provide the optimum contrast to the reflective background.

For printed colored areas on silver sheeting, the coefficients of retroreflection shall not be less than 50% of the values for colored sheeting in Table A.

Table B - CIE Chromaticity Coordinate Limits

Color	x	y	x	y	x	y	x	y	Reflectance Limit (Y) Min	Max	Munsell Paper
White	.303	.287	.368	.353	.340	.380	.274	.316	35.0		6.3GY 6.77/0.8
Yellow	.498	.412	.557	.442	.479	.520	.438	.472	29.0	45.0	1.25Y 6/12
Red	.613	.297	.708	.292	.636	.364	.558	.352	8.0	12.0	8.2R 3.78/14.0
Blue	.144	.030	.244	.202	.190	.247	.066	.208	1.0	4.0	5.8PB 1.32/6.8
Green	.030	.380	.166	.346	.286	.428	.201	.776	3.5	9.0	.65BG 2.84/8.45
Brown	.445	.353	.604	.396	.556	.443	.445	.386	4.0	9.0	5YR 3/6

B. Color

Colors of the retroreflective sheeting conform to Table B when measured in accordance with Federal Specification FP-85, section 718.01 (a) or ASTM D 4956.

C. Adhesives

Series 2200 sheetings have a heat activated adhesive which conforms to the adhesive requirements of FP-85 (Class 2) and ASTM D 4956 (Class 2). The heat-activated adhesive is dry and positionable and is for use in the heat-vacuum applicator. Sheeting coated with this adhesive is perforated to assist in air evacuation during vacuum applications.

Series 3200 sheetings have a pressure-sensitive adhesive which conforms to the adhesive requirements of FP-85 (Class 1) and ASTM D 4956 (Class 1). The pressure sensitive adhesive is recommended for application by hand or by using a mechanical squeeze roller applicator. This type adhesive lends itself to large scale rapid production of signs. Applications should be made with sheeting and substrate at temperatures above 65°F (18°C).

Series 5200 sheetings have High Tack adhesive, an aggressive pressure-sensitive adhesive which conforms to the adhesive requirements for ASTM D 4956 (Class 4). It is particularly suited for application at temperatures as low as -10°F (-23°C).

Series 3260 sheetings have the edge perforated for electronic cutting machines and is intended for the production of traffic control letters, legends, logos, etc. These sheetings meet requirements for Series 3200 sheeting.

Test Methods For Adhesive And Film Properties

Unless test methods and requirements are specially described in attachments, the adhesive and film properties listed below are applicable to all enclosed lens materials.

A. Standard Conditioning

All applied and unapplied test specimens shall be conditioned for 24 hours at 73°F ± 2°F (23°C ± 1°C) and 50% ± 4% R.H. before testing.

B. Standard Test Panel and Application

Unless otherwise specified the reflective sheeting shall be applied according to the manufacturer's recommendations to smooth 0.040" (1.0 mm) minimum thickness 6061-T6 or equivalent aluminum panels that have been degreased and lightly acid etched.

Lack of contamination of test panels must be confirmed by passing water break and tape snap test as described in Information Folder 1.7.

C. Test Methods For Adhesive and Film Properties:

Adhesion

Sheeting Series	Test Weight	Test Method	Requirement
2200	1-3/4 lb. (0.8 Kg)	Apply 4" (10 cm) of 1" x 6" (2.54 x 15 cm) strip to test panel and condition. Face panel down and suspend test weight from free end.	Not more than 2" (5.0cm) of peel in 5 minutes.
3200/3260	1-3/4 lb. (0.8 Kg)		
5200	1 lb. (0.5 Kg)		

Impact Resistance		
Sheeting Series	**Test Method**	**Requirement**
2200 3200/3260 5200	Apply 3" x 5" (7.6 x 12.7 cm) of sheeting to test panel and condition. Subject center of sheeting face to impact from a 2 pound (0.91Kg) weight with a 5/8 inch (16mm) rounded tip dropped from a 10 inch pound (11.5 cm/Kg) setting on a Gardner Variable Impact Tester.	No separation from panel or cracking outside the immediate impact area.
Shrinkage	Following conditioning of 9" x 9" samples, place specimen on flat surface with adhesive side up.	Shrinkage not greater than 1/32" (0.8mm) in 10 minutes, or more than 1/8" (3.2mm) in 24 hours in any dimension.
Flexibility	Following conditioning of 1" x 6" sample remove liner and dust adhesive with talc. At standard condition, bend in one second around 1/8" (3.2 mm) mandrel with adhesive side facing mandrel.	No cracking.
Gloss	Test in accordance with ASTM D523 using an 85° glossmeter.	Rating not less than 40.

Use

A. Application

Engineer grade sheeting should be conditioned prior to application to provide a minimum sheeting temperature of 65°F (18°C) throughout the roll or sheet stack.

Most satisfactory applications are made with mechanical applicators to properly prepared substrates. The equipment and accessories that **must be used** are as follows:

Heat Activated Adhesive

1. Heat lamp vacuum applicator with temperature control.
2. Removed protective liner from adhesive and place glossy unprinted side of liner against sign face. Sheeting and liner may require hand perforation to aid in air evacuation. For details on vacuum application see Information Folder 2.1.

Pressure Sensitive Adhesive

1. 48" Squeeze Roll Applicator. See Information Folder 1.4.
2. Hand application. To obtain maximum initial adhesion use firm pressure with 2" (5 cm) rubber roller or plastic squeegee PA1 or equivalent. Multiple, heavy overlapping strokes should be used. Resqueegee all edges. See Information Folder 1.5.

B. Substrates

For traffic sign use, most clean, smooth, relatively non-porous, flat, rigid, weather resistant surfaces can be prepared for application of retroreflective sheeting. Common substrates found to be most reliably durable have been properly prepared sheet aluminum and extrusions. Users are urged to carefully evaluate all others. See Information Folder 1.7.

C. Process Colors

Scotchlite reflective sheeting engineer grade may be processed into traffic signs by screen processing, using Scotchlite™ Process Colors Series 700. Use of other process colors series is not recommended. Process at 60-80°F (16-27°C) at relative humidity of 20-50%. For screen processing of traffic signs, PE 157 screen mesh, screened with a fill pass, is recommended. Consult Information Folder 1.8 and Product Bulletin 700 for details. 3M assumes no responsibility for failure of sign face legends or backgrounds that have been processed with non-3M process colors.

D. Drying of Screen Process Colors

Processed signs should be air dried for 24 hours while racked individually to allow adequate air circulation. Before oven drying, rack individually for 1/2 hour air dry for flow out. Oven dry unapplied sheets at 160°F (70°C) for up to 2 hours. Oven dry processed applied signs at 175°F (80°C) for up to 2 hours. See Information Folder 1.8.

E. Cutting

The sheeting may be hand cut or die cut one sheet at a time, and band sawed or guillotined in stacks. Whenever two or more pieces are used side by side they must be matched to assure uniform day color and night appearance. For details on cutting and matching see Information Folder 1.10. Series 3260 sheeting is designed for use on electronic cutting machines. In order to reduce the possibility of stress cracking, the inside corners of cut out letters and symbols should be rounded using the largest radius consistent with acceptable appearance. Minimum radius should be 1/8 inch on a 3 inch letter.

F. Prespacing and Premasking

Use prespacing tape SCPS-2 as a carrier for electronically cut or die cut letters, numerals or symbols to aid rapid, accurate application of legends. Sheeting may be premasked to protect the surface during painting or to aid hand application of large or irregular shaped pieces. See Information Folder 1.10.

G. Edge Sealing and Clear Coating

Clear coating of enclosed lens Scotchlite reflective sheeting is not recommended. Normal effective performance life is reduced by clear coating. Edge spotting of cutout letters such as those on street name signs in highly industrialized areas, or where deicing salts are used, can be minimized by coating the sign with Edge Sealer 735.

H. Cleaning

Refer to Information Folder 1.11 for procedures on cleaning signs.

Storage

Scotchlite sheeting should be stored in a cool, dry area, preferably at 65-75°F (18-24°C) and 30-50% relative humidity, and should be applied within one year after purchase.

Rolls should be stored horizontally in the shipping carton. Partially used rolls should be returned to the shipping carton or suspended horizontally from a rod or pipe through the core. Unprocessed sheets should be stored flat. Finished signs should be stored on edge.

Screen processed faces or signs must be protected with No. 8 resin coated paper or the liner from series 2200 or 3200 sheeting as slipsheeting. Place the glossy side of the slipsheeting against the sign face. Double faced signs must have the glossy side of the slipsheet against each face of the sign.

Avoid banding, crating, or stacking which puts signs or faces under pressure. Package for shipment in accordance with commercially accepted standards to prevent movement and chafing which may cause damage during handling. Store sign packages indoors on edge.

Do not allow panels or finished signs to become wet in shipment or storage. Should packaged signs become wet, unpack immediately and permit signs to dry.

See Information Folder 1.11 for details of storage and packaging.

General Performance Considerations

The durability of Scotchlite reflective sheeting engineer grade will depend upon substrate selection and preparation, compliance with recommended application procedures, geographic area, exposure conditions, and maintenance.

Maximum durability of engineer grade sheeting can be expected in applications subject to vertical exposure on stationary objects when processed and applied according to 3M recommendations to properly prepared aluminum according to Information Folder 1.7 on Sign Base Surface Preparation.

The user must determine the suitability of any nonmetallic sign backing for its intended use. Applications to unprimed, excessively rough or non-weather-resistant surfaces, or exposure to severe or unusual conditions can shorten the durability of such applications.

Signs in mountainous areas that are covered by snow for prolonged periods may also have reduced durability.

Scotchlite process colors, when used according to 3M recommendations, are generally expected to provide performance comparable to colored reflective sheeting, except for certain lighter colors, such as yellow, gold, or heavily toned colors or blends containing yellow or gold, whose durability depend on how much of each color is used. Dilution of color and atmospheric conditions in certain geographical areas may result in reduced durability.

Scotchcal film 3655 Black, Scotchcal film 7720-12, Controltac film 180-12 Black, and Scotchlite electronic cuttable film series 1170 can be expected to perform satisfactorily for the life of the sign when direct applied to engineer grade sheeting, except where shortened durability is stated in the literature.

Literature Reference

Screen Processing	
Scotchlite™ Process Colors Series 700	PB 700
Color Application Instructions	IF 1.8
Application	
Vacuum Applicator Instructions	IF 1.1
Squeeze Roll Applicator Instructions	IF 1.3
Sign Base Materials	IF 1.7
Premasking and Prespacing	IF 1.10
Application Instructions for Heat Vacuum Applicators	IF 2.1
Maintenance and Specifications	
Storage, Maintenance and Removal Instructions	IF 1.11

3M assumes no responsibility for any injury, loss or damage arising out of the use of a product that is not of our manufacture. Where reference is made in literature to a commercially available product, made by another manufacturer, it shall be the user's responsibility to ascertain the precautionary measures for its use outlined by the manufacturer.

Important Notice

All statements, technical information and recommendations herein are based on tests we believe to be reliable, but the accuracy or completeness therof is not guaranteed, and the following is made in lieu of all warranties, expressed or implied, including the implied warranties of merchantability and fitness for purpose: Seller's and manufacturer's only obligation shall be to replace such quantity of the product proved to be defective. Before using, user shall determine the suitability of the product for its intended use, and user assumes all risk and liability whatsoever in connection therewith. NEITHER SELLER NOR MANUFACTURER SHALL BE LIABLE EITHER IN TORT OR IN CONTRACT FOR ANY LOSS OR DAMAGE, DIRECT, INCIDENTAL, OR CONSEQUENTIAL, ARISING OUT OF THE USE OF OR THE INABILITY TO USE THE PRODUCT. No statement or recommendation not contained herein shall have any force or effect unless in an agreement signed by officers of seller and manufacturer.

3M
Traffic Control Materials Division
3M Center, Building 225-5S-08
P.O. Box 33225
St. Paul, MN 55133-3225

3M Canada Inc.
P.O. Box 5757
London, Ontario N6A 4T1

3M Mexico, S.A. de C.V.
Apartado Postal 14-139
Mexico, D.F. 07070

Printed on recycled paper
75-0300-2295-0