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ISO 16293-2

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Glass in building — Basic soda lime silicate glass products —

Part 2: Float glass

Verre dans la construction — Verre de silicate sodocalcique —

Partie 2: Glace

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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The committee responsible for this document is ISO/TC 160, *Glass in building*, Subcommittee SC 1, *Product considerations*.

A list of all parts in the ISO 16293 series can be found on the ISO website.

Glass in building — Basic soda lime silicate glass products —

Part 2: Float glass

1 Scope

This document specifies dimensional and minimum quality requirements (in respect of optical and visual faults) for float glass for use in building, as defined in ISO 16293-1.

This document applies to float glass supplied in stock sizes and final cut sizes.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 16293-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

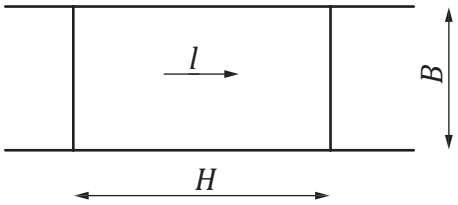
— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1
length
H
dimension of the straight edge of the glass parallel to the direction of draw of the glass ribbon

Note 1 to entry: See Figure 1.

[SOURCE: ISO 11485-1:2011, 2.26, modified]



Key
l direction of draw
H length
B width

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

3.2
width
B
dimension of the edge of the glass perpendicular to the direction of the glass ribbon

Note 1 to entry: See Figure 1.

3.3
stock sizes
glass sizes that are intended to be re-cut to obtain *final cut sizes* (3.7)

Note 1 to entry: Stock sizes can be jumbo sizes, split sizes or supplied sizes.

3.4
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

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.

Note 2 to entry: The usual maximum length is 6 000 mm. Oversize plates where the nominal length, *H*, is greater than 6 000 mm, can be produced to special order.

3.5
split sizes
glass delivered in the following size ranges:

Nominal length *H*: 1 000 mm to 2 550 mm;

Nominal width *B*: 3 210 mm

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.

3.6
supplied size
pane of glass that has been supplied as raw material for cutting down to a size for installation, delivered in the following size ranges:

Nominal length *H*: any;

Nominal width *B*: <3 210 mm

Note 1 to entry: In some cases, nominal width can be $B < 3\,810$ mm

3.7
final cut size
pane of glass that has been cut down to the dimensions being required either for installation or processing into a final product, e.g. insulating glass units, thermally toughened safety glass, of those dimensions

Note 1 to entry: The minimum final cut size shall have dimensions *H* or *B* not less than 100 mm and a minimum surface area of not less than $0{,}05\,m^2$.

3.8
optical faults
faults which lead to distortions in the appearance of objects observed through the glass

3.9
visual faults
faults which alter the visual quality of the glass

Note 1 to entry: Visual faults include spot faults and linear/extended faults.

3.10
spot fault
defect in the glass having a limited size and being composed of a nucleus, which can be accompanied by a *halo* (3.11) of distorted glass

3.11
halo
area of glass locally distorted, generally around a nucleus

3.12
linear/extended faults
faults which can be on or in the glass, in the form of deposits, marks or scratches that occupy an extended length or area

3.13
edge defect
defect which can occur on the edge of a glass sheet in the form of entrant and emergent faults and/or bevels

4 Dimensional requirements

4.1 Thickness

4.1.1 General

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 by means of an instrument of the calliper micrometre type.

4.1.2 Tolerances

All four measurements, rounded to the nearest 0,1 mm, shall not vary from the nominal thickness by more than the tolerances shown in Table 1.

NOTE For thicknesses not described in Table 1, the tolerance of the nominal thickness immediately lower shall apply.

For nominal thickness <2 mm, the tolerance is ±0,1 mm.

Table 1 — Tolerances on nominal thickness

Nominal thickness (mm)	Tolerances (mm)
2	±0,2
3	±0,3
4	±0,3
5	±0,3
6	±0,3
8	±0,6
10	±0,6
12	±0,8
15	±0,8
19	±1,2
22	±1,2
25	±1,2

4.2 Length, width and squareness

4.2.1 Jumbo and split sizes

The tolerances on nominal dimensions length, *H*, and width, *B*, for jumbo and split sizes are ±5 mm.

The limits of squareness are described by the difference between diagonals. Limits are given in Table 2.

Table 2 — Limit on the difference between diagonals for jumbo and split sizes

Dimensions in millimetres

Nominal thickness	Limit on the difference between diagonals			
	Jumbo sizes	Split sizes		
		$(H, B) \leq 1500$	$1500 < (H, B) \leq 3000$	$(H, B) > 3000$
2, 2,5, 2,7, 3, 4, 5, 6	10	3	4	5
8, 10, 12	10	4	5	6
15, 19, 22, 25	10	5	6	8

4.2.2 Supplied and final cut sizes

The tolerances on nominal dimensions length, *H*, and width, *B*, for supplied and final cut sizes are given in Table 3.

The limits of squareness are described by the difference between diagonals. Limits are given in Table 4.

Table 3 — Tolerance, *t*, on the nominal dimensions length and width for supplied and final cut sizes

Dimensions in millimetres

Nominal thickness	Tolerance, *t*		
	Supplied size	Final cut sizes	
		$(H, B) \leq 3\,000$	$(H, B) > 3\,000$
2, 2,5, 2,7, 3, 4, 5, 6	±4	±2	±3
8, 10	±4	±3	±4
12, 15	±4	±3	±4
19, 22, 25	±5	±5	±5

Table 4 — Limit on the difference between diagonals for supplied and final cut sizes

Dimensions in millimetres

Nominal thickness	Limit on the difference between diagonals		
	Supplied and final cut sizes		
	$(H, B) \leq 1\,500$	$1500 < (H, B) \leq 3\,000$	$(H, B) > 3\,000$
2, 2,5, 2,7, 3, 4, 5, 6	3	4	5
8, 10, 12	4	5	6
15, 19, 22, 25	5	6	8

5 Quality requirements

5.1 General

One quality level is considered in this document. This is determined by evaluation of the optical and visual faults.

The manufacturer(s) should be consulted if higher levels of quality are required.

5.2 Methods of observation and measurement

5.2.1 Optical faults

A screen bearing an assembly of black and white stripes (zebra) is observed through the glass to be examined.

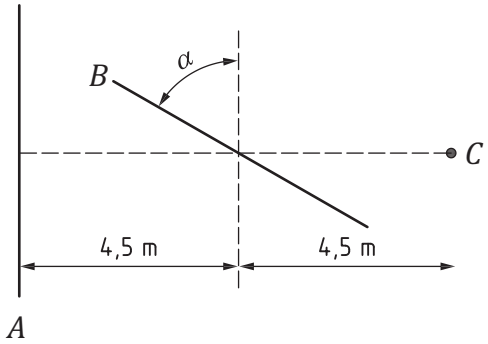
The usual size of screen is between 1 500 mm × 1 150 mm and 2 500 mm × 2 000 mm. It consists of a translucent white background with parallel black stripes, 25 mm wide and 25 mm apart, inclined at 45°.

The screen is uniformly lit from behind with white daylight fluorescent tubes. The illuminance of the screen measured 1 m from it shall be between 400 lux and 1 200 lux. The measurement shall be taken at a point on a line normal to the centre of the screen. The walls of the test room should be painted with a dark non-reflective paint having a diffuse reflection ≤0,10.

The glass to be examined shall be held vertically in a support frame. The centre of the glass shall be at a distance of 4,5 m from the screen and on a line normal to the centre of the screen. The glass shall be capable of being rotated around a vertical axis. The glass shall be held with the direction of draw of the glass vertical. Appropriate critical viewing angles, α, formed by the glass and the screen should be indicated (see Figure 2). The observer stands still at a distance of 9 m from the centre of the screen on a line passing through the axis of rotation.

The glass being examined is rotated from an angle $\alpha = 90°$ until there is no longer any distortions of the lines on the screen. The angle, α (see Figure 2), at which this occurred is noted.

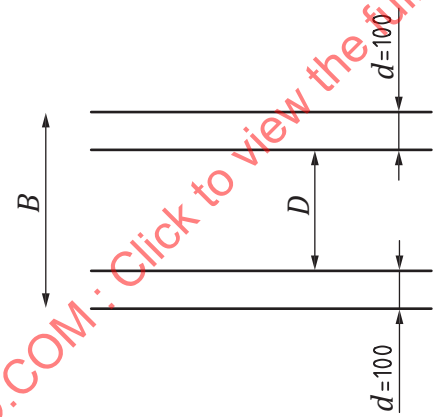
For stock sizes, the glass samples are obtained by splitting the full width of the pane into pieces with a width, *B*, of about 800 mm, and a length, *H*, between 300 mm and 500 mm. The distortion is measured in the areas *D* and *d* as shown in Figure 3. The distortion of the final cut sizes shall use the data of stock sizes. However, when the data does not exist, the sample shall be evaluated by the method of Figure 2.



Key

A screen
B glass sample
C observer

Figure 2 — Plan view showing set up of zebra test



Key

B width (approximately 800 mm)
d measurement zone
D measurement zone

Figure 3 — Zones for the measurement of optical distortion

5.2.2 Visual faults

5.2.2.1 Spot faults

Conditions of observation of spot faults are described in Annex A. The categories of spot faults are defined by the maximum dimension (diameter or length) of the halo or of the nucleus.

The nucleus dimensions are measured with a micrometre with graduations in tenths of a millimetre, and the halo dimension is measured according to the method defined in Annex A.

Note the number of spot faults and the biggest dimension of the halo or of the nucleus and relate to the four categories of spot faults as shown in Table 5.

Table 5 — Categories of spot faults

Nucleus dimension	Halo dimension
≤1,0 mm	≤3,0 mm
>1,0 mm and ≤2,0 mm	>3,0 mm and ≤6,0 mm
>2,0 mm and ≤3,0 mm	>6,0 mm and ≤9,0 mm
>3,0 mm	>9,0 mm

NOTE In some circumstances, if not possible to measure the halo, then only the nucleus size has to be measured.

5.2.2.2 Linear/extended faults

The glass pane to be examined is illuminated in conditions approximating to diffuse daylight and is observed in front of a matt black screen (reflection coefficient between 0,2 and 0,4).

Place the pane of glass to be examined vertically in front of the screen and parallel to it. Arrange the point of observation 2 m from the glass, keeping the direction of observation normal to the glass surface.

View the pane of glass, and note the presence of visually disturbing faults.

5.2.3 Edge defects for final cut sizes

5.2.3.1 Entrant and emergent faults

These faults are shown in Figures 4 and 5. The dimensions h_1, h_2 and p and the glass thickness, e, are measured.

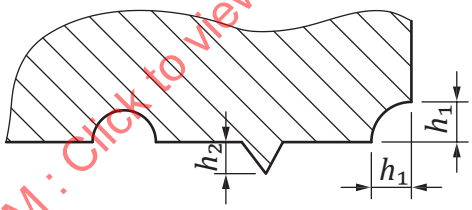


Figure 4 — Entrant and emergent faults (surface view)

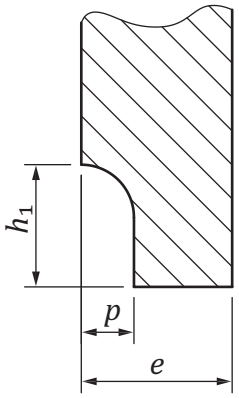


Figure 5 — Entrant faults (edge view)

5.2.3.2 Bevel

This fault is shown in Figure 6. The dimension, *d*, and the glass thickness, *e*, are measured.

Figure 6 — Bevel (edge view)

5.3 Acceptance levels

5.3.1 Optical faults

When viewed under the conditions of observation as described in 5.2.1, the angle, α, at which there is no disturbing distortion shall be not less than the appropriate critical viewing angle given in Table 6.

Table 6 — Critical viewing angles

Nominal thickness in mm	Angle, α, in zone, D, in degrees	Angle, α, in zone, d, in degrees
1,9, 2, 2,5, 2,7	40	40
3	45	40
≥4	50	45

5.3.2 Spot faults

The allowable numbers for each of the categories of faults (see Table 5) for stock sizes and final cut sizes are shown in Table 7, using the nucleus or the halo dimension as acceptance criteria.

Table 7 — Allowable numbers of faults for stock sizes and final cut sizes

Nucleus dimension	Halo dimension	Stock size (max per m^2)	Final cut size (max per m^2)
≤1,0 mm	≤3,0 mm	any number	any number
>1,0 mm and ≤2,0 mm	>3,0 mm and ≤6,0 mm	1,32/m^2	1,32/m^2
>2,0 mm and ≤3,0 mm	>6,0 mm and ≤9,0 mm	0,66/m^2	0,66/m^2
>3,0 mm	>9,0 mm	0,5/m^2	0/m^2

5.3.3 Linear/extended faults

5.3.3.1 Jumbo and split sizes

When examined by the method in 5.2.2.2, the allowable number of faults is an average of 0,05 faults in 20 m^2 of glass, related to at least 20 tonnes.

5.3.3.2 Supplied sizes

When examined by the method in 5.2.2.2, the allowable number of faults is an average of 0,05 faults per 20m^2.

5.3.3.3 Linear/extended faults for final cut sizes

When examined by the method in 5.2.2.2, no linear/extended faults are allowed.

5.3.4 Edge defects for final cut sizes

The limitations on entrant and emergent faults and bevel are given in Table 8.

Table 8 — Limitations on edge defects

Edge defect	Limitations
Entrant fault	$h_1 < e$ mm $P < (e/2)$ mm
Emergent fault	$h_2 < e$ mm, but shall not exceed 10 mm
Bevel	The ratio (d/e) shall be less than 0,5, but d shall not exceed 10 mm
The limitations only apply when there is no risk of breakage resulting from thermal stress. In applications where thermal stress breakage may apply, the manufacturers' recommendations on edge quality should be followed.	

6 Designation

Float glass in compliance with this document shall be designated, respectively, by the following:

— the type;

— a reference to this document, i.e. ISO 16293-2;

— the tint (manufacturer's reference) or clear;

— the nominal thickness in mm;

— the nominal length, H, and width, B, in mm;

EXAMPLE Float glass clear, intended for use in buildings, thickness 3 mm, length 6,00 m, width 3,21 m, is designated as follows:

Float glass - ISO 16293-2 - clear 3 mm, 6 000 mm × 3 210 mm.

Annex A
(informative)

Method for measuring the halo size of spot fault

A.1 Conditions of observation

The method for measuring spot fault size including halo is based on the projection technique, using a point source projector and a screen (see Figure A.1).

A projector with a Mercury Vapour Short-Arc Lamp of 200 Watts is placed at 4,65 m +/– 0,10 m from the projection screen.

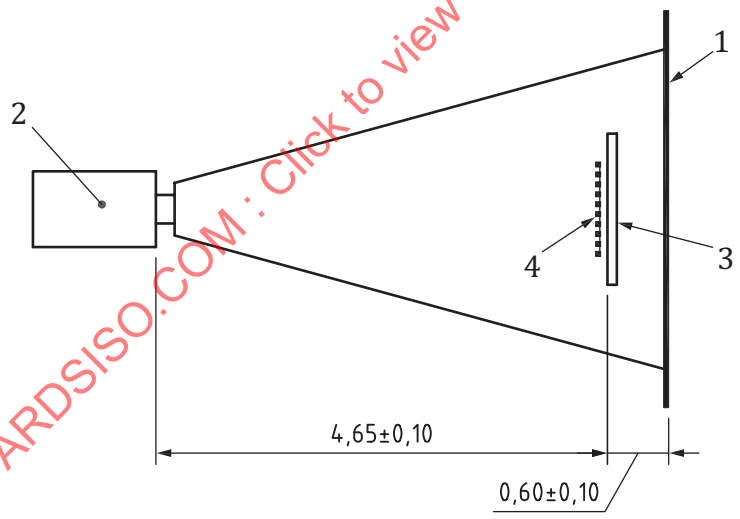
NOTE 1 Any other method that is better or equivalent may be used.

NOTE 2 Equipment "OSRAM HBO 200 Watts lamp" has been found to be suitable[1].

The glass or sample containing the spot fault is placed at 0,60 m +/– 0,10 m of a projection screen, in the light beam of the projector.

The sample is maintained parallel to the screen. The spot fault image (nucleus and deformation) appears on the screen.

Dimensions in metres



Key

1 screen
2 point source projector
3 glass sample with spot fault
4 distortion gauge

Figure A.1 — Method of observation of the sample

1) OSRAM HBO 200 W ® is the trade name of a product supplied by OSRAM in Mercurius straat 28, B-1930 Nossegem or in Steineme Furt, D-86167 Augsburg. This information is given for the convenience of users of this standard and does not constitute an endorsement by ISO of the product named. Equivalent products may be used if they are shown to lead to the same results.