

# 3M Diamond Grade™ Roll Up Sign Sheeting

Series RS20/RS24

Product Bulletin RS20/RS24

December 2007

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## Description

3M™ Diamond Grade™ Roll Up Sign Sheeting Series RS20/RS24 is a visible light-activated fluorescent wide angle prismatic lens reflective sheeting designed for the production of roll up traffic control signs used in construction work zones.

This sign sheeting is designed to provide higher nighttime sign brightness than sheetings that use glass bead lenses. RS24 sheeting has higher daytime brightness than ordinary (non-fluorescent) colored sheeting.

Series RS20/RS24 sheeting is backed with a strong, flexible, gray-coated fabric.

## Color

White  
Fluorescent Orange

## Product Code

RS20  
RS24

## Photometrics

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

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

## 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>

## Color Test – Ordinary Colored Sheeting

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>

**Table A - CIE Daytime Chromaticity Coordinate Limits<sup>1</sup> and Luminance Factor Minimum**

Color	1		2		3		4		Luminance Factor Y (%) Min.
	x	y	x	y	x	y	x	y	
White	.303	.300	.368	.366	.340	.393	.274	.329	40
Fluorescent Orange	.583	.416	.535	.400	.595	.351	.645	.355	30

<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.

<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 (R<sub>A</sub>)

The values in Table C 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 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 the R<sub>A</sub> in Table C.

**Table C**  
**Minimum Coefficient of Retroreflection**  
**R<sub>A</sub> for New Sheeting**  
**(cd/lux/m<sup>2</sup>)**

#### White

Observation <sup>1</sup> Angle	Entrance Angle <sup>2</sup>		
	-4°	30°	45°
0.2°	300	180	100
0.5°	200	75	60
1.0°	15	15	15

#### Fluorescent Orange

Observation <sup>1</sup> Angle	Entrance Angle <sup>2</sup>		
	-4°	30°	45°
0.2°	200	120	60
0.5°	120	50	30
1.0°	10	10	10

<sup>1</sup> Observation (Divergence) Angle - The angle between the illumination axis and the observation axis.

<sup>2</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.

### Orientation

3M™ Diamond Grade™ Roll Up Sign Sheeting Series RS20/RS24 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.

For purposes of test measurement of RS24 sheeting, it is important for the material to have a datum mark (the orientation arrow) 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.

### Resistance to Accelerated Weathering

The retroreflective surface of the sheeting is weather resistant and shows no appreciable cracking, blistering, crazing, edge lifting or curling, or dimensional change of more than 1/32m (0.08cm) after one year’s unprotected outdoor exposure in Florida, south facing and inclined 45° from the vertical, or after 1500 hours’ exposure in xenon arc weatherometer in accordance with ASTM G26, Type B, Method A. Wash panels following exposure 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 is expected to be not less than 50% of Table C values when measured according to ASTM E-810. The color is expected to conform to the requirements of Table B. Where more than one panel is measured, the coefficient of retroreflection will be the average of all determinations.

### Interlocking Diamond Seal Pattern

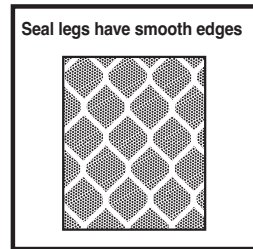
Diamond Grade sheeting is differentiated from other prismatic or encapsulated lens sheeting by the distinctive seal pattern in the sheeting. Under normal light, this seal pattern will appear lighter in color than the reflective portion (see Figure 1).

### Orientation Marks (Arrows)

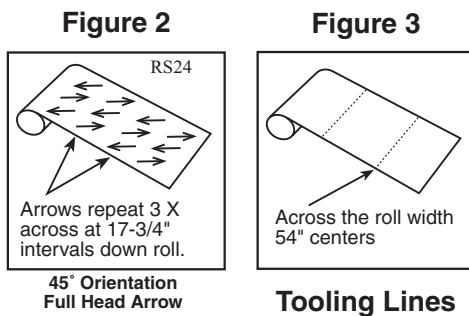
RS24 sheeting is made with small orientation (↖) arrows in the surface. These arrows point at a 45° angle. See Figure 2. The arrows assist in proper orientation of the sheeting for maximum angularity of signs (arrows point up and down). The arrows are the same color as the seal pattern and are repeated three times across a 48 inch roll and downweb at 17-3/4 inch intervals (see Figure 2). RS20 does not have orientation arrows.

## Tooling Lines

The manufacturing of a prismatic sheeting results in tooling lines being present in the product. In Diamond Grade RS20/RS24 sheeting these lines (slightly thicker than the seal pattern legs) occur across the web every 54 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).



**Figure 1** - Sheeting is positioned at 90° rotation angle.



**Note:** RS20 does not have orientation arrows.

## Test Methods of Film Properties

### A. Conditioning

1. Shrinkage, flexibility and gloss measurements are performed on new test specimens which have been conditioned for 24 hours at 73°F ± 3°F (23°C ± 1°C) and 50% ± 5% relative humidity before testing. This condition is maintained during the test.

### B. Standard Test Panel and Application

Unless otherwise specified, apply the reflective sheeting according to the manufacturer's recommendations to smooth 0.040 inch (0.10 cm) minimum thickness 6061-T6 or equivalent aluminum panels that have been degreased and lightly etched. Lack of contamination of test panels must be confirmed by passing water break test and tape snap test as described in Information Folder 3.4.

## Properties

### 1. Impact Resistance

#### Test Method

Apply Scotch™ Double Coated Tape 665 to an etched aluminum panel of Alloy 6061-T6 0.04 inch x 3 inch x 5 inch. Apply RS20/RS24 to the taped surface grey side down and condition as in A1 above. Subject sheeting to 50 inch-pounds (5.7 Nm) impact in accordance with ASTM D-2794.

#### Requirement

No separation from panel or cracking outside the immediate impact area.

### 2. Shrinkage

#### Test Method

Following conditioning of 9 inch x 9 inch samples, place specimen on flat surface with gray 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.

### 3. Flexibility

#### Test Method

Condition a 1 inch x 6 inch sample. At standard conditions, bend in one second around 1/8 inch (3.2 mm) mandrel with gray side facing mandrel.

#### Requirement

No cracking.

### 4. Gloss

#### Test Method

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

#### Requirement

Rating not less than 50

### 5. Tensile Strength

#### Test Method

Test in accordance with Federal Standard 191 Method 5100 except using a 2 inch jaw gap and a cross head speed of 6 inches/minute.

#### Requirement

Typical force values of:

- Warp Direction – 130 pounds force
- Fill Direction – 150 pounds force

## 6. Tear Resistance

### Test Method

Test in accordance with ASTM D1044 except use a cross head of 12 inches/minute.

### Requirement

Typical tear values of:

- Warp Direction – 50 pounds force
- Fill Direction – 60 pounds force

## Use

**A.** RS20/RS24 sheeting is designed for sewing or riveting corner pockets or snaps. Cross brace supports can then be used in conjunction with portable sign stands. Cross braces should not bow more than 1/2 inch when inserted. All corner pockets should be fabric, plastic or rubber. Plastic or rubber molded pockets should have rounded edges. Washers should be rubber or plastic. Metal washers should be backed with rubber or plastic washers.

## B. Process Colors

Screening Method/Thinning/Conditioning for Processing

An off contact screen process method is the preferred screening method for 3M™ Diamond Grade™ Roll Up Sign Sheeting Series RS20/RS24. The screening table must be perfectly flat. When screening Diamond Grade roll up sheets, hold the sheets in place using a vacuum table or if a vacuum table is not available, sheets can be held in place on a non-porous table surface using a thin, uniform layer of low tack pressure sensitive adhesive. The screen mesh size should be in the (PE157 -PE 230) range of monofilament fabric. Stenciling the process colors or use of other screen fabric mesh sizes may not produce satisfactory color or durability and are not recommended.

3M™ Process Color Series 1805 (black) is the only recommended ink color for Diamond Grade roll up sheeting Series RS24. For thinning Series 1805, use only CGS 50 or CGS 80 thinner. Series 1805 colors must dry for 24 hours (on drying rack) before rolling up. See Product Bulletin 1800 or call 3M Technical Services at 1-800-553-1380 extension 4-1.

3M™ Process Color Series 990 is the only recommended ink for Diamond Grade Series RS20. Series 990 ink must be used with 4430R clear ink that protects the colors from rewetting. Series 990 colors must dry a minimum of three hours before the 4430R clear coat is applied.

## D. Storage

Diamond Grade roll up sheeting should be stored in a cool, dry area, preferably at 65° to 75°F (18° to 24°C) and 30 to 50% relative humidity, and should be used within one year after purchase.

### **Unprocessed sheets should be stored flat.**

See Information folder 1.11 for details of storage and packaging. Finished roll up signs should be stored dry and rolled up properly per OEM specifications.

## Health and Safety Information

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

## General Performance Considerations

The durability of Series RS20/RS24 roll up sign sheeting will depend upon preparation, compliance with recommended application procedures, geographic area, exposure conditions, and maintenance.

## Warranty

3M warrants that 3M™ Diamond Grade™ Roll Up Sign Sheeting Series RS20/RS24 sold by 3M to be used as components for roll up traffic control signs used in work zones in the United States and Canada will remain effective for its intended use and meet the stated minimum values for coefficient of retroreflection for three years, subject to the following provisions:

### **Minimum Coefficient of Retroreflection** Candelas per Footcandle per Square Foot or Candelas per Lux per Square Meter

Sheeting Color	Minimum Coefficient of Retroreflection (Three Years)
White	50% of stated values of Table C
Fluorescent Orange	50% of stated values of Table C

\*All measurements shall be made after sign cleaning according to 3M recommendations and in accordance with ASTM E810 “Standard Test Method for Coefficient of Retroreflection of Retroreflective Sheeting.”

If Series RS20/RS24 roll up sign surface is processed in accordance with all 3M application and fabrication procedures provided in 3M’s product bulletins, information folders and technical memos (which will be furnished to the agency upon request), including the exclusive use of 3M matched component systems, process colors, and recommended application equipment; and

If the sign deteriorates due to natural causes to the extent that: 1) the sign is ineffective for its intended purpose when viewed from a moving vehicle under normal day and night driving conditions by drivers with normal vision, or 2) the coefficient of retroreflection is less than the minimum herein specified 3) RS24 fluorescent sheeting color retention does not meet requirement (weathered) in Table C, 3M’s sole responsibility and purchaser’s and user’s exclusive remedy shall be that 3M will provide pro-rata replacement of the 3M materials.

### **Conditions**

Such failure must be solely the result of design or manufacturing defects in the Series RS20/RS24 roll up sign sheeting and not of outside causes such as: improper fabrication, handling, maintenance or installation; process colors, thinner, coatings, or overlay films and sheetings not made by 3M; use of equipment not recommended by 3M; failure of sign hardware; exposure to chemicals, abrasion and other mechanical damage from fasteners used to mount the sign; collisions, vandalism or malicious mischief.

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 the signs have been dated at the time of sheeting application, which constitutes the start of the warranty period.

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.

### **Limitation of Liability**

3M’s liability under this warranty is limited to replacement as stated herein, and 3M assumes no liability for any incidental or consequential damages, such as lost profits, business or revenues 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, AND ANY IMPLIED WARRANTY ARISING OUT OF A COURSE OF DEALING OR OF PERFORMANCE, CUSTOM OR USAGE OF TRADE.

### **Literature Reference (Available from 3M)**

#### **Screen Processing**

PB1805      3M™ Process Colors

#### **Application**

IF 1.10	Cutting, Matching, Premasking & Prespacing Instructions
IF 1.11	Storage Maintenance and Removal Instructions

**FOR INFORMATION OR ASSISTANCE**

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