Quartz Glass Tubes

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

Characteristics
High purity, temperature stability, corrosion resistant, transparent

Heraeus Quarzglas’ material grades are qualified at major players in the semiconductor and solar industry. Heraeus offers quartz glass tubes in a very broad diameter range from 2 mm up to 900 mm. It is a specialty of Heraeus to be able to supply tubes made through various production routes and of different material grades. Quartz glass tubes are either made 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 10 – 60 mm with a wall thickness of 1 mm up to 6 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. The whole diameter range (2 – 900 mm) is covered by this process. Additional annealing is optional for all quartz glass tubes.

For high temperature applications Heraeus offers quartz glass tubes with better temperature stability (less sagging). These tubes have been impregnated with an agent to trigger cristobalite formation. This crystalline layer forms once the tube has been exposed to temperatures of 1150°C. The crystal layer supports the glass, resulting in significantly lower sagging of the tube. Once crystal formation has started, it is necessary to keep the tubes at temperatures above 300°C.

Dimensions (mm)

<table>
<thead>
<tr>
<th>Single Step</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Wall Thickness</td>
<td>1 – 2</td>
<td>1 – 2.5</td>
<td>1 – 3</td>
<td>1 – 4</td>
<td>1 – 5</td>
<td>1 – 5.5</td>
<td>1 – 6</td>
<td>1.2 – 5</td>
<td>1.4 – 4.5</td>
<td>1.5 – 4</td>
<td>1.5 – 3.5</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Multi Step</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Wall Thickness</td>
<td>0.5 – 2</td>
<td>0.8 – 3.5</td>
<td>1 – 4.5</td>
<td>1.2 – 4.5</td>
<td>1.8 – 6</td>
<td>2 – 8</td>
<td>2.2 – 8</td>
<td>2.5 – 10</td>
<td>3 – 12</td>
<td>3 – 13</td>
<td>≥ 4</td>
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</tbody>
</table>
**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 elasticity (at 20°C)**: 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.)**: 30 N/mm²
- **Bending strength (approx.)**: 67 N/mm²
- **Sound velocity**: 5720 m/s

**Thermal Data**

- **Softening temperature °C**: 1710
- **Annealing temperature °C**: 1220
- **Strain temperature °C**: 1125
- **Max. working temperature continuous °C**: 1150
- **Short-term °C**: 1300

**Chemical Purity – Typical trace elements and OH content (ppm by weight oxide)**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Prod. Route</th>
<th>Al</th>
<th>Ca</th>
<th>Cl</th>
<th>Cr</th>
<th>Cu</th>
<th>Fe</th>
<th>K</th>
<th>Li</th>
<th>Mg</th>
<th>Mn</th>
<th>Na</th>
<th>Ti</th>
<th>Zr</th>
<th>OH</th>
</tr>
</thead>
<tbody>
<tr>
<td>HSQ 100</td>
<td>E</td>
<td>15</td>
<td>0.5</td>
<td>n.s.</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
<td>0.1</td>
<td>0.4</td>
<td>0.6</td>
<td>0.05</td>
<td>&lt;0.05</td>
<td>0.3</td>
<td>1.1</td>
<td>0.7</td>
<td>n.s.</td>
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<td>&lt;0.05</td>
<td>0.1</td>
<td>0.4</td>
<td>0.6</td>
<td>0.05</td>
<td>&lt;0.05</td>
<td>0.3</td>
<td>1.1</td>
<td>0.7</td>
<td>&lt;30</td>
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<tr>
<td>HSQ 400</td>
<td>E</td>
<td>HSQ 100 with chemical precursor</td>
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<td></td>
<td></td>
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<td>n.s.</td>
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<td>&lt;0.05</td>
<td>0.1</td>
<td>0.1</td>
<td>0.05</td>
<td>0.05</td>
<td>&lt;0.05</td>
<td>0.3</td>
<td>1.1</td>
<td>0.7</td>
<td>&lt;30</td>
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<td>HSQ 700 with chemical precursor</td>
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<th>OH</th>
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<tbody>
<tr>
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<td>&lt;0.02</td>
<td>&lt;0.01</td>
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<td>HSQ 910</td>
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<td>&lt;8.94</td>
<td>&lt;0.02</td>
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**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
- 300°C: 1.55
- 500°C: 1.67
- 400°C: 1.84
- 950°C: 2.68

**Mean expansion coefficient K⁻¹**

- 0 … 100°C: 5.1 x 10⁻⁵
- 0 … 200°C: 5.8 x 10⁻⁵
- 0 … 300°C: 5.9 x 10⁻⁵
- 0 … 600°C: 5.4 x 10⁻⁵
- 0 … 900°C: 4.8 x 10⁻⁵
- -50 to 0°C: 2.7 x 10⁻⁵

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*The data given here is correct at February 2012 and is subject to change.*

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