ABRISA TECHNOLOGIES
HEF® PHOTONICS

Your Total Solution Partner

Fabrication Fact

Glass Strengthening Methods

Strengthening glass can be done via three primary processes; tempering, thermal strengthening and chemical strengthening in order to increase the heat resistance and overall strength of the glass.

Heat Tempering

Toughened or tempered glass is a type of safety glass processed by controlled thermal treatments to increase its strength compared with normal glass. Tempering puts the outer surfaces into compression and the inner surfaces into tension. Such stresses cause the glass, when broken, to crumble into small granular chunks instead of splintering into jagged shards as plate glass (aka: annealed glass) create. The granular chunks are less likely to cause injury.

As a result of its safety and strength, toughened glass is used in a variety of demanding applications, including passenger vehicle windows, shower doors, architectural glass doors and tables, refrigerator trays, as a component of bulletproof glass, for diving masks, and various types of plates and cookware.

Heat tempering of glass is available in sizes of 160” x 92” (4,064 mm x 2,336.8 mm). This process can be done on glass with a minimal thickness of 1/8” (3.175 mm) and a maximum thickness of 1/2” (12.7 mm), (1” thick for smaller parts – up to 30” x 24” or 762 mm x 609.6 mm). In the heat tempering process, the glass substrate is placed onto a roller table and then it goes through a furnace, heating up the glass above its annealing point up to about 720°C in some cases. The glass is then quickly cooled (quenched) with forced air drafts.

Heat Strengthening

The heat-treatment process of ordinary float glass consists in heating the glass beyond its softening point (over 600°C) and then cooling it down rapidly. This cooling freezes the outer surfaces in their dilated mode while allowing the inner material to retract as temperature drops, thus creating compression strength on the outer layers and tension in the inner layer. Compression strengths in tempered glass are higher than in heat strengthened glass.

Heat strengthening of glass is available in sizes of 168” x 96” (4,367.2 mm x 2,438.4 mm). This process can be done on glass with a minimal thickness of 1/8” (3.175 mm) and a maximum thickness of 1/2” (12.7 mm), (1” or 25.4 mm thick for smaller parts – up to 32”x 25” or 812.8 mm x 635 mm). In the heat strengthening process, the glass substrate is processed similar to a fully tempered part, except that the temperature and cycle times, along with the quenching parameters are varied.

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Chemical Strengthening

Abrisa Technologies' High Ion Exchange or HIE™ glass is chemically strengthened glass that has increased strength as a result of a post-product chemical process. Glass is submersed in a bath containing a potassium salt (typically potassium nitrate) at 300°C. This causes sodium ions in the glass surface to be replaced by potassium ions from the bath solution. These potassium ions are larger than the sodium ions and therefore wedge into the gaps left by the smaller sodium ions when they migrate to the potassium nitrate solution. This replacement of ions causes the surface of the glass to be in a state of compression and the core in compensating tension. The surface compression of chemically strengthened glass may reach up to 690 MPa. This process typically increases the strength of the glass by 6 to 8X that of float glass. The ion-exchange process creates a deep compression layer on the surface of the glass structure, reducing the introduction of flaws once incorporated into the end product and put into service.

Chemically strengthened glass is available in a minimum thickness of 0.30mm (0.012″), and a maximum thickness of 19mm or (0.75″). Minimum size is 25.4mm x 25.4 mm or (1″ x 1″) and a maximum size of 1,168.4 mm x 736.6 mm (46" x 29"). Diagonal maximum size of 1056.8mm x 736.6mm or (42″ x 29″) – approximately 51″ diagonal.

Property Changes Due to Strengthening Glass

	Heat Tempering Change	Heat Strengthening Change	Chemical Strengthening Change (8 Hours)	Chemical Strengthening Change (16 Hours)
Impact Resistance*	5 to 6x	N/A	3 to 4	4 to 5x
Bending Strength*	4 ti 5x	2x	3.5x	2.5 to 3x
Resistance to Temperature*	4x	2.4x	1.8 to 2.5x	1.8 to 2.5x
Vickers Hardness*	N/A	M/A	1.4x	1.4x
Maximum Temperature	243°C	230°C	300°C	300°C
Avg. Compressive Stress at Surface**	>69MPa	24MPa to 69MPa	Avg>165MPa	Avg>325MPa

**Relative increase over annealed glass. 5x means 5 times greater.*
***As measured by FSM 6000 measurement tool.*

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Glass Fabrication

Coating Deposition

CNC Machining

Strengthening - Chemical & Heat

Screen Printing of Graphics

Abrisa Technologies, a member of HEF Photonics, is a globally recognized technology glass fabrication and optical thin film coating company with expertise in high volume manufacturing and engineering capabilities, delivering Total Solutions that provide excellent performance, fitness-for-use and economies of scale.

Our US based, state-of-the-art ISO 9001:2015 and ITAR registered facilities include Abrisa Industrial Glass in Santa Paula, CA and ZC&R Coatings for Optics in Torrance CA. These two divisions produce solutions from cut-to-order coated glass components to custom complex and ready-to-install fabricated, strengthened, optically coated, electronically enabled and branded sub-assemblies.

Our Total Solutions serve a variety of markets including Micro-Electronics, Defense and Avionics, Display, Industrial Automation, Optical Sensors, Imaging, Photonics, Medical & Dental, Life Science and more.

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CERTIFIED ISO 9001:2015 · ITAR International Traffic in Arms Regulations Compliant · REACH COMPLIANT · ROHS COMPLIANT

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