

Technical Bulletin

1008 – Inspection of Glass Defects

August 2024 V2.0

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Cited national standards:

AS/NZS 4667:2000 Quality Requirements for cut to size and processed glass

AS 4666:2012 Insulating Glass Units

AS 2208:2023 Safety glazing materials in buildings

Introduction

Glass for buildings supplied and installed in Australia is almost exclusively manufactured using the float process and is known as float glass. This process results in extremely flat surfaces with few imperfections. This glass can then cut/drilled/polished/tempered/laminated/made into an insulated glass unit or a combination of all to result in the end product.

Customer Expectations

Most customers expect glass to be perfect; free of any marks/scratches/bubbles etc. and completely transparent. However, glass is handled multiple times from the initial float process to installation on site, imperfections may occur. This technical bulletin serves to help customers and consumers understand what is considered an allowable defect based on relevant Australian Standards used by the glass industry and how to inspect glass once installed.

Relevant Quality Standards

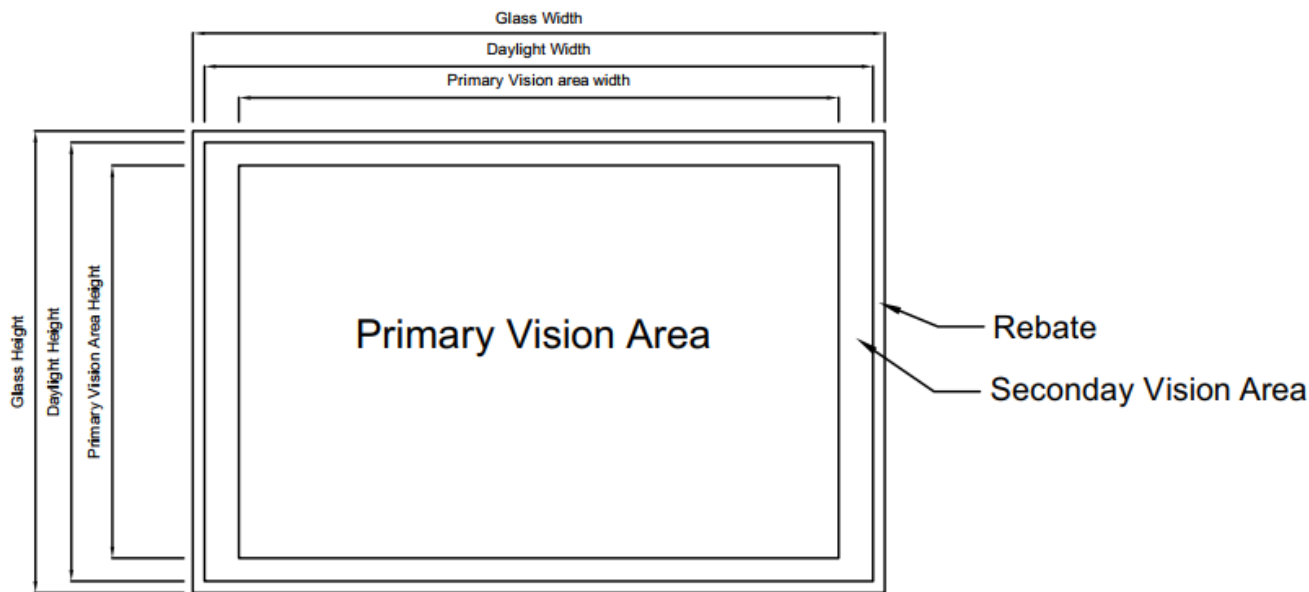
AS/NZS 4667 is the applicable standard for individual panes of glass, whereas AS 4666 is applicable to insulated glass units only. An IGU will be manufactured to both standards, the glass panes themselves to 4667 and the construction/composition the IGU to 4666. Both of these standards are production standards for use by glass processors. They do have inspection criteria, which are specifically to be undertaken in controlled conditions inside the factory before glass is despatched to site. Safety glass for use in buildings must also be manufactured to AS 2208, which does include allowable criteria for distortion caused by furnacing of glass.

This technical bulletin will include guidance on how to inspect glass on site, based on these criteria.

Inspection of glass defects after installation

Glass inspection should be carried out as early as reasonably practical following installation or supply. Prior to inspection, ensure glass is cleaned in accordance with manufacturer’s recommendations, the surface of the glass is free of moisture and glass is being examined in natural daylight but not in direct sunlight.

During inspection, glass inside the rebate (frame around the edges) is ignored as it is hidden from view by the frame. The visible glass size is referred to the daylight size and is split into two areas: Primary and Secondary vision areas. The secondary vision area is defined as an outer strip forming 10 to 15% of the total daylight size as per AS 4666 tables 5.5 and 5.6. The remaining central section of the glass is the Primary vision area.



- 1. View glass from a distance of 3m inside the room whilst facing square on to the glass.
- 2. Maximum viewing time of 60s.
- 3. Any scratch or bubble visible in the primary vision area following points 1 and 2 above is a defect.

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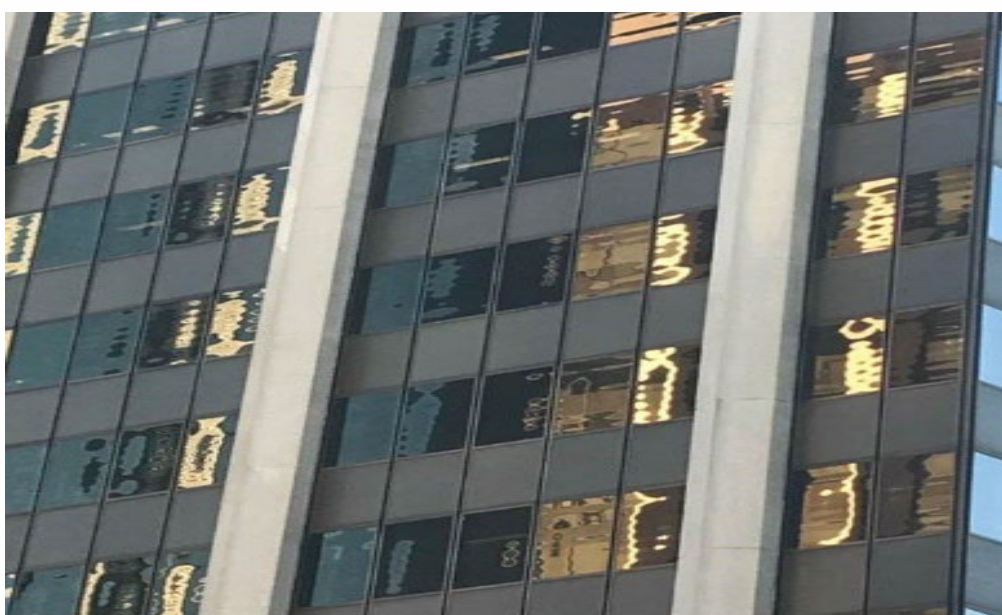


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Roller Wave

To temper glass in a furnace, glass is moved into the furnace itself by means of mechanised rollers, much like a conveyor belt. The glass is then heated to temperatures in excess of 600°C and becomes soft. The glass is still resting on the rollers at this point, so it takes on a slight wave like shape. It is then cooled down or 'quenched' by large fans in a separate compartment whilst still on said rollers. As the glass is now cooled, it will retain the wave pattern and is no longer as flat as it was before being in the furnace. Roller wave is more noticeable on reflective or darkly tinted glass. A maximum of 0.15mm between peak and trough is permitted and must be measured with a calibrated steel ruler and feeler gauge set.

NOTE, when orientated vertically roller wave can be much more noticeable when walking past the glass panes. However, vertical roller wave is not considered a defect. Glass processors do our best to orient glass the correct way on the furnace bed to avoid this, but often we are given two dimensions instead of specific height x width by our customers who are not aware of the implications of roller wave.



Roller wave is most visible on reflective glass

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Edge Kink

Edge kink is similar in appearance and cause to roller wave, but only occurs at the edge of tempered glass. As with roller wave mentioned previously, edge kink is more noticeable in reflective or darkly tinted glass, and has an allowable maximum of 0.2mm. It must also be measured with a calibrated steel rule and feeler gauge set.

Other glass allowances for imperfections

AS 4666 and AS/NZS 4667 contain allowable tolerances for flatness, squareness, length & width vs original order sizes and depth of IGU secondary seal. Most of the following defects/tolerances are difficult to measure once installed.

Flatness for single glazed glass

Thickness	Horizontal dimension		
	0-1500	1501-3000	3001-5000
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

Flatness for double glazing

Thickness	Horizontal dimension		
	0-1500	1501-2500	>2501
3	1 in 500	1 in 500	N/A
4	1 in 500	1 in 500	1 in 575
5	1 in 750	1 in 500	1 in 575
6	1 in 750	1 in 625	1 in 575
8	1 in 1000	1 in 625	1 in 700
10	1 in 1000	1 in 850	1 in 700
12	1 in 1000	1 in 1000	1 in 875

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Squareness for single glazing

For all glass with the longest edge equal to 1200mm or less, a maximum of 5mm difference is permitted between diagonal measurements. For glass with its longest edge longer than 1200mm, a maximum of 10mm difference is permitted.

Squareness for double glazing

Longest edge	Max. difference in diagonals
0-500	2mm
501-1500	4mm
1501-2500	6mm
<2501	8mm

Height & width tolerances for single glazing

Glass type	Thickness	Length	Tolerance
Mono T	0-6mm	ALL	+/- 2mm
	8-25mm	ALL	+/- 3mm
Annealed	0-6mm	ALL	+/- 2mm
	8-25mm	ALL	+/- 3mm
Patterned	0-6mm	<1200	+/- 3mm
	8-12mm	<1200	+/- 4mm
	0-6mm	>1200	+/- 3mm
	8-12mm	>1200	+/- 4mm
Laminate	ALL	<1200	+/- 2mm
	<10mm	>1200	+/- 2mm
	>10mm	>1200	+/- 3mm

Height & width tolerances for double glazing

As per single glazing but with the following additional requirements for relative dimensions of each pane;

- Residential units with 0-6mm thick glass panes +/- 1mm
- Residential units with 8mm or thicker glass panes +/- 1.5mm
- Commercial units with all glass thicknesses +/- 1.5mm

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IGU sealant dimensions & spacer bar alignment

AS 4666 permits a minimum sealant depth of 4mm, measured in from the edge of the glass. In addition to this, a small variation in spacer depth is also permitted, provided the minimum 4mm of sealant is present. This is +2.0/-1.0mm, and is measured from the inside edge of the spacer at the corners of the unit.

What is not considered a defect?

There are multiple phenomena that occur as a result of manufacturing processes and are not considered to be defects. These phenomena do not occur every time and can be minimised or prevented by avoiding specific glass types & compositions on a situational basis. Contact AGG for further assistance. These phenomena are listed & explained below

- Anisotropy
- Haze
- Brewster's Fringes
- Newton's Rings
- Preferential Wetting
- Vertical roller wave

Anisotropy

Anisotropy is when the surface of glass appears to have light and dark patches when polarised light is reflected from it. It is caused by the tempering process and is most commonly noticeable when wearing polarised sunglasses or in specific lighting conditions. Anisotropy is an inherent property of tempered glass and therefore is not considered a defect. The effect can also be more noticeable in an IGU with multiple panes of tempered glass.



Anisotropy

Page 6

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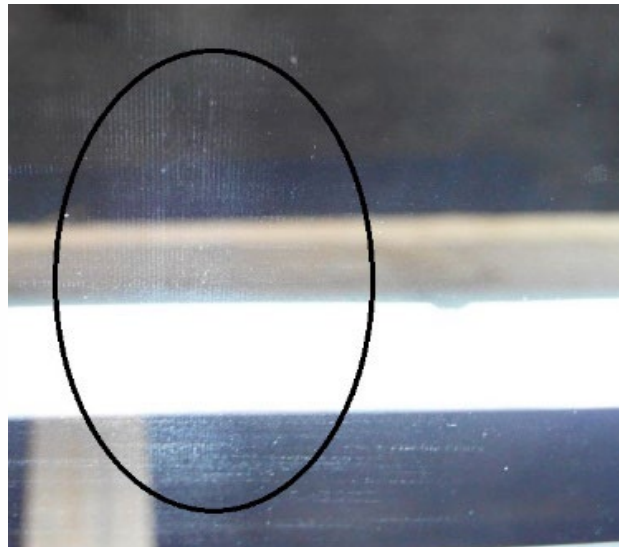
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Haze

Haze is a light milky visual appearance in the glass when visible light contracts the glass. Most of this light passes through the glass, the rest is either reflected, absorbed or scattered. If enough light is scattered then the glass will have a light, milky appearance. Haze is present in all forms of glass, but is not noticeable to the human eye in clear glass.

Haze can be noticeable on coated glass and with both clear and coloured laminates. Local lighting conditions compared to background lighting also contribute to how visible haze will be. Haze can appear blue with some LowE coatings and is very dependent on light intensity and the angle at which light hits the glass. As such, haze can be visible during some times of the day but not others. As haze is an inherent property of all transparent material, it is not considered as a defect.



An example of haze

Brewster's Fringes

Much like Newton's Rings, Brewster's Fringes are the result of light reflecting off glass. However, they are not caused by glass deflecting, rather by multiple light sources from different angles. As such, they present as rainbow lines but with a much more random pattern than what is seen in Newton's Rings. They are not considered a defect as they are caused by foreign light sources.

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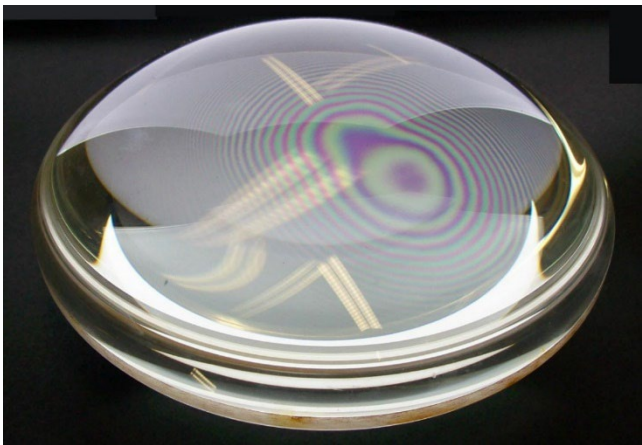


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Newton's Rings

An IGU is a flexible pressure vessel and under the right conditions the difference between the air (or gas) pressure inside and outside the IGU can cause both glass panes to deflect towards each other. When they get quite close, rainbow patterned circles can appear on the glass surface, centred on where the gap between the panes is the smallest. These patterns are caused by the varying refraction angles in the surfaces of the glass panes, and is not considered a defect. They can also occur under specific wind pressures. The chance of Newton's rings occurring is reduced by specifying thicker glass, which lowers deflection in each glass pane.



An example of Newton's Rings

Preferential Wetting

Preferential wetting is a side effect of using certain lifting aids such as vacuum suckers to move glass panes, and becomes visible when the glass is wet. These devices do not leave a residue on the glass but do change the surface conditions. This alters the amount of friction available on that spot and alters how water behaves when in contact with the glass. These patterns fade over time and do not change the performance of the glass. They are not considered a defect.

Multiple Reflections

Every glass pane will reflect a certain amount of light that touches it, how much is determined by the glass type such as tinted, coated or reflective glass. When looking through a double glazed unit, there will be two reflections. This is most noticeable when appreciating a view of city lights from a nearby hill. Reflection and refraction are natural properties of all transparent materials and therefore are not considered a defect.

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