

Tempered Glass Product Data Sheet

Annealed float glass can be cut to a desired finished size and tempered to provide a glass product with greater resistance to thermal, mechanical or impact loads or to break in a manner that allows its use where safety glass is mandated by federal law or building code. Although tempered glass has increased resistance to thermal loads, it is not a fire-rated glazing product.

Syracuse Glass Company's TUFFVUE Tempered glass is available in 1/8" – 3/4" thickness in a size range from a minimum of 4"x10" to a maximum of 84" x 144". Clear, Tinted, Reflective, Low E, and most Rolled Pattern Glass can be tempered. Glass products with extremely uneven surfaces can not be tempered.

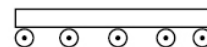
Tempered glass is used where high resistance to mechanical loads calls for maximum glass strength achievable for a given glass thickness, and where a safety glazing product is mandated by law, by building code or by a desire for maximum safety in the event of human impact.

While tempered glass is very strong, it can be broken. And when it does break, it disintegrates into tiny pieces. Therefore it should be used with caution where falling material would be a concern, like windows in a multi-story building over a court yard or plaza, or where security is of paramount concern, like a prison or jewelry store display window, or in a furniture application where glass disintegration would risk collateral damage, like a shelf or table holding precious objects. Tempering also enables heat absorbing glass products to withstand high thermal loads and stresses, but the industry recommends the use of heat strengthened glass where thermal stress is predicted. The tempering process adds distortion and changes the glass surface, factors that should be considered if appearance of reflected images is critical.

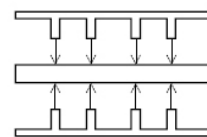
Tempering Process

Syracuse Glass Company fabricates tempered glass with a UNIGLASS state-of-the-art electrically heated horizontal furnace with the latest technological innovation in tempering – convection. The glass is conveyed into a heating chamber where it oscillates on ceramic rollers until it reaches a temperature of approximately 1200 degrees Fahrenheit.

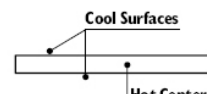
The glass exits the furnace into a quench chamber where it is rapidly cooled by air driven through a series of nozzles by two six hundred horsepower motors. The air is directed to both surfaces of the piece of glass uniformly - top and bottom. The quench process locks the top and bottom surfaces and edges in a state of high compression around a central core in compensating tension. The compression zone is about 20 percent of the glass thickness from each surface, surrounding a center core tension zone of about 60 percent of the glass thickness.



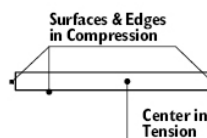
Furnace



Air Quench



Rapid Cool



Final Condition

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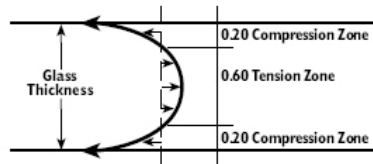
Properties

- Tempered glass has about four times the strength to resist impact, or mechanical and thermal loads compared to annealed glass of equal thickness.
- The color, clarity, chemical composition and light transmission characteristics of glass remain unchanged after tempering.
- Tempering does not reduce glass deflection under load. Glass deflection can be reduced by using glass of greater thickness.
- Tempered glass breaks into small pieces less likely to cause injury than annealed or heat strengthened glass.
- Tempered glass can not be cut or drilled, sandblasted or etched, or edge polished or ground. Any fabrication or field alteration will weaken or break tempered glass.
- Tempered glass is subject to rare "spontaneous breakage" caused by one or a combination of these causes: surface or edge damage, deep scratches or gouges, severe weld spatter, missile or windborne debris impact, glass to metal contact, wind/thermal loading or rare inclusions or impurities in the float glass that weaken the compression layer of the glass. Breakage may occur long after the damaging event, as a result of normal thermal or wind cycling, but seemingly for no apparent cause.
- **When** tempered glass breaks, the resulting small pieces can vacate the framing system under a lateral load. Other fabricated glass options like laminated glass or heat strengthened glass are less likely to leave the framing system in the case of breakage.
- **When** viewing tempered glass in certain conditions, a pattern of iridescent spots or darkish shadows may become visible. This is the strain pattern created by the quench process. Sharp viewing angles, polarized light, thick glass, and glass coatings increase the visibility of the strain pattern.
- The original flatness of glass is slightly modified by the tempering process, causing reflected images to be more distorted than annealed glass. Warp, bow, and roller distortion are inherent characteristics of tempered glass. Syracuse Glass Company produces product among the best in the industry, but distortion of reflected images can not be entirely eliminated, especially when viewed at high incidence angles, with even the best equipment and craftsmanship. As distortion is not easily quantifiable, full scale mock-up samples are recommended for critical viewing areas.
- **As** a result of hot glass contact with ceramic rollers, some glass surface changes will occur. Minute glass particles (fines) from the glass cutting and edging process, and airborne dust may adhere to one or both glass surfaces. Also, the physical contact of the soft glass surface with the rollers may result in a marking of the glass surface. These surface conditions are typically not visible to the eye under normal viewing conditions. Tempered glass surfaces should not be cleaned with razor blades or metal scrapers.
- **Sizes**, locations, and quantities of holes and notches in tempered glass must be governed by ASTM C1048 guidelines.
- Tempered glass must have seamed or polished edges.
- Tempered glass is supplied with a permanent identifying mark in one corner identifying the manufacturer and the applicable safety glazing standards unless ordered "no logo".

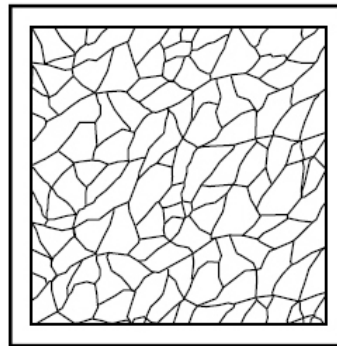
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Stress

Tempered glass gains its added strength from these compressed surfaces. However, if the surface is penetrated by a scratch or an impact, the glass will break into a number of small particles.



Final Stress Distribution. The sum of the forces in compression equals the force in tension.



Typical Breakage Pattern

Certifications:

TUFFVUE Tempered Glass Products manufactured by Syracuse Glass Company meet the requirements of :

- **ASTM C1036** Standard Specification for Flat Glass
- **ASTM C1048** Standard Specification for Heat Treated Flat Glass
- **ANSI Z97.1** American National Standard for Safety Glazing Materials Used in Buildings
- **16 CFR 1201** Category II Consumer Products Safety Commission Safety Standard for Architectural Glazing Materials

Syracuse Glass Company is a licensee of the Safety Glazing Certification Council (SGCC), a non-profit corporation that provides third-party certification of safety glazing materials through unannounced in-plant inspections and laboratory testing.