BS EN 16477-1:2016

BSI Standards Publication

Glass in building — Painted glass for internal use

Part 1: Requirements

National foreword

This British Standard is the UK implementation of EN 16477-1:2016.

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Verre dans la construction - Verre laqué destiné à un usage à l'intérieur - Partie 1 : Exigences

Glas im Bauwesen - Farbiges Glas für den Innenbereich - Teil 1: Anforderungen

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European foreword

This document (EN 16477-1:2016) has been prepared by Technical Committee CEN/TC 129 “Glass in Building”, the secretariat of which is held by NBN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2017, and conflicting national standards shall be withdrawn at the latest by June 2017.

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1 Scope

This European Standard specifies minimum quality requirements (in respect of optical, visual and edge faults) and durability tests for painted glass for internal use in building.

This standard applies to testing of paints that can be used to produce painted glass. The test of durability are undertaken on soda lime silicate glass as being a representative substrate.

Painted glass that conforms to this standard, may have substrate as follows: basic glass, special basic glass, chemically strengthened basic glass, thermally treated basic and special basic glass, laminated glass or laminated safety glass.

The painted glass may be translucent, transparent or opaque and supplied in stock/standard sizes and as-cut finished sizes.

NOTE 1 Artistic products are excluded from the scope of this standard.

For painted glass used in aggressive and/or constantly high humidity atmospheres, e.g. horse riding halls, swimming pools, medical baths, saunas, etc. this standard is not applicable.

NOTE 2 Bathrooms and kitchens are not considered as constantly high humidity atmospheres.

This standard does not give requirements for framing, fixing or other support systems.

NOTE 3 Useful advice on these items is contained in the informative Annex C.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 572-2, *Glass in building - Basic soda lime silicate glass products - Part 2: Float glass*

EN 572-8:2012+A1:2016, *Glass in building - Basic soda-lime silicate glass products - Part 8: Supplied and final cut sizes*

EN 1096-1, *Glass in building - Coated glass - Part 1: Definitions and classification*

EN 1748-1-1, *Glass in building - Special basic products -Borosilicate glasses - Part 1-1: Definition and general physical and mechanical properties*

EN 1748-2-1, *Glass in building - Special basic products - Glass ceramics - Part 2-1 Definitions and general physical and mechanical properties*

EN 1863-1, *Glass in building - Heat strengthened soda lime silicate glass - Part 1: Definition and description*

EN 12150-1, *Glass in building - Thermally toughened soda lime silicate safety glass - Part 1: Definition and description*

EN 12337-1, *Glass in building - Chemically strengthened soda lime silicate glass - Part 1: Definition and description*

EN 13024-1, *Glass in building - Thermally toughened borosilicate safety glass - Part 1: Definition and description*

EN 14178-1, *Glass in building - Basic alkaline earth silicate glass products - Part 1: Float glass*

EN 14321-1, *Glass in building - Thermally toughened alkaline earth silicate safety glass - Part 1: Definition and description*

prEN 15681-1, *Glass in building - Basic alumino silicate glass products - Part 1: Definitions and general physical and mechanical properties*

EN 15682-1, *Glass in building - Heat soaked thermally toughened alkaline earth silicate safety glass - Part 1: Definition and description*

EN ISO 12543-1, *Glass in building - Laminated glass and laminated safety glass - Part 1: Definitions and description of component parts (ISO 12543-1)*

EN ISO 16474-2:2013, *Paints and varnishes - Methods of exposure to laboratory light sources - Part 2: Xenon-arc lamps (ISO 16474-2)*

EN ISO 11664-4, *Colorimetry - Part 4: CIE 1976 L*a*b* Colour space (ISO 11664-4)*

EN ISO 2409, *Paints and varnishes — Cross-cut test*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
painted glass
flat glass whose rear surface has been coated with a paint

3.2
paint
organic coating covering glass

3.3
uniform paint
paint which are uniform in colour and reflection in an area of minimum one square centimetre and where colour and reflection are not angle dependant from 0° to 45° from vertical

3.4
non-uniform paint
paint which are not uniform

Note 1 to entry: examples of non-uniform paint are paint containing metallic particles, phosphorescent paint, thermochromic paint, etc.

3.5
glass substrate
basic glass, special basic glass, chemically strengthened basic glass, thermally treated basic and special basic glass, laminated glass or laminated safety glass

3.6
jumbo sizes
glass delivered in the following sizes:

– nominal length *H*: 4 500 mm, 5 100 mm or 6 000 mm;

– nominal width *B*: 3 210 mm

[SOURCE: EN 572-2:2012, 3.2]

Note 1 to entry: The usual width is 3 210 mm. Exceptional production requirements can cause this to be reduced but the nominal width is never below 3 150 mm.

3.7
stock/standard sizes
panes of painted glass supplied with as-cut edges which are intended for further processing

3.8
finished sizes
finished panes of painted float glass cut from stock/standard sizes which may be used as-cut or subject to further processing, e.g. edges working, drilling, face decoration etc

3.9
paint coating(s) faults
faults which are directly related to the paint coating, for example scratches, spot faults, and variation of colour or lack of adhesion of the paint coating

3.10
spot faults
punctual disturbance that can be observed from the glass side

Note 1 to entry: spot faults may come from a glass defect e.g. nuclei (solid or gaseous inclusions), deposits, crush marks or from a paint coating defect e.g. dust, pinhole, de-wetting

3.11
lack of adhesion point
spot fault where the paint is no longer adhered to the glass, detected in reflection as a more brilliant point

3.12
linear faults
scratches, extended spot faults etc. on the glass surface or on the paint, seen from the glass surface side

3.13
glass brush marks
very fine circular scratches that are barely visible and are associated with glass cleaning techniques

3.14
variation of colour
change of colour that may occur after an ageing test e.g. fading

3.15
edge defect
defect which can occur on the edge of a cut size piece in the form of entrant and emergent fault and/or bevel

[SOURCE: EN 572-8:2012+A1:2016, 3.13]

3.16
cluster
group of not less than 3 spot faults, separated by not more than 50 mm

[SOURCE: EN 1036-1:2007, 3.19]

3.17
halo
distortion zone around a spot fault

[SOURCE: EN 1036-1:2007, 3.20]

4 Materials

4.1 Glass products

4.1.1 General

The glass substrates used for the production of painted glass:

— shall be covered by Harmonized European Specifications (as defined in regulation EU 305/2011) as listed below or

— if not covered by Harmonized European Specifications demonstration shall be made that those glasses have a chemical composition and a mechanical stability over time equivalent to the requirements of the relevant standard listed.

4.1.2 Glass substrates

Painted glass when covered by Harmonized European Specifications, shall conform to:

— Soda lime silicate float glass conforming to EN 572-2;

— Special basic glass conforming to EN 1748-1-1, EN 1748-2-1, EN 14178-1, prEN 15681-1;

— Thermally treated glass conforming to EN 12150-1, EN 1863-1, EN 13024-1, EN 14321-1, EN 15682-1;

— Chemically strengthened basic glass conforming to EN 12337-1;

— Laminated glass or laminated safety glass conforming to EN ISO 12543-1;

— Coated glass conforming to EN 1096-1;

The glass substrate may also be acid-etched and sand blasted glass.

4.2 Paint coating(s)

The glass described in 4.1 shall be covered partially or completely by one or more paint layers.

5 Dimensional requirements

5.1 Thickness

The actual thickness shall be the average of four measurements, taken to the nearest 0,01 mm, one taken at the centre of each side. Measurement shall be performed by an appropriate instrument e.g. a calliper micrometre.

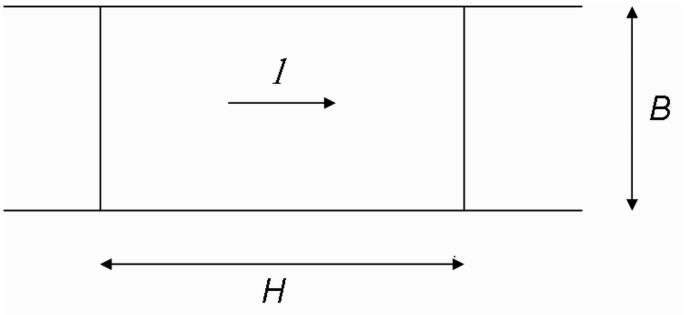
The nominal thickness of the painted product declared by the manufacturer is the nominal thickness of the substrate. The actual thickness, rounded to the nearest 0,1 mm shall not vary from the declared thickness by more than the tolerances of the substrate.

5.2 Length, width and squareness

5.2.1 Width B and length H

When painted glass sizes are quoted for rectangular panes, the first dimension shall be the width B and the second dimension the length H as shown in Figure 1.

Dimensions in millimetres



Key

H Length of rectangular pane

B Width of rectangular pane

l Direction of draw

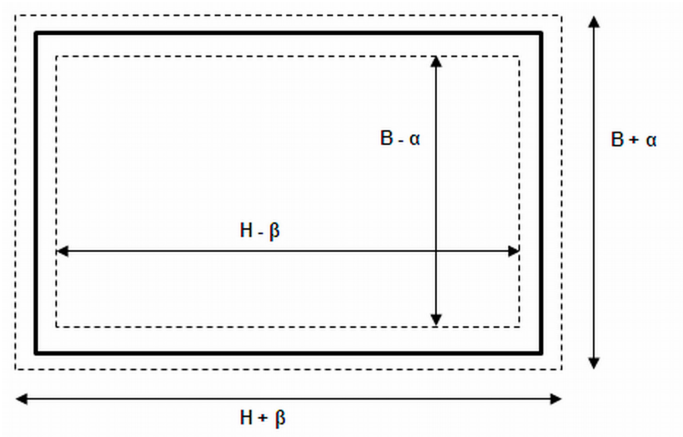
Figure 1 — Relationship between length, width and direction of flaw

Each dimension shall be within the limit deviations specified.

5.2.2 Methods of measuring dimensions and squareness

The nominal dimensions for width B and length H being given, the pane shall not be larger than the nominal dimensions increased by the tolerance or smaller than the nominal dimensions reduced by the tolerance (see Figure 2).

The squareness of rectangular glass panes is expressed by the difference between its diagonals (see Figure 3). The difference between the two diagonals shall not be larger than the deviation mentioned in product standard corresponding to the glass substrate.



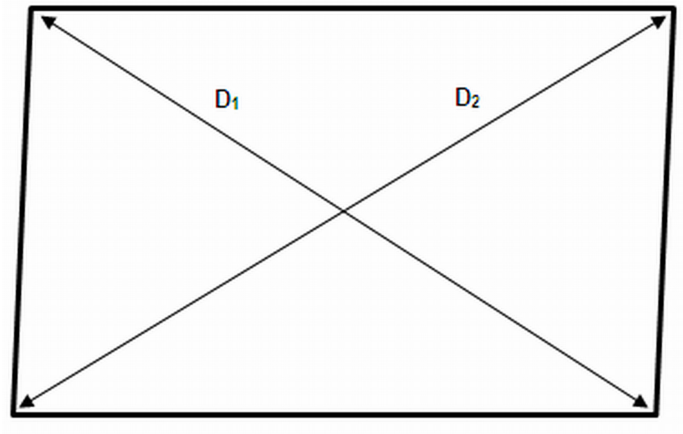
Key

B Width

H Length

α,β Tolerance limits for dimensions

Figure 2 — Determination of dimensions



Key

D1, D2 Diagonals

Figure 3 — Determination of diagonals

Evaluation methods and tolerances of the glass substrate product standard apply.

NOTE For non-rectangular panes refer to manufacturer

6 Quality requirements

6.1 General

The defects affecting appearance are:

— specific to the glass substrate (see appropriate standards as given in 4.1)

— specific to the paint

If a defect specific to the glass substrate is more visible because of the paint, it will be treated as a paint defect.

6.2 Quality assessment and inspection methods for painted glass

6.2.1 Visual inspection method

6.2.1.1 Inspection of the opaque painted glass (in reflection)

The painted glass shall be observed in a vertical position against an unlit background, glass side, with the naked eye and under normal diffused lighting conditions, from a distance of 1 m. Each examination will take ≤ 30 s. The direction of observation is normal, i.e. at right angle, to the painted glass. The use of an additional lighting source, e.g. spotlight, is not allowed. Defects on painted side are acceptable as long as they are not visible from the glass side.

NOTE Normal diffused lighting conditions is assumed to be natural daylight or simulated daylight illuminant D65, observer 10°, between 300 and 600 Lux at the painted glass.

6.2.1.2 Inspection of the translucent and transparent painted glass (in transmission)

The painted glass shall be observed in a vertical position against a lit background, glass side, with the naked eye and under normal diffused lighting conditions, from a distance of 1 m. Each examination will take ≤ 30 s. The direction of observation is normal, i.e. at right angle, to the painted glass. The use of an additional lighting source, e.g. spotlight, is not allowed. Defects on painted side are acceptable as long as they are not visible from the glass side.

NOTE Normal diffused lighting conditions is assumed to be natural daylight or simulated daylight illuminant D65, observer 10°, between 300 and 600 Lux at the painted glass.

6.2.2 Measurement of the Δ E*

The Δ E* is used to evaluate the ageing of the painting and should be measured on the glass side, according to Annex B.

6.2.3 Painted glass faults

Glass and paint faults are assessed using the method in 6.2.1. The dimension and number of spots, hairline scratches and scratches that cause disturbance to vision shall be noted.

6.2.4 Edge faults

The edge quality of stock/standard or as-cut finished painted glass can be affected by the presence of entrant/emergent faults and shelling. Using the inspection method of 6.2.1, the edges of the painted glass panes shall be checked for the presence of shells, corners on/off and edge vents.

6.3 Acceptance levels

6.3.1 Glass faults

The acceptance level for painted glass faults are given in:

— Table 1 for stock/standard sizes;

— Table 2 for as-cut finished sizes.

The Tables 1 and 2 are valid for painted glass manufactured from soda lime silicate float glass. For other glass substrates see manufacturer.

Table 1 — Acceptance levels of faults in painted glass in stock/standard sizes [a]

Linear faults length (mm)	Painted glass [b]	
	Jumbo size	All different sizes
	Max defects /sheet (19,3 m^2)	Defects / m^2
Brush marks (≤50)	8	0,37
Scratches (≤50)	3	0,14
Spot faults diameter [c] (mm)	Painted glass	
	Jumbo size	All different sizes
	Max defects /sheet (19,3 m^2)	Defects / m^2
≤ 0,5	Accepted [d]	Accepted [d]
> 0,5 and ≤ 1	10	1,35
> 1	1	0,16

a A border zone of 50 mm around the painted glass shall be discarded and not subjected to defect restriction.

b The average shall be calculated taking into account the total individual pack area (m^2). All calculation assume mathematical rounding.

c The dimensions stated are without the effect of the halo (see EN 572–2) and relate to the largest of the fault dimensions.

d Accepted, providing they do not form a cluster.

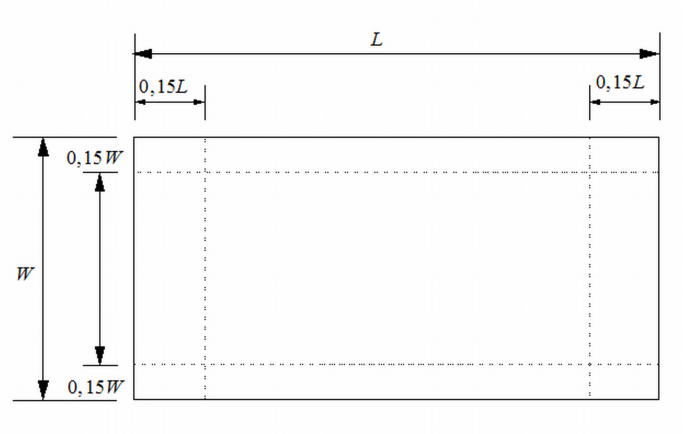
Table 2 Table 2 — Acceptance levels of faults in painted glass in as-cut finished sizes

Area finished sizes cut or cut and ground	Spot faults [c]					Linear faults	
	Centre zone		Border zone [a, b]			Brush marks	Scratches
	≥ 0,2mm [d] ≤ 0,5mm	> 0,5mm	≥ 0,2mm ≤ 0,5mm	> 0,5mm ≤ 1,0mm	> 1,0mm	< 50 mm	
≤ 1,0 m²	1	0	2	0	0	0	0
1,01 to 1,5 m²	2	0	3	1	0	1	0
> 1,51 m²	3	0	4	2	0	2	0

a The size of the border zone is determined as 15 % of the edge length and width (see Figure 4).

b The dimensions stated are without the effect of the halo (see EN 572–2) and relate to the largest of the fault dimensions.

c Defects smaller than 0,2 mm are accepted providing they do not form a cluster.



Key

H Length

B Width

Figure 4 — Determination of central and border zone

6.3.2 Edge faults for finished sizes

6.3.2.1 Chips or shells Entrant and emergent faults

These faults are shown in Figures 5 and 6. For stock/standard sizes, entrant or emergent chips or shells, visible under the conditions in 6.2.1, shall be accepted provided they do not exceed a maximum length and depth of 10 mm and half the nominal glass thickness (see figure 5).

Dimension in millimetre

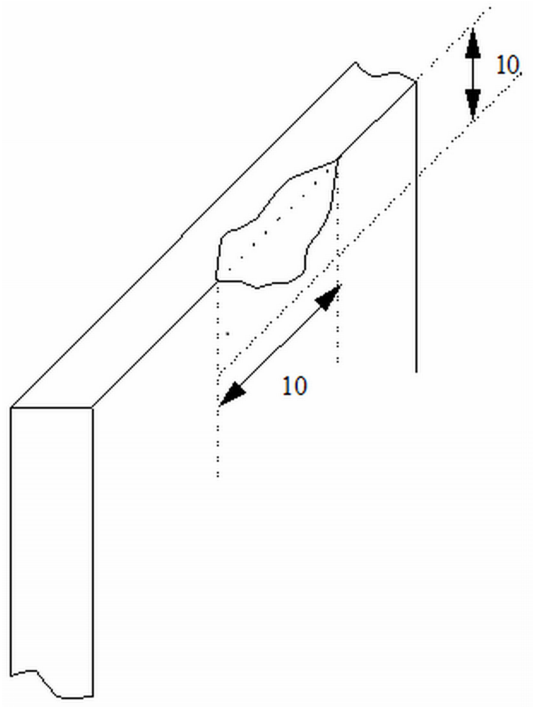


Figure 5 — Entrant and emergent faults – surface view

For as-cut finished sizes, entrant or emergent chips or shells, visible under the conditions in 6.2.1, shall be accepted provided they are not greater than 1,5 mm deep (see Figure 6).

Dimensions in millimetres

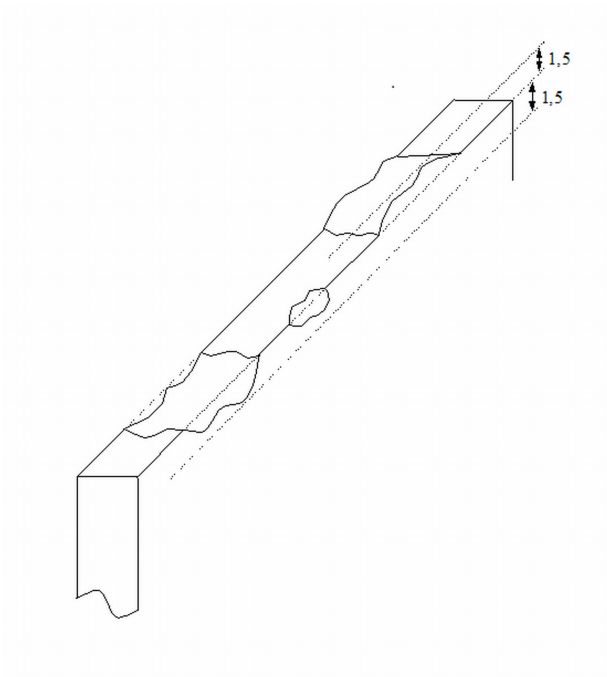


Figure 6 — Entrant faults – edge view

6.3.2.2 Corners on/of

For stock/standard sizes occasional corners on/off (see Figure 7), visible under the conditions in 6.2.1, shall be allowed. No more than 5 % of the sheets on a delivery shall be affected.

Dimensions in millimetres

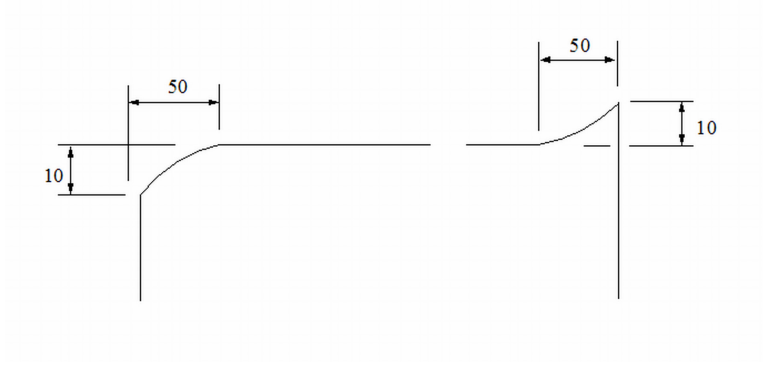


Figure 7 — Dimension of corners on/off

For as-cut finished sizes corners on/off shall not be allowed.

6.3.2.3 Vented (cracked) edges

Vented (cracked) edges, visible under conditions described in 6.2.1, shall not be allowed with either stock/standard sizes or as-cut finished sizes.

6.3.3 Colour variation between production batches or in one installation

In order to avoid colour differences due to deviation from batch to batch, panes placed next to each other should ideally come from the same production batch.

The allowable variation of the colourimetric measurements, measured on the glass side, between adjacent panes of uniform paint shall be:

$$\Delta E^* \leq 2{,}0$$

The Δ E* should be measured on the glass side, according to Annex B.

7 Classification of painted glass

Two classes are defined:

— Class A: painted glass for all internal applications;

— Class B: painted glass for continuously dry internal applications only.

NOTE Continuously dry internal applications exclude bathrooms, shower cabinets, kitchens.

8 Testing of painted glass

8.1 Durability

8.1.1 General

The durability of painted glass for internal use shall be determined by a number of tests, in accordance with the following specifications:

— High humidity test (see Annex A: condensation water test);

— High temperature test without water;

— Radiation resistance test.

8.1.2 Test specimens

The painted glass shall be cut to the specimen size of 100 mm x 100 mm and stored in ambient conditions at least 24 h before testing. Cutting oils shall not be used during cutting of the specimen. For each test, three samples shall be tested.

Defaults present before testing shall be identified before ageing and shall not be taken into account in the assessment of the test. Colour values shall be evaluated on each sample of uniform paint claiming for class A following Annex B and recorded.

Concerning the radiation resistance test, the glass thickness shall be the minimum thickness produced. If the test equipment does not allow this sample dimension, the test specimens may be cut to other dimensions providing that the area is not less than 10 000 mm^2. The maximum allowable number of defects after test will be calculated proportionally to the real area of the sample tested.

8.1.3 High humidity test (condensation water test)

8.1.3.1 Position of specimens

The specimens shall be placed in the testing cabinets with the paint coating side up at an angle as defined in Annex A.

8.1.3.2 Test condition

Test will be conducted according to Annex A, at (40 ± 3)°C, during 168 h.

8.1.3.3 Evaluation

The specimens shall be examined in conditions described in 6.2.1. A magnifying glass shall be used to measure spot fault diameter(s) with the exception of an extreme corner.

The sample may be gently rinsed with demineralized or distilled water before examination. Evaluation shall be done at least three hours after in order to allow the sample to dry at room temperature.

8.1.3.4 Acceptance criteria

Painted glass when tested shall comply with the following:

Class A

— 5 spot faults or lack of adhesion greater or equal to 0,5 mm and ≤ 1 mm in diameter shall be allowed on the total of the three tested samples. Spots faults ≤ 0,5 mm are allowed provided they do not form a cluster;

— Δ E* ≤ 2,0 on each tested sample for painted glass with uniform paint;

— for painted glass with non-uniform paint no disturbing colour variation shall be observed at 1m compared to a reference sample.

Class B

— This test is not required for class B products. No criteria are defined.

8.1.4 High temperature test without water

8.1.4.1 Test procedure

The three test specimens shall be heated in an oven to a temperature of 65 (+0, −3) °C. This temperature shall be maintained for a period of 168 h, and then the test specimens allowed to cool to room temperature.

8.1.4.2 Evaluation

The specimens shall be examined in conditions described in 6.2.1. A magnifying glass shall be used to measure spot fault diameter(s) with the exception of an extreme corner.

The sample may be gently rinsed with demineralized or distilled water before examination.

The Δ E* shall be measured on the glass side, according to Annex B.

8.1.4.3 Acceptance criteria

Painted glass when tested shall comply with the following:

Class A

— 3 Spot fault or lack of adhesion greater or equal to 0,5 mm and ≤ 1 mm in diameter shall be allowed on the total of the three tested samples. Spots faults smaller than 0,5 mm shall be allowed provided they do not form a cluster;

— Δ E* ≤ 2,0 on each tested sample for painted glass with uniform paint;

— for painted glass with non-uniform paint no disturbing colour variation shall be observed at 1m compared to a reference sample.

Class B

— 5 Spot fault or lack of adhesion greater or equal to 0,5 mm and ≤ 1 mm in diameter shall be allowed on the total of the three tested samples. Spots faults smaller than 0,5 mm shall be allowed provided they do not form a cluster;

— Δ E* shall not be measured.

8.1.5 Radiation resistance test

8.1.5.1 Position of specimens

The specimens shall be placed in the testing cabinets with the glass side facing the lamps.

8.1.5.2 Test condition

The test shall be conducted following EN ISO 16474-2:2013, Table 4, cycle 5.

8.1.5.3 Evaluation

The specimens shall be examined in conditions described in 6.2.1. A magnifying glass shall be used to measure spot fault diameter(s) with the exception of an extreme corner .

The Δ E* shall be measured on the glass side, according to Annex B.

8.1.5.4 Acceptance criteria

If the sample area is different from 10 000 mm^2, the number of defect should be corrected to be proportional to this area of 10 000 mm^2.

Painted glass when tested shall comply with the following:

Class A

— 3 spot faults or lack of adhesion greater or equal to 0,5 mm and ≤ 1 mm in diameter shall be allowed. Spots faults smaller than 0,5 mm shall be allowed provided they do not form a cluster;

— Δ E* ≤ 2,0 on each tested sample for painted glass with uniform paint;

— for painted glass with non-uniform paint no disturbing colour variation shall be observed at 1 m compared to a reference sample.

Class B

— When examined through the glass, a maximum of 10 lack of adhesion points by area of 10 000 mm^2, with a maximum diameter of 1mm shall be allowed;

— Δ E* shall not be measured.

8.2 Paint coating(s) adhesion

The adhesion of the paint coating(s) shall be assessed by means of the 'Cross cut test' given in EN ISO 2409. The test shall be carried out manually or automatically, using the 6 bladed cutter. The results shall comply with classification according to EN ISO 2409:

For both Class A and class B, the results shall comply with classification number (2) using brush or (3) using tape.

8.3 Summary of the tests and requirements, by classes

Table 3 — Summary of the test condition and requirements on painted glass

Tests	Class A		Class B	
	Conditions	Criteria	Conditions	Criteria
High Humidity Annex A	40°C 168 h	5 off lack of adhesion points ≥ 0,5 mm and ≤ 1mm allowed (total on the 3 tested samples) Δ E* ≤ 2,0[a] on each tested sample of uniform painted glass	N.A.	N.A.
High temperature 8.1.4	65°C 168 h	3 off lack of adhesion points ≥ 0,5 mm and ≤ 1mm allowed (total on the 3 tested samples) Δ E* ≤ 2,0[a] on each tested sample of uniform painted glass	65°C 168 h	5 off lack of adhesion points ≥ 0,5 mm and ≤ 1 mm allowed (total on the 3 tested samples) Δ E* not measured
Radiation 8.1.5.2	500 h	on each tested sample: 3 off lack of adhesion points ≥ 0,5 mm and ≤ 1mm allowed Δ E* ≤ 2,0 [a] on each tested sample of uniform painted glass	500 h	10 off lack of adhesion points_____ ≥ 0,5 mm and ≤ 1 mm allowed Δ E* not measured
Adhesion 8.2		Results class 2 (brush) or class 3 (tape)		Results class 2 (brush) or class 3 (tape)
[a] for painted glass with non-uniform paint no disturbing colour variation shall be observed at 1m compared to a reference sample				

Annex A
(normative)

Condensation water test in constant atmosphere

A.1 Purpose and scope

This test method describes the general conditions that shall be observed when submitting specimens to condensation water-constant atmospheres, in order to ensure that the results of tests carried out in different laboratories are reproducible.

The tests are designed to determine the behaviour of the specimens in humid ambient atmospheres, and to pinpoint any defects of the protection of the specimens against corrosion. The behaviour of the specimens in these test atmospheres does not, however, enable any direct assertions to be made in respect of the service life expectation of the components tested under real conditions of use.

The shape and the preparation of the specimens, the duration of the test, the evaluation of the test and the assessment of the test results do not form part of the subject matter of this test method.

A.2 Test conditions

Condensation water test atmospheres promote the condensation of atmospheric humidity on the surfaces of specimens, the temperatures of which are lower than the temperature of the saturated air in the test cabinet, due to radiation onto the cabinet walls or to the cooling of the specimen.

The constant atmospheric temperature in the test cabinet during the condensation process of the condensation water test atmospheres of this standard shall be (40 ± 3) °C.

The quantity of condensation water formed on the surface of the specimen may also have an important influence on the action of the condensation water. This quantity will be affected by the ambient temperature in the installation room or by the cooling of the specimen.

The condensate which drips off the specimen consists of condensation water and also in some instances of solid and liquid constituents of the specimens dissolved in the condensation water or mixed in it.

Reproducible results can only be expected on condition that the test atmosphere is the same and that the test procedure is the same.

A.3 Climatic testing device

A.3.1 Climatic chamber

A vapour-tight climatic chamber is essential for testing with a warm and humid atmosphere. The material of the inner walls shall be corrosion-resistant and shall not affect the specimens. The climatic chamber shall be usually equipped with a floor trough that acts as the receptacle for the quantity of water prescribed in A.4.1. The rest cabinet conditions shall be achieved by heating the water in the floor trough.

NOTE The heating-up time will depend on the nature and quantity of the specimens, and also on the ratio of the water surface of the floor trough to the wall surface of the test cabinet, and on the water temperature.

The water temperature shall not exceed 60 °C.

The dimensions of the climatic chamber and the arrangement of its temperature measuring and control equipment can be modified, provided that the test conditions in accordance with A.2 and A.4.3 are observed and that the temperature of the test atmosphere in the useful space is measured.

An example of a condensation water climatic testing device is illustrated in Figure A.1.

A.3.2 Installation of the climatic chamber

The climatic chamber shall be installed in a room with an ambient atmosphere not containing any corrosive constituents.

NOTE A decrease in the ambient temperature will result in an increase in the quantity of condensation water.

A.3.3 Device of the accommodation of the specimens (specimen holder)

The device for the accommodation of the specimens shall consist of a corrosion resistant material and shall not promote the corrosion of the specimens. It shall allow the specimens to be arranged in accordance with the requirements of A.4.3.

A.4 Procedure

A.4.1 Filling the floor trough

The floor trough shall be filled with pure water (distilled water or de-ionized water).

NOTE The water may be changed typically monthly.

A.4.2 Specimens

Only specimens which are not capable of influencing one another mutually shall be tested together at any one time.

A.4.3 Arrangement of the specimens

The specimens shall be arranged in the test cabinet in such a way that they are not in close contact with each other and that they are able to radiate heat adequately.

The following minimum spacing shall be observed:

— distance from the walls: not less than 100 mm;

— distance of the bottom edge of the specimens from the surface of the water: not less than 200 mm;

— spacing between adjoining specimens: not less than 20 mm.

Inclination angles shall be between 60 and 75° from the horizontal. The sample shall be loaded in a square rather than diamond position.

Steps shall be taken to ensure that no condensation water is allowed to drip onto the specimens from the walls of the test cabinet or from other specimens arranged overhead, when the specimens are positioned.

A.4.4 Test sequence

A.4.4.1 Start up

After the specimens have been positioned and after the climatic chamber has been closed, the heating for the floor trough water or for the climatic testing device shall be switched on, and the test cabinet shall be heated up to the atmospheric temperature of (40 ± 3)°C. This temperature shall be attained within 1,5 h. Condensation water shall be formed on the specimens.

A.4.4.2 Condensation water constant atmosphere

The temperature prescribed in A.2, and therefore the condensation process, shall be maintained in the test cabinet for the entire prescribed duration of the test.

A.4.5 End of test

The test shall be terminated after 168 h.

A.4.6 Interruption

Short interruptions (typically less than 5 min) of the test such as to briefly introduce or replace other samples shall be allowed. Longer interruptions shall be recorded accurately in the test report.

A.4.7 Cleaning procedure

All test pieces shall be cleaned with demineralized water and with a soft tissue. Drying shall also be done with a soft tissue. If necessary this procedure can be repeated.

A.5 Test report

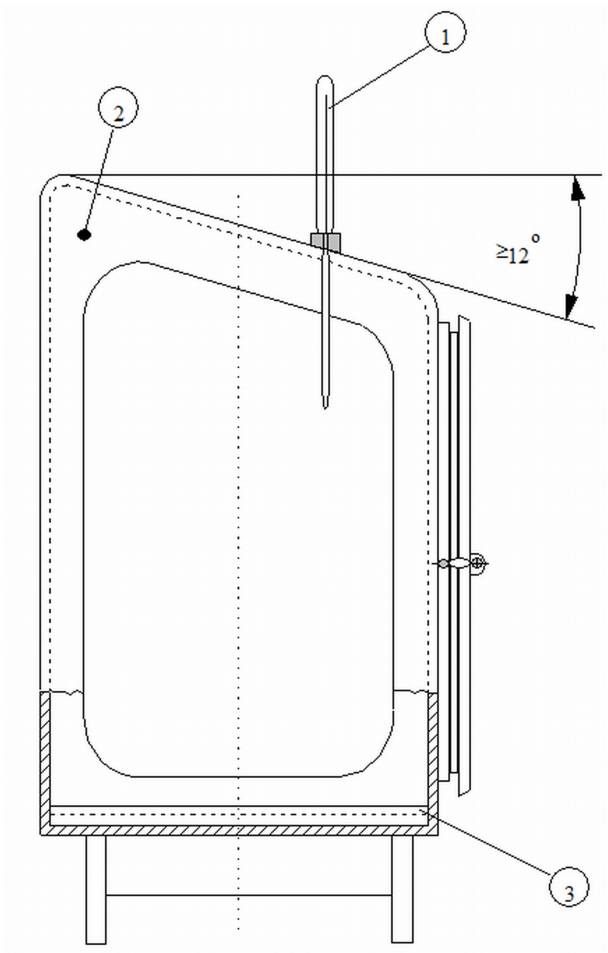
The following information shall be provided in the test report quoting this standard as reference:

— exact description of the specimens, including their pre-treatment if applicable;

— duration of test;

— reason and duration of possible test interruptions (e.g. power failure);

— observations made on the test specimens after test in compliance with Clause 8.



Key

1 Temperature measuring device
2 Pressure relief valve
3 Floor trough filled with water

Figure A.1 — Example of a condensation water climatic testing device with glass walls

Annex B
(normative)

Determination of the Δ E*

B.1 General

The colour quantification is used to evaluate the durability of the paint. It allows to assess the chemical modification of components of the paint, leading to a premature replacement of the product.

It is also used to assess the colour variation between batches.

B.2 Colour quantification

Various methods have been devised in the past for quantifying colour and expressing it numerically with the aim of making it easier and more accurate. The method used here is the L*a*b* colour-space, defined by CIE in 1976 (see EN ISO 11664-4).

The L*a*b* colour space (also referred to as CIELAB) is one of the most popular colour spaces for measuring object colour and is widely used in a variety of fields, because it provides more uniform colour differences in relation to visual differences. Furthermore it enables the colour to be quantified.

This colourimetric system can be visualized by a three-dimensional colour space, where every colour can be represented by a set of 3 coordinates: L*, a* and b*. The L* indicates the lightness; a* and b* are the chromaticity coordinates. They indicate the colour directions where positive values of a* show the red direction, negative values the green direction, positive values of b* show the yellow direction, negative values the blue direction. The colour space centre is achromatic (neutral).

NOTE The parameters L*, a* and b* can be used for quantifying the painted glass colour, observed from the glass side (in reflection) or to characterize the properties of transmission of light through the painted glass.

B.3 Measurement of the colour

The parameters L*, a* and b* shall be measured using either spectrophotometers or colourimeters. As this standard deals with Δ E* it is not necessary to establish a correlation between results from spectrophotometers and colourimeters.

NOTE 1 These colourimeters can be portable instruments, suitable for use on site and as instructed by the manufacturer. Whether used in a laboratory or on site, these devices have a similar sensitivity to that of the human eye

The measurements shall always be undertaken following EN ISO 11664-4 with the same light source and illumination method to ensure that the measurement conditions are the same, regardless of whether it is day or night, indoors or outdoors. This ensures that simple and accurate measurements are undertaken to provide numerical values that are independent of external factors.

NOTE 2 Portable colourimeters currently used on site are limited to the measurement of colour in reflection, with an angle of observation corresponding to the vertical. Laboratory instruments can measure the characteristics of glass panes in transmission and reflection under different angles of observation

The colour of an object depends on the light source. The standard illuminant shall be D65 representing the average daylight, and the angle of observation shall be 10°.

NOTE 3 For sake of simplification the 10 subscript is omitted in this standard

The measurements shall be undertaken at a minimum of three points in each evaluated painted glass pane equally distributed. A mean value shall be calculated.

For translucent or transparent paints, the colour measurement shall be done in reflection mode. The background shall be white and the same as for the reference measurement. For cut sizes measurements shall not be undertaken at any point within 100 mm of an edge. For painted glass as stock/standard sizes, measurements shall not be undertaken nearer than 150 mm from an edge. This is due to the potential for the colour near to the edge to differ slightly from the colour in the centre. Furthermore, the measurements on site may be affected by the proximity of the frame and the edge of the framed glass pane.

B.4 Calculation of Δ E*

The differences of colour between two panes (pane 1 and pane 2) shall be quantified using tolerances on the parameters L*, a* and b*, which are noted as Δ L*, Δ a* and Δ b*, respectively, and calculated following Formulae (B.1), (B.2), (B.3):

$$\Delta L^* = L^*_{\text{pane 2}} - L^*_{\text{pane 1}} \quad \text{(B.1)}$$

$$\Delta a^* = a^*_{\text{pane 2}} - a^*_{\text{pane 1}} \quad \text{(B.2)}$$

$$\Delta b^* = b^*_{\text{pane 2}} - b^*_{\text{pane 1}} \quad \text{(B.3)}$$

Δ E* shall be calculated as the Euclidean distance following Formula (B.4):

$$\Delta E^* = [(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2]^{1/2} \quad \text{(B.4)}$$

Annex C
(informative)

Fixing of painted glass and cleaning after installation

C.1 General

The type of painted glass and fixing/cleaning should be suitable for the environment. Consideration and recognition should be given with regard to durability of the painted glass.

For all installations, the appropriate building safety regulation and installation rules should be followed.

The general appearance of the painted glass may be affected by a number of parameters including e.g. the colour of the background, translucency of the paint, colour of the adhesive and lighting conditions.

C.2 Factors affecting durability

The susceptibility of painted glass to damage will largely depend on the environment in which it is used. The following recommendations should always be considered:

— Between the painted glass and wall or any other mounting surface air circulation should be allowed for. There should be a gap of at least 5 mm for painted glass less than 1 m high or a gap of 5 mm to 10 mm for painted glass with height of more than 1 m in order to ensure good ventilation.

— If several glasses mounted side by side in a plane, it should be ensured that there is a gap between all butting edges. As an assembly guide, a suitable 1 mm separator might be inserted during fixing.

— The mounting materials used should not be of an aggressive nature. Any contact with hard materials shall be avoided.

— When painted glass is inserted into profiles, the edges can be damaged by condensation, bathing lotions, cleaning chemicals etc. which may remain within the profile. To avoid this, the painted glass should be mounted on small suitable blocks following EN 12488 within the profile.

— The surface and body of the substrate material to which the painted glass is to be fixed should be clean, dry, free of humidity, acid, alkali and any other aggressive materials and, when required, should be appropriate for the use of adhesives.

— Surfaces to be in contact with adhesives should be adequately prepared.

— The adhesive manufacturer’s instructions should always be observed.

— All adhesives, double-sided tapes, etc, used should be compatible with the painted glass . All cleaning agents should be compatible with the painted glass.

— All adhesives, double sided tapes, etc. used for fixing should be applied vertically.

— The selection and application of adhesives, along with the choice of substrate and preparation for fixing the painted glass, is the responsibility of the installer.

— Where the effect of painted glass is enhanced by illumination (e.g. by spotlight), excessive warming of the painted glass should be avoided to prevent deterioration of the paint, or fracture of the glass.

Bibliography

[1] EN 12488, *Glass in building - Glazing recommendations - Assembly principles for vertical and sloping glazing*

[2] EN 14179-1, *Glass in building - Heat soaked thermally toughened soda lime silicate safety glass - Part 1: Definition and description*

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