

Summary of Glass Defects and Tolerances

PART / PROCESS NUMBER	PROCESS NAME / OPERATION DESCRIPTION	CHARACTERISTICS	PRODUCT	METHODS				
				GLASS TOLERANCE			STANDARD REFERENCE	EVALUATION / MEASUREMENT TECHNIQUE
				SGU	LGU	DGU		
1	Final Inspection	1	Glass Width(W) & Height (H) :-	± 2.0mm	± 2.0mm	± 2.0mm	A1.0 EN12150 - 1 (Refer Table 2.0)	Measurement tape
		2	Glass diagonal difference	± 2.0mm	± 2.0mm	± 2.0mm	A1.0 EN12150 - 1 - 2015 (Refer Table 3.0)	Measurement tape
		3	Thickness	± 0.20mm for upto 6mm ± 0.30mm from 8mm to 12mm	± 1.0mm	± 1.0mm	EN572 - 2 EN12543 - 5 EN1279	Micrometer or Vernier Caliper
		4	Displacement	NA	≤1.0mm for Tempered Glass 0mm for Annealed Glass on Height Side	≤2.0mm	A2.0 EN12543 - 5 (Refer Fig.3&Table 6.0)	Straight edge with graduated scale
		5	Hole Diameter and Offset Tolerance	NA	≤ 2.0mm for hole dia. <20mm ≤ 3.0mm for ≥ 20mm to 100mm	NA	A1.0 EN12150 - 1 (Refer Table 9.0)	Measurement tape
		6	Hole Position Tolerance	NA	± 2mm	NA	A1.0 EN12150 - 1 (Refer Table 2.0)	Measurement tape
		7	Distortion - Roller Wave	0.15mm	0.15mm as a Monolithic Glass	0.15mm as a Monolithic Glass	A1.0 EN12150 - 1 (Refer Table 4.0 & 5.0)	Straight Edge with Feeler Gauge
			Distortion - Edge Lift	0.30mm	0.30mm as a Monolithic Glass	0.30mm as a Monolithic Glass		Straight Edge with Feeler Gauge
	Distortion - Overall Bow	1.5mm/m	1.5mm/m as a Monolithic Glass	1.5mm/m as a Monolithic Glass	Straight Edge with Taper Scale			
		8	Visual	A4.0 Visual inspection at 1.5m distance in a normal day light / Not direct sunlight. a) Scratch 25mm max. allowed (Refer Table 7.0) b) Chipping - Half of the thickness & twice the length allowed (Where length refers to thickness of glass) (Refer Table 3.0) c) Any spot defects - i) <0.5mm not to be considered as a defect ii) >1.5mm not allowed 1no./m2 (Refer Table 5.0)	A4.0 Visual inspection at 1.5m distance in a normal day light / Not direct sunlight. a) Scratch 25mm max. allowed (Refer Table 7.0) b) Chipping - Half of the thickness & twice the length allowed (Where length refers to thickness of glass) (Refer Table 3.0) c) Any spot defects - i) <0.5mm not to be considered as a defect ii) >1.5mm not allowed 1no./m2 (Refer Table 5.0) d) Bubbles - Shall not exceed 5% area of 15mm from edge for the glass size <5m2, 20mm fro edge for the glass size >5m2. Defect size of 5mm allowed in edge area (Refer point 5, 8 & 9)	A4.0 Visual inspection at 1.5m distance in a normal day light / Not direct sunlight. a) Scratch 25mm max. allowed (Refer Table 7.0) b) Chipping - Half of the thickness & twice the length allowed (Where length refers to thickness of glass) (Refer Table 3.0) c) Any spot defects - i) <0.5mm not to be considered as a defect ii) >1.5mm not allowed 1no./m2 (Refer Table 5.0)	ASTM C 1036 - 16 for Scratches & Chipping EN12543 - 6 for Bubbles	Visual

ANNEXURE**EN12150 - 1** Glass in building - Thermally toughened soda lime silicate safety glass - Part 1: Definition and description**Glass Width(W) & Height (H)**Table 2 — Tolerances on width, *B*, and length, *H*

Dimensions in millimetres

Nominal dimension of side, <i>B</i> or <i>H</i>	Tolerance, <i>t</i>	
	nominal glass thickness, <i>d</i> ≤ 8	nominal glass thickness, <i>d</i> > 8
≤ 2 000	± 2,0	± 3,0
2 000 < <i>B</i> or <i>H</i> ≤ 3 000	± 3,0	± 4,0
> 3 000	± 4,0	± 5,0

Glass Diagonal (D)

Table 3 — Limit deviations for the difference between diagonals

Dimensions in millimetres

Limit deviation <i>v</i> on the difference between diagonals		
Nominal dimension <i>B</i> or <i>H</i>	nominal glass thickness, <i>d</i> ≤ 8	nominal glass thickness, <i>d</i> > 8
≤ 2 000	≤ 4	≤ 6
2 000 < <i>B</i> or <i>H</i> ≤ 3 000	≤ 6	≤ 8
> 3 000	≤ 8	≤ 10

EN12543 - 5 Glass in building - Laminated glass and laminated safety glass -
Part 5: Dimensions and edge finishing

Displacement

3.2.3 Displacement

Displacement d (see figure 3) is the misalignment at any one edge of the constituent glass panes or plastic glazing sheet material making up the laminated glass.

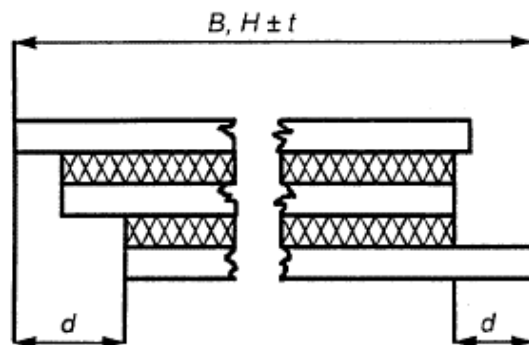


Figure 3: Displacement

The maximum displacement d shall be as given table 5. Width B and length H shall be considered separately.

Table 5: Maximum Displacement

Nominal dimension B or H mm	Maximum permissible displacement d mm
$B, H \leq 1000$	2,0
$1000 < B, H \leq 2000$	3,0
$2000 < B, H \leq 4000$	4,0
$B, H > 4000$	6,0

EN12150 - 1 Glass in building - Thermally toughened soda lime silicate safety glass - Part 1: Definition and description

Hole Diameter & Offset Tolerance

Table 9 — Tolerances on hole diameters

Dimensions in millimetres

Nominal hole diameter, \emptyset	Tolerances
$4 \leq \emptyset \leq 20$	$\pm 1,0$
$20 < \emptyset \leq 100$	$\pm 2,0$
$100 < \emptyset$	consult the manufacturer

Hole Positioning Tolerance

Table 2 — Tolerances on width, B , and length, H

Dimensions in millimetres

Nominal dimension of side, B or H	Tolerance, t	
	nominal glass thickness, $d \leq 8$	nominal glass thickness, $d > 8$
$\leq 2\ 000$	$\pm 2,0$	$\pm 3,0$
$2\ 000 < B$ or $H \leq 3\ 000$	$\pm 3,0$	$\pm 4,0$
$> 3\ 000$	$\pm 4,0$	$\pm 5,0$

Roller Wave, Edge Lift, and Overall Bow

Table 4 — Maximum allowable values of overall bow and roller wave distortion for horizontally toughened glass

Glass Type	Maximum allowable value for distortion	
	Overall bow mm / m	Roller Wave mm
Uncoated float glass in accordance with EN 572-1 and EN 572-2	3,0	0,3
Others ^a	4,0	0,5

^a For enamelled glass which is not covered over the whole surface the manufacturer should be consulted.

NOTE Dependent upon the wavelength of the roller wave an appropriate length of gauge needs to be used.

Table 5 — Maximum allowable values for edge lift for horizontal toughening

Type of glass	Thickness of glass mm	Maximum allowable values mm
Uncoated float glass in accordance with EN 572-1 and EN 572-2	3	0,5
	4 to 5	0,4
	6 to 25	0,3
Others ^a	3 to 19	0,5

^a For enamelled glass which is not covered over the whole surface the manufacturer should be consulted.

NOTE 1 Dependent upon the wavelength of the roller wave an appropriate length of gauge needs to be used.

NOTE 2 For uncoated float glass with a thickness of 2 mm it is advised to consult the manufacturer.

ASTM C 1036 Standard Specification for Flat Glass¹

TABLE 7 Allowable Linear Blemish Size and Distribution for Cut Size and Stock Sheet Qualities

Linear Blemish Size ^A Intensity Length	Q3 Quality 3 Distribution	Q4 Quality 4 Distribution
Faint ≤ 75 mm (3 in.)	Allowed	Allowed
Faint > 75 mm (3 in.)	Allowed	Allowed
Light ≤ 75 mm (3 in.)	Allowed	Allowed
Light > 75 mm (3 in.)	Allowed	Allowed
Medium ≤ 75 mm (3 in.)	Allowed with a minimum separation of 600 mm (24 in.)	Allowed
Medium > 75 mm (3 in.)	None allowed	Allowed
Heavy ≤ 150 mm (6 in.)	None allowed	Allowed with a minimum separation of 600 mm (24 in.)
Heavy > 150 mm (6 in.)	None allowed	None allowed

TABLE 1 Type I, Class 1 and 2 Quality and Use

Quality-Q3
(cut-size or stock sheets)

Production of architectural glass products including coated, heat treated, laminated, and other select glass products.

Quality-Q4
(cut-size or stock sheets)

General glazing applications.

TABLE 5 Allowable Point Blemish Size and Distribution For Cut Size Qualities

Blemish Size mm (in.) ^{B,C,D}	Q3 Quality 3	Q4 Quality 4
< 0.50 (0.02)	Allowed	Allowed
≥ 0.50 < 0.80 ≥ (0.02) < (0.03)	Allowed	Allowed
≥ 0.80 < 1.20 ≥ (0.03) < (0.05)	Allowed	Allowed
≥ 1.20 < 1.50 ≥ (0.05) < (0.06)	Allowed with a minimum separation of 600 mm (24 in.) ^F	Allowed
≥ 1.50 < 2.00 ≥ (0.06) < (0.08)	Allowed with a minimum separation of 600 mm (24 in.) ^F	Allowed
≥ 2.00 < 2.50 ≥ (0.08) < (0.10)	None allowed	Allowed with a minimum separation of 600 mm (24 in.) ^F
≥ 2.5 ≥ (0.10)	None allowed	None allowed

TABLE 3 Allowable Shell Chip Size and Distribution for Cut Size and Stock Sheet Qualities of Type 1—Transparent Flat Glass

Description	Q3	Q4
Chip depth	Chip depth \leq 50 % of glass thickness	Chip depth \leq 50 % of glass thickness
Chip width ^A	Chip width \leq glass thickness or 6 mm (¼ in.) whichever is greater	Not limited
Chip length ^A	Chip length \leq 2 times the chip width	Not limited

A5.0

EN12543 - 6 Glass in building - Laminated glass and laminated safety glass - Part 6: Appearance

5 Defects in the edge area for framed edges

When inspected according to the test method given in clause 9, defects which do not exceed 5 mm in diameter are permitted in the edge area. For panes sizes \leq 5 m² the width of the edge area is 15 mm. The edge area width is increased to 20 mm for pane sizes $>$ 5 m². If bubbles are present, the bubbled area shall not exceed 5 % of the edge area.

8 Defects on edge which will not be framed

Laminated glass is usually installed in frames; when it is unframed, its edges may be

- ground edges;
- polished edges;
- bevelled edges.

in accordance with EN ISO 12543-5.

In such conditions shells, bubbles, interlayer defects and retractions are permissible if they do not become obvious when subjected to the test method (see clause 9).

9 Test method

The laminated glass to be observed is put in a vertical position, in front of and parallel to a matt grey screen, lit by diffuse daylight or equivalent.

The observer will be at a distance of 2 m from the glass observing it perpendicularly (the matt screen being on the other side of the glass).

Defects that are disturbing when viewed shall be marked.