



# Diamond Grade<sup>TM</sup> DG<sup>3</sup> Reflective Sheeting Series 4000

## Health & Safety

Refer to the package label and, if relevant, the Material Safety Data Sheet for health, safety, and handling information on the products referenced in this bulletin. For 3M products, if necessary, you may contact our Toxicology/Product Responsibility Department on 01344 858000.

## Product Description

Diamond Grade DG<sup>3</sup> Reflective Sheetting Series 4000 is a super-high efficiency, full cube retro-reflective sheetting designed for the production of traffic control signs and delineators that are exposed vertically in service. DG<sup>3</sup> sheetting is designed to have the highest retro-reflective characteristics at long, medium and short road distances as determined by the R<sub>A</sub>, value at 0.2°, 0.5° and 1.0° observation angle in Table A. Retroreflective performance at these angles represents the most common viewing geometries encountered by the driving public..

During the day and at times of low ambient light levels, Diamond Grade DG<sup>3</sup> Fluorescent Reflective Sheetting provides higher visibility than non-fluorescent signs made with ordinary coloured sheettings.

Applied to properly prepared substrates, Diamond Grade DG<sup>3</sup> Series 4000 should provide long-term service.

Colour	Product Code
White	4090
Yellow	4091
Red	4092
Blue	4095
Interstate Green	4097
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Fluorescent Yellow	4081
Fluorescent Yellow Green	4083
Fluorescent Orange	4084

## Coefficients of Retroreflection

The minimum initial coefficient of retro-reflection R<sub>A</sub> (cd/lux/m<sup>2</sup>) of Diamond Grade DG<sup>3</sup> 4000 (averaged for 0° and 90° rotation), when measured in accordance with the procedure specified in CIE Publication No. 54, using CIE standard illuminant A, conforms to the values in Table A.

Table A

Obs Angle.	Colour	Entrance Angles		
		-5	15°	40°
0.20°	White	570	360	100
	Yellow	425	275	75
	Red	114	110	20
	Interstate Green	57	36	10
	Blue	26	15	4.5
	Fluorescent Yellow	340	250	60
	Fluorescent Yellow Green	460	300	80
	Fluorescent Orange	170	100	30
0.50°	White	400	240	50
	Yellow	300	188	37
	Red	80	57	10
	Interstate Green	40	27	5
	Blue	18	12	1.5
	Fluorescent Yellow	240	160	30
	Fluorescent Yellow Green	320	190	40
	Fluorescent Orange	120	84	15
1.0°	White	120	80	25
	Yellow	90	60	19
	Red	24	15	5
	Interstate Green	12	8	3
	Blue	5.4	4	0.8
	Fluorescent Yellow	72	43	15
	Fluorescent Yellow Green	96	60	20
	Fluorescent Orange	36	24	7

**Table B**

Colour	1		2		3		4		Luminance Factor, $\beta$
	x	y	x	y	x	y	x	y	
White	0.303	0.300	0.368	0.366	0.340	0.393	0.274	0.329	$Y \geq 0.40$
Yellow	0.498	0.412	0.557	0.442	0.479	0.520	0.438	0.472	$0.45 \geq Y \geq 0.24$
Red	0.648	0.351	0.735	0.265	0.629	0.281	0.565	0.346	$0.15 \geq Y \geq 0.03$
Blue	0.140	0.035	0.244	0.210	0.190	0.255	0.065	0.216	$0.10 \geq Y \geq 0.01$
Light Green	0.026	0.399	0.166	0.364	0.286	0.446	0.207	0.771	$0.12 \geq Y \geq 0.01$
Fluorescent Yellow	0.479	0.520	0.446	0.483	0.512	0.421	0.557	0.442	$Y \geq 0.45$
Fluorescent Yellow Green	0.387	0.610	0.369	0.546	0.428	0.496	0.460	0.540	$Y \geq 0.60$
Fluorescent Orange	0.583	0.416	0.535	0.400	0.595	0.351	0.645	0.355	$Y \geq 0.25$

Note: Where points lie on the spectral boundary, they are joined by that boundary and not a straight line.

## Chromaticity

The chromaticity and the luminance factor shall comply with the limits defined in Table B when illuminated with CIE Standard Illuminant D65. The sample shall be illuminated at 0° to the surface and measure the reflected light in the direction of 45° to the normal to its surface (CIE O/45 geometry).

## Performance Compliance

3M™ Diamond Grade™ DG<sup>3</sup> Reflective Sheeting Series 4000 complies with requirements on BS 8408:2005 and has been rated using that standard. Luminance and Performance Indices for these products are available from 3M.

## Orientation

Diamond Grade DG<sup>3</sup> is designed to be an effective wide angle reflective sheeting regardless of the 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 application angles, especially at increasing entrance angles, it is possible to get the widest entrance angle light return when the sheeting is orientated in a particular manner.

When extra wide entrance angle performance is important for a given situation, you may elect to apply the material with a specific orientation.

If high entrance performance beyond 50° is a requirement for your application, you can achieve this performance by positioning the applied sheeting at the 0° application angle.

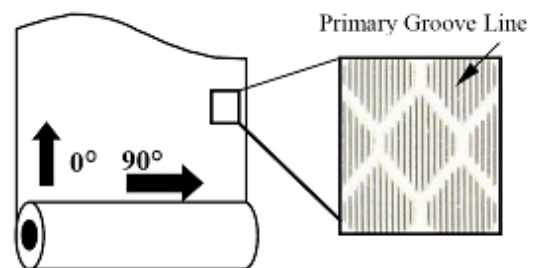


Figure 1 – Sheeting is positioned at 0° application angle.

When the “primary groove line” is vertical in the applied sheeting, the Diamond Grade DG<sup>3</sup> is said to be at a 0° orientation. When the “primary groove line” is horizontal in the applied sheeting, the Diamond Grade DG<sup>3</sup> is said to be at a 90° orientation

However, unless the location and/or position calls for extra-wide entrance angularity performance, signs using Diamond Grade DG<sup>3</sup> can be manufactured and installed using the orientation that most efficiently utilises the reflective sheeting.

**NOTE:** In cases where panels, strips and text are placed on the same surface, it is recommended they be placed in the same orientation.

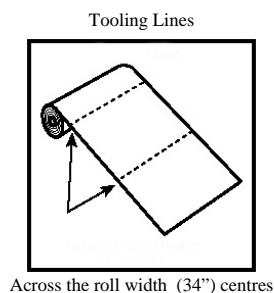
## Distinguishing Marks

Diamond Grade™ DG<sup>3</sup> can be distinguished from other Diamond Grade products by the presence of the “primary groove line.”

## Tooling Lines

The manufacture of prismatic sheeting results in tooling lines being present in the product. In Diamond Grade DG<sup>3</sup> these lines are slightly thicker than the seal pattern legs. Tooling lines are more noticeable in shop light but are not observable on the road either in daylight or night under reflected light (Figure 2).

Figure 2



## Substrates

For traffic signs properly prepared Aluminium and British Steel HP200 are the only substrates recommended by 3M. See Instruction Bulletin 5.1 for recommended substrate preparation.

Users are urged to carefully evaluate all other substrates for adhesion and sheeting durability. Sheeting failures caused by the substrate or improper surface preparation are not the responsibility of 3M.

Diamond Grade DG<sup>3</sup> Series 4000 is designed primarily for application to flat substrates.

## Fabrication Methods

### Application

Diamond Grade DG<sup>3</sup> Series 4000 incorporates a pressure-sensitive adhesive and should be applied at room temperature (15 to 18°C) by any of the following methods:

- Automated squeeze roll applicator
- Hand squeeze roll applicator
- Hand application

### Splicing

Diamond Grade DG<sup>3</sup> Series 4000 should be butt spliced when more than one piece of sheeting is used on one piece of substrate. Ideally the pieces should not touch each other. A splice gap of up to 1.5mm is acceptable. This is to prevent buckling as the sheeting expands in extreme temperature and humidity cycles.

All pieces on a single sign must be applied with the same orientation. If pieces of the same colour are being used side by side on a surface, they should be matched to assure uniform daytime colour and night appearance.

### Imaging

#### Screen Print Applications

- 3M™ Process Colours 880I

#### Copy Part Applications

- 3M™ Scotchcal™ Film 3650-12 (Black)
- 3M™ Scotchcal™ Film 7720-12
- 3M™ Controltac™ Scotchcal™ Film 180-12
- 3M™ ElectroCut™ FilmSeries 1170

#### All Applications

- Selected 3M application tapes

**NOTE: Care should be taken to avoid flexing Series 4000 sheeting immediately after screen printing. Screen-printed material is best immediately run through a conveyor drier. Otherwise it must be sufficiently ventilated during the filling of the rack. If the print is not ventilated properly, the solvents within the ink may damage the top-film of the Diamond Grade sheeting. Refer to Product Bulletin 880I for more details.**

### Electronic Cutting

Diamond Grade DG<sup>3</sup> Series 4000 may be kiss or die cut using flat bed plotters.

Friction fed plotters that have at least 600 grams of downforce can be used to kiss cut Diamond Grade DG<sup>3</sup> Series 4000 using a 60° cutting blade.

Additional drive wheels may be needed to improve tracking.

Letter heights less than 3 inches and stroke widths less than 18mm are not recommended.

## Edge Sealing

Edge sealing Diamond Grade DG<sup>3</sup> Series 4000 is generally not required to maintain overall product performance.

However, following extended exposure, airborne dust particles may become trapped within the row of cut cells along the sheeting edge. This should have no adverse effect on sheeting performance unless occurring in legends or shapes with narrow stroke widths (less than 18mm).

## Cleaning

Signs that require cleaning should be flushed with water; then washed with a dilute detergent solution, which is pH neutral and not abrasive. Flush with clean water after washing. Use only soft sponges or other tools that will not scratch the signface. Do not use solvents to clean signs. See Instruction Bulletin 1.11.

If pressure washing equipment is used, limit nozzle pressure to 80 bar (1000psi). Nozzle should be held at least 1 metre away from the sign using a wide fan pattern, and at an angle no more than 15 degrees from perpendicular to the sign .

**Note: Dew resistant coated signfaces must be flushed only with water. Detergents must not be used.**

## Storage and Packaging

Diamond Grade DG<sup>3</sup> Series 4000 should be stored in a cool, dry area, preferably at 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.

Screen processed material must be protected with SCW 568 slipsheet paper. Place the glossy side of the ship sheeting against the sheeting face and pad the face with closed cell packaging foam.

Unapplied screened sheeting must be stored flat and interleaved with SCW 568 slipsheet, glossy side against the sheeting face.

Avoid banding, crating, or stacking signs or faces. Package for shipment in accordance with commercially acceptable standards to prevent movement and chafing.

Panels or finished signs must remain dry during shipment and storage. If packaged material becomes wet, unpack immediately and allow to

dry. See Instruction Bulletin 1.11 for information on packing for storage and shipment.

## Indoor Storage of Finished Signs

Finished signs and applied blanks should be stored face to face, on edge on wooden battens. Signs must be protected with SCW-82 slipsheet or liner paper. Place the glossy side against signface and pad with closed cell packaging foam.

## Outdoor Storage of Finished Signs

If outdoor storage is necessary, remove all packaging and store signs face to face, on edge on wooden battens with a gap between signfaces to allow air movement.

Signs kept in metal containers must be stored as above for outdoor storage.

## Expected Effective Performance Life

The effective performance life of Diamond Grade DG<sup>3</sup> Series 4000 will depend on substrate selection and preparation and compliance with recommended application, storage and maintenance procedures.

Permanent static traffic signs incorporating Diamond Grade DG<sup>3</sup> Series 4000 applied to Aluminium or British Steel HP200 substrates which have been prepared in accordance with 3M recommended procedures, have an expected performance life as stated below when mounted vertically. Application to substrates other than those above or incorrect substrate preparation may shorten the effective performance life of the sheeting.

## Vertical Exposure

### Standard Colours

Unprinted	12 years
Printed using 3M™ Process Colour Series 880I	12 years

### Fluorescent Colours

Unprinted	10 years
Printed using 3M™ Process Colour Series 880I	10 years

Exposure in non-vertical applications (more than 10° from vertical) may significantly shorten performance life. Horizontal applications are not warranted.

## Literature

<b>Related 3M Literature</b>	<b>Bulletins</b>
3M™ Process Colour Series 880I	<b>880I</b>
Substrate selection and preparation	<b>5.1</b>
Application, storage and cleaning	<b>5.13.1</b>

## Important Notice To Purchaser

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## Technical Assistance

For help on specific questions relating to 3M Traffic Safety Systems Division products, contact your local Technical Service Representative.

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