

Technische informatie Simax ® borosilicaatglas (te verwerken in combinatie met andere merken borosilicaatglas)

Glas

SIMAX® is a special kind of borosilicate glass, highly resistant to water effects and with an increased chemical durability. An important Czech glass expert, Dr. M. B. Volf, the author of the „Technical Glass“ encyclopedia known worldwide, has fathered this special glass. Hence, it is impossible to imagine laboratories and chemical plants equipment without SIMAX® glass.

Voordelen

SIMAX® products have become well-known due to their stability, their easy workability and a high resistance to sudden temperature variations. Due to the minimum thermal expansibility, SIMAX® represents an excellent construction material for the chemical and laboratory instruments production and for applications in industrial technological equipment made of glass. SIMAX® products are corrosion-resistant and they behave absolutely neutrally in deleterious chemicals in almost any chemical field, which is a very significant advantage, if compared with other materials. Borosilicate glass is highly resistant to water, acids, saline solutions, organic compounds, and, likewise, to halogenides. Besides this, products made of SIMAX® glass feature, in addition, a very good resistance to various kinds of lye. For more details on physical and chemical properties please refer to the following pages.

We offer a wide assortment of tubes, capillaries, bars of circular section and profiled section with high precision in all sizes.

Kwaliteit

Just the same way as any other Kavalier glass product, SIMAX® tubes, capillaries and bars have been manufactured using the most advanced technologies. SIMAX® borosilicate glass 3.3 products comply with the most relevant international standards (e. g. ISO 3585, respectively, ČSN ISO 3585, and, ASTM E 438 Type I, Class A). All manufacturing phases are controlled electronically, and, these are thoroughly controlled thanks to a perfect Quality Management System. SIMAX® glass has been awarded a TÜV CERT Certificate according to EN ISO 9001:2000.

Quality attributes have been described on the following pages in the Chapter „Technical Conditions“.

Verdere verwerking

SIMAX® tubes, capillaries and bars may be used in a very wide field. The main one represents laboratories and chemical plants. Thus far the offer extends, from simple reagent glass, through filtering devices, to various chilling and distillation apparatuses.

SIMAX® tubes, capillaries and bars made of borosilicate glass 3.3 can be found in large chemical facilities and waste water treatment plants, in piping installations, in measuring and control technologies, and, in biotechnologies. Among other technical fields of application rank, for example, heat exchangers, tubes for explosion prevention and flow meters. Industrial art manufactures unique products ranging from simple sconces, decorative objects to richly decorated tumblers and goblets for wine or effervescent wine.

SIMAX®: Fysische en chemische eigenschappen

Fysische eigenschappen Simax ® borosilicaatglas	
Mean linear and thermal coefficient of expansion α (20 degrees Centigrade; 300 degrees Centigrade) according to ISO 7991	$3,3 \cdot 10^{-6} \text{ K}^{-1}$
Transformation temperature T_g	525 degrees Centigrade
Glass temperature at 1013 (upper chilling temperature)	560 degrees Centigrade
Viscosity η in dPa . s: 107,6 (softening temperature)	825 degrees Centigrade
Viscosity η in dPa . s: 104,0 (working range)	1 260 degrees Centigrade
Highest short-term admissible working range	500 degrees Centigrade
Density ρ at 20 degrees Centigrade	2,23 g. cm ³
Modulus of elasticity E (Young's modulus)	64 103 MPa
Poisson's ratio μ	0,2
Thermal conductivity λ (20 to 100 degrees Centigrade)	1,2 W.m-1.K-1
Temperature for specific electric resistance $10^8 \Omega \cdot \text{cm}$ (DIN 52326) tkIOO	250 degrees Centigrade
Logarithm of electric bulk resistivity ($\Omega \cdot \text{cm}$) at 250 degrees Centigrade	8
Logarithm of electric bulk resistivity ($\Omega \cdot \text{cm}$) at 350 degrees Centigrade	6,5
Dielectric properties (1 MHz, 25 degrees Centigrade)	
Permittivity ϵ	4,6
Loss factor $\tan \delta$	$37 \cdot 10^{-4}$
Refractive index ($\lambda = 587.6 \text{ nm}$) nd	1 473
Photoelastic constant (DIN 52314) K	$4,0 \cdot 10^{-6} \text{ mm}^2 \cdot \text{N}^{-1}$

SIMAX® buizen en capillairen breeksterkte

Bursting strength (p) calculation with a known wall thickness (t) and a given outside diameter (D):

$$p = \frac{t \cdot 20 \cdot \frac{K}{S}}{D - t}$$

Wall thickness (t) calculation with a given bursting strength (p) and outside diameter (D):

$$p = \frac{t \cdot 20 \cdot \frac{K}{S}}{D - t}$$

D = outside diameter in mm

t = wall thickness in mm

p = bursting strength in bar

K/S = admissible stress in N . mm⁻²

SIMAX® borosilicate glass 3.3 admissible stress: $K/S = 7 \text{ N} \cdot \text{mm}^{-2}$ according to ČSN EN 1595 Standard: Pressure Vessels Made of Borosilicate Glass 3.3; General Principles for Construction, Manufacturing and Testing.

Bursting strength (p) affects, among others, the following:
 thermal difference between the inside and outside walls
 surface quality
 working the tips
 compliance with assembling conditions in accordance with pressure vessels regulations
 tube length
 The manufacturer may perform an exact calculation, where necessary.

In addition, the following should be taken into consideration:

ČSN EN 1595:1998 Pressure Vessels Made of Borosilicate Glass 3.3 General Principles for Construction, Manufacturing and Testing

ČSN EN 12585:1999 Glass Equipment, Pipes and Pipe Fittings. Piping and Pipe Fittings with a Nominal Diameter of DN 15 to 1000. Compatibility and Interchangeability

Resistance to Temperature Variations

Resistance to temperature variations corresponds according to ISO 718 to the thermal difference between the hot test piece and the cold water bath (room temperature), where the first cracks appear on 50 per cent of samples, when these will have been quickly dipped into the water bath. Resistance to temperature variations of tubes, capillaries and bars depends on the wall thickness, shape and size of the chilled surface, surface condition, tension and final working. Uneven, flash heating or fast chilling may easily lead to cracking due to the resulting tension. It is recommendable not to exceed the thermal difference of 120 degrees Centigrade. At thicker walls, this thermal difference is limited to lower values. As for examples of resistance to temperature variations of tubes and bars made of SIMAX® borosilicate glass 3.3 some values measured have been specified hereinafter. These values may be considered indicators, because considerable differences may exist among parts of the same sizes:

Wall thickness in mm	Resistance to temperature variations in K
1	303
3	175
5	136
7	115

The manufacturer may perform an exact calculation, where necessary.

Chemische samenstelling

(main components in percentage by weight)

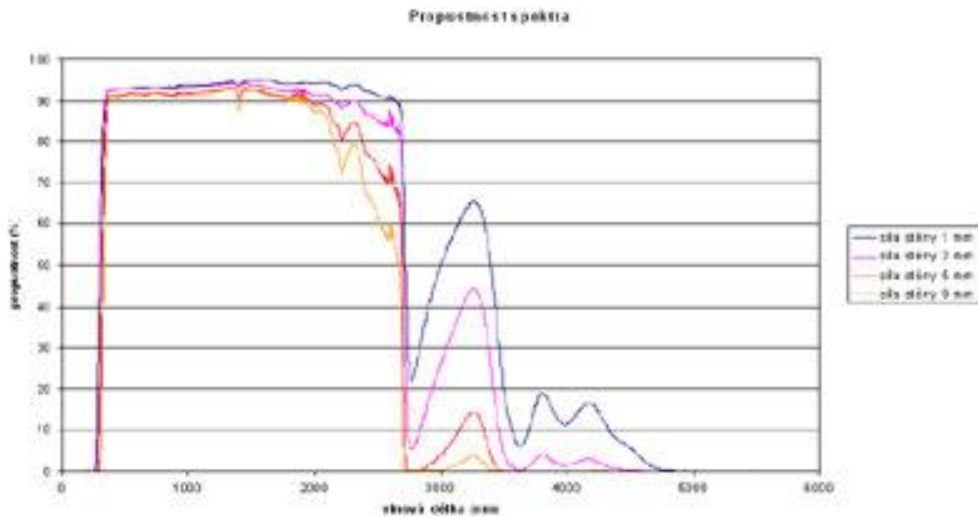
SiO ₂	B ₂ O ₃	Na ₂ O + K ₂ O	Al ₂ O ₃
80,6	13	4	2,4

Chemische bestendigheid	
Class of Resistance to Water Effects (ISO 719)	HGB 1
Class of Resistance to Acid Effects (ISO 1776 a DIN 12116)	Class S1
Class of Resistance to Various Kinds of Lye (ISO 695)	Class A2

SIMAX® borosilicate glass 3.3 is highly resistant to water effects, neutral and acid solutions, heavy acids and their mixtures, to chlorine, bromine, iodine and organic compounds. Even in long-term effects and at temperatures above 100 degrees Centigrade, this glass outstrips with its chemical durability most metals and other raw materials.

Due to water and acid effects the glass releases small amounts only, mostly those of monovalent ions. At the same time, on the glass surface, there is formed a very thin, permeable siliceous gel layer, which ensures resistance to further effects. Hydrogen fluoride, hot phosphoric acid and alkaline solutions have affect on the glass surface, depending on concentration and temperature.

Licht transmissie



Instructies voor de verwerking van Simax borosilicaatglas

SIMAX® tubes, capillaries and bars material properties guarantee a very good workability in glass forming and dividing, which is usual with technical glass. To remove temporary stress, which originates in processing, it is appropriate to warm the glass through well up to a temperature of 550 degrees Centigrade, and, to leave it at this temperature over a period of time of at maximum 30 minutes; as a rule, in thin-walled products a fraction of this time would suffice. With regard to glass chemical durability the stabilization time should be as short as possible. For subsequent cooling down, the chilling speeds have been recommended as per the below table:

Koelsnelheid

Wanddikte in mm	Temperatuurbereik		
	560 to 490 °C	490 to 440 °C	440 to 20 °C
3	14 °C/min	28 °C/mm	up to 447 °C/min
6	3 °C/min	6 °C/min	up to 111 °C/min
12	0,6 °C/min	1,6 °C/min	up to 28 °C/min

In the event that it is necessary to cool the product down several times, the sum of all the stabilization times at 550 degrees Centigrade should not exceed two hours. SIMAX® products may be melted without stress with borosilicate glasses of the same type, and, processed and stabilized at the same temperatures. SIMAX® tubes, capillaries and bars may be printed using silver- and copper-based diffusion colours and silk-screen-printing colours.

Kavalier SIMAX®: Technische condities

Lengte

Standard lengths are:

Buizen		1500 +10 mm -0 mm
Capillair		1500 ±10 mm
Staven	diameter van 3 tot 6 mm	1500 ±20 mm
	diameter van 7 tot 16 mm	1500 ±10 mm
	diameter van 18 tot 30 mm	1500 ±30 mm
Ander dan rond assortiment		1500 ±20 mm

Special lengths of tubes (depending on the outside diameter) may be ordered on request in lengths from 1,000 to 7,500 mm.

Onrondheid

Out-of-roundness according to ISO 1101 is dependent on the outside diameter. The following limit values have been set as fixed:

Tubes	
Diameter < 180 mm	smax 0,7 % of the outside diameter
Capillaries	
Diameter < 10 mm	smax 1,0 % of the outside diameter
Bars	
Diameter < 20 mm	smax 1,0 % of the outside diameter
20 mm <= diameter <= 30	smax 1,5 % of the outside diameter

Afwijking op de wanddikte

The difference between the maximum and minimum wall thickness at arbitrary point of a tube may not exceed 12 % of the wall nominal thickness.

Kromheid

Tubes deflection according to ISO 1101 may be as follows:	
Outside diameter => 4 - < 6 mm	at maximum 4,0 mm / 1500 mm
Outside diameter => 6 - < 30 mm	at maximum 1,5 mm / 1000 mm
Outside diameter => 30 - < 100 mm	at maximum 2,0 mm / 1400 mm
Outside diameter => 100 - <= 180 mm	at maximum 2,5 mm / 1400 mm

Bars and capillaries are supplied with a deflection of at maximum 4 mm over 1,500 mm of the product length.

Non-circular assortment is supplied as follows :
tubes with a deflection of at maximum 0.4 % of nominal length
capillaries and bars with a deflection of at maximum 0.6 % of nominal length

Restspanning

Buizen

Outside diameter in mm	$\varnothing < 40$	$40 \leq \varnothing \leq 60$	$\varnothing > 60$
Internal stress over the tube length	3 MPa	3,5 MPa	2,5 MPa
	102,9 nm/cm	120,05 nm/cm	85,75 nm/cm
Internal stress at the edge	4 MPa	3,5 MPa	2,5 MPa
	137,2 nm/cm/td>	120,05 nm/cm	85,75 nm/cm

Bars are delivered, as a standard, not chilled, in bars of a diameter of 18 up to and included 30 mm, which may be supplied as chilled by mutual consent.

Non-circular assortment – Profiled tubes, capillaries and bars are delivered as not chilled.

Stenen en slieren

Stenen	Stenen/ 1 kg of glass
Size < 0,3 mm	permitted
Size => 0,3 - < 1,0 mm	max. 2
Size => 1,0 - <= 2,0 mm	max. 1
Size > 2,0 mm	prohibited

Slieren	Slieren/ 1 kg of glass
Size < 0,3 mm	permitted
Size => 0,3 - < 1,0 mm	max. 4
Size => 1,0 - <= 3,0 mm	max. 2
Size > 3,0 mm	prohibited

The grain size is considered as corresponding to stones or striae size.

Luchtbelllen

Length

Bubbles length corresponds to the length of all bubbles => 20 mm.

Permitted length of bubbles is 0.8 m/10 m of a tube.

Bubbles < 20 mm: 20 pcs/1 kg of glass.

Width

Bubbles wider than 1 mm are prohibited in tubes with a diameter of $\varnothing \leq 100$ mm.

Bubbles wider than 2 mm are prohibited in tubes with a diameter of $\varnothing > 100$ mm.

Note: capillary bubble is a bubble drawn in the direction of the length of a product in the form of a capillary with a length greater than 2 mm.

Afwerking van de uiteinden en afwijking op de haaksheid Tubes

Tubes	Tubes tips	Front surfaces perpendicularity deviation
	non fire-	
$4 \leq \varnothing \leq 5$	polished	–
$5 < \varnothing \leq 100$	fire-polished	2,5
$100 < \varnothing \leq$		
180	fire-polished	4

In fire-polishing the tips, wall thickness may get enlarged by 0.1 mm.

Capillaries and bars are supplied as non fire-polished. Non-circular assortment is supplied with non fire-polished tips, with the exception of tubes fluted inside, which are supplied with fire-polished tips.

Verpakking

Products are supplied in bulk packaging, with a sufficient protection against damage in transportation and storage.