Quartz Glass Tubes

Characteristics

- Tight geometrical tolerances
- High chemical purity
- Low bubble and inclusion content

Applications

- Process chambers, tubes and parts
- Semiconductor, photovoltaic and industrial applications

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 600 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. These tubes are available with snap cut or machine cut ends.

Heraeus' multi-step quartz glass tubing covers a wide variety of material grades. With this process it is possible to supply electrically fused as well as 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.

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

HSQ-T is part of Heraeus' new synthetic material family: Neonyx. HSQ-T is fully manufactured from synthetic raw material, guaranteeing highest levels of purity and consistency, along lowest in class contamination levels and zero inclusion and bubble count.

Chemical Properties (Typical Values)

Trace Element Concentration (ppm)

Electrically fused quartz	Li	Na	K	Mg	Ca	Fe	Cu	Cr	Ni	Mn	Ti	Zr	Al	OH
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 (S)	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*

Synthetic fused silica	Li	Na	K	Mg	Ca	Fe	Cu	Cr	Ni	Mn	Ti	Zr	Al	OH
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
HSQ®-T	< 0.01	< 0.01	< 0.01	< 0.01	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	150-200

*OH content can be reduced by additional annealing.

Available Dimensions (mm)

Typical length between 1000 – 3000 mm (other dimensions possible on request)

Direct drawn tubing (HSQ® 100, 300, 330 (S))

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

Multi step tubing (HSQ® 300, 330 (S), 400, 700, 900, HSQ-T)

Technology	Outer Diameter	Wall Thickness
Free drawn from heavy walled cylinder (S-Zug)	2–8	0.4–2.0
	>8–17	0.8–3.5
	>17–40	1.2–6.0
	>40–90	1.8–6.0
Drawn from heavy walled cylinder using a forming tool (H-Zug)	55–160	2–10
	>160–210	2–12
	>210–310	3–12
	>310–470	3.5–13
Resized mother tube (direct drawn) only available in HSQ® 300 and 330	200–300	5–6
	>300–460	4–6
Resized H-Zug tube	>460–600	5–7

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

Technology	Outer Diameter	Wall Thickness
Directly drawn out of melting crucible in dedicated tube runs	170	5.0
	197	5.0; 6.5; 7.5
	235	7.5; 9.5
	285	7.7

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 Elasticity (at 20°C)	7.25×10^4 N/mm²
Modulus of Torsion	3.0×10^4 N/mm²
Poisson's Ratio	0.17
Compressive Strength	~ 1150 N/mm²
Tensile Strength	~ 50 N/mm²
Bending Strength	~ 67 N/mm²
Torsional Strength	~ 30 N/mm²
Sound Velocity	5720 m/s

Electrical Data

Resistivity [Ω×cm]	
20°C	10^{18}
400°C	10^{10}
800°C	6.3×10^6
1200°C	1.3×10^5
Dielectric strength [kV/mm] (sample thickness ≥ 5 mm)	
20°C	25...40
500°C	4...5
Dielectric loss angle (tg δ)	
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

Thermal Data

	electrically fused	synthetic
Softening temperature	1710°C	1600°C
Annealing temperature	1220°C	1100°C
Strain temperature	1125°C	1000°C
Max. working temperature		
continuous	1160°C	950°C
short-term	1300°C	1200°C

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 thermal expansion coefficient K^{-1}	
-50...0°C	2.7×10^{-7}
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}

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Germany
Heraeus Quarzglas GmbH & Co. KG
Heraeus Conamic
Kleinostheim, Germany
Phone: +49 6181 35-7444
conamic.basematerials.eu@heraeus.com

USA
Heraeus Quartz North America, LLC.
Heraeus Conamic
Chandler, Arizona, USA
Phone: +1 678 714-4306
conamic.basematerials.us@heraeus.com

UK
Heraeus Conamic UK Ltd.
Wallsend, UK
Phone: +44 191 2598-411
conamic.basematerials.eu@heraeus.com

Korea
Heraeus Korea Corporation
Heraeus Conamic Anseong Factory
Miyang-myeon, Gyeonggi-do, Korea
Phone: +82 31 671-7601
conamic.basematerials.kr@heraeus.com

China
Heraeus ShinEtsu Quartz (China) Inc.
Pudong, Shanghai, China
Phone: +86 21 6867 2266-809
conamic.basematerials.cn@heraeus.com

Japan
Shin-Etsu Quartz Products Co., Ltd.
Shinagawa, Tokyo, Japan
Phone: +81 3 6737-0221
division3@sqp.co.jp

Taiwan
Heraeus Materials Technology Taiwan Ltd.
Taipei, Taiwan
Phone: +886 2 2627-1111
conamic.basematerials.tw@heraeus.com

www.heraeus-conamic.com