HEAT-TREATED GLASS

Heat-treated glass is subject to a thermal process to optimize its mechanical characteristics and make it more resistant to breakage.

DESCRIPTION

Because glass is easily breakable, it may be desirable to submit it to a heat treatment to make it stronger.

During a thermal tempering process, glass is heated in a tempering oven to a temperature of around 600 °C to bring it to a its softening point. Then it will be rapidly cooled (quenched) by cool air blown on the glass surface.

This process creates a state of high compression on the glass surface because the outside hardens while the core is still soft, giving superior mechanical strength to the glass.

Tempered glass will have a mechanical resistance of 4 times annealed glass. It will break into small non sharp pebbles.

Heat strengthened glass is produced using the same process as tempered glass, but at a lower level of surface compression that the former. Its mechanical strength is twice that of annealed glass. It will break into large fragments that will likely remain in the glazing pocket when broken

	Annealed glass	Tempered glass	Heat-strengthened glass
Resistance		Approximately 4 times stronger than annealed glass	Approximately twice stronger than annealed glass
Breakage pattern			
	Large shards that will probably fall from the glazing pocket	Small pebble pieces that will probably fall out of the glazing pocket	Large pieces that will likely remain in the glazing pocket
Thermal resistance	None	Yes	Yes
Safety Glazing	No	Yes	No
Susceptible to Nickel Sulfide inclusions	No	Yes	No

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RECOMMANDATIONS

Size and hole positioning for tempered glass according to ASTM C-1048

Summarized from th Glass Association of North America (GANA) technical bulletin.

1 Hole position

a For all glass thicknesses, the minimum distance from the edge of the hole to the nearest edge of the glass must be the greatest between (see Table 1)

i 6 mm

and

ii twice the glass thickness

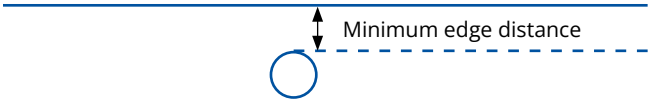

Table 1

THICKNESS	MINIMAL DISTANCE
3.3 mm	7mm ou 1/4”
4 mm	8mm ou 5/16”
5 mm	10 mm ou 3/8”
6 mm	12mm ou 1/2”
10 mm	20mm ou 13/16”
12 mm	24mm ou 1”
15 mm	30mm ou 1 3/16”
19 mm	38mm ou 1 1/2”

b The minimum distance from the edge of the hole to a corner of the glass must be 6.5 times the thickness of the glass when the corner is 90 degrees and more.

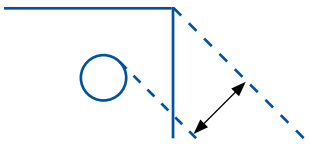

Table 2

THICKNESS	MINIMAL DISTANCE
3.3 mm	21,5mm ou 7/8”
4 mm	26mm ou 1”
5 mm	32,5mm ou 1 1/4”
6 mm	39mm ou 1 1/2”
8 mm	52mm ou 2”
10 mm	65mm ou 2 9/16”
12 mm	78mm ou 3”
15 mm	97,5mm ou 3 7/8”
19 mm	123,5mm ou 4 7/8”

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2 Minimum distance between holes

For all glass thicknesses, the minimum distance between holes is the greatest distance between:

i 10 mm

and

ii Twice the glass thickness

3 Dimension of round holes

For all glass thickness, the minimum dimension of the hole must be the greatest diameter between:

i 6,4 mm

and

ii glass thickness

Tableau 3

THICKNESS	MINIMUM DIAMETER
3.3 mm	6.4 mm (7mm drill bit)
4 mm	6.4 mm (7mm drill bit)
5 mm	6.4 mm (7mm drill bit)
6 mm	6.4 mm (7mm drill bit)
8 mm	8 mm
10 mm	10 mm
12 mm	12 mm
15 mm	15 mm
19 mm	19 mm

RECOMMENDATIONS FOR FIXED PANELS FULLY TEMPERED

Fixed panels of interior glass partitions restrained on top and bottom only require special design considerations.

Recommend minimum thickness for fully tempered glass used in Butt-Glazed fixed interior panels restrained at top and bottom only

HEIGHT	MINIMUM THICKNESS
Up to1.5m (5’)	6mm (1/4”)
Between 1.5m & 2.4m (5’ & 8’)	10mm (3/8”)
Between 2.4m & 3.0m (8’ & 10’)	12mm (1/2”)
Between 3.0m & 3.6m (10’ & 12’)	16mm (5/8”)
Between 3.6m & 4.2m (12’ & 14’)	19mm (3/4”)
Between 4.2m & 4.8m (14’ & 16’)	22mm (7/8”)
Between 4.8m & 5.5m (16’ & 18’)	25mm (1’)
Over 5.5m (18’)	Not recom-mended

For additional information, refer to GANA Technical bulletin – APPENDIX 1

“Recommendation for fully tempered interior butt glazed fixed glass panels.”

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THERMAL BREAKAGE

Temperature variation on the glass will cause expansion or contraction. When glass is exposed to the sun, the center will heat up faster than the edges.

Several factors will also influence the warming. Building orientation, shading factors, glass tint, etc. Indoor environment can also be a warming factor with the addition of blinds, curtains, or opaque stickers.

The difference in temperatures will cause stress in the glass which, if too great can cause breakage. Tempering or heat strengthening of the glass are two heat treatment that will improve its resistance to thermal stress.

HEAT-TREATMENT DEFECTS

Heat treatment will inevitably lead to certain defects, despite Laurier Architectural great expertise and its state-of-the-art equipment. The thinner the glass the more it is subject to deformation. The main deformations are roller marks, deflections or warping and strain pattern.

ROLLER MARKS

As the glass is heated to bring it close to its softening point, and it is laid on the bed of oscillating rollers in the glass furnace, the surface of the glass will be impregnated with the shape of these rollers. Laurier Architectural carries out appropriate checks using a Zebra chart at the exit of each tempering oven and industry quality standards are applied.

BOW/WARP

ASTM C1048 specifies what is tolerated in this defect type according to glass size and thickness.

STRAIN PATTERN

ASTM C1048 mentions the strain pattern which is visible under certain angle and light conditions as something inevitable and specific to tempered. It is not to be confused with discoloured or non-conforming glass.

STANDARDS

Glass

ASTM C1036-16 Standard de specification for flat glass

CAN/CGSB 12.3 M91 (R2017) Standard Canadian - Clear float

Tempered glass

CGSB-12.1-2017 Safety glazing

ASTM C1048 Heat treated flat glass

ANSI-Z97.1-2015, National American Standard for Safety Glazing used in buildings

16CFR 1201 II, Safety Standard for Architectural Glazing Materials

DIN EN 14179-1, Heat Soaked Thermally Toughened Soda Lime Silicate Safety Glass.