Glassware

Glass is an inorganic mixture of metal oxides fused together at high temperatures, which upon cooling, solidifies into the clear, rigid, non-crystalline, versatile material known widely across the globe.

Pyrex® Borosilicate Glass

All Pyrex®, Quickfit®, SVL® and many MBL® branded SciLabware products are manufactured from borosilicate glass (unless otherwise stated).

Standards

Pyrex® is a borosilicate glass which meets the specifications of the following standards:

ISO 3585, DIN 12217	Type 3.3 borosilicate glass
ASTM E-438	Type 1 Class A borosilicate glass
US Pharmacopoeia	Type 1 borosilicate glass
European Pharmacopoeia	Type 1 glass

Due to the demanding conditions that borosilicate glass is subjected to, maximum chemical toughness, minimum thermal expansion and high resistance to thermal shock make Pyrex® the ideal material for use in the laboratory.

Many SciLabware Ltd products also conform to other standards set out for laboratory glassware; for example beakers comply to ISO 3819 and volumetric flasks comply to ISO 1042 and DIN 12664. Typically these standards will specify not only glass type, but also dimensional detail, volumetric accuracy and tolerances.

Chemical Composition

Pyrex® glass has the following typical composition (% by weight):

SiO_2	=	80.6%
B_2O_3	=	13.0%
Na_2O	=	4.0%
Al_2O_3	=	2.3%

Physical Properties

Coefficient of expansion (20 – 300°C)	=	$3.3x10^{-6}K^{-1}$
Density	=	$2.23g/cm^3$
Refractive index (Sodium D line)	=	1.474
Dielectric constant (1MHz, 20°C)	=	4.6
Specific heat (20°C)	=	750J/kg°C
Thermal conductivity (20°C)	=	1.14W/m°C
Poissons Ratio (25 - 400°C)	=	0.2

Chemical Properties

Pyrex® borosilicate glass has a very high resistance to attack from water, acids, salt solutions, halogens and organic solvents. Only hydrofluoric acid, hot concentrated phosphoric acid and strong alkaline solutions cause appreciable corrosion of the glass.

Hydrolytic resistance

For many applications, it is important that laboratory glassware has excellent hydrolytic resistance; e.g. during steam sterilisation procedures, where repeated exposure to water vapour at high temperature can leach out alkali (Na^+) ions. Pyrex® borosilicate glass has a relatively low alkali metal oxide content and consequently a high resistance to attack from water. Pyrex® fits into Class 1 of glasses for hydrolytic resistance according to ISO 719 (98°C) and ISO 720 (121°C).

Acid resistance

Glasses with a high percentage weight of silica (SiO_2) are less likely to be attacked by acids. Pyrex® borosilicate glass is over 80% silica and therefore remarkably resistant to acids (with the exception of hot concentrated phosphoric acid and hydrofluoric acid). Glass is separated into 4 acid resistance classes and Pyrex® corresponds to Class 1 in accordance with DIN 12116 and meets the requirements of ISO 1776.

Alkali resistance

Alkaline solutions attack all glasses and Pyrex® can be classified as moderately resistant. The alkali resistance of Pyrex® borosilicate glass meets Class 2 requirements as defined by ISO 695 and DIN 52322.

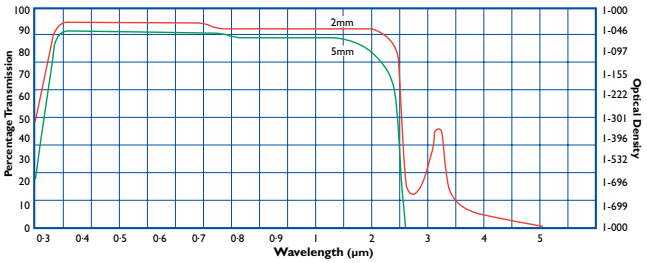
Temperature resistance

Pyrex® borosilicate glass has excellent thermal properties at both high and low temperatures. The maximum recommended working temperature for laboratory glassware manufactured from Pyrex® is 500°C (for short periods of time only). Special care should be taken at temperatures above 150°C to ensure both heating and cooling are achieved in a slow and uniform manner (see Care and Maintenance of Laboratory Glassware).

Pyrex® also performs excellently at lower temperatures. Pyrex® can withstand conditions down to approximately -192°C and is suitable for use with liquid nitrogen. In normal laboratory use, temperatures of -70°C are easily sustained for lengthy periods. Again special care should be taken to avoid sudden changes in temperature, and cooling should be achieved in a slow uniform manner.

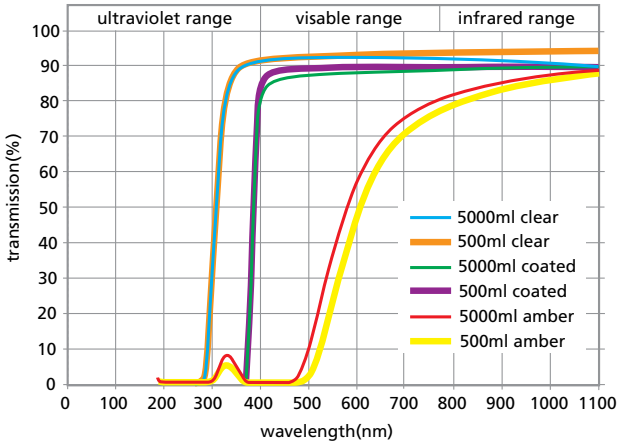
Optical data

Pyrex® borosilicate glass is clear and colourless in appearance and thus transmits light through the visible range of the spectrum. This quality makes it ideal for work involving photochemical reactions, for example chlorinations. The graph (above) shows the degree of transmission of light as a function of wavelength in the ultra-violet, visible and infra-red regions of the spectrum. For the majority of glassware detailed in our catalogue, the thickness of the glass is 2–5mm.



Amber coated Pyrex® glassware

Several SciLabware glass products, including media-lab bottles and volumetric flasks, are available in amber-coated glass. The glassware is coated on the exterior surface with a brown diffusion colour which results in a strong absorption in the short wavelength region up to 500nm. This feature is particularly useful when handling reagents that are light-sensitive.



Glassblowing data

Listed in this catalogue are some Pyrex® and Quickfit® items that are suitable for further manipulation and processing. These items include stopcocks, ground glass joints, sinters and screwthreads. When working with these products, Glassblowers may find the following information useful regarding Pyrex® borosilicate glass:

Working point	=	1252°C
Softening point	=	821°C
Annealing point	=	565°C
Strain point	=	510°C

Pyrex® bottles with retrace codes

Pyrex® media bottles are used in many laboratory processes but they are also used in packaging, which often has to meet the strict requirements of the United States and European Pharmacopoeias (USP and EP), GMP and ISO 9000.

To meet these stringent requirements, all Pyrex® media bottles are now printed with a 'Retrace Code'. This retrace code allows the product to be traced to the point of production and the matching batch. This code is our commitment to support your quality management documentation and can be easily downloaded from the SciLabware web site by keying in the 8-digit code shown on the side of the bottle. 'Retrace' codes can be found on all Pyrex® 1516/: 1517/: 1518/: 1519/: and 1520/: series bottles.

Pyrex® bottles with plastic coating

The Pyrex® range of 1518: media-lab bottles have a plastic coating to provide protection from mechanical impact and to help reduce leakage of the contents should the glass break.

The maximum working temperature for these bottles is 135°C but long term exposure (>30 mins) should be avoided.
Avoid exposure to direct heat from a hotplate or a Bunsen flame. The 1518: media bottle is suitable for freezing at -30°C and can also be used in microwave ovens.

Please note that the plastic coating does not increase the permissible pressure at which the bottles can be used and a protective screen is recommended for all pressure work.

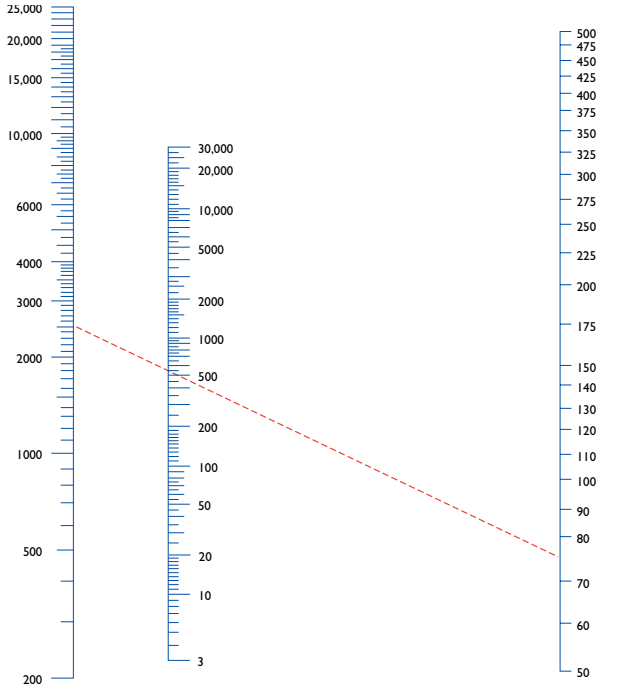
Centrifuge tubes

This catalogue lists a number of Pyrex® and Quickfit® centrifuge tubes. Within the product information for each entry we advise the maximum Relative Centrifugal Force (RCF) they can be subjected to.

Before centrifuging, it is important to calculate the actual RCF values that will be generated. This can quickly be determined by using the following nomogram.

To calculate the RCF value at any point along the tube, measure the radius, in mm, from the centre of the centrifuge spindle to the particular point.

RCF Values



Speed of Centrifuge (rpm)

Relative centrifugal force (xg)

Radius in mm from centre of centrifuge spindle to point along tube or bottle

NB: The chosen point should be the base of the tube as this area will experience the maximum RCF.

Note the radius value from the right of the table and draw a line to the appropriate centrifuge speed value on the left hand column. The RCF value is the point where the line crosses the centre column.

The nomogram is based on the following equation:

$$RCF = (11.17 \times 10^{-7})\ RN^2$$

R = Rotational radius (in mm)

N = Rotational speed (in RPM)

The allocated RCF values are for tubes in good condition. Do not use centrifuge tubes which are scratched, abraded or chipped as the strength will be seriously impaired.

Sintered discs

The SciLabware ranges of filtration glassware utilise sintered discs manufactured from Pyrex® borosilicate glass. Since they are manufactured from Pyrex® they are resistant to the majority of corrosive reagents, unaffected by ammonia, sulphuric acid and other solvents that are damaging to filter paper. The sintered glassware is available in six porosity classes from 0 – 5, as outlined in the table below. The pore sizes indicated, give a range of pores present within the sinter disc. Therefore, the size of particles that will be obstructed will generally be of a size at the upper end of the range.

Porosity Grade	ISO 4793 designation	Pore index (mic.)	Principal uses
0	P250	160 - 250	Coarse filtration, gas dispersion and support for other filter material
1	P160	100 - 160	Course precipitate filtration, gas dispersion, coarse grain material filtration
2	P100	40 - 100	Medium and crystalline precipitate filtration, medium filtration and washing of gases
3	P40	16 - 40	Analytical work with medium precipitates
4	P16	10 - 16	Analytical work with fine precipitates
5	P10	4 - 10	Bacteria filtration

In addition to the above detail, sinters should be treated under the same conditions as described in the general Pyrex® thermal properties as listed on page 13.

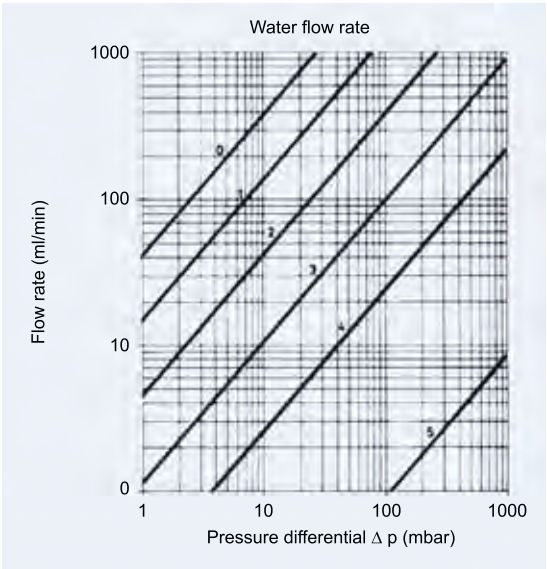
When using new sintered glassware for the first time, we recommend a wash with hydrochloric acid followed by several rinses with distilled water to remove any residual glass dust particles from the sinter.

Sintered discs (continued)

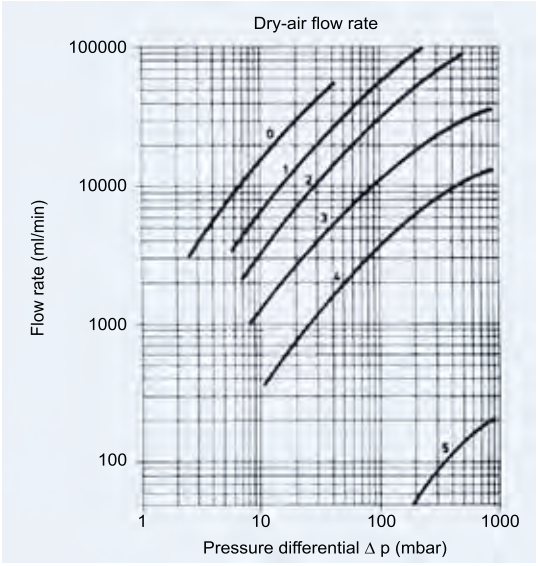
In order to select the correct sinter for any specific application, in addition to the porosity, it is also useful to know the flow rates of liquids and gases through the sinters. These values are given in the charts below for water and air. The data applies to 30mm diameter filter discs. The flow rates for other disc diameters can be calculated by multiplying the value read off by the conversion factor given in the table below.

Filter disc dia. mm	10	20	30	40	60	90	120	150	175
Conversion factor	0,13	0,55	1	1,5	2,5	4,3	6,8	9,7	15

Water flow rate

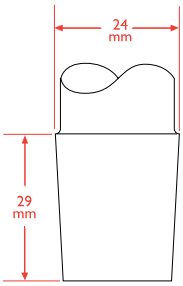


Dry-air flow rate

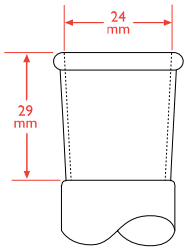


Quickfit® Products

Conical joints

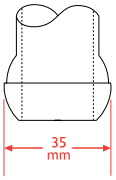


24/29 cone

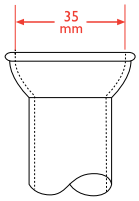


24/29 socket

Spherical joints

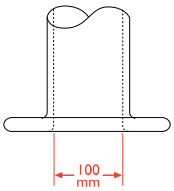


S35 ball



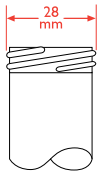
S35 cup

Flat flange



100mm bore flange

Screwthread



28 screwthread

Conical Joints - size designation

Size designation	Actual dia. of wide end (mm)	Actual dia. of narrow end (mm)	Nominal length of engagement (mm)
7/16	7.5	5.9	16
10/19	10.0	8.1	19
12/21	12.5	10.4	21
14/23	14.5	12.2	23
19/26	18.8	16.2	26
24/29	24.0	21.1	29
29/32	29.2	26.0	32
34/35	34.5	31.0	35
40/38	40.0	36.2	38
45/40	45.0	41.0	40
50/42	50.0	45.8	42
55/44	55.0	50.6	44
60/46	60.0	55.4	46

Quickfit® screwthread joints

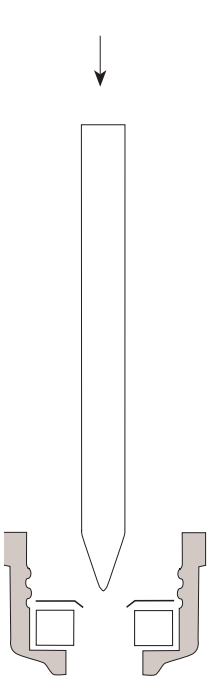


Fig 1

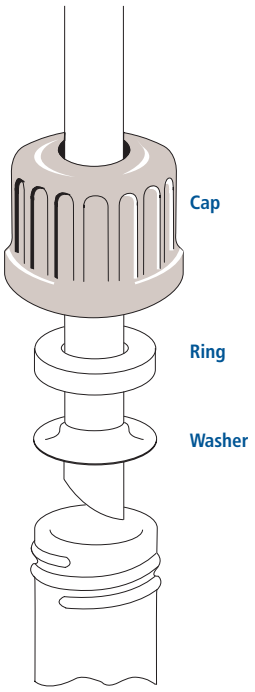


Fig 2

Screwcap assembly

When using screwthreads it is important that the PTFE washer is fitted carefully and correctly. This is best achieved by opening out the washer to the correct diameter using a tapered former. This should be carried out with the silicone rubber ring and PTFE washer in position in the plastic cap as shown in **Fig1**. Withdraw the tapered former and remove the rubber ring and washer from the cap.

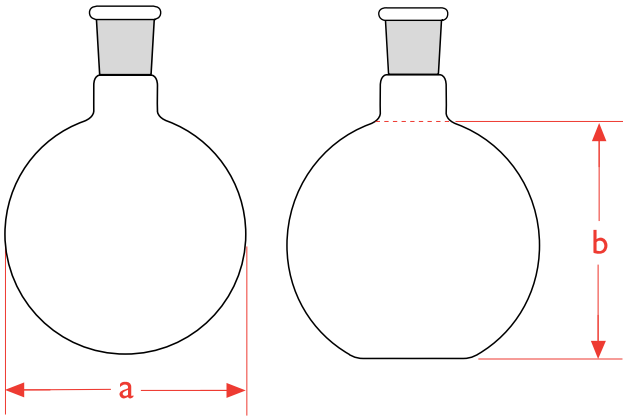
Fit each component separately to the fitting which is to be held, as shown in **Fig 2**, and screw the cap on to the thread. It is advisable that the ends of all fittings should be slightly tapered or fired in a Bunsen flame to remove sharp edges and produce a slight taper.

Quickfit® flask dimensions

The body diameter of Quickfit® Round Bottomed and Flat Bottomed flasks comply with ISO 1773 (BS 6352).

Nominal capacity ml	Approx bulb dia. 'a' mm	Approx bulb height 'b' mm	Nominal capacity ml	Approx bulb dia. 'a' mm	Approx bulb height 'b' mm
5	25	-	1000	132	115
10	30	-	2000	166	155
25	40	-	3000	188	-
50	50	40	5000	220	-
100	65	55	10000	279	-
150	75	65	20000	345	-
250	85	75	-	-	-
500	105	95	-	-	-

Quickfit® flask dimensions



Volumetric Glassware

SciLabware Ltd manufactures two brands of volumetric glassware, Pyrex® and MBL®. As the name indicates Pyrex® volumetrics are manufactured solely from Pyrex® borosilicate glass. MBL® volumetric products are manufactured from borosilicate and soda-lime glass. Soda-lime glass is generally used for Class B products or where long term exposure to chemicals is unlikely, e.g. one mark pipettes.

Pyrex® volumetric glassware has superior thermal and chemical resistance and is better suited to glassware for storage of solutions, e.g. flasks.

The use of Pyrex® borosilicate glass for volumetric glassware means accuracy is retained over a longer working lifetime than their soda-lime equivalents. With everyday use, volumetric glassware requires recalibration. Soda-lime glass items will generally necessitate twice as many recalibrations as items constructed from borosilicate glass.

ASTM 542 and ISO 4787 international standards for calibration of laboratory volumetric glassware recommend that volumetric flasks are recalibrated at the following intervals (or sooner if chemical corrosion is observed): Borosilicate – 10 years; Soda-lime – 5 years.

Volumetric accuracy

SciLabware volumetric glassware is manufactured and calibrated in accordance with international ISO standards to permit very accurate determination and measurement of specific volumes. They are available in two accuracy classes: Class A/AS and Class B. The two classes differ in the accuracy of measurement with a Class A/AS being the highest accuracy, and class B is approximately half of a class A. Class AS has the same high tolerances as Class A, but is designed to permit more rapid outflow on burettes and pipettes.

Inscriptions

SciLabware volumetric glassware is manufactured and calibrated in accordance with international ISO requirements. All of our volumetric glassware is marked with a set of inscriptions in accordance with any specific standard associated with it.

Tolerance	Class A/AS – Highest level of accuracy. Class B – General purpose work calibrated to a lower level of accuracy
Standard	The standard to which the product conforms
Graduation	Pyrex® and MBL® volumetric glass is graduated in ml (millilitres) in accordance with ISO
IN	Calibrated to contain
EX	Calibrated to deliver
Blowout	Indication that last drop should be blown out of jet
Temp °C	All Pyrex® and MBL® volumetric glassware is calibrated at 20°C
Certification	All Class A/AS Works Certified glassware bears a serial number for identification and traceability.

Certification

Many of our range of volumetric products are available with certification. Our certificates confirm that the product has been tested for compliance to the appropriate standard. Below is an overview of the certification that is offered by SciLabware.

Works Certified Products

Pyrex® and MBL® Class A/AS Works Certified volumetric flasks, pipettes, cylinders and burettes are inscribed with an individual serial number and are supplied with an individual calibration certificate. Each certificate includes details of the actual volume, uncertainty estimation for the calibration and the required tolerance for compliance.

Batch certificates

For our ranges of Pyrex® Class A volumetric flasks and cylinders and MBL® Class AS pipettes a downloadable batch certificate is available from the SciLabware website. The batch certificate contains detailed information pertaining to the specific production batch including average volume and standard deviation for the batch.

To download a batch certificate visit www.scilabware.com and go the 'certificates' section then follow the links for the specified product. Simply enter the serial number marked on each volumetric item and the batch certificate is downloaded as a pdf.

Re-calibration

Normally, volumetric glassware only needs re-calibrating after extensive or demanding usage, which may have affected the original accuracy.

Re-calibration is usually not necessary if:

- The glassware is new but been in storage for some time. Age does not affect accuracy.
- The glassware is only subjected to moderate temperatures such as cleaning in a washing machine or sterilising in an autoclave at 121°C.
- The glassware has been used for less than 5 years with no repeated use of corrosive chemicals or strong acids/ alkalis.

However, recalibration should definitely be considered under the following circumstances:

- The glassware is made from soda-lime glass and has been in use for 5 years.
- The glassware is made from borosilicate and has been in use for 10 years.
- The glassware has been subjected to temperatures in excess of 150°C.
- The glassware is frequently used with strong acids or bases.
- There are any signs of chemical corrosion e.g. frosting of internal glass surfaces.

Care and maintenance of laboratory glassware

SciLabware Ltd has a commitment to provide the highest quality glassware products. All of our glassware is manufactured with great care in order to provide you with a reliable piece of laboratory equipment. To obtain maximum life and performance from your glassware, correct handling is essential. The following notes will serve as a guide to new users and to remind more experienced handlers of the recommended procedures.

General precautions

Before using any piece of glassware, take time to examine it carefully and ensure that it is in good condition. Do not use any glassware which is scratched, chipped, cracked or etched. Defects like these can seriously weaken the glass and make it prone to breakage in use.

- Dispose of broken or defective glassware safely. Use a purpose-designed disposal bin that is puncture resistant and clearly labelled.

- Pyrex® laboratory glassware should under no circumstances be disposed of in a domestic glass recycling stream (e.g. bottle banks), since its high melting point make it incompatible with other glass (soda-lime glass) for recycling. The correct method of disposal is to include it in with general waste in accordance with the relevant guidelines, provided that the glass is free of any harmful chemical contamination.

- Never use excessive force to fit rubber bungs into the neck of glass aspirators, test tubes, conical flasks, etc. Take care to select the correct size.

- Many SciLabware products are provided with durable, easy to use screwthread connectors, to allow installation of any tubing. When attaching tubing, ensure the screwthread connector is removed from the glassware, the tubing is lubricated and protective gloves are worn. Never use excessive force to connect rubber hose or tubing.

- Lifting or carrying large glass flasks, beakers or bottles etc. by the neck or rim can be very dangerous. It is best to provide support from the base and sides.

- When stirring solutions in glass vessels, such as beakers and flasks, avoid using stirring rods with sharp ends which can scratch and weaken the glassware.

- Do not mix concentrated sulphuric acid with water inside a glass measuring cylinder. The heat of reaction can break the seal at the base of the cylinder.

- We recommend that all glassware is washed before it is first used.

- Wash glassware promptly after use to avoid hard dried residues. Use a biodegradable, phosphate free detergent, specially formulated for laboratory use.

- Do not use cleaning brushes which are badly worn and where the metal spine may scratch the glass.

Heating and cooling

The maximum recommended working temperature for Pyrex® and Quickfit® glassware is 500°C (for short periods only). However, once the temperature exceeds 150°C extra special care should be taken to ensure that heating and cooling is achieved in a slow and uniform manner.

- Pyrex® borosilicate glass is microwave safe. However, as with any microwave vessel, be sure it holds a microwave absorbing material, such as water, before placing in the oven. Many SciLabware items utilise plastic screwcaps and connectors. These are typically manufactured from polypropylene or PTFE, both of which are microwave safe.

- Do heat vessels gently and gradually to avoid breakage by thermal shock. Similarly, allow hot glassware to cool gradually and in a location away from cold draughts.

- If you are using a hotplate, ensure that the top plate is larger than the base of the vessel to be heated. Also, never put cold glassware onto a hotplate which is already well heated. Warm up gradually from ambient temperature.

- When autoclaving Pyrex® containers, e.g. bottles with screwcaps – always slacken off the caps. Autoclaving with tightly screwed caps can result in pressure differences and consequent breakage.

- If you are using a Bunsen burner, employ a soft flame and use a wire gauze with ceramic centre to diffuse the flame.

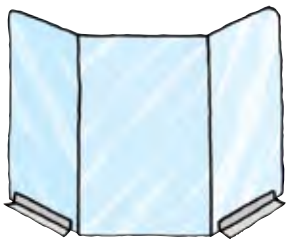
Preparation of media

Take great care when heating liquids that have a HIGH VISCOSITY. Viscous liquids can act as thermal insulators and can cause 'hot spots' leading to thermal breakage of the glassware. This is particularly important with MEDIA SOLUTIONS as the viscosity usually increases considerably during preparation.

- Do regularly stir the solution to assist even distribution of heat. If using a magnetic stirrer set the speed to ensure adequate agitation of the whole liquid.
- Do not use glass vessels with thick walls e.g. Pyrex® 'Heavy Duty Ware' or standard beakers or flasks which have capacities of 5 litres or greater.

Vacuum and Pressure Use

Because working conditions can vary enormously, SciLabware cannot guarantee any glassware against breakage when used under vacuum or pressure. The application of positive pressures inside glass apparatus is particularly hazardous and should be avoided if at all possible. Safety precautions should always be taken to protect personnel and a number of these are listed below:



- Always use an adequate safety screen and/or protective cage.
- Under no circumstances use glassware that is scratched, cracked or chipped. Its strength will be seriously impaired.
- Do not use flat bottomed vessels such as Erlenmeyer flasks and bottles under vacuum as they are likely to implode. Exceptions are vessels with specially thickened walls such as Büchner filter flasks and desiccators.
- Avoid stress caused by over-tightening clamps. Support glassware gently where possible.
- Never subject glassware to sudden pressure changes. Always apply and release pressure gradients and vacuums gradually.

Ground Glass Joints

Lubricate the ground surfaces of joints to prevent leakage in use and facilitate separation. Use a silicone-free laboratory grease and apply a light coat completely around the upper part of the joint

Alternatively, consider PTFE joint sleeves which can be fitted between the cone and socket.

- If ground glass joints do seize, then the following remedies can be considered;

  - Always wear thick protective gloves and safety spectacles. Never use force.
  - Carefully rock the cone in its socket to achieve separation.
  - If the joint is 'dry', try to provide lubrication. Hold the joint upright and add penetrating oil to the top of the cone. Wait until the penetrating oil is well into the joint before trying to separate.
  - If the use of temperature is permissible, e.g. no volatile liquids present, then warm the outer socket under a running stream of hot water from the tap. Hold under the tap for a few minutes before trying to separate.

Sintered Glassware

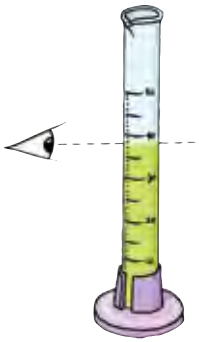
New apparatus with sintered glass discs should be washed before use to remove loose particles of dust etc. Wash through with hot dilute hydrochloric acid followed by a thorough rinse with water.

- Do ensure that the porosity of the sintered disc is appropriate for the application. Porosity 0 sinters are for coarse filtration, whilst higher grades give progressively finer filtration.
- Never subject sintered glassware to differential pressures exceeding 100kN/m^2 (1 bar).

Volumetric Glassware

Do ensure that all volumetric glassware is kept scrupulously clean. Dirt, and especially grease, can distort the shape of the meniscus and also cause droplets of liquid to adhere to the vessel walls. Both seriously impair accuracy. (Good cleanliness is indicated by uniform wetting of the glass surface with distilled water).

- Never pipette by mouth. Always use a purpose designed pipette filler.
- Autoclaving at 121°C and cleaning in automatic dishwashers is acceptable and will not affect the accuracy of Pyrex® or MBL® glassware.



- All items should be held in a vertical position when reading the meniscus. The meniscus should be at eye level to avoid parallax errors.
- If using strong corrosive acids etc. select volumetric ware manufactured from chemically resistant Pyrex® borosilicate glass.
- Do not expose volumetric glassware to direct heat e.g. hotplates, bunsen flame.

Pyrex® is a registered trade mark of Corning Inc.
SciLabware is a registered user.