# 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 $\alpha$ (20 °C; 300 °C) according to ISO 7991 | | $3.3 \times 10^{-6}$ $K^{-1}$ |
| Transformation temperature Tg. | | 525 °C |
| Glass temperature at viscosity $\eta$ in dPa.s | 1013 (upper cooling temperature) | 560 °C |
| Glass temperature at viscosity $\eta$ in dPa.s | 107,6 (softening temperature) | 825 °C |
| Glass temperature at viscosity $\eta$ in dPa.s | 104 (working range) | 1260 °C |
| Highest short-term admissible working range | | 500 °C |
| Density $\rho$ at 20 °C | | 2,23g. $cm^{-3}$ |
| Modulus of elasticity E (Young modulus) | | $64 \times 10^3$ MPa |
| Poisson ratio μ | | 0.20 |
| Thermal conductivity $\lambda$ (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

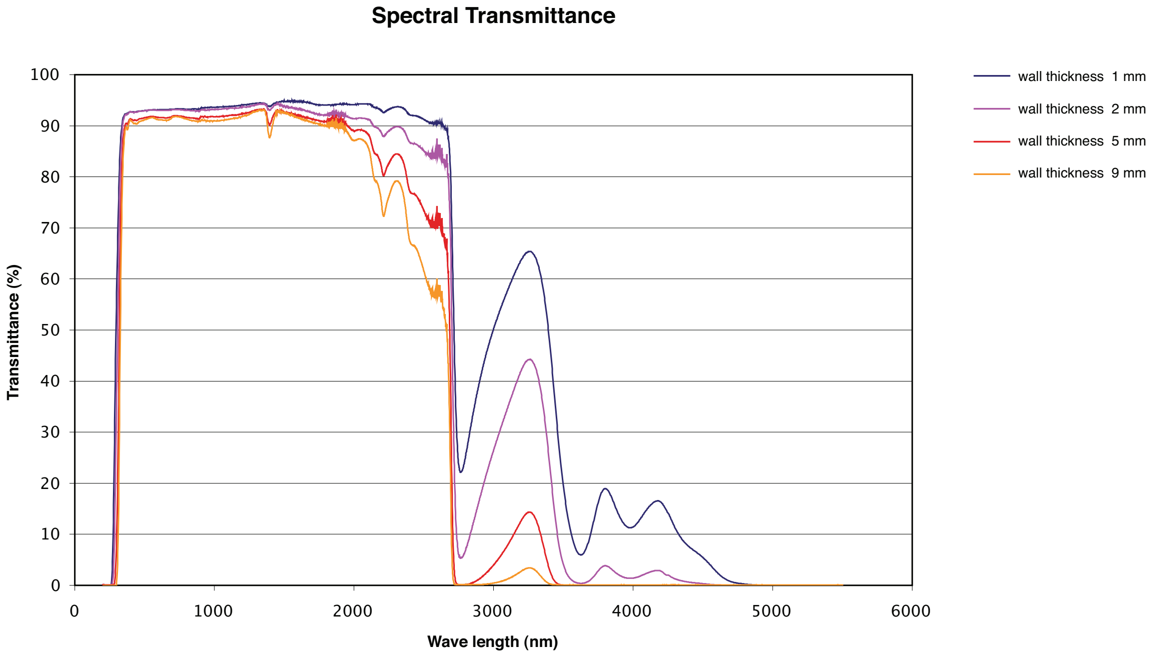
| Maximum wall thickness | Rise | Dwell | Temperature Drop | | |
|---|---|---|---|---|---|
| | 20–550 °C | 560 °C | 560–490 °C | 490–440 °C | 440–40 °C |
| 3mm | 140 °C/min | 5 °C/min | 14 °C/min | 28 °C/min | 140 °C/min |
| 6mm | 30 °C/min | 10 °C/min | 3 °C/min | 6 °C/min | 30 °C/min |
| 9mm | 15 °C/min | 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 ($\lambda$ = 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) — $4.9 \times 10^{-3}$

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 |

| Chemical resistance of materials | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Substance groups + 20°C | PE | PP | PBT | PTFE | ETFE | VMQ | NR | FKM | N.K. |
| Alcohols | ++ | ++ | ++ | ++ | ++ | + | + | – | + |
| Aldehydes | + | + | ++ | ++ | ++ | + | + | – | + |
| Alkaline solutions | ++ | ++ | +/– | ++ | ++ | – | + | – | + |
| Esters | + | + | + | ++ | ++ | – | + | – | – |
| Ethers | – | – | + | ++ | ++ | – | – | – | + |
| Aliphatic hydrocarbons | – | ++ | ++/+ | ++ | ++ | – | – | ++ | – |
| Aromatic hydrocarbons | – | + | ++/+ | ++ | ++ | – | – | ++ | – |
| Halogenated hydrocarbons | – | + | + | ++ | ++ | – | – | ++ | – |
| Ketones | + | + | +/– | ++ | ++ | – | – | ++ | – |
| Diluted or weak acids | ++ | ++ | ++ | ++ | ++ | – | + | ++ | + |
| Strong acids | ++ | ++ | + | ++ | ++ | – | – | ++ | – |
| Oxidizing acids | – | + | – | ++ | ++ | – | – | + | – |

++ *= very good resistance*
\+ *= good resistance*
– *= low resistance*

# PRINCIPLES OF USING LABORATORY GLASSWARE SIMAX

## 1. CLEANING

The laboratory glassware can be cleaned either manually or in a laboratory dish washer using usual cleaning and disinfecting agents. It is recommended to wash the glass before the first use.
Laboratory glassware which came into contact with infectious substances should be cleaned and sterilized with hot air or steam. In this way, burning-on of impurities and damaging of glass by possibly adhered chemicals is prevented.

*A) Manual cleaning:*
a) Laboratory glassware should be wiped and washed with a cloth or a sponge using a cleaning solution.
b) Do not use abrasive washing agents as they can scratch the glass.
c) Avoid extended exposition to alkaline media at temperatures above 70 °C as printing can be destroyed.

*B) Washing in dish washers:*
Washing of laboratory glassware in dish washers is more considerate than manual cleaning. The glass gets into contact with a cleaning solution for a relatively short time only during the phase of rinsing when the solution is sprayed on the glass surface.
• *When inserting the glassware into a dish waster care should be taken to prevent mutual impacts.*

## 2. SAFETY INSTRUCTIONS FOR USER

- Never expose the laboratory glassware to sudden changes in temperature. Prevent taking hot glassware out of a drier and putting it on a cold or wet laboratory table. The warning is particularly applicable to a thick-walled glassware, such as suction flasks or desiccators.
- Before each evacuation or pressure stress of glass flasks, make visual inspection of a faultless state (for heavy scratches, impacts, etc.). Damaged glass flasks must not be used for works under pressure or vacuum.
- The laboratory glassware under pressure or vacuum should be handled with care (e.g. with suction flasks, desiccators).
- Do not expose the glassware to sudden changes in pressure.
- To prevent developing stress in the glass do not heat up glass flasks under vacuum or pressure from one side or with an open flame.
- The laboratory glassware with flat bottom (e.g. Erlenmeyer flasks, flasks with flat bottom) should not be exposed to pressure stress.

## LABORATORY BOTTLES SIMAX

Laboratory bottles are made of the borosilicate glass 3.3. featuring excellent chemical properties and a high thermal resistance. They are chemically resistant and stable. After completion with a plastic pouring ring, they enable liquids to be easily poured out. All bottles of the volume 100ml and higher have the same thread size, the screw cups can be mutually interchanged.
The bottle, pouring ring, and screw cup can be sterilized.

**Handling instructions:**
*a) Freezing of substances*
- Freeze the bottle in a skew position (about 45°) and filled up to max. 3/4 (volume expansion).
- Temperature limit: –40 °C as plastic lids and pouring rings do not resist to lower temperatures.

*b) Thawing of substances*
- Thawing of a frozen material can be carried out by submerging the bottle into a liquid bath (temperature difference should not exceed 100 °C). The frozen material will thus be heated up uniformly from all sides and the bottle will not be damaged. Thawing can also be accomplished slowly from the top so that the surface is first liquefied and the material can expand.

*c) Sterilization*
- During sterilization, the screw cup can only lightly be fitted on the bottle (screwed with max. one rotation). Pressures are not equalized when the bottle is closed. The pressure difference created in this way can result in the bottle breakage.

*d) Pressure resistance*
- The laboratory bottles are not suitable for works under pressure or vacuum.