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TECH TALK

Chemically Strengthened Glass

The Process - Annealed glass can be strengthened to provide increased resistance to thermal and mechanical stresses. In the Chemical strengthening process, glass is submersed in a molten salt bath of potassium nitrate at temperatures below the annealing range of the glass. The ion exchange occurs during the submersion cycle when the larger alkali potassium ions exchange places with the smaller alkali sodium ions in the surface of the glass. As the smaller sodium ions vacate the surface of the glass, the larger alkali potassium ions “wedge” their way into the voids.

The Result - Chemically strengthened glass is significantly stronger than annealed glass, depending upon the glass composition, strengthening process, level of abrasion, and the application environment. The chemical strengthening process does not affect the color, clarity, and light transmission of the glass. Likewise, hardness, specific gravity, expansion coefficient, softening point, thermal conductivity, solar transmittance and stiffness remain unchanged. The only physical properties that change are improved flexural and tensile strength and improved resistance to thermal stress and thermal shock. Under uniform loading, chemically strengthened glass is stronger than annealed glass of the same size, type, and thickness. Unlike other thermally treated glasses, chemically strengthened glass is not subject to roller wave and remains essentially distortion free.

Why Chemically Strengthen?- The ion exchange process is often used to strengthen glass that is too complex in shape or too small or large to be thermally strengthened. In architectural, transit, and security applications, chemically strengthened glass is often laminated to meet impact standards. Because it breaks into large shards, it is not considered to be a safety glazing product, and, therefore, must be laminated to meet federal safety glazing requirements.

Classification of Chemically Strengthened Glass - ASTM C1422-99, “Standard Specification for Chemically Strengthened Flat Glass” classifies the product according the case depth and surface compression. These categories are independent of each other. Increasing levels of surface compression permits an increasing amount of flexure and greater case depths, which offer more protection from strength reduction caused by abuse and abrasion. The Chemically Strengthened Glass manufactured at Bent Glass Design is classified as Level 2 (surface compression $> 25,000$ psi $\leq 50,000$ psi), Level B (case depth ≤ 0.006 inch).

Modulus of Rupture- For day-to-day quality control, Bent Glass Design runs Modulus of Rupture tests to evaluate the strength of the Chemically Strengthened Glass. A four-point flexure test is used for this purpose. A typical MOR on 1/8” Chemically Strengthened Glass is 32,000 to 42,000 psi. The typical MOR on annealed glass is 6,000 psi.

Evaluation of End Use Performance - Other tests may be required to assess conformance with a particular end use application. For instance, security laminates may call for physical attack, ballistics, or mechanical impact tests. Safety glazing in railroad applications must comply with ballistics and large impact tests enacted by the Federal Railroad Administration. These tests are usually performed at outside test laboratories and are identified in the architectural specification or procurement documents. Chemically strengthened glass can be used interchangeably with heat-strengthened glass. In other cases, the specific properties of the materials will dictate their use.

Material Certification – should be requested at the time of order.