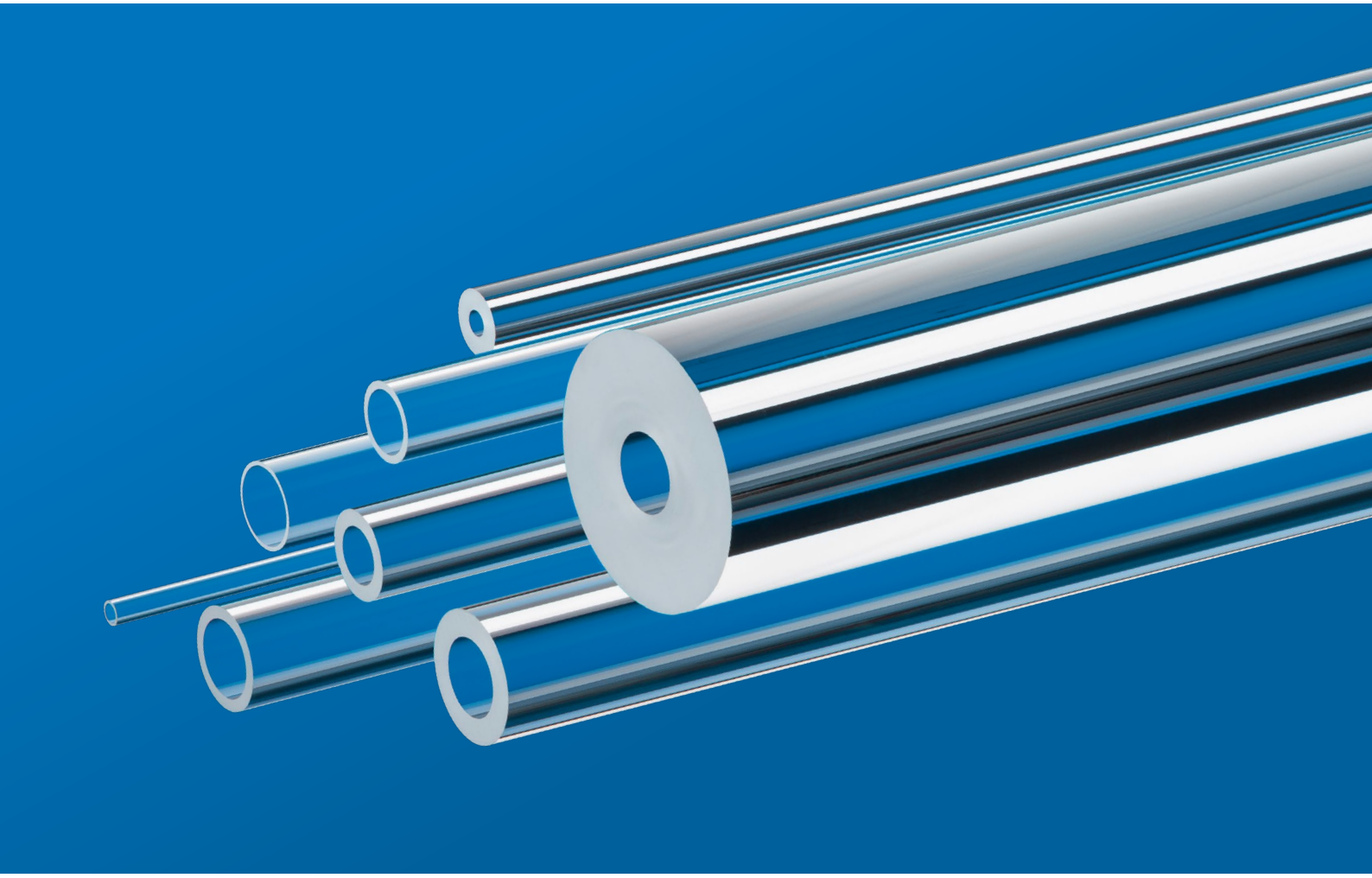
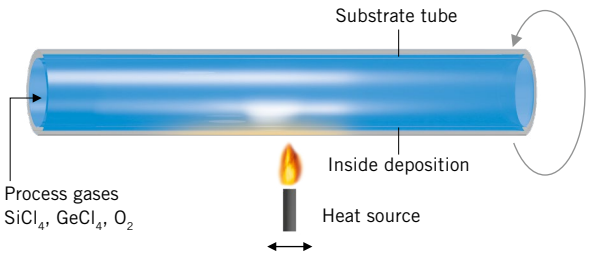


High Purity Fused Silica Tubes for Specialty Fiber Production

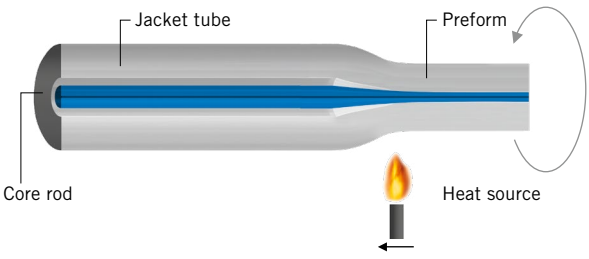
From the first natural fused quartz tubes in 1976 to today's synthetic fused silica materials, Heraeus has been an integral part in the production of optical fibers. These silica tubes are used as substrate material for the core deposition, cladding material or redrawn into capillaries for Photonic Crystal Fibers.

Heraeus has continuously improved the quality and performance of the tubes serving the fiber optics industry. Heraeus uses proprietary processes that allows the production of fused silica tubes without the use of forming tools. These processes yield tubes of excellent purity and high geometrical performance.

CVD process inside a substrate tube



Cladding a core with a jacket tube



Tubes for active and passive core rod production

Fused silica tubes are used in key steps of optical fiber production. Chemical Vapor deposition (CVD) processes rely on high purity and precise geometrical properties of tubes to produce excellent core rods. Heraeus F 300® material with a specified OH content below 1 ppm is the material of choice and the gold standard in the fiber optic community.

For your demanding applications Heraeus offers furthermore a product portfolio of fused silica with special material properties which allow for example a viscosity or refractive index match. For tight geometrical tolerance requirements Heraeus has engineered an enhanced tube production process to improve ovality and siding characteristics. Tubes with these improved geometrical characteristics are indicated as "HP" for high precision tubes.

Tubes used as cladding material

Heraeus fused silica tubes can be used not only for the manufacturing of core rods, in the deposition process, but also as cladding material, jacketing the core rod. The tubes are available in a wide range of sizes. Heraeus fused silica tubes can be tailored to customer specific requirements. Applying Heraeus tubes as cladding material in the rod in tube process (RIT) benefits from the low hydroxyl content of our material. As a result the interface between the core rod and cladding material stays free of hydroxyl ions.

Typical Geometrical Parameters

Typical values	Small substrate tubes	Substrate tubes, (HP substrate tubes)	Small jacket tubes	Large jacket tubes
Outer diameter (OD)	10 – 20 mm	20 – 40 mm	40 – 60 mm	60 – 90 mm
Wall thickness (WT)	1 – 4 mm	1 – 4 mm	4 – 15 mm	15 – 30 mm
OD tolerance	± 0.02 ... 0.2 mm	± 0.03 ... 0.2 mm	± 0.1 ... 0.3 mm	± 0.2 ... 0.4 mm
WT tolerance	± 0.02 ... 0.2 mm	± 0.03 ... 0.2 mm	± 0.1 ... 0.3 mm	± 0.2 ... 0.4 mm
Ovality	0.03 ... 0.2 mm (HP: 0.01 ... 0.03 mm)	0.05 ... 0.2 mm (HP: 0.01 ... 0.05 mm)	0.1 ... 0.25 mm	0.15 ... 0.3 mm
Siding	0.05 ... 0.12 mm (HP: 0.02 ... 0.05 mm)	0.07 ... 0.12 mm (HP: 0.02 ... 0.05 mm)	0.1 ... 0.2 mm	0.15 ... 0.3 mm
CSA deviation	1 ... 3 %	1 ... 2 %	0.7 ... 2 %	0.5 ... 1 %
Bow	0.3 ... 0.5 mm/m	0.2 ... 0.4 mm/m	0.2 ... 0.4 mm/m	0.2 ... 0.4 mm/m
Material Grades	F300, F500, F320, F520, F110, F310	F300, F500, F320, F520, F110, F310	F300, F500, F320, F520	F300

(For a detailed definition of the various parameters, please visit www.herae.us/tubegeowiki)

Typical Material Parameters

		F110	Spectrosil	F300	F500	F310	F320		F520	
Viscosity dPas [1150°C]		12.7	11.9	13.1	13.1	13.1	-0.10 % -0.20 % -0.30 % -0.40 %	11.8 11.5 11.2 10.6	-0.10 % -0.20 % -0.30 % -0.40 %	11.8 11.5 11.2 10.6
Refractive index* [x10^{-3}]		-0.1 ... 0	-0.16 ... -0.25	+0.35 ... +0.5	+0.35 ... +0.5	0	-0.10 % -0.20 % -0.30 % -0.40 %	-1.17 ... -0.59 -3.28 ... -2.56 -4.29 ... -3.36 -6.34 ... -5.39	-0.10 % -0.20 % -0.30 % -0.40 %	-1.17 ... -0.59 -3.28 ... -2.56 -4.29 ... -3.36 -6.34 ... -5.39
Cl-content [ppm]	typical	200 ... 300	<0.15	800 ... 2,000	800 ... 2,000	<0.2	-0.10 % -0.20 % -0.30 % -0.40 %	200 ... 300 200 ... 300 ~1,000 –	-0.10 % -0.20 % -0.30 % -0.40 %	200 ... 300 200 ... 300 ~1,000 –
F-content [ppm]		–	–	–	–	–	-0.10 % -0.20 % -0.30 % -0.40 %	~3,200 ~6,800 ~10,800 ~16,000	-0.10 % -0.20 % -0.30 % -0.40 %	~3,200 ~6,800 ~10,800 ~16,000
Trace impurities		Below detection limit of ICP-MS								
OH [ppm]	specified typical	– 400	– 1,000	≤1 ≤0.2	≤0.1 ≤0.02	200	≤1 ≤0.2		≤0.1 ≤0.02	

* Difference to un-doped silica (Heraeus standard)

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