Insulating Glass Breakage

Glass Breakage can occur for many reasons, including from impact, thermal stress, bending (racking of the sash) or from excessive pressure differences between the airspace and the outside air. Glass is a brittle material and will fracture when subjected to a critical tensile stress level. Scratches, chips, or digs in the glass surface can produce stress concentrators that reduce glass strength. If these surface defects are severe enough or stress high enough, they can produce glass breakage when the glass is under stress.

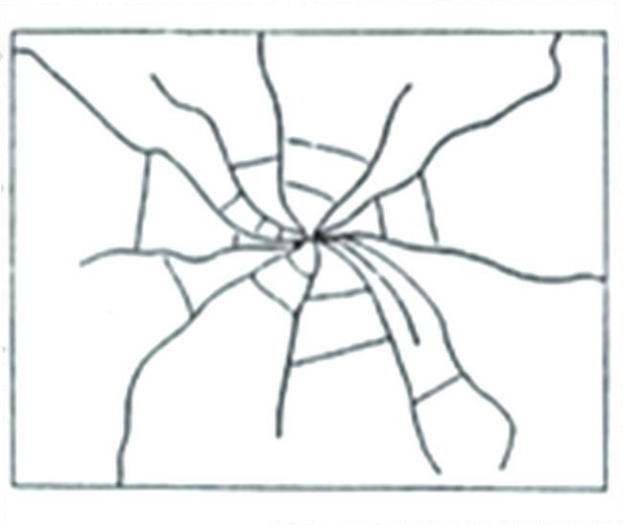

Fig IG24-1: Impact Pattern

A typical impact breakage pattern is shown in Figure IG24-1. Due to the small particle size when glass fractures from impact, the glass may evacuate the opening which can conceal the fracture pattern.

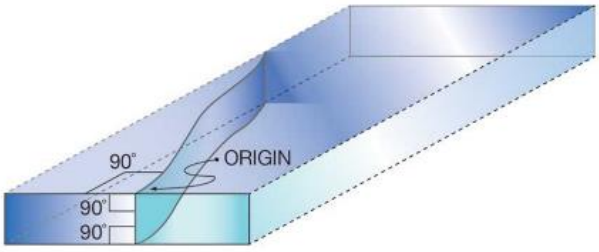

Fig IG24-2: Thermal Stress

A typical breakage pattern from thermal stress is shown in Figure IG24-2 and is caused by the glass not being able to sustain the thermal conditions experienced at the installation site. Conditions that can produce thermal breakage of glass panes can be related to, but not limited to, a combination of the following: high absorption glass products, outdoor overhangs, indoor shading (blinds, draperies, etc.) size of the window, and flaws at the glass edge.

One typical case for thermal breakage is the use of solar absorbing glass or coatings on the room side of the IG unit. They raise the central glass temperature on the room side pane, while the glass edges remain cold. This temperature gradient produces thermal stress in the room side glass pane and if there are any significant edge flaws, thermal breakage could take place initiating at the flaw. Thermal break patterns generally occur at 90 degrees to the edge of glass. Additional thermal breakage information can be found in TSB IG07. The use of heat strengthened and tempered glass will virtually eliminate the chance of thermal breakage.

A typical breakage pattern for glass bending is shown in Figure IG24-3 and is usually caused by a racking of the window sash i.e. in a casement unit with one of the locks engaged and the homeowner tries to open the window.

Fig IG24-3: Low Level Bending

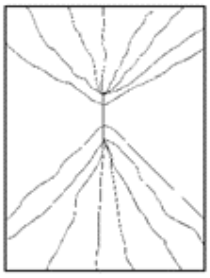

Fig IG24-4: Pressure Difference

A typical breakage pattern from excessive pressure differences between the airspace and outside air is shown in Figure IG24-4. This type of breakage is not very prevalent and is due to the glass not being able to meet the bending stresses induced by the deflection of glass panes. Specific causes of breakage are due to extreme pressure differences between the airspace and the outside air, resulting in

severely negative (bowed-in) or severely positive (bowed-out) glass units. Breakage from bowed-out glass panes is extremely rare and can be caused by shipment of the IG units to altitudes in excess of 3,000 feet (contact Cardinal IG for additional information).

A typical breakage pattern for tempered glass is shown in Figure IG24-5. Tempered glass is classified as a safety glazing material because when it fractures it breaks into relatively harmless fragments with no jagged edges or shards.

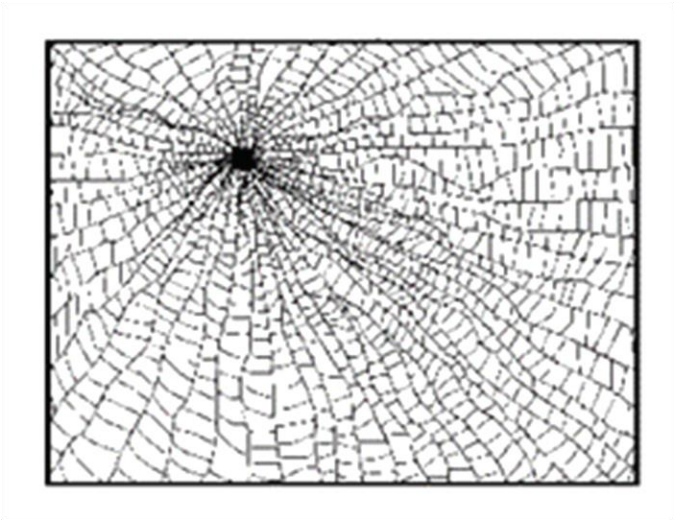

Fig IG24-5: Tempered

All glass products have some level of inclusions i.e. seeds, bubbles, and stones which are an unavoidable part of the glass forming process. These inclusions are controlled to minimum levels and usually are not visible to the naked eye. One type of a very rare inclusion is called a nickel sulfide stone. This particular type of stone may undergo a phase transformation (shrink) in tempered glass due to the re-heat/quench operation. Over a period of time, these particles will tend to revert back to their original state (expand). This phase transformation can cause tempered glass to fracture spontaneously, but this is a rare occurrence. Annealed and heat-strengthened glass will not have fractures from inclusions i.e. nickel sulfide stones.

Naturally, any glass that has fractured in the field should be replaced. Breakage of tempered glass is rare because of its exceptional strength and impact resistance. Breakage that does occur with tempered glass usually occurs from impacts from lawn mower debris, stones, carpenter tools etc.

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