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Commercial Branding and Transportation Division

3M™ Diamond Grade™ Flexible Work Zone Sheeting Series 3910 for Use on Reboundable Plastic Traffic Control Devices

Product Bulletin 3910
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1 Description

3M Diamond Grade Flexible Work Zone Sheeting Series 3910 (“Sheeting”) is a wide angle prismatic lens reflective sheeting intended for reflectorizing reboundable traffic control devices such as polyethylene drums, posts and tubes. Series 3910 Sheeting is precoated with a pressure sensitive adhesive conforming to ASTM D 4956 Class 1 adhesive requirements. Fluorescent yellow (3911) and fluorescent orange (3914) Sheeting are visible-activated fluorescent reflective sheetings as defined in ASTM E991.

For details of the features and benefits of Series 3910 Sheeting, please refer to http://www.3M.com/roadsafety.

Series 3910 Sheeting is available in the following colors.

Table 1. Product Codes by Color

Color	Product Code
White	3910
Fluorescent Yellow	3911
Fluorescent Orange	3914

2 Specifications

2.1 Daytime Color (x, y, Y)

The chromaticity coordinates and luminance factors of the Sheeting conform to the requirements shown in Table 2.

Table 2. CIE Chromaticity Coordinate Limits[a] for New Sheeting

Color	1		2		3		4		Limit Y (%)
	x	y	x	y	x	y	x	y	Min.
White	0.303	0.300	0.368	0.366	0.340	0.393	0.274	0.329	40
Yellow	0.479	0.520	0.446	0.483	0.512	0.421	0.557	0.442	45
Orange	0.583	0.416	0.535	0.400	0.595	0.351	0.645	0.355	25

a. The four pairs of chromaticity coordinates define the acceptable color limits when under CIE D65 illumination, in terms of the CIE 1931 Standard Colorimetric System.

2.2 Color test - Ordinary Color

Conformance to standard chromaticity (x, y) and luminance factor (Y %) requirements shall be determined by instrumental method in accordance with ASTM E 1164 on Sheeting applied to smooth aluminum test panels cut from Alloy 6061-T6 or 5052-H38. The values shall be determined on a HunterLab ColorFlex 45/0 spectrophotometer. Calculations shall be performed using CIE Illuminant D65 and the 2° standard observer.[1]

2.3 Color test - Fluorescent Color

Conformance to standard chromaticity (x, y) and luminance factor (Y %) requirements should be determined by instrumental method in accordance with ASTM E 991 on Sheeting applied to smooth aluminum test panels cut from Alloy 6061-T6 or 5052-H38. The values shall be determined on a HunterLab ColorFlex 45/0 spectrophotometer. Computations shall be done using CIE Illuminant D65 and the 2° standard observer.[1]

2.4 Coefficient of Retroreflection

Table 3 presents the minimum coefficients of retroreflection, R_A, for new Series 3910 Sheeting, expressed in candelas per lux per square meter ($cd/lux/m^2$).

Table 3. Minimum Coefficient of Retroreflection, R_A, Values for Series 3910 Sheeting, ($cd/lux/m^2$)

Color	Observation Angle[a]	Entrance Angle[b]		
		-4°	30°	45
White	0.1	1000	600	180
	0.2	550	300	130
	0.5	200	100	50
	1.0	15	10	7.5
Fluorescent Yellow	0.1	450	180	150
	0.2	300	120	100
	0.5	135	51	40
	1.0	15	10	7.5
Fluorescent Orange	0.1	375	200	50
	0.2	200	120	40
	0.5	80	50	30
	1.0	10	7.5	5

a. Observation (Divergence) Angle - The angle between the illumination axis and the observation axis.
b. Entrance (Incidence) Angle - The angle from the illumination axis to the retroreflector axis. The retroreflector axis is an axis perpendicular to the retroreflective surface.

1. The instrumentally determined color values of retroreflective sheeting can vary significantly depending on the make and model of colorimetric spectrophotometer as well as the color and retroreflective optics of the sheeting (David M. Burns and Timothy J. Donahue, Measurement Issues in the Color Specification of Fluorescent Retroreflective Materials for High Visibility Traffic Signing and Personal Safety Applications, Proceedings of SPIE: Fourth Oxford Conference on Spectroscopy, 4826, pp. 39-49, 2003). For the purposes of this document, the HunterLab ColorFlex 45/0 spectrophotometer shall be the reference instrument.

2.5 Test for Coefficient of Retroreflection

Conformance to coefficient of retroreflection requirements are to be determined instrumentally, in accordance with ASTM E-810 “Test Method for Coefficient of Retroreflection Sheeting.”

3 Physical Properties

3.1 Interlocking Diamond Seal Pattern

Diamond Grade sheeting is differentiated from other prismatic or encapsulated lens sheeting by the distinctive seal pattern in the sheeting. Under normal light, this seal pattern will appear lighter in color than the reflective portion, as illustrated in Figure 1.

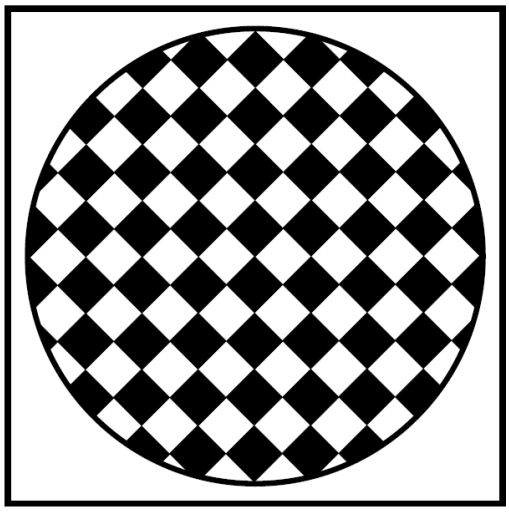

Figure 1. An enlarged illustration of the Interlocking diamond seal pattern enlarged.

3.2 Tooling Lines

The manufacturing process of prismatic sheeting results in tooling lines. In Diamond Grade sheeting these lines are slightly thicker than the seal pattern legs and occur across the web, as shown in Figure 2. Tooling lines are more pronounced under shop light but cannot be seen on the road either under daylight or at night time typical use conditions (see).

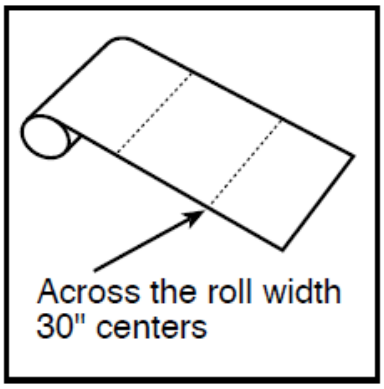

Figure 2. Tooling Lines.

4 Recommended Substrates & Application Procedures

Series 3910 Sheeting has been designed for application to clean polyethylene-based work zone devices such as drums, tubes, and posts. Polyethylene substrates must be properly flame-treated or corona-treated before Sheeting application (see 3M Information Folder 3.3 for information on substrate preparation). Application of Series 3910 Sheeting to plasticized polyvinyl chloride (PVC) devices is NOT recommended.

The application temperature (and substrate temperature) should exceed 60°F (15°C), and the Sheeting must be applied with firm pressure using a plastic squeegee or rubber roller.

Note: Care must be taken to avoid misalignment of Sheeting during application. Series 3910 Sheeting will flex minimally and unusual stretching may cause minor wrinkles. These wrinkles do not affect product performance. Sheeting should be overlapped at splices by ½”-1”.

5 Process Colors

Series 3910 Sheeting may be screen processed, before or after mounting on a substrate, using 3M Process Colors Series 990. Series 990 process colors must be clear coated with 4430R clear coat after the ink has been allowed to air dry for three hours. Unprocessed Sheeting and Sheeting processed only with opaque black do not need to be clear coated. For screen processing, use a P. E. 157 screen mesh and a fill pass. See 3M Information Folder 1.8 for details.

6 Storage, Packaging, and Cleaning

Series 3910 Sheeting should be stored in a cool, dry area, preferably at a temperature of 65-75°F (18-24°C) and a relative humidity 30-50%, and should be applied within two years of manufacture. Rolls should be stored horizontally in their shipping cartons. Partially used rolls should be returned to their shipping cartons or suspended horizontally from rods or pipes through their cores. Devices such as drums should be stored or shipped in vertical stacks to avoid scuffing.

Sheeting that requires cleaning should be flushed with water, then washed with a detergent solution and soft bristle brush or sponge. Avoid pressure that may damage the materials. Flush Sheeting with water following washing. Do not use solvents to clean Sheeting. See 3M Information Folder 1.10 for further details.

7 Durability

The durability of Series 3910 Sheeting depends upon many factors including, but not limited to, substrate selection and preparation, compliance with recommended application procedures, geographic area, exposure conditions, and maintenance. The user is responsible for determining if the Sheeting is suitable for the intended use when applied to a chosen substrate or device. Application to improperly prepared, excessively rough or non-weather resistant surfaces, and exposure to severe or unusual conditions can reduce Sheeting durability.

The purchaser should select a suitable test for determining the durability of the Sheeting when applied to a chosen device or substrate. For reboundable substrates, the test should incorporate the plastic manufacturer’s procedure for testing the impact resistance of the reboundable plastic traffic control device.

8 Health and Safety Information

Read all health hazard, precautionary, and first aid statements found in the Safety Data Sheets (SDS) and Article Information Sheets for important health, safety, and environmental information. To obtain SDSs and Article Information Sheets for 3M products, go to 3M.com/SDS, contact 3M by mail, or for urgent requests call 1-800-364-3577.

9 3M Warranty

The basic warranty and any applicable additional warranty are collectively referred to as the "3M Warranty."

10 3M Basic Warranty and Limited Remedy

Sheeting is warranted to be free of defects in materials and manufacture, and to meet the specifications stated in this product bulletin at the time of shipment ("3M Basic Warranty"). If the Sheeting is proven not to have met the 3M Basic Warranty on its shipment date, then a buyer's exclusive remedy, and 3M's sole obligation, at 3M's option, will be refund or replacement of the Sheeting.

10.1 Additional Warranty

3M makes the Additional Warranty (as defined below) regarding traffic control and guidance devices made with the Sheeting for use in the United States and Canada ("Device"). Any Additional Warranty is contingent on all components involved in that Additional Warranty being stored, applied, installed, and used only as 3M recommends in its Product Bulletins and Other Product Information.

3M warrants that Sheeting sold by 3M to be used as components in Devices will remain effective for its intended use for three (3) years, measured from the date of initial installation ("Installation Date"), subject to the following provisions:

Warranty Policy for Series 3910 applied to Polyethylene Traffic Control Devices

The 3M Warranty policy for Sheeting applied to polyethylene Devices is effective only following 3M OEM Certification. For 3M Certification, contact 3M Technical Service at 1-800-327-3431 extension 4.

Sheeting that has been properly applied to a polyethylene device by a 3M Certified Manufacturer/OEM, according to the instructions detailed in 3M Information Folder 3.3, may be eligible for a 3M Warranty claim if:

- The device has been officially rejected by the DOT for Sheeting performance, or
- The Sheeting demonstrates adhesion loss that compromises the retro-reflective performance of the Device.

Please contact your 3M sales representative to initiate a warranty claim. If the Sheeting is verified defective by 3M Technical Service then a buyer's exclusive remedy, and 3M's sole obligation, is that 3M will credit Sheeting, device, transportation, and labor costs for the replacement of the polyethylene Device for up to three (3) years, prorated according to the schedule set forth in Table 4:

Table 4. Cost Prorating Schedule

0-12 Months	100%
13-24 Months	66%
25-36 Months	33%
36+ Months	0%

Control charting data, as outlined under quality control in 3M Information Folder 3.3, is required for 3M Warranty consideration.

10.2 Terms and Conditions

- Sheeting must be processed and applied to a vertically-mounted (±10°) 3M recommended substrate as described in this product bulletin and in accordance with all 3M application, fabrication, and cleaning procedures provided in 3M's product bulletins, information folders (including but not limited to 3M Information Folder 4.9), and applicable technical memos (which will be furnished to the manufacturer upon request).
- Any third-party imaging or altering of the Sheeting not endorsed by 3M will void the 3M Warranty.
- A Sheeting's failure to meet the 3M Warranty must be solely the result of design or manufacturing defects in the Sheeting and not of (a) outside causes including improper storage, fabrication, handling, maintenance, or

installation; (b) use of process colors, thinners, coatings, or other chemicals not recommended by 3M; (c) use of application procedures or equipment not recommended by 3M; (d) failure of Device (e) exposure to chemicals or solvents not recommended by 3M; (f) abrasion and other physical damage; (g) snow or any other burial of the marking; (h) collisions, vandalism, or malicious mischief; or (i) an act of God.

- Sheeting buckling, wrinkling, and bubbling are not covered by the 3M Warranty.
- Sheeting loss on a Device that has been caught under a vehicle and dragged on the pavement is not covered by the 3M Warranty.
- Sheeting loss on a Device that has been repaired by a non-3M Certified manufacturer/OEM is not covered by the 3M Warranty.
- Sheeting loss on a Device that has been refurbished is not covered by the 3M Warranty.
- Sheeting loss on a Device that is cracked or split is not covered by the 3M Warranty (Sheeting is not expected to hold the device together).
- 3M reserves the right to determine the method of replacement. Replacement sheeting will carry the unexpired warranty of the Sheeting it replaces.
- Claims made under the 3M Warranty will be honored only if 3M is presented with a traceable record of the Sheeting's Installation Date, 3M is notified of a potential failure within thirty days of discovery, reasonable information requested by 3M is provided, 3M is permitted to verify the cause of the failure, and defective Devices are made available for pick up by 3M.

10.3 Disclaimer

THE 3M WARRANTY IS MADE IN LIEU OF ALL OTHER WARRANTIES OR CONDITIONS, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OR CONDITION OF MERCHANTABILITY, OR FITNESS FOR A PARTICULAR PURPOSE, OR ANY IMPLIED WARRANTY ARISING OUT OF A COURSE OF DEALING OR OF PERFORMANCE, CUSTOM, OR USAGE OF TRADE.

10.4 Limitation of Liability

Except for the limited remedy stated above, and except where prohibited by law, 3M will not be liable for any loss or damage arising from the Sheeting or any 3M product, whether direct, indirect, special, incidental, or consequential damages (including but not limited to lost profits, business, or revenue in any way), regardless of the legal theory asserted including warranty, contract, negligence, or strict liability.

11 Other Product Information

Always confirm that you have the most current version of the applicable product bulletin, information folder, or other product information from 3M's Website at http://www.3M.com/roadsafety.

12 Literature References

3M IF 1.7	Sign Base Surface Preparation
3M IF 1.8	Process Color Instructions
3M IF 1.10	Cutting, Premasking, and Prespacing
3M IF 3.3	Application Procedures for Applying 3M Reflective Sheeting to Rebounable Traffic Control Devices
3M IF 4.9	Diamond Grade™ and Flexible Prismatic Conspicuity Markings

ASTM Test Methods are available from ASTM International, West Conshohocken, PA.

For Information or Assistance
Call: 1-800-553-1380
In Canada Call:
1-800-3M HELPS (1-800-364-3577)

Internet:
http://www.3M.com/roadsafety

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.

Commercial Branding and Transportation
3M Center, Building 223-3N-30
St. Paul, MN 55144

Phone 1-800-553-1380
Web 3M.com/roadsafety