



Diamond Grade™ Flexible Work Zone Sheeting

Series 3910

For Use on Reboundable Plastic Traffic Control Devices

Product Bulletin 3910

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Replaces PB 3910 dated July 2004

Description

3M™ Diamond Grade™ Flexible Work Zone Sheeting Series 3910 is a wide angle prismatic lens reflective sheeting intended for reflectorizing reboundable traffic control devices such as polyethylene drums, posts and tubes. Series 3910 reflective sheeting is precoated with a pressure sensitive adhesive conforming to ASTM D 4956 Class 4 adhesive requirements.

Fluorescent orange (3914) is a visible-activated fluorescent reflective sheeting as defined in ASTM E991.

Series 3910 is available in the following colors:

<u>Product No.</u>	<u>Color</u>
3910	White
3914	Fluorescent Orange

Photometrics

Daytime Color (x,y,Y)

The chromaticity coordinates and luminance factor of the retroreflective sheeting conform to Table A below.

Color Test – Fluorescent Color

Conformance to standard chromaticity (x, y) and luminance factor (Y %) requirements shall 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 for CIE Illuminant D65 and the 2° standard observer.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. Computations shall be done for CIE Illuminant D65 and the 2° standard observer.²

²The 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 referee instrument.

Table A - CIE Chromaticity Coordinate Limits¹ and Luminance Factor Minimum

Color	1		2		3		4		Luminance Factor
	<u>x</u>	<u>y</u>	<u>x</u>	<u>y</u>	<u>x</u>	<u>y</u>	<u>x</u>	<u>y</u>	<u>Min.</u>
White	.305	.305	.355	.355	.335	.375	.285	.325	40
Fluorescent Orange	.506	.404	.562	.350	.645	.355	.570	.429	30

¹The four pairs of chromaticity coordinates define the acceptable color limits for CIE D65 illumination in terms of the CIE 1931 Standard Colorimetric System.

Coefficients of Retroreflection (RA)

The values in Table C are minimum coefficients of retroreflection expressed in candelas per lux per square meter (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 for Coefficient of Retroreflection of Retroreflective Sheeting."

Table C
Minimum Coefficient of Retroreflection R_A
Candelas per Footcandle per Square Meter
or (cd/lux/m²)

3910 White

Observation ³ Angle	Entrance Angle ⁴		
	-4°	30°	45°
0.1	1000	600	180
0.2	550	300	130
0.5	200	100	50
1.0	12	15	15

3914 Fluorescent Orange

Observation ³ Angle	Entrance Angle ⁴		
	-4°	30°	45°
0.1	375	200	50
0.2	200	120	40
0.5	80	50	30
1.0	10	10	10

³ Observation (Divergence) Angle – The angle between the illumination axis and the observation axis.

⁴ Entrance (Incidence) Angle – The angle from the illumination axis to the retroreflector axis. The retroreflector axis is an axis perpendicular to the retroreflective surface.

Recommended Substrates & Application Procedure

Series 3910 sheeting is designed for application to clean polyethylene-based work zone devices such as drums, tubes, and posts. The polyethylene substrate must be properly flame-treated or corona treated before sheeting application (see Information Folder 3.3 for 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 exercised to avoid misalignment during application. This sheeting will flex minimally and unusual stretching may cause minor wrinkles. These wrinkles do not affect product performance. Overlap splicing between 1/2 to 1 inch is recommended.

Process Colors

3M™ Diamond Grade™ Flexible Work Zone Sheeting Series 3910 may be screen processed before or after mounting on a substrate using 3M™ Process Colors Series 990. Series 990 must be clear coated with 4430R clear coat after the Series 990 inks air dry for three hours.

Unprocessed sheeting and sheeting processed only with opaque black need not be clear coated. For screen processing use PE157 screen mesh and a fill pass. See Information Folder 1.8 for details.

Resistance to Accelerated Weathering

The retroreflective surface of the sheeting is weather resistant and should show no appreciable cracking, blistering, crazing, edge lifting or curling, or dimensional change of more than 1/32 inch (0.08cm) after one year's unprotected outdoor exposure, south facing and inclined 45° from the vertical. Following weather exposure, panels shall be washed in a 5% HCL solution for 45 seconds, rinsed thoroughly with clean water, blotted with a soft clean cloth and brought to equilibrium at standard conditions. After cleaning, the coefficient of retroreflection shall not be less than 50% of the values in Table C. The chromaticity is expected to conform to the requirements of Table A for weathered sheeting. Where more than one panel of a color is measured, the coefficient of retroreflection will be the average of all determinations.

Optical Stability

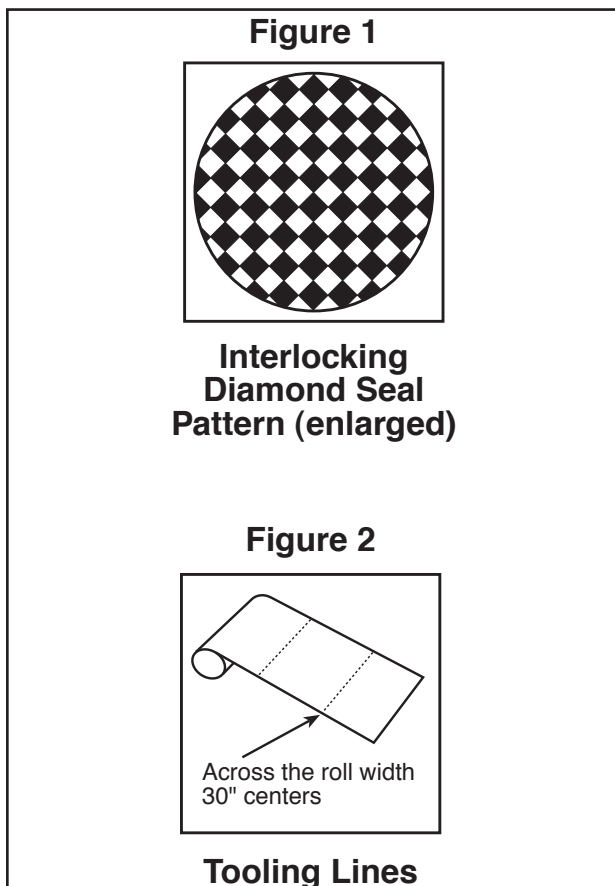
To measure optical stability the retroreflective sheeting should be conditioned for 24 hours and exposed to $160 \pm 5^\circ\text{F}$ ($71 \pm 3^\circ\text{C}$) for 24 hours in an air circulating oven. After heat exposure the sheeting should retain between 80% to 120% of the minimum coefficient of retroreflection in Table C.

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 (see Figure 1).

Tooling Lines

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



Test Methods for Adhesive and Film Properties

A. Conditioning

All measurements are performed on test specimens which have been conditioned for 24 hours at $73^\circ\text{F} \pm 2^\circ\text{F}$ ($23^\circ\text{C} \pm 1^\circ\text{C}$) and $50\% \pm 4\%$ relative humidity before testing. This condition is maintained during the test.

B. Standard Test Panel and Application

Unless otherwise specified, the reflective sheeting shall be applied according to Information Folder 1.7 to smooth, 0.040 inch (0.10 cm) 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 test and tape snap test as described in Information Folder 1.7.

1. Adhesion

Test Weight – 1-3/4 lbs. (0.8 kg)

Test Method – Apply 4 inches (10 cm) of 1 x 6 inch (2.54 x 15 cm) strip to the test panel and condition. Face panel down and suspend test weight from free end.

Requirement – Not more than 2 inches (5.0 cm) of peel in 5 minutes.

2. Impact Resistance

Test Method – Apply sheeting to a standard panel 3 x 6 inch (7.6 x 15.2 cm) with a thickness of .040 inch (.10 cm), and condition. Subject sheeting to a 100 inch/pounds (11.3 Nm) impact using a 5/8 inch (1.6 cm) diameter rounded tip in accordance with ASTM D-2794.

Requirement – No separation from panel or cracking outside immediate impact area, when tested at 32°F (0°C) and 73°F (23°C).

3. Shrinkage

Test Method – Following conditioning of 9 x 9 inch samples, remove liner, place specimen on flat surface with adhesive side up.

Requirement – Shrinkage not greater than 1/32 inch (0.8 mm) in 10 minutes, or more than 1/8 inch (3.2 mm) in 24 hours in any dimension.

4. Flexibility

Test Method – Following conditioning of 1 x 6 inch sample, remove liner and dust adhesive with talc. At standard conditions, bend in one second around 1/8 inch (3.2 mm) mandrel with adhesive side facing mandrel.

Requirement – No cracking, peeling, or delamination.

5. Gloss

Test Method – Test in accordance with ASTM D523 using an 85° glossmeter.

Requirement – Rating not less than 50.

Cleaning

Sheetings 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 materials. Flush with water following washing. Do not use solvents to clean sheeting. See Information Folder 1.10.

Storage and Packaging

Series 3910 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 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.

Devices such as drums should be stored or shipped vertically stacked to avoid scuffing during shipment.

Health and Safety Information

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

General Performance Considerations

The durability of 3M™ Diamond Grade™ Work Zone Sheeting Series 3910 will depend 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 must determine the suitability of this material on any specific substrate for its intended use. Applications on unprimed, excessively rough or non-weather resistant surfaces, some plastics, or exposure to severe or unusual conditions can reduce the durability of such applications.

Warranty

3M warrants that 3M™ Diamond Grade™ Flexible Work Zone Sheeting Series 3910 sold by 3M to be used as components for traffic control devices in the United States and Canada will remain effective for its intended use for three years, subject to the following provisions:

Warranty Policy⁵ for Series 3910 applied to Polyethylene Traffic Control Devices

3M Series 3910 Sheeting that has been properly applied⁶ by a 3M Certified Manufacturer/OEM⁵ to a polyethylene device may be eligible for a warranty claim if:

- The device has been officially rejected by the DOT for sheeting performance **or**,
- Series 3910 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, 3M will credit a prorated amount of the reflective sheeting, device, transportation, and labor for replacement of the polyethylene device for up to 3 years, as set forth below:

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

Control charting data as outline under quality control in Information Folder 3.3 will be required for warranty consideration.

Note: All defective devices covered under this policy must be:

- Marked with sheeting application date.
- Available for pick up by 3M.

Conditions

Such failure must be solely the result of design or manufacturing defects in the 3M Diamond Grade flexible work zone sheeting and not of outside causes such as: improper fabrication, handling, maintenance or installation; use of process colors, thinners, coatings, or overlay films and sheetings not made by 3M; use of application equipment not recommended by 3M; failure of device; exposure to chemicals, abrasion and other damage; collisions, vandalism or malicious mischief.⁷

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 this warranty will be honored only if 3M is notified of a failure within a reasonable time, reasonable information requested by 3M is provided, and 3M is permitted to verify the cause of the failure.

⁵The warranty policy is effective following 3M OEM Certification. For 3M Certification, contact 3M Technical Service at 1-800-553-1380 extension 41.

⁶Please refer to 3M Information Folder 3.3.

⁷The following are not covered:

- Sheeting buckles, wrinkles or bubbles.
- Sheeting loss on a device that has been caught under a vehicle and dragged on the pavement.
- Sheeting loss on a device that has been repaired by a non-3M Certified manufacturer/OEM.
- Sheeting loss on a device that has been refurbished.
- Sheeting loss on a device that is cracked or split (sheeting is not expected to hold the device together).

Limitation of Liability and Remedies

3M's liability under this warranty is limited to replacement or allowance as stated herein, and 3M assumes no liability for incidental or consequential damages such as lost profits, business or revenue in any way related to the product regardless of the legal theory on which the claim is based.

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

Literature Reference

- IF 1.7 Sign Base Surface Preparation
- IF 1.8 Color Application Instructions
- IF 1.10 Cutting, Matching, Premasking and Prespacing Instructions
- IF 3.3 Application Procedures for Applying 3M Reflective Sheeting to Rebounable Traffic Control Devices

FOR INFORMATION OR ASSISTANCE

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1-800-553-1380**

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1-800-887-3238**

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