

TECHNICAL INFORMATION

INTRODUCTION

Borosilicate glass 3.3 are widely used as the basis for the construction of complete process systems all over the chemical, dyestuff, food, pharmaceutical, and petrochemical industries. The abbreviation for the coefficient of linear expansion is $(3.3 \pm 0.1) \times 10^{-6} \text{ K}^{-1}$. This is lower than any other industrial glass. Since this glass expands less, the tensile stresses in the glass wall during heating are less, which means that it is able to withstand a greater thermal shock and the maximum working pressure for a given operating temperature is greater.

One reason for this widespread use is the special properties of borosilicate glass 3.3 (see below), complemented by the use of other highly corrosion resistant materials such as PTFE and ceramics. Secondly, borosilicate glass is able to withstand a greater thermal shock and the maximum working pressure for a given operating temperature is greater.

CHEMICALS COMPOSITION OF BOROSILICATE GLASS -3.3

The chemical composition of borosilicate 3.3 glass used in the manufacture of process plant and pipeline components is as the following approximate compositions.

Component	% by weight
SiO ₂	80.6
B ₂ O ₃	12.5
Na ₂ O	4.2
Al ₂ O ₃	2.2
Other	0.5%

RESISTANCE TO CHEMICAL

Borosilicate glass is resistant to almost all substances except hydrofluoric acid, phosphoric acid and hot strong caustic solutions. Of these, hydrofluoric acid has the most serious effect and, even when a solution contains a few parts per million, corrosion will occur.

Phosphoric acid and caustic solutions cause no problem when cold but at elevated temperatures corrosion occurs. Caustic solutions up to 30% concentration can be handled safely at ambient temperature.

PROPERTIES OF BOROSILICATE GLASS 3.3

The very large use of this material throughout the world in the chemical and pharmaceutical industries as well as many other allied areas, is mainly due to its chemical and thermal properties (see also ISO 3585) together with a great number of other benefits that make a distinction borosilicate glass 3.3 from other materials of construction. These include special properties such as:

- ☞ Smooth, pore-free surface
- ☞ Transparency
- ☞ Outstanding corrosion resistance
- ☞ Physiological suitability
- ☞ Non-flammability
- ☞ Catalytic inertness.
- ☞ Neutral smell and taste.

PHYSICAL PROPERTIES

Borosilicate glass 3.3 differs from other materials of construction used for process plant not only because of its virtually universal resistance to corrosion (see below) but also because of its very low thermal expansion coefficient. There is, therefore, no need for expensive measures to compensate for thermal expansion resulting from changes in temperature. This becomes of particular significance in the layout of long runs of glass pipeline.

The most important physical properties for the construction of plant are listed below (see also ISO 3585 and EN 1595).

Coefficient of linear thermal expansion 20/300°C = $(3.3 \pm 0.1) \times 10^{-6} \text{K}^{-1}$

Thermal conductivity between 20 and 200°C = $1.3 \text{W m}^{-1} \text{K}^{-1}$

Specific heat capacity between 20 and 100°C = $0.8 \text{kJ kg}^{-1} \text{K}^{-1}$

Specific heat capacity between 20 and 200°C = $0.9 \text{kJ kg}^{-1} \text{K}^{-1}$

MECHANICAL PROPERTIES

The lack of ductility of glass prevents the equalization of stresses at local irregularities of flaws and the breaking strength varies considerably about a mean value. This latter is commonly found to occur at a tensile strength of about 700kg/cm^2 .

In order to allow for the spread of breaking stress, the safety factor is applied when determining the wall thickness requirement to allow operation up to values given in the table of working pressure.

Density $2.23 \times 10^3 \text{Kg/m}^3$

Modulus of elasticity $E = 6500 / \text{mm}^2$

Permissible Tensile and bending strength $K/S = 6 \text{N/mm}^2$

Permissible Compressive strength $K/S = 100 \text{N mm}^2$

Poisson's ratio (transverse contraction figure) $\nu = 0.2$

OPTICAL PROPERTIES

Borosilicate glass 3.3 shows no appreciable light absorption in the visible area of the spectrum, and consequently it is clear and colourless.

With borosilicate glass 3.3 the transmission of UV light, which is of great importance for photo-chemical reactions, is somewhat greater in the middle spectrum than with normal window glass. The chlorine molecule absorbs in the 280 to 400nm range, it can be seen that plant made from this material is, therefore, ideal for chlorination and sulphochlorination processes. .

PERMISSIBLE OPERATING TEMPERATURE

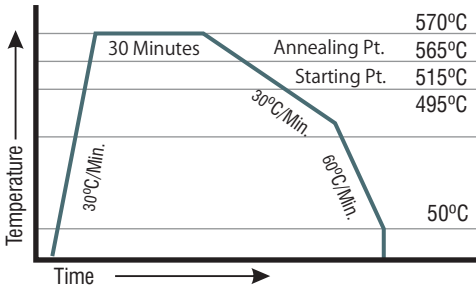
All Glass components and complete plant can be operated safely at temperature 200°C. provided that there is no sudden temperature shock.

This practical working temperature limit is set by the physical properties of the sideline equipments like gaskets, PTFE bellows, couplings and structure & supports, but not the glass components.

ANNEALING

Annealing of glass is the process where the glass is heated and kept for a defined period of time to relieve internal stresses. Careful cooling under controlled conditions is essential to ensure that no stresses are reintroduced by chilling/cooling.

TECHNICAL INFORMATION

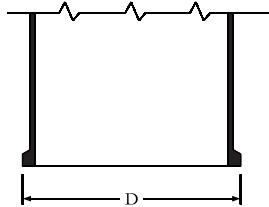
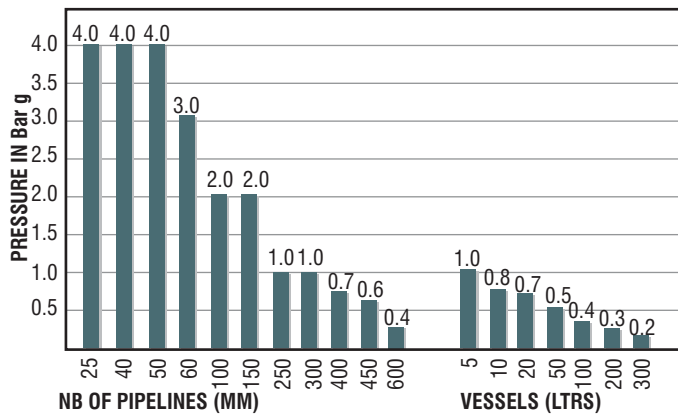


THERMAL SHOCK

Quick changes in temperature across the walls of glass components should be avoided during operation both indoors and outside. They result in increased thermal stress in the glass, which, as described above, has an adverse effect on the permissible operating pressure of the plant components. Although it is not possible to give a definite figure applicable to all the operating conditions likely to be encountered in practice, a maximum permissible thermal shock of 120°C can be taken as a general guide.

PERMISSIBLE OPERATING PRESSURE

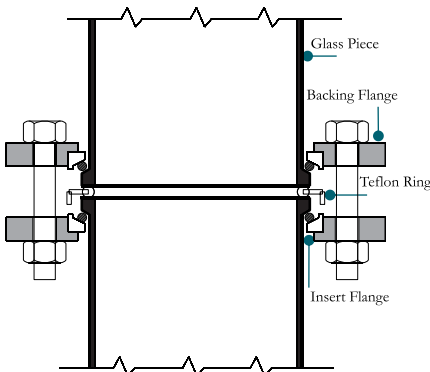
The permissible internal operating working pressures depends on the nominal diameter size of glass components and external temperature. The maximum working pressure for a complete glass plant is determined by the lowest rated components in the systems. All glass components are suitable at full vacuum over the entire temperature range. Bar is a measure of absolute pressure.



GLASS BUTTRESS ENDS

The glass process plant and pipeline components detailed in this catalogues have standard Flat buttress ends as per our standard, which are interchangeable with any international standard. We can also supply Ball & socket (Spherical ends forms), and tapered type buttress ends as per international standard upon the request.

The major dimensions of the safety flat buttress ends can be found in the table below, in conjunction with the illustrations alongside.



Nominal bore DN mm	Buttress end diameter D mm	Tolerances (+)
25	42.5	(+)0.0, (-)1.5
40	57.5	(+)0.0, (-)1.5
50	70	(+)0.0, (-)1.5
80	99.5	(+)0.0, (-)1.5
100	133	(+)0.0, (-)2.0
150	185	(+)0.0, (-)2.0
200	232	(+)0.0, (-)2.0
225	259	(+)0.0, (-)2.0
300	340	(+)1.0, (-)3.0
400	464	(+)1.0, (-)4.0
450	525	(+)1.0, (-)4.0
600	684	(+)2.0, (-)6.0

FLANGE DIMENSIONS BALL SOCKET

(as per international standard)

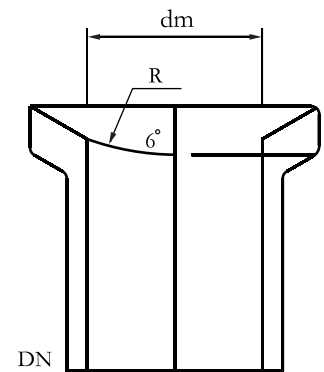
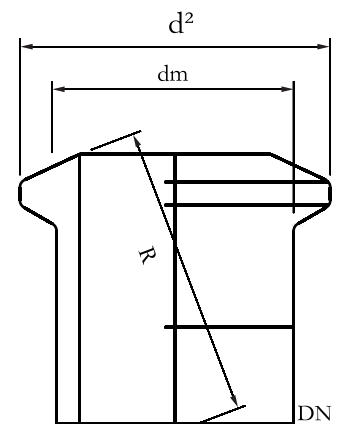
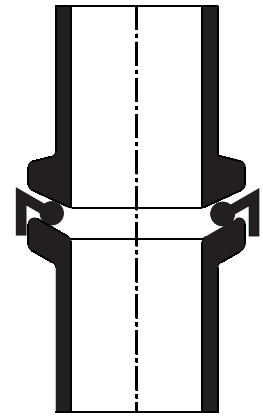
DN	L	CAT. REF.
15	50	APT07
25	100	APT1
40	150	APT1.5
50	150	APT2
80	200	APT3
100	250	APT4
150	250	APT6
225	375	APT9
300	450	APT12

DN	d2 mm	dm	R mm
15	30	23	18
25	44	34	25
40	62	51	40
50	76	63	50
80	110	96	80
100	130	116	100
150	184	169	150
200	233	220	200
300	338	321	300
400	464	435	-
450	526		
492	-		
600	684		
646	-		

LENGTH & TOLERANCE OF GLASS COMPONENTS

The tolerance on length L together with dimension L1, L2 and L3 of components, unless otherwise specified for given components in this catalogue. As per international standard.

Nominal Bore DN	Length (L, L1, L2, L3)
DN 15 to 40	3 mm
DN 50 to DN 225	3.5 mm
DN 300 to DN 450	4.0 mm
DN 600 _____	5.0mm



TECHNICAL INFORMATION

TECHNICAL SERVICES:

The following technical services are available on per day charges basis.

1. Engineer
2. Skilled Fitter
3. Semi Skilled Fitter
4. Helper

TRANSPORTATION:

Glass is very fragile item, therefore buyers always cover the insurance at our end, for a consider safe side.

REPAIRS:

Though any damaged glass equipment can be repaired, mostly it is not economical to do so. Generally the repair which involves less than a third of its original work is worth to carry out repairing. Repair work is costly because:

1. It generally requires greater skill than making a new one.
2. Since it involves high risk of total breakage, the risk of total loss of time spent on its repairing goes along with.
3. The work involved in receiving a damaged equipment, identifying it throughout the handling, cleaning it, estimating its repairing charges, re-estimating the repairing charges in case damage extends etc are relatively expensive.
4. Each job requires individual attention throughout the execution.

However, while sending equipment for repairing, following care must be taken:

1. Inform the nature of breakage and get an estimate of repairing charges in advance to avoid the loss of transportation expenses in case it is uneconomical to go for repairing.
2. Since repairing takes longer time to fit into production schedules and completion of repairing is highly uncertain, it is generally suggested to arrange for a substitute equipment to continue the work.
3. Equipment to be repaired should be clean. Since it can be cleaned better and at less cost at owner's premises. It should be cleaned before sending it for transportation. This also makes it safer to transport.
4. Pack with extra care, since cracks in glass have a tendency to extend with every jerk.
5. If Possible, send broken pieces along with it.
6. Generally repairing work is accepted only for the equipment manufactured by us, and is repaired at owner's risk only.

DIMENSIONS, WEIGHTS AND SPECIFICATIONS

In this catalogue, dimensions, weights and other specifications are taken more or less in accordance with Corning. This is to keep the flexibility of maximum interchange ability. However, some differences are unavoidable due to local manufacturing conditions. All the odd dimensions are rounded off.

All the dimensions and weights are approximate. The specifications given in the catalogue are intended to present a general description of the items. Since manufacturing of glass equipment involves all manual operations, certain tolerances are obvious and permissible while passing the items through quality control.

MODIFICATIONS

We reserve the right to carry out technical modifications of products and data mentioned in this catalogue as and when require.

Standards Practiced : DIN ISO-3585, DIN ISO-3586, DIN ISO-3587,
DIN ISO-4704 BSEN-1595, DIN ISO-718