KEY MESSAGE

THERMAL STRESS GLASS BREAKAGE

With the increased use of thermally efficient glass products in Australia, it is becoming increasingly more common for windows to be glazed with solar control glasses that are prone to thermal problems and which, under certain conditions, could break. It is important that the industry understands what thermal stress glass breakage is and why it occurs.

Thermal breakage is not usually a fault of the glass. It occurs in many circumstances due to the conditions a pane of glass may be exposed to. Some products are more prone to thermal stress than others; this publication has been produced to help reduce the instances of thermal stress and glass breakage.

Thermal stress glass breakage is not covered by a glass supplier's warranty so it is important to understand how to avoid thermal stress glass breakage.

WHAT IS THERMAL STRESS GLASS BREAKAGE?

Thermal stress breakage occurs as a result of uneven heating in the glass. When part of the glass expands with heat and another part of the glass resists expansion because it is not being heated, stresses build up in the pane. When the stress is greater than the strength of the glass a thermal break can occur.

Typical conditions are:

- **A sunny, cold winter day.** Typically part of the window may be shaded under an overhang, behind a corner of the building, by a tree, or a neighbouring building.
- **Blinds or drapes** can reflect heat back into a sealed unit. If proper clearance between the glass and the blind is not maintained it can exaggerate this problem and overheat the glass.
- **Something placed on the inside of the window**, for example a sign or blinds, can also create the conditions to cause thermal stress to occur.
- **A hot, sunny, summer day.** This is less common but can occur especially if heat is being reflected back through the window by blinds or drapes.
- **Cool Cold mornings.** The centre of the glass absorbs the heat, the edge is cold.

Thermal stress is most commonly seen in glass that absorbs and retains heat, such as Low-E glass, tinted glass, and sometimes reflective glass when the coating is on the #2 side. Tempered/ toughened and heat strengthened glasses are resistant to thermal stress.

GLASS STRENGTH AND LIKELIHOOD OF THERMAL BREAKAGE

Different glass products have different tolerances to thermal stress. Some products are far more likely to break due to thermal stress. It is important to assess the likelihood of thermal stress when selecting glass types for use. The below information will help make a decision as to the likelihood of a problem arising when selecting different products.

The relative strengths of different types of glass are (from strongest to weakest):

- Tempered or Toughened Glass
- Heat Strengthened Glass
- Thin Float Glass
- Thin Laminated Float Glass
- Thick Float Glass
- Thick Laminated Float Glass
- Wired Glass

Increasing strength decreases the likelihood of thermal breakage.

Please note when these types of glass are altered such as for tinting, Low E and reflective coatings the risk of thermal stress increases. It is

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recommended that when using these products a thermal assessment of the building envelope is undertaken.

A window can be fine for a number of years and then one day the conditions will be just right and it will crack. This is not something that is warranted because there is no control over the environmental conditions that cause the problem.

Another important factor in thermal breakage is the quality of the edge finish of the glass pane. Shells, vents or sharks teeth will add to the likelihood of a thermal breakage. All glass should be supplied as per AS 4667:2000 for glass cutting defect limits.

ADDITIONAL FACTORS THAT MAY INFLUENCE THERMAL BREAKAGE

- Glass framing that is in direct contact with concrete or other materials that contribute to the cooling of the glass edge.
- Excessive coverage of the glass edge by the frame.
- Heat-absorbing films attached to the glass after installation.
- The use of internal shading devices such as curtains, drapes or venetian blinds . If shading devices are used, they must be placed away from the glass to allow for a free flow of air at the glass surface.
- External shading on the glass can also have significant effect on thermal stress.
- Glass Framing that is in direct contact with concrete or other materials that contribute to the cooling of the glass edge
- Blinds or curtains can have an enormous effect on the thermal stress. Light coloured blinds, close to the glass with a pelmet significantly increase glass stress.
- The airflow from room cooling or heating vents, must be directed away from the glass
- Generally speaking, the greater the glass edge area, the greater the risk of thermal breakage

HOW IS THERMAL STRESS CAUSED?

Thermal stress in a glass pane is caused by a temperature difference in one part of the glass sheet compared to another part. The greater the temperature difference, the greater the thermal stress.

Solar energy is the major cause of temperature difference in glass; the process of thermal stress breakage is shown in figures 1 to 3.

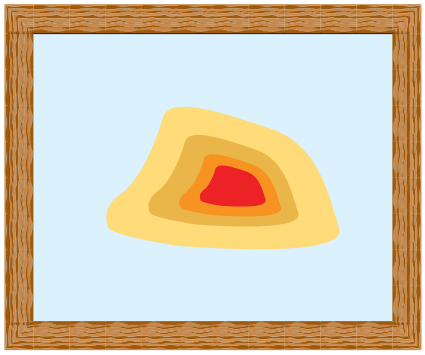

Figure 1 Solar energy warms the centre of the glass pane, which rises in temperature. The glass edges are hidden by the frame or shaded by an object so they remain cooler.

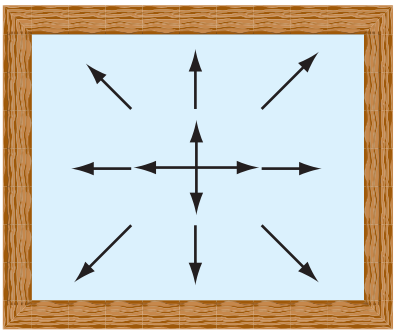

Figure 2 The centre area of the glass expands more than the edges; Simultaneously light coloured frames reflect heat away keeping the edge of the glass cooler than the exposed glass.

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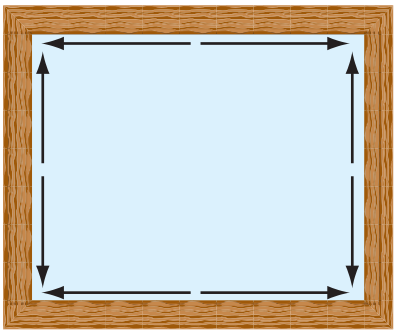

Figure 3 The edges are then under stress to expand, this equals thermal stress. If this thermal stress meets or exceeds the breaking strength of the glass, thermal stress fracture of the glass pane occurs.

Glass types have a different resistance to thermal stress. The table below gives some examples of the thermal stress resistance of glass from temperature differences in the glass pane.

Table 1 Temperature differences that different glass types can resist (for glass in good undamaged condition).

Glass Type	Temperature difference at thermal stress breakage
Tempered/Toughened Glass	About 250 °C
Annealed/Float Glass	About 40 °C
Rough Cast Glass	About 30 °C
Wired Glass	About 25 °C

Tempered/Toughened Glass and Heat Strengthened glass are unlikely to experience excessive thermal stress resulting in breakage.

Annealed/Float Glass are more likely to experience thermal stress and breakage, this includes laminated float glass products.

WHAT DOES A THERMAL STRESS BREAKAGE IN GLASS LOOK LIKE?

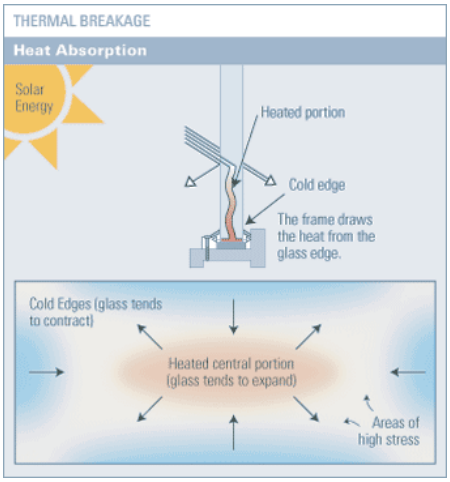

Figure 4 Characteristics of Thermal Breakage.

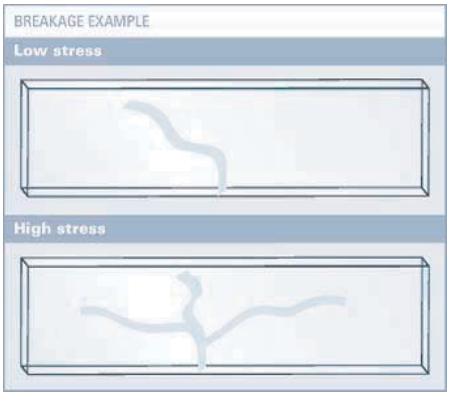

Figure 5 Characteristics of Low and High Stress Thermal Breakage.

Figures 4 and 5 shows the characteristics of thermal stress breakage in glass. Thermal breaks arc 90 degrees to both the surface and the edge.

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RECOMMENDATIONS

- If using a product that is prone to thermal stress conditions as outlined have a thermal assessment completed.
- If concerned about thermal breakage use toughened or heat strengthened products.
- Advise your customer of the possibility of thermal breakage and that it is not a warrantied item.
- Speak with your glass supplier and get their advice.
- Ensure care is taken on edges of high performance glass products that are prone to thermal breakage.
- Check the edge quality of products received that are prone to thermal breakage and ensure high quality finish as per AS 4667:2000. A good clean cut edge is the best finish along with fully polished edges. Ground edges and arrissed edges may not be as good. Glass with damaged edges will take less stress than clean cut glass.

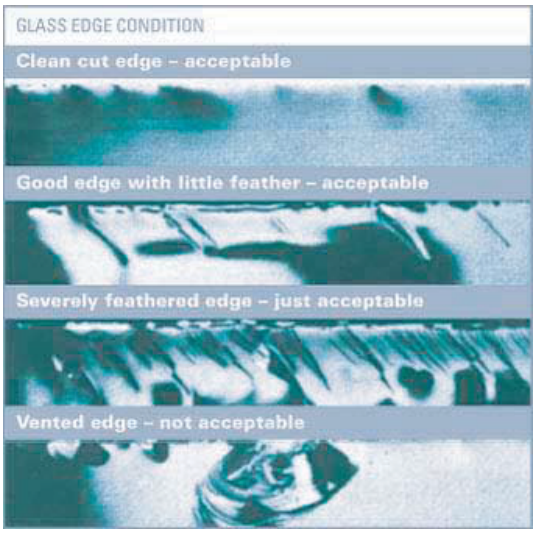

Figure 6 Acceptable Edge of Glass Conditions.

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Images: Figures 4 - 6 sourced from Metrotech Glass [Website]: Catalogue & Reference Guide - Glass: Special Glass Products - 9.8 Thermal Breakage

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