



# Diamond Grade™ Flexible Work Zone Sheeting

Series 3910

For Use on Reboundable Plastic Traffic Control Devices

Product Bulletin 3910

September 2013

Replaces Product Bulletin 3910 dated September 2007

## 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 is precoated with a pressure sensitive adhesive conforming to ASTM D 4956 Class 1 adhesive requirements. Fluorescent yellow (3911) and fluorescent orange (3914) are visible-activated fluorescent reflective sheetings as defined in ASTM E991.

Series 3910 is available in the following colors:

Product No.	Color
3910	White
3911	Fluorescent Yellow
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 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 for CIE Illuminant D65 and the 2° standard observer.<sup>2</sup>

### 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.<sup>2</sup>

<sup>2</sup>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 referee instrument.

**Table A- CIE Chromaticity Coordinate Limits<sup>(1)</sup> and Luminance Factor Minimums**

Color	1		2		3		4		Luminance Factor Min.
	x	y	x	y	x	y	x	y	
White	.303	.300	.368	.366	.340	.393	.274	.329	40
Fluorescent Yellow	.479	.520	.446	.483	.512	.421	.557	.442	45
Fluorescent Orange	.583	.416	.535	.400	.595	.351	.645	.355	25

<sup>(1)</sup>The four pairs of chromaticity coordinates define the acceptable color limits for CIE D65 illumination in terms of the CIE 1931 Standard Colorimetric System.

**Photometrics  
(continued)**

**Coefficients of Retroreflection (R<sup>λ</sup>)**

The values in Table B are minimum coefficients of retroreflection expressed in candelas per lux per square meter (cd/lux/m<sup>2</sup>).

**Test for Coefficients of Retroreflection**

Conformance to coefficient of retroreflection requirements should be determined by instrumental method in accordance with ASTM E-810 “Test Method for Coefficient of Retroreflection of Retroreflective Sheeting.”

**Table B**  
**Minimum Coefficient of Retroreflection R<sub>A</sub>**  
**Candelas per Footcandle per Square Meter**  
**or (cd/lux/m<sup>2</sup>)**

3910 White

Observation <sup>3</sup> Angle	Entrance Angle <sup>4</sup>		
	-4°	30°	45°
0.1	1000	600	180
0.2	550	300	130
0.5	200	100	50
1.0	15	10	7.5

3911 Fluorescent Yellow

Observation <sup>3</sup> Angle	Entrance Angle <sup>4</sup>		
	-4°	30°	45°
0.1	450	180	150
0.2	300	120	100
0.5	135	51	40
1.0	15	10	7.5

3914 Fluorescent Orange

Observation <sup>3</sup> Angle	Entrance Angle <sup>4</sup>		
	-4°	30°	45°
0.1	375	200	50
0.2	200	120	40
0.5	80	50	30
1.0	10	7.5	5

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

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

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**Recommended  
Substrates &  
Application Procedure**

3M™ Diamond Grade™ Flexible Work Zone Sheeting 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 a half inch to one inch is recommended.

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**Process Colors**

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 do not need to be clear coated. For screen processing use PE157 screen mesh and a fill pass. See Information Folder 1.8 for details.

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**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).

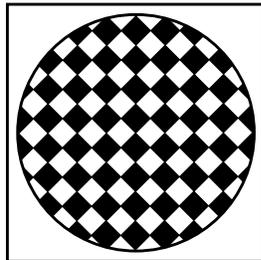
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**Tooling Lines**

The manufacturing process of prismatic sheeting requires tooling lines. In Diamond Grade sheeting these lines are slightly thicker than the seal pattern legs 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).

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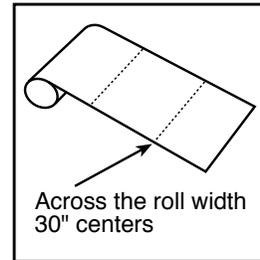
**Figure 1**



Interlocking Diamond Seal  
Pattern (enlarged)

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**Figure 2**



Tooling Lines

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**Adhesive and Film Properties****Standard Test Panels**

Unless otherwise specified herein, sheeting should be applied to test panels and conditioned in accordance with ASTM D4956 and test methods and conditions should conform to ASTM D4956.

**Properties**

The following properties should conform to the requirements in ASTM D4956.

1. **Adhesion**
2. **Outdoor weathering**
  - retained coefficient of retroreflection
  - colorfastness
3. **Shrinkage**
4. **Flexibility**
5. **Liner removal**
6. **Impact resistance**
7. **Night time color**

In addition, Series 3910 sheeting will conform to the following properties.

**1. Gloss**

**Test Method** - Test in accordance with ASTM D523 using a 60° glossmeter.

**Requirement** - Rating not less than 50.

**2. Optical Stability**

**Test Method** - Apply a 3 inch x 6 inch sample to a test panel. Measure  $R_A$  then place it in an oven at  $71^\circ\text{C} \pm 3^\circ\text{C}$  ( $160^\circ\text{F} \pm 5^\circ\text{F}$ ) for 24 hours followed by conditioning at standard conditions for 2 hours.

**Remeasure  $R_A$ .**

**Requirement** - The sheeting shall retain a minimum of 85% and a maximum of 115% of the original coefficient of retroreflection.

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**Cleaning**

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

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**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.

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**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.

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**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.

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**3M Basic Product  
Warranty and Limited  
Remedy**

3M™ Diamond Grade™ Flexible Work Zone Sheeting Series 3910 (“Product”) is warranted to be free of defects in materials and manufacture at the time of shipment and to meet the specifications stated in this Product Bulletin. If the product is proven not to have met the Basic Warranty on its shipment date, then a buyer’s exclusive remedy, and 3M’s sole obligation, at 3M’s option, will be refund replacement of the sheeting.

**General Warranty Terms**

1. 3M makes the Additional Warranty (as defined below) as to any traffic control and guidance in the United States and Canada (“device”) made with 3M™ Diamond Grade™ Flexible Work Zone Sheeting Series 3910 (“Product”). 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.

2. The Basic Warranty and any applicable Additional Warranty are collectively referred to as the “3M Warranty.” EXCEPT TO THE EXTENT PROHIBITED BY APPLICABLE LAW, THE 3M WARRANTY IS MADE IN LIEU OF ALL OTHER WARRANTIES, RIGHTS OR CONDITIONS, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND THOSE ARISING FROM A COURSE OF DEALING, CUSTOM OR USAGE OF TRADE. A BUYER IS RESPONSIBLE FOR DETERMINING IF A PRODUCT IS SUITABLE FOR ITS PARTICULAR PURPOSE AND APPLICATION METHODS.

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**Additional Warranty  
and Limited Remedy**

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 Policy<sup>5</sup> for Series 3910 applied to Polyethylene Traffic Control Devices**

Series 3910 that has been properly applied<sup>6</sup> by a 3M Certified Manufacturer/OEM<sup>7</sup> 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 then a buyer’s exclusive remedy, and 3M’s sole obligation, is that, 3M will credit a prorated amount of the reflective sheeting, device, transportation, and labor for replacement of the polyethylene device for up to three years, as set forth below:

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

Control charting data as outlined 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.

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**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 sheeting not recommended in this bulletin or not made by 3M; use of application equipment not recommended by 3M; failure of device; exposure to chemicals, abrasion and other damage; snow burial or any other device burial; collisions, vandalism or malicious mischief.<sup>7</sup>

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.

<sup>5</sup>The warranty policy is effective following 3M OEM Certification. For 3M Certification, contact 3M Technical Service at 1-800-553-1380 extension 4.

<sup>6</sup>Please refer to 3M Information Folder 3.3.

<sup>7</sup>The 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).

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**Warranty  
(continued)****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.

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**Literature Reference**

- |                         |   |
|-------------------------|---|
| Information Folder 1.7  | Sign Base Surface Preparation   |
| Information Folder 1.8  | Color Application Instructions  |
| Information Folder 1.10 | Cutting, Matching, Premasking and<br>Prespacing Instructions  |
| Information Folder 3.3  | Application Procedures for Applying<br>3M Reflective Sheeting to Reboundable<br>Traffic Control Devices |

**FOR INFORMATION OR ASSISTANCE  
CALL: 1-800-553-1380**

**In Canada Call:  
1-800-265-1840**

**Internet: [www.3M.com/roadwaysafety](http://www.3M.com/roadwaysafety)**

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 contained herein are based on tests we believe to be reliable, but the accuracy or completeness thereof is not guaranteed, and the following is made in lieu of all warranties, or conditions express or implied. Seller's and manufacturer's only obligation shall be to replace such quantity of the product proved to be defective. Neither seller nor manufacturer shall be liable for any injury, loss or damage, direct, special or consequential, arising out of the use of or the inability to use the product. Before using, user shall determine the suitability of the product for his/her intended use, and user assumes all risk and liability whatsoever in connection therewith. Statements or recommendations not contained herein shall have no force or effect unless in an agreement signed by officers of seller and manufacturer.

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