



3MTM Diamond GradeTM Fluorescent VIP Reflective Sheeting 3983

Visual Impact Performance (VIP) 3983 Fluorescent Yellow Green

Health & Safety

Refer to the package label and the Material Safety Data Sheet for health, safety, and handling information on the products referenced in this bulletin. For 3M products, if necessary, you may contact our Toxicology/Product Responsibility Department on 01344 858000.

Description

3MTM Diamond GradeTM Fluorescent VIP Reflective Sheatings are durable wide angle prismatic lens sheetings that fluoresce when subjected to wavelengths in the visible spectrum. They are designed for the production of durable traffic control signs and delineators that are exposed vertically in service. This sheeting is designed to provide higher night-time sign brightness than sheetings that use glass bead lenses and higher daytime brightness than ordinary (non-fluorescent) coloured sheetings.

Applied to properly prepared sign backings, fluorescent VIP sheeting should provide long term service.

- Colour: Fluorescent Yellow Green
- Product Code: 3983

Photometrics

Daytime Colour (x, y, Y)

The chromaticity co-ordinates and total luminance factor of the retroreflective sheeting conform to Table A below.

Colour Test

Conformance to daytime colour requirements shall be determined instrumentally, on sheeting applied to aluminium test panels, using a 2-monochromator spectrophotometer employing annular 45/0 (or equivalent 0/45) illuminating and viewing geometry.¹ The total chromaticity co-ordinates and total luminance factor shall be calculated from the total spectral radiance factors computed for CIE illuminant D65 in accordance with ASTM E-308 "Practice for Computing the Colours of Objects by Using the CIE System" for the CIE 1931 (2°) standard colorimetric observer. The measurements shall be made on a Labsphere BPC-450 Bispectral Fluorescent Colorimeter or equivalent.

¹ "Metrology of fluorescent retroreflective materials and its relationship to their daytime visibility" by David M Burns and Norbert L Johnson, Analytica Chimica Acta, 380, 211-226 (1999).

Table A - CIE Chromaticity Co-ordinate Limits* and Total Luminance Factor Minimum

Colour	1		2		3		4		Total Luminance Factor Y (%)
Fluorescent Yellow Green	\bar{x} 0.387	\bar{y} 0.520	\bar{x} 0.46	\bar{y} 0.540	\bar{x} 0.421	\bar{y} 0.486	\bar{x} 0.368	\bar{y} 0.539	<u>Min</u> 60

*The four pairs of chromaticity co-ordinates define the acceptable colour limits for CIE D65 illumination in terms of the CIE 1931 Colorimetric System

Fluorescence (Y_F)

Fluorescent luminance properties differentiate fluorescent sheeting from ordinary (non-fluorescent) sheeting. The additional sign luminance produced by fluorescence is directly related to the increased visual performance of fluorescent signing under the varying conditions of daylight illumination encountered in outdoor signing applications. The Fluorescent Luminance Factor Y_F , provides a standardised measure of the fluorescent luminance. The numerical value of Y_F sheeting under specified illumination and viewing conditions 1) verifies the fluorescent properties of the sign sheeting (for non-fluorescent sheeting $Y_F=0$) and 2) quantifies the fluorescent content (efficiency) of the sign sheeting. The magnitude of Y_F can be used to assess whether the fluorescent content is sufficient to provide high daytime visibility performance under poor visibility conditions. The minimum fluorescence luminance factor (Y_F) values of the retroreflective sheeting conform to Table B.

Table B Fluorescence Luminance Factor Minimum for New Sheeting

Colour	Y_F (%) min
Fluorescent Yellow Green	35

Fluorescence Test

Conformance to fluorescence luminance factor requirements shall be determined instrumentally, one sheeting applied to aluminium test panels, using a 2-monochromator spectrophotometer employing annular 45/0 (or equivalent 0/45) illuminating and viewing geometry¹. The fluorescence luminance factor shall be calculated from the fluorescence spectral radiance factors computed for CIE illuminant D65 in accordance with AASTM E-308 "Practice for Computing the Colours 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.

¹ "Metrology of fluorescent retroreflective materials and its relationship to their daytime visibility" by David M Burns and Norbert L Johnson, Analytica Chimica Acta, 380, 211-226 (1999).

Coefficients of Retroreflection (R_A)

The values in Table C are minimum coefficients of retroreflection expressed in candelas per lux per square metre (cd/lux/m²).

Test for Coefficients of Retroreflection

Conformance to coefficient of retroreflection requirements shall be determined by instrumental method in accordance with ASTM E-810 "Test Method of Coefficient of Retroreflection of Retroreflective Sheeting" and per E-810 the values of 0° and 90° Rotation are averaged to determine the R_A in Table C.

Table C - Minimum Coefficient of Retroreflection R_A for New Sheeting (cd/lux/m²)

Observation ² Angle	Entrance Angle ³		
	-4°	30°	45°
0.1°	543	383	95
0.2°	325	203	75
0.5°	238	108	24
1.0°	63	35	8

²Observation (Divergence) Angle - The angle between the illumination axis and the observation axis.

³Entrance (Incidence) Angle - the angle from the illumination axis to the retroreflector axis. The retroreflector axis is an axis perpendicular to the retroreflective surface.

Orientation

Diamond Grade Fluorescent VIP reflective sheeting is designed to be an effective wide angle reflective sheeting regardless of its orientation on the substrate or ultimate orientation after installation. However, because the efficiency of light return from cube corner reflectors is not equal at all rotation angles, it is possible to get the widest entrance angle light return when the sheeting is oriented in a particular way.

When extra wide entrance angle performance is important for a given sign type or situation, you may elect to make the signs with a specific orientation. However, unless the location and/or position calls for extra-wide entrance angularity performance (exceeding 35°) signs can be manufactured and installed using the orientation that most efficiently utilises the reflective sheeting.

For the purposes of test measurement of the sheeting, it is important for the material to have a datum mark (the orientation arrows) so that the sample can be properly oriented in the test machinery. In those situations where extra wide entrance angle performance is required, this arrow can be used to assure the preferred orientation.

NOTE: In cases where letters and numbers are placed on the same sign, it is recommended they be placed with identical orientation.

Interlocking Diamond Seal Pattern

Series 3980 sheeting has the same interlocking seal pattern as series 3990 sheeting. This pattern is unique to 3M wide angle prismatic retroreflective sheetings. Because of the small cube corners used in series 3980 sheeting, the seal cell walls or “legs” appear smooth.

Seal legs have smooth edges



3M™ Diamond Grade™ VIP
Reflective Sheeting

Figure 1

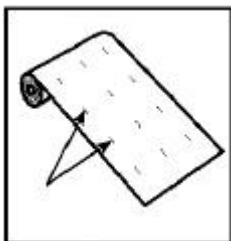
Datum Marks (Arrows)

Series 3980 sheeting is made with small arrows in the surface repeated three times across a 91.44cm (36”) roll and at 30.48cm (12”) interval (Figure 2) down the roll. These arrows which point down the length of the roll serve as reference marks for photometric testing. The arrows are also used as visual aids to sheeting orientation when fabricating signs for special high entrance angle situations. The arrow differentiates VIP sheeting from other Diamond Grade sheetings.

Tooling Lines

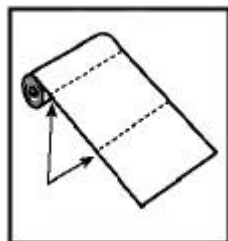
The manufacturing of a prismatic sheeting results in tooling lines being present in the product. In Fluorescent VIP sheeting these lines are slightly thicker than the seal pattern legs and occur down the web every 86.36cm (34 inches). Tooling lines are noticeable in shop light but are not observable on the road either in daylight or at night under typical use conditions (Figure 3).

Orientation Arrows



Arrows repeat 3 x on a
91.44 cm (36”) roll 30.48cm
(12”) intervals down roll

Tooling Lines



Across the roll width
86.36cm (34”) centres

Series 3980 sheeting has a pressure-sensitive adhesive that is recommended for room temperature application. Room temperature application is defined as 18°C (65°F) or higher.

Test Methods of Adhesive and Film

Standard Test Panels

Unless otherwise specified, the reflective sheeting shall be applied according to the manufacturer’s recommendations to smooth 0.0063 inches (1.6mm) minimum thickness 6061-T6, 5052-H38 or equivalent aluminium panels that have been degreased and lightly acid etched. Lack of contamination of test panels must be confirmed by passing the water break test and tape snap test.

Properties

Standard Conditioning - all mounted and unmounted test specimens shall be conditioned for 24 hours at 23°C ± 1°C (73°F ± 2°F) and 50% ± 4% R.H. before testing.

1. Adhesion

Test Weight 0.8kg (1-¾ lbs). Test Method - Apply 10cm (4”) of 2.54 x 15 cm (1” x 6”) stripe to panel and condition, face panel down and suspend test weight from free end.

Requirement - Not more than 5.0cm (2”) of peel in 5 minutes.

2. Impact Resistance

Test Method - Apply sheeting to a standard panel 7.6cm x 15.2cm (3” x 6”) and condition. Subject sheeting to a 5.7Nm (50 inch pounds) impact in accordance with ASTM D-2794.

Requirement - No separation from panel or cracking outside immediate impact area.

3. Shrinkage

Test Method -Following condition 22.9cm x 22.9cm (9” x 9”) samples, remove liner, place specimen on flat surface with adhesive side up.

Requirement - shrinkage not greater than 0.8mm (1/32”) in 10 minutes or more than 3.2mm (1/8”) in 24 hours in any dimension.

4. Flexibility

Test Method - Following conditioning of 2.54cm x 15cm (1”x6”) sample, remove liner and dust adhesive with talc. At standard conditions, bend in one second around 3.22mm (1/8”) mandrel with adhesive side facing mandrel.

Requirement - No cracking, peeling or delamination.

Adhesive

5. Gloss

Test Method - Test in accordance with ASTM D523 using a 85° glossmeter.

Requirement - Rating not less than 50.

Sign Fabrication Methods

Application

Diamond Grade fluorescent VIP sheeting series 3980 incorporates a pressure-sensitive adhesive and should be applied to the sign substrate at room temperature (18°C/65°F) or higher by any of the following methods:

- Mechanical squeeze roll application.
- Hand squeeze roll applicator.
- Hand application.

Splicing - Series 3980 sheeting should be butt spliced when more than one piece of sheeting is used on one piece of substrate. The sheeting pieces should not touch each other at the splice and gap of up to 1.6mm (1/16") is acceptable. All pieces must be applied with the same orientation on the finished sign.

Double Faced Signs - Series 3980 sheeting on the first side must be protected from damage from the steel bottom roll of squeeze roll applicators with FR-2 sponge rubber and SCW82.

Substrates

For traffic sign use, recommended product application is limited to properly prepared aluminium, with the exception that extrusions are to be trimmed rather than wrapped, and flat panel signs are to be carefully trimmed so that sheeting from adjacent panels do not touch on the assembled signs. Users are urged to carefully evaluate all other substrates for adhesion and sign durability. Diamond Grade fluorescent VIP sheeting is designed primarily for application to flat substrates. Any use that requires a radius of curvature of less than five inches should also be supported by rivets or bolts. Plastic substrates are not recommended where cold shock performance is essential. Sign failures caused by the substrate or improper surface preparation are not the responsibility of 3M.

Screen Processing

Fluorescent VIP sheeting may be screen processed into traffic signs before or after mounting on a sign substrate, using 3M™ Process Colours Series 880I (see Product Bulletin 880I). Series 880I process colours can be screen processed at 16-38°C (60-100°F) at relative humidity of 20-60%.

Use of other process colours series is not recommended.

3M assumes no responsibility for failure of sign face legends or backgrounds that have been processed with non-3M process colours or 3M process colours other than those listed above.

A PE 157 (61/62T) screen mesh with a fill pass is recommended.

Care should be taken to avoid flexing the sheeting before and especially after screening to eliminate the possibility of cracking from improper handling techniques.

Cutting and Matching

The sheeting may be hand cut or die cut one sheet at a time, and band sawed or guillotined in stacks. VIP sheeting can be hand cut from either side with a razor blade or other sharp hand tool. Like all reflective sheetings, when two or more pieces are used side by side on a sign. They must be matched to assure uniform day colour and night appearance.

Cutting equipment such as guillotines and metal shears which have pressure plates on the sheeting when cutting may damage the optics. Padding the pressure plate and easing it down onto the sheets being cut will significantly reduce damage.

Maximum stack height for cutting VIP sheeting is 3.81cm (1½") or 5 sheets.

Multi-piece signs should have all panels or pieces oriented identically for uniform appearance under all viewing conditions (arrow and the seal pattern in the same direction).

Edge sealing VIP sheeting is generally not required. Following extended exposure, airborne dust particles may become trapped within the row of cut cells along the sheeting edge. This should have no adverse effect on sign performance. If the user chooses to edge seal, series 880I toner should be used.

Cleaning

Signs that require cleaning should be flushed with water, then washed with a detergent solution and bristle brush or sponge. Avoid pressure that may damage the sign face. Flush with water following washing. Do not use solvents to clean signs.

Storage and Packaging

Fluorescent VIP sheeting should be stored in a cool, dry area, preferably at 18-24°C (65-75°F) and 30-50% relative humidity and should be applied within one year of 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 and applied blanks should be stored on edge.

Screen processed signs must be protected with SCW 568 slipsheet paper. Place the glossy side of the ship sheeting against the sign face and pad the face with closed cell packaging foam. Double faced signs must have the glossy side of the shipsheet against each face of the sign.

Unmounted screen faces must be stored flat and interleaved with SCW 568 slipsheet, glossy side against the sign face.

Avoid banding, crating, or stacking signs. Package for shipment in accordance with commercially accepted standards to prevent movement and chafing. Store sign packages indoors on edges. Panels or finished signs must remain dry during shipment and storage. If packaged signs become wet, unpack immediately and allow signs to dry.

General Performance Considerations

The durability of Diamond Grade fluorescent VIP reflective sheeting series 3980 will depend upon substrate selection and preparation, compliance with recommended application procedures, geographic area, exposure conditions, and maintenance.

Maximum durability of series 3980 sheeting can be expected in applications subject to vertical exposure on stationary objects when processed and applied to properly prepared aluminium according to 3M recommendations.

The user must determine the suitability of any non-metallic 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 performance in such applications.

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

Colour Stability

Diamond Grade Fluorescent VIP reflective sheeting will change in colour appearance at a rate comparable to non-fluorescent sheeting during the warranty period.

After the warranty period, the colour of fluorescent VIP sheeting may degrade more rapidly than non-fluorescent

sheeting. The rate of fluorescent degradation is accelerated in climates with high levels of solar irradiation and high temperatures. Colour changes may be expected to first appear on south-facing signs.

Periodic sign inspection and regular sign replacement are strongly recommended in order for agencies to establish their own effective service life expectation, beyond the warranty period.

3M™ Scotchcal™ Film 3650-12 Black, Scotchcal film 7720-12, 3M™ Controltac™ Plus Film 180-12 Black and 3M™ ElectroCut™ Film Series 1170 can be expected to perform satisfactorily for the life of the sign when direct applied to series 3980 sheeting, except where shortened durability is stated in the literature.

Warranty

3M warrants that 3M™ Diamond Grade™ Fluorescent reflective sheeting used in the manufacture of road traffic signs will remain effective for its intended purpose and will meet the stated minimum values in the Reflective Sheeting Performance Guarantee statements (see Table D).

In the event of a sign surface made with one of the above 3M materials failing to meet the performance levels stated in the above referenced Reflective Sheeting Performance Guarantee statements, 3M will under take to:

If the failure occurs in the first 7 years for 3M Diamond Grade Fluorescent reflective sheeting, then 3M will, at its expense, restore the sign surface to its original effectiveness.

If the failure occurs in the years 6 through 7 for 3M Diamond Grade Fluorescent reflective sheeting, then 3M will furnish the necessary amount of retroreflective sheeting to restore the sign surface to its original effectiveness.

Conditions

All 3M sign face materials must be processed and applied in accordance with 3M application and fabrication procedures provided in 3M's product bulletins, information folders, production standards manuals and technical memos (which will be furnished on request), including the exclusive use of 3M Matched Component Systems (MCS™), screen printing inks and clears, electronic cuttable films, protective overlay films and recommended application equipment.

Table D

Minimum Coefficient of Retroreflection and Fluorescence Luminance Factor (all measurements shall be made after cleaning according to 3M recommendations)				
Colour	Warranty Period	Minimum Coefficient of Retroreflection (R_A) cd/lux/m ² at -4° Entrance Angle		Minimum Fluorescent Luminance Y_F %
		Observation Angle	R_A	
Fluorescent	10 years	0.2°	140	20%
Yellow		1.0°	25	
Green				

Important Notice to Purchaser

Technical information provided by 3M is based on experience and/or tests believed to be reliable but its accuracy is not guaranteed and the results may not be relevant to every user's application. 3M does not accept responsibility or liability, direct or consequential, arising from reliance upon any information provided and the user should determine the suitability of the products for their intended use.

Nothing in this statement will be deemed to exclude or restrict 3M's liability for death or personal injury arising from its negligence.

All questions of liability relating to 3M products are governed by the seller's terms of sale subject where applicable to the prevailing law.

If any goods supplied or processed by or on behalf of 3M prove on inspection to be defective in material or workmanship 3M will (at its option) replace the same or refund to the Buyer the price of the goods or services.

Except as set out above, all warranties and conditions, whether expressed or implied, statutory or otherwise are excluded to the fullest extent permissible at law.

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