

BELGIQUE

Glaverbel
Chaussée de La Hulpe 166 • B-1170 Bruxelles
Tel. 02 674 31 76 • Fax 02 674 31 64
sales.belgium@glaverbel.com

**CZECH
REPUBLIC**

Glaverbel Czech
Skarska 450 • CZ-41674 Teplice
Tel. (0417) 50 11 11 • Fax (0417) 27 777
czech@glaverbel.com

DANMARK

Glaverbel Danmark A/S
Landemaerket 3
DK-1119 København K
Tel. 33 91 12 23 • Fax 33 91 20 04

DEUTSCHLAND

Bluhm & Plate GmbH
Von Bronsart-Strasse 14
D-22885 Barsbüttel-Hamburg
Tel. (040) 670 88 40
Fax (040) 670 88 410
info@bluhm.de

Clemens Schlatt
Robert Bosch-Strasse 36
D-46397 Bocholt-Westfalen
Tel. (02871) 9 94 00
Fax (02871) 18 36 81
schlatt@glaverbel.com

**ESPAÑA/
PORTUGAL**

Glaverbel Iberica
Calle Industria 333
Apartado 37 • E-08912 Badalona
Tel. (93) 460 97 00 • Fax (93) 460 97 10
info@sp.glaverbel.com

FRANCE

Glaverbel France S.A.
Tour Pascal A, Place des Degrés 6
F-92045 Paris La Défense Cedex
Tel. 01 55 91 30 00
Fax 01 55 91 32 60
gvb.france@glaverbel.com

GREECE

Glaverbel Hellas
Spefsippou 44
Kolonaki
GR-10676 Athinai
Tel. (01) 72 99 210 (20-21)
Fax (01) 72 99 211

ITALIA

Glaverbel Italy
Via Filippo Turati, 7 • I-20121 Milano
Tel. (02) 626 90 110 • Fax (02) 657 01 01
gvb.italy@glaverbel.com

NEDERLAND

Glaverned B.V.
Postbus 6139 • NL-4000 HC Tiel
Tel. (0344) 67 99 22 • Fax (0344) 67 97 24
glaverned@glaverbel.com

NORGE

Glaverbel Norge A/S
Skovveien 3 • N-0257 Oslo 2
Tel. 22 43 02 40 • Fax 22 55 83 24
gvb.norge@glaverbel.com

ÖSTERREICH

Glaverbel Austria S.A.
Longschamps 25
CH-2068 Hauterive NE - Schweiz
Tel. +41 32 753 71 33
Fax +41 32 753 61 78
gvb.suisse@glaverbel.com

POLSKA

Glaverbel Polska Sp.z o.o.
Byslawska 73, Falenica, Warszawa 4-993
Tel. (0048) 22 872 0223 - 872 0323
Fax (0048) 22 872 9760
glaverbelpolska@glaverbel.com

**SUISSE
SCHWEIZ**

Glaverbel Suisse S.A.
Longschamps 25
CH-2068 Hauterive NE
Tel. (032) 753 71 33
Fax (032) 753 61 78
gvb.suisse@glaverbel.com

SVERIGE

Glaverbel Svenska AB
P.O. Box 209 • S-18323 Täby
Tel. (08) 768 40 80
Fax (08) 768 40 81
gvb.svenska@glaverbel.com

**UNITED
KINGDOM**

Glaverbel (UK) Ltd.
Chestnut Field, Regent Place, Rugby,
Warwickshire CV21 2TL
Tel. (01788) 53 53 53
Fax (01788) 56 08 53
gvb.uk@glaverbel.com

Glaverbel has representatives worldwide. Please contact us for additional addresses.



Glaverbel
www.glaverbel.com

Headquarters:
Chaussée de La Hulpe 166 - B-1170 Brussels
Tel. +32 2 674 31 11 • Fax + 32 2 672 44 62

CURVED GLASS



CURVED GLASS

The use

of curved

glass offers

fresh design

possibilities

for your living

and working

environment.

Its many

applications

mean that

you can choose

from a wide

range of

combinations

when designing

glass components

or walls.

The product

Curved glass is produced by gradually heating flat glass to a temperature just above its softening point, and then letting it mould itself to a concave or convex mould laid out horizontally in a bending furnace. Once the moulding process is complete, the unit is cooled in a controlled manner to ensure that the end product is free of any internal stress.

Applications

When used outdoors, curved glass lends an original finish to facades. In vertical walls and glass roofs, it yields an original look (building angles, display windows, roofing for street furniture, double security doors, and so on).

Indoors, curved glass can be used in balustrades, lift walls, display counters, office partitions and elsewhere.



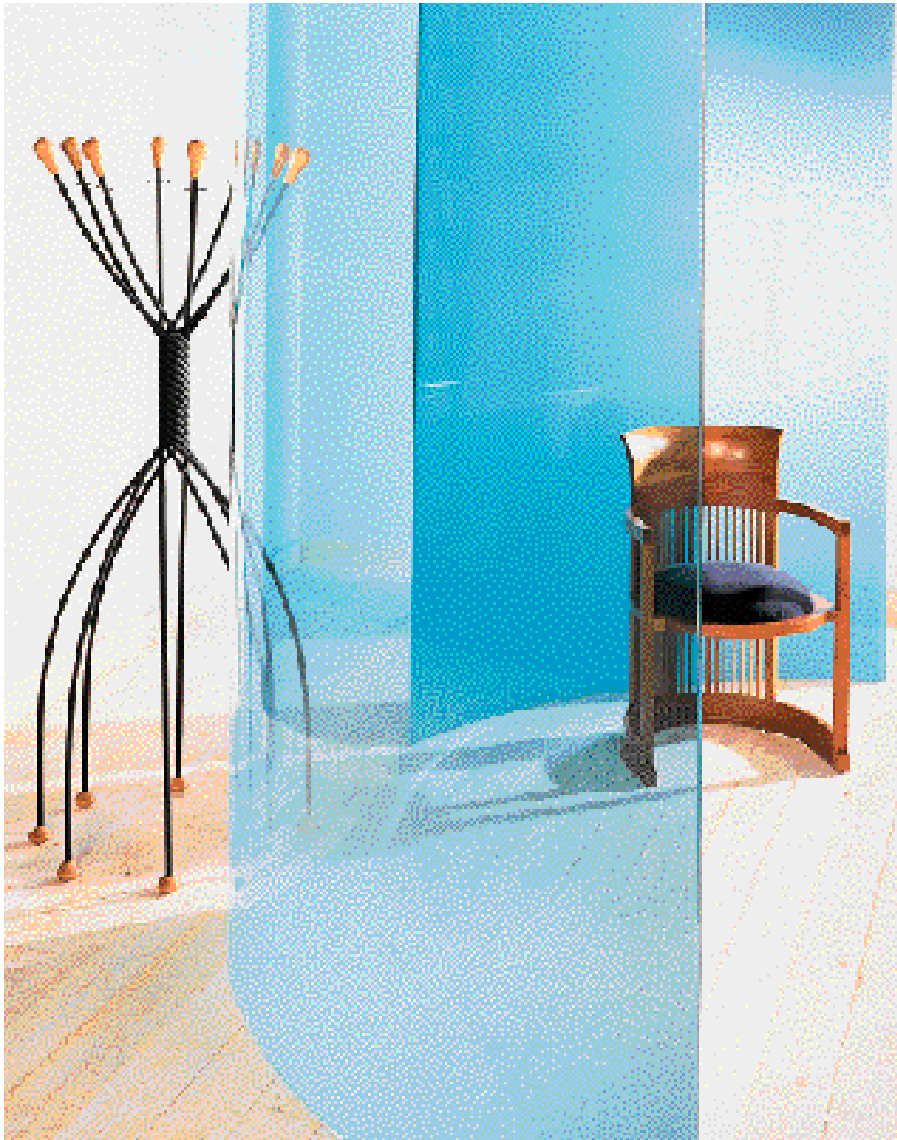
Handling

Certain precautions must be observed when handling curved glass so as to limit the risk of breakage. The rules on handling are governed chiefly by the size of the glass, its weight and its curve radius. The glasses must be held by the straight edges and by the middle of the curve when handled.

Storage

Curved glasses are best stored upright on their girth.

For a short-term storage we would advise to store the glass in its original packaging.



CURVED GLASS

Glazing

The general guidelines governing the glazing of insulating glasses and security glasses are also valid for curved glasses.

The frame

To facilitate the glazing of glasses, the frames should preferably be designed with the glazing bead on the convex side of the glass.

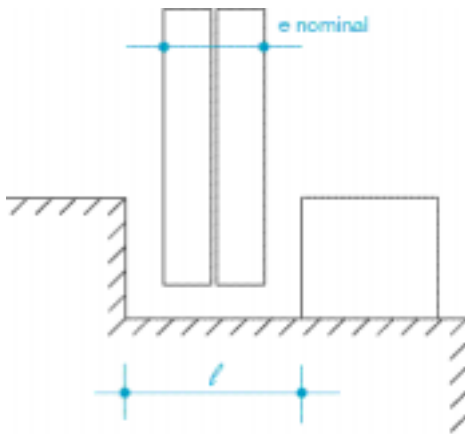
When sizing the rebates account must be taken of greater deformation than for flat glasses. The rebate should be designed in such a way that it can allow deformation due to the curving and prevent any glass/frame contact.

The frame may under no circumstances induce any tension in the glass.

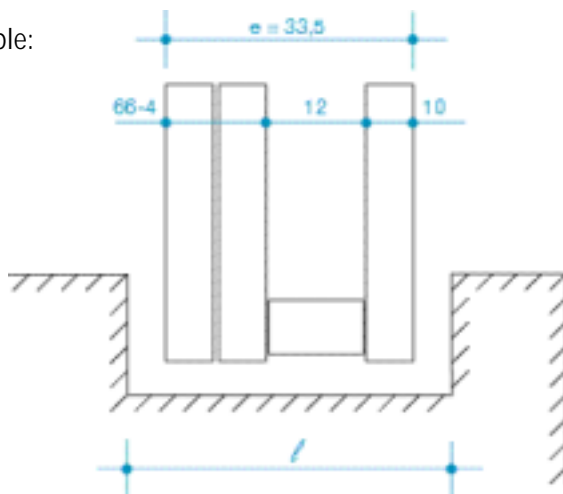
The useful width of the rebate should take account of the manufacturing tolerances of the curved glass. It can be determined as follows:

$$l = \text{thickness of the pane} + \text{thickness of the largest component} + 8 \text{ mm}$$

This formula applies to monolithic curved sheets, curved laminated glasses and curved insulating glasses



Example:

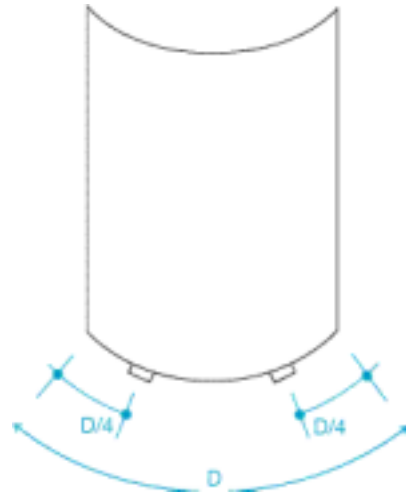


$$l = 33,5 + 10 + 8 = 51,5 \text{ mm}$$

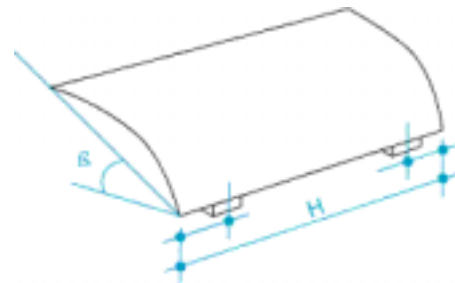
Blocking

Setting blocks

Sheets which are stored vertically are blocked at 2 points, located about 1/4 of the way along the evolute from either end.



Horizontally stored sheets are supported by two setting blocks arranged lengthwise along the straight sides, about 1/10 to 1/5 of H.



For β angles measuring less than 45° 2 setting blocks arranged as described above are also used along the upper side.

Spacing blocks

In both instances, spacing blocks must be arranged judiciously.

- depending on the tolerances for deformation of the frame and glass;
- so as to correctly centre the sheets in the rebates without clamping it and in such a way that significant localized stresses caused by wind or snow are not created

Sealing

The glasses are best sealed with silicone gaskets.

Drainage

The rules governing drainage are the same for curved glass as for flat glass.

What types of glass can be curved?

All basic float glasses (between 4 and 19 mm thick) can be used to make annealed curved glass.

The following types of glass can be curved:

- Planibel (clear and body tinted)
- Stopsol Classic and Supersilver (*)
- Pyrolitic low-emissivity glass (*)
- Imagin patterned glasses

(*) Feasibility with the coating in the convex or concave position depends on the curve parameters; to be determined on a case-by-case basis.

What kind of curved glasses are available?

Annealed curved glass: the glass is produced through gravitational pull on flat glass which is gradually heated.

Stratobel laminated annealed curved glass: This consists of two or more sheets of stacked annealed glass which is then curved and assembled with PVB interlayers measuring at least 0.76 mm thick. This glass can be used to comply with security and sound insulation requirements.

All curved laminated glasses can be fabricated to suit safety and security applications which comply with different standards e.g. BS, DIN, NFP, NBN, prEN, etc. We can also produce bullet-proof compositions with a symmetrical structure, less than 30 mm thick and weighing less than 100 kg per sheet.

Curved insulating glass: This is a sealed insulated unit whose constituent glasses are curved and separated by a metal interlayer. The constituent curved glasses may be annealed laminated or annealed single glasses. Assembling curved glass into insulating glass makes it possible to achieve a k-value of 2.8 to 2.9 W/m².K (or 1.8 to 1.9 W/m².K with Pyrolitic low-emissivity glass).

Please consult us for other types of glass.

Edge finish

Each component is cut and shaped prior to curving and assembly. Consequently, the individual components in the final product may be slightly offset.

Curved glasses can be supplied with:

- arrisled edges
- ground edges, flat or round, matte or polished
- holes and notches

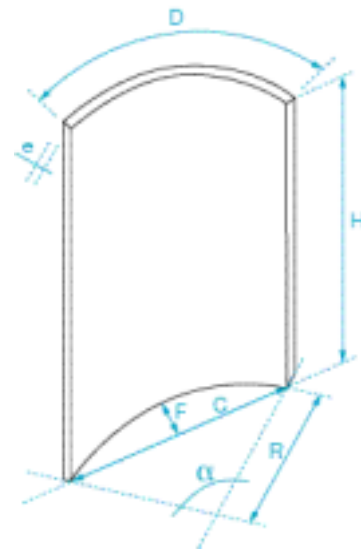
Decoration

Decorative treatments such as screen-printing (*) and enamelling (*) may be applied to curved glasses prior to the curving process to the side that does not come into contact with the mould.

A decorative film may be incorporated in laminated curved glass.

(*) Enamels are vitrified at a high temperature but the glass substrate is annealed. Consequently, this is neither a safety/security glass nor a glass resistant to thermal stresses.

Practical information for specifying a curved glass with a regular curve



There are three kinds of information:

1. Product definition:
 - type of the glass product
 - glass thickness
2. Height (H) of the cylinder generatrix
3. The curve, defined by
 - D = girth
 - C = chord length
 - F = depth
 - R = curve radius
 - a = angle at centre

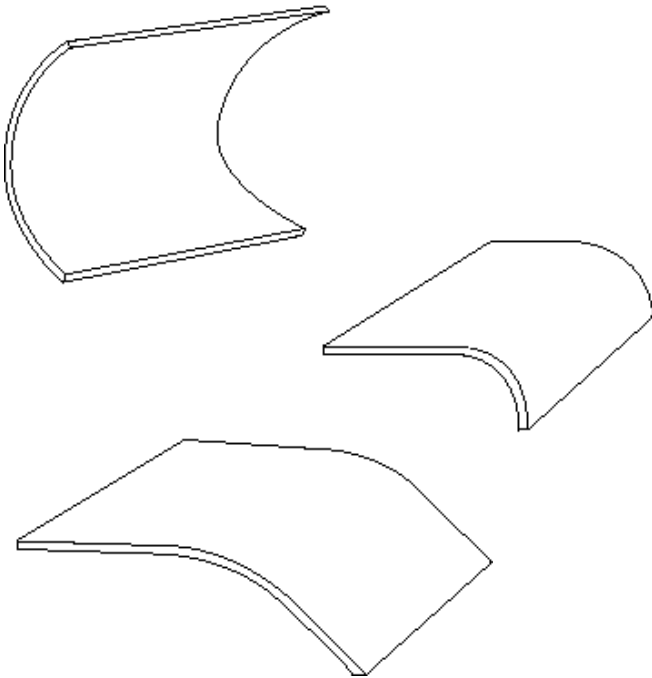
Two of these parameters are enough to calculate the others.

NB:

- The various parameters will always be read, by default, starting from the inner side (concave part of the glass).
- The description of laminated curved glass should give, in the order of stacking, the type of glass, the direction in which the coatings (if any) are facing and the thickness of each glass component and plastic interlayer.

Typical curved glass shapes

Examples of some of the shapes possible with curved glass.



Please consult us for all possibilities in each case.

Maximum sizes of curved glasses

Regular curve

The typical maximum sizes for curved glasses in annealed or laminated glass are:

Height		Development
2,800 mm	x	1,800 mm
1,700 mm	x	2,800 mm

Elbow

Maximum height: 1,400 mm
(please consult us for heights between 1,400 and 2,000 mm)
Minimum radius: 150 mm

For other sizes or other glass products please consult us on a case-by-case basis.

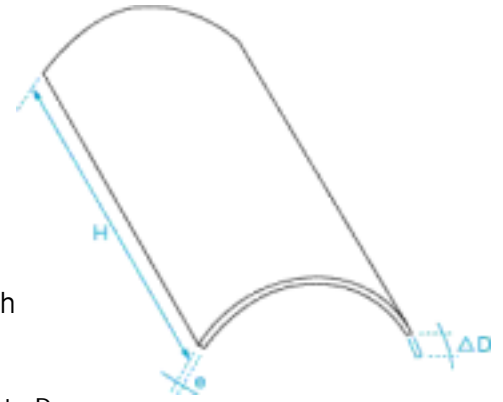
Manufacturing tolerances

1. Dimensional tolerances

Tolerance for length
 $\Delta H = \pm 3 \text{ mm}$

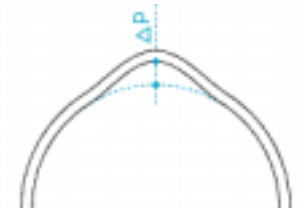
Tolerance for evolute D
 $\Delta D = \pm 3 \text{ mm}$

Tolerance for thickness e:
depends on tolerances of the products used.



2. Deformation tolerances

2.1. Tolerances of curve ΔP
This is the measurement, taken using calipers, of the gap between the template and the curve of the edges that fit into the rabbet.

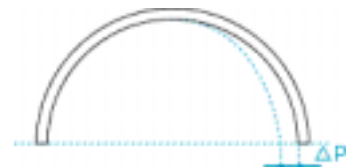


Monolithic curved glass

$\Delta P = \text{max. } 1/2 \text{ of thickness}$

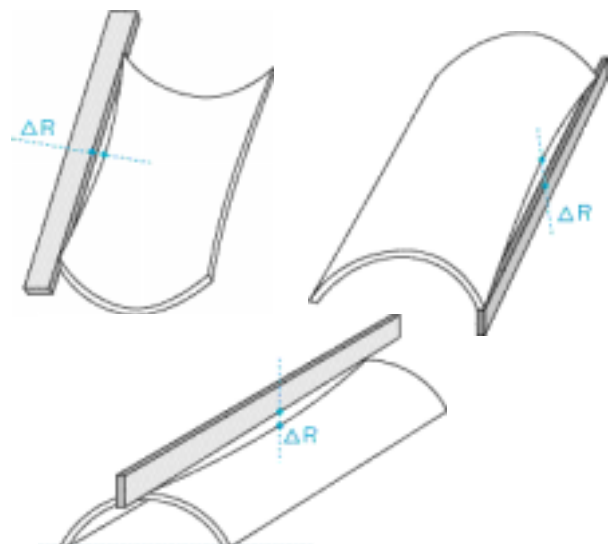
Laminated curved glass or curved insulating glass

$\Delta P = \text{max. } 1/2 \text{ of thickness of the thickest component}$



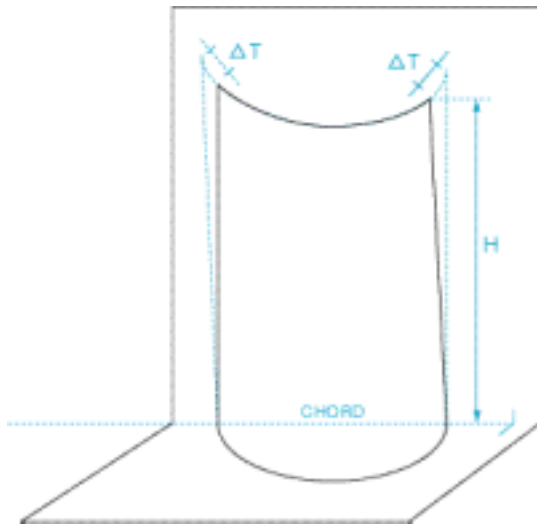
2.2. Tolerances for straightness of edges

$\Delta R = \text{max. } 2 \text{ mm/m}$



2.3. Tolerance for distortion or torsion

With the sheet of glass placed on its evolute, the measurement of T is made with respect to a plane set perpendicular to the base plane and passing through the chord of the base curve.



For H up to 1 m : $T = 4$ mm
 For 1 m < H < 2 m : $T = 8$ mm
 For 2 m < H < 3 m : $T = 12$ mm

2.4. Tolerances for offset



Applicable to curved laminated glasses
 - with two glass components
 $\Delta D = \pm 2$ mm

- with more than two glass components
 To be determined with the producer bearing in mind the number and thickness of the components.

Ordering curved glass

When ordering (or when drafting an offer or ascertaining the feasibility of an order), it is imperative that the following basic information be given:

- quantity per type of sheet;
- nature of the glass desired;
- composition of the glass;
- height of the glass;
- two of the D, C, F, R or a components (see definitions in the section entitled "Practical information for specifying a curved glass with a regular curve");
- a template is needed for a curved glass with an irregular curve;
- the type of shaping or special processing.

Optical quality

The optical aspect of curved glasses is influenced by the characteristics of the constituent glasses, as well as by the characteristics induced by the curving process.

Sizing

The main measurements needed for correctly defining the sizes of a curved glass are given in the section entitled "Practical information for specifying a curved glass with a regular curve".

It is necessary to clearly specify whether the dimensions given are calculated with respect to the convex or concave side of the glass. If this information is not given, then it will be assumed that the dimensions are given in respect of the concave side and the curved glass will be manufactured based on that assumption.

For added security, it would be very useful to create a template. Various materials can be used, but in every case the template must be made of a rigid material which does not deform when subjected to heat or moisture.

The template will include the entire length of the girth, including the straight parts.

It is strongly recommended that you check the conformity of the template in place and that you inform us of the application or end use of the curved glass.

