

EUROPEAN ASSESSMENT DOCUMENT

EAD 120001-00-0106

October 2015

Microprismatic retro-reflective sheetings

The reference title and language for this EAD is English. The applicable rules of copyright refer to the document elaborated in and published by EOTA.

This European Assessment Document (EAD) has been developed taking into account up-to-date technical and scientific knowledge at the time of issue and is published in accordance with the relevant provisions of Regulation (EU) 305/2011 as a basis for the preparation and issuing of European Technical Assessments (ETA).

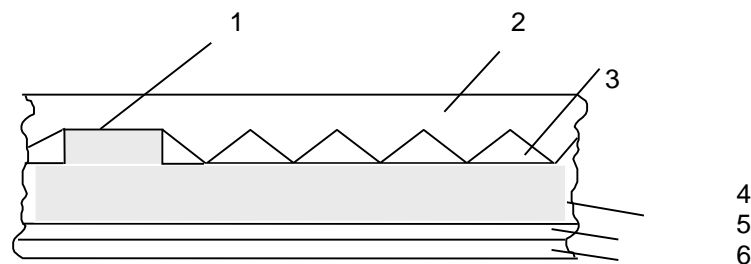
Contents

1	Scope of the EAD	4
1.1	Description of the construction product	4
1.2	Information on the intended use(s) of the construction product	4
1.2.1	Intended use(s)	4
1.2.2	Working life/Durability	5
1.3	Specific terms used in this EAD (if necessary in addition to the definitions in CPR, Art 2)	5
2	Essential characteristics and relevant assessment methods and criteria	5
2.1	Essential characteristics of the product	5
2.2	Methods and criteria for assessing the performance of the product in relation to essential characteristics of the product	6
2.2.1	Daylight chromaticity and luminance factor	6
2.2.2	Night-time colour	7
2.2.3	Coefficient of retro-reflection	7
	Rotational symmetry	7
2.2.4	Impact resistance	7
2.2.5	Temperature resistance	8
2.2.6	Visibility after weathering	8
2.2.7	Adhesion test	10
3	Assessment and verification of constancy of performance	11
3.1	System of assessment and verification of constancy of performance to be applied	11
3.2	Tasks of the manufacturer	11
3.3	Tasks of the notified body	13
4	Reference documents	13
	Annex 1 – Specific Test Conditions	14

1 SCOPE OF THE EAD

1.1 Description of the construction product

The microprismatic retro-reflective sheetings consist of microprismatic retro-reflective 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 sheetings have a smooth surface and may or may not have orientation marks, visible from the face.



- 1 seal lines
- 2 prismatic lens layer
- 3 air layer
- 4 sealing layer
- 5 adhesive
- 6 substrate

Figure 1 – Basic principle

The product is supplied as a single sheet or processed with colour and/or overlay film. The complete set of microprismatic retro-reflective sheetings is given in the following list:

- microprismatic retro-reflective sheetings with or without clear overlay film
- microprismatic retro-reflective sheetings processed with process colours with or without clear overlay film
- microprismatic retro-reflective sheetings with coloured overlay film and with or without clear overlay film.

Each colour of the sheetings is specified in the ETA by a colour box in the CIE-system with minimum defined 4 colour coordinates (x, y) and luminance factor β based on the specifications given by the manufacturer

The product is not covered by harmonised European standard 12899-1:2007.

Concerning product packaging, transport, storage, maintenance, replacement and repair it is the responsibility of the manufacturer to undertake the appropriate measures and to advise his clients on the transport, storage, maintenance, replacement and repair of the product as he considers necessary.

It is assumed that the product will be installed according to the manufacturer's instructions or (in absence of such instructions) according to the usual practice of the building professionals.

Relevant manufacturer's stipulations having influence on the performance of the product covered by this European Assessment Document shall be considered for the determination of the performance and detailed in the ETA.

1.2 Information on the intended use(s) of the construction product

1.2.1 Intended use(s)

The construction product is used to manufacture sign faces for traffic signs according to EN 12899-1. The intended use includes for example:

- retro-reflective signs,
- road delineators with retro-reflective devices,
- variable message signs.

The intended use excludes road-markings as defined in EN 1436. The substrate used is aluminium, galvanized steel, polycarbonate or other.

1.2.2 Working life/Durability

The assessment methods included or referred to in this EAD have been written based on the manufacturer's request to take into account a working life of the microprismatic retro-reflective sheeting for the intended use of 10 years when installed in the works (provided that the microprismatic retro-reflective sheeting is subject to appropriate installation (see 1.1 and 1.2). These provisions are based upon the current state of the art and the available knowledge and experience.

When assessing the product, the intended use as foreseen by the manufacturer shall be taken into account. The real working life may be, in normal use conditions, considerably longer without major degradation affecting the basic requirements for works¹.

The indications given as to the working life of the construction product cannot be interpreted as a guarantee neither given by the product manufacturer or his representative nor by EOTA when drafting this EAD nor by the Technical Assessment Body issuing an ETA based on this EAD, but are regarded only as a means for expressing the expected economically reasonable working life of the product.

1.3 Specific terms used in this EAD (if necessary in addition to the definitions in CPR, Art 2)

Table 1.1 Specific terms

Term	Symbol	Definition
Luminance factor	β	2.2.1
Daylight chromaticity	x, y	2.2.1
Night-time colour	x, y	2.2.2
Coefficient of retro-reflection	R_A	2.2.3
Observation angle	α	2.2.3
Entrance angle	β	2.2.3
Rotation angle	ε	2.2.3
Orientation angle	ω_s	2.2.3

2 ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSMENT METHODS AND CRITERIA

2.1 Essential characteristics of the product

Table 2.1 shows how the performance of microprismatic retro-reflective sheeting is assessed in relation to the essential characteristics.

¹ The real working life of a product incorporated in a specific works depends on the environmental conditions to which that works is subject, as well as on the particular conditions of the design, execution, use and maintenance of that works. Therefore, it cannot be excluded that in certain cases the real working life of the product may also be shorter than the working life referred to above.

Table 2.1 Essential characteristics of the product and methods and criteria for assessing the performance of the product in relation to those essential characteristics

No	Essential characteristic	Assessment method	Type of expression of product performance (level, class, description)
Basic Works Requirement 4: Safety and accessibility in use			
Visibility characteristics			
1	Daylight chromaticity (x, y)	2.2.1	Value / Level
2	Luminance factor (β)	2.2.1	Value / Level
3	Night-time colour (x, y)	2.2.2	Value / Level
4	Coefficient of retro-reflection (R_A)	2.2.3	Value / Level
Durability			
5	Impact resistance	2.2.4	EN 12899-1:2007
6	Temperature resistance	2.2.5	Value / Level
7	Visibility after accelerated artificial weathering	2.2.6, 2.2.1, 2.2.3	Value / Level with the indication of the relevant method of weathering*
8	Visibility after natural weathering	2.2.6, 2.2.1, 2.2.3	
9	Adhesion	2.2.7	Value / level
* In every case it shall be stated whether the performance of the product are the results of: <ul style="list-style-type: none"> - accelerated artificial weathering or - natural weathering. 			

2.2 Methods and criteria for assessing the performance of the product in relation to essential characteristics of the product

Reference substrate for tests is aluminium, unless the product is intended to be used on a different substrate.

2.2.1 Daylight chromaticity and luminance factor

The daylight chromaticity coordinates (x, y) and the luminance factor (β) shall be measured in accordance with CIE Publication 15 Colourimetry using 45° a:0° geometry and shall be calculated from the total spectral radiance factors computed for CIE standard Illuminant D65 (EN ISO 11664-2) for the CIE 1931 (2°) standard colourimetric observer (EN ISO 11664-1, Chapter 5).

The position of the sample in the measuring system shall 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 specific test conditions are specified in Annex 1.

For each test specimen, the results of the tests are given in the ETA, by each colour, as chromaticity coordinates (x, y) and levels of luminance factor β .

Note: The manufacturer may establish, for each colour, the tolerance sphere for daylight chromaticity expressed by chromaticity coordinates on the basis of the test results, and this tolerance sphere should be given in the declaration of performance as the performance of the product in relation to this essential characteristic.

2.2.2 Night-time colour

The chromaticity coordinates (x, y) shall be measured in accordance with CIE 2-19/June 1996 Report and shall be calculated from the total spectral radiance factors computed for CIE standard Illuminant A (EN ISO 11664-2, Chapter 4) for the CIE 1931 standard colourimetric 2° observer (EN ISO 11664-1, Chapter 5).

The specific test conditions are specified in Annex 1.

For each test specimen, the results of the tests are given in the ETA, by each colour, as chromaticity coordinates (x, y).

Note: The manufacturer may establish, for each colour, the tolerance sphere for night-time colour expressed by chromaticity coordinates on the basis of the test results, and this tolerance sphere should be given in the declaration of performance as the performance of the product in relation to this essential characteristic.

2.2.3 Coefficient of retro-reflection

The coefficient of retro-reflection R_A shall be measured in accordance with Art. 4.4 CIE Publication No. 54.2, retro-reflection using CIE Standard Illuminant A (EN ISO 11664-2). Any of the apertures recommended by CIE Publication No. 54.2 Art. 6.10 may be used. Measurements shall be taken at the specified observation angle α , entrance angle β , rotation angle ε , and orientation angle ω_s . If not otherwise specified in this EAD, 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 according to manufacturer's specification either $\varepsilon = 0^\circ$ or $\varepsilon = 0^\circ$ and 90° and the orientation angle shall be $\omega_s = 0^\circ$.

Table 2.2 Geometries of measurements, as relevant:

observation angle α	entrance angle β_1 ($\beta_2 = 0^\circ$)				
0,1°	5°	15°	20°	30°	40°
0,2°	5°	15°	20°	30°	40°
0,33°	5°	15°	20°	30°	40°
0,5°	5°	15°	20°	30°	40°
1°	5°	15°	20°	30°	40°
1,5°	5°	15°	20°	30°	40°
2°	5°	15°	20°	30°	40°

Rotational symmetry

For the determination of the rotational symmetry the coefficient of retro-reflection has to be measured 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 has to be calculated when rotating from $\varepsilon - 75^\circ$ to $+ 50^\circ$ in 25° steps.

For each test specimen, the results of the tests are given in the ETA, by each colour and by each respective angle combination, as levels of coefficients of retro-reflection.

2.2.4 Impact resistance

The test is carried out according to EN 12899-1:2007 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 100 mm x 100 mm.

The specific test conditions are specified in Annex 1.

When evaluated according EN 12899-1/ZA.1 and 4.1.2 there shall be no cracking or delamination from any substrate, outside a circle of 6 mm radius with the point of impact as the centre.

The impact resistance is given in ETA.

2.2.5 Temperature resistance

The photometric properties of the test specimens shall be determined by measuring the coefficient of retro-reflection R_A according to test method under 2.2.3. Measurements shall be taken only for the observation angle $\alpha = 0,33^\circ$ and entrance angle $\beta_1 = 5^\circ$ ($\beta_2 = 0^\circ$; $\varepsilon = 0^\circ$).

The test specimens shall then be exposed in an air circulating oven for a period of 24 hours according to the temperature applied for by the manufacturer. After exposure the test specimens shall be conditioned as described in Annex 1.

The photometric properties of the test specimens shall be re-determined by re-measuring the coefficient of retro-reflection R_A according to this clause.

For each test specimen, the test temperature and the results are given in the ETA, by each colour, as levels of coefficients of retro-reflectivity before and after the temperature treatment.

2.2.6 Visibility after weathering

In order to prevent a delay of the issuing process concerning the first issue of an ETA accelerated artificial weathering may be used to predict durability. However, testing by natural weathering should start at the same time as testing by accelerated artificial weathering. The result of natural weathering should be used to replace the result of accelerated artificial weathering specified in the ETA.

2.2.6.1 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 EN ISO 4892-2. Preparation of test specimens should be in accordance with the general guideline given in EN ISO 4892-2. The samples shall be exposed in accordance to EN ISO 4892-2 using the parameters given in the following table, for a period of 2000 hours.

The temperature measurement during accelerated artificial weathering shall correspond to EN ISO 4892-1 and EN ISO 4892-2. Either a black-standard or a black-panel thermometer may be used subject to the thermal conductivity of the substrate of test specimens as described in EN ISO 4892-1. The thermometer used shall be stated in the test report and in the ETA. Reflective sheetings are typically applied on metallic substrates as e.g. aluminium. In this case the non-insulated black panel thermometer shall be used.

Table 2.3 – Artificial weathering test parameters

Exposure parameters	Air and water cooled lamp
Light/dark/water spray cycle	Continuous light with water spray on specimens for 18 min every 2 h
Black surface temperature during light only periods	(65 ± 3) °C
Relative humidity	(50 ± 5)%
Irradiance (W/m ²) controlled at 340 nm over 300 nm to 400 nm range	0,51 60

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 generally mean that irradiance error is in the order of ± 10 %.

Test specimens shall be then conditioned as described in Annex 1 and the following tests are carried out:

- Daylight chromaticity coordinates (according to clause 2.2.1)
- Luminance factor (according to clause 2.2.1)
- Coefficient of retro-reflection (according to clause 2.2.3)

After exposure in accordance with clause 2.2.6.1, the retro-reflective sheeting surface of the test specimens shall show no flaking, blistering, or any lack of adhesion. ((see 2.2.6.2 after natural weathering, same term))

2.2.6.2 Visibility after natural weathering

The retro-reflective sheeting surface of the test specimens of a minimum of 20 cm x 20 cm in dimension shall be subjected to 3 years unprotected natural weathering, facing the equator (south) and inclined 45° from the vertical, taking into account the different European climatic conditions in term of temperature, UV and RH, in accordance with EN ISO 877, using method A. After the exposure period, the test specimens shall be washed, using a soft brush or sponge to avoid scratching, and given a final flush with e.g. de-ionized water. Test specimens shall be then conditioned as described in Annex 1 and the following tests are carried out:

- Daylight chromaticity coordinates (according to clause 2.2.1)
- Luminance factor (according to clause 2.2.1)
- Coefficient of retro-reflection (according to clause 2.2.3)

After exposure in accordance with clause 2.2.6.2, the retro-reflective sheeting surface of the test specimens shall show no flaking, blistering, or any lack of adhesion.

2.2.6.3 Daylight chromaticity and luminance factor after weathering

After exposure in accordance with clauses 2.2.6.1 or 2.2.6.2, the daylight chromaticity and luminance factor shall be measured according to clause 2.2.1.

For each test specimen, the results of the tests are given in the ETA, by each colour, as chromaticity coordinates (x, y) and levels of luminance factor β.

Note: The manufacturer may establish, for each colour, the tolerance sphere for daylight chromaticity after weathering expressed by chromaticity colour coordinates on the basis of the test results, and this tolerance sphere should be given in the declaration of performance as the performance of the product in relation to this essential characteristic.

2.2.6.4 Coefficient of retro-reflection after weathering

After exposure in accordance with clauses 2.2.6.1 or 2.2.6.2, the coefficient of retro-reflection R_A , shall be measured according to clause 2.2.3 at an observation angle $\alpha = 0,33^\circ$ (or $\alpha = 0,2^\circ$) and $\alpha = 1^\circ$ (if specified for new material) and entrance angle $\beta_1 = 5^\circ$ and 30° ($\beta_2 = 0^\circ$), The reading is taken at $\varepsilon = 0^\circ$.

For each test specimen, the results of the tests are given in the ETA, by each colour and by each respective angle combination, as levels of coefficients of retro-reflection after accelerated artificial weathering or after natural weathering.

2.2.7 Adhesion test

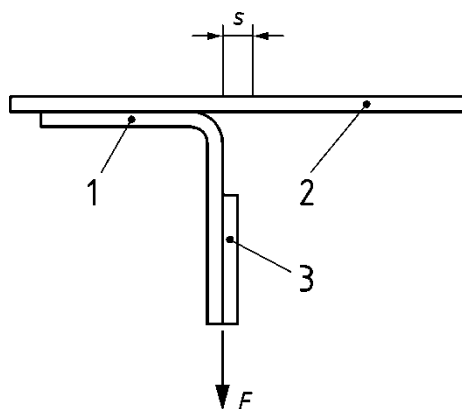
A sheeting strip of 25 mm x 150 mm (whereof 100 mm are adhered and 50 mm are not adhered) is attached on a substrate with minimum dimensions of 200 mm x 70 mm by means of the adhesive at the back of the sheet shown in Figure 2. After 72 h of mature, a hanging weight with a mass of $F = 0,8$ kg is applied to the sheeting strip and the slip s [mm] of the sheeting stripe is observed during the following 5 minutes. The test shall be carried out at a temperature of $(23 \pm 3)^\circ\text{C}$ and a relative humidity of $(50 \pm 5)\%$.

The slip after 5 minutes (by each respective adhesive type and family of sheeting) is given in the ETA.

The test is valid only for a particular substrate material and a family of sheetings with identical adhesive and sealing layer (see Fig. 1). Test shall be performed for each combination of substrate and family as applied.

Note: The manufacturer may establish, for each adhesive type and family of sheetings, the maximal value of slip after 5 minutes on the basis of the test results, and this maximal value should be given in the declaration of performance as the performance of the product in relation to this essential characteristic. Declared slip after 5 minutes (by each respective adhesive type and family of sheetings) is given in the ETA.

Test method:



Legend

- 1 strip of sheeting of 25 mm x 150 mm
- 2 substrate
- 3 hanging weight $F = 0,8 \text{ kg} \pm 1 \text{ g}$

Test conditions

$t = 5 \text{ min}$

Mature before test:

72 h, $(23 \pm 3)^\circ\text{C}$, RH $(50 \pm 5)\%$.

Figure 2 — Adhesion test

3 ASSESSMENT AND VERIFICATION OF CONSTANCY OF PERFORMANCE

3.1 System of assessment and verification of constancy of performance to be applied

For the products covered by this EAD the applicable European legal act is: Decision 1996/0579/EC.

The system is: 1

3.2 Tasks of the manufacturer

The cornerstones of the actions to be undertaken by the manufacturer of the product in the procedure of assessment and verification of constancy of performance are laid down in Table 3.1.

Table 3.1 Control plan for the manufacturer; cornerstones

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Factory production control (FPC) [including testing of samples taken at the factory in accordance with a prescribed test plan]					
Microprismatic retro-reflective sheeting (including all its constituents)					
1	Raw material	Incoming raw material to be tested according to the QS manual of the manufacturer, if necessary	Verification of the purchasing specification documentation, given by the manufacturer	Sample verification if necessary according to the QS manual of the manufacturer	According to the QS manual of the manufacturer
2	Production process (all necessary steps)	According to the QS manual of the manufacturer	According to the QS manual of the manufacturer	According to the QS manual of the manufacturer	
3	Content, emission and/or release of dangerous substances	Chemical analysis according to the specifications in the QS manual of the manufacturer, if necessary	Verification of the material specification given by the raw material supplier	Sample verification if necessary according to the QS manual of the manufacturer	
4	Daylight chromaticity (x, y) and luminance factor (β)	Colour meter	Verification and documentation of the calibration certificate of the instrument	Five samples per colour and type at the start and end of each batch	
5	Night-time colour (x, y)	Measuring instruments as specified in the QS manual of the manufacturer, if necessary	According to the QS manual of the manufacturer, if required.		

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Factory production control (FPC) [including testing of samples taken at the factory in accordance with a prescribed test plan]					
Microprismatic retro-reflective sheeting (including all its constituents)					
6	Retro-reflection coefficient (R_A)	Photogoniometer system or portable retro-reflectometer	Verification and documentation of the calibration certificate of the instrument		
7	Impact resistance	Impact resistance testing equipment	According to the QS manual of the manufacturer	One	One sample per batch of continuous production with example of a sign face material
8	Temperature resistance	Measuring instruments and climate chamber as specified in the QS manual of the manufacturer	According to the QS manual of the manufacturer, if required	To be tested, only if required.	According to the QS manual of the manufacturer if required
9	Resistance to natural weathering – retro-reflective sheeting	Natural weathering area	According to the QS manual of the manufacturer	One per colour and type	Every 5 Years
10	Storage	Storage condition according to the provisions of the manufacturer. Measuring the ambient room temperature and relative humidity	According to the QS manual of the manufacturer	Inspection of the storage condition during the yearly FPC	One time per year during the factory production control (FPC)
11	Adhesion	Test of adhesion	According to the QS manual of the manufacturer	Three per adhesive type and family of sheetings if required	According to the QS manual of the manufacturer if required

3.3 Tasks of the notified body

The cornerstones of the actions to be undertaken by the notified body in the procedure of assessment and verification of constancy of performance for microprismatic retro-reflective sheetings are laid down in Table 3.2.

Table 3.2 Control plan for the notified body; cornerstones

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Initial inspection of the manufacturing plant and of factory production control					
1	The notified body shall ascertain that in accordance with the control plan, the manufacturing plant of the manufacturer and the factory production control are suitable to ensure the constancy of the performance of the microprismatic retro-reflective sheeting.				–
Continuous surveillance, assessment and evaluation of factory production control					
2	It shall be verified that the system of factory production control is maintained in accordance with the control plan with the view to ensure the constancy of the product performance.				once a year

4 REFERENCE DOCUMENTS

As far as no edition date is given in the list of standards thereafter, the standard in its current version at the time of issuing the European Technical Assessment is of relevance.

EN 1436	Road marking materials. Road marking performance for road users
EN 12899-1	Fixed, vertical road traffic signs - Part 1: Fixed signs
EN ISO 139+A1	Textiles - Standard atmospheres for conditioning and testing
EN ISO 877	Plastics - Methods of exposure to solar radiation - Part 1: General guidance
EN ISO 4892-1	Plastics - Methods of exposure to laboratory light sources - Part 1: General guidance
EN ISO 4892-2	Plastics - Methods of exposure to laboratory light sources - Part 2: Xenon-arc lamps
CIE 1931	Standard colourimetric observer
CIE 2-19	Report June 1996
CIE 15	Colourimetry
EN ISO 11664-1	Colorimetry - Part 1: CIE standard colorimetric observers (ISO 11664-1:2007)
EN ISO 11664-2	Colorimetry - Part 2: CIE standard illuminants (ISO 11664- 2:2007)

ANNEX 1 – SPECIFIC TEST CONDITIONS

The microprismatic retro-reflective sheetings and prepared test specimens shall be conditioned according to ISO 139+A1 “Standard atmospheres for conditioning and testing”, Art. 3.2.1.

All tests shall be done on at least three specimens. The measured values of all three specimens shall be stated within the ETA

For the preparation of test specimens, the microprismatic retro-reflective sheeting samples must be installed on to smooth aluminum alloy panels of a 2,0 mm ($\pm 0,05$) thickness. The aluminium alloys shall be of a quality such as AlMg₂MnO₃ or equivalent and the installation shall be in accordance with manufacturer provisions.

For all the foreseen tests, sheetings shall be positioned according to the manufacturer provisions. Therefore on the back side of the aluminium substrate the sheetings shall be labeled clearly with an orientation mark and the name/code of the product.

Due to the different features of sheetings and colours, the number and the minimal dimensions of the samples used for tests are indicated in Table A1.1 for microprismatic retro-reflective sheetings with or without process colour or overlay film, with or without clear overlay film.

Table A1.1 Test specimens for microprismatic retro-reflective sheetings with or without clear overlay film

Test	Microprismatic retro-reflective sheeting with or without clear overlay
Daylight chromaticity (x, y)	3 specimens of at least 10 x 10 cm of each system
Luminance factor (β)	Use specimens listed above
Night-time colour (x, y)	Use specimens listed above
Coefficient of retro-reflection (R_A)	Use specimens listed above
Impact resistance	3 specimens of at least 15 x 15 cm of each system
Temperature resistance	3 specimens of at least 10 x 10 cm of each system
Visibility after accelerated artificial weathering	3 specimens of at least 5,5 x 10 cm of each system *)
Visibility after natural weathering	3 specimens of at least 20 x 20 cm of each system
Adhesion test	3 specimens of 25 mm x 150 mm attached to a substrate of at least 200 mm x 70 mm of each system

Note: *) Implicated dimensions of test specimen have to be stated in the ETA.

Use of historical data

Historical data may where appropriate be taken into account under the responsibility of the TAB issuing the ETA. This necessitates sufficient similarity concerning assessment methods and criteria.