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Safety glazing materials in buildings



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Safety glazing materials in buildings

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Preface

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee BD-007, Glazing and Fixing of Glass to supersede AS/NZS 2208: 1996.

After consultation with stakeholders in both countries, Standards Australia and Standards New Zealand decided to develop this document as an Australian Standard rather than an Australian/New Zealand Standard.

The objective of this document is to set out test requirements for safety glazing materials for use in buildings. The test requirements for the different glazing materials are designed to promote safety and to reduce or minimize the likelihood of cutting and piercing injuries. The safety glazing materials covered are —

- (a) laminated (flat and curved);
- (b) toughened (flat and curved);
- (c) organic-coated;
- (d) organic-backed safety mirror; and
- (e) organic-backed safety painted glass.

The test requirements for the different glazing materials are designed to promote safety and to reduce or minimize the likelihood of cutting and piercing injuries.

The major changes in this edition are as follows:

- (i) Removal of requirements for testing and classification of Grade B safety glazing materials.
- (ii) Inclusion of tests methods for curved toughened safety glass and curved laminated safety glass.
- (iii) The inclusion of testing and classification of 15 mm, 19 mm, 22 mm and 25 mm toughened safety glass.

The terms “normative” and “informative” are used in Standards to define the application of the appendices to which they apply. A “normative” appendix is an integral part of a Standard, whereas an “informative” Appendix is only for information and guidance.

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Introduction

Where glazing material is so situated that accidental breakage is reasonably foreseeable, the glazing materials and thicknesses required for wind loading may not be adequate. While the accident rate for breakage of glazing material glazed at low level is significant among most age groups, it is particularly high in the up to 19 years age group. Research in the United Kingdom, New Zealand and Australia has shown that a high proportion of all reported accidents with glazing material involve glazed doors and side panels in all types of buildings. In certain specialized rooms, such as gymnasiums, the breakage of glazing material located at high level is also a potential danger. In these and other similar danger areas, safety glazing materials meeting the requirements of this document will reduce the risk of injury.

Although these safety glazing materials will break under sufficient impact, their fracture characteristics are such that if broken, the likelihood of cutting and piercing injuries will be minimized.

The aim of the impact tests is to assess the fracture characteristics of a safety glazing material which has been broken at some predetermined minimum impact energy level dependent upon the intended application of the material. If the safety glazing material does not fracture at this minimum energy level, it needs to be tested again at higher energy levels until it is fractured, in order to assess the fracture characteristics.

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Safety glazing materials in buildings

Section 1 Scope and General

1.1 Scope

This document sets out test requirements for safety glazing materials for use in buildings. The test requirements for the different glazing materials are designed to promote safety and to reduce or minimize the likelihood of cutting and piercing injuries.

The safety glazing materials covered are —

- (a) laminated (flat and curved);
- (b) toughened (flat and curved);
- (c) organic-coated; and
- (d) organic-backed safety mirror; and
- (e) organic-backed safety painted glass.

NOTE 1 Alternative methods for demonstrating conformance to this document are given in [Appendix A](#).

NOTE 2 This document is not intended to restrict the use of materials or methods of test not specified herein where such materials or methods of test can be demonstrated to be the equal of, or superior to, those specified.

NOTE 3 Notes on safe performance criteria and human dynamics data are given in [Appendix B](#).

1.2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document.

NOTE Documents referenced for informative purposes are listed in the Bibliography.

AS 1288, *Glass in buildings — Selection and installation*

AS 1599, *Pressure-sensitive and water activated adhesive tape for packaging and office applications*

ISO 4892-2, *Plastics — Methods of exposure to laboratory light sources — Part 2: Xenon-arc lamps*

ASTM C1651, *Standard Test Method for Measurement of Roll Wave Optical Distortion in Heat-Treated Flat Glass*

ASTM D2565, *Standard Practice for Xenon-Arc Exposure of Plastics Intended for Outdoor Applications*

ASTM G155-13, *Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials*

DIN 50-017, *Condensation water test atmospheres*

1.3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

1.3.1

curved glass

glass that has been formed into a curved shape by a heating process

1.3.2**drop height**

vertical distance from the horizontal centre-line of the maximum diameter of the impacting object when it is released relative to the horizontal centre-line of the impacting object when it is at rest (see Figure D.1)

1.3.3**edge kink**

(inherent) periodic distortion produced in horizontally heat-treated glass, at the leading and trailing edge of the plate, as a result of the glass during the heat treating process not being supported by a roller

1.3.4**heat-strengthened glass**

glass which has been subjected to a special heat treatment, so that the residual surface compression stresses lies between 24 MPa and 52 MPa

1.3.5**heat-strengthened laminated safety glass**

laminated safety glass utilizing two or more panels of heat-strengthened glass in the make-up

1.3.6**laminated glass**

glass consisting of two or more sheets of glass permanently bonded together by one or more sheets of plastic interlayer

1.3.7**laminated safety glass**

laminated glass satisfying the relevant requirements for a safety glazing material

Note 1 to entry: For requirements regarding safety glazing materials, see [Clause 3.1](#)

1.3.8**may**

indicates the existence of an option

1.3.9**organic-backed safety mirror**

glazing material consisting of a piece of mirror with a sheet of organic material permanently bonded to the rear face (behind mirror)

1.3.10**organic-coated glass**

glazing material consisting of a continuous polymeric coating, sheet or film permanently bonded to a piece of glass on the internal surface which is not exposed to the elements

1.3.11**organic-backed safety painted glass**

glazing material consisting of a piece of painted glass with a sheet of organic material permanently bonded to the rear face

1.3.12**roller wave**

(inherent) periodic distortion produced in horizontal heat-treated glass as a result of the glass during the heat-treating process being in contact with the rollers

1.3.13**safety glazing material**

material constructed, treated or permanently combined with other materials which, if fractured, produces fragments which are less likely to pierce or cause severe cuts than fragments of ordinary annealed glass

Note 1 to entry: All safety glazing materials are classified as Grade A according to the performance requirements in [Section 3](#).

1.3.14**shall**

indicates that a statement is mandatory

1.3.15**should**

indicates a recommendation

1.3.16**toughened laminated safety glass**

laminated safety glass utilizing two panels of toughened safety glass in the make-up

1.3.17**toughened glass**

glass which has been subjected to a process of pre-stressing

Note 1 to entry: If fractured, toughened glass breaks into numerous small pieces, some of which may be interlocking and forming clumps, that may fall out as separate clumps of glass.

Note 2 to entry: The residual surface compression is a minimum of 69 MPa.

1.3.18**toughened safety glass**

toughened glass satisfying the relevant requirements for a safety glazing material

Note 1 to entry: For requirements regarding safety glazing materials, see [Clause 3.1](#).

1.4 Testing

Testing shall be carried out for different glazing materials, or for differences within a type of glazing material that may noticeably affect performance in the impact, fragmentation or environmental durability tests. Such differences may include, but are not limited to, nominal thickness or thicknesses, method of manufacture, types and amounts of additives and composition of base materials and adhesives.

1.5 Classification

Safety glazing materials that meet the requirements in [Section 3](#) shall be classified as Grade A.

1.6 Marking

Glazing material conforming to this document shall be legibly marked with the following:

- (a) The name or registered trademark of the manufacturer or supplier.
- (b) The number of this Australian Standard, i.e. AS 2208.
- (c) An indication of the plant of manufacture or supply, usually in the form of letter or number.
- (d) An indication that the material is Grade A.

- (e) A number to indicate the nominal thickness for standard glazing material in millimetres (see [Table 2.1](#)), or a number to indicate the minimum thickness for non-standard glazing material to the nearest tenth of a millimetre.
- (f) Organic-coated glass marking shall include:
 - (i) The year of application.
 - (ii) The statement “Valid for 20 years post installation”.
 - (iii) The statement “To maintain safety, do not remove this film”.
- (g) A letter, word or combinations thereof to indicate the type of glazing material used in the product, as follows:
 - (i) The letter “T” or the word “toughened”, indicating a toughened safety glass.
 - (ii) The letter “L” or the word “laminated”, indicating a laminated safety glass.
 - (iii) The letters “TL” indicating that the material is toughened laminated safety glass.
 - (iv) The letters “HSL” indicating a heat-strengthened laminated safety glass.
 - (v) The letters “RPL” indicating a resin pour laminated safety glass.
 - (vi) The letters “OCG IN” indicating organic-coated glass. The marking shall be under the organic coating, the letters “IN” indicating the side of the material which is not to be exposed to the elements.
 - (vii) The letters “OBM” indicating organic-backed mirror.
 - (viii) The letter “OBPG” indicating organic-backed painted glass.
 - (ix) Any combinations of the above letters, e.g. “TRPL” indicating toughened resin-poured laminated glass.

Where non-permanent marking is used it shall be of a type that remains legible until examined by the appropriate authorities, that can be removed and that will self-destruct when removed.

NOTE An example of a trademark for a 10 mm thick laminated heat strengthened, Grade A safety glazing material by ABC company is as follows:

HSL ABC Co. To AS 2208 — GRADE A — 10

Where provided, a statement of conformance to this document on a product, or on packaging or promotional material related to that product, shall be verifiable.

1.7 Vents

Toughened safety glass shall be free from vents exceeding 2 mm in length. Toughened safety glass shall also be free of any cracks or vents extending from tong marks towards the interior of the glass.

NOTE 1 A vent is a minute crack which may be induced during the toughening process.

NOTE 2 The production of small indentations (tong marks) close to the edge of sheets of toughened safety glass is a feature inherent in some manufacturing processes and the presence of such marks is permissible except as specified above.

Section 2 Dimensional specifications

2.1 General

This section sets out the required thickness, size tolerance, squareness of rectangular panels and flatness of panels for safety glass in order to conform to this document.

NOTE Prior to furnacing, toughened safety glass should be finished to a minimum standard whereby all edges are arrised. Arrised edges are formed by grinding a chamfer or bevel approximately 1 mm wide on all sharp edges and corners.

2.2 Thickness requirements

2.2.1 General

Glass thickness shall be determined in accordance with [Appendix C](#).

2.2.2 Standard nominal thickness of safety glass

Safety glass, as specified in this document, refers to safety glass having a standard nominal thickness in accordance with [Table 2.1](#).

2.2.3 Non-standard thickness of glazing material

Thicknesses of safety glass other than those specified in [Table 2.1](#) may be utilized, but shall meet all other relevant test requirements of this document. For glass that does not satisfy the thickness tolerances for the standard nominal thickness specified in [Table 2.1](#), the minimum glass thickness shall be marked.

NOTE 1 The use of non-standard thickness will require interpolation to satisfy the requirements of AS 1288.

Table 2.1 — Thickness limits for standard nominal thickness of glass

millimetres

Type of glass	Standard nominal thickness	Glass thickness limits	
		Minimum	Maximum
Toughened glass	3	2.8	3.2
	4	3.8	4.2
	5	4.8	5.2
	6	5.8	6.2
	8	7.7	8.3
	10	9.7	10.3
	12	11.7	12.3
	15	14.5	15.5
	19	18.0	20.0
	22	20.8	23.2
	25	23.5	26.5

Table 2.1 (continued)

Type of glass	Standard nominal thickness	Glass thickness limits	
		Minimum	Maximum
Laminated glass, including annealed, toughened and heat-strengthened laminated glass	5	4.6	5.4
	6	5.6	6.4
	8	7.6	8.4
	10	9.6	10.4
	12	11.6	12.4
	16	15.4	16.6
	20	19.4	20.6
	24	23.4	24.6
Toughened patterned glass	3	2.5	3.9
	4	3.5	4.5
	5	4.5	5.5
	6	5.5	7
	8	7.0	9.0
	10	9.0	11
	12	10.5	13.5

NOTE 1 Glass thickness limits specified for laminated glass exclude interlayer thickness; e.g. 6 mm applies to 6.38 mm, 6.76 mm, 7.52 mm, etc. The thickness of the interlayer (which itself has a thickness tolerance of ± 0.03 mm per 0.38 mm interlayer) should be added, including the interlayer e.g. 6.38 mm = 2.8 + 0.35 + 2.8 = 5.95 mm minimum and $3.2 + 0.41 + 3.2 = 6.81$ mm maximum.

NOTE 2 An increased interlayer thickness may be needed due to manufacturing limitations.

NOTE 3 Excluding the interlayer, add the individual components for laminated glass. The maximum and minimum thicknesses as appropriate should be used.

NOTE 4 For glass which does not satisfy the thickness tolerance for standard nominal thickness specified above, the minimum glass thickness may be used to determine the standard nominal thickness in accordance with the glass thickness limits. For example, for a maximum thickness 6.9 mm and a minimum thickness 5.1 mm, mark as 5 mm.

2.3 Size tolerance requirements

Tolerance on sizes for all safety glass shall be as specified in [Table 2.2](#).

Table 2.2 — Size tolerance for glass of standard nominal thickness

millimetres

Standard nominal thickness	Tolerance limits			
	Non-patterned		Patterned	
	< 1200	≥ 1200	< 1200	≥ 1200
3	±2	±2	±3	±4
4	±2	±2	±3	±4
5	±2	±2	±3	±4
6	±2	±2	±3	±4
8	±2	±2	±4	±5
10	±2	±3	±4	±5
12	±2	±3	±4	±5
15	±2	±3	—	—
19	±2	±3	—	—

Table 2.2 (continued)

Standard nominal thickness	Tolerance limits			
	Non-patterned		Patterned	
	< 1200	≥ 1200	< 1200	≥ 1200
25	±2	±3	—	—

NOTE For non-standard glass thicknesses, interpolation is needed.

2.4 Squareness of rectangular panels

The squareness of rectangular panels shall be such that the difference between the two diagonals does not exceed 5 mm for panels where the largest dimension is less than 1200 mm, and 10 mm for all other panels.

2.5 Flatness requirements

2.5.1 General

The flatness of panels shall be within the following limits:

- (a) *Localized warp* — 1.0 mm over any 200 mm span.
- (b) *Overall bow and warpage* — As specified in [Table 2.3](#).

Flatness measurements shall be checked against a straightedge with the panel standing within 5° of vertical and horizontal measurement.

Table 2.3 — Flatness limits for glass of standard nominal thickness

millimetres

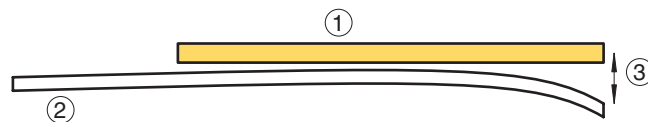
Standard nominal thickness	Bow		
	0 to 1500	1501 to 3000	3001 to 5000
3	1 in 200	1 in 150	—
4	1 in 200	1 in 150	—
5	1 in 300	1 in 200	1 in 200
6	1 in 350	1 in 250	1 in 200
8	1 in 400	1 in 300	1 in 250
10	1 in 400	1 in 300	1 in 250
12	1 in 400	1 in 300	1 in 250
15	1 in 400	1 in 300	1 in 250
19	1 in 400	1 in 300	1 in 250
25	1 in 400	1 in 300	1 in 250

NOTE For non-standard glass thicknesses, interpolation is needed.

2.5.2 Flatness requirements for edge kink

The leading and trailing edge kink shall be no greater than 0.20mm for all thicknesses of heat-treated glass.

Edge kink shall be measured using a steel ruler and a feeler gauge on the leading and trailing 300 mm of glass parallel to the direction of travel. See [Figure 1](#) for an example of the measurement of edge kink.

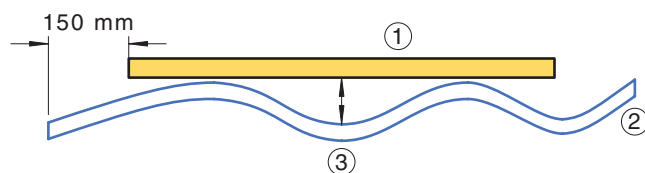
**Key**

- 1 Steel ruler
- 2 Toughened safety glass
- 3 Edge kink

Figure 1 — Measurement of edge kink**2.5.3 Flatness requirements for roller wave**

Roller wave shall be not greater than 0.15 mm for all thicknesses of heat-treated glass, excluding 150 mm from all edges.

Roller wave shall be measured using a three-point contact gauge in accordance with ASTM C1651 or with a steel ruler and feeler gauge. See [Figure 2](#) for an example of the measurement of wave or roller wave distortion.

**Key**

- 1 Steel ruler
- 2 Toughened safety glass
- 3 Roller wave distortion

Figure 2 — Measurement of wave or roller wave distortion

Section 3 Test requirements

3.1 General

Glazing materials shall be classified as Grade A safety glazing materials if they satisfy the relevant impact test performance requirements (or fragmentation test for toughened glass), in addition to the applicable tests listed in [Table 3.1](#).

An impact or fragmentation test shall be carried out for toughened safety glass.

A uniformity and surface compression test in accordance with [Appendix I](#) shall not be used as a substitute for an impact or fragmentation test of toughened safety glass.

Table 3.1 — Testing for safety glazing materials

Test	Glazing type (flat and curved glass)					
	Flat and curved laminated safety glass	Flat and curved toughened safety glass	Flat and curved heat-strengthened and toughened laminated safety glass	Resin pour laminated safety glass	Organic-backed safety glass	Organic-backed safety mirror and painted glass
Impact (see Clause 3.2)	X	X	X	X	X	X
Fragmentation (see Clause 3.3)	—	X	—	—	—	—
Boil (see Clause 3.4)	X	—	X	X	—	—
Weathering (see Clause 3.5)	—	—	—	—	X	—
Ageing (see Clause 3.6)	—	—	—	—	—	X
X indicates test to be conducted.						
NOTE The boil test for heat-strengthened and toughened laminated glass may use laminates from ordinary annealed glass manufactured simultaneously.						

3.2 Impact test

3.2.1 Test specimens

Test specimens shall be prepared in a manner representative of typical installation practice. For example, if a safety organic-coated glass is used, the coating shall be applied to the test specimen in a manner that is representative of typical application (that is, confined within the visible sight lines only).

3.2.2 Orientation of test specimens

For symmetric material, the impact test shall be carried out by impacting on either face. Symmetric material is any material symmetric about the geometric centre plane through its thickness, including toughened glass and some laminated glass.

For asymmetric material, the classification shall be based on impact test results for impact on the face that is shown to give the worst performance. Asymmetric material is any material not symmetric about the geometric centre plane through its thickness, including laminated glass with mixed glass types or thicknesses.

3.2.3 Test procedures

Flat Grade A glazing material tested in accordance with [Appendix D](#), or curved Grade A glazing material tested in accordance with [Appendix J](#), shall —

- (a) not break at a drop height of 300 mm; or
- (b) shall meet the requirements for breakage given in [Appendix D](#).

If breakage does not occur at 300 mm, the drop height shall be progressively increased to 450 mm, 600 mm, 750 mm, 900 mm, 1200 mm and 1500 mm. If breakage occurs in a manner that does not meet the requirements for breakage as given in [Appendix D](#), it shall not be classified as Grade A. In the event of the glazing material not breaking, a centre-punch with sufficient force shall be used to deform or break the glazing material and examine the fracture pattern in accordance with [Appendix D](#).

3.3 Fragmentation test

A sample which conforms to the minimum particle count specified in [Table 3.2](#) shall be deemed to meet the requirements for Grade A safety glazing materials specified in [Clause 3.1](#). Flat safety glazing material shall be tested in accordance with [Appendix E](#). Curved safety glazing material shall be tested in accordance with [Appendix K](#).

Table 3.2 — Fragmentation test — Minimum particle count

Nominal glazing material thickness mm	Minimum number of particles per square of 50 mm side
3	30
4	30
5	40
6	40
8	40
10	40
12	40
15	30
19	30
22	30
25	30

3.4 Boil test

When tested in accordance with [Appendix F](#), the glazing material may crack. The glazing material shall be classified as Grade A if no bubbles or other defects develop more than 12 mm from the edge of the test specimen or from any cracks that have developed.

Any test specimen which cracks to an extent that the results are not clear, shall be discarded. Another specimen shall be tested in its stead.

3.5 Weathering test

3.5.1 Safety organic-coated glass

Safety organic-coated glass, when tested in accordance with [Appendix G](#), shall have —

- (a) an adhesion value, when exposed to weathering, of not less than 90 percent of the adhesion value when not exposed to weathering; and