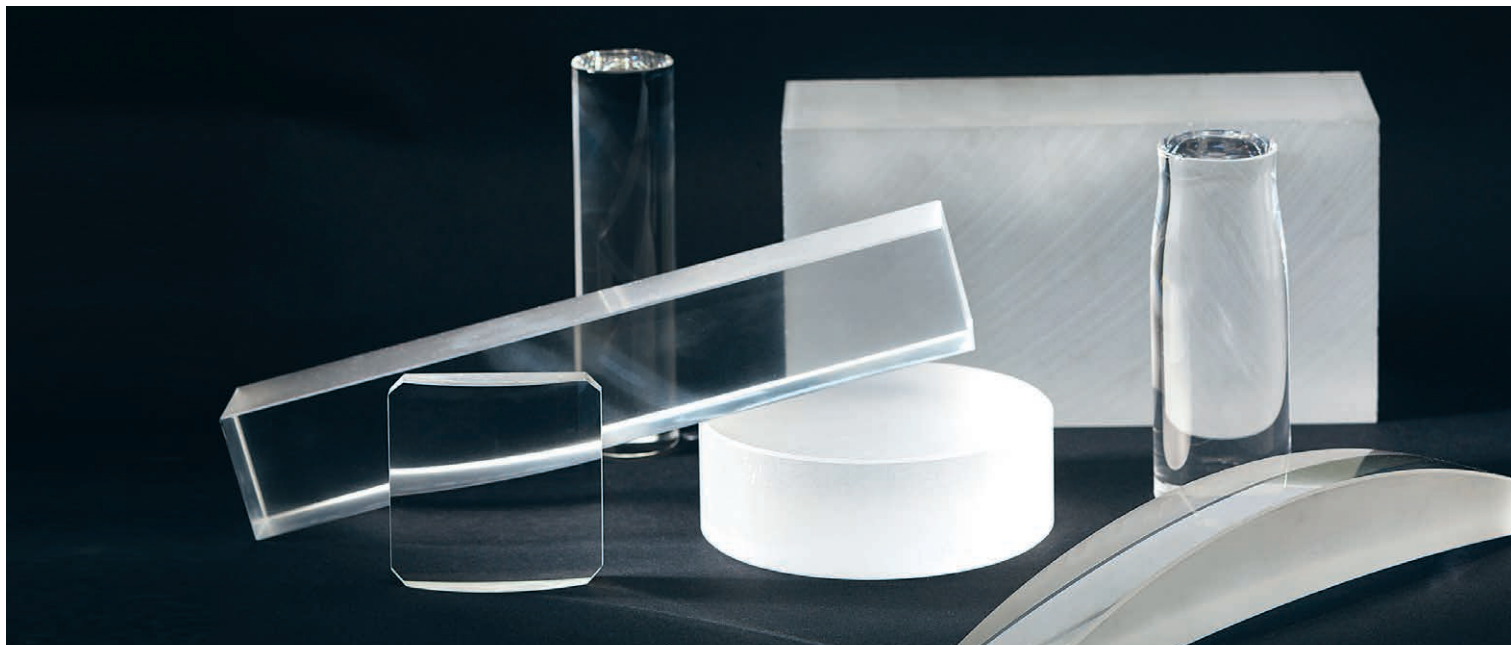


SQ Fused Silica – ultrapure fused silica

In 5 quality grades



Description

SQ Fused Silica – Especially for the production of optical and photonic devices in the fiber optic, semiconductor and display technology markets, as well as for optical applications and laser applications. The particularly inclusion- and bubble-free material features excellent optical and physical properties:

- Laser durability
- Refractive index homogeneity
- Thermal stability and temperature shock resistance
- Low stress birefringence
- Small thermal expansion coefficients.

Due to the high OH and H₂ content our fused silica SQ shows extremely low fluorescence and high stability under high-energy UV and laser radiation.

Application

- Excimer laser optics and beam guiding systems
- DUV and UV optics components
- Standard optics (VIS and NIR)
- UV rods, preforms and optical fibers
- Laser fusion
- Technical applications → Fused silica vessels, windows
- Lithography and microlithography applications → stepper lenses, photo mask blanks, wafers and lithography optics

Design / quality

LEONI offers SQ Fused Silica as ingot or semifinished product (round disc, rod, plate, block etc.) in five quality grades concerning homogeneity, absence of striae and application type. The quality grades are adjusted to individual customer needs in proven measuring and selection procedures. Thus, the fused silica can be used in the optical application range from DUV to NIR.

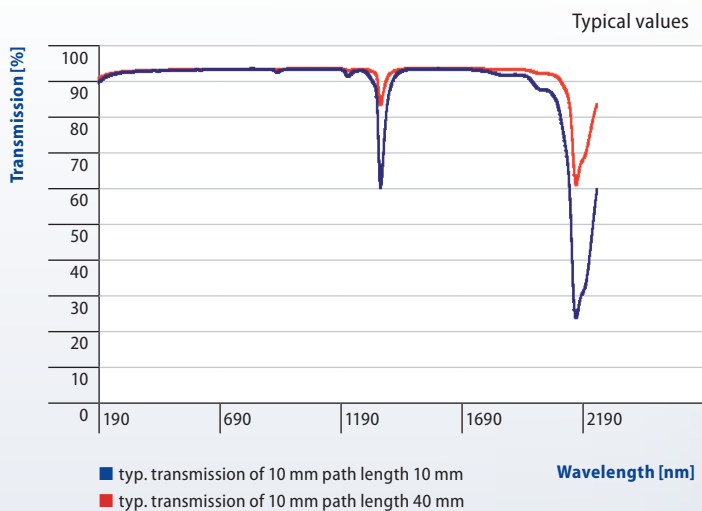
Quality grades *

- **SQ0:** is a 3D material free of striae and striations in any functional direction. It is recommended for requirements in optical elements with several light directions such as prisms and lenses.
- **SQ1:** With high homogeneity and free of striae and striations in the functional direction. Typical applications are optical elements such as lenses, discs, wafers and rods / fibers.
- **SQT:** not specified concerning homogeneity, striations and striae. This quality level is recommended for technical applications.
Excimergrade Fused Silica – available as SQ1 or SQ0: Excellent transmission at 193 nm / 248 nm. Lowest level of laser-induced fluorescence (LIF).
- **SQ0-E193 / SQ1-E193** (ArF excimer grade)
- **SQ0-E248 / SQ1-E248** (KrF excimer grade)

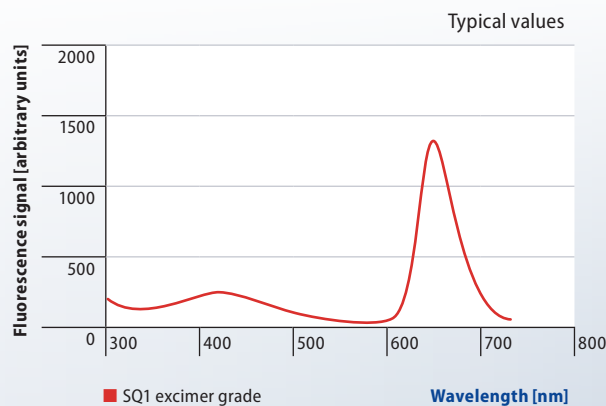
* acc. to customer-specific needs / applications

Spectral transmission

(typical transmission [T_g] including Fresnel reflection losses)



Example of an LIF spectrum (IPHT Jena)



Red fluorescence: sensitive criterion for NBOHC (Non Bridging Oxygen Hole Center). Very low level is characteristic for a high Hydrogen content.
Blue fluorescence: sensitive criterion for ODC (Oxygen Deficiency Centers)

Fluorescence

The quality levels for excimer laser wavelengths (ArF, KrF) are selected by measuring the LIF factor (laser induced fluorescence). The standardised method with reference samples has been established at the IPHT in Jena for over 10 years now.

Irradiation parameters per LIF standard:

- laser wavelength 193 nm
- energy density 210 mJ / cm²
- repetition rate 10 Hz

Optical properties

Quality grade	Bubbles and inclusions ⁴		Homogeneity data		Stress birefringence
	according to ISO 10110-3	max. diameter	local inhomogeneities	refractive index change Δn ^{2,3} in functional directions	standard ⁴
		[mm]	striations and striae ¹ as per ISO 10110-4		
SQ0	1 / 1 × 0.063	0.07	2/- ; 5 in all directions	standard: PV ≤ 40 ppm	≤ 5
SQ1	1 / 1 × 0.063	0.07	2/- ; 5 in functional directions		≤ 5
SQT	not defined	0.5	not specified	on request	≤ 10

¹ Shadow method, polarizer and interferometer are used for striae and striation detection.

² Homogeneity Δn is tested interferometrically (5% outer edge exclusion)

³ Lower values with respect to size and processing available on request.

⁴ Bubbles and inclusions < 0.05 mm in diameter are not considered in these cases.

Quality grade	Internal transmittance [%] for 10 mm sample thickness			OH content	Other Contaminants
	λ=193 nm	λ=248 nm	λ=300 nm	[ppm]	[ppm]
SQ0	≥ 98.0	≥ 99.5	≥ 99.9	approx. 1200	≤ 0.05
SQ1	≥ 98.0	≥ 99.5		approx. 1200	≤ 0.05
SQT	—	≥ 95.0		800 – 1400	≤ 0.6
SQ-E193	≥ 99.3	≥ 99.8		approx. 1200	≤ 0.05
SQ-E248	≥ 99.0	≥ 99.8		approx. 1200	≤ 0.05

All grades show internal transmittance ≥ 99,9 % in the wavelength range from 300 nm to 900 nm.

All grades show hydrogen content of 1 * 10¹⁸ Mol./cm³ approx.