

Mechanical Properties of Tempered Glass

As a generalization, toughened glass is mechanically some four to five times stronger than non-toughened glass of the same thickness. Since strength is measured in various ways, no one absolute figure can be given. A general indication of the mechanical properties is to be found here.

IMPACT STRENGTH

Under impact, toughened glass is much stronger than normal glass. For example: 3/4" thick toughened glass will withstand the dropping of a 1/2 pound steel ball from 36 feet, whereas the same 1/2 pound ball will generally cause breakage of 3/4" thick normal plate glass if dropped from 3 feet.

MAINTAINED CONCENTRATED LOAD STRENGTH (PSI)

	<u>Ordinary Glass</u>	<u>Toughened Glass</u>	<u>Ingot Iron</u>
Modulus of Elasticity or E	9,000,000	10,000,000	29,800,000
Modulus of Rupture or R	6,000	25,000	26,000
Compression Strength or C	12,000	30,000	20,600

With these figures and the following formula, various concentrated load calculations can be made. It is suggested that reasonable safety factors be used in all instances, whether specifically included in the formulae or not.

DEFLECTION OF LOADED RECTANGULAR PLATE SUPPORTED AT BOTH ENDS

$$D = Wl^3/(4E w t^3)$$

RUPTURE LOAD OF A CENTER LOADED RECTANGULAR PLATE SUPPORTED AT BOTH ENDS

$$W = 2 wt^2R/3l$$

CRUSHING LOAD OF A PLATE AT CRUSH POINT

$$W = Cwl$$

- W = Weight in pounds (include glass if applicable)
- l = Length of specimen in inches (between fulcrums only if applicable)
- D = Deflection in inches
- t = Thickness in inches
- w = Width in inches

MAINTAINED UNIFORMLY DISTRIBUTED LOAD STRENGTH

The following formula indicates the safe load for rectangular toughened glass supported continuously on all edges.

$$P=84000t^2/Af$$

- P = Uniformly distributed unit load in pounds per square inch (psi)
t = Thickness in inches
A = Area in square inches (for length/width ratio of 4/1 or greater use: $A=4w^2$)
f = Factor of safety, usually taken as 10

IRREGULAR SHAPES

Glass which is irregular in outline can often be toughened. Some shapes, however, are difficult to support in the toughening furnace. Secure approval of unusual designs before concluding that the shape can be toughened.