Technical Information

Borosil Low Expansion Borosilicate Glass:

From the 16th century to the present day, chemical research teams have been using glass containers for a very simple reason... As the glass container is transparent, the contents and the reaction are clearly visible. However, since chemists need to heat, cool and mix chemical substances, ordinary glass is not always appropriate for laboratory work.

Laboratory work requires apparatus made of glass that can readily be moulded into any desired shape or form. It requires glass that offers maximum inertness when in contact with the widest range of chemical substances. The glass should have the capability to withstand thermal shock without fracture, and it should facilitate high temperature work without deforming. It should be resilient enough to survive the everyday knocks to which it will be subjected in normal laboratory handling, washing and sterilising processes.

Borosil is the trade name of such a glass.

The products represent optimum mechanical, thermal and chemical behaviour. This glass is used in laboratories as well as for industrial applications, where thermal shock resistance, mechanical resistance as well as unusual chemical resistance are required.

Borosil glass is a low alkali borosilicate Type 3.3 glass. Its typical chemical composition is given below. It is virtually free from the Magnesia-Lime-Zinc group, and is also completely free of arsenic and other heavy metals.

	Approx % by weight
SiO_2	81
B_2O_3	13
Na_2O / K_2O	4
Al_2O_3	2

Thermal Properties

Borosil glass has a low co-efficient of thermal expansion. Consequently, the thermal stresses under a given temperature gradient are also low. The glass can withstand higher temperature gradients and also sudden temperature changes / thermal shocks. Minute scratching of the glass surface can, however, reduce its thermal resistance.

'Strain Point' should be regarded as the maximum safe operating temperature for Borosil glassware. When heated above 500°C, the glass may acquire permanent stresses on cooling.

All Borosil laboratoryware is annealed in a modern Lehr, under strictly controlled conditions to ensure minimal residual stresses in the products.

The typical thermal properties of Borosil glassware are mentioned below :

Coefficient of Linear Expansion	**32.5 x10^{-7}cm / cm / ^{0}C**
Strain Point	**515^{0}C**
Annealing Point	**565^{0}C**
Softening Point	**820^{0}C**
Specific Heat	**0.2**
Thermal Conductivity (Cal / cm^3 / ^{0}C / sec)	**0.0027**

Chemical Data

BOROSIL 3.3 Glass is highly resistant to water, neutral and acid solutions, concentrated acids and acid mixtures, and to chorine, bromine, iodine and organic substances. The chemical resistance of this glass is superior to that of most metals and other materials, even when exposed to long processing periods and temperatures above 100 °C. A slight release of mainly monovalent ions takes place after exposure of the glass to water or acids. A very thin layer of impervious silica gel is subsequently formed on the surface of the glass, which in turn slows clown further attack. At higher temperatures and in more concentrated forms the glass surface is subject to increased attack by hydrofluoric acid, hot phosphoric acid and alkaline solutions.

Hydrolytic Class (ISO 719)	**HGB 1**
Acid Class (DIN 12 116)	**S 1**
Alkali Class (ISO 695)	**A 2**

Safe Use of Glassware

Borosil laboratory apparatus is designed to perform efficiently and last long, provided it is used with proper care. The following notes are presented to assist users in deriving the maximum life and performance from their Borosil apparatus.

The following precautions will assist in preventing failures during heating and cooling procedures.

- Do not leave the vessel unattended when evaporation work is being carried out. The vessel may crack or explode as the 'dryness' condition approaches and if the heat source is not adjusted correctly. Decrease the temperature gradually as the liquid level drops.
- Always stay cautious when removing glassware from a heat source. Avoid placing it on a cold or damp surface.
- Even though glassware can withstand extreme temperatures, please keep in mind that sudden temperature changes may cause the vessel to break.
- Always cool vessels slowly to prevent thermal breakage.
- Never apply heat to badly scratched or etched vessels as their thermal strength would have been greatly reduced.
- Never apply point source heating to a vessel; it increases the possibility of breakage.
- All laboratory glassware will withstand to thermal shock of 120^{0}C
- Always diffuse the heat source by using a metal gauze or air/water bath. Alternatively, move the vessel slowly in relation to the heat source to ensure even heating.

- Adjust the Bunsen Burner to get a large, soft flame. It will heat slowly, but uniformly. Uniform heat is a critical factor for some chemical reactions.
- Ensure that the flame is in contact with the vessel below the liquid level. Heating above this level may result in breakage of the vessels.
- Always use anti-bumping devices in the vessel, such as powdered pumice or glass wool, when the vessel and its contents are required to be heated rapidly.
- Never use any material with sharp edges, such as broken porcelain, as an anti-bumping device. This will cause internal abrasions and reduce the mechanical and thermal strength of the vessel.
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- Avoid heating glassware over electric heaters with open elements. Uneven heat of this type can induce localised stress and increase the possibility of breakage.
- Always keep in mind that a hot plate will retain heat long after the appliance has been switched off.
- Always ensure that the surface of the hot plate is larger in area than the base of the vessel being heated. A plate that is under-sized for the job at hand will result in uneven heating and may even cause breakage of the glassware.
- Always ensure that manufacturer's instructions are followed when using electrical heat sources.

Mixing and Stirring

- Always use a teflon sleeve or a similar device on stirring rods, to prevent scratching of the inside of the vessel.
- When using a glass vessel with a magnetic stirrer, always
- use a covered follower. This prevents abrasion of the inside of the vessel.
- When using a glass or metal mechanical stirrer in a glass vessel, always pre-determine the height of the stirrer before use, to ensure that the stirrer blade does not come in contact with the base or sides of the vessel.
- Never mix sulphuric acid and water inside a glass measuring cylinder. The heat caused by the reaction can break the base of the cylinder.

Vacuum and Pressure

- Never use glassware beyond the recommended safe limit.
- Always use a safety screen when working with glassware subjected to pressure or vacuum.
  Never subject glassware to sudden pressure changes
- Apply and release positive or negative pressures gradually.
- Laboratory Bottles are not recommended for use under pressure or vacuum, unless otherwise specified.

Joining and Separating Glass Apparatus

- When storing glass stopcocks and joints, insert a thin strip of paper between the joint surfaces to prevent them from sticking.
- Do not store stopcocks with lubricants on the ground surfaces for long durations.
- Glass stopcocks on Burettes and Separating Funnels require frequent lubrication to prevent them from sticking.
- If a ground joint sticks, separation can usually be achieved by carefully rocking the Cone in the socket, or gentle tapping the socket flange on a wooden surface, or by heating the socket and not the Cone in a localised flame. Using penetrating oil facilitates separation.
- When using lubricants, it is advisable to apply a light coat of grease all around the upper part of the joint. Use only a small amount, and avoid greasing the part of the joint that comes in contact with the inside of the apparatus.
- Three types of lubricants are commonly used on standard taper joints.
  (a) Hydrocarbon grease is the most widely used. It can be removed easily by most laboratory solvents, including acetone.
  (b) As hydrocarbon grease is easy to remove, silicon grease is usually preferred for higher temperature or high vacuum applications. It can be removed with chloroform easily.
  (c) For long-term reflux or extraction reactions, a water-soluble, organic and insoluble grease such as glycerin, is suitable. Glycerin can be removed by means of water.
- When inserting glass tubing into a bung, it is recommended to use water, oil or glycerol on both, the tubing as well as the rubber bung. Always wear heavy protective gloves or similar protection when carrying out this operation.
- Always fire-polish the rough ends of the glass tubing before attempting to insert it into flexible tubing. The lubricants recommended above may also prove useful.
- Never attempt to pull a thermometer out of a rubber bung; always cut the bung away.

Personal Safety

- Use tongs or asbestos gloves to remove any glassware from heat. Hot glass can cause severe burns.
- Protective gloves, safety shoes, aprons and goggles should be worn to safeguard against chemical accidents, spilling or splattering.
- Always flush the outside of the acid bottle with water before opening it. Do not place the stopper on the counter top, where someone else may come in contact with acid residue.
- Care should be taken when handling mercury. Even a miniscule amount of mercury in the base of a drawer can poison the atmosphere in an entire room. Mercury toxicity