

Defects and Tolerance Guidelines and Glass Characteristics

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Architectural Windows & Doors follows the Australian Standards; Manufacturer's Warranty and QBCC Standards and Tolerances Guide to determine whether a product should reasonably be considered defective. The following information has been compiled from relevant excerpts from these sources.

How to check for blemishes Source: QBCC

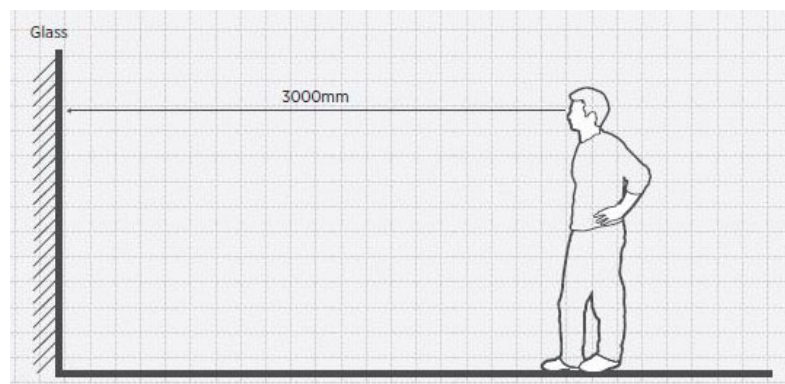
1. Clean the glass in accordance with manufacturers recommendations 2. Stand in the room no less than 3 metres away from the glass and look directly through it. Glass must be viewed at 90 degrees to the window. a. Inspect the glass in natural daylight, but not looking directly towards the sun and with no visible moisture on the surface of the glass. b. Where it is not possible to stand at the correct distance then stand as far away as you can from the glass. c. Exclude 50mm wide band around edge of the glass from the check when viewing IGUs. What to expect when viewed as described While AS4667 is the definitive reference, generally flat transparent glass, including laminated or toughened or coated glass is acceptable if;

- There are no bubbles in the glass greater than 5mm in diameter.
- A panel of glass contains one bubble between 1mm and 5mm in diameter per 1.6m x 1.6m of area.
- There are bubbles smaller than 1mm in diameter.
- Scratches should not be visible from 3m or more.

Section 1.4 Viewing and inspecting distances

Generally, variations in the surface colour, texture and finish of walls, ceilings, floors and roofs, and variations in glass and similar transparent materials are to be viewed where possible from a normal viewing position. A normal viewing position is looking from a distance of **1.5m** or greater (**3m for glass**) with the surface or material being illuminated by "non-critical light". "Noncritical light" means the light that strikes the surface is diffused and is not glancing or parallel to that surface. Slight variations in the colour and finish of materials do not constitute a defect.

FIGURE 1.4 NORMAL VIEWING POSITIONS

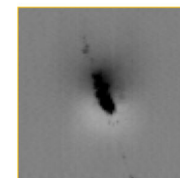


TYPICAL DEFECTS IN FLOAT GLASS PRODUCTION

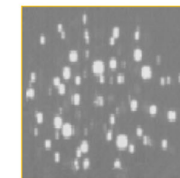
Bubble



Inclusion



Tin Defects



Ream



REFER TO TABLE 4; TABLE 5.5 FOR ALLOWABLE IMPERFECTIONS

Section 18.3 Glazing

Within the first 12 months from completion of the work, scratches, fractures, chips or other blemishes on glazing and mirrors are defects if they are caused by the contractor and can be seen from a normal viewing position as per Figure 1.4. Glass shall be inspected in a vertical position at an angle perpendicular (90 degrees) to the surface under natural day lighting conditions, the glass shall not be in direct sunlight during the inspection. Imperfections such as scratches, scars and rubs shall not be visible from a distance of 3 metres and the maximum allowable imperfections shall be in accordance with AS 4667 Quality Requirements for Cut-to-size and Processed Glass.

Refer to the AS4667 / AS4666 Tables on Pages 3 & 4 for more information about defects



The Appearance of Haze in Glass Products *Source: Viridian Glass*

Not all light which enters a piece of glass is able to pass directly through. Some of it is absorbed and some is scattered by components within the glass. If sufficient light is scattered then it will appear as a haze in the glass. The visibility of this haze will depend on the surrounding conditions. If sunlight is striking the glass directly then this intense strong light source will require very little of the light to be scattered before it is bright enough to be visible as haze. If the glass is in shadow then it is subject to reflected light from the surrounding environment. As the light intensity is much lower than direct sunlight the haze is much less noticeable. The brightness of the background also has an important impact on the visibility of any haze. A bright background will reflect a lot more light than a dark background. The brightness from a light background can be sufficient to drown out the haze which will make it appear less visible. A darker background will make any haze appear more visible.

A glass panel which is partially shaded may appear to show haze in the non-shaded region but not in the shaded region. The degree of light scatter in both regions is the same as a percentage of the light passing through the glass in each region but the light intensity in the non-shaded region is much higher than the shaded region so the haze is much more noticeable in the non-shaded region. It is quite possible for a glass product to exhibit haze at one time of the day and not at another as it is possible for the same type of glass to exhibit haze in one building and not in another. Haze is a characteristic which is a consequence of the materials used. It will not change.

The following products may exhibit haze under the right light conditions:

EnergyTech™ SolTech™ EVantage™ ComfortPlus™ SmartGlass™ Enviroshield Performance VLam™ and any products which are made up using these products as components, such as double glazing. Be careful when selecting product which is being offered as having a particular haze level or less haze than a competing product.

Thermal Breakage *Source: National Glass*

Thermal breakage occurs where annealed glass breaks due to excessive temperature differences between the centre and the edges of the glass. In this situation while the centre of the glass starts to warm and expand, the edges remain cool thus restricting the expansion, resulting in breakage. Wired, tinted, reflective, low-E coated glass and IGU's are most susceptible to thermal breakage. Toughening or heat strengthening will prevent thermal breakage.

Factors Influencing Thermal Breakage

Climate: Consideration should be given to minimum and maximum daytime temperature differences. Breakages can occur, for example with morning temperature rises where the glass can heat up quickly while the edges remain cool. **Edge quality:** Annealed glass edges should be clean cut with minimal defects. Thermally suspect laminated glass should have edges flat ground. **Panel size and thickness:** The chances of thermal breakage increase as the area of glass and thickness increases because of potential cutting, glazing and handling problems. Any damage introduced to the edge at these stages can impact adversely on the thermal safety of the panel. **Edge cover** The chance of breakage increases with edge cover over 40mm.

Glazing material: Dark coloured materials will promote fewer edge temperature differences than light coloured frames. Concrete and wood have a higher thermal breakage factor than metal or plastic frames. **External shading devices:** External shading devices, building overhangs and mullion or column depth which may cast unfavourable shadows will increase the possibility of breakage. **Internal shading and back-up material:** Confined spaces can create excessive heat build up. Light coloured blinds or venetians which reflect heat have a higher thermal breakage factor than dark coloured ones. If there is a gap of 50mm or more around the perimeter of the internal shading device, the glass is considered ventilated and a lower breakage factor is applied. In confined spaces such as spandrel glass applications, the glass may be exposed to temperatures as high as 70°C. **Cooling and heating sources:** Direct air streams from these sources onto the glass surface can create excessive temperature differences with resultant breakages. **IGU's or double glass units:** Multiple panel glazing creates higher thermal stress on the outside pane. Thus in certain situations, this pane may have to be heat strengthened or toughened. **Film application:** Application of film products, paper, posters or paint will increase the possibility of thermal breakage.

It is recommended that a **thermal assessment** be carried out to determine the level of stress and/or the possibility of breakage. Thermal breakage is not covered by the manufacturer's warranty. Consult our sales staff for more information.

AS 4667:2000 (R2016)
TABLE 4
**GLASS QUALITY - MAXIMUM ALLOWABLE IMPERFECTIONS
FOR THICKNESSES 6.0mm OR LESS**


Blemish Type	Blemish size and limit of frequency							
	Types 1 and 2		Types 4 and 6		Type 7		Types 3 and 5	
Bubbles and inclusions	Up to 2.5 m ²	Over 2.5 m ²	Up to 2.5 m ²	Over 2.5 m ²	Up to 2.5 m ²	Over 2.5 m ²	Up to 2.5 m ²	Over 2.5 m ²
< 1.0mm	1	2	2	2	2	4	2	4
1.0 mm - 5.0 mm	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
< 5.0 mm	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Stains	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Scratches, scars and rubs	Refer Clause 9.2.5							
Ream and other linear distortion	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Edge quality	Max, size equal to glass thickness			Nil	Nil	Nil	Nil	Nil
* shells / flanges	Nil	Nil	Nil					
* broken corner and corners on/off	Nil	Nil	Nil					
* vented edges	Nil	Nil	Nil					
* shark's teeth	Less than 100% of glass thickness with no venting			Nil	Nil	Nil	Nil	Nil
Surface vent	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Surface blisters	Nil	Nil	> 15mm - Nil (6 to 15 mm) - 1 (3 to 6mm) - 4 (not clustered)	> 15mm - Nil (6 to 15 mm) - 2 (3 to 6mm) - 6 (not clustered)	> 15mm - Nil (6 to 15 mm) - 1 (3 to 6mm) - 4 (not clustered)	> 15mm - Nil (6 to 15 mm) - 2 (3 to 6mm) - 6 (not clustered)	Nil	Nil
Process surface imperfections	Refer Clause 9.2.4							

NOTES:

1. Glass greater than 6.0 mm in thickness may contain proportionally more and larger imperfections.
2. Heat-strengthened and toughened glass may be subjected to spontaneous fracture due to the presence of inclusions such as nickel sulphide, silicones, and the like even when such inclusions are smaller than those allowed in the table above. Manufacturers apply proprietary testing methods to minimize the presence of such inclusions.
3. Linear interpolation as defined in AS 1288 shall apply for non-standard thicknesses.

Clause 9.2.4 Process surface imperfection	Place specimen in a vertical position at a distance of approximately 1m from a brick wall or similar background showing straight lines. Look through the sample at a distance of 1m from the sample using daylight without directly sunlight or with background light suitable for observing each type of surface imperfection. View the sample at an angle of not less than 30° (vision interference angle). The line of vision shall be perpendicular to the wall. The cleaned glass should be supported in a vertical position 900 mm in front of a well-lit background. The sheet should then be inspected by an observer, in a direction perpendicular on its surface. Tile imperfections shall not be visible from a distance of 3m.
Clause 9.2.5 Scratches, scars and rubs	Inspect the glass held in a perpendicular position using daylight without direct sunlight, or with a background light suitable for observing any imperfections. Imperfections shall not be visible from a distance of 3m.

AS 4666:2012
TABLE 5.5
**ALLOWABLE SURFACE IMPERFECTIONS AND INCLUSIONS FOR
 GLASS UP TO 12mm NOMINAL THICKNESS INTENDED FOR USE IN
 RESIDENTIAL INSULATING GLASS UNITS**

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IGU size mm (Up to)	Central primary vision zone mm	Ream		Scars		Bubbles		Seeds		Scratches	
		Primary mm	Secondary mm	Primary mm	Secondary mm	Primary mm	Secondary mm	Primary mm	Secondary mm	Primary mm	Secondary mm
500 x 350	500 x 350	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
750 x 550	650 x 500	Nil	Nil	Nil	Nil	Nil	1 x 0.3	Nil	Nil	Nil	Nil
1000 x 700	900 x 600	Nil	Nil	Nil	Nil	Nil	1 x 0.3	Nil	1 x 0.3	Nil	1 x 50 x 0.75
1250 x 900	1100 x 750	Nil	Nil	Nil	1 x 3	1 x 0.3	2 x 0.3	Nil	1 x 0.3	1 < 50 x 0.5	1 x 50 x 0.75
1500x 1000	1300 x 850	Nil	Nil	Nil	1 x 3	1 x 0.3	2 x 0.3	Nil	1 x 0.3	1 < 50 x 0.5	1 x 50 x 0.75
2000 x 1200	1800 x 950	Nil	Nil	Nil	1 x 5	1 x 0.3	2 x 0.5	Nil	1 x 0.5	1 < 50 x 0.5	1 x 75 x 0.75
2500 x 1500	2200 x 1200	Nil	Nil	Nil	1 x 5	1 x 0.3	3 x 0.5	Nil	1 x 0.5	1 < 75 x 0.5	1 x 75 x 0.75
3000 x 1800	2700 x 1500	Nil	Nil	Nil	2 x 5	2 x 0.5	4 x 0.5	Nil	2 x 0.5	1 < 75 x 0.5	1 x 75 x 0.75
3500 x 2500	3000 x 2000	Nil	Nil	Nil	2 x 5	3 x 0.5	4 x 0.5	Nil	2 x 0.5	1 < 75 x 0.5	1 x 75 x 0.75

NOTES:

- Scratches to the primary vision area are unacceptable if visible from a distance of 3m. If detailed inspection is required, glass shall be viewed in a perpendicular position using a daylight background. Glass panes requiring this degree of inspection should not be viewed when they are standing in direct sunlight and the viewing period should not be more than 60 seconds.
- For all coated glass types individual pin holes up to 1.5 mm in diameter are acceptable. In secondary vision areas, individual pinholes up to 2 mm are acceptable. The maximum number of pinholes allowed for panes up to 3m² of glass is three pinholes, separated by a minimum distance of 500 mm. For each 1 m² of glass over this area one extra pinhole is allowed. A single cluster of pinholes may exist in the secondary vision area providing it consists of no more than five pinholes of less than 0.75 mm in diameter that are not visible from a distance of 3 m. If detailed inspection is required, glass shall be viewed in a perpendicular position using a daylight background. Glass panes requiring this degree of inspection are not to be viewed when they are standing in direct sunlight and the viewing period shall not exceed 60 seconds.
- Measurements of fault sizes are recommended to be performed using a PEAK LUPE seven times magnifier or equivalent.
- Accumulative fault conditions apply to any given glass size, i.e. 1000 mm x 700 mm may contain 1 mm x 3 mm seed, plus one 50 mm x 0.75 mm scratch to the secondary vision area whilst also containing one by less than 50 mm x 0.5 mm scratch to the primary viewing area.
- For units exceeding 3500 mm x 2500mm, the primary vision zone rests 300 mm from all four edges and acceptable fault conditions shall remain the same as for 3500 mm x 2500 mm size units.

Glass Types (refer AS4667 Table 4)

Type 1	Annealed glass, clear or tinted (heat absorbing) - general glazing, and multi-glazing, quality.
Type 2	Toughened glass, including toughened safety glass, clear or tinted (heat absorbing) - general glazing and multi-glazing quality.
Type 3	Laminated glass, including laminated safety glass, clear or tinted (heat absorbing) - general glazing and multi-glazing quality.
Type 4	Patterned annealed glass - general glazing and multi-glazing quality.
Type 5	Patterned laminated glass - general glazing and multi-glazing quality.
Type 6	Patterned, toughened glass - general glazing and multi-glazing quality.
Type 7	Wired, clear or tinted glass - general glazing and multi-glazing quality.