Heraeus

SUPRASIL® 1, 2, 3 and SUPRASIL® Standard

1. GENERAL PRODUCT DESCRIPTION

Heraeus SUPRASIL 1, 2, 3 and SUPRASIL Standard are high purity synthetic fused silica materials manufactured by flame hydrolysis of $SiCl_4$. They combine excellent physical properties with outstanding optical characteristics in the deep UV and the visible wavelength range. The index homogeneity is controlled and specified either in one direction (the direction of use or functional direction) or even in all three dimensions. In addition, the materials provide excellent resistance to damage by high energy UV laser radiation.

All synthetic fused silica SUPRASIL grades are practically free from bubbles and inclusions.

The optical homogeneity, which is the main criteria for very low transmitted wavefront distortion, refers to three categories:

- SUPRASIL 1 is an optically isotropic 3D material. It is highly homogeneous and has no striations in all three dimensions. These properties are very important for multiple axis optics such as prisms, steep lenses, beam splitters or etalons.

- SUPRASIL 2 and 3 are homogeneous in the primary functional direction. Weak striations, if any, are parallel to the major faces and do not affect the optical performance.

  SUPRASIL 2 and 3 are the preferred materials for demanding optics in one directional use such as lenses, UV-laser windows, optical flats, etc.

- SUPRASIL Standard is free from striations through the functional direction. The index homogeneity Δn is not specified.

  SUPRASIL Standard is the most economic grade within the SUPRASIL family and is available in one size, 125 ± 5 mm diameter, in random lengths. It is often used for substrates, mirrors, lightguide elements, beam delivery elements, microscope slides and UV-windows.

For general technical data please refer to our data sheet POL-O/107E "Quartz Glass for Optics - Data and Properties".

2. OPTICAL DATA OF SUPRASIL 1, 2, 3 and SUPRASIL Standard

2.1 Bubbles and Inclusions

(Bubbles ≤ 0.08 mm diameter are disregarded)

2.1.1 Bubble class: better than 0 (as per DIN 58927 2/70)

i.e. total bubble cross section within the volume is ≤ 0.03 mm^2/100 cm^3.

2.1.2 Maximum bubble diameter

SUPRASIL 1	:	≤ 0.1 mm	for pieces ≤ 6 kg
SUPRASIL 2 and 3	:	≤ 0.15 mm ≤ 0.25 mm	for pieces ≤ 6 kg for pieces > 6 - 30 kg
SUPRASIL Standard	:	≤ 0.15 mm	for pieces ≤ 25 kg

2.1.3 Inclusions : None

2.1.4 Spots : None

2.2 Refractive Index and Dispersion

2.2.1 Refractive Index

n_c = 1.45637 at 656.3 nm
n_d = 1.45846 at 587.6 nm
n_F = 1.46313 at 486.1 nm
n_g = 1.46669 at 435.8 nm
n = 1.50855 at 248 nm

At 20°C, 1 bar atmospheric pressure
Accuracy: ± 3 • 10^{-5}

2.2.2 Dispersion

$n_F - n_C = 0.00676$

$$v_d = \frac{n_d - 1}{n_F - n_C} = 67.8 \pm 0.5$$

2.3 Optical Homogeneity

2.3.1 Granular Structure: None

2.3.2 Striations

SUPRASIL 1: In all three dimensions free from striations, i.e. better than grade A, MIL-G-174-B.

SUPRASIL 2, 3 and Standard: In primary functional direction free from striations, i.e. grade A, MIL-G-174-B; weak striations, if any, are parallel to the major faces.

2.3.3 Index Homogeneity

Specified across 90% of diameter or sidelength for machined parts, respectively 80% for raw formed ingots.

SUPRASIL 1: In all three dimensions guaranteed total $\Delta n \leq 5 \cdot 10^{-6}$;
with power subtracted Δn (p.s.) $\leq 2 \cdot 10^{-6}$;
on special request total $\Delta n \leq 2 \cdot 10^{-6}$.

(Maximum weight ca. 6 kg; larger pieces available on request).

SUPRASIL 2: In primary functional direction guaranteed total $\Delta n \leq 5 \cdot 10^{-6}$;
with power subtracted Δn (p.s.) $\leq 2 \cdot 10^{-6}$;
on special request total $\Delta n \leq 1 \cdot 10^{-6}$.

(No special limits on size and weight).

SUPRASIL 3: In primary functional direction guaranteed total $\Delta n \leq 10 \cdot 10^{-6}$;
with power subtracted Δn (p.s.) $\leq 5 \cdot 10^{-6}$.

(No special limits on size and weight).

SUPRASIL Standard: Not specified

(Available only in 125 ± 5 mm diameter, random lengths)

Δn (p.s.) (power subtracted) is calculated by subtracting from a measured Δn distribution the proportion that gives an exactly spherical aberration of an originally plane optical phasefront. This subtraction procedure is built into most modern interferometer software as an option.

2.4 Residual Strain

SUPRASIL 1, 2, 3: ≤ 5 nm/cm across 80% of diameter or side length
≤ 5...15 nm/cm in the rim area.

SUPRASIL Standard: ≤ 10 nm/cm across 80% of diameter
≤ 10...15 nm/cm in the rim area.

2.5 Spectral Transmittance

2.5.1 Typical transmission curves (including Fresnel reflection losses) for a 10 mm path length are shown in the figure.

2.5.2 Decadic Extinction Coefficient at 200 nm

$k_{200} < 0.005\ cm^{-1}$ (typical)
$k_{200} < 0.01\ cm^{-1}$ (guaranteed)

Using the definition:

Transmittance $T = 10^{-kd}$
with d = thickness of sample

2.5.3 Infrared Absorption

OH absorption bands occur at wavelengths around 1.39 µm, 2.2 µm, and 2.72 µm according to an OH content of less than 1000 ppm (weight).

2.6 Fluorescence: None

With 254 nm excitation (low pressure Hg lamp and Schott UG 5 filter) and visual inspection.

2.7 Radiation Resistance

Excellent resistance to damage by high energy UV-laser radiation.

High laser damage threshold.

No degradation of visible transmittance after exposure to Co^{60} □-radiation
(1.15 MeV) with 0.063 Mrad/h for 98 h.

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QUARZGLAS

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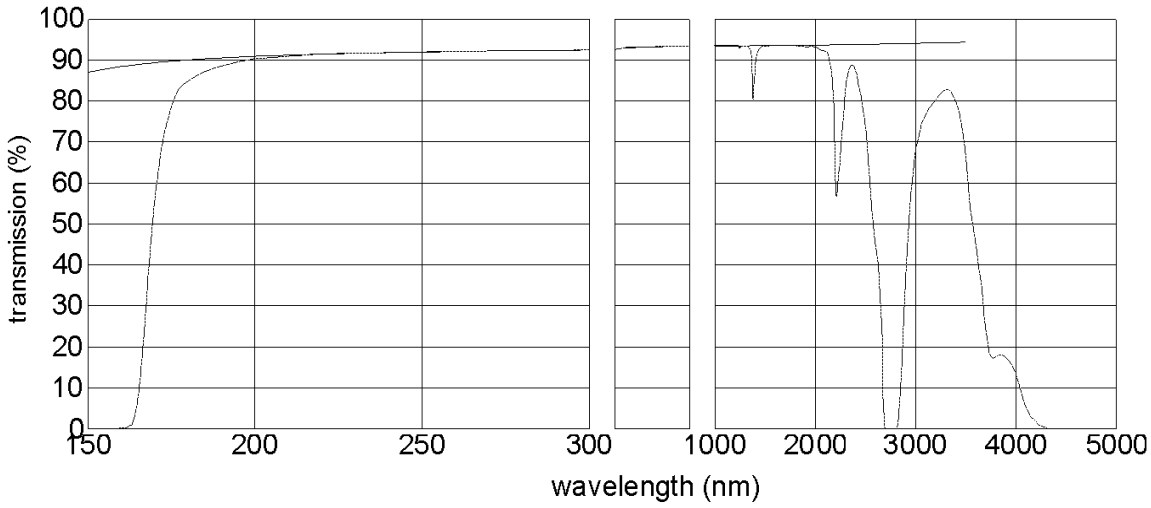
Suprasil 1, 2, 3 and Standard

(path length: 10 mm)



Typical spectral transmission including Fresnel reflection loss.
The uppermost nearly straight line indicates the calculated
Fresnel reflection loss of two uncoated surfaces.