SIMAX GLASS

Products made of the SIMAX glass are smooth and imporous, perfectly transparent, catalytically indifferent, corrosion-resistant even in long-lasting operations, sufficiently homogeneous, and free of any heterogeneous particles. The SIMAX glass is very friendly to the environment and is absolutely unexceptionable from the ecological viewpoint.
The Glassworks KAVALIER have been counted among the most important world producers supplying products from the borosilicate glass, type 3.3.

CHEMICAL COMPOSITION

(main components in percentage by weight)

SiO_2	B_2O_3	$Na_2O + K_2O$	Al_2O_3
80.6	13	4	2.4

RESISTANCE AGA/NST

water at 98 °C	(pursuant to ISO 719)	HGB 1
water at 121 °C	(pursuant to ISO 720)	HGA 1
acids	(pursuant to ISO 1776)	1
effect of water solution of alkali mixture	(pursuant to ISO 695)	A2 or better

The SIMAX borosilicate glass 3.3 is highly resistant to effects of water, neutral and acid solutions, strong acids and their mixtures, chlorine, bromine, iodine, and organic compounds. Even in long-term effects and at temperatures above 100 °C, this glass outstrips, with its chemical durability, most metals and other raw materials.
Due to effects of water and acids, the glass releases only small amounts of mostly univalent ions. At the same time, a very thin permeable siliceous gel layer is formed on the glass surface, which ensures resistance to further effects. Hydrogen fluoride, hot phosphoric acid, and alkaline solutions attack the glass surface, depending on concentration and temperature.

SIMAX: PHYSICAL PROPERTIES

PHYSICAL DATA

Mean linear and thermal coefficient of expansion α (20 °C; 300 °C) according to ISO 7991		$3.3 \times 10^{-6} K^{-1}$
Transformation temperature Tg.		525 °C
Glass temperature at viscosity η in dPa.s	1013 (upper cooling temperature)	560 °C
Glass temperature at viscosity η in dPa.s	107,6 (softening temperature)	825 °C
Glass temperature at viscosity η in dPa.s	104 (working range)	1260 °C
Highest short-term admissible working range		500 °C
Density ρ at 20 °C		$2,23 g. cm^{-3}$
Modulus of elasticity E (Young modulus)		64×10^3 MPa
Poisson ratio μ		0.20
Thermal conductivity λ (20 to 100 °C)		$3.3 \times 10^{-6} K^{-1}$

MECHANICAL STABILITY OF SIMAX GLASS

Mechanical properties and service life of products made of the SIMAX glass are largely done by the stage of their finish, especially in their entirety, i.e. depth failure on surface in manipulation and secondary thermal treatment.

Glass mass scratch hardness of 6° of Mohs scale	
Admissible tensile stress	3.5 MPa
Admissible bending stress	7.0 MPa
Admissible compressive stress	100.0 MPa

THERMAL PROPERTIES OF SIMAX GLASS

High resistance of product made of the SIMAX glass to sudden change in temperature – heat stability – is done by low coefficient of linear thermal expansion, relatively low modulus of tensile elasticity, as well as relatively high thermal conductivity resulting in a lower thermal gradient in the product wall.
On cooling and heating the glass product, an undesirable internal stress arises. Breakage of the glass product due to temperature change is caused by tensile stress on the product surface arising due to action of linear dilatability of the glass on quick cooling from the product surface.
With a mechanical failure in the product surface, the heat stability can be significantly reduced.

Wall thickness (in mm)	Resistance to heat shock (D °C)
1	303
3	175
6	124
10	96

The manufacturer may perform an exact calculation, where necessary.

COOLING OF SIMAX GLASS

Cooling represents a thermal process the purpose of which is keeping from formation of undesirable and inadmissibly high thermal stress in the glass which would reduce the product resistance, and/or removing of stress already arisen.

Cooling cycle comprises three stages:
- **Temperature increase** (product heating) with heating rate from the inlet temperature to the upper cooling value.
- **Dwell** (pause, tempering, stabilization) of products at upper cooling temperature for certain time when the temperature differences in the product must be equalized, including stress reduction to an admissible limit.
- **Temperature decrease** (cooling and additional cooling) of the product with cooling rate from the upper to the lower cooling value (this stage is important as the permanent stress can arise), and from the lower cooling temperature to the final value or ambient temperature (important for subsequent practical manipulation with the product).

Concrete cooling cycle is specified in the table..

TEMPERATURE RANGE

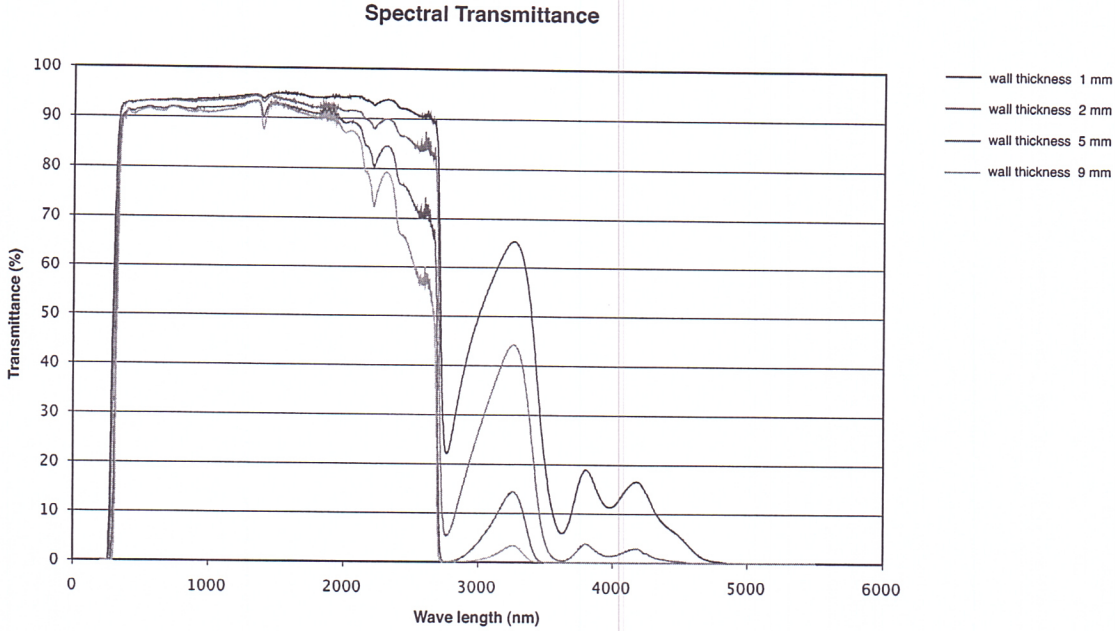
Maximum wall thickness	Rise	Dwell	Temperature Drop		
	20–550 °C	560 °C	560–490 °C	490–440 °C	440–40 °C
3mm	140 °C/min	5 °C/min	14 °C/min	28 °C/min	140 °C/min
6mm	30 °C/min	10 °C/min	3 °C/min	6 °C/min	30 °C/min
9mm	15 °C/min	18 °C/min	1,5 °C/min	3 °C/min	15 °C/min
12mm	8 °C/min	30 °C/min	0,6 °C/min	1,6 °C/min	8 °C/min

OPTICAL PROPERTIES OF SIMAX GLASS

The Glass SIMAX is transparent and clear; it does not show substantial absorption in visible spectrum.
Permeability of ultra-violet rays enables the products made of the SIMAX glass to be used for photochemical reactions.

Refractive index (λ = 587.6 nm) n_d	1.473
Photoelastic constant (DIN 52314) K	$4{,}0.10^{-6}$ mm².N⁻¹

LIGHT TRANSMITTANCE



ELECTRICAL PROPERTIES OF SIMAX GLASS

At usual temperatures, the SIMAX glass is a non-conducting material – it is an insulant.

• Specific resistance in damp-proof medium (20 °C) higher than	10^{13}–10^{15} Ω.cm
• Permittivity ε (20 °C, 1 MHz)	4.6
• Loss angle tg δ (20 °C, 1 MHz)	4.9×10^{-3}

Dielectric losses increase sharply with rising temperature and they change with frequency.

PLASTIC ACCESSORIES

The Simax laboratory glassware are complemented with various plastic accessories, the properties of which can be found in the tables below.

PLASTICS USED WITH LABORATORY GLASS

Materials for laboratory glass accessories		
Type	Designation	Thermal stability (° C)
PE	Polyethylene	– 40 to + 80
PP	Polypropylene	– 40 to + 140
PBT	Polybutylene terephthalate	– 45 to + 180
PTFE	Polytetrafluoroethylene	– 200 to + 260
ETFE	Ethylene tetrafluoroethylene	– 100 to + 180
VMQ	Silicone rubber	– 50 to + 230
NR	Rubber for food	– 40 to + 70
FKM	Fluorocarbon - Viton	– 20 to + 200
N.K.	Natural cork	– 20 to + 200