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Technical Assessment Body issuing the European Technical Assessment: UBAtc.
UBAtc has been designated according to Article 29 of Regulation (EU) No 305/2011
and is member of EOTA (European Organisation for Technical Assessment)

Trade name of the construction product:

Product family to which the construction product belongs:

Manufacturer:

Manufacturing plants:

Website:

This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of:

This version replaces

This European Technical Assessment contains:

1. 3M™ Diamond Grade™ DG³ Prismatic Digital Sheeting 4090DS + 3M™ Piezo Inkjet Ink + 3M™ Protective Overlay Film 1170
2. 3M™ Diamond Grade™ DG³ Prismatic Digital Sheeting 4090DS + 3M™ Piezo Inkjet Ink + 3M™ Protective Overlay Film 1170 + 3M™ Premium Protective Overlay Film 1160

Micro-prismatic retro-reflective sheeting for traffic signs

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20 pages, including 2 annexes, which form an integral part of the document.



European Organisation
for Technical Assessment

Legal bases and general conditions

- 1 This European Technical Assessment is issued by UBAtc (Union belge pour l'Agrément technique de la construction, i.e. Belgian Union for technical Approval in construction), in accordance with:
 - Regulation (EU) No 305/2011¹ of the European Parliament and of the Council of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC
 - Commission Implementing Regulation (EU) No 1062/2013² of 30 October 2013 on the format of the European Technical Assessment for construction products
 - European Assessment Document (EAD) : EAD 120001-01-0106
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- 13 Subject to the application introduced, this European Technical Assessment is issued in English and may be issued by the UBAtc in its official languages. The translations correspond fully to the English reference version circulated in EOTA.
- 14 This European Technical Assessment was first issued by UBAtc on: 2017-07-26. Compared with the 1st version, this ETA comprises an additional production facility and the combination with an additional anti-graffiti layer (referred as product n° 2 on the front page). Clause 3.2 has been added.

¹ OJEU, L 88 of 2011/04/04

² OJEU, L 289 of 2013/10/31

Technical Provisions

1 Description of the construction product

1.1 General

The product consists in 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 as "3M Diamond Grade DG³ Prismatic Digital Sheeting 4090DS + 3M Piezo Inkjet Ink + 3M Protective Overlay Film 1170", with or without 3M Premium Protective Overlay Film 1160".

1.2 Components of "3MTM Diamond GradeTM DG³ Prismatic Digital Sheeting 4090DS + 3MTM Piezo Inkjet Ink + 3MTM Protective Overlay Film 1170, with or without 3MTM Premium Protective Overlay Film 1160"

The complete set of Micro-prismatic retro-reflective sheeting is given in table 1.1. The mixing ratio of the Piezo Inkjet Ink for the various traffic colours has been deposited with UBAtc.

The manufacturer's specification of the initial daylight chromaticity and luminance factor is given in table 1.2 by means of a colour box in the 1931 CIE (2°) system. The manufacturer's specification of the daylight chromaticity and luminance factor 'in-use' (or after the durability test) is given in table 1.3 by means of a colour box in the 1931 CIE (2°) system.

Components	Trade name	Colours/code	Characteristics
Micro-prismatic retro-reflective sheeting	3M TM Diamond Grade TM DG ³ Prismatic Digital Sheeting 4090DS	White 4090DS	Nominal Thickness: 0,35 mm Rolls in various length and widths
Process Colour for digital printing	3M TM Piezo Inkjet Ink Series 8800UV or 8900 UV*	Yellow Red Blue Green Orange Brown Grey Dark Green	18-20 mg/l
3M TM Protective Overlay Film		Clear 1170	Combined Nominal Thickness: 0,50 mm
3M TM Premium Protective Overlay Film		Clear 1160	Combined Nominal Thickness: 0,65 mm

* 3M Piezo Ink Jet Ink Series 8800 UV or 8900 UV are variations of the same basic ink formulations. The difference between Series 8800 and 8900 are the dispersant and stabilizer packages to make the ink suitable for the different printer models and printheads. The curable components are identical. 3M markets both ink series as equal alternatives with the same performances.

Table 1.1: Complete set of Micro-prismatic retro-reflective sheeting covered by this ETA

Colours	Chromaticity Coordinates				Luminance Factor β	
	1	2	3	4		
White <i>Tolerance Sphere*</i>	x y	0.305 0.315	0.335 0.345	0.325 0.355	0.295 0.325	≥ 0.40
Yellow <i>Tolerance Sphere*</i>	x y	0.494 0.505	0.470 0.480	0.513 0.437	0.545 0.454	≥ 0.24
Red <i>Tolerance Sphere*</i>	x y	0.735 0.265	0.700 0.250	0.610 0.340	0.660 0.340	≥ 0.03
Red on Yellow <i>Tolerance Sphere*</i>	x y	0.735 0.265	0.700 0.250	0.610 0.340	0.660 0.340	≥ 0.03
Blue <i>Tolerance Sphere*</i>	x y	0.130 0.090	0.160 0.090	0.160 0.140	0.130 0.140	≥ 0.01
Green <i>Tolerance Sphere*</i>	x y	0.110 0.415	0.170 0.415	0.170 0.500	0.110 0.500	≥ 0.03
Orange <i>Tolerance Sphere*</i>	x y	0.631 0.369	0.560 0.360	0.506 0.404	0.570 0.429	≥ 0.14
Brown <i>Tolerance Sphere*</i>	x y	0.455 0.397	0.523 0.429	0.479 0.373	0.558 0.394	0.03-0.09
Grey <i>Tolerance Sphere*</i>	x y	0.305 0.315	0.335 0.345	0.325 0.355	0.295 0.325	0.11-0.18
Dark Green <i>Tolerance Sphere*</i>	x y	0.313 0.682	0.313 0.453	0.248 0.409	0.127 0.557	0.01-0.07

* Chromaticity Coordinates are similar to EN 12899-1:2007 Class CR2

Table 1.2: Manufacturer's specification for initial daylight chromaticity and luminance factor

Colours	Chromaticity Coordinates				Luminance Factor β	
	1	2	3	4		
White <i>Tolerance Sphere*</i>	x y	0.355 0.355	0.305 0.305	0.285 0.325	0.335 0.375	≥ 0.40
Yellow <i>Tolerance Sphere*</i>	x y	0.545 0.454	0.487 0.423	0.427 0.483	0.465 0.534	≥ 0.24
Red <i>Tolerance Sphere*</i>	x y	0.735 0.265	0.674 0.236	0.569 0.341	0.655 0.345	≥ 0.03
Red on Yellow <i>Tolerance Sphere*</i>	x y	0.735 0.265	0.700 0.250	0.610 0.340	0.660 0.340	≥ 0.03
Blue <i>Tolerance Sphere*</i>	x y	0.078 0.171	0.150 0.220	0.210 0.160	0.137 0.038	≥ 0.01
Green <i>Tolerance Sphere*</i>	x y	0.007 0.703	0.248 0.409	0.177 0.362	0.026 0.399	≥ 0.03
Orange <i>Tolerance Sphere*</i>	x y	0.631 0.369	0.560 0.360	0.506 0.404	0.570 0.429	≥ 0.14
Brown <i>Tolerance Sphere*</i>	x y	0.455 0.397	0.523 0.429	0.479 0.373	0.558 0.394	0.03-0.09
Grey <i>Tolerance Sphere*</i>	x y	0.350 0.360	0.300 0.310	0.285 0.325	0.335 0.375	0.11-0.18
Dark Green <i>Tolerance Sphere*</i>	x y	0.313 0.682	0.313 0.453	0.248 0.409	0.127 0.557	0.01-0.07

* Chromaticity Coordinates are similar to EN 12899-1:2007 Class CR1

Table 1.3: Manufacturer's specification for daylight chromaticity and luminance factor 'in-use'

2 Information on the intended use of the construction product

2.1 Intended uses

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,
- trans-illuminated traffic bollards,
- road delineators with retro-reflective devices,
- variable message signs.

The envisaged substrates or structures are commonly, but not only, based on aluminium, galvanised steel or processed polymers. The test specimens for this ETA have been prepared on smooth aluminium panels, according to EAD 120001-01-0106, Annex 1.

The assumed intended working life of the product is 10 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 Technical Assessment Body.

2.2 Assumptions under which the fitness of the product(s) for the intended use was favourably assessed

2.2.1 Manufacturing directives

The “3M Diamond Grade DG³ Prismatic Digital Sheeting 4090DS + 3M Piezo Inkjet Ink + 3M Protective Overlay Film 1170 + 3MTM Premium Protective Overlay Film 1160”, shall correspond, as far as their composition and manufacturing process is concerned, to the products subject to the assessment tests. A manufacturing process has been deposited with UBAtc.

2.2.2 Installation

2.2.2.1 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 1.1 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.

Only the components described in clause 1.1 of this ETA may be used for the systems “3M Diamond Grade DG³ Prismatic Digital Sheeting 4090DS + 3M Piezo Inkjet Ink + 3M Protective Overlay Film 1170 + 3MTM Premium Protective Overlay Film 1160”.

2.2.2.2 Design

Users are urged to carefully evaluate all substrates for adhesion and sign durability. “3M Diamond Grade DG³ Prismatic Digital Sheeting 4090DS” is designed primarily for application to flat substrates.

2.2.2.3 Application

“3MTM Diamond GradeTM DG³ Prismatic Digital Sheeting 4090DS”

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, if any.

“3M Diamond Grade DG³ Prismatic Digital Sheeting 4090DS” 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 shall be directed at the substrate only.

Users are urged to carefully evaluate all substrates for adhesion and sign durability. “3M Diamond Grade DG³ Prismatic Digital Sheeting 4090DS” is designed primarily for application to flat substrates. Sign failures caused by the substrate due to improper surface preparation are not the responsibility of the ETA holder.

3MTM Piezo Inkjet Ink Series 8800 UV or 8900 UV

3M Piezo Ink Jet Ink Series 8800 UV or 8900 UV are designed as part of the 3M MCSTM (Matched Component System) for application using the Durst Rho 161TS / 162TS / 163 and EFI H1625RS Printer onto 3M Diamond Grade DG³ Prismatic Digital Sheeting 4090DS 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 Protective Overlay Film 1170 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 or 8900UV.

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

3MTM Protective Overlay Film 1170

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.

3M Protective Overlay Film 1170 shall always be applied, following below instructions:

To avoid a silvering artefact (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: > 8 bar

3M™ Premium Protective Overlay Film 1160

Premium 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 Premium Protective Overlay Film is typically done on the finished signface (for digitally printed signs after the application of Protective Overlay Film 1170).

Alternatively, for digitally printed signs, the 1170 and 1160 Protective Overlay Film may be purchased prelaminated as combination and applied in a single lamination step by the user. The Combination of Protective Overlay Films shall always be applied, following above instructions for the 1170 Film.

2.3 Recommendations

2.3.1 Recommendations on packaging, transport and storage

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

3 Methods and criteria for assessing the performance of the product in relation to

essential characteristics of the product

Essential Characteristics of the product
Basic Works Requirement 4: Safety and accessibility in use

No	Essential Characteristic	Clause	Product Performance
Visibility Characteristics			
1	Daylight Chromaticity and Luminance Factor	3.x.1	Value
2	Night-time colour	3.x.2	No performance assessed
3	Coefficient of Retro-reflection	3.x.3	Value (average of three samples)
4	Rotational symmetry	3.x.4	Value (Ratio)
Durability			
5	Impact resistance	3.x.5	EN 12899-1:2007
6	Temperature resistance	3.x.6	No performance assessed
7	Daylight Chromaticity and Luminance Factor after accelerated artificial weathering	3.x.7.1	Value
8	Coefficient of Retro-reflection after accelerated artificial weathering	3.x.7.2	Value (average of three samples)
9	Visibility after natural weathering	3.x.8	No performance assessed
10	Adhesion	3.x.9	No performance assessed

3.1 3M™ Diamond Grade™ DG³ Prismatic Digital Sheeting 4090DS + 3M™ Piezo Inkjet Ink + 3M™ Protective Overlay Film 1170

3.1.2 Night-time colour

No performance assessed.

3.1.1 Daylight Chromaticity and Luminance Factor

The characteristics of initial daylight chromaticity and luminance factor have been determined according to EAD120001-01-0106, clause 2.2.1 and have been specified in Annex 1, clause 1.1, of this ETA.

3.1.3 Coefficient of Retro-reflection

The Coefficient of Retro-reflection has been determined according to EAD120001-01-0106, clause 2.2.3. The rotation angle ϵ has been set to 0° according to the manufacturer's specification. The result of the test is given as average of three samples.

Geometry of measurements		Colour								
α	β_1 ($\beta_2 = 0$)	White	Yellow	Red	Blue	Green	Orange	Brown	Grey	Dark Green
0.1°	+5°	1482	608	219	143	117	477	179	738	117
	+15°	1167	473	169	111	91	368	138	573	90
	+20°	982	394	141	92	75	307	115	480	74
	+30°	617	241	86	56	46	189	70	299	44
	+40°	296	113	41	27	22	91	32	143	21
0.2°	+5°	916	392	142	87	72	306	116	459	74
	+15°	782	324	118	72	59	252	95	384	60
	+20°	679	279	101	61	51	217	81	332	51
	+30°	444	178	64	40	33	140	52	215	32
	+40°	220	86	31	20	16	69	25	106	16
0.33°	+5°	643	316	108	79	66	242	91	339	66
	+15°	516	235	81	56	47	181	67	262	46
	+20°	449	202	70	47	34	155	56	225	39
	+30°	279	126	44	28	24	98	35	139	23
	+40°	129	58	20	13	11	45	16	64	11
0.5°	+5°	571	314	115	67	61	248	93	310	62
	+15°	435	228	81	51	46	179	66	231	46
	+20°	377	191	68	43	38	148	54	196	37
	+30°	237	120	41	27	24	92	33	124	23
	+40°	103	51	17	12	10	40	14	54	10
1.0°	+5°	164	124	46	21	25	95	37	91	25
	+15°	139	103	39	18	20	80	30	79	21
	+20°	127	92	34	16	18	65	27	72	18
	+30°	85	65	23	12	12	50	19	50	12
	+40°	53	37	13	6,5	6,8	28	10	29	6,7
1.5°	+5°	50	45	16	6,8	9,0	33	13	28	9,5
	+15°	40	40	15	5,8	7,7	30	12	23	8,3
	+20°	36	36	13	5,1	7,0	27	11	21	7,3
	+30°	34	29	11	4,4	5,6	22	8,6	19	5,6
	+40°	20	19	6,9	2,9	3,5	14	5,3	12	3,4
2.0°	+5°	15	17	6,2	2,0	3,3	12	5,0	8,8	3,8
	+15°	15	16	5,9	2,0	3,1	12	4,7	8,5	3,5
	+20°	15	15	5,3	1,9	2,8	11	4,3	8,0	3,2
	+30°	12	12	4,6	1,6	2,3	9,2	3,5	6,6	2,6
	+40°	10	10	3,5	1,3	1,7	7,3	2,6	5,6	1,8

3.1.4 Rotational symmetry

The rotational symmetry has been determined according to EAD120001-01-0106, clause 2.2.3 "rotational symmetry". The rotation angle ϵ has been set to 0° according to the manufacturer's specification.

White Rotational symmetry	
#	Ratio
Sample 1	1 : 1,30
Sample 2	1: 1,29
Sample 3	1: 1,29

Yellow Rotational symmetry	
#	Ratio
Sample 1	1 : 1,24
Sample 2	1: 1,23
Sample 3	1: 1,14

Red Rotational symmetry	
#	Ratio
Sample 1	1 : 1,24
Sample 2	1: 1,25
Sample 3	1: 1,24

Blue Rotational symmetry	
#	Ratio
Sample 1	1 : 1,14
Sample 2	1 : 1,17
Sample 3	1 : 1,13

Green Rotational symmetry	
#	Ratio
Sample 1	1 : 1,12
Sample 2	1 : 1,13
Sample 3	1 : 1,15

Orange Rotational symmetry	
#	Ratio
Sample 1	1 : 1,23
Sample 2	1 : 1,21
Sample 3	1 : 1,15

Brown Rotational symmetry	
#	Ratio
Sample 1	1 : 1,22
Sample 2	1 : 1,21
Sample 3	1 : 1,20

Grey Rotational symmetry	
#	Ratio
Sample 1	1 : 1,21
Sample 2	1 : 1,25
Sample 3	1 : 1,25

Dark Green Rotational symmetry	
#	Ratio
Sample 1	1 : 1,07
Sample 2	1 : 1,15
Sample 3	1 : 1,13

3.1.5 Impact resistance

The Impact resistance has been determined according to EAD120001-01-0106, clause 2.2.4.

Sample	Test Result
White	No apparent cracking or delamination observed
Yellow	
Red	
Blue	
Green	
Orange	
Brown	
Grey	
Dark Green	

3.1.6 Temperature resistance

No performance assessed

3.1.7 Visibility after weathering

The artificial weathering has been done according to EAD 120001-01-0106, clause 2.2.6.1, with the use of a (non-insulated) black-panel thermometer. The size of the specimens is (5,5 x 10) cm.

3.1.7.1 Daylight Chromaticity and Luminance Factor after accelerated artificial weathering

The daylight chromaticity and luminance factor, verified according to EAD120001-01-0106, clause 2.2.1, tested after accelerated artificial weathering test, have been specified in Annex 1, clause 1.2 of this ETA.

3.1.7.2 Coefficient of Retro-reflection after accelerated artificial weathering

The Coefficient of Retro-reflection after accelerated artificial weathering tests has been determined according to EAD 120001-01-0106, clause 2.2.6.4, with an observation angle $\alpha = 0,33^\circ$ and $\beta_1 = 5^\circ$ and 30° . The rotation angle ε has been set to 0° according to the manufacturer's specification. The result of the test is given as average of three samples.

Colours	Geometry of Measurements			
	$\alpha = 0,33^\circ$ $\beta_1 = 5^\circ$	$\alpha = 0,33^\circ$ $\beta_1 = 30^\circ$	$\alpha = 1,0^\circ$ $\beta_1 = 5^\circ$	$\alpha = 1,0^\circ$ $\beta_1 = 30^\circ$
White	674	279	162	86
Yellow	351	141	124	64
Red	112	46	42	22
Blue	84	31	22	11
Green	87	32	28	14
Orange	263	107	89	46
Brown	97	39	36	19
Grey	353	147	90	47
Dark Green	73	27	26	13

3.1.8 Visibility after natural weathering

No performance assessed

3.1.9 Adhesion

No performance assessed

3.2 3M™ Diamond Grade™ DG³ Prismatic Digital Sheeting 4090DS + 3M™ Piezo Inkjet Ink + 3M™ Protective Overlay Film 1170 + 3M™ Premium Protective Overlay Film 1160

3.2.2 Night-time colour

No performance assessed.

3.2.1 Daylight Chromaticity and Luminance Factor

The characteristics of initial daylight chromaticity and luminance factor have been determined according to EAD120001-01-0106, clause 2.2.1 and have been specified in Annex 2, clause 2.1, of this ETA.

3.2.3 Coefficient of Retro-reflection

The Coefficient of Retro-reflection has been determined according to EAD120001-01-0106, clause 2.2.3. The rotation angle ε has been set to 0° according to the manufacturer's specification. The result of the test is given as average of three samples.

Geometry of measurements		Colour								
α	β_1 ($\beta_2 = 0$)	White	Yellow	Red	Blue	Green	Orange	Brown	Grey	Dark Green
0.1°	+5°	1479	544	195	115	131	430	163	681	103
	+15°	1145	423	150	87	100	332	126	529	80
	+20°	957	352	123	72	82	275	105	442	66
	+30°	596	212	73	43	49	167	63	272	39
	+40°	284	98	34	20	23	79	29	129	18
0.2°	+5°	931	358	129	71	83	278	107	429	67
	+15°	770	291	104	57	66	227	87	356	54
	+20°	660	249	88	48	56	194	75	306	45
	+30°	425	156	55	30	35	122	47	196	28
	+40°	210	75	26	15	17	60	23	96	14
0.33°	+5°	681	293	98	66	76	219	87	323	60
	+15°	517	215	73	46	53	162	64	245	42
	+20°	439	181	61	37	43	137	54	209	35
	+30°	269	111	38	22	26	85	33	129	21
	+40°	125	50	17	10	12	40	15	60	9.5
0.5°	+5°	604	292	105	57	71	225	91	300	58
	+15°	447	211	73	42	52	161	65	218	42
	+20°	377	176	60	35	43	134	54	185	34
	+30°	235	109	36	22	26	82	33	115	21
	+40°	103	46	15	10	12	35	14	50	9.1
1.0°	+5°	161	121	44	19	28	89	40	89	26
	+15°	143	99	35	16	23	73	33	75	21
	+20°	133	87	31	14	20	65	28	68	18
	+30°	89	59	21	10	14	45	19	47	12
	+40°	54	35	12	5.7	7.7	26	11	29	6.6
1.5°	+5°	47	46	16	6.2	10	32	16	27	10
	+15°	40	40	14	5.3	8.8	28	13	23	8.6
	+20°	38	36	13	4.8	8.0	26	12	21	7.7
	+30°	35	28	10	4.0	6.3	20	9.0	18	5.7
	+40°	21	18	6.4	2.6	4.0	13	5.8	11	3.5
2.0°	+5°	16	18	6.3	2.1	3.9	12	6.1	9.1	4.3
	+15°	15	16	5.7	1.9	3.5	11	5.3	8.5	3.6
	+20°	14	15	5.3	1.8	3.2	10	4.9	7.6	3.3
	+30°	12	12	4.4	1.5	2.7	8.5	3.9	6.1	2.6
	+40°	10	9.4	3.3	1.2	2.0	6.7	2.9	5.3	1.9

3.2.4 Rotational symmetry

The rotational symmetry has been determined according to EAD120001-01-0106, clause 2.2.3 "rotational symmetry". The rotation angle ε has been set to 0° according to the manufacturer's specification.

White Rotational symmetry	
#	Ratio
Sample 1	1 : 1,27
Sample 2	1 : 1,27
Sample 3	1 : 1,24

Yellow Rotational symmetry	
#	Ratio
Sample 1	1 : 1,20
Sample 2	1 : 1,18
Sample 3	1 : 1,17

Red Rotational symmetry	
#	Ratio
Sample 1	1 : 1,26
Sample 2	1 : 1,19
Sample 3	1 : 1,27

Blue Rotational symmetry	
#	Ratio
Sample 1	1 : 1,12
Sample 2	1 : 1,12
Sample 3	1 : 1,14

Green Rotational symmetry	
#	Ratio
Sample 1	1 : 1,16
Sample 2	1 : 1,10
Sample 3	1 : 1,13

Orange Rotational symmetry	
#	Ratio
Sample 1	1 : 1,25
Sample 2	1 : 1,16
Sample 3	1 : 1,24

Brown Rotational symmetry	
#	Ratio
Sample 1	1 : 1,24
Sample 2	1 : 1,16
Sample 3	1 : 1,20

Grey Rotational symmetry	
#	Ratio
Sample 1	1 : 1,24
Sample 2	1 : 1,22
Sample 3	1 : 1,23

Dark Green Rotational symmetry	
#	Ratio
Sample 1	1 : 1,13
Sample 2	1 : 1,12
Sample 3	1 : 1,12

3.2.5 Impact resistance

The Impact resistance has been determined according to EAD120001-01-0106, clause 2.2.4.

Sample	Test Result
White	No apparent cracking or delamination observed
Yellow	
Red	
Blue	
Green	
Orange	
Brown	
Grey	
Dark Green	

3.2.6 Temperature resistance

No performance assessed

3.2.7 Visibility after weathering

The artificial weathering has been done according to EAD 120001-01-0106, clause 2.2.6.1, with the use of a (non-insulated) black-panel thermometer. The size of the specimens is (5,5 x 10) cm.

3.2.7.1 Daylight Chromaticity and Luminance Factor after accelerated artificial weathering

The daylight chromaticity and luminance factor, verified according to EAD120001-01-0106, clause 2.2.1, tested after accelerated artificial weathering test, have been specified in Annex 2, clause 2.2 of this ETA.

3.2.7.2 Coefficient of Retro-reflection after accelerated artificial weathering

The Coefficient of Retro-reflection after accelerated artificial weathering tests has been determined according to EAD 120001-01-0106, clause 2.2.6.4, with an observation angle $\alpha = 0,33^\circ$ and $\beta_1 = 5^\circ$ and 30° . The rotation angle ε has been set to 0° according to the manufacturer's specification. The result of the test is given as average of three samples.

Colours	Geometry of Measurements			
	$\alpha = 0,33^\circ$ $\beta_1 = 5^\circ$	$\alpha = 0,33^\circ$ $\beta_1 = 30^\circ$	$\alpha = 1,0^\circ$ $\beta_1 = 5^\circ$	$\alpha = 1,0^\circ$ $\beta_1 = 30^\circ$
White	544	225	148	75
Yellow	285	105	116	56
Red	93	36	39	19
Blue	69	23	20	9.8
Green	89	31	32	15
Orange	220	82	85	42,7
Brown	105	39	44	21
Grey	316	122	86	43
Dark Green	75	25	30	14

3.2.8 Visibility after natural weathering

No performance assessed

3.2.9 Adhesion

No performance assessed

4 Assessment and verification of constancy of performance (AVCP) system applied, with reference to its legal base

In accordance with Regulation (EU) N° 305/2011, Article 65, Directive 89/106/EEC is repealed, but references to the repealed Directive shall be construed as references to the Regulation.

The system of assessment and verification of constancy of performance, specified in the Decision of the Commission 1996/579/EC of 1996/06/24³, as amended by Commission Decision 1999/453/EC of 1999/06/18⁴, is specified in the following Table.

Table 2 – System of assessment and verification of constancy of performance

Road traffic signs	For circulation areas	Any	1

* See Annex V to Regulation (EU) N° 305/2011

5 Technical details necessary for the implementation of the AVCP system, as foreseen in the applicable EAD

5.1 Tasks for the ETA-holder

The cornerstones of the actions to be undertaken by the manufacturer of the product in the process of assessment and verification of constancy of performance are laid down in clause 3.2 of the European Assessment Document 120001-01-0106.

The manufacturer is allowed to use similar test or control methods, using different equipment and test samples under different conditions, as long as the manufacturer ensures constant product performances, but the frequency of control shall be respected.

5.2 Tasks of notified bodies

The cornerstones of the actions to be undertaken by the notified body in the procedure of assessment and verification of constancy of performance are laid down in clause 3.3 of the European Assessment Document 120001-01-0106.

6 Reference documents

See clause 4 of the European Assessment Document 120001-01-0106.

NOTE: The editions of reference documents given above are those which have been adopted by the UBAtc for its specific use when establishing this ETA. When new editions become available, these supersede the editions mentioned only when confirmed by the UBAtc.

³ see OJEU L 254, 8.10.1996, p. 52

⁴ see OJEU L 178, 14.7.1999, p. 50

UBATc asbl is a non-profit organization according to Belgian law. It is a Technical Assessment Body notified by the Belgian notifying authority, the Federal Public Services Economy, SMEs, Self-Employed and Energy, on 17 July 2013 in the framework of Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC and is member of the European Organisation for Technical Assessment, EOTA (www.eota.eu).

This European Technical Assessment has been issued by UBATc asbl, in Sint-Stevens-Woluwe, on the basis of the technical work carried out by the Assessment Operator, COPRO.

On behalf of UBATc asbl,

On behalf of the Assessment Operator,
COPRO, responsible for the technical
content of the ETA,



Peter Wouters,
director



Benny De Blaere,
director



Dirk Van Loo,
CEO COPRO

The most recent version of this European Technical Assessment may be consulted on the UBATc website (www.ubatc.be).

Annex 1

3M™ Diamond Grade™ DG³ Prismatic Digital Sheeting 4090DS + 3M™ Piezo Inkjet Ink + 3M™ Protective Overlay Film 1170

Daylight Chromaticity and Luminance Factor, initial and after accelerated artificial weathering

1.1 Daylight Chromaticity and Luminance Factor, initial

Colours	Chromaticity Coordinates					Luminance Factor β
		1	2	3	4	
White Tolerance Sphere	x	0.305	0.335	0.325	0.295	≥ 0.40
	y	0.315	0.345	0.355	0.325	
White Sample 1	x	0.310				0.42
	y	0.327				
White Sample 2	x	0.311				0.42
	y	0.328				
White Sample 3	x	0.311				0.42
	y	0.327				
Yellow Tolerance Sphere	x	0.494	0.470	0.513	0.545	≥ 0.24
	y	0.505	0.480	0.437	0.454	
Yellow Sample 1	x	0.478				0.28
	y	0.477				
Yellow Sample 2	x	0.475				0,25
	y	0.475				
Yellow Sample 3	x	0.477				0,27
	y	0.479				
Red Tolerance Sphere	x	0.735	0.700	0.610	0.660	≥ 0.03
	y	0.265	0.250	0.340	0.340	
Red Sample 1	x	0.634				0.07
	y	0.331				
Red Sample 2	x	0.634				0.07
	y	0.332				
Red Sample 3	x	0.637				0.07
	y	0.332				
Blue Tolerance Sphere	x	0.130	0.160	0.160	0.130	≥ 0.01
	y	0.090	0.090	0.140	0.140	
Blue Sample 1	x	0.141				0.04
	y	0.125				
Blue Sample 2	x	0.145				0.06
	y	0.137				
Blue Sample 3	x	0.142				0.05
	y	0.128				
Green Tolerance Sphere	x	0.110	0.170	0.170	0.110	≥ 0.03
	y	0.415	0.415	0.500	0.500	
Green Sample 1	x	0.160				0.06
	y	0.442				
Green Sample 2	x	0.158				0.05
	y	0.481				
Green Sample 3	x	0.159				0.06
	y	0.449				
Orange Tolerance Sphere	x	0.631	0.560	0.506	0.570	≥ 0.14
	y	0.369	0.360	0.404	0.429	
Orange Sample 1	x	0.550				0.15
	y	0.407				
Orange Sample 2	x	0.546				0.14
	y	0.411				
Orange Sample 3	x	0.536				0.14
	y	0.402				
Brown Tolerance Sphere	x	0.455	0.523	0.479	0.558	0.03-0.09
	y	0.397	0.429	0.373	0.394	
Brown Sample 1	x	0.521				0.05
	y	0.405				
Brown Sample 2	x	0.525				0,05
	y	0.399				
Brown Sample 3	x	0.527				0,04
	y	0.397				

Colours	Chromaticity Coordinates					Luminance Factor β
		1	2	3	4	
Grey Tolerance Sphere	x	0.305	0.335	0.325	0.295	0.11-0.18
	y	0.315	0.345	0.355	0.325	
Grey Sample 1	x	0.318				0.15
	y	0.333				
Grey Sample 2	x	0.318				0.14
	y	0.333				
Grey Sample 3	x	0.317				0.13
	y	0.331				
Dark Green Tolerance Sphere	x	0.313	0.313	0.248	0.127	0.01-0.07
	y	0.682	0.453	0.409	0.557	
Dark Green Sample 1	x	0.227				0.06
	y	0.513				
Dark Green Sample 2	x	0.205				0.06
	y	0.562				
Dark Green Sample 3	x	0.226				0.08
	y	0.560				

1.2 Daylight Chromaticity and Luminance Factor, after accelerated artificial weathering

Colours	Chromaticity Coordinates					Luminance Factor β
		1	2	3	4	
White	x	0.355	0.305	0.285	0.335	≥ 0.40
Tolerance Sphere	y	0.355	0.305	0.325	0.375	
White Sample 1	x	0.310				0.43
	y	0.327				
White Sample 2	x	0.310				0.45
	y	0.326				
White Sample 3	x	0.312				0.43
	y	0.328				
Yellow	x	0.545	0.487	0.427	0.465	≥ 0.24
Tolerance Sphere	y	0.454	0.423	0.483	0.534	
Yellow Sample 1	x	0.469				0.30
	y	0.479				
Yellow Sample 2	x	0.472				0.28
	y	0.476				
Yellow Sample 3	x	0.472				0.28
	y	0.482				
Red	x	0.735	0.674	0.569	0.655	≥ 0.03
Tolerance Sphere	y	0.265	0.236	0.341	0.345	
Red Sample 1	x	0.622				0.08
	y	0.335				
Red Sample 2	x	0.618				0.07
	y	0.334				
Red Sample 3	x	0.624				0.07
	y	0.337				
Blue	x	0.078	0.150	0.210	0.137	≥ 0.01
Tolerance Sphere	y	0.171	0.220	0.160	0.038	
Blue Sample 1	x	0.143				0.04
	y	0.143				
Blue Sample 2	x	0.147				0.06
	y	0.142				
Blue Sample 3	x	0.144				0.05
	y	0.134				
Green		0.007	0.248	0.177	0.026	≥ 0.03
Tolerance Sphere		0.703	0.409	0.362	0.399	
Green Sample 1	x	0.177				0.08
	y	0.422				
Green Sample 2	x	0.162				0.05
	y	0.471				
Green Sample 3	x	0.156				0.06
	y	0.436				
Orange	x	0.631	0.560	0.506	0.570	≥ 0.14
Tolerance Sphere	y	0.369	0.360	0.404	0.429	
Orange Sample 1	x	0.538				0.17
	y	0.411				
Orange Sample 2	x	0.547				0.15
	y	0.411				
Orange Sample 3	x	0.528				0.17
	y	0.408				
Brown	x	0.455	0.523	0.479	0.558	0.03-0.09
Tolerance Sphere	y	0.397	0.429	0.373	0.394	
Brown Sample 1	x	0.512				0.06
	y	0.407				
Brown Sample 2	x	0.518				0.05
	y	0.400				
Brown Sample 3	x	0.523				0.05
	y	0.405				
Grey	x	0.350	0.300	0.285	0.335	0.11-0.18
Tolerance Sphere	y	0.360	0.310	0.325	0.375	
Grey Sample 1	x	0.318				0.15
	y	0.333				
Grey Sample 2	x	0.318				0.13
	y	0.332				
Grey Sample 3	x	0.319				0.14
	y	0.333				

Colours	Chromaticity Coordinates				Luminance Factor β	
		1	2	3		4
Dark Green Tolerance Sphere	x	0.313	0.313	0.248	0.127	0.01-0.07
	y	0.682	0.453	0.409	0.557	
Dark Green Sample 1	x		0.226			0.06
	y		0.498			
Dark Green Sample 2	x		0.208			0.06
	y		0.555			
Dark Green Sample 3	x		0.249			0.06
	y		0.529			

Annex 2

3M™ Diamond Grade™ DG³ Prismatic Digital Sheeting 4090DS + 3M™ Piezo Inkjet Ink + 3M™ Protective Overlay Film 1170 + 3M™ Premium Protective Overlay Film 1160

Daylight Chromaticity and Luminance Factor, initial and after accelerated artificial weathering

2.1 Daylight Chromaticity and Luminance Factor, initial

Colours		Chromaticity Coordinates				Luminance Factor β
		1	2	3	4	
White Tolerance Sphere	x	0.305	0.335	0.325	0.295	≥ 0.40
	y	0.315	0.345	0.355	0.325	
White Sample 1	x	0.309				0.44
	y	0.326				
White Sample 2	x	0.308				0.44
	y	0.323				
White Sample 3	x	0.308				0.41
	y	0.324				
Yellow Tolerance Sphere	x	0.494	0.470	0.513	0.545	≥ 0.24
	y	0.505	0.480	0.437	0.454	
Yellow Sample 1	x	0.477				0.28
	y	0.476				
Yellow Sample 2	x	0.480				0.26
	y	0.472				
Yellow Sample 3	x	0.480				0.27
	y	0.475				
Red Tolerance Sphere	x	0.735	0.700	0.610	0.660	≥ 0.03
	y	0.265	0.250	0.340	0.340	
Red Sample 1	x	0.628				0.08
	y	0.332				
Red Sample 2	x	0.637				0.06
	y	0.325				
Red Sample 3	x	0.639				0.07
	y	0.328				
Blue Tolerance Sphere	x	0.130	0.160	0.160	0.130	≥ 0.01
	y	0.090	0.090	0.140	0.140	
Blue Sample 1	x	0.142				0.04
	y	0.123				
Blue Sample 2	x	0.145				0.05
	y	0.133				
Blue Sample 3	x	0.142				0.05
	y	0.129				
Green Tolerance Sphere	x	0.110	0.170	0.170	0.110	≥ 0.03
	y	0.415	0.415	0.500	0.500	
Green Sample 1	x	0.170				0.08
	y	0.431				
Green Sample 2	x	0.166				0.07
	y	0.434				
Green Sample 3	x	0.156				0.06
	y	0.446				
Orange Tolerance Sphere	x	0.631	0.560	0.506	0.570	≥ 0.14
	y	0.369	0.360	0.404	0.429	
Orange Sample 1	x	0.548				0.16
	y	0.406				
Orange Sample 2	x	0.548				0.15
	y	0.406				
Orange Sample 3	x	0.545				0.15
	y	0.398				

Colours	Chromaticity Coordinates					Luminance Factor β
		1	2	3	4	
Brown Tolerance Sphere	x	0.455	0.523	0.479	0.558	0.03-0.09
	y	0.397	0.429	0.373	0.394	
Brown Sample 1	x	0.517				0.05
	y	0.404				
Brown Sample 2	x	0.496				0.06
	y	0.394				
Brown Sample 3	x	0.522				0.05
	y	0.399				
Grey Tolerance Sphere	x	0.305	0.335	0.325	0.295	0.11-0.18
	y	0.315	0.345	0.355	0.325	
Grey Sample 1	x	0.316				0.15
	y	0.331				
Grey Sample 2	x	0.316				0.15
	y	0.330				
Grey Sample 3	x	0.316				0.13
	y	0.331				
Dark Green Tolerance Sphere	x	0.313	0.313	0.248	0.127	0.01-0.07
	y	0.682	0.453	0.409	0.557	
Dark Green Sample 1	x	0.222				0.06
	y	0.496				
Dark Green Sample 2	x	0.228				0.07
	y	0.561				
Dark Green Sample 3	x	0.249				0.06
	y	0.527				

2.2 Daylight Chromaticity and Luminance Factor, after accelerated artificial weathering

Colours	Chromaticity Coordinates					Luminance Factor β
		1	2	3	4	
White	x	0.355	0.305	0.285	0.335	≥ 0.40
Tolerance Sphere	y	0.355	0.305	0.325	0.375	
White Sample 1	x	0.308				0.42
	y	0.323				
White Sample 2	x	0.308				0.44
	y	0.323				
White Sample 3	x	0.309				0.44
	y	0.325				
Yellow	x	0.545	0.487	0.427	0.465	≥ 0.24
Tolerance Sphere	y	0.454	0.423	0.483	0.534	
Yellow Sample 1	x	0.470				0.29
	y	0.478				
Yellow Sample 2	x	0.473				0.27
	y	0.474				
Yellow Sample 3	x	0.474				0.28
	y	0.477				
Red	x	0.735	0.674	0.569	0.655	≥ 0.03
Tolerance Sphere	y	0.265	0.236	0.341	0.345	
Red Sample 1	x	0.615				0.08
	y	0.335				
Red Sample 2	x	0.624				0.06
	y	0.330				
Red Sample 3	x	0.619				0.07
	y	0.330				
Blue	x	0.078	0.150	0.210	0.137	≥ 0.01
Tolerance Sphere	y	0.171	0.220	0.160	0.038	
Blue Sample 1	x	0.145				0.04
	y	0.157				
Blue Sample 2	x	0.148				0.06
	y	0.155				
Blue Sample 3	x	0.145				0.06
	y	0.155				
Green		0.007	0.248	0.177	0.026	≥ 0.03
Tolerance Sphere		0.703	0.409	0.362	0.399	
Green Sample 1	x	0.189				0.09
	y	0.443				
Green Sample 2	x	0.184				0.08
	y	0.447				
Green Sample 3	x	0.172				0.07
	y	0.449				
Orange	x	0.631	0.560	0.506	0.570	≥ 0.14
Tolerance Sphere	y	0.369	0.360	0.404	0.429	
Orange Sample 1	x	0.537				0.16
	y	0.409				
Orange Sample 2	x	0.538				0.15
	y	0.410				
Orange Sample 3	x	0.527				0.16
	y	0.400				
Brown	x	0.455	0.523	0.479	0.558	0.03-0.09
Tolerance Sphere	y	0.397	0.429	0.373	0.394	
Brown Sample 1	x	0.497				0.07
	y	0.408				
Brown Sample 2	x	0.492				0.07
	y	0.398				
Brown Sample 3	x	0.509				0.06
	y	0.400				
Grey	x	0.350	0.300	0.285	0.335	0.11-0.18
Tolerance Sphere	y	0.360	0.310	0.325	0.375	
Grey Sample 1	x	0.317				0.16
	y	0.332				
Grey Sample 2	x	0.317				0.15
	y	0.331				
Grey Sample 3	x	0.317				0.14
	y	0.332				

Colours	Chromaticity Coordinates				Luminance Factor β	
		1	2	3		4
Dark Green Tolerance Sphere	x	0.313	0.313	0.248	0.127	0.01-0.07
	y	0.682	0.453	0.409	0.557	
Dark Green Sample 1	x	0.228				0.07
	y	0.488				
Dark Green Sample 2	x	0.243				0.08
	y	0.558				
Dark Green Sample 3	x	0.264				0.07
	y	0.517				