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GGF Data Sheet: Laminated Glass and Laminated Safety Glass

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1. Scope

1.1 This GGF Data Sheet specifies the characteristics of flat laminated glass and flat laminated safety glass for use in buildings. It covers both stock and finished sizes as manufactured. This GGF Data Sheet does not apply to panes of area < 0.05 m².

1.2 This GGF Data Sheet covers laminated glass and laminated safety glass manufactured using one and/or more of the following types of interlayers:

1.2.1 Folio interlayers, e.g. polyvinyl butyral (pvb), polyethylene acetate (eva), polyurethane (pu), ionoplast.

1.2.2 Cast in place resin interlayers, e.g. poly methly methacylate (pmma), polyurethane (pu), epoxy.

1.2.3 Fire protection interlayers, intumescent interlayers.

1.3 This GGF Data Sheet gives definitions, dimensional sizes and tolerances as well as methods of determining visual and optical quality.

1.4 All flat laminated glass covered by this GGF Data Sheet will meet, where appropriate, the following standards:

- EN 14449 Glass in building – Laminated glass and laminated safety glass – Evaluation of conformity/Product standard
- EN ISO 12543 Glass in building – Laminated glass and laminated safety glass -

  Part 1: Definitions and descriptions of component parts

  Part 2: Laminated safety glass

  Part 3: Laminated glass

  Part 4: Test methods for durability

  Part 5: Dimensions and edge finishing

  Part 6: Appearance

1.5 Curved laminated glass and curved laminated safety glass is excluded from this GGF Data Sheet.

NOTE: For information on curved laminated safety glass see GGF Data Sheet 4.12.4 Curved Glass Part 4: Curved Laminated Glasses.

2. Definitions

NOTE: The definitions used in this GGF Data Sheet have, where possible, been taken from the appropriate European standards, i.e. EN 14449, EN ISO 12543 Parts 1-6.

2.1 General

2.1.1 Laminated glass

Assembly consisting of one sheet of glass with one or more sheets of glass and/or plastics glazing sheet material joined together with one or more interlayers.

2.1.2 Interlayer

Layer or material acting as an adhesive and separator between plies of glass and/or plastics glazing sheet material.

NOTE: The interlayer can also give additional performance to the finished product, e.g. enhanced impact resistance, resistance to fire, solar control, acoustic insulation, etc.

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2.1.3 Laminating processes

2.1.3.1 Folio lamination process

Process where the interlayer is a solid film which is placed between the plies of glass or plastics glazing sheet material and is then subjected to pressure and/or heat to produce the final product.

2.1.3.2 Cast-in-place lamination process

Process where the interlayer is obtained by pouring a liquid between the plies of glass or plastics glazing sheet material that is then chemically cured to produce the final product.

NOTE: Other lamination processes than those defined in clause 2.1.3.1 and clause 2.1.3.2 are available which do not necessarily fit into either of the two methods described above.

2.1.4 Stock sizes

Sizes that are intended to be re-cut or further processed for final use.

2.1.5 Finished sizes

Sizes which are either manufactured to size or cut from stock sizes, and may be further processed, e.g. edgeworked, drilled or face decorated etc.

NB: In clause 2.1.6 to clause 2.1.10 the term 'laminated glass' can also mean 'laminated safety glass'.

2.1.6 3-ply laminated glass

Laminated glass manufactured from a pane of glass together with either another pane of glass or plastics glazing sheet material and interlayer.

2.1.7 5-ply laminated glass

Laminated glass manufactured from either 3 panes of glass or 2 panes of glass and 1 pane of plastics glazing sheet material together with 2 interlayers.

2.1.8 Flat laminated glass

Laminated glass in which the constituent glass and/or plastics glazing sheet materials have not been deliberately formed or bent in the course of manufacture.

2.1.9 Symmetrical laminated glass

Laminated glass in which, from both outer surfaces, the sequence of glass panes, plastics glazing sheet material and interlayer(s) by type, thickness, finish and/or general characteristics is the same.

2.1.10 Asymmetrical laminated glass

Laminated glass in which, from both outer surfaces, the sequence of glass panes, plastics glazing sheet material and interlayer(s) by type, thickness, finish and/or general characteristics is different.

2.2 Products

NB: With the exception of clause 2.2.1 the term 'laminated glass' can also refer to 'laminated safety glass'.

2.2.1 Laminated safety glass

Laminated glass where in the case of breakage the interlayer serves to retain the glass fragments, limits the size of opening, offers residual resistance and reduces the risk of cutting or piercing injuries.

NB: A laminated safety glass has no fire resistance properties unless it meets clause 2.2.2 or clause 2.2.3.

2.2.2 Laminated glass with fire resistant properties

Laminated glass which does not achieve its fire resistance by means of interlayer(s) which react to high temperatures.

NOTE: The fire resistance is a result of fire resistant components incorporated into the fire resistant glass.

2.2.3 Fire resistant laminated glass

Laminated glass where at least one interlayer reacts to the high temperature to give the product its fire resistance.

NOTE: This product may also contain glass components that are themselves fire resistant.

2.2.4 Laminated security glass

Laminated glass designed to withstand a specified level of attack.

NOTE: For further information see GGF Data Sheet Series 8.1 Security Glazing.

The following types are available:

2.2.4.1 Manual attack resistant laminated glass

Laminated glass designed to resist attack by means of an axe, crowbar, pickaxe, etc. and to delay access to a protected space for a short period of time.

NOTE: For further information see GGF Data Sheet 8.1.2 Security Glazing - Part 2: Manual Attack Resistant Glazing.

2.2.4.2 Bullet resistant laminated glass

Laminated glass designed to provide protection against firearm attack.

NOTE: For further information see GGF Data Sheet 8.1.3 Security Glazing - Part 3: Bullet Resistant Glazing.

2.2.4.3 Blast resistant laminated glass laminated glass

Designed to reduce the injurious effects of accidental or intentional blast forces.

NOTE: For further information see GGF Data Sheet 8.1.4 Security Glazing - Part 4: Explosion Resistant Glazing.

2.2.5 Solar control laminated glass laminated glass

Incorporating a body tinted and/or coated glass and/or a tinted interlayer.

2.2.6 Ultraviolet control laminated glass

Laminated glass incorporating a special interlayer which absorbs > 99 % of the ultraviolet radiation reaching the glass surface.

NOTE: Ultraviolet radiation measured over the range 280 nm to 380 nm.

2.2.7 Acoustic laminated glass

Laminated glass incorporating a special interlayer that gives enhanced sound reduction properties.

2.2.8 Laminated thermally treated glass

Laminated glass incorporating one or more of the following glass types:

- Heat strengthened glass (to EN 1863)
- Thermally toughened glass (to EN 12150)
- Heat strengthened thermally toughened glass (to EN 14179)

NOTE: For further information on these types of glass see GGF Data Sheet 4.4 Quality of Thermally Toughened Soda Lime Silicate Safety Glass for Building and GGF Data Sheet 4.4.1 Thermally Treated Soda Lime Silicate Glass Products - General.

2.2.9 Translucent laminated glass

Laminated glass manufactured incorporating a patterned glass, a surface treated glass and/or a light diffusing interlayer.

3. Glass Components

Laminated glass and laminated safety glass may be manufactured from any combination of the glass types given in Annex A.

4. Interlayers

The types of interlayer materials available and their processing conditions are given in Annex B.

5. Performance

5.1 Laminated glass

A laminated glass is one that conforms to the definition given in EN ISO 12543-3 and meets the appropriate durability tests as given in EN ISO 12543-4.

5.2 Laminated safety glass

A laminated safety glass is one that conforms to the definition given in EN ISO 12543-2, has a pendulum impact performance classification of minimum 3(B)3 in accordance with EN 12600 and meets the appropriate durability tests as given in EN ISO 12543-4.

5.3 Laminated glass with fire resistant properties

A laminated glass or laminated safety glass product, see clause 5.1 and clause 5.2, that incorporates as part of its makeup a 'fire resistance' glass pane.

NOTE: Fire resistance being determined and classified according to EN 13501-2.

5.4 Fire resistant laminated glass

A laminated glass or laminated safety glass product, see 5.1 and 5.2, that incorporates as part of its makeup intumescent interlayer(s), i.e. an interlayer that reacts to high temperatures.

The interlayer can be either an intumescent one, i.e. one that swells under heat, or a specialist cast in place resin layer that chars when subjected to fire.

NOTE: Fire resistance being determined and classified according to EN 13501-2.

NB: The product types in clauses 5.5, 5.6 and 5.7 may also be classified as laminated glass or laminated safety glass, see clauses 5.1 and 5.2.

5.5 Laminated security glass

A laminated glass or laminated safety glass product, see clause 5.1 and clause 5.2, that when tested can meet the requirements of one and/or more of the following.

5.5.1 Manual attack resistant laminated glass

The performance requirements are determined and specified in EN 356.

5.5.2 Bullet resistant laminated glass

The performance requirements are determined and specified in EN 1063.

5.5.3 Blast resistant laminated glass

The performance requirements are determined and specified in EN 13541.

5.6 Ultraviolet control laminated glass

The ultraviolet transmission is determined in accordance with EN 410.

5.7 Acoustic laminated glass

The sound reduction properties are determined in accordance with EN 12758.

6. Thickness and Thickness Tolerances

6.1 Nominal thickness

The nominal thickness of a flat laminated glass or laminated safety glass shall be the sum of the nominal thickness of the constituent panes of glass, and plastics glazing sheet material, and the interlayer(s).

6.2 Thickness tolerance (limit deviation on thickness)

The thickness tolerance of the laminated glass/laminated safety glass shall not exceed the sum of the tolerances of the constituent glass panes, as specified in the appropriate product standard (see Annex A), and that of the interlayer.

6.2.1 Interlayer thickness tolerances

The thickness tolerance of the interlayer is dependent on the interlayer type (see Annex B).

Details of the tolerances are given in 6.2.2, 6.2.3 and 6.2.4.

Laminated glass containing different interlayer types is covered in 6.2.5.

6.2.2 Folio interlayers

Thickness tolerances (limit deviations) to be taken into account are given in Table 1a.

Nominal Interlayer Thickness	Limit Deviation
< 2 mm	± 0.1 mm
≥ 2 mm	± 0.2 mm

Table 1a: Limits on deviation of folio interlayer(s)

6.2.3 Cast in place interlayer

Thickness tolerances (limit deviations) to be taken into account for cast in place interlayers are given in Table 1b.

Nominal Interlayer Thickness	Limit Deviation
< 1 mm	± 0.4 mm
≥ 1 mm, < 2 mm	± 0.5 mm
≥ 2 mm, < 3 mm	± 0.6 mm
≥ 3 mm	± 0.7 mm

Table 1b: Limits on deviation of cast in place interlayer(s)

6.2.4 Fire resistant interlayer(s)

Thickness tolerances (limit deviations) to be taken into account for fire resistant interlayers are given in Table 1c..

Nominal Interlayer Thickness	Limit Deviation
< 1 mm	± 0.4 mm
≥ 1 mm, < 2 mm	± 0.5 mm
≥ 2 mm, < 5 mm	± 0.6 mm
≥ 5 mm	± 1.0 mm

Table 1c: Limits on deviation of fire resistant interlayer(s)

6.2.5 Combinations of interlayer types

The thickness tolerances (limit deviation) to be taken into account for combination interlayers is the square root of the sum of the squares of the individual interlayer limit deviations, rounded to the nearest 0.1mm .

6.3 Calculated nominal thickness and thickness tolerances

These are given in the following examples:

EXAMPLE 1:

A laminated safety glass made from 2 panes of float glass of 3 mm nominal thickness and a folio interlayer of 0.38 mm.

From EN 572-2, the thickness tolerance on 3 mm float glass is ± 0.2 mm.

The folio interlayer is less than 2 mm so the tolerance is ± 0.1 mm.

Therefore, the nominal thickness of the laminated glass is 6.4 mm and the tolerance is ± 0.5 mm.

EXAMPLE 2:

A 5-ply laminated security glass is made from 3 panes of nominal 3 mm float glass and 2 x 1.14 mm folio interlayers.

From EN 572-2, the thickness tolerance on 3 mm float glass is ± 0.2 mm.

The total thickness of folio interlayer is 2 x 1.14 mm, i.e. 2.28 mm.

As this is > 2 mm then the tolerance on the interlayer is ± 0.2 mm.

Therefore, the nominal thickness of the laminated glass is 11.3 mm and the thickness tolerance is [3 x ± 0.2] + [± 0.2] = ± 0.8 mm.

EXAMPLE 3:

A fire resistant laminated safety glass made from four sheets of float glass of nominal thickness 3 mm, a folio interlayer of 0.5 mm thickness and two fire resistant interlayers of 1.5 mm thickness.

Nominal thickness:

4 x 3 mm + 0.5 mm + 2 x 1.5 mm = 15.5 mm

Limit deviation:

$4 \times (\pm\ 0.2\ \text{mm}) \pm \sqrt{(0.1^2\ \text{mm} + 0.5^2\ \text{mm} + 0.5^2\ \text{mm})}$
$= \pm\ 0.8\ \text{mm} \pm 0.714\ \text{mm}$
$= \pm\ 1.5\ \text{mm}$

Therefore, the nominal thickness of the fire resistant laminated safety glass is 15.5 mm and the thickness tolerance (limit deviation) is ± 1.5 mm.

6.4 Measurement of actual thickness

The thickness of the pane shall be calculated as the mean of measurements taken at the centres of the four sides. The measurement shall be taken to an accuracy of 0.01 mm and the mean is rounded to the nearest 0.1 mm. The individual measurements when rounded to the nearest 0.1 mm shall also be within the tolerances.

For translucent laminated glass manufactured from a patterned glass the measurements shall be made by means of an instrument of the plate gauge type with a diameter of 55 mm + 5 mm.

7. Sizes and Dimensional Tolerances Including Displacement

7.1 Width B and length H

When laminated 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.

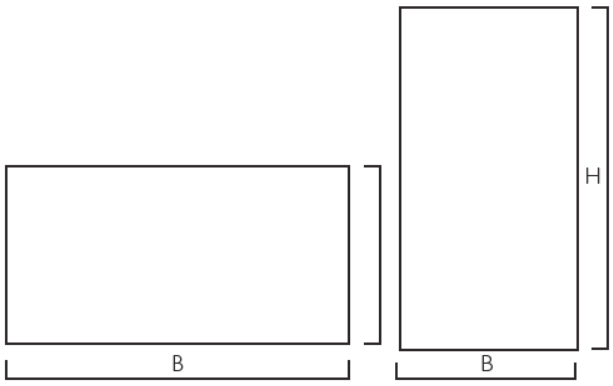


Figure 1: Examples of width, B, and length, H, relative to the pane shape

NOTE: The maximum width and length of laminated glass are dependent on the constituent glass and interlayer(s) used in its composition and on the manufacturing plant of each individual manufacturer. Each manufacturer should indicate the maximum and minimum size they can produce.

7.1.1 Methods of measuring dimensions and squareness

The pane of glass shall not be larger than the nominal dimensions, given in accordance with 7.1, either increased by the upper limit deviation t1 or smaller than the nominal dimensions reduced by the lower deviation limit t2 (see Figure 2).

The squareness of rectangular glass panes is expressed by the difference between its diagonals.

7.1.2 Limit deviations

Limit deviations on width B and length H shall be in accordance with Table 2 for finished sizes and stock sizes. Any displacement shall be included in these limit deviations.

NOTE: Displacement is covered in 7.1.3.

Dimensions in mm

Nominal Dimension B or H	Nominal thickness ≤ 8 mm	Nominal thickness > 8 mm	
		Each glass pane < 10 mm nominal thickness	At least one glass pane ≥ 10 mm nominal thickness
≤ 2000	+ 3.0 - 2.0	+ 3.0 - 2.0	+ 5.0 - 3.5
≤ 3000	+ 4.5 - 2.5	+ 5.0 - 3.0	+ 3.0 - 2.0
≥ 3000	+ 5.0 - 3.0	+ 6.0 - 4.0	+ 7.0 - 5.0

Table 2: Limit deviations t on width B and length H

The limit deviations in Table 2 shall not be applied to fire resistant laminated glass and fire resistant laminated safety glass. In these cases, the manufacturer shall specify the limit deviations.

If one component of the laminated glass is a toughened or heat strengthened glass an additional tolerance of ± 3 mm shall be taken into account.

The difference between the two diagonal lengths of the pane of glass shall not be larger than the deviation limit, v, as specified in Table 3.

Dimensions in mm

Nominal Dimension B or H	Nominal thickness ≤ 8 mm	Nominal thickness > 8 mm	
		Each glass pane < 10 mm nominal thickness	At least one glass pane ≥ 10 mm nominal thickness
≤ 2000	6	7	9
≤ 3000	8	9	11
≥ 3000	10	11	13

Table 3: Limit deviations, v, on the difference between diagonals

7.1.3 Displacement

Displacement d (see Figure 2) is the misalignment at any one edge of the constituent glass panes or plastic glazing sheet material making up the laminated glass.

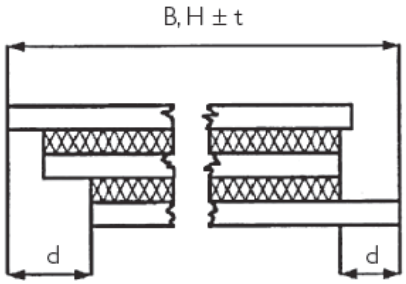


Figure 2: Displacement

The maximum displacement d shall be as given in Table 4. Width B and length H shall be considered separately.

Nominal Dimension B or H	Maximum permissible Displacement d
B, H ≤ 1000	2.0 + 1[a)]
1000 < B, H ≤ 2000	3.0 + 1[a)]
2000 < B, H ≤ 4000	4.0
B, H > 4000	6.0

Table 4: Maximum displacement

[a)] (additional tolerance for thermally toughened and heat strengthened glass)

8. Edgework

8.1 Laminated glasses incorporating thermally treated glass components

Thermally toughened safety glass and heat strengthened glass shall not be cut, sawn, drilled or edge worked before or after making into a laminate.

NOTE: Thermally treated glass components may be individually worked before toughening or heat strengthening in accordance with the applicable standard; e.g. EN 1863-1, EN 12150-1, EN 13024-1, and EN 14179-1, EN 14321-1, EN 15682-1.

8.2 Cut edge

Cut edges shall be either originally cut edges of the constituent glass panes not subsequently worked (see Figure 3), or the edges of the laminated glass which have been cut and not subsequently worked (see Figure 4).

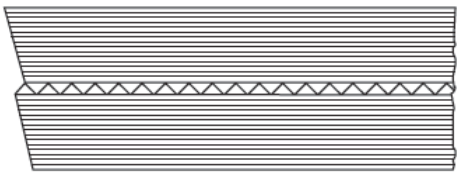


Figure 3: Cut edge built by cut edges of the constituent glass panes not subsequently worked

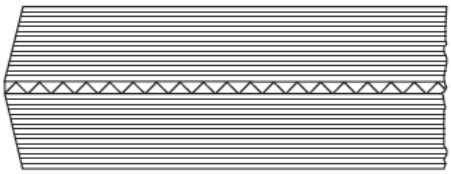


Figure 4: Cut edge of cut laminated glass, not subsequently worked

NOTE: The edges of fire resistant laminated glass and fire resistant laminated safety glass may be protected by an adhesive tape.

8.3 Worked edge

Details of the types of worked edges that are available are given in 8.3.1 to 8.3.7.

8.3.1 Arrissed edge

The originally cut edges of the outer glass panes of the laminated glass shall be ground off (see Figure 5).

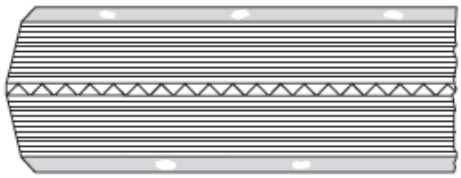


Figure 5: Arissed edge (with blank spots)

8.3.2 Ground edge

The glass shall be arrissed and flat ground (see Figure 6).

NOTE: Some bright areas may still exist on the edge face.

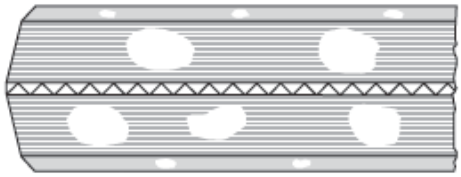


Figure 6: Ground edge (with bright areas)

8.3.3 Smooth ground edge

The edge face of the arrissed glass shall be ground and then smoothed with a finer grit than is used for ground edges, and all bright areas shall be removed (see Figure 7).

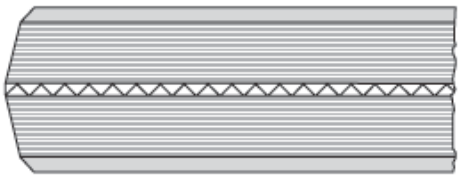


Figure 7: Smooth ground edge (no bright areas)

8.3.4 Polished edge

The previously smooth ground edge shall be polished in order to obtain a high lustre on the arrissed and smoothed edges surface (see Figure 8).

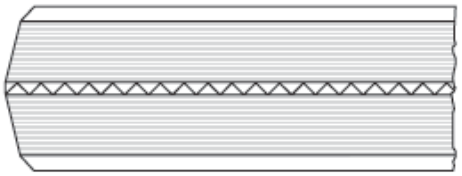


Figure 8: Polished edge (no bright areas)

8.3.5 Bevelled edge

A bevel edge shall be smooth ground or polished edge with an angle not exceeding 60 °. The limit deviation on bevel angle shall be ± 3 ° (see Figure 9).

NOTE: For greater angles and their limit deviations the manufacturer should be contacted.

The nominal dimension B or H shall be reduced by 2 mm to 3 mm to cater for an arrissed edge.

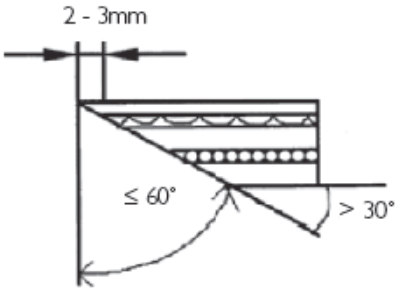


Figure 9: Bevel edge

8.3.6 Sawn edge

Sawn edge shall be obtained by cutting with a saw.

NOTE: The appearance is similar to ground edges but without bright spots and arrising.

8.3.7 Water jet cut edge

Water jet cut edge shall be obtained by cutting with a water jet.

NOTE: The appearance is similar to smooth ground edges but without bright spots and arrissing.

9. Flatness

The flatness of laminated glass is dependant on the flatness of the constituent parts and can be influenced by the manufacturing conditions.

For the flatness of final cut sizes of folio laminated glass ask the manufacturer.

10. Appearance

10.1 Optical

Flat laminated/laminated safety glass is manufactured by combining the glass panes with an interlayer. The optical quality is dependant upon the glass and interlayer type and the lamination process employed to manufacture the product.

10.1.1 Folio interlayer/lamination

The final product has the optical quality of the component glass panes.

10.1.2 Cast in place interlayer/lamination

The final product will not have the optical quality of the component glass panes. This is caused by the laminated/ laminated safety glass developing a concave or convex shape.

10.1.3 Intumescent interlayer

The final product may have the same optical quality of the component glass panes.

10.2 Visual including edge bubbles

The visual quality/appearance of flat folio laminated glass is determined by means of a visual inspection test (see 10.2.4).

The presence of spot defects, linear defects and edge bubbles will be allowed depending on their size, frequency, position, size of the pane, make-up of the pane of laminated glass and whether or not they are obtrusive when the glass is inspected.

10.2.1 Defects in vision area

10.2.1.1 Spot defects

Spot defects which have been observed are noted and measured. They are assessed in relationship to their size, d, see Table 5.

Size of Defect, d, mm	
$d < 0.5$	± 0.4 mm
$0.5 < d \leq 1.0$	± 0.5 mm
$1.0 < d \leq 3.0$	± 0.6 mm
$d > 3.0$	± 0.7 mm

Table 5: Acceptance criteria for defects

Laminated glass make-up	Distance between defects in mm
3 ply	≥ 200
5 ply	≥ 180
7 ply	≥ 150
≥ 9 ply	≥ 100

Table 6a: Separation distances for accumulations not to occur

Size of pane, A, m²	Number of permissible defects			
	3 ply	5 ply	7 ply	≥ 9 ply
$A \leq 1$	1	2	3	4
$1 < A \leq 2$	2	3	4	5
$2 < A \leq 8$	1/m²	1.5/m²	2/m²	2.5/m²
$A > 8$	1.2/m²	1.8/m²	2.4/m²	3/m²

Table 6b: Number of permissible defects

10.2.1.2 Linear Defects

Linear defects that have been observed are assessed as given in Table 7.

Size of pane, A, m²	Number of permissible linear defects of length, l, mm	
	$l < 30$	$l \geq 30$
$A < 5$	Allowed	Not allowed
$5 < A < 8$	Allowed	1
$A > 8$	Allowed	2

Table 7: Allowable linear defects

10.2.2 Defects in edge area

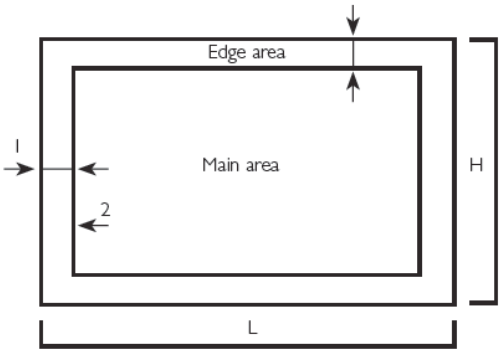
10.2.2.1 Framed edges

Defects that have been observed in the edge area are assessed as follows:

- Defects of diameter < 5 mm allowed
- Bubbles occupying < 5 % of edge area allowed

The edge area (see Figure 10) is defined with respect to the edge width as follows:

- Area of pane < 5 m² then edge width < 15 mm
- Area of pane > 5 m² then edge width < 20 mm



Key
1 - Edge area
2 - Sight line of panel

Figure 10: Edge area to be examined on finished sizes ready for glazing

10.2.2.2 Defects in unframed edges

When used unframed the edge quality should be in compliance with clause 8.3.3, 8.3.4 or 8.3.5.

The following defects:

- Shells
- Bubbles
- Interlayer faults
- Interlayer retraction

are permissible if not obvious when subjected to the visual inspection (see 10.2.4).

For laminated glasses incorporating thermally treated glasses the following applies:

- Exposed edges
- Surface faults as a result of the thermal treatment process allowed if not visible when inspected as per 10.2.4
- Any bubbles around edges, cut outs, notches or drilled holes are allowed as long as they do not extend more than 15 mm from the 'edge'

10.2.3 Interlayer defects

These are not allowed in the vision area if obvious.

10.2.4 Inspection method

The laminated glass pane to be observed is placed vertically, in front of and parallel to a matt grey screen, lit by diffused daylight or equivalent.

The inspection shall not be undertaken in direct sunlight nor shall directional light sources, e.g. spotlights be used.

The observer stands 3 metres from the glass observing it perpendicularly (the matt screen being on the other side of the glass).

The observer marks all defects that are disturbing when viewed under this regime.

11. Marking

11.1 General

There are no requirements in EN 14449, i.e. the hEN, for the marking of laminated/laminated safety glass.

11.2 Safety glazing regulations

The laminated safety glass when installed MUST be clearly and indelibly marked with the marking visible after installation.

Details of critical locations, classification of product to be installed and marking are given in BS 6262-4.

Marking shall consist of the following:

- Manufacturer's name or trade mark;
- The standard number, i.e. EN 14449, and
- Classification according to EN 12600, i.e. 3(B)3, 2(B)2 or 1(B)1.

11.3 Fire regulations

The latest version of England & Wales Building Regulation Approved Document B recommends that all installed fire resistant glass be marked.

The marking must be clear and visible after installation to allow unambiguous identification.

12. Health and Safety

The cutting of laminated glass and laminated safety glass has to be undertaken safely.

The use of burning methylated spirits to warm the interlayer is considered unsafe and should be prohibited.

ANNEX A

Glass components

A.1 Basic soda lime silicate glasses

Soda lime silicate glasses products that are in accordance with EN 572 -9. They are as follows:

A.1.1 Float glass EN 572-2

A.1.2 Polished wired glass EN 572-3

A.1.3 Drawn sheet glass EN 572-4

A.1.4 Patterned glass EN 572-5

A.1.5 Wired patterned glass EN 572-6

A.2 Special basic glasses

Special basic glass products that are in accordance with the following:

A.2.1 Borosilicate glass EN 1748-1-2

A.2.2 Glass ceramics EN 1748-2-2

A.2.3 Alkaline earth silicate glass EN 14178-2

A.2.4 Alumino silicate glass EN 15681-2

A.3 Thermally treated glasses

Thermally treated glass that is in accordance with the following:

A.3.1 Heat strengthened soda lime silicate glass EN 1863-2

A.3.2 Thermally toughened soda lime silicate safety glass EN 12150-2

A.3.3 Heat soaked thermally toughened soda lime silicate safety glass EN 14179-2

A.3.4 Thermally toughened borosilicate safety glass EN 13024-2

A.3.5 Thermally toughened alkaline earth silicate safety glass EN 14321-2

A.3.6 Heat soaked thermally toughened alkaline earth silicate safety glass EN 15682-2

A.4 Chemically strengthened glass

Chemically strengthened soda lime silicate glass that is in accordance with EN 12337-2

A.5 Acid etched, sandblasted glass

NOTE 1: Standards are being written for these products.

NOTE 2: The treated surface should not be in contact with the interlayer.

A.6 Coated glass

Coated glass products that are in accordance with EN 1096-4.

NOTE: Care should be taken if the coating is to be in contact with the interlayer. The coated glass manufacturer's advice should be sought.

ANNEX B

Interlayer types

B.1 Folio Interlayer(s)

B.1.1 Polyvinyl butyral – pvb

B.1.2 Polyethylene acetate – eva

B.1.3 Polyurethane – pu

B.1.4 Ionoplast

B.1.5 Others

B.2 Cast in Place Interlayer(s)

B.2.1 Polymethyl methacrylate – pmma

B.2.2 Polyurethane – pu

B.2.3 Epoxy

B.2.4 Others

B.3 Intumescent Interlayer(s)

B.3.1 Sodium Silicate

Annex C

Bibliography

British Standards

BS 6262-4:2005 Glazing for buildings - Part 4: Code of practice for safety related to human impact

European Standards

EN 356:2000 Glass in building.- Security glazing - Testing and classification of resistance against manual attack

EN 410:1998 Glass in building - Determination of luminous and solar characteristics of glazing

EN 572-2:2004 Glass in building - Basic soda lime silicate glass products - Part 2: Float glass

EN 572-3 Glass in building - Basic soda lime silicate glass products - Part 3: Polished wired 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 572-9 Glass in building - Basic soda lime silicate glass products - Part 9: Evaluation of conformity/Product standard

EN 1063 Glass in building - Security glazing - Testing and classification of resistance against bullet attack

EN 1096-4 Glass in building - Coated glass - Part 4: evaluation of conformity/product standard

EN 1748-1-2 Glass in building - Special basic products - Borosilicate glasses - Part 1-2: Evaluation of conformity/Product standard

EN 1748-2-2 Glass in building - Special basic products - Glass Ceramics - Part 2-2: Evaluation of conformity/Product standard

EN 1863-2 Glass in buildings - Heat strengthened soda lime silicate glass - Part 2: Evaluation of conformity/Product standard

EN 12150-2 Glass in building. - Thermally toughened soda lime silicate safety glass. Part 2: Evaluation of conformity/Product standard

EN 12337-2 Glass in buildings - Chemically strengthened soda lime silicate glass - Part 2: Evaluation of conformity/Product standard

EN 12600 Glass in building - Pendulum test - Impact test method and classification for flat glass

EN 12758 Glass in building - Glazing and airborne sound insulation. Product descriptions and determination of properties

EN 13024-2 Glass in buildings - Thermally toughened borosilicate safety glass - Part 2: Evaluation of conformity/ Product standard

EN 13501-2 Fire classification of construction products and building elements - Part 2: Classification using data from fire resistance tests, excluding ventilation services

EN 13541 Glass in building - Security glazing - Testing and classification of resistance against explosion pressure

EN 14178-2 Glass in buildings - Basic alkaline earth silicate glass products - Part 2: Evaluation of conformity/Product standard

EN 14179-2 Glass in buildings - Heat soaked thermally toughened soda lime silicate safety glass - Part 2: Evaluation of conformity/Product standard

EN 14321-2 Glass in buildings - Thermally toughened alkaline earth silicate safety glass - Part 2: Evaluation of conformity/ Product standard

EN 14449 Glass in buildings - Laminated glass and laminated safety glass - Evaluation of conformity/Product standard

EN 15681-2 Glass in buildings - Basic alumino silicate glass products - Part 2: Evaluation of conformity/Product standard

EN 15682-2 Glass in buildings - Heat soaked thermally toughened alkaline earth silicate safety glass - Part 2: Evaluation of conformity/Product standard

International/European Standards

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

EN ISO 12543-2 Glass in building - Laminated glass and laminated safety glass - Part 2: Laminated safety glass

EN ISO 12543-3 Glass in building - Laminated glass and laminated safety glass - Part 3: Laminated glass

EN ISO 12543-4 Glass in building. - Laminated glass and laminated safety glass - Part 4: Test methods for durability

EN ISO 12543-5 Glass in building - Laminated glass and laminated safety glass - Part 5: Dimensions and edge finishing

EN ISO 12543-6 Glass in building. - Laminated glass and laminated safety glass - Part 6: Appearance

Building Regulations

England and Wales Building Regulations Approved Document B Fire Safety

GGF Data Sheets

GGF Data Sheet 4.4 Quality of Thermally Toughened Soda Lime Silicate Safety Glass for Building

GGF Data Sheet 4.4.1 Thermally Treated Soda Lime Silicate Glass Products - General

GGF Data Sheet 4.12.4 Curved Glass Part 4: Curved Laminated Glasses

GGF Data Sheet 8.1.1 Security Glazing - Part 1: Definitions and Description

GGF Data Sheet 8.1.2 Security Glazing - Part 2: Manual Attack Resistant Glazing

GGF Data Sheet 8.1.3 Security Glazing - Part 3: Bullet Resistant Glazing

GGF Data Sheet 8.1.4 Security Glazing - Part 4: Explosion Resistant Glazing