

European Technical Approval**ETA 13/0303****Trade Name**

1. 3M™ Diamond Grade™ DG³ Series 4000 + 3M™ Piezo Inkjet Ink Series 8800UV + 3M™ Premium Protective Overlay Film 1160
2. 3M™ Diamond Grade™ DG³ Series 4000 + 3M™ Electrocut Film Series 1170 + 3M™ Dew Resistant Overlay Film 1180

Holder of the approval

3M Deutschland GmbH
Carl Schurz Strasse,
D- 41453- Neuss - Deutschland

Website

www.3m.com

Generic type and use of construction product

Micro-prismatic retro-reflective sheeting for traffic signs

Validity from:

2013-06-27

to

2018-06-26

Manufacturing plant(s):

3M Deutschland GmbH Plant Hilden, Düsseldorfstr. 121-125, D-40705 Hilden, Germany

3M Brownwood, HW 377S, Texas 76801 - US

This European Technical Approval contains:

15 pages, including 1 annex which forms an integral part of this ETA



European Organisation for Technical Approvals
Organisation Européenne pour l'Agrément Technique
Europäische Organisation für Technische Zulassungen

I. LEGAL BASES AND GENERAL CONDITIONS

1. This European Technical Approval is issued by UBAtc in accordance with:
 - Council Directive 89/106/EEC of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products¹, modified by Council Directive 93/68/EEC² and Regulation (EC) N° 1882/2003 of the European Parliament and of the Council³,
 - Belgian law of 25 March 1996 concerning the adaptation of legislative and administrative provisions of Member States to the Construction Products Directive (89/106/EEC) for construction products⁴ and Belgian Royal Decree of 18 August 1998 concerning construction products⁵
 - Common Procedural Rules for Requesting, Preparing and the Granting of European Technical Approvals set out in the Annex to Commission Decision 94/23/EC⁶
2. The UBAtc is authorized to check whether the provisions of this European Technical Approval are met. Checking may take place in the manufacturing plant(s). Nevertheless, the responsibility for the conformity of the products to the European Technical Approval and for their fitness for the intended use remains with the holder of the European Technical Approval.
3. This European Technical Approval is not to be transferred to manufacturers or agents of manufacturers other than those indicated on page 1, or manufacturing plants other than those laid down in the context of this European Technical Approval.
4. This European Technical Approval may be withdrawn by UBAtc, in particular pursuant to information by the Commission according to Article 5(1) of Council Directive 89/106/EEC.
5. Reproduction of this European Technical Approval including transmission by electronic means shall be in full. However, partial reproduction can be made with the written consent of UBAtc. In this case partial reproduction has to be designated as such. Texts and drawings of advertising brochures shall not contradict or misuse the European Technical Approval.
6. The European Technical Approval is issued by the approval body in its official languages. These versions correspond fully to the version circulated in EOTA. Translations into other languages have to be designated as such.
7. The ETA holder confirms to guarantee that the product(-s) to which this approval relates, is/are produced and marketed in accordance with and comply with all applicable legal and regulatory provisions, including, without limitation, national and European legislation on the safety of products and services. The ETA-holder shall notify the UBAtc immediately in writing of any circumstance affecting the aforementioned guarantee. This approval is issued under the condition that the aforementioned guarantee by the ETA holder is continuously observed.
8. This ETA includes components that are already covered by 11/0521, with new combinations from the existing 'toolkit' of inks, overlay etc.

¹ Official Journal of the European Communities N° L 40, 11.2.1989, p. 12

² Official Journal of the European Communities N° L 220, 30.8.1993, p. 1

³ Official Journal of the European Union N° L 284, 31.10.2003, p. 1

⁴ Belgian Law Gazette, 21.05.1996

⁵ Belgian Law Gazette, 11.09.1998

⁶ Official Journal of the European Communities N° L 17, 20.1.1994, p. 34

II. SPECIFIC CONDITIONS OF THE EUROPEAN TECHNICAL APPROVAL

1 Definition of product and intended use

1.1 Definition of the product

The product consists of a micro-prismatic retro-reflective sheeting made of optical prismatic lenses elements formed in a transparent synthetic resin, sealed and backed with a pressure sensitive adhesive to form a durable bond to the sign substrates. The sheeting has a smooth surface with a distinctive interlocking seal pattern and may or may not have orientation marks, visible from the face.

The product is supplied in the combinations listed in chapter 1.1.

In case of digital printing, Process Colour Series 8800 UV are generally protected by a colourless overlay film, e.g. Premium Protective Overlay Film 1160.

ETA 11/0521 and ETA 11/0522 cover additional combinations of 3M™ Diamond Grade™ DG³ Reflective Sheeting Series 4000 with various overlay films and process colours.

1.2 Components

An overview of the complete set of components of "3M Diamond Grade DG³ series 4000", and combinations with or without "3M Electrocut Film series 1170" or "Process Colour Piezo Inkjet Ink Series 8800 UV", and with or without 3M Dew Resistant Overlay Film 1180 or 3M Premium Protective Overlay Film 1160" is given in table 1.

This ETA contains new product combinations;		3M™ Diamond Grade™ DG ³ Series 4000 + 3M™ Piezo Inkjet Ink Series 8800UV + 3M™ Premium Protective Overlay Film 1160	
Initial performance and performance after accelerated artificial weathering		3M™ Diamond Grade™ DG ³ Series 4000 + 3M™ Electrocut Film Series 1170 + 3M™ Dew Resistant Overlay Film 1180	
Use option 1, see Annex 1			
Components	Trade name	Colours/code	Characteristics
Micro-prismatic retro-reflective sheeting	3M™ Diamond Grade™ Reflective Sheeting Series 4000	White 4090	Thickness: 0.32 – 0.49 mm Rolls in various length and width
		Yellow 1171	Combined Thickness: 0.549 mm Rolls in various length and width
Overlay film	3M™ Electrocut Film series 1170	Red 1172	
		Blue 1175	
		Green 1177	
Process colour for digital printing	II. Piezo Inkjet Ink Series 8800 UV	Yellow 8804	18-20ml/m ²
		Red 8802	
		Blue 8803	
		Green 8808	
		Brown 8809	
Protective Overlay films	3M™ Dew Resistant Overlay Film 1180	Orange 8806	Combined Thickness: 0.549 mm Rolls in various length and width
		3M™ Premium Protective Overlay Film 1160 (anti-graffiti)	Combined Thickness: 0.549 mm Rolls in various length and width

Table 1 : Components of the product

1.3 Intended use

The construction product is used to manufacture sign faces for traffic signs. The intended use includes, for example:

- retro-reflective signs, retro-reflective and trans-illuminated signs (See also EN 12899-1)
- trans-illuminated traffic bollards (See also EN 12899-2)
- fixed retroreflector for road delineators (See also EN 12899-3)
- variable message signs (See also EN 12966-1)

The intended use excludes road-markings as defined in EN 1436. The assumed intended working life of the product is 12 years provided that it is subjected to appropriate use and maintenance. The indications given as to the working life of the product cannot be interpreted as a guarantee given by the Manufacturer or by the Approval Body.

2 Characteristics of product and methods of verification

2.1 General

The identification tests and the assessment of fitness for use for the products listed in chapter 1.1 were carried out according to the verification methods in clause 3 of this ETA.

The ETA is issued for the product on the basis of information/data deposited at UBAtc which identify the product that was assessed and judged. Changes to the production process of the product or to its components which could result in deposited information/data being incorrect, shall be notified to UBAtc before they are introduced and UBAtc will assess whether or not such changes affect the ETA and, if so, whether further assessment and/or modification to the ETA shall be necessary.

The characteristics of the product not mentioned in this ETA nor in the annexes shall correspond to the respective values laid down in the Technical Documentation of this ETA, checked by UBAtc.

Details of test results are included in the related Evaluation Report.

2.2 Characteristics of the product

2.2.1 Hygiene, health and the environment

2.2.1.1 Release of dangerous substances

The product complies with the provisions of Guidance Paper H ("A harmonized approach relating to Dangerous substances under the construction products directive", Edition 2002) about dangerous substances.

A written declaration of conformity in this respect was made by the manufacturer. In addition to the specific clauses relating to dangerous substances contained in this European Technical Approval, there may be other requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the EU Construction Products Directive, these requirements need also to be complied with, when and where they apply.

2.2.2 Safety in use of "3M Diamond Grade DG³ series 4000 printed with 3M Piezo Inkjet Ink Series 8800UV + 3M Premium protective overlay film 1160"

2.2.2.1 Visibility of "3M Diamond Grade DG³ series 4000 printed with 3M Piezo Inkjet Ink Series 8800UV + 3M Premium protective overlay film 1160"

2.2.2.1.1 Day-time colour and Luminance Factor

The characteristics of Day-time colour and Luminance Factor have been determined according to clause 3.2.1

Colours		Chromaticity Coordinates				Luminance Factor β	
		1	2	3	4	Class B1	Class B2
Yellow reference	x	0.494	0.470	0.513	0.545	≥ 0.16	≥ 0.24
	y	0.505	0.480	0.437	0.454		
Yellow on White results		Pass				Class B2	
Red reference	x	0.735	0.700	0.610	0.660	≥ 0.03	≥ 0.03
	y	0.265	0.250	0.340	0.340		
Red on White results		Pass				Class B2	
Green reference	x	0.110	0.170	0.170	0.110	≥ 0.03	≥ 0.03
	y	0.415	0.415	0.500	0.500		
Green on White results		Pass				Class B2	
Blue reference	x	0.130	0.160	0.160	0.130	≥ 0.01	≥ 0.01
	y	0.090	0.090	0.140	0.140		
Blue on White results		Pass				Class B2	
Brown reference	x	0.455	0.523	0.479	0.558	0.04 – 0.06	0.03 – 0.09
	y	0.397	0.429	0.373	0.394		
Brown on White results		Pass				Class B2	
Orange reference	x	0.631	0.560	0.506	0.570	≥ 0.14	≥ 0.14
	y	0.369	0.360	0.404	0.429		
Orange on White results		Pass				Class B2	

Table 2 : Day-time colour and Luminance factor

2.2.2.1.2 Coefficient of Retro-reflection Case A

The Coefficient of Retro-reflection - Case A has been determined according to clause 3.2.2. For material processed with process colours, with or without clear overlay film, the minimum value of the coefficient of Retro-reflection shall not be less than 70% of the values specified in the tables.

Colour	Class R3B Germany
Yellow on white	pass
Red on white	pass
Green on white	pass
Blue on white	pass
Orange on white	pass

Table 3 : Coefficient of retro-reflection Case A

2.2.2.1.3 Rotational symmetry

The rotational symmetry has been determined according to clause 3.2.3.

Colours	Pass/Fail
Yellow on White	Pass
Red on White	Pass
Blue on White	Pass
Green on White	Pass
Brown on White	Pass
Orange on White	Pass

Table 4 : Rotational symmetry

2.2.2.1.4 Impact resistance

The Impact resistance has been determined according to clause 3.2.4.

Product	Colour of the sheeting	Colour of the film	Observations after the test
"3M Diamond Grade DG ³ series 4000 printed with 3M Piezo Inkjet Ink Series 8800UV + 3M Premium protective overlay film 1160"	White 4090	Orange Yellow Red Blue Green Brown	Pass: no cracking has been observed outside the impact area.

Table 5 : Impact resistance

2.2.3 Durability of "3M Diamond Grade DG³ series 4000 printed with 3M Piezo Inkjet Ink Series 8800UV + 3M Premium protective overlay film 1160"

2.2.3.1 Visibility after accelerated artificial weathering of "3M Diamond Grade DG³ series 4000 printed with 3M Piezo Inkjet Ink Series 8800UV + 3M Premium protective overlay film 1160"

2.2.3.1.1 Day-time colour and Luminance factor after accelerated artificial weathering of "3M Diamond Grade DG³ series 4000 printed with 3M Piezo Inkjet Ink Series 8800UV + 3M Premium protective overlay film 1160"

The tests were performed according to clause 3.3.

Colours		Chromaticity Coordinates				Luminance Factor β	
		1	2	3	4	Class B1	Class B2
White reference	x	0.355	0.305	0.285	0.335	≥ 0.27	≥ 0.40
	y	0.355	0.305	0.325	0.375		
White results		Pass				Class B2	
Yellow reference	x	0.545	0.487	0.427	0.465	≥ 0.16	≥ 0.24
	y	0.454	0.423	0.483	0.534		
Yellow on White results		Pass				Class B2	
Red reference	x	0.735	0.674	0.569	0.655	≥ 0.03	≥ 0.03
	y	0.265	0.236	0.341	0.345		
Red on White results		Pass				Class B2	
Green reference	x	0.007	0.248	0.177	0.026	≥ 0.03	≥ 0.03
	y	0.703	0.409	0.362	0.399		
Green on White results		Pass				Class B2	
Blue reference	x	0.078	0.150	0.210	0.137	≥ 0.01	≥ 0.01
	y	0.171	0.220	0.160	0.038		
Blue on White results		Pass				Class B2	
Brown reference	x	0.455	0.523	0.479	0.558	0.04 – 0.06	0.03 – 0.09
	y	0.397	0.429	0.373	0.394		
Brown on White results		Pass				Class B2	

Table 6 : Day-time colour and Luminance factor

2.2.3.1.2 Coefficient of retro-reflection Case A after accelerated artificial weathering test of "3M Diamond Grade DG³ Series 4000 + 3M Piezo Inkjet Ink Series 8800UV + 3M Premium protective overlay film 1160"

The tests were performed according to clause 3.3. The values shall not be less than 80% of the values required for new material under clause 3.2.2, as appropriate.

Colour	Class R3B Germany
Yellow on white	pass
Red on white	pass
Green on white	pass
Blue on white	pass
Orange on white	pass

Table 7 : Coefficient of retro-reflection Case A

Colours		Chromaticity Coordinates				Luminance Factor β	
		1	2	3	4	Class B1	Class B2
Yellow reference	x	0.494	0.470	0.513	0.545	≥ 0.16	≥ 0.24
	y	0.505	0.480	0.437	0.454		
Yellow results	x	Pass				Class B2	
	y						
Red reference	x	0.735	0.700	0.610	0.660	≥ 0.03	≥ 0.03
	y	0.265	0.250	0.340	0.340		
Red results	x	Pass				Class B2	
	y						
Green reference	x	0.110	0.170	0.170	0.110	≥ 0.03	≥ 0.03
	y	0.415	0.415	0.500	0.500		
Green results	x	Pass				Class B2	
	y						
Blue reference	x	0.130	0.160	0.160	0.130	≥ 0.01	≥ 0.01
	y	0.090	0.090	0.140	0.140		
Blue results	x	Pass				Class B2	
	y						

Table 8 : Day-time colour and Luminance factor

2.2.4.1.2 Coefficient of Retro-reflection Case A

The Coefficient of Retro-reflection - Case A has been determined according to clause 3.2.2.

Colour	Class R3B Germany
Yellow	pass
Red	pass
Green	pass
Blue	pass

Table 9 : Coefficient of retro-reflection Case A

2.2.4 Safety in use of "3M Diamond Grade DG³ series 4000 + 3M Electrocut Film Series 1170 + 3M Dew Resistant Overlay Film 1180"

2.2.4.1 Visibility of "3M Diamond Grade DG³ series 4000 + 3M Electrocut Film Series 1170 + 3M Dew Resistant Overlay Film 1180"

2.2.4.1.1 Day-time colour and Luminance Factor

The characteristics of Day-time colour and Luminance Factor have been determined according to clause 3.2.1

2.2.4.1.3 Rotational symmetry

The rotational symmetry has been determined according to clause 3.2.3.

Colours	Pass/Fail
Yellow	Pass
Red	Pass
Green	Pass
Blue	Pass

Table 10 : Rotational symmetry

2.2.4.1.4 Impact resistance

The Impact resistance has been determined according to clause 3.2.4.

Product	Colours	Observations after test
"3M Diamond Grade DG ³ series 4000 + 3M Electrocut Film Series 1170 + 3M Dew Resistant Overlay Film 1180"	Yellow Red Blue Green	Pass: no cracking has been observed outside the impact area.

Table 11 : Impact resistance

2.2.5 Durability of "3M Diamond Grade DG³ series 4000 + 3M Electrocut Film Series 1170 + 3M Dew Resistant Overlay Film 1180"

2.2.5.1 Visibility after accelerated artificial weathering of "3M Diamond Grade DG³ series 4000 + 3M Electrocut Film Series 1170 + 3M Dew Resistant Overlay Film 1180"

2.2.5.1.1 Day-time colour and Luminance factor after accelerated artificial weathering of "3M Diamond Grade DG³ series 4000 + 3M Electrocut Film Series 1170 + 3M Dew Resistant Overlay Film 1180"

The tests were performed according to clause 3.3.

Colours		Chromaticity Coordinates				Luminance Factor β	
		1	2	3	4	Class B1	Class B2
Yellow reference	x	0.545	0.487	0.427	0.465	≥ 0.16	≥ 0.24
	y	0.454	0.423	0.483	0.534		
Yellow results	x	Pass				Class B2	
	y						
Red reference	x	0.735	0.674	0.569	0.655	≥ 0.03	≥ 0.03
	y	0.265	0.236	0.341	0.345		
Red results	x	Pass				Class B2	
	y						
Green reference	x	0.007	0.248	0.177	0.026	≥ 0.03	≥ 0.03
	y	0.703	0.409	0.362	0.399		
Green results	x	Pass				Class B2	
	y						
Blue reference	x	0.078	0.150	0.210	0.137	≥ 0.01	≥ 0.01
	y	0.171	0.220	0.160	0.038		
Blue results	x	Pass				Class B2	
	y						

Table 12 : Day-time colour and Luminance factor

2.2.5.1.2 Coefficient of retro-reflection Case A after accelerated artificial weathering test of "3M Diamond Grade DG³ Series 4000 + 3M Electrocut Film Series 1170 + 3M Dew Resistant Overlay Film 1180"

The tests were performed according to clause 3.3. The values shall not be less than 80% of the values required for new material under clause 3.2.2, as appropriate.

Colour	Class R3B Germany
Yellow	pass
Red	pass
Green	pass
Blue	pass

Table 13 : Coefficient of retro-reflection Case A

3 Verification Methods for determining the relevant characteristics of the construction product

3.1 Hygiene, health and the environment

3.1.1 Release of dangerous substances

The product/kit shall comply with all relevant European and national provisions applicable for the uses for which it is brought to the market. The attention of the applicant should be drawn on the fact that for other uses or other Member States of destination there may be other requirements which would have to be respected.

3.2 Safety in use

3.2.1 Day-time colour and Luminance Factor

The chromaticity coordinates (x, y) and the luminance factor (β) are measured in accordance with CIE Publication 15.2 Colourimetry – 1986 using 45/0 geometry and shall be calculated from the total spectral radiance factors computed for CIE illuminant D65 for the CIE 1931 (2°) standard colorimetric observer.

The position of the sample in the measuring system will be indicated by an orientation mark. The orientation mark has to be adjusted 90° to the incident plane. The incident plane is formed out of the rectangle on the sample surface and the incoming light beam.

The chromaticity coordinates shall be within the colour boxes and the Luminance factor shall comply with values in Table 3.2.1.

Colour		Chromaticity Coordinates				Luminance Factor β	
		1	2	3	4	Class B1	Class B2
Yellow	x	0.494	0.470	0.513	0.545	≥ 0.16	≥ 0.24
	y	0.505	0.480	0.437	0.454		
Red	x	0.735	0.700	0.610	0.660	≥ 0.03	≥ 0.03
	y	0.265	0.250	0.340	0.340		
Orange	x	0.631	0.560	0.506	0.570	≥ 0.14	≥ 0.14
	y	0.369	0.360	0.404	0.429		
Green	x	0.110	0.170	0.170	0.110	≥ 0.03	≥ 0.03
	y	0.415	0.415	0.500	0.500		
Brown	x	0.455	0.523	0.479	0.558	0.04 – 0.06	0.03 – 0.09
	y	0.397	0.429	0.373	0.394		
Blue	x	0.130	0.160	0.160	0.130	≥ 0.01	≥ 0.01
	y	0.090	0.090	0.140	0.140		

Table 14 : Permitted colour area in CIE 1931 diagram and Luminance factors for daylight appearance of new materials

3.2.2 Coefficient of Retroreflection

The coefficient of retro-reflection R' is measured in accordance with CIE Publication No. 54.2, Retro-reflection using CIE Standard Illuminant A. Any of the recommended apertures may be used. Measurements shall be taken at the specified observation angle α and entrance angle β . The entrance angle β shall be set by its first component β_1 with the second component $\beta_2 = 0^\circ$, the rotation angle ϵ shall be $\epsilon = 0^\circ$ and the orientation angle ω_s shall be $\omega_s = 0^\circ$.

The requirements of minimum coefficient of Retro-reflection R' are specified in table 15.

Minimum Coefficient of Retroreflection, Performance Class R3B for Germany

Geometry of measurement		Colours					
Observation Angle α	Entrance Angle β_1	White	Yellow	Red	Blue	Orange	Green
0.33	5	300	195	60	19	150	30
1.0	5	35	23	7	2.5	18	3.5
1.5	5	15	10	3	1	7.5	1.5
0.33	20	240	155	48	16	120	24
1.0	20	30	20	6	2	15	3
1.5	20	13	8	2.5	-	6.5	1
0.33	30	165	110	33	11	83	17
1.0	30	20	13	4	1.5	10	2
1.5	30	9	6	2	-	4.5	-
0.33	40	30	20	6	2	15	3
1.0	40	3.5	2	1	-	2	-
1.5	40	1.5	1	-	-	1	-

Table 15 : Minimum Coefficient of Retroreflection, Performance Class R3B for Germany

For material processed with process colours, with or without clear overlay film, the minimum value of the coefficient of Retro-reflection shall not be less than 70% of the values specified in the tables. For material processed with red process colour or red overlay film over yellow microprismatic sheeting, the coefficient of Retro-reflection shall not be less than 50% of the values specified in the tables.

3.2.3 Rotational symmetry

Additional requirement for performance class 3A and 3B: When measured according to clause 3.2.2, rotational symmetry, for the observation angle $\alpha = 0.33^\circ$ and entrance angle $\beta_1 = 5^\circ$ ($\beta_2 = 0^\circ$), the ratio between the minimum and the maximum coefficient of Retro-reflection when rotating from $\varepsilon - 75^\circ$ to $+ 50^\circ$ in 25° steps, shall not be greater than 2.5.1.

3.2.4 Impact resistance

The test is carried out according to EN 12899-1 using a hard body having a mass of 450 g with a contact radius of 50 mm. The hard body is dropped from a height of 220 mm on a sample that shall be supported over an open area of 100 mm x 100 mm.

3.3 Visibility after accelerated artificial weathering

The apparatus shall be either an air cooled or water cooled Xenon arc weathering device capable of exposing samples in accordance with ISO 4892-2: 1994.

Preparation of test specimens should be in accordance with the general guideline given in ISO 4892-2: 1994.

The samples shall be exposed in accordance to ISO 4892-2: 1994 using the parameters given in the following table, for a period of 2000 hours.

Exposure parameters	Air cooled lamp	Water cooled lamp
Light/dark/water spray cycle	Continuous light with water spray on specimens for 18 minutes every 2 hours	Continuous light with water spray on specimens for 18 minutes every 2 hours
Black standard temperature during light only periods	(65 ± 3) °C using a black standard thermometer	(65 ± 3)°C using a black standard thermometer
Relative humidity	(50 ± 5) %	(50 ± 5) %
Irradiance (W/m ²) controlled at		
- over 300-400 nm range	60	60
- over 300-800 nm range	550	630

Table 16 a: Artificial weathering test parameters

Note 1 – Water used for specimen spray should contain no more than 1 ppm silica. Higher levels of silica may produce spotting on samples and variability in results. Water of the required purity may be obtained by distillation or by a combination of deionisation and reverse osmosis.

Note 2 – Whilst irradiance levels should be set at the above levels, variations in filter ages and transmissivity, and in calibration variations, will be generally mean that irradiance error will be in the order of ± 10%.

After weathering, following test shall be carried out

- day time colour (according to clause 3.2.1)
- Luminance factor (according to clause 3.2.1)
- Coefficient of Retroreflection – (according to clause 3.2.2)

After exposure the coefficient of retro-reflection measured at an observation angle $\alpha = 0.33^\circ$ (or $\alpha = 0.2^\circ$) and $\alpha = 1^\circ$ (if specified for new materials) and entrance angle $\beta_1 = 5^\circ$ and 30° ($\beta_2 = 0^\circ$), shall not be less than 80% of the values required for new material in 3.2.2.

After exposure the chromaticity co-ordinates and Luminance factor measured according to clause 3.2.1, shall comply with

the requirements specified in Table 16b, as appropriate.

Colour		Chromaticity Coordinates				Luminance Factor β	
		1	2	3	4	Class B1	Class B2
Yellow	x	0.545	0.487	0.427	0.465	≥ 0.16	≥ 0.24
	y	0.454	0.423	0.483	0.534		
Red	x	0.735	0.674	0.569	0.655	≥ 0.03	≥ 0.03
	y	0.265	0.236	0.341	0.345		
Green	x	0.007	0.248	0.177	0.026	≥ 0.03	≥ 0.03
	y	0.703	0.409	0.362	0.399		
Orange	x	0.631	0.560	0.506	0.570	≥ 0.14	≥ 0.14
	y	0.369	0.360	0.404	0.429		
Brown	x	0.455	0.523	0.479	0.558	0.04 – 0.06	0.03 – 0.09
	y	0.397	0.429	0.373	0.394		
Blue	x	0.078	0.150	0.210	0.137	≥ 0.01	≥ 0.01
	y	0.171	0.220	0.160	0.038		

Table 16b: Permitted colour area in CIE 1931 diagram and Luminance factors for daylight appearance after accelerated weathering test or after outdoor exposure

4 Evaluation of Conformity and CE Marking

4.1 Attestation of conformity system

The system of attestation of conformity is System 1 as described in Council Directive 89/106/EEC. Annex III, Clause 2 "Certification of Conformity of the product by an Approved Body and is detailed as follows:

- a) Task of the manufacturer
 - 1) Factory Production Control (FPC), including further testing of samples taken at the factory by the manufacturer in accordance with the prescribed test plan.
- b) Tasks of the approval body
 - 1) Initial Type Testing (ITT) of the product
 - 2) Initial inspection of the factory and of the Factory Production Control (FPC)
 - 3) Continuous surveillance, assessment and approval of the FPC.

4.2 Responsibilities

4.2.1 Task of the manufacturer

4.2.1.1 Factory Production Control (FPC)

The ETA holder has a FPC system in his plants and exercises permanent internal control of the production, including test samples in accordance with his control plan.

The control plan and the provisions taken by the ETA holder for components not produced by him have been agreed with the Approval Body and deposited with UBAtc where it is only made available to Notified Bodies involved in the conformity attestation procedure.

This control plan will be given to the Notified Body chosen by the ETA holder to perform the foreseen tasks on attestation of conformity.

The manufacturer only uses raw materials supplied with the relevant inspection documents as laid down in the control plan. The incoming raw materials are subjected to verifications by the manufacturer before acceptance.

All the elements, requirements and provisions adopted by the manufacturer are documented in a systematic manner in the form of written processes and procedures. This production control system ensures conformity with this ETA.

The results of FPC are recorded and evaluated. The records include:

- Designation of the product, raw materials and components
- Type of control or testing
- Date of the product's manufacture and date of testing of the product or raw materials and components
- Results of controls and testing and, if appropriate, comparison with requirements
- Signature of person responsible for FPC

The records shall be presented to the inspection body during the continuous surveillance. On request, they shall be presented to UBAtc.

Details of the extent, nature and frequency of testing and controls to be performed with FPC shall correspond to the control plan which is part of the technical documentation of this ETA.

4.2.2 Tasks of the Notified Body

4.2.2.1 Initial Type Testing (ITT)

For ITT, the results of the test performed as part of the assessment for this ETA shall be used unless there are changes in the production line or plant. In such cases, the necessary new ITT has to be agreed between UBAtc and the Notified Body involved.

4.2.2.2 Initial Inspection of factory and Factory Production Control (FPC)

The Notified Body shall ascertain that, in accordance with the control plan the factory (in particular, employees and equipment) and the FPC are suitable to ensure continuous and orderly manufacturing of the components according to specifications mentioned in clause 2 and 3 of this ETA.

4.2.2.3 Continuous surveillance, assessment and approval of FPC

The Notified Body should visit the factory at least once a year for surveillance. It has to be verified that the system of FPC and the specified manufacturing process are maintained, taking into account the deposited control plan. Continuous surveillance and assessment of FPC have to be performed in accordance to the control plan.

During each visit, the Notified Body shall utilize an ad-hoc check list and shall examine, among others:

- the control registers of raw materials, products in course of manufacture and finished products
- The document attesting the respect of the control frequencies
- The conformity of the products subjected to this ETA

In cases where the provisions of the ETA and the control plan are no longer fulfilled, the conformity certificate should be withdrawn.

4.3 CE Marking

The CE marking shall be affixed on the product or the packaging or on the transport documents (DDT) accompanying the components of the product. The symbol "CE" shall be followed by identification number of the Notified Body involved and shall be accompanied by the following information:

- Name or identification mark of the ETA holder
- Legal address of the ETA holder and the manufacturing plants
- The last 2 digits of the year in which the CE marking was affixed
- The number of the CE certificate of conformity of FPC
- The number of this ETA
- Product identification
- Product Performance referring to this ETA

5 Assumptions under which the fitness of the products for the intended use was favourably assessed

5.1 Manufacturing

3M Diamond Grade DG³ series 4000, and combinations with or without 3M Electrocut Film series 1170 or Piezo Inkjet Ink Series 8800 UV, and with or without 3M Dew Resistant Overlay Film 1180 or 3M Premium Protective Overlay Film, shall correspond, as far as their composition and manufacturing process is concerned, to the products subject to the approval tests. A manufacturing process has been deposited with UBAtc.

5.2 Installation

5.2.1 General

It is the responsibility of the ETA holder to guarantee that the information about design and installation of the systems as described in clause 2.1 of this ETA, are effectively communicated to the concerned people. This information can be given using reproductions of the respective parts of this ETA. Besides, all the data concerning the execution shall be indicated clearly on the packaging and or the enclosed instruction sheets using one or several illustrations.

In any case, it is suitable to comply with national regulations and particularly concerning national traffic code.

5.2.2 Design

The substrate used in this ETA is aluminium. Properly prepared aluminium sheets and aluminium extrusions are found to be most reliable. Most clean, smooth, relatively non-porous, flat, rigid, weather resistant surfaces are satisfactory

for proper application of Diamond Grade sheeting. Those found to be most reliable and durable are properly prepared aluminum sheets and aluminum extrusions. Users are urged to carefully evaluate all other substrates for adhesion and sign durability, including impact resistance.

5.2.3 Application

5.2.3.1 3M Diamond Grade DG³ Reflective Sheeting Series 4000

The sheeting must be stored in a cool, dry area, preferably at 18-24°C and 30-50% RH, and should be applied within one year from delivery. Rolls should be stored horizontally in the shipping carton. Partially used rolls should be returned to the shipping carton or suspended horizontally on a rod or pipe through the core.

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

Package for shipment must prevent movement and chafing. Store sign packages indoors on edges. Panels or finished signs must remain dry during shipping and storage. If packaged signs become wet, unpack immediately and allow to dry.

The recognition and preparation of the substrate as well as the generalities about the application of this product series, which is fully described in the current version of the ETA holder catalogue, its technical bulletins and web site www.3M.com/TSS, shall be carried out in compliance with national regulations in effect, if any.

"3M Diamond Grade DG³ Reflective Sheeting Series 4000" sheeting incorporates a pressure sensitive adhesive and shall be applied to the sign substrate at room temperature (18°C) or higher by any of the following methods: mechanical squeeze roll applicator, hand squeeze roll applicator, hand application. If the heater is needed to warm to the minimum application temperature of 18°C, it must be directed at the substrate only.

Users are urged to carefully evaluate all substrates for adhesion and sign durability. "3M Diamond Grade DG³ Reflective Sheeting Series 4000" is designed primarily for application to flat substrates. Sign failures caused by the substrate or improper surface preparation are not the responsibility of the ETA holder.

5.2.3.2 3M Electrocut film Series 1170

Electrocut film shall be stored in a cool, dry area 18-24°C and 30 – 50 % RH, and shall be used within one year from date of purchase.

These overlay films have a transparent film release liner designed to aid the cutting process and the removal of the film weed after cutting. It is recommended that inside radius corner fonts be used when cutting film. More over the ETA holder recommend the following steps:

- Adjust knife pressure to cut cleanly through the film without cutting into the liner. A 30° blade works best. Spacing between the letters or numbers should be adjusted to the aesthetic preference of the user. Consult the operating manual for instructions on how to regulate spacing. Do not cut at high speed on variable speed machines.
- Avoid sharp bends when cutting and handling film as this may cause film to release from the liner.
- After cutting is complete, lay sheets flat, face to face, back to back. Always store sheets in this manner until the sheeting has been weeded and transfer tape has been applied.
- Use a stripping tool designed for weeding films that has a blunt (not sharp) edge.
- After weeding is complete, store sheets flat, face to face, and back to back, until transfer tape has been applied.
- Transfer tape can be applied either by hand using a plastic squeegee or through a hand squeeze roll laminator. If applying the transfer tape by hand, care must be taken to always squeeze from the centre to the outside in all directions.

Series 1170 film may be applied to the sheeting either before or after the sheeting has been applied to a substrate. The use of hand squeeze roll laminator is recommended to ensure satisfactory results. Use the "split liner method" – Start in the middle of the sheet and remove half the liner to ensure proper alignment.

After Series 1170 film and sheeting have been applied, remove the transfer tape by carefully removing the tape at as low angle as possible

- When the application tape has been removed, re-roll the sign through the laminator to ensure good adhesion. Adequate pressure is a key factor relating to the ultimate strength and durability of the sheeting - to - substrate adhesion.
- A clean cutting blade is required. To remove the adhesive build up use soft cloth damped with mineral spirits, isopropyl alcohol or 3M Natural Cleaner.

5.2.3.3 3M Piezo Inkjet Ink Series 8800 UV

3M Piezo Ink Jet Ink Series 8800UV is designed as part of the 3M MCS™ (Matched Component System) for application using the Durst Rho 161TS / 162TS Printer onto 3M Diamond Grade DG³ Series 4000 BEFORE mounting the sheeting onto a sign substrate. These UV-curable inks are durable, weather-resistant, and have excellent colour retention when used in combination with 3M ElectroCut™ Film 1170 or 3M Dew Resistant Overlay Film 1180 or 3M Premium Protective Overlay Film 1160 as an overlamine.

Detailed printing guidelines in order to achieve traffic sign colours according to this ETA can be obtained in the latest Product Bulletin for 3M Piezo Ink Jet Ink Series 8800UV.

Above mentioned overlaminates must always be applied, following below instructions:

- To avoid a silvering artifact (trapped air between ink layer and overlamine), the lamination process should be conducted under a controlled set of conditions.
- Recommended laminator specifications and set-up:
- Roll diameter: max. 350 mm; Roll weight: approximately 80 kg; Roll width: 1400-1600 mm
- Core size: 3 inches; 2 Take-up shafts; 2 Supply shafts
- Heatable top roller: min. 45°C; Pressure: > 3 N/mm²

3M Piezo Ink Jet Ink Series 8800UV should not be stored at elevated temperatures. It must be used within the indicated shelf life.

5.2.3.4 Protective Overlay Films : 3M Dew Resistant Overlay Film 1180 and 3M Premium Protective Overlay Film 1160

Protective Overlay film shall be stored in a cool, dry area at 18-24°C and 30 – 50 % RH, and shall be used within one year from date of purchase.

The application of any Protective Overlay Film is typically done on the finished signface (after the application of the ECF and ink) but PRIOR to the application of frames or sign assembly. The Protective Overlay Film must be applied using a squeeze roll applicator (see 3M Information Folder IF1.13). The split liner method may be used.

3M Dew Resistant Overlay Film Series 1180 provides a very sensitive active layer that is prone to contamination and scratches. This active layer is therefore protected by a water-soluble, clear protective coating. This protective coating should remain on the sign as long as possible. Ideally it should be removed after the traffic sign is erected. If the protective coating is removed before sign erection, precautions have to be taken to prevent any contamination or mechanical damage. Due to the protective coating, it is strongly recommended NOT to overlap the Dew Resistant Overlay Film.

Annex 1: Use Options

VISIBILITY		USE OPTIONS											
		Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8	Option 9	Option 10	Option 11	Option 12
Daytime Colour		Tm 4.4.2.1 Lv 5.4.1	Tm 4.4.2.1 Lv 5.4.1	Tm 4.4.2.1 Lv 5.4.1	Tm 4.4.2.1 Lv 5.4.1	Tm 4.4.2.1 Lv 5.4.1	Tm 4.4.2.1 Lv 5.4.1	Tm 4.4.2.1 Lv 5.4.1	Tm 4.4.2.1 Lv 5.4.1	Tm 4.4.2.1 Lv 5.4.1	Tm 4.4.2.1 Lv 5.4.1	Tm 4.4.2.1 Lv 5.4.1	Tm 4.4.2.1 Lv 5.4.1
Luminance factor		Tm 4.4.2.1 Lv 5.4.1	Tm 4.4.2.1 Lv 5.4.1	Tm 4.4.2.1 Lv 5.4.1	Tm 4.4.2.1 Lv 5.4.1	Tm 4.4.2.1 Lv 5.4.1	Tm 4.4.2.1 Lv 5.4.1	Tm 4.4.2.1 Lv 5.4.1	Tm 4.4.2.1 Lv 5.4.1	Tm 4.4.2.1 Lv 5.4.1	Tm 4.4.2.1 Lv 5.4.1	Tm 4.4.2.1 Lv 5.4.1	Tm 4.4.2.1 Lv 5.4.1
Fluorescence Luminance factor		NOT TO BE TESTED	NOT TO BE TESTED	Tm 4.4.2.2 Lv 5.4.2	NOT TO BE TESTED	Tm 4.4.2.2 Lv 5.4.2	NOT TO BE TESTED	NOT TO BE TESTED	Tm 4.4.2.2 Lv 5.4.2	NOT TO BE TESTED	NOT TO BE TESTED	NOT TO BE TESTED	NOT TO BE TESTED
Night-time colour		NOT TO BE TESTED	Tm 4.4.2.3 Lv 5.4.3	Tm 4.4.2.3 Lv 5.4.3	Tm 4.4.2.3 Lv 5.4.3	Tm 4.4.2.3 Lv 5.4.3	Tm 4.4.2.3 Lv 5.4.3	NOT TO BE TESTED	NOT TO BE TESTED	NOT TO BE TESTED	NOT TO BE TESTED	Tm 4.4.2.3 Lv 5.4.3	NOT TO BE TESTED
Coefficient of Retro-reflection-Case A or Case B		Tm 4.4.2.4 Lv 5.4.4	Tm 4.4.2.4 Lv 5.4.4	Tm 4.4.2.4 Lv 5.4.4	Tm 4.4.2.4 Lv 5.4.4	Tm 4.4.2.4 Lv 5.4.4	Tm 4.4.2.4 Lv 5.4.4	Tm 4.4.2.4 Lv 5.4.4	Tm 4.4.2.4 Lv 5.4.4	Tm 4.4.2.4 Lv 5.4.4	Tm 4.4.2.4 Lv 5.4.4	Tm 4.4.2.4 Lv 5.4.4	Tm 4.4.2.4 Lv 5.4.4
Colour Contrast Factors		NOT TO BE TESTED	Tm 4.4.2.5 Lv 5.4.5	NOT TO BE TESTED	Tm 4.4.2.5 Lv 5.4.5	NOT TO BE TESTED	Tm 4.4.2.5 Lv 5.4.5	Tm 4.4.2.5 Lv 5.4.5	NOT TO BE TESTED	Tm 4.4.2.5 Lv 5.4.5	NOT TO BE TESTED	NOT TO BE TESTED	NOT TO BE TESTED
Total luminous transmittance		NOT TO BE TESTED	NOT TO BE TESTED	NOT TO BE TESTED	Tm 4.4.2.6 Lv 5.4.6	NOT TO BE TESTED	Tm 4.4.2.6 Lv 5.4.6	NOT TO BE TESTED	NOT TO BE TESTED	Tm 4.4.2.6 Lv 5.4.6	NOT TO BE TESTED	NOT TO BE TESTED	NOT TO BE TESTED
Impact resistance		Tm 4.4.2.7 Lv 5.4.7	Tm 4.4.2.7 Lv 5.4.7	Tm 4.4.2.7 Lv 5.4.7	Tm 4.4.2.7 Lv 5.4.7	Tm 4.4.2.7 Lv 5.4.7	Tm 4.4.2.7 Lv 5.4.7	Tm 4.4.2.7 Lv 5.4.7	Tm 4.4.2.7 Lv 5.4.7	Tm 4.4.2.7 Lv 5.4.7	Tm 4.4.2.7 Lv 5.4.7	Tm 4.4.2.7 Lv 5.4.7	NOT TO BE TESTED
DURABILITY													
Temperature resistance		NOT TO BE TESTED	Tm 4.7.1 Lv 5.7.1	Tm 4.7.1 Lv 5.7.1	Tm 4.7.1 Lv 5.7.1	NOT TO BE TESTED	NOT TO BE TESTED	Tm 4.7.1 Lv 5.7.1	Tm 4.7.1 Lv 5.7.1	Tm 4.7.1 Lv 5.7.1	Tm 4.7.1 Lv 5.7.1	Tm 4.7.1 Lv 5.7.1	NOT TO BE TESTED
Visibility after accelerated weathering test	Day-time colour (*)	Tm 4.7.2 + 4.4.2.1 Lv 5.7.2	Tm 4.7.2 + 4.4.2.1 Lv 5.7.2	Tm 4.7.2 + 4.4.2.1 Lv 5.7.2	Tm 4.7.2 + 4.4.2.1 Lv 5.7.2	Tm 4.7.2 + 4.4.2.1 Lv 5.7.2	Tm 4.7.2 + 4.4.2.1 Lv 5.7.2	Tm 4.7.2 + 4.4.2.1 Lv 5.7.2	Tm 4.7.2 + 4.4.2.1 Lv 5.7.2	Tm 4.7.2 + 4.4.2.1 Lv 5.7.2	Tm 4.7.2 + 4.4.2.1 Lv 5.7.2	Tm 4.7.2 + 4.4.2.1 Lv 5.7.2	Tm 4.7.2 + 4.4.2.1 Lv 5.7.2
	Luminance factor (*)	Tm 4.7.2 + 4.4.2.1 Lv 5.7.2	Tm 4.7.2 + 4.4.2.1 Lv 5.7.2	Tm 4.7.2 + 4.4.2.1 Lv 5.7.2	Tm 4.7.2 + 4.4.2.1 Lv 5.7.2	Tm 4.7.2 + 4.4.2.1 Lv 5.7.2	Tm 4.7.2 + 4.4.2.1 Lv 5.7.2	Tm 4.7.2 + 4.4.2.1 Lv 5.7.2	Tm 4.7.2 + 4.4.2.1 Lv 5.7.2	Tm 4.7.2 + 4.4.2.1 Lv 5.7.2	Tm 4.7.2 + 4.4.2.1 Lv 5.7.2	Tm 4.7.2 + 4.4.2.1 Lv 5.7.2	Tm 4.7.2 + 4.4.2.1 Lv 5.7.2
	Fluorescence Luminance factor (*)	NOT TO BE TESTED	NOT TO BE TESTED	Tm 4.7.2 + 4.4.2.2 Lv 5.7.3	NOT TO BE TESTED	Tm 4.7.2 + 4.4.2.2 Lv 5.7.3	NOT TO BE TESTED	NOT TO BE TESTED	4.7.2 + 4.4.2.2 Lv 5.7.3	NOT TO BE TESTED	NOT TO BE TESTED	NOT TO BE TESTED	NOT TO BE TESTED
	Coefficient of Retro-reflection (*)	Tm 4.7.2 + 4.4.2.4 Lv 5.7.4	Tm 4.7.2 + 4.4.2.4 Lv 5.7.4	Tm 4.7.2 + 4.4.2.4 Lv 5.7.4	Tm 4.7.2 + 4.4.2.4 Lv 5.7.4	Tm 4.7.2 + 4.4.2.4 Lv 5.7.4	Tm 4.7.2 + 4.4.2.4 Lv 5.7.4	Tm 4.7.2 + 4.4.2.4 Lv 5.7.4	Tm 4.7.2 + 4.4.2.4 Lv 5.7.4	Tm 4.7.2 + 4.4.2.4 Lv 5.7.4	Tm 4.7.2 + 4.4.2.4 Lv 5.7.4	Tm 4.7.2 + 4.4.2.4 Lv 5.7.4	Tm 4.7.2 + 4.4.2.4 Lv 5.7.4
Visibility after outdoor exposure	Day-time colour	Tm 4.7.3 + 4.4.2.1 Lv 5.7.2	Tm 4.7.3 + 4.4.2.1 Lv 5.7.2	Tm 4.7.3 + 4.4.2.1 Lv 5.7.2	Tm 4.7.3 + 4.4.2.1 Lv 5.7.2	Tm 4.7.3 + 4.4.2.1 Lv 5.7.2	Tm 4.7.3 + 4.4.2.1 Lv 5.7.2	Tm 4.7.3 + 4.4.2.1 Lv 5.7.2	Tm 4.7.3 + 4.4.2.1 Lv 5.7.2	Tm 4.7.3 + 4.4.2.1 Lv 5.7.2	Tm 4.7.3 + 4.4.2.1 Lv 5.7.2	Tm 4.7.3 + 4.4.2.1 Lv 5.7.2	Tm 4.7.3 + 4.4.2.1 Lv 5.7.2
	Luminance factor	Tm 4.7.3 + 4.4.2.1 Lv 5.7.2	Tm 4.7.3 + 4.4.2.1 Lv 5.7.2	Tm 4.7.3 + 4.4.2.1 Lv 5.7.2	Tm 4.7.3 + 4.4.2.1 Lv 5.7.2	Tm 4.7.3 + 4.4.2.1 Lv 5.7.2	Tm 4.7.3 + 4.4.2.1 Lv 5.7.2	Tm 4.7.3 + 4.4.2.1 Lv 5.7.2	Tm 4.7.3 + 4.4.2.1 Lv 5.7.2	Tm 4.7.3 + 4.4.2.1 Lv 5.7.2	Tm 4.7.3 + 4.4.2.1 Lv 5.7.2	Tm 4.7.3 + 4.4.2.1 Lv 5.7.2	Tm 4.7.3 + 4.4.2.1 Lv 5.7.2
	Coefficient of Retro-reflection	Tm 4.7.3 + 4.4.2.1 Lv 5.7.2	Tm 4.7.3 + 4.4.2.4 Lv 5.7.4	Tm 4.7.3 + 4.4.2.4 Lv 5.7.4	Tm 4.7.3 + 4.4.2.4 Lv 5.7.4	Tm 4.7.3 + 4.4.2.4 Lv 5.7.4	Tm 4.7.3 + 4.4.2.4 Lv 5.7.4	Tm 4.7.3 + 4.4.2.4 Lv 5.7.4	Tm 4.7.3 + 4.4.2.4 Lv 5.7.4	Tm 4.7.3 + 4.4.2.4 Lv 5.7.4	Tm 4.7.3 + 4.4.2.4 Lv 5.7.4	Tm 4.7.3 + 4.4.2.4 Lv 5.7.4	Tm 4.7.3 + 4.4.2.4 Lv 5.7.4
	Fluorescence Luminance factor	NOT TO BE TESTED	NOT TO BE TESTED	Tm 4.7.3 + 4.4.2.2 Lv 5.7.3	NOT TO BE TESTED	Tm 4.7.3 + 4.4.2.2 Lv 5.7.3	NOT TO BE TESTED	NOT TO BE TESTED	Tm 4.7.3 + 4.4.2.2 Lv 5.7.3	NOT TO BE TESTED	NOT TO BE TESTED	NOT TO BE TESTED	NOT TO BE TESTED

Tm = Test method

Lv = Limit values

(*) = The tests after accelerated exposure can be carried out for the first issue of the ETA in order not to delay the issuing process. In case of further issue of the ETA, then these tests shall be carried out after the outdoor exposure.

Table 1 – Use options

Note: The assessment of the product is performed according to the content of the Option chosen by the manufacturer. Details concerning the characteristics foreseen by the chosen Option as well as test results will be included in an Annex of the ETA.