

The Importance of Fabrication Prior to Heat-Treatment

Glass applications frequently require a variety of glass edge and/or surface fabrication. Some common fabrication processes include: edge seaming, grinding, polishing, hole-drilling, notch-cutting, surface-grooving, sand-blasting, and etching. The Glass Association of North America (GANA) does not recommend glass fabrication after heat-treatment because it may weaken the glass and/or cause it to break. This recommendation is confirmed in Section 7 of ASTM C 1048, Standard Specification for Heat-Treated Flat Glass-Kind HS, Kind FT Coated and Uncoated Glass, which states, "All fabrication, such as cutting to overall dimensions, edgework, drilled holes, notching, grinding, sandblasting, and etching, shall be performed before heat-strengthening or tempering and shall be as specified."

The Heat-Treating Process

In order to provide greater resistance to thermal and mechanical stresses, and to achieve required break patterns for safety glazing applications, annealed float glass and patterned glass can be strengthened through a thermal process known as heat-treating. The most commonly used process for heat-treating architectural products calls for glass to be cut to the desired size and shape, and edges prepared to the specified condition. The glass is washed and then transported through a tempering furnace where it is uniformly heated to approximately 1150 °F (621 °C). Upon exiting the furnace, the glass is rapidly cooled (quenched) by blowing air onto all surfaces simultaneously.

The cooling process places the surfaces of the heat-treated glass into a state of high compression and the central core in tension. As shown in Figure 1, each surface compression zone is approximately 20% of the glass thickness and the middle 60 % of the glass thickness is the tension zone.

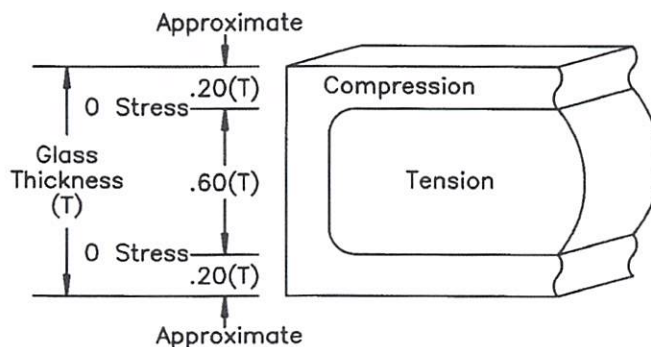


Figure 1
 Heat-Treated Glass Compression and Tension Zones

Alteration of Surface Stress - Brought About by Fabrication After the Heat-Treatment Process

Fabricating glass after it has been heat-treated, such as grinding, sandblasting or etching, may compromise the compression and tension zones of the glass resulting in a weaker or broken piece of glass. Cutting and drilling heat-treated glass will result in breakage. Compromising the surface compression zones of fully tempered glass may also negatively affect its ability to comply with the industry safety glazing standards.

Penetration of a surface compression layer is a cause of heat-strengthened and fully tempered glass breakage. For example, each compression layer in a lite of heat-treated glass is approximately 20% of the glass thickness, penetration can occur in as little as 0.025" (0.64 mm) for 1/8" (3 mm) thick glass and 0.040" (1.02 mm) for 1/4" (6 mm) thick glass.

Heat-treated glass can be further fabricated by any process that does not alter the surface compression layer such as sputtered (vacuum deposition) coatings onto the surface; assembly of laminates and insulating glass units; and adding films and coatings for opacification.

Heat-Treated Laminated Glass

Two or more lites of heat-treated glass can be laminated when glass retention after breakage is desired to meet performance or building code requirements. Typical applications include canopies, skylights, railings, glass floors, curtain wall and storefront systems. Unlike annealed laminates, heat-treated laminates cannot undergo additional fabrication after laminating.

Similar to monolithic heat-treated glass, ASTM C1172 *Standard Specification for Laminated Architectural Flat Glass* states, "All dimensional fabrication, such as cutting to overall dimensions, edgework, drilling, notching, grinding, sandblasting, and etching on laminates containing heat-strengthened, chemically strengthened, or fully tempered glass shall be performed prior to strengthening or tempering."

In addition, ASTM C1172 gives length and width tolerances for rectangular shapes of symmetrically laminated glass including mismatch. These tolerances are shown below:

Laminate Thickness Designation, <i>t</i>	Heat strengthened/Tempered Glass Tolerance
$t < \frac{1}{4}$ in (6.4 mm)	+7/32 in, -3/32 in (+5.6mm – 2.4mm)
$\frac{1}{4}$ in $< \frac{1}{2}$ in (6.4mm $<$ 12.7mm)	+1/4 in, -1/8 in (+6.4mm, -3.2mm)
$\frac{1}{2}$ in $<$ 1 in (12.7mm $<$ 25.4mm)	+5/16 in, - 1/8 in (+7.9mm, -3.2mm)

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