Heraeus

SUPRASIL® 3001 and 3002

Data sheet

M&S-SO_11_05_05_E

1 General product information

SUPRASIL 3001 and 3002 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 to the near IR.

Product properties

Low OH-content

Due to its low OH-content (~1ppm OH) SUPRASIL 3001 and 3002 materials have nearly no OH absorption bands up to 2600 nm.

Excellent index homogeneity

SUPRASIL 3001 and 3002 materials are refined to produce a high degree of index homogeneity, controlled and specified either in one direction (the direction of use or functional direction) or even in all three dimensions.

The index homogeneity, a key specification effecting low wave front deviation, is specified in 2 grades:

SUPRASIL 3001: is an optically isotropic 3D-material. It is highly homogeneous and has no striations on all three dimensions. These properties are very important for multiple axis optics such as prisms, steep lenses, beam splitters, etalons or retro-reflectors and light pipes.

SUPRASIL 3002: is homogeneous in the primary functional direction. Weak striations, if any, are parallel to the major faces and do not affect the optical performance. SUPRASIL 3002 is the preferred material for demanding UV-optics in one directional use such as laser windows, optical flats or lenses.

Low absorption

Low OH and low trace impurities combine to produce the optimal low absorption material. In addition to low UV and visible wavelength absorption, SUPRASIL 3001 and 3002 materials feature a very low absorption in the range of 900 nm to 1400 nm. As Heraeus Quarzglas is not able to measure the low absorption itself, the values cannot be guaranteed. However, Heraeus Quarzglas had done external absorption measurements at 1064 nm and 1319 nm.

Typical absorption values:

Absorption at 1064 nm:	0.25	ppm / cm
Absorption at 1319 nm:	1	ppm / cm

(see 2.5.3)

Free from bubbles

SUPRASIL 3001 and 3002 are practically free from bubbles and inclusions.

Application

SUPRASIL 3001 and 3002 materials are ideal for broadband application from UV to NIR requiring optimized material properties.

- Ideally suited for high energy lasers with the need for **lowest absorption** in the range of 900 nm to 1400 nm
- **Wide band** application with high transmission (see below) in the range of 190 nm to 3000 nm

2 Optical data for SUPRASIL 3001 and 3002

2.1 Bubbles and inclusions*

*(Bubbles and inclusions < 0.08 mm diameter are not counted)

2.1.1 Bubble grade

- Superior to 0 (according to DIN 58927)
- The sum of the cross sections of all bubbles within a piece is 0.03 mm² and is related to 100 cm^3 of a volume (TBCS-value).

2.1.2 Bubbles according to DIN ISO 10110

SUPRASIL 3001: 1/ 2*0.10 unit weight < 6 kg

SUPRASIL 3002: 1 / 1*0.16 unit weight < 6 kg
1 / 1*0.25 unit weight 6 - 30 kg

2.1.3 Inclusions

- None

2.2 Refractive index and dispersion

2.2.1 Refractive index

n_C = 1,456 at 656,3 nm

n_d = 1,458 at 587,6 nm

n_F = 1,463 at 486,1 nm

n_g = 1,466 at 435,8 nm

n = 1,508 at 248 nm

at 20℃, 1 bar atmospheric pressure

2.3 Index homogeneity

2.3.1 Granualar structure

- None

2.3.2 Striation

SUPRASIL 3001:

- No striations in all three dimensions, i.e. superior to striae class A according to MIL-G-174-B.

SUPRASIL 3002:

- No striations in the primary functional direction, i.e. striae class A according to MIL-G-174-B.
- Weak striations, if any, are parallel to the major faces.

2.3.3 Index homogeneity (Δn)

Specified over 90% of the diameter or of the side length of a ground piece, respectively 80% for raw ingots.

SUPRASIL 3001:

- In three dimensions $\Delta n \cdot \leq 4 \cdot 10^{-6}$; on request $\Delta n \leq 1 \cdot 10^{-6}$.
- Maximum weight approximate 15 kg, bigger unit weight on request

SUPRASIL 3002:

- In primary functional direction $\Delta n \leq 5 \cdot 10^{-6}$; on request $\Delta n \leq 1 \cdot 10^{-6}$.
- Dimensions and weight are practically boundless

2.4 Residual strain

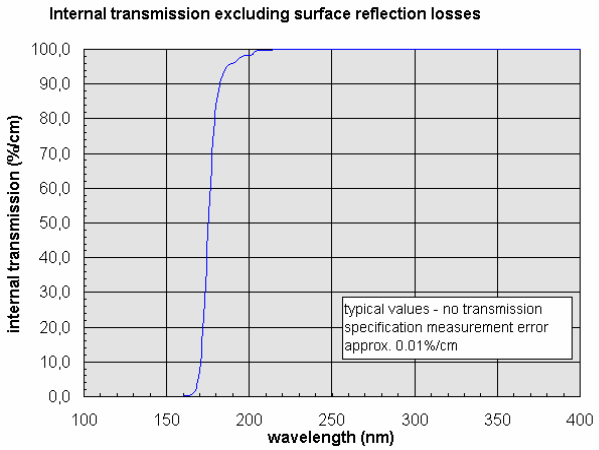
SUPRASIL 3001 and 3002:

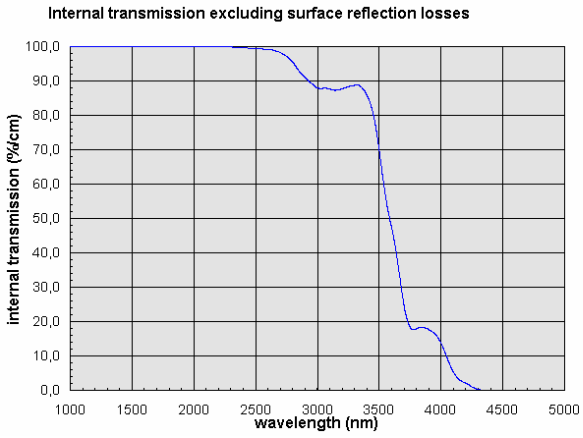
- 5 nm/cm over 70% of the diameter or of the side length
- 6 nm/cm over 80% of the diameter
- 5 - 15 nm/cm within the peripheral zone

2.5 Spectral transmission

2.5.1 Typical transmission graphs

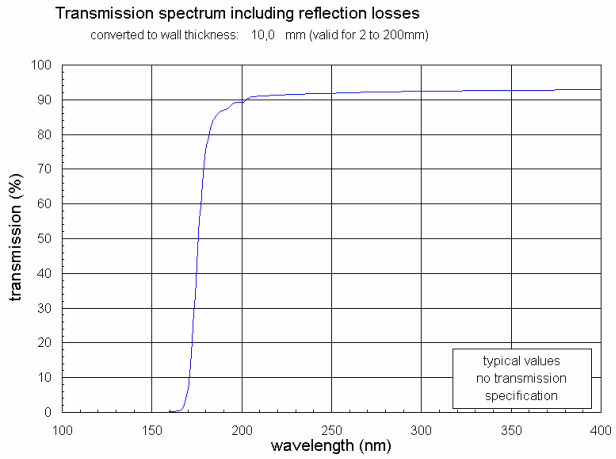
- Internal transmission



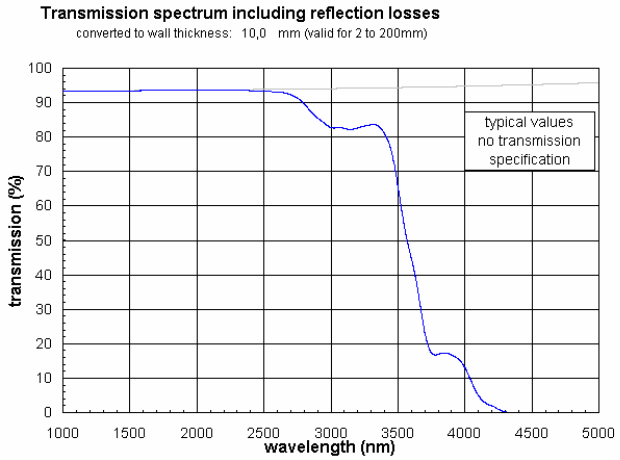


- Typical transmission graph (including Fresnel reflection losses) for a wall thickness of 10mm

Broadband transmission covers 190 nm to 2600 nm



NIR Transmission cover all NIR lasers from 800-2600 nm



2.5.2 Decadic absorption coefficient at 200 nm

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

$k_{200} < 0.01\ cm^{-1}$ (specified)

Internal transmission $T = 10^{-kd}$
and d = wall thickness

2.5.3 Infrared absorption

- Practically no OH absorption

Absorption at 1064 nm	typical: 0.25ppm/cm
Absorption at 1319 nm	typical: 1 ppm / cm

Kondilenko&Co-Workers, Ginzton Lab, Stanford University, private communication, 2005

2.6 Fluorescence: light blue

At stimulation with light at a wavelength of λ = 254 nm (Hg low pressure lamp and Schott UG 5 filter) and visual inspection.

2.7 Application range

While other Heraeus materials are ideally suited for UV or visible applications, the key properties of SUPRASIL 3001 and SUPRASIL 3002 are designed for broadband and NIR applications.

2.7.1 NIR Lasers

The combination of high material purity and low OH-content result in exceeding low absorption at 1064 nm and other lasers wavelengths. Ideal for high power lasers operating in the near-infrared.

2.7.2 Some lasers well suited for this material

ND:Yag: 266 nm, 355 nm, 532 nm, 1064 nm
Nd: Glass: 1054 nm
Ytterbium:glass: 1100 nm, 1064 nm
Er:Glass: 1534 nm

2.7.3 Tunable lasers

using operating ranges anywhere from 190 nm to 3000 nm

SUPRASIL 3002 – for lenses, windows laser debris shields

SUPRASIL 3001 - for prisms, etalons, light pipes

2.7.4 Laser Diode Optics

Medical Science
In the prevalent 940 nm laser-wavelength, that is used by laser diodes in the field of medical science as well as in material handling and in route guidance systems.

Telecommunications
Laser diodes optics used for 1300 to 1400 nm telecom applications can benefit from the combined low absorption and bubble free content.

Spectroscopy
The broadband (UV to NIR) characteristics transmission of this material are ideal for spectroscopy optics covering 190 nm to 3500 nm.

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