

Tech Talk: Tempered Glass

Description

Tempering is a process whereby annealed glass is reheated in an oven to a temperature of 1,112 °F. (600 °C). The glass then goes through a rapid cooling process called quenching that cools the outer surface of the glass much faster than the center. The result is that the outer surfaces of the glass are put into compression while the interior remains in tension. This compression layer makes tempered glass four to five times stronger than annealed glass. According to ASTM C1048, tempered glass has a minimum surface compression of 10,000+ psi (69 MPa). It generally breaks at 24,000 psi (165.47 MPa).

When tempered glass breaks, the particle sizes are small, unlike annealed or heat strengthened glass. These small particles are less likely to cause injury. Tempered glass is acceptable for use in both automotive and architectural safety glazing applications.

Heat-strengthened glass goes through a similar re-heating process as tempered glass, however, the cooling rate is slower than the rate required for tempering. The glass is twice as strong as annealed glass and has a similar break pattern to annealed glass. Unless it is laminated, heat-strengthened glass does not meet the requirements for safety glazing. According to ASTM C1048, heat-strengthened glass has a surface compression of 3,500 psi to 7,500 psi (24 MPa to 52 MPa).

Heat-treated vs. Chemically strengthened Glass

Tempered and heat-strengthened glass typical show a depth of the compression layer at 20% of the glass thickness. Chemically strengthened glass, in contrast, can be significantly stronger than the standard heat-treating process, but its depth of layer is microns thick.

Standards

Standard	Type
ASTM C1048	Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass
ANSI Z97.1	Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.
ANSI Z26.1	Safety Glazing Materials for Glazing Motor Vehicles and Motor Vehicle Equipment Operating on Land Highways - Safety Standard

Limitations

Both tempered and heat-strengthened glass will vacate the frame if broken. Both products can be laminated for applications where a post-breakage glass barrier is required. ASTM C1048 requires all fabrication for tempered or heat strengthened glass (cutting, hole-drilling, polishing, etc.) to be completed prior to strengthening.