Technical Bulletin

1003 - Thermal Stress Breakage

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Australian Glass Group®

TB 1003 - Thermal Stress Breakage

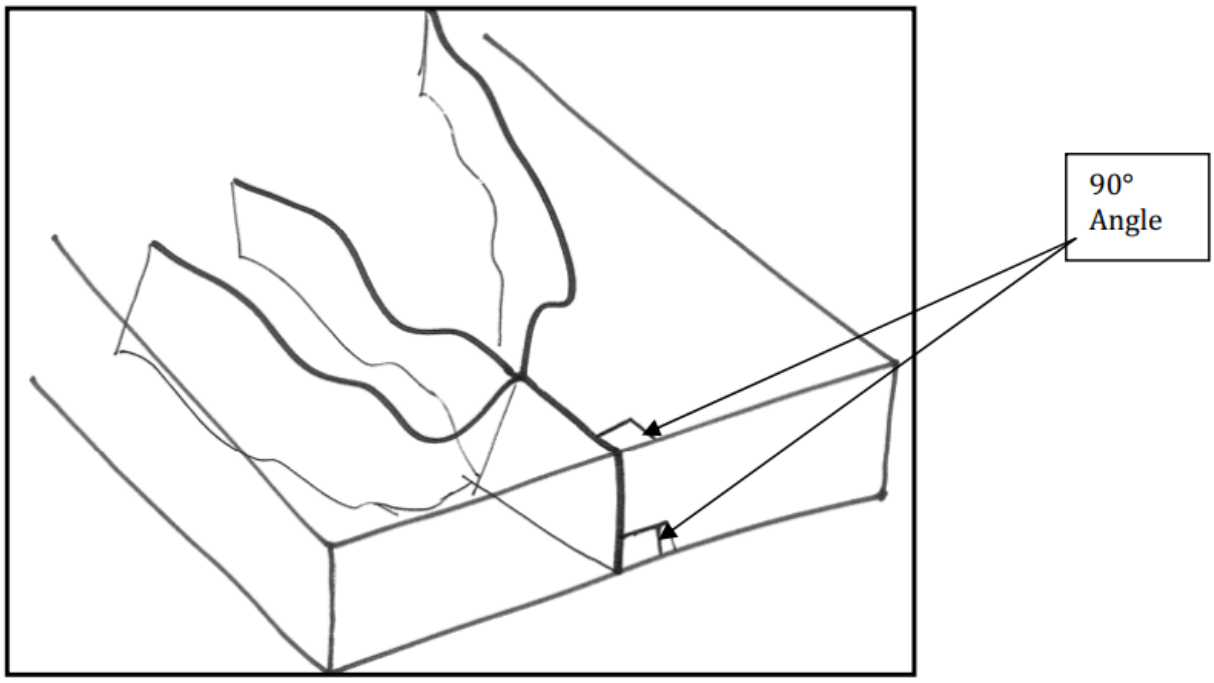
In recent years the increase in minimum energy performance requirements of glazing has dictated a shift from clear glass to tinted and/or coated glass. If this glass is not heat treated, it can be susceptible to breakage from thermal stress. Careful consideration of glass types and heat treatment methods is required to avoid the possibility of thermal stress cracking.

What is thermal stress?

Thermal stress is stress that is caused by unequal temperatures present in the same pane of glass. This causes the warmer parts of the glass to expand more than the cooler parts. Once the difference in temperature between these two regions is large enough, the stress caused by differing amounts of thermal expansion is too much for the glass and it cracks.

Cracks that are caused by thermal stress are different to cracks caused by other means, and are easily identifiable. Thermal stress cracks will emanate from the edge of the glass, at an angle of 90 degrees from both the glass edge and the glass face. This straight line crack continues for some distance depending on whether it was a low stress crack or a high stress crack.

A low stress crack will have a longer straight section before the crack begins to meander. In contrast, a high stress crack will have a shorter straight section before splitting into several branches. Below is a depiction of a high stress thermal crack.



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Solutions

The weakest part of glass is the edge, and if there are any imperfections the glass is more susceptible to thermal stress cracks. Normal framed window glazing only has edges arrised, which is a small rough grind to remove the sharp edge, making it safer for factory workers and installers to handle. These edges could be either flat ground or flat polished to create smoother edges thereby reducing the risk of thermal stress.

The most significant solution is to Heat Treat the glass from annealed to either heat strengthened or toughened glass. Heat strengthened glass can withstand a temperature differential of around 75°C, whereas toughened glass can withstand around 200°C. Toughened glass also has the added benefit of being Grade A safety glass for compliance purposes. Both heat strengthened and toughened glass will dramatically minimise the risk of thermal stress breakage.

Causes of thermal stress

- Annealed glass with high heat absorption
- External shading
- Internal shading
- Heating devices
- Frame colour
- Larger glass panes

Annealed glass types that absorb high levels of heat are the most at risk of thermal stress breakage. These include tints, some coated glass and any glass that has a solar control film added. Generally speaking, dark tinted annealed glass is the most at risk when all other factors are constant, as the tint causes the glass to absorb high levels of heat. This is highlighted by the edges of the glass commonly concealed inside the frame remaining cool.

It has been estimated that for every 1 degree difference in temperature between edge and centre of glass, the stress in the glass increases by 0.62MPa. Given that temperature differences can easily be in the order of 20 to 30 degrees, a stress of 12 to 19MPa can be generated which is enough to cause a crack.

External shading elements such as fences, eves, trees and external blinds all cast shadows onto nearby glass. These shadows obviously vary between seasons. Typically, cold clear mornings followed by bright sunshine days with a shading factor on the one pane of glass represent the worst offending scenario for thermal stress.

Internal shading elements include close fitting blinds or curtains. The impact of these depends on their colour and proximity to the glass. 50mm is the minimum recommended gap, with 150mm being preferred. Also, it is recommended that blinds/curtains leave a gap of 50mm at the head and 25mm at the sill to allow any heat trapped there to escape.

Lightly coloured frames reflect more heat than darker colours that absorb more heat, meaning the portion of the glass inside the frame is cooler. This will increase the difference in temperature across the glass pane, so lighter coloured frames actually increase the thermal stress in the glass.

Any heating devices should be orientated so that hot air is not blown directly onto the glass from close proximity and note that larger glass panes have the opportunity to absorb more solar energy than smaller panes.

Thermal stress cracks are not covered by AGG's warranty and we recommend a Thermal Stress assessment if you have any concerns.

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