BRITISH STANDARD

BS 952-1:1995

Glass for glazing —

Part 1: Classification

Confirmed
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Committees responsible for this British Standard

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Association of Building Engineers

Department of the Environment (Building Research Establishment)

Department of the Environment (Property and Buildings Directorate)

Flat Glass Manufacturers' Association

Glass and Glazing Federation

Royal Institute of British Architects

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Contents

Foreword

This Part of BS 952 was prepared by Subcommittee B/520/1. It has been used for many years as a valuable source of background and contractual information by architects, specifiers and other glass users.

The first edition of this British Standard was published in 1941 and it has since been revised in 1953, 1964 and 1978, principally to take account of product developments. This present revision, which has been prepared under the direction of the Sector Board for Building and Civil Engineering, supersedes the 1978 edition, which is withdrawn. It brings up to date the information on glass types, thicknesses, mass/unit area and normally available maximum sizes. New sections have been added covering coated glass, borosilicate glass and glass ceramics to reflect the increasing use of these products.

Work is currently in progress within CEN/TC 129, Glass in building, to produce European Standards for the various glass types. The first product standards, dealing with basic soda lime-silicate glasses (BS EN 572-1 to BS EN 572-7), have recently been published. Further standards covering all of the major processed glass products and glass compositions will be published as European Standards over the next few years and adopted as British Standards, thus augmenting the information within this standard.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

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Summary of pages
This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 21 and a back cover.

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Section 1. General

1.1 Scope

This Part of BS 952 classifies glass for use in building into three glass compositions: the commonly used soda lime-silicate glass, borosilicate glass and glass ceramics. Terms and definitions, together with details of nominal thickness, thickness tolerance, mass/unit area and the normally available maximum sizes are given.

1.2 Normative references

This Part of BS 952 incorporates, by reference, provisions from other publications. These normative references are made at the appropriate places in the text and the cited publications are listed on the inside back cover. For dated references, only the edition cited applies; any subsequent amendments to, or revisions of, any of the cited publication apply to this Part of BS 952 only when incorporated in the reference by amendment or revision. For undated references, the latest edition of the cited publication applies, together with any amendments.

1.3 Definitions

For the purposes of this British Standard, the following definitions apply.

1.3.1
annealed glass
glass that has been subjected to controlled cooling to reduce the presence of residual stresses in the glass thus allowing easy cutting. It is ordinary glass which includes float glass, sheet glass, patterned glass and wired glass and is independent of the glass composition

1.3.2
off-line coating
process whereby individual pieces of glass, e.g. annealed, toughened, heat strengthened or laminated, are coated

1.3.3
on-line coating
process whereby the coating is applied to the surface of a continually moving ribbon of glass during the manufacturing process, prior to the glass being initially cut

1.3.4
safety glass
glass which when tested in accordance with BS 6206 either does not break, or breaks safely, and affords protection from cutting and piercing injuries in the event of accidental human impact

1.3.5
security glass
glass that affords protection against a specified level of attack [see **4.3.3**b)]

1.3.6
translucent glass
glass that transmits light with varying degrees of diffusion so that vision is not clear

NOTE The diffusion may be produced either by patterning the surface during manufacture, or by surface treatment after manufacture, i.e. sandblasting, acid etching, etc. These processes are dealt with in BS 952-2.

1.3.7
transparent glass
glass that transmits light and permits clear vision through it

1.4 Materials

1.4.1 General

All glasses for use in building (see **1.4.2**, **1.4.3** and **1.4.4**) should be such that the physical and chemical characteristics can be considered constant over time. They should be:

a) insensitive to photochemical effects, i.e. the spectral properties (transmission of light and solar energy) are not modified by direct or indirect solar radiation.

b) insensitive to attack from the environment, i.e. surface deterioration will not develop after glazing under normal conditions of use, provided the glass is cleaned at reasonable intervals.

1.4.2 Soda lime-silicate glass (see BS EN 572-1)

The proportions by mass of the principal constituents of all the soda lime-silicate glass products covered by BS EN 572 and this standard are:

Silicon dioxide	SiO_2	69 %	to	74 %
Calcium oxide	CaO	5 %	to	12 %
Sodium oxide	Na_2O	12 %	to	16 %
Magnesium oxide	MgO	0 %	to	6 %
Aluminium oxide	Al_2O_3	0 %	to	3 %

1.4.3 Borosilicate glass

The proportions by mass of the principal constituents of all the borosilicate glass products covered by this standard are:

Silicon dioxide	SiO_2	70 %	to	87 %
Boron oxide	B_2O_3	7 %	to	15 %
Sodium oxide	Na_2O			
Potassium oxide	K_2O	1 %	to	8 %
Aluminium oxide	Al_2O_3			
Others		0 %	to	8 %

1.4.4 Glass ceramics

The proportions by mass of the principal constituents of all the glass ceramic products covered by this standard are:

Silicon dioxide	SiO_2	50 %	to	80 %
Aluminium oxide	Al_2O_3	15 %	to	27 %
Lithium oxide	Li_2O	0 %	to	5 %
Zinc oxide	ZnO	1 %	to	5 %
Titanium dioxide	TiO_2	0 %	to	5 %
Zirconium dioxide	ZrO_2	0 %	to	5 %
Magnesium oxide	MgO			
Calcium oxide	CaO	0 %	to	8 %
Barium oxide	BaO			
Sodium oxide	Na_2O			
Potassium oxide	K_2O	0 %	to	2 %
Others		0 %	to	5 %

1.5 Dimensions

1.5.1 Thickness

1.5.1.1 *General*

The methods for the determination of glass thickness are given in the relevant product standard, e.g. BS EN 572-2 for soda lime-silicate float glass.

1.5.1.2 *Tolerances*

The tolerances on thickness are given in the appropriate product standard. They are reproduced in this standard in tables relating to the availability of that particular product.

1.5.2 Length, width and squareness

1.5.2.1 *General*

The method for the determination of length, width and squareness are given in the relevant product standard, e.g. BS EN 572-2 for soda lime-silicate float glass.

1.5.2.2 *Tolerances*

These are given in the relevant product standard. They can relate to both stock and finished sizes depending on the product. They are not reproduced in this standard.

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Section 2. Annealed flat soda-lime-silicate glass

2.1 Float glass (see BS EN 572-2)

2.1.1 Clear float glass

This is transparent glass, the surfaces of which are flat and parallel so that they provide clear, undistorted vision and reflection. Float glass is manufactured by allowing glass from a tank furnace to flow across a bath of molten metal.

2.1.2 Body tinted float glass

This is transparent glass in which the whole body of the glass is tinted.

Tints available are green, grey, bronze and blue. Thicknesses available are 3, 4, 5, 6, 8, 10 and 12 mm; whether all thicknesses are available in each tint depends on the manufacturer. Normal maximum sizes may differ from those for clear float glass.

2.1.3 Availability of clear float glass

Table 1 gives the range of nominal thicknesses, thickness tolerances, mass/unit area and maximum sizes normally available for clear float glass.

Table 1 — Availability of clear float glass (see **2.1.3**)

Nominal thickness mm	Tolerance on thickness mm	Approximate mass/unit area kg/m^2	Normal maximum size mm
3	±0.2	7.5	3 210 × 6 000
4	±0.2	10.0	3 210 × 6 000
5	±0.2	12.5	3 210 × 6 000
6	±0.2	15.0	3 210 × 6 000
8	±0.3	20.0	3 210 × 6 000
10	±0.3	25.0	3 210 × 6 000
12	±0.3	30.0	3 210 × 6 000
15	±0.5	37.5	3 210 × 6 000
19	±1.0	47.5	3 210 × 6 000
25	±1.0	62.5	3 210 × 5 100

NOTE Mass/unit area (i.e. kg/m^2) was traditionally referred to as "weight" in the glass and glazing industries.

2.2 Sheet glass (see BS EN 572-4)

2.2.1 Clear sheet glass

This is transparent glass manufactured by the flat drawn process. Sheet glass has natural fire-finished surfaces but, because the two surfaces are never perfectly flat and parallel, there is always some distortion of vision and reflection.

2.2.2 Body tinted sheet glass

This is transparent glass in which the whole body of the glass is tinted. Such glass reduces solar radiation transmission by increased absorption.

Generally available are green, grey and bronze tints. For information on thicknesses and normal maximum sizes the manufacturers should be consulted.

2.2.3 Availability of clear sheet glass

Table 2 includes the range of nominal thicknesses, thickness tolerances, mass/unit area and maximum sizes normally available for clear sheet glass.

Table 2 — Availability of clear sheet glass (see **2.2.3**)

Nominal thickness mm	Tolerance on thickness mm	Approximate mass/unit area kg/m²	Normal maximum size mm
3	±0.3	7.5	2 440 × 1 320
4	±0.3	10.0	2 880 × 2 130
5	±0.3	12.5	2 440 × 2 130
6	±0.3	15.0	2 440 × 2 130

2.3 Patterned glass (see BS EN 572-5)

2.3.1 Clear patterned glass

This is translucent glass manufactured by the rolling process. Usually the deeper the pattern, the greater the obscuration and diffusion.

2.3.2 Body tinted patterned glass

Body tinted patterned glass is similar to clear patterned glass but with the whole of the glass tinted during manufacture. The tints are incorporated either to give solar control properties or for a decorative purpose.

Thicknesses and tints available are dependent on the manufacturer. Maximum sizes available may differ from those of clear patterned glass.

2.3.3 Availability of clear patterned glass

Table 3 includes the range of nominal thicknesses, thickness tolerances, mass/unit area and maximum sizes normally available for clear patterned glass.

Table 3 — Availability of clear patterned glass (see **2.3.3**)

Nominal thickness mm	Tolerance on thickness mm	Approximate mass/unit area kg/m²	Normal maximum size mm
3	±0.5	7.5	2 140 × 1 320
4	±0.5	10.0	2 140 × 1 320
6	±0.5	15.0	2 140 × 1 320
8	±0.8	20.0	2 140 × 1 320
10	±1.0	25.0	2 140 × 1 320

2.4 Wired glass

2.4.1 General

Wired glass has steel wire mesh completely embedded in it. Only one type of wire mesh is used and this is welded at all intersections, i.e. Georgian (12.5 mm square).

Wired glass, like other annealed glass, is liable to crack when subjected to heavy loading, impact or thermal shock. The embedded wire, however, holds the glass together and breaks only under a severe blow. Wired glass can provide a fire resistance of up to 2 h in an appropriate pane size and frame (see PD 6512).

The process of manufacture may result in some of the meshes being distorted. In considering the use of wired glass in situations demanding a good appearance it should be borne in mind that glass having a truly regular arrangement of wires may not always be obtainable. However, adjacent panels can be lined up one way, if required, by special selection.

2.4.2 Wired patterned glass (see BS EN 572-6)

This is translucent wired glass with a patterned surface.

2.4.3 Polished wired glass (see BS EN 572-3)

This is transparent wired glass produced by grinding and polishing wired patterned glass.

2.4.4 Safety wired glass

This is wired glass containing a stronger wire which allows the product to be classified as a safety glass. Available in both patterned and polished forms.

2.5 Availability of wired glass

Table 4 includes the range of nominal thicknesses, thickness tolerances, mass/unit area and maximum sizes normally available for ordinary wired and safety wired glass.

Table 4 — Availability of wired glass (see **2.5**)

Type	Nominal thickness mm	Tolerance on thickness mm	Approximate mass/unit area kg/m^2	Normal maximum size mm
Ordinary wired				
Patterned	7	±0.7	16.5	1 980 × 3 700
Polished	6	$^{0}_{+1.4}$	16.5	1 980 × 3 300
Safety wired				
Patterned	7	±80.7	16.5	1 985 × 3 500
Polished	6	$^{0}_{+1.4}$	16.5	1 985 × 3 300

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Section 3. Coated glass

3.1 General

Coated glass is a glass substrate to which has been applied a coating, i.e. one or more thin solid layers of inorganic materials, in order to modify one or more of its properties. The properties modified are:

— light reflectance/transmittance;
— solar heat reflectance/transmittance;
— surface emissivity.

The glass substrate can be any type of glass, e.g. float, sheet, patterned, toughened, heat strengthened or laminated, and any composition, e.g. soda lime-silicate, borosilicate.

Only the major generic groupings of coated glass are mentioned.

3.2 Reflective float glass

This is transparent glass which has a reflective surface coating applied either on-line or off-line. The reflective surface layer may be on a clear or tinted float glass. Transmission of solar radiation is reduced by increased reflection and absorption. The glass has a coloured metallic appearance.

NOTE Under appropriate lighting levels this type of coated glass can give the phenomenon referred to as “one-way vision”.

3.3 Low-emissivity float glass

This is transparent glass which has a low-emissivity surface coating applied either on-line or off-line. The low-emissivity coating is generally applied to a clear float glass. Surface emissivity is altered from 0.9 for a normal glass, to a value of $\leq$ 0.2 with the addition of the coating.

3.4 Anti-reflection float glass

This is transparent glass which has an anti-reflection surface coating applied off-line to both surfaces of the glass. The anti-reflection coating is generally applied to clear float glass. The light reflectance of the glass is reduced to < 1 %.

3.5 Availability of coated glass

The thickness and sizes available for coated glass is dependent on many factors, one of which is whether they are produced on-line or off-line. Information on thicknesses, sizes, performance and colour should be obtained from the manufacturer.

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Section 4. Processed flat soda lime-silicate glass

4.1 Thermally toughened glass

4.1.1 General

Thermally toughened glass is produced by subjecting annealed glass to a process of heating and rapid cooling which induces high compression in the surface and a compensating tension in the centre. Because of this pre-stressing, thermally toughened glass is less liable than annealed glass to break as a result of impact, mechanical load or thermal stress. If thermally toughened glass breaks, it will fragment into comparatively harmless pieces. Thermally toughened glass can be produced to conform to BS 6206 and can therefore be classified as a safety glass.

Predetermined sizes are necessary because once the glass has been thermally toughened it cannot be cut or worked. If thermally toughened glass is required in a ratio of length to width exceeding 7:1, the manufacturers of the thermally toughened glass should be consulted.

4.1.2 Types of thermally toughened glass

The following types of thermally toughened glasses are available.

a) *Clear float or sheet glass.* This glass is produced from clear float or clear sheet glass, (see **2.1.1** and **2.2.1**).

b) *Solar control glass.* This glass is available in the following forms.

1) *Body tinted float or sheet glass* (see **2.1.2** and **2.2.2**). The manufacturer should be contacted regarding available tints and thicknesses.

2) *Reflective float glass* (see **3.2**). The manufacturer/processor should be contacted regarding availability. Sizes may differ between on-line coatings which are thermally toughenable and off-line coatings which have to be applied onto thermally toughened glass.

c) *Low-emissivity float glass* (see **3.3**). The manufacturer/processor should be contacted regarding availability. Sizes may differ between on-line coatings which are thermally toughenable and off-line coatings which have to be applied onto thermally toughened glass.

d) *Patterned glass* (see **2.3.1** and **2.3.2**). A range of thicknesses and patterns in thermally toughened form is available. For details the manufacturer should be consulted.

e) *Opaque glass.* This is normally clear float or sheet glass which has a coloured ceramic frit fired into one surface during the thermal toughening process. An extensive range of colours is available and the manufacturer should be consulted for details.

f) *Cladding glass.* This is a body tinted or reflective coated glass which in thermally toughened form is opacified, i.e. made opaque, by means of an organic coating or film. The sizes available will, in general, be the same as for the thermally toughened substrate.

g) *Insulating infill panels.* These normally consist of thermally toughened glass, e.g. solar control glass, body tinted or reflective glass, opaque glass or cladding glass with a backing of insulating material which can either be adhered to the glass or retained in a box behind the glass.

4.1.3 Availability of thermally toughened glass

Table 5 gives the types, nominal thickness and maximum sizes normally available for thermally toughened glass.

4.1.4 Heat soaked thermally toughened glass

This is thermally toughened glass (see **4.1.2**) which as part of its manufacture has been subjected to a sustained temperature for a specific time such that a large proportion of any nickel sulfide inclusions present are converted to the stable form. Availability is similar to thermally toughened glass (see **4.1.3**).

4.2 Heat strengthened glass

4.2.1 General

Heat strengthened glass is produced by subjecting annealed glass to a process of heating and rapid cooling which induces compression in the surface and a compensating tension in the centre. Because of this pre-stressing, heat strengthened glass is less liable than annealed glass to break as a result of impact, mechanical load or thermal stress. However, when heat strengthened glass breaks, it will break like annealed glass.

Predetermined sizes are necessary because once the glass has been heat strengthened it cannot be cut or worked. If heat strengthened glass is required in a ratio of length to width exceeding 7:1 the manufacturers should be consulted.

4.2.2 Types of heat strengthened glass

All the types of thermally toughened glass listed in **4.1.2** can also be manufactured as heat strengthened glass.

4.2.3 Availability of heat strengthened glass

The thicknesses, sizes and types of heat strengthened glass available from a particular manufacturer will depend on the availability of the necessary manufacturing equipment. The manufacturer should be consulted as to availability.

Table 5 — Availability of thermally toughened glass (see **4.1.3**)

Type	Nominal thickness mm	Normal maximum size mm
Clear float or sheet	3	1 300 × 2 100
	4	1 500 × 2 200
	5	1 600 × 3 200
	6	2 000 × 4 200
	8	2 000 × 4 200
	10	2 000 × 4 200
	12	2 000 × 4 200
	15	1 700 × 4 200
	19	1 500 × 4 200
	over 19	Enquiries should be submitted to the manufacturers of toughened glass
Body tinted float or sheet	4	1 500 × 2 200
	5	1 600 × 3 200
	6	2 000 × 4 200
	8	2 000 × 4 200
	10	2 000 × 4 200
	12	2 000 × 4 200
Patterned	4	1 300 × 2 000
	6	1 300 × 2 500
	10	1 500 × 2 500
Opaque	6	1 500 × 3 210
	10	2 000 × 3 500

4.3 Laminated glass

4.3.1 General

Laminated glass consists of two or more panes of glass with an interlayer of reinforcing material between each pane. The interlayers are permanently bonded to the glass panes under carefully controlled processing. The interlayers are resistant to penetration and they absorb impact shock, holding the glass in place and preventing extensive spalling of glass fragments. The degree of protection provided by laminated glass depends on the overall thickness and construction.

Laminated glass can usually be cut to size and worked after manufacture. The techniques used depend on the type and construction of the laminated glass.

4.3.2 Construction

Laminated glass may be used for a wide range of functions, hence it is necessary to define the type and thickness of the glass and the requirements for the interlayer. Laminated glasses are commonly referred to by the number of layers, i.e. two panes of glass with one interlayer is known as 3-ply. Most annealed, toughened and heat strengthened glasses can be incorporated into laminated glasses.

The most common interlayer is polyvinyl butyral (pvb), which is a thin plastics sheet material, and is available in thicknesses that are multiples of 0.38 mm. The laminating process uses high temperature and pressure which produces a high optical quality product.

There are available a number of liquid interlayers generally referred to as cast-in-place resins which are poured between the glasses and then reacted, both to cure the resin as well as to adhere it to the glass surfaces.

4.3.3 Polyvinyl butyral (pvb) laminated glass

This is the normally available type of laminated glass. The general performance groups of this product are as follows.

a) *Laminated safety glass.* This is a safety glass which is normally a 3-ply laminate with either a 0.38 mm or 0.76 mm interlayer depending on the performance classification required. If, after impact, the glass is not ruptured it will continue to offer protection against the weather and may still act as a safety barrier.

b) *Laminated security glass.* This glass is designed to withstand a specified level of attack. The following types are available.

1) *Manual attack resistant glass.* This is either a 3-ply laminate with a 1.52 mm interlayer, or a 5-ply laminate with two 1.14 mm interlayers. It is designed to resist manual attack by means of an axe, crowbar, pickaxe, etc. and to delay access to a protected space for a short period of time. The performance requirements for manual attack resistant glass are specified in BS 5544.

2) *Bullet-resistant glass.* This is designed to provide protection against firearm attack. Thicknesses range upwards from 19 mm, the thickness and construction is dependent on the type of weapon and ammunition against which protection is required. The performance requirements for bullet-resistant glass are specified in BS 5051.

3) *Blast-resistant glass.* This is designed to reduce the injurious effects of accidental or intentional blast forces. It may combine the characteristics of safety, manual attack resistant and/or bullet-resistant glasses.

c) *Solar control laminated glass.* This is available in the following types.

1) *Heat absorbing solar control laminated glass.* This either incorporates a tinted interlayer or a body tinted glass in the laminate.

2) *Coated laminated glass.* This either incorporates a thin overall coating adjacent to the interlayer, or a coated glass, i.e. reflective float glass (see **3.2**) in the laminate make-up. Glass and/or interlayer may also be tinted.

d) *Ultraviolet control laminated glass.* This incorporates a special pvb interlayer which absorbs $\geqslant$ 99 % of the ultraviolet radiation (measured over the range 280 nm to 380 nm) reaching the glass surface and thus gives a measure of protection against fading. The glass is as transparent as any clear laminated glass.

e) *Acoustic control laminated glass.* A slight improvement in sound reduction will be achieved with laminated glass when compared with the same total thickness of solid (monolithic) glass due to the sound damping properties of the interlayer in combination with the glass layers. There will also be improved attenuation at the coincident frequency and at higher frequencies, and less significant improvement at lower frequencies.

f) *Translucent laminated glass.* This can be manufactured incorporating a patterned glass (only applicable for glasses with shallow pattern, see **2.3.1**), a surface treated glass (see BS 952-2) and/or a light diffusing interlayer.

g) *Laminated wired glass.* This can be manufactured to fulfil three differing functions, as follows.

1) *Fire-resistance.* This type incorporates a wired glass (see **2.4**) in the laminate. When glazed in suitable sizes and frames it can offer fire-resistance (integrity).

2) *Manifestation.* This type incorporates fine wires in the interlayer which run parallel in one direction only at approximately 30 mm centres. These wires are to indicate the presence of the glass.

3) *Alarm.* This type incorporates a continuous thin wire filament embedded in the interlayer so that when the glass is broken, an electric circuit controlling an alarm is activated.

4.3.4 Availability of pvb laminated glass

Table 6 gives general information on thicknesses, thickness tolerances, mass/unit area and maximum sizes normally available for a range of safety and manual attack resistant laminated glasses.

Table 6 — Availability of pvb laminated glass (see 4.3.4)

Type	Nominal thickness mm	Tolerance on thickness mm	Approximate mass/unit area kg/m²	Normal maximum size mm
Safety glass	4.4	±0.4	11.0	2 100 × 1 200
	4.8	±0.4	11.0	2 140 × 1 320
	6.4	±0.4	16.0	3 210 × 6 000
	6.8	±0.4	16.0	3 210 × 6 000
	8.4	±0.4	21.0	3 210 × 6 000
	8.8	±0.4	21.0	3 210 × 6 000
Manual attack	7.5	±0.4	16.0	3 210 × 6 000
	9.5	±0.4	21.0	3 210 × 6 000
	11.3	±0.6	23.5	2 500 × 4 500
	11.5	±0.4	26.0	3 210 × 6 000

4.3.5 Cast-in-place resin laminated glass

A wide variety of resin systems exist that can be used to manufacture laminated glass. Therefore, dependent upon the resin type, viscosity and thickness, a whole range of laminated glass with wide ranging properties can be manufactured. Generally speaking cast-in-place laminates are produced for the following uses.

a) *Decorative.* The resin systems lend themselves to the incorporation of colour and pearlizing particles. This leads to the possibility of producing both transparent and translucent glasses.

b) *Safety.* As a result of the thicker interlayers required with cast-in-place resins, patterned glass with deep patterns, and toughened glass can be satisfactorily laminated.

c) *Acoustic control.* The ability to modify the viscosity of the cured resin system and its thickness means that significant improvements in sound reductions are possible.

4.3.6 Availability of cast-in-place resin laminated glass

As the number of possible permutations of resin type, thickness, viscosity and colour as well as glass type are numerous the manufacturer should be consulted.

4.3.7 Intumescent interlayer laminated glass

This glass incorporates special inorganic interlayers which, when subjected to heat, turn opaque and intumesce. Depending on the thickness of the glass/interlayer combination a fire resistance (integrity and insulation) of up to 2 h can be achieved using appropriate glass and frame sizes (see PD 6512).

This glass can also incorporate solar control glass and/or patterned glass in the laminations using either pvb or cast-in-place lamination techniques. Generally, intumescent interlayer laminated glasses are safety glasses.

4.3.8 Availability of intumescent interlayer laminated glass

As the number of permutations is large the manufacturer should be consulted.

4.4 Insulating glass units

4.4.1 General

Insulating glass units comprise two or more panes of glass hermetically sealed at their periphery. The air space, or spaces, so formed are generally filled with dehydrated air. However, other gases may be used e.g. argon for improved thermal insulation, sulfur hexafluoride for improved acoustic insulation. Air space widths normally vary from 6 mm to 20 mm. Units can be manufactured from any of the range of flat glasses: annealed, toughened, heat strengthened, coated or laminated.

The thermal insulation of an insulating glass unit can be improved by the use of a low-emissivity glass (see **3.3**) and/or use of an appropriate gas filling.

4.4.2 Availability of insulating glass units

Because of the different manufacturing techniques available and the large range of possible glass combinations, the manufacturer should be consulted for information.

4.5 Silvered glass

Silvered glass is produced by the deposition of silver on to glass. The silver deposit is then protected by coatings or coverings according to the intended use of the glass and the degree of protection necessary, such as in the manufacture of mirrors.

Venetian strip silvering (or striped silvering) is a process by which alternate bands of silvered and clear glass are produced to form what is often referred to as “one-way vision” glass (see also **3.2**).

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Section 5. Miscellaneous soda lime-silicate glasses

5.1 Flashed or pot coloured sheet glass

Flashed or pot coloured sheet glass is a transparent glass available in a variety of colours. There are two methods of manufacture available.

a) A thin layer of colour is flashed onto clear glass and this is known as "flashed colour". The transparency of the flashed glass will depend on the colour used.

b) The whole thickness of the glass may be tinted and this is known as "pot colour".

Table 7 gives thicknesses, mass/unit areas and maximum sizes normally available.

5.2 Diffuse reflection glass

This is a glass, in which one surface is lightly textured so as to produce slight diffusion without excessive obscuration, thus avoiding the nuisance of reflection.

NOTE To perform correctly, it is essential that the diffuse reflection glass is not more than 19 mm (depending on type) in front of the surface it covers.

Diffuse reflection glass is generally available in a nominal 2 mm thickness with normal maximum size of 1 840 mm × 1 240 mm. It is possible, however, to produce a diffuse reflection glass by acid-etching (see BS 952-2).

Diffuse reflection glass can be supplied in bent or toughened form, enquiries for which should be submitted to the manufacturer.

5.3 Copper lights

Copper lights are panels of small panes of glass held together with copper sections. Copper-light glazing may be used for fire-resistant glazing (see PD 6512). The use of copper light glazing in critical locations is covered by BS 6262-4.

5.4 Leaded lights

Leaded lights are panels consisting of small panes of glass held together with lead cames. Reinforcement may be provided by steel-covered cames, by cames strengthened by the insertion of steel strip, or by saddle bars. The use of strengthened cames or saddle bars with leaded light glazing depends on the situation of the final assembly. The use of leaded lights in critical locations is covered by BS 6262-4.

NOTE Leaded lights should not be confused with decorative leading which is lead strip applied to a single pane of glass.

5.5 Bullions

Bullions were originally the thick portion obtained from spun crown glass, but this form of glass is now also available as a simulation.

5.6 Hollow glass blocks

Transparent and translucent blocks are available manufactured by a pressing process in which two hollow "dishes" are formed and subsequently fused together to form a hollow, hermetically-sealed block. A variety of shapes, sizes and colours are available.

5.7 Lenses: roof and pavement

Translucent lenses are available in a variety of shapes and sizes, being produced by a pressing process. Certain types are made in toughened glass to give a high degree of resistance to impact, blast and fire.

Table 7 — Availability of flashed and pot coloured sheet glass (see 5.1)

Type	Range of thickness mm	Approximate mass/unit area kg/m²	Normal maximum size mm
Flashed colour	1.5 to 2.6	5.0	1 400 × 1 700
	2.7 to 3.3	7.5	1 700 × 2 200
	3.5 to 4.2	9.5	1 700 × 2 400
	4.0 to 5.0	11.5	1 700 × 2 400
	5.0 to 6.0	13.5	1 700 × 2 400
Pot colour	2.5 to 3.0	6.5	1 500 × 1 600
	4.0	10.0	1 500 × 1 800

5.8 Channel shaped glass (see BS EN 572-7)

Channel shaped glass is formed by rolling glass in the shape of a shallow U-section channel, the flanges of which impart sufficient strength generally to enable each length to be fixed at the ends only. It has a textured surface and is therefore translucent. It is available either wired or unwired. The wired version incorporates wires in parallel lines approximately 30 mm apart, for the purpose of manifestation, and is known as “wireline”.

5.9 Mouth-blown antique and opalescent glasses

Mouth-blown antique glass, also known as Venetian glass, is produced by a glassblower blowing a long cylinder of glass. This is then cut, flattened and annealed. Each piece is unique, contains bubbles and ream and is of uneven thickness with varying surface textures. It is similar in character to medieval glass. Available in a wide range of tints, with a normal maximum size of 900 mm × 600 mm.

Opalescent glasses are produced by a similar process. They are opaque glass with two or more colours streaked in the body of the glass. Available in a range of colour combinations, with a normal maximum size of 1 000 mm × 800 mm.

Section 6. Special composition glasses

6.1 Borosilicate glass

6.1.1 General

This is a glass which, as a result of its composition (see **1.4.3**), has a high thermal shock resistance.

6.1.2 Annealed flat borosilicate glass

This is manufactured in a number of forms, e.g. drawn sheet, float, rolled and patterned. Depending on the manufacturing method clear and tinted borosilicate glass can be produced either transparent or translucent.

6.1.3 Toughened flat borosilicate glass

Any of the forms of flat borosilicate glass can be toughened to increase resistance to impact, mechanical and thermal stress.

6.1.4 Heat strengthened flat borosilicate glass

Any of the forms of flat borosilicate glass can be heat strengthened to increase resistance to mechanical and thermal stress.

6.1.5 Availability of flat borosilicate glass

Because of the number of manufacturing techniques the manufacturer should be consulted for information on thicknesses, thickness tolerances, mass/unit area and normally available maximum sizes.

6.2 Glass ceramics

6.2.1 General

These consist of a crystalline and a residual glass phase. The glass is produced by normal manufacturing techniques, e.g. rolling, drawing, and is then subjected to a heat treatment process which transforms, in a controlled manner, part of the glass into a fine grain crystalline phase. The glass ceramic has properties which deviate from those of the glass from which it was transformed. Glass ceramics are produced from a glass of a composition (see **1.4.4**) designed to have a zero coefficient of thermal expansion and hence have a very high thermal shock resistance.

6.2.2 Annealed flat glass ceramics

These are manufactured in a number of forms, e.g. float, drawn sheet and rolled. Depending on the manufacturing method, clear and tinted glass ceramic can be produced, either transparent or translucent.

6.2.3 Availability of glass ceramics

Because of the specialist nature of these products, the manufacturer should be consulted for information on availability.

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List of references (see clause 2)

Normative references

BSI publications

BRITISH STANDARDS INSTITUTION, London

BS 952, *Glass for glazing.*

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BS 6262-4:1994, *Safety related to human impact.*

BS EN 572, *Glass in building — Basic soda lime silicate glass products.*

BS EN 572-1:1995, *Definitions and general physical and mechanical properties.*

BS EN 572-2:1995, *Float glass.*

BS EN 572-3:1995, *Polished wired glass.*

BS EN 572-4:1995, *Drawn sheet glass.*

BS EN 572-5:1995, *Patterned glass.*

BS EN 572-6:1995, *Wired patterned glass.*

BS EN 572-7:1995, *Wired or unwired channel shaped glass.*

PD 6512, *Use of elements of structural fire protection with particular reference to the recommendations given in BS 5588 "Fire precautions in the design and construction of buildings".*

PD 6512-3:1987, *Guide to the fire performance of glass.*

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