BS EN 1096-1:2012

BSI Standards Publication

Glass in building — Coated glass

Part 1: Definitions and classification

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National foreword

This British Standard is the UK implementation of EN 1096-1:2012. It supersedes BS EN 1096-1:1999 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee B/520/1, Basic and transformed glass products.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Compliance with a British Standard cannot confer immunity from legal obligations.

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English Version

Glass in building - Coated glass - Part 1: Definitions and classification

Verre dans la construction - Verre à couche - Partie 1: Définitions et classification

Glas im Bauwesen - Beschichtetes Glas - Teil 1: Definitionen und Klasseneinteilung

This European Standard was approved by CEN on 3 December 2011.

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Foreword

This document (EN 1096-1:2012) 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of an identical text or by endorsement, at the latest by July 2012, and conflicting national standards shall be withdrawn at the latest by July 2012.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 1096-1:1998.

EN 1096, *Glass in building - Coated glass*, is composed of the following parts:

— Part 1: Definitions and classification

— Part 2: Requirements and test methods for A, B and S coatings

— Part 3: Requirements and test methods for C and D coatings

— Part 4: Evaluation of conformity/Product standard

— Part 5: Test method and classification for the self-cleaning performances of coated glass surfaces

The main changes compared to the previous edition are:

— reference to the future EN 1096-5: Test method and classification for the Self-cleaning performances of coated glass surfaces;

— Clause 3, Terms and definitions, and Clause 5, Glass substrates, were reorganised and completed;

— addition of a definition of shading coefficient (6.3);

— the wavelengths defining the thermal range were corrected according to EN 12898;

— the identity card is moved to an informative annex.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This European Standard defines the characteristics, properties and classification of coated glass for use in building.

Test methods and procedures used to establish durability are in Parts 2 and 3 of this standard.

Factory production control and evaluation of conformity, including Annex ZA, are in Part 4 of this standard.

Test methods for determination of self cleaning performances of coated glass are in Part 5.

This standard applies to coated glass for glazing application for use in normally occupied domestic or commercial premises.

This standard is not applicable to:

— adhesive backed polymeric films on glass (prEN 15755-1);

— mirrors made from silvered float glass (EN 1036-1);

— enamelled glass (EN 12150-1, EN 1863-1, 14179-1).

— Painted glass (standard in development)

2 Normative references

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

EN 410:2011, *Glass in building — Determination of luminous and solar characteristics of glazing*

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

EN 572-4, *Glass in building — Basic soda lime silicate glass products — Part 4: Drawn sheet glass*

EN 572-5, *Glass in building — Basic soda lime silicate glass products — Part 5: Patterned glass*

EN 572-6, *Glass in building — Basic soda lime silicate glass products — Part 6: Wired patterned glass*

EN 572-7, *Glass in building — Basic soda lime silicate glass products — Part 7: Wired or unwired channel shaped glass*

EN 673:2011, *Glass in building — Determination of thermal transmittance (U value) — Calculation method*

EN 674, *Glass in building — Determination of thermal transmittance (U value) — Guarded hot plate method*

EN 675, *Glass in building — Determination of thermal transmittance (U value) — Heat flow meter method*

EN 1096-2, *Glass in building — Coated glass — Part 2: Requirements and test methods for A, B and S coatings*

EN 1096-3, *Glass in building — Coated glass — Part 3: Requirements and test methods for C and D coatings*

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: Definition 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 safety soda lime silicate safety glass — Part 1: Definition and description*

EN 12898:2001, *Glass in building — Determination of the emissivity*

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 14179-1, *Glass in building — Heat soaked thermally toughened soda lime silicate safety glass — Part 1; Definition and description*

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*

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

prEN 15683-1, *Glass in building — Thermally toughened soda lime silicate channel shaped safety glass — Part 1: Definition and description*

EN ISO 12543-2, *Glass in building — Laminated glass and laminated safety glass — Part 2: Laminated safety glass (ISO 12543-2)*

EN ISO 12543-3, *Glass in building — Laminated glass and laminated safety glass — Part 3: Laminated glass (ISO 12543-3)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 410:2011, EN 673:2011 and EN 12898:2001 and the following apply.

NOTE For the purposes of these definitions, the term thermally toughened also applies to heat soaked thermally toughened.

3.1 Product definition

3.1.1
coated glass
glass substrate, as defined in 3.1.2, to which has been applied a coating, as defined in 3.1.3, in order to modify one or more of its properties

NOTE The properties modified could be one and/or more of the following:

- light transmittance/reflectance;
- solar heat transmittance /reflectance;
- ultra violet transmittance;
- emissivity;
- self-cleaning performances.

3.1.2
glass substrate
basic glass, special basic glass, chemically strengthened basic glass, thermally treated basic and special basic glass, laminated glass or laminated safety glass (see Clause 4)

3.1.3
coating
one or more thin solid layers of inorganic materials applied on to the surface of a glass substrate by various methods of deposition

3.1.4
on-line coating
treatment of the surface of a moving continuous ribbon of a basic glass, at a stage during its manufacture, before it is cut

3.1.5
off-line coating
application of a coating to individual pieces of glass within a manufacturer's or processor's premises

3.1.6
additive methods of deposition:
single or multilayer systems (consisting of metals, oxides, nitrides, fluorides, diamond like carbon or other compounds) added to the surface of the glass by different methods

3.1.7
coated annealed glass
coated glass which has an annealed glass substrate

3.1.8
coated toughened or heat strengthened glass
coated glass which has a thermally toughened or heat strengthened glass substrate

3.1.9
thermally treated coated glass
coated glass that is thermally toughened or heat strengthened

3.1.10
coated glass - to be toughened or to be heat strengthened
coated glass which has to be thermally toughened or heat strengthened to meet its final spectrophotometric properties

3.1.11
toughenable or heat strengthenable coated glass
coated glass which can be thermally toughened or heat strengthened while keeping its final spectrophotometric properties

3.2 Definitions of luminous, solar and thermal properties

3.2.1
colour rendering in transmission (R_a)
change in colour of an object as a result of the light being transmitted by the coated glass

3.2.2
light reflectance of coated side (ρ_v)
fraction of the incident light that is reflected by the coated glass when the light is incident on the coated side

3.2.3
light reflectance of uncoated side (ρ'_v)
fraction of the incident light that is reflected by the coated glass when the light is incident on the uncoated side

3.2.4
light transmittance (τ_v)
fraction of the incident light that is transmitted by the coated glass

3.2.5
nominal colour in reflection of coated side
colour of the glass observed from the coated side

3.2.6
nominal colour in reflection of uncoated side
colour of the glass observed from the uncoated side

3.2.7
nominal colour in transmission
colour of the glass observed in transmission

NOTE Nominal colour in 3.2.5, 3.2.6 and 3.2.7 is defined with a qualitative indication.

3.2.8
normal emissivity (ε_n)
ratio, in a direction normal to the surface, of the emissive power of the coated surface of the glass to the emissive power of a black body

NOTE For method of determination see EN 12898.

3.2.9
solar direct reflectance of coated side (ρ_e)
fraction of the incident solar radiation that is reflected by the coated glass when the radiation is incident on the coated side

3.2.10
solar direct reflectance of uncoated side (ρ'_e)
fraction of the incident solar radiation that is reflected by the coated glass when the radiation is incident on the uncoated side

3.2.11
solar direct transmittance (τ_e)
fraction of incident solar radiation that is directly transmitted by the coated glass

3.2.12
total solar energy transmittance (solar factor) (g)
total fraction of the incident solar radiation that is transmitted by the coated glass

NOTE For method of calculation see EN 410.

3.2.13
shading coefficient (SC)
ratio of the solar factor of the glass to the solar factor of a reference glass (clear float)

3.2.14
thermal transmittance (*U*)
quantity of heat flowing, under steady conditions, in unit time, through a unit surface of the coated glass, for each degree of temperature difference between inside and outside

NOTE 1 For method of calculation see EN 673.

NOTE 2 In some instances, the symbol U_g is used for the U-value of glazing.

3.2.15
ultraviolet transmittance (τ_{UV})
fraction of the incident UV component of the solar radiation that is transmitted by the coated glass

3.3 Definitions of appearance defects

3.3.1
uniformity defect
slight visible variation in colour, in reflection or transmission, within a coated glass pane or from pane to pane

3.3.2
stain
defect in the coating larger than punctual defect, often irregularly shaped, partially of mottled structure

3.3.3
punctual defect
punctual disturbance of the visual transparency looking through the glass and of the visual reflectance looking at the glass

NOTE Spot, pinhole and scratch are types of punctual defect.

3.3.3.1
spot
defect that commonly looks dark against the surrounding coating, when viewed in transmission

3.3.3.2
pinhole
punctual void in the coating with partial or total absence of coating and it normally contrasts clear relative to the coating, when viewed in transmission

3.3.3.3
scratch
variety of linear score marks, whose visibility depend on their length, depth, width, position and arrangements

3.3.4
cluster
accumulation of very small defects giving the impression of stain

3.4 Symbols

ε_n	normal emissivity
g	total solar energy transmittance (solar factor)

SC	shading coefficient
ρ_e	solar direct reflectance of coated side
ρ'_e	solar direct reflectance of uncoated side
ρ_v	light reflectance of coated side
ρ'_v	light reflectance of uncoated side
R_a	colour rendering in transmission
τ_e	solar direct transmittance
τ_v	light transmittance
τ_{UV}	ultraviolet transmittance
U	thermal transmittance (U-value)
NOTE Some glasses are coated on both sides; in which case they do not have an uncoated side but two coated sides.	

4 Description of additive methods of deposition

4.1 Chemical film formation processes:

Processes where chemical reactions produce films on the glass from liquid, vapour or powder.

NOTE The following are examples:

a) **wet chemical deposition:**
mixture of a dissolved metal salt and a reducing compound is sprayed on to the glass surface. A reduction reaction takes place and fine grained metal is precipitated.

b) **sol-gel coating:**
solutions of metallo-organic-compounds are dip coated and pyrolytically transformed into suitable oxides.

c) **chemical-vapour deposition:**
Compounds in a vapour phase reacting chemically on the hot surface of the glass substrate.

d) **spray-coating:**
Sprayed liquids reacting pyrolytically on the hot surface(s) of the glass substrate.

e) **powder coating:**
Powders reacting chemically on the hot surface of the glass substrate.

4.2 Physical film formation processes

Processes under vacuum conditions, whereby materials from a source are transferred as elements, compounds or ions which subsequently condensation on the glass surface producing the film.

NOTE 1 Chemical reactions can also be associated with this process.

NOTE 2 The following are examples:

a) **evaporation:**
Material forming the coating is evaporated by heating and deposited on the glass surfaces.

b) **sputtering:**
In a gas discharge, ions bombard a target causing sputtering of material which condenses on the glass surface.

4.3 Other processes

Coatings may also be produced by combinations of the techniques described in 4.1 and 4.2.

5 Glass substrates

The following glass substrates may be used for the production of coated glass:

5.1 Basic glasses

These are glass products manufactured from soda lime silicate glass in accordance with EN 572-1 and consist of the follows:

- Float glass EN 572-2
- Drawn sheet glass EN 572-4
- Patterned glass EN 572-5
- Wired patterned glass EN 572-6
- Wired and unwired channel shaped glass EN 572-7

5.2 Special basic glasses

These are glass products manufactured from a variety of compositions, which are in accordance with appropriate European standards, and consist of the follows:

- Borosilicate glass EN 1748-1-1
- Glass ceramics EN 1748-2-1
- Alkaline earth silicate glass EN 14178-1
- Alumino silicate glass prEN 15681-1

5.3 Processed glasses

5.3.1 Strengthened glasses

These are soda lime silicate glasses that have been strengthened by thermal or chemical means and are as follows:

- Heat strengthened EN 1863-1
- Chemically strengthened EN 12337-1

5.3.2 Thermally toughened safety glasses

These are glasses that have been toughened by thermal treatment and are as follows:

- Thermally toughened soda lime silicate safety glass EN 12150-1
- Thermally toughened borosilicate safety glass EN 13024-1
- Heat soaked thermally toughened soda lime silicate safety glass EN 14179-1
- Thermally toughened alkaline earth silicate safety glass EN 14321-1
- Heat soaked thermally toughened alkaline earth silicate safety glass prEN 15682-1
- Thermally toughened soda lime silicate channel shaped safety glass prEN 15683-1

5.3.3 Laminated glasses

These are glasses that are in accordance with EN ISO 12543-1 and consist of the following:

- Laminated glass EN ISO 12543-3
- Laminated safety glass EN ISO 12543-2

6 Luminous, solar and thermal properties

6.1 General

The purpose of applying thin coatings on glass is the modification of the spectrophotometric properties of the glass substrate.

NOTE An example of modification of properties/behaviour other than the spectrophotometric are indicated in EN 1096-5.

The properties of a coating cannot be considered separately from those of the glass substrate to which it is attached. Therefore the 'glass substrate – coating combination' is the finished product, i.e. the coated glass.

The following spectral ranges have to be considered according to EN 410 and EN 12898:

a) the spectral range for photopic vision,

b) the spectral range of the solar radiation,

c) the emission spectrum of the black body at 283 K.

6.2 Spectrophotometric properties

6.2.1 General

The spectrophotometric properties of a coated glass are quantified by the parameters listed in paragraphs 6.2.2 to 6.2.5 and measured in accordance with EN 410 and EN 12898.

NOTE The contribution of the rear surface of the pane is included.

6.2.2 Ultraviolet range

This is defined as 280 nm to 380 nm, in EN 410. The property to be determined is as follows:

Ultraviolet transmittance; τ_{UV}

6.2.3 Visible range

This is defined as 380 nm to 780 nm, in EN 410. The properties to be determined are as follows:

Light transmittance; τ_v

Nominal colour in transmission

Colour rendering in transmission; R_a

Light reflectance of coated side; ρ_v

Light reflectance of uncoated side; ρ'_v

Nominal colour in reflection of coated side

Nominal colour in reflection of uncoated side

When required the colour rendering in transmission, R_a, can be determined according to EN 410.

When required the colour in reflection of coated and uncoated side can be characterised quantitatively, see CIE 015-2004.

6.2.4 Solar range

This is defined as 300 nm to 2500 nm, in EN 410. The properties to be determined are as follows:

Solar direct transmittance; τ_e

Solar direct reflectance of coated side; ρ_e

Solar direct reflectance of uncoated side; ρ'_e

Total solar energy transmittance (solar factor); g

Shading Coefficient; SC

When a coated glass is used as a monolithic glazing it is required that the solar factor has to be calculated.

NOTE The solar factor can change if the internal and external surfaces of the coated glass are reversed.

6.2.5 Thermal range

This is defined as 5 µm to 50 µm, in EN 12898. The property to be determined is as follows:

Normal emissivity; ε_n

When a coated glass is used as a monolithic glazing it is required that the thermal transmittance, (U value) has to be determined.

Where U-values are required they shall be obtained by calculation in accordance with EN 673. Measurements according to EN 674 or EN 675 shall only be undertaken in the event of calculations in accordance with EN 673 being impractical.

6.3 Tolerance on determined properties

Nominal values are determined for the coated glass, i.e. combination of glass substrate and coating.

Due to the inherent variations in the manufacturing processes the actual/measured values may vary from the nominal values.

7 Classification of coated glass

The coated glass manufacturer declares the applicable class for the product. This declaration states where the product shall be used.

The classification system is based on the positioning of the coated surface when the coated glass is glazed. This glazed position determines the type and extent of attack, e.g. humidity, atmospheric pollution, abrasion, etc., that the coating will experience during its working life.

Coated glass can be classified into one of the following five classes:

Class A: The coated surface of the glass can be positioned on the outer or the inner face of the building.

Class B: The coated glass can be used as monolithic glazing but the coated surface shall be on the inner face of the building.

Class C: The coated glass shall be used only in insulating glass units and the coated surface should be facing into the unit cavity.

Class D: The coated glass shall be incorporated into an insulating glass unit, with the coated surface facing into the unit cavity, as soon as they are coated.

Class S: The coated surface of the glass can be positioned on the outer or the inner face of the building but these types of coated glasses can only be used in specifically defined applications e.g. shop fronts.

NOTE 1 For Class C coated glass special care in the transportation, handling, general transformation and storage of the monolithic sheets should be considered. In some instances the coating may need to be removed in the region of the unit edge seal, edge stripped, to ensure appropriate levels of adhesion of the edge seal to the glass substrate (see EN 1279-4).

NOTE 2 Class D coated glasses are not suitable as monolithic glass.

NOTE 3 Class D coated glass, when incorporated into an insulating glass unit, should have the edge seal made to the glass substrate, i.e. the coating should be stripped.

NOTE 4 Class S coated glass, because of their special applications, have a lower life expectancy for the coatings than would be expected for coated glasses, i.e. Class A or B, that are for normal use in buildings.

The durability of the declared classification for a coated glass shall be proven by subjecting the coated glass to the appropriate durability test as follows:

Class A, B and S coated glass shall be tested to and meet the requirements of EN 1096-2.

Class C and D coated glass shall be tested to and meet the requirements of EN 1096-3.

8 Appearance

8.1 General

The defects affecting appearance are:

— Specific to the glass substrate (see appropriate standard as given in Clause 5).

— Specific to the coating.

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

8.2 Detection of defects

8.2.1 General

The defects are detected visually by an observation of the coated glass in transmission and/or reflection. An artificial sky or daylight may be used, as the source of illumination.

8.2.2 Artificial sky

The artificial sky is a plane emitting diffuse light with a uniform brightness and a general colouring index R_a higher than 70 (see CIE 013.3-1995).

It is obtained by using a light source whose correlated colour temperature is in the range between 4000 K and 6000 K. In front of the arrangement of light sources is a light scattering panel, without spectral selectivity. The illuminance level, on the glass surface shall be between 400 lx and 20000 lx.

8.2.3 Daylight illumination

Daylight illumination is a uniform overcast sky, without direct sunlight.

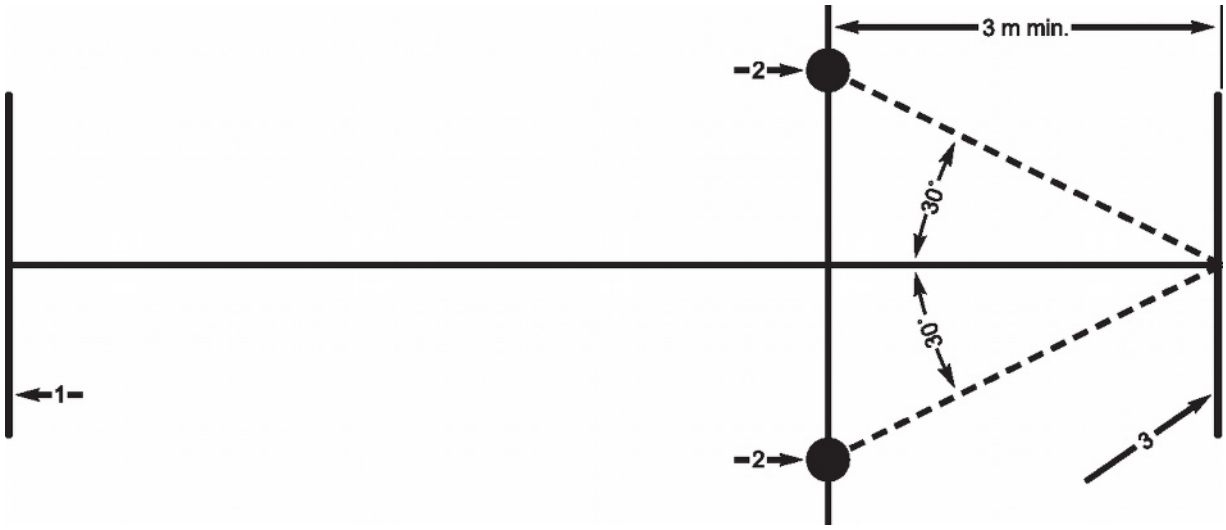
8.3 Conditions of examination

8.3.1 General

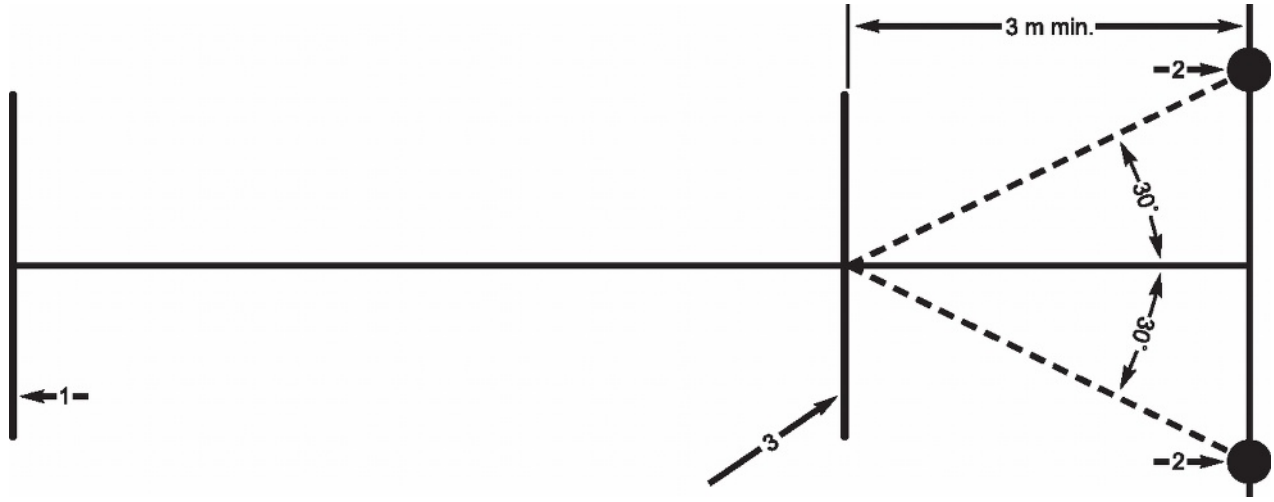
Coated glass may be examined in stock size plates or in finished sizes ready for installation. The examination may be undertaken in the factory or on site when glazed.

The pane of coated glass being examined is viewed from a minimum distance of 3 m. The actual distance will be dependent on the defect being considered and which illumination source is being used. The examination of the coated glass in reflection is performed by the observer looking at the side which will be the outside of the glazing. The examination of the coated glass in transmission is performed by the observer looking at the side which will be the inside of the glazing. During the examination the angle between the normal to the surface of the coated glass and the light beam proceeding to the eyes of the observer after reflection or transmission by the coated glass shall not exceed 30° (see Figure 1).

a) Reflection



b) Transmission



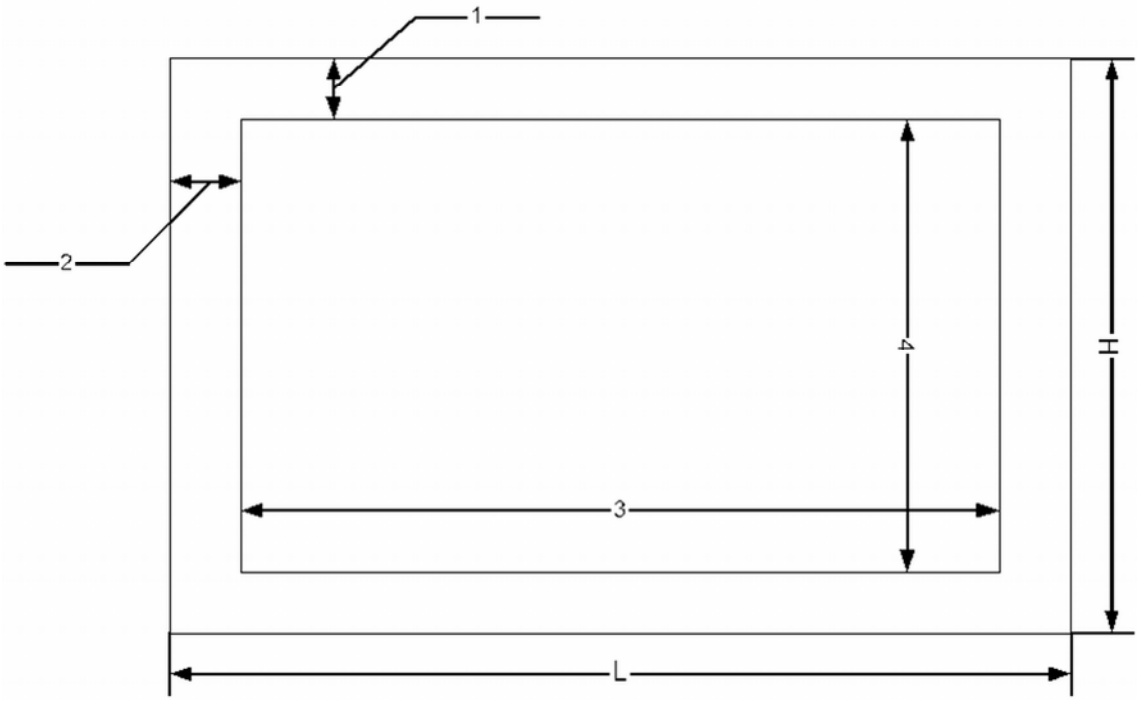
Key

1	illumination source
2	observer position
3	coated glass sample

NOTE These are a plan views.

Figure 1 — Schematics of examination procedures for coated glass

For panes of coated glass in finished sizes ready to be installed both the main area and an edge area of the pane shall be examined (see Figure 2).



Key

1 edge area height is 5 % of H dimension

2 edge area length is 5 % of L dimension

3 central area length is 90 % of L dimension

4 central area height is 90 % of H dimension

Figure 2 — Areas to be examined on finished sizes ready for glazing

Each examination will take no more than 20 s.

8.3.2 Uniformity defects and stains

Under the conditions of examination, given in 8.3, note any coating variations either within one pane or between neighbouring panes which are visually disturbing.

8.3.3 Punctual defects

Under the conditions of examination, given in 8.3, note any spots, pinholes and/or scratches that are visually disturbing.

For spots/pinholes measure the size and note the number relative to the size of the pane. If there are any clusters found their position relative to the through vision area shall be determined.

For scratches determine whether or not they are in the main or edge area. Measure the length of any scratches noted. For scratches > 75 mm long determine the distance between adjacent scratches. For scratches ≤ 75 mm long note any area where their density produces visual disturbance.

8.4 Acceptance criteria of coated glass defects

The acceptance criteria for defects in coated glass, examined according to 8.3, are given in Table 1.

Table 1 — Acceptance criteria for coated glass defects

DEFECT TYPES	ACCEPTANCE CRITERIA		
	PANE/PANE	INDIVIDUAL PANE	
UNIFORMITY/STAIN	Allowed as long as not visually disturbing	Allowed as long as not visually disturbing	
	Not applicable	MAIN AREA	EDGE AREA
PUNCTUAL			
Spots/Pinholes; > 3 mm		Not allowed	Not allowed
> 2 mm and ≤ 3 mm		Allowed if not more than 1/m^2	Allowed if not more than 1/m^2
Clusters;		Not allowed	Allowed as long as not in area of through vision
Scratches;			
> 75 mm		Not allowed	Allowed as long as they are separated by > 50 mm
≤ 75 mm		Allowed as long as local density is not visually disturbing	Allowed as long as local density is not visually disturbing

9 Product information

9.1 General

The manufacturer of the coated glass shall supply all the spectrophotometric properties as detailed in Clause 6. This information can be supplied in any form and via any media the manufacturer determines. One possible form, i.e. an identity card, is shown in Annex A

Those properties that are required to be published for regulatory reasons are given in EN 1096-4.

9.2 Additional information

The manufacturer shall also supply all necessary information, where appropriate, with regards to the following topics:

Transportation

Handling

Storage

Cutting

Washing

Processing, e.g. toughening, laminating, insulating glass unit production

Cleaning

Glazing

Annex A
(informative)

Example of presentation of coated glass properties

PRODUCT REFERENCE Coated 1 or 2 sides)	
CHARACTERISTIC	NOMINAL VALUE
Ultraviolet range τ_{UV}	
Visible range τ_v ρ_v ρ'_v R_a	
Solar range τ_e ρ_e ρ'_e g SC	
Thermal range ε_n U	
Classification: A, B, C, D or S	
Glass substrate Type Clear/Tinted Nominal thickness EN reference	
Nominal colour in transmission	
Nominal colour in reflection Coated side Uncoated side	

Bibliography

[1] EN 572-8, *Glass in buildings — Basic soda lime silicate glass products — Part 8: Supplied and final cut sizes*

[2] CIE 013.3-1995, *Method of measuring and specifying colour rendering properties of light sources*

[3] CIE 015-2004, *Colorimetry*

[4] prEN 15755-1, *Glass in buildings — Adhesive backed polymeric filmed glass - Part 1: Definitions and descriptions*

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