

Thanks to a railroad glass scientist needing to create a lantern that got hot but did not shatter when rain or snow got on it we now have pyrex glass. The word Pyrex comes from the Greek Word pyro or fire, and Ex which refers to the type of glass. It does not expand or change shape when heated. This may be why Pyrex glass in the 1960s and '70s was used in the windows of the Apollo and Gemini spacecraft.

Composition of Pyrex Glass: Density (g/cm<sup>3</sup>) = 2.23000E+00 Mean Excitation Energy (eV) = 134.000000

Properties Of Borosilicate (PYREX 7740) Glass Chemical Resistance Borosilicate glass is inert to almost all materials with the exception of hydrofluoric acid, hot phosphoric acid and hot alkalis. Of these, hydrofluoric acid has the most serious effect and, even when a solution contains a few parts per million, attack will occur. Phosphoric acid and caustic solutions cause no problems when cold but at elevated temperatures corrosion occurs. Caustic solutions up to 30% concentration can be handled safely at ambient temperatures.

Physical Properties: Composition Low-expansion borosilicate glass has the following approximate chemical composition: SiO<sub>2</sub> 81% Na<sub>2</sub>O 4.0% K<sub>2</sub>O 0.5 B<sub>2</sub>O<sub>3</sub> 13.0% Al<sub>2</sub>O<sub>3</sub> 2.0% For further details please refer to ASTM E 438, "Standard Specification for Glasses in Laboratory Apparatus."

Linear Coefficient of Expansion: Between 32°F and 572°F [0°C and 300°C], per ASTM Method E 228) 18.1 x 10<sup>-7</sup> in/in/7°F 32.5x10<sup>-7</sup> cm/cm/°C Annealing: All fittings and all straight lengths are annealed to reduce internal stress. This also makes the pipe easier to field fabricate.

Thermal Conductivity: 0.73 Btu/hr-ft<sup>2</sup>-°F/ft 0.0035 cal/sec-cm<sup>2</sup>-°C/cm Specific Heat: 0.20 Btu/lb-°F 0.20 cal/gm-°C Dielectric Constant: at 23°C and 1M Hz per ASTM Method D 150: 4.6 ±0.2 Density: Approximately 139 lb/ft<sup>3</sup> (2.23 gm/cm<sup>3</sup>) Young's Modulus: per ASTM Method C215: in the range of 9 x 10<sup>6</sup> to 10 x 10<sup>6</sup> psi.

Mechanical Strength: The mechanical properties of glass differ from those of metals. The lack of ductility of glass prevents the equalization of stresses at local irregularities or flaws and the breaking strength varies considerably about a mean value. This latter is commonly found to occur at a tensile strength of about 70 kg/cm<sup>2</sup> (1000 psi). The glass should be adequately supported and appropriate allowance should be made for special conditions such as high temperatures, dense liquids, etc. Subject to the above, maximum working pressures are as specified in the following table.

Working Temperatures Borosilicate glass retains its mechanical strength and will deform only at temperatures which approach its strain point. The practical upper limit for operating temperatures is much lower and is controlled by the temperature differentials in the glass, which depend on the relative temperatures of the contents of the equipment and the external surroundings. Provided borosilicate glass is not subjected to rapid change in temperature, creating undue thermal shock, it can be operated safely at temperatures up to 450°F (232°C). The normal limiting factor is actually the gasket material. The degree of thermal shock (usually defined as sudden chilling) which it can withstand depends on many factors, for example: stresses due to operating conditions; stresses imposed in supporting the equipment; the wall thickness of the glass, etc. It is therefore undesirable to give an overall figure but, as a general guide, sudden temperature changes of up to about 216°F (120°C) can be accommodated At sub-zero temperatures, the tensile strength of borosilicate glass tends to increase and equipment can be used with safety at cryogenic temperatures.

Chemical Hardening Killerglass is chemical hardened by our three step hardening process to increase the impact resistance of the borosilicate glass 300-400% Making this the ideal product for severe duty applications.