



# Fluorescent Orange Prismatic Work Zone Sheeting Series 3924S Sheeting With Pressure Sensitive Adhesive

**Product Bulletin 3924S**

**February 2012**

Replaces PB 3924S dated Oct. 2007

## Description

3M™ Fluorescent Prismatic Reflective Sheeting Series 3924S is a microprismatic retroreflective sheeting designed for the production of durable traffic control signs for the work zone. The sheeting consists of prismatic lenses formed in a transparent resin, sealed, and backed with a pressure-sensitive adhesive and poly liner. Applied to properly prepared sign substrates, 3924S will provide long term service.

The pressure sensitive sheeting is available in roll widths up to 48 inches in a fluorescent orange work zone color.

Color	Product Code
Fluorescent Orange	3924S

## Photometrics

### Daytime Color (x,y,Y)

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

## Color Test – Fluorescent Sheetings

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.<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.

## Coefficients of Retroreflection (RA)

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

**Table A - CIE Daytime Chromaticity Coordinate Limits<sup>1</sup>**

Color	1		2		3		4		Luminance Factor Y (%) Min.
	x	y	x	y	x	y	x	y	
Orange	.583	.416	.535	.400	.595	.351	.645	.355	25

<sup>1</sup>The four pairs of chromaticity coordinates determine the acceptable color in terms of the CIE 1931 Standard Colorimetric System.

## 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” and per E-810 the values of 0° and 90° rotation are averaged to determine conformance to the  $R_A$  limits in Table B.

**Table B - Minimum Coefficient of Retroreflection  $R_A$  for new fluorescent sheeting (cd/lux/m<sup>2</sup>)**

-4° Entrance Angle <sup>3</sup>	Observation Angle <sup>2</sup>	
	0.2°	0.5°
	Orange	230
30° Entrance Angle <sup>3</sup>	Observation Angle <sup>2</sup>	
	0.2°	0.5°
	Orange	130

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

<sup>3</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.

## Adhesive

Series 3924S sheeting has a pressure-sensitive adhesive that is recommended for room temperature application. Room temperature application is defined as 60°F (16°C) or higher.

## Adhesive and Film Properties

### Standard Test Panels

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

### Properties

The following properties shall 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, 3924S 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° C ± 3° C (160°F ± 5°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.

## Sign Fabrication Methods

### Application

Series 3924S incorporates a pressure-sensitive adhesive and should be applied to the sign substrate at room temperature (60°F/16°C) or higher by any of the following methods:

Mechanical squeeze roll applicator - IF 1.4

Hand squeeze roll applicator - IF 1.6

\*Note - never direct the Calrod™ heater at the sheeting during application. If the heater is needed to warm to the minimum application temperature of 60°F, direct it at the substrate only.

### Hand Application

Hand application is recommended for legend and copy only. Refer to 3M Information Folder 1.5 for more details.

Hand applications will show some visual irregularities, which are objectionable to aesthetically critical customers. To obtain a close-up uniform appearance, a roll laminator must be used.

### Splices

Series 3924S sheeting must 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. This is to prevent buckling as the sheeting expands in extreme temperature and humidity exposure.

## Substrates

For traffic sign use, substrates found to be most reliable and durable are properly prepared aluminum sheets and extrusions. Users are urged to carefully evaluate all other substrates for adhesion and sign durability. Other substrates that may be satisfactory for proper application of sheeting will have the following characteristics:

- Clean
- Smooth
- Flat
- Rigid
- Dimensionally stable
- Weather resistant
- Non-porous
- High surface energy (passes water break test)

Refer to Information Folder 1.7 for surface preparation recommendations. Substrates with low surface energy such as polyethylene and other plastics will require additional preparation such as flame treatment (preferred), mechanical abrasion or use of adhesion promoters prior to sheeting application. Flat panels are to be carefully trimmed so that sheeting from adjacent panels does not touch on assembled signs.

3924S sheeting is designed primarily for applications 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 required; however, this product has a universal adhesive and can be used on plastic (flame treated) substrates. Sign failures caused by the substrate or improper surface preparation are not the responsibility of 3M.

## Imaging

Series 3924S sheeting may be processed into traffic signs by any of the imaging methods described below. 3M assumes no responsibility for failure of sign face legends or backgrounds that have been processed with non-3M process colors or imaging materials other than those listed below.

### Screen Processing

Series 3924S sheeting may be screen processed into traffic signs before or after mounting on a sign substrate, using 3M Process Colors Series 880I or Series 880N. Series 880I or 880N process colors can be screened at 60-100°F (16-38°C) at relative humidity of 20-50%. A PE 157 screen mesh with a fill pass is recommended. See Information Folder 1.8 for details. No clear coating is required and is not recommended. Use of other process colors series is not recommended. **Care should be taken to avoid flexing Series 3924S sheeting before and**

**especially after screening to eliminate the possibility of cracking from improper handling techniques.**

### 3M™ ElectroCut™ Film

3M™ ElectroCut™ Film 1175 black may be used to provide copy for traffic control signs on 3924S sheeting. Refer to Product Bulletin 1170 for fabrication procedures.

### Vinyl Graphic Films

Scotchcal™ Vinyl Series 3650, Series 7720 and Series 7725 may be used to provide copy for traffic control signs on 3924S sheeting. Refer to Scotchcal™ product literature for more information.

### Latex Ink Jet Printing

Series 3924S sheeting may be imaged with HP 789 series black latex ink in conjunction with the HP Designjet L25500 Printer, or with 792 series black latex ink in conjunction with the HP Designjet L26500 Printer. Refer to Information Folder 3.4 for more information.

**Note:** With the exception of 3M branded products, 3M does not represent that any printer or printer accessory recommended in 3M literature will meet customer requirements, any federal, state or local regulations or any applicable safety standards. Such determination is the responsibility of the printer owner.

## Cutting

3924S sheeting may be cut into letters and shapes of at least 3 inches in height and stroke widths of at least 1/2 inch. Smaller sizes are not recommended. Sealing cut edges of 3924S sheeting is not required.

### Plotter Cutting

Programmable knife cut (electronic cutting)

1. Flat bed plotters can either die cut or kiss cut and offer the most consistently reliable performance.
2. Friction Fed plotter. Kiss cut only. Success has been achieved using plotters that have 600 grams of down force and a 60° cutting blade. Additional drive wheels may need to be added to improve tracking. An alternative procedure is to cut sheeting from the liner side. Blade force and knife depth must be set to score but not cut through the topfilm. Break apart individual copy or apply premask to retain spacing.

### Other Cutting Methods

3924S sheeting may be hand cut or die cut one sheet at a time, and band sawed or guillotined in stacks. 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 3924S sheeting is 1 ½ inch or 50 sheets. Details on cutting can be found in Information Folder 1.10.

## Cleaning

Signs 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 sign face. Flush with water following washing. Do not use solvents to clean signs. Refer to Information Folder 1.10.

## Storage and Packaging

Series 3924S 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. Unprocessed sheets should be stored flat. Finished signs and applied blanks should be stored on edge.

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

Unmounted screened or printed 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. Refer to Information Folder 1.11 for instructions on packing for storage and shipment.

## Installation

Nylon washers are required when twist style fasteners are used to mount the sign.

## General Performance Considerations

The durability of 3924S sheeting and finished signs using 3M Matched Component materials will depend upon substrate selection and preparation, compliance with recommended application procedures, geographic area, exposure conditions, and maintenance. Maximum durability of 3924S sheeting can be expected in applications subject to vertical exposure on stationary objects when processed and applied to properly prepared

aluminum according to 3M recommendations provided in Information Folder 1.7. The user must determine the suitability of any nonmetallic sign backing for its intended use. Sign failures caused by the substrate or improper surface preparation are not the responsibility of 3M. Applications to unprimed, excessively rough or non-weather resistant surfaces or exposure to severe or unusual conditions can shorten the performance of such applications. Signs in mountainous areas that are covered by snow for prolonged periods may also have reduced durability. Atmospheric conditions in certain geographic areas may result in reduced durability.

3M has tested the HP Designjet Printers and black latex inks: L25500 printer/series 789 black ink, and L25600 printer/series 792 black ink; and when applied within parameters defined in IF 3.4 the resulting sign performance is considered to be commensurate with typically expected sign life. However, this imaging system is not covered as part of the 3M Matched Component system noted in the General Warranty Terms.

## 3M Basic Product Warranty and Limited Remedy

3M™ Fluorescent Work Zone Sheeting Series 3924S (“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 3924S Sheeting 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 or replacement of the sheeting.

## General Warranty Terms:

1. 3M makes the Additional Warranty (as defined below) as to any traffic control and guidance sign in the United States and Canada (“Sign”) made with 3M™ Fluorescent Work Zone Sheeting Series 3924S (“Product”) and the Matched Component materials listed in Table D. 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.

3. A Sign’s failure to meet the 3M Warranty must be solely the result of the Product or the matched component materials’ design or manufacturing defects. 3M has no obligation under the 3M Warranty if a sign failure is caused by:

improper fabrication, handling, maintenance or installation; non-vertical applications where the Sign face is more than +/- 10% from vertical; use of any material or product not made by 3M or not included in Table D; use of application equipment not recommended by 3M; failure of sign substrate; loss of adhesion due to incompatible or improperly prepared substrate; exposure to chemicals, abrasion and other mechanical damage; snow burial or any other sign burial; collisions, vandalism or malicious mischief.

4. 3M reserves the right to determine the method of replacement, and any replacement Product will have the remainder of the original Product’s unexpired 3M Warranty. Claims made under this warranty will be honored only if

– The Sign was dated upon completion of fabrication

(“Fabrication Date”) using a permanent method (sticker, permanent marker or crayon, metal stamp, etc.)

– 3M is notified of a 3M Warranty claim during any applicable Warranty Period and the owner or fabricator provides the information reasonably required by 3M to verify if a 3M Warranty is applicable.

### Additional Warranty and Limited Remedy

1. The Additional Warranty for a Sign made with the Product is that the Sign will: (a) remain effective for its intended use when viewed from a moving vehicle under normal day and night driving conditions by a driver with normal vision, and (b) after cleaning, will meet the minimum values for coefficient of retroreflection stated in Table C for three years measured from the Sign’s Fabrication Date.

- $R_A$  shall be measured per ASTM E810.

- All measurements shall be made after cleaning according to 3M recommendations.

2. If any Sign made with the Product is proven not to have met the Additional Warranty, then a buyer’s exclusive remedy, and 3M’s sole obligation, at 3M’s option, is that 3M will provide pro-rated replacement of the 3M materials.

**Table C**  
**Minimum Coefficient of Retroreflection and Luminance Factors**  
(All measurements shall be made after cleaning according to 3M recommendations)

	Minimum Coefficient of Retroreflection ( $R_A$ ) cd/lux/m <sup>2</sup> at -4° Entrance Angle		Minimum Luminance Factor (Y)
Color	Observation Angle	$R_A$	%
Orange	0.2	115	25

**Table D. Matched Component Materials.**

Matched Components	
Process Colors	Series 880I
Process Colors	Series 880N
ElectroCut™ Film	Series 1170
3M Scotchcal™ Black Vinyl Film	Series 3650, 7720, 7725
Slipsheet	SCW 568
Prespacing Tape	SCPS-2
Premasking Tape	SCPM-3
Transfer Tape	TPM-5

Refer to 3M Information Folders and Product Bulletins for detailed information about recommended application procedures and equipment.

## 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 any materials prior to handling or use.

## Other Product Information

**Always confirm that you have the most current version of the applicable Product Bulletin, Information Folder or Other Product Information.**

<b>IF 1.4</b>	Instructions for Interstate Squeeze Roll Applicator
<b>IF 1.5</b>	Hand Application Instructions
<b>IF 1.6</b>	Hand Squeeze Roll Applicator
<b>IF 1.7</b>	Sign Base Surface Preparation
<b>IF 1.8</b>	Process Color Application Instructions
<b>IF 1.10</b>	Cutting, Premasking, and Prespacing
<b>IF 1.11</b>	Sign Maintenance Management
<b>PB 880I</b>	Process Color 880I
<b>PB 880N</b>	Process Color 880N
<b>PB 1170</b>	ElectroCut™ Film
<b>IF 3.4</b>	Ink Jet Imaging with HP Designjet L25500 Printer and HP 789 Series latex Inks

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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