23 July 2019

INSULATING GLASS UNITS IN RESIDENTIAL BUILDINGS

A GUIDE TO SURFACE QUALITY STANDARDS

A guide to tolerances, materials and workmanship in new residential construction was published by the Ministry of Business, Innovation & Employment in 2015 to provide assistance to contractors and home owners who may be unsure of what constitutes a defect for the purposes of the Building Act 2004.

The guide mainly covers aesthetics issues and outlines what constitutes acceptable levels of workmanship in standard domestic construction types under normal conditions. Windows, doors and glass are covered by Section 5 of the guide.

What is considered acceptable glass quality, and what is not, is shown in the table below from page 42 of the guide:

GLASS	
✗	Glass is blemished, marked (e.g scratches, mortar, stain, paint spatter), distorts view or is poorly cut.
✗	Inconsistent tint colour or appearance across the window.
✗	The glass does not conform to the requirements set out in AS/NZS 4666:2012[29], or AS/NZS 4667:2000[30].
✗	Where designers have provided appropriate information surrounding the end location of the glazing units, including wind zones and altitude to the manufacturer, Newtons Rings and excessive visual distortion are manufacturing defects.
✓	Brewsters fringes and preferential wetting patterns are not considered a defect.

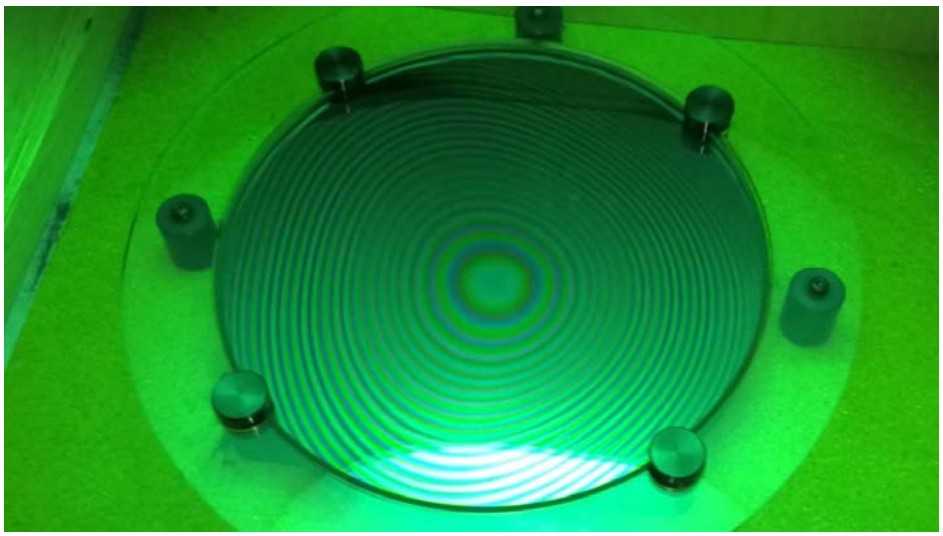
The requirements set out in AS/NZS 4666:2012 and AS/NZS 4667:2000 are summarized on the following pages.

1. DEFLECTION AND REFLECTION

Small changes in temperature and pressure can cause glass to bow outwards or inwards and change the images reflected from the window. These distortions are an inevitable consequence of the laws of physics and cannot be eliminated.

Excessive deflections are not considered a defect unless the customer has provided the end location and altitude of the glazing, and design wind pressures to Viridian Glass for design of the IGU.

2. NEWTON'S RINGS

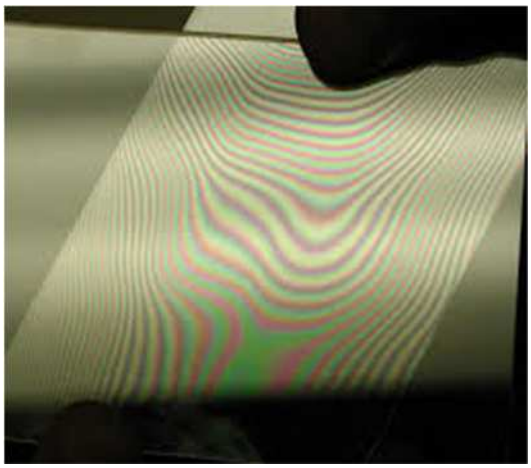


In a large IGU, the two glass panes may be displaced by air pressure until they touch in the middle. When this happens, Newton's Rings, which are roughly circular and coloured bands, may form in the centre of the unit.

Newton's Rings can easily be avoided in large IGUs by allowing cavities that are at least 12 mm wide to suit design wind pressures.

Newton's Rings are not considered a defect unless the customer has provided the end location and altitude of the glazing, and design wind pressures to Viridian Glass for design of the IGU.

3. BREWSTERS FRINGES



Under certain lighting conditions, Brewsters fringes are sometimes visible when multiple light reflections occur in IGUs of high-quality float glass panes of identical thickness (for example 4 mm float on 4 mm float from the same stock sheet).

These interference fringes are faint coloured bands of irregular shapes, and they can be located anywhere over the surface.

These fringes are not considered a defect.

4. PREFERENTIAL WETTING PATTERNS

These patterns are visible when the glass surface gets wet from rain, condensation or washing.

They are caused by manufacturing tools and equipment, and devices such as vacuum lifters and separation pads, that came into contact with the glass during manufacture, handling and installation.

Although these tools and equipment, and devices did not leave a visible residue on the glass, they have changed the surface condition, and this creates patterns on the glass surface when it gets wet.

These patterns do not affect the functionality, performance or longevity of the units, and may dissipate in time.

These patterns are not considered a defect.

5. PHOTOELASTICITY OR ANISOTROPY

The variation of stress across the surface of toughened glass from the toughening process can result in light and dark areas being visible (sometimes

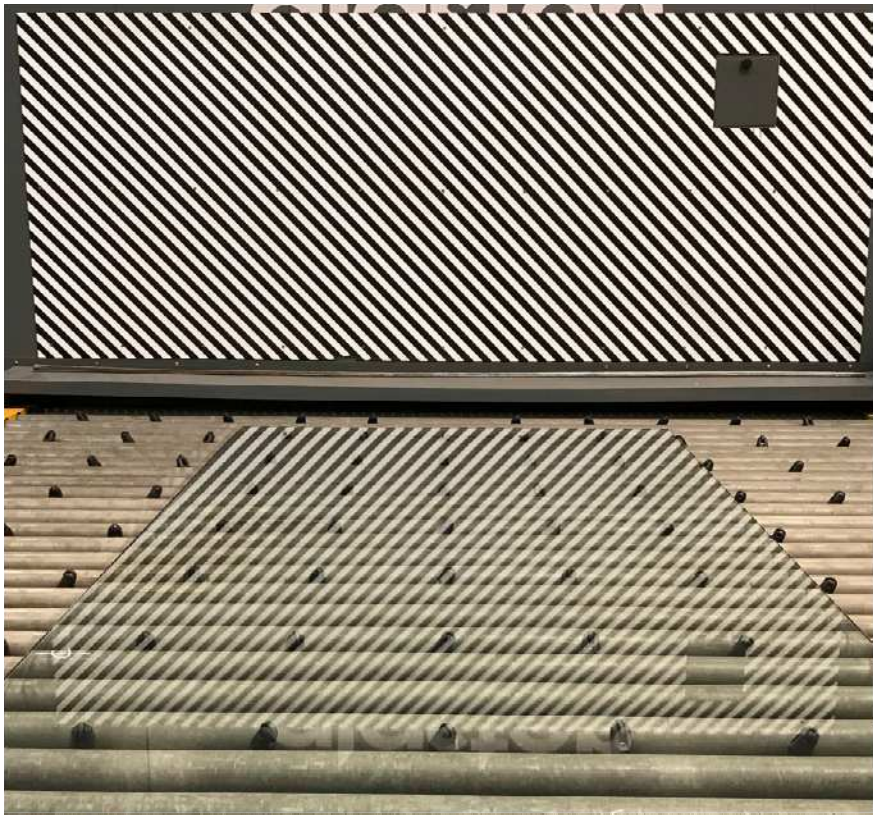
known as ‘leopard spots’) when polarised light is incident on the glass. This phenomenon is known as photoelasticity.

This photoelastic effect is an inherent characteristic of all heat-treated glass, and is more noticeable on thicker glass, coated glass, and laminated glass through polarized glasses.

This effect may be accentuated when there are two or more layers of toughened glass in an IGU.

Photoelasticity or anisotrophy is not considered a defect.

6. DISTORTION IN TOUGHENED GLASS – BOW, ROLLER WAVES AND EDGE KINK



Zebra board used for visual check of glass distortion

Glass surface distortion from bow, roller waves, and edge kink is a **normal** attribute of heat-treated toughened glass.

It distorts objects when viewed through or reflected from the glass, and it is more pronounced when viewed from an angle.

Acceptable bow limits are provided below from Table 3 of AS/NZS 4667:2000.

Glass thickness mm	Horizontal glass dimensions		
	0 to 1500	1501 to 3000	3001 to 5000
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

Bow exceeding these limits are considered a defect.

Glass distortion can be pronounced in toughened laminated glass, especially when roller waves and/or edge kinks in the two sheets of glass coincide.

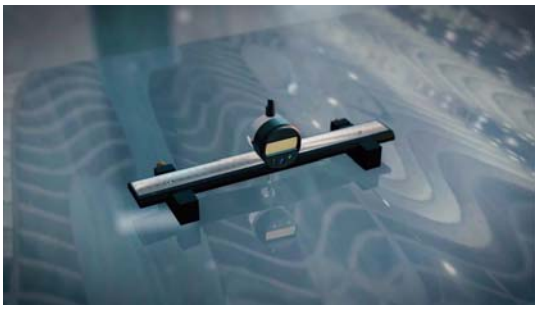
Whenever possible, heat treated glass should be installed with the roller waves positioned horizontally across the panels.

Glass distortion from roller wave and/or edge kink is not considered a defect.

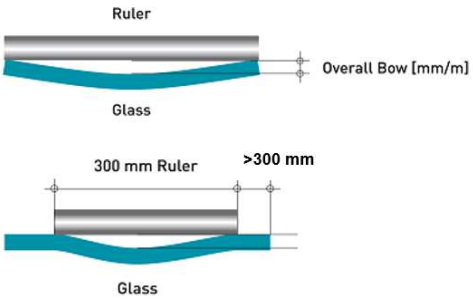
Although there are no New Zealand industry standards on roller wave and edge kink, Viridian Glass manufacturing tolerances are:

- Roller wave: 0.15 mm measured at least 300 mm from the leading or trailing edge
- Edge kink: 0.30 mm measured within 300 mm of the leading or trailing edge

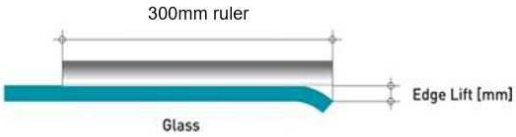
Roller wave and edge kink can be measured with a roller wave gauge, or a 300 mm steel ruler and feeler gauge as shown on the next page.



Roller wave gauge



Roller wave



Edge kink

Feeler gauge

7. SCRATCHES, BLEMISHES, MARKS AND INCLUSIONS

Allowable surface imperfections and inclusions for glass up to 12 mm thick in IGUs are provided by Table 5.5 of AS/NZS 4666:2012.

Allowable scars, bubbles, seeds and scratches from this table are provided in the next page for the primary vision zone and the periphery secondary zone.

Scratches to the primary vision area are unacceptable if visible when viewed for not more than 60 seconds in a perpendicular position from a distance of 3 m using a daylight background.

Accumulative faults apply to any given glass size.

For more information, please refer to Table 5.5 of AS/NZS 4666:2012.

Allowable Surface Imperfections for Glass up to 12mm Viewed From 3m Using a Daylight Background									
IGU size mm (up to)	Primary vision zone mm	Scars		Bubbles		Seeds		Scratches	
		Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary
500 x 350	500 x 350	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
750 x 550	650 x 500	Nil	Nil	Nil	1 x 0.3	Nil	Nil	Nil	Nil
1000 x 700	900 x 600	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	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
1500 x 1000	1300 x 850	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	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	1 x 5	2 x 0.5	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	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	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

Table 5.5 of AS/NZS 4666:2012