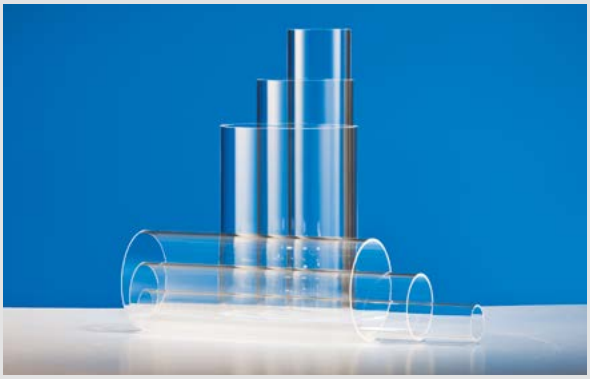
Quartz Glass Tubes



Applications

Process chambers, tubes and parts for semiconductor, photovoltaic and industrial applications

Characteristics

High purity, temperature stability, corrosion resistant, transparent

Heraeus Conamic' material grades are qualified at major players in the semiconductor and photovoltaic industry. Heraeus offers quartz glass tubes in a very broad diameter range from 2 mm up to 960 mm. It is a specialty of Heraeus to be able to supply tubes made by various production routes and of different material grades. Quartz glass tubes are either drawn in a cost efficient single step process or a very flexible multi step process.
In the single step process, very pure and tightly controlled raw material is continuously electrically fused to form quartz glass tubes. The range of direct-drawn tubes covers an outer diameter of 9 – 235 mm with a wall thickness from 1 mm up to 10 mm depending on the outer diameter. These tubes are available with snap cut or machine cut ends. In the multi step process, batches of quartz glass are formed to the desired dimensions.

Heraeus' multistep quartz glass tubing covers a wide variety of material grades. With this process it is possible to supply electrically fused as well as flame fused and synthetic quartz glass tubes.

For high temperature applications Heraeus offers quartz glass tubes as HSQ® 400 with better temperature stability (less sagging). These tubes have been impregnated with an agent to trigger cristobalite formation. The crystal layer supports the glass, resulting in significantly lower sagging of the tube.

HSQ® 330S is a new selected grade that guarantees particularly low metal concentrations as required for super high purity semiconductor materials.

Dimensions (mm)

Direct drawn tubing (Material grade: HSQ® 100, 300, 330)

Technology	directly drawn out of melting crucible; only available in HSQ® 100										directly drawn out of melting crucible; only available in HSQ® 300, 330					
Outer Diameter	9 – < 10	10 – < 15	15 – < 20	20 – < 25	25 – < 30	30 – 40	> 40 – 45	> 45 – 55	> 55 – 60	> 60 – 64	120 – 140	> 140 – 150	> 150 – 160	> 160 – 180	> 180 – 200	> 200 – 235
Wall Thickness	1	1 – 2	1 – 3	1 – 4	1 – 5	1 – 6	1 – 5	1.5 – 4	1.5 – 3	1.5 – 2	2 – 3	2 – 4	2 – 6	3 – 7	3 – 8	5 – 10

Multi step tubing (Material grade: HSQ® 300, 330, 351, 400, 700, 751, 900)

Technology	free drawn from heavy walled cylinder (S-Zug)				drawn from heavy walled cylinder using a forming tool (H-Zug)				resized mother tube (direct drawn) *		resized H-Zug tube				
Outer Diameter	2 – 8	> 8 – 17	> 17 – 40	> 40 – 90	55 – 160	> 160 – 210	> 210 – 310	> 310 – 360	200 – 300	> 300 – 460	> 360 – 460	> 460 – 550	> 550 – 650	> 650 – 700	> 700
Wall Thickness	0.4 – 2.0	0.8 – 3.5	1.2 – 6.0	1.8 – 6.0	2 – 10	2 – 12	3 – 12	3.5 – 13	5 – 6	4 – 6	3.5 – 12	5 – 11	5 – 10	6 – 9	On request

* only available in HSQ® 300 and 330.

Mother tubing for resizing (Material grade: HSQ® 300/330; Length (mm): 2500; 3000; 3500)

Outer Diameter	170	197	235
Wall Thickness	5.0	5.0; 6.5; 7.5	9.5

Chemical purity – Trace element concentration (ppm)

Typical Values (= Statistical Average Value)

	Li	Na	K	Mg	Ca	Fe	Cu	Cr	Ni	Mn	Ti	Zr	Al	OH
Electrically fused quartz														
HSQ® 100/300/400**	0.5	0.2	0.3	< 0.03	0.5	0.1	0.01	< 0.01	< 0.01	< 0.03	1.1	1.0	15	< 30*
HSQ® 330	0.5	0.1	0.2	< 0.03	0.5	0.1	< 0.01	< 0.01	< 0.01	< 0.03	1.1	1.0	15	< 30*
HSQ® 700	< 0.01	< 0.02	0.1	< 0.03	0.4	0.1	< 0.01	< 0.01	< 0.01	< 0.01	1.1	1.0	15	< 30*
Flame fused quartz														
HSQ® 351	0.3	0.6	0.6	< 0.03	0.6	0.1	< 0.01	< 0.01	< 0.01	< 0.03	1.1	1.0	15	175
HSQ® 751	0.1	< 0.03	0.1	0.1	0.7	0.1	< 0.01	< 0.01	< 0.01	< 0.01	1.4	0.8	8	175
Synthetic fused silica**														
HSQ® 900	< 0.002	< 0.01	< 0.01	< 0.01	< 0.02	< 0.03	< 0.001	< 0.001	n. s.	< 0.0005	< 0.03	< 0.04	< 0.04	0.2

* OH content can be reduced by additional annealing.
**HSQ®400: Higher aluminium content on the outer surface due to chemical stabilization coating.

** Chlorine content: HSQ® 900: 1500 ppm

Technical Properties (typical values)

Mechanical Data	
Density	2.203 g/cm³
Mohs Hardness	5.5 … 6.5
Micro Hardness	8600 … 9800 N/mm²
Knoop Hardness	5800 … 6100 N/mm²
Modulus of elasticitiy (at 20°C)²	7.25 x 104 N/mm²
Modulus of torsion	3.0 x 104 N/mm²
Poisson's ratio	0.17
Compressive strength (approx.)	1150 N/mm²
Tensile strength (approx.)	50 N/mm²
Bending strength (approx.)	67 N/mm²
Torsional strength (approx.)	30 N/mm²
Sound velocity	5720 m/s

Thermal Data	**electrically fused**	**flame fused**	**synthetic**
Softening temperature °C	1710	1660	1600
Annealing temperature °C	1220	1160	1100
Strain temperature °C	1125	1070	1000
Max. working temp. continuous °C	1160	1110	950
Short-term °C	1300	1250	1200

Mean specific heat J/kg·K	
0 … 100 °C	772
0 … 500 °C	964
0 … 900 °C	1052

Heat conductivity W/m·K	
20 °C	1.38
100 °C	1.47
200 °C	1.55
300 °C	1.67
400 °C	1.84
950 °C	2.68

Mean expansion coefficient K^{-1}	
0 … 100 °C	5.1×10^{-7}
0 … 200 °C	5.8×10^{-7}
0 … 300 °C	5.9×10^{-7}
0 … 600 °C	5.4×10^{-7}
0 … 900 °C	4.8×10^{-7}
-50 … 0 °C	2.7×10^{-7}

Electrical resistivity in in Ω*cm	
20 °C	10^{18}
400 °C	10^{10}
800 °C	6.3×10^{6}
1200 °C	1.3×10^{5}

Dielectric strength in kV/mm (sample thickness ≥ 5 mm)	
20 °C	25 … 40
500 °C	4 … 5

Dielectric loss angle (tgδ)	
1 kHz	5.0×10^{-4}
1 MHz	1.0×10^{-4}
3×10^{10} Hz	4.0×10^{-4}

Dielectric constant (ε)	
20 °C, 0 … 10^{6} Hz	3.70
23 °C, 9 … 10^{8} Hz	3.77
23 °C, 3×10^{10} Hz	3.81

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