Quartz Glass Plates

Applications
Etch tanks, windows, support plates, pedestals for reaction chambers, cover plates

Characteristics
High temperature stability, corrosion resistant, transparent or opaque

Heraeus Quarzglas provides transparent quartz glass plates with very good transmission and opaque plates with high reflectivity. Transparent quartz glass plates are offered in a wide variety of grades, from cost efficient direct drawn plates, to plates cut from various solid materials. They are used for instance to produce etch tanks or as windows and cover plates for various applications.

Heraeus Quarzglas’ grades are primarily differentiated by the production route and the chemical impurity characteristics. Therefore, transparent quartz glass plates are divided into two larger groups: flame fused and electrically fused. In each group a variety of grades is available, each with individual advantages for specific applications.

Direct drawn plates
Material grade: HSQ® 100
Length (mm): Standard: 1500, Max. length: 2500

<table>
<thead>
<tr>
<th>Thickness (mm)</th>
<th>Width (mm) as drawn</th>
<th>Width (mm) with specified thickness tolerances</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.0</td>
<td>190</td>
<td>130</td>
</tr>
<tr>
<td>2.3</td>
<td>220</td>
<td>150</td>
</tr>
<tr>
<td>2.5</td>
<td>230</td>
<td>170</td>
</tr>
<tr>
<td>3.0</td>
<td>250</td>
<td>200</td>
</tr>
<tr>
<td>3.5</td>
<td>260</td>
<td>210</td>
</tr>
<tr>
<td>4.0</td>
<td>270</td>
<td>220</td>
</tr>
<tr>
<td>5.0</td>
<td>285</td>
<td>250</td>
</tr>
<tr>
<td>6.0</td>
<td>320</td>
<td>280</td>
</tr>
<tr>
<td>7.0</td>
<td>330</td>
<td>290</td>
</tr>
<tr>
<td>8.0</td>
<td>335</td>
<td>300</td>
</tr>
</tbody>
</table>

Also available with ground surface in standard length 700 mm.

In addition to transparent quartz glass Heraeus has a unique opaque material with exceptionally low transmission, which is also available in the form of plates (OM 100). It is made in a ceramic process and frequently used to block and reflect heat radiation.

Heraeus Quarzglas cuts quartz glass solids into plates using band and wire saws. While band saws allow larger sizes to be cut, wire sawn plates have a smoother surface finish and excellent parallelism.

Depending on the size, specific surface finishes can be selected: cut or drawn, ground or polished. In addition to an improved surface finish, Heraeus Quarzglas offers to cut plates to customized shapes through water jet or laser cutting.

Cut plates
Material grade: HSQ® 300, 330, TSC-3®, TSC-4, Spectrosil® 1000

<table>
<thead>
<tr>
<th>Cutting capabilities</th>
<th>Band saw cut</th>
<th>Wire saw cut</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thickness (mm)</td>
<td>&gt; 5</td>
<td>2 – 14</td>
</tr>
<tr>
<td>Max. cut size (mm)</td>
<td>700 x 2000</td>
<td>500 x 600</td>
</tr>
</tbody>
</table>

Contour trimming capabilities
<table>
<thead>
<tr>
<th>Standard cut (Water jet)</th>
<th>Precision cut (Laser)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thickness (mm)</td>
<td>≥ 3</td>
</tr>
<tr>
<td>Max. cut size (mm)</td>
<td>≥ 35 x 35</td>
</tr>
</tbody>
</table>

Plate cross section

w₂: as drawn
w₂: with specified thickness tolerances
Chemical purity – Trace element concentration (ppm)

<table>
<thead>
<tr>
<th>Electrically fused quartz</th>
<th>Li</th>
<th>Na</th>
<th>K</th>
<th>Mg</th>
<th>Ca</th>
<th>Fe</th>
<th>Cu</th>
<th>Cr</th>
<th>Ni</th>
<th>Mn</th>
<th>Ti</th>
<th>Zr</th>
<th>Al</th>
<th>OH</th>
</tr>
</thead>
<tbody>
<tr>
<td>HSQ® 100/300</td>
<td>0.5</td>
<td>0.2</td>
<td>0.3</td>
<td>&lt;0.03</td>
<td>0.5</td>
<td>0.1</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.03</td>
<td>1.1</td>
<td>1.0</td>
<td>15</td>
<td>&lt;30*</td>
</tr>
<tr>
<td>HSQ® 330</td>
<td>0.5</td>
<td>0.1</td>
<td>0.2</td>
<td>&lt;0.03</td>
<td>0.5</td>
<td>0.1</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.03</td>
<td>1.1</td>
<td>1.0</td>
<td>15</td>
<td>&lt;30*</td>
</tr>
<tr>
<td>OM® 100</td>
<td>0.1</td>
<td>0.1</td>
<td>0.2</td>
<td>&lt;0.03</td>
<td>0.4</td>
<td>0.1</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.03</td>
<td>1.1</td>
<td>1.0</td>
<td>15</td>
<td>n.s.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Flame fused quartz</th>
<th>Li</th>
<th>Na</th>
<th>K</th>
<th>Mg</th>
<th>Ca</th>
<th>Fe</th>
<th>Cu</th>
<th>Cr</th>
<th>Ni</th>
<th>Mn</th>
<th>Ti</th>
<th>Zr</th>
<th>Al</th>
<th>OH</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSC-3®</td>
<td>0.2</td>
<td>0.3</td>
<td>0.2</td>
<td>&lt;0.01</td>
<td>0.4</td>
<td>0.05</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>1.1</td>
<td>0.8</td>
<td>15</td>
<td>170</td>
</tr>
<tr>
<td>TSC-4</td>
<td>0.04</td>
<td>0.2</td>
<td>0.08</td>
<td>&lt;0.01</td>
<td>0.7</td>
<td>0.1</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>1.3</td>
<td>0.7</td>
<td>8</td>
<td>170</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Synthetic fused silica</th>
<th>Li</th>
<th>Na</th>
<th>K</th>
<th>Mg</th>
<th>Ca</th>
<th>Fe</th>
<th>Cu</th>
<th>Cr</th>
<th>Ni</th>
<th>Mn</th>
<th>Ti</th>
<th>Zr</th>
<th>Al</th>
<th>OH</th>
</tr>
</thead>
<tbody>
<tr>
<td>HSQ® 900</td>
<td>&lt;0.002</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;0.02</td>
<td>&lt;0.03</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.0005</td>
<td>&lt;0.03</td>
<td>&lt;0.04</td>
<td>&lt;0.04</td>
<td>0.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spectrosil® 1000</td>
<td>&lt;10</td>
<td>&lt;10</td>
<td>&lt;10</td>
<td>&lt;10</td>
<td>&lt;10</td>
<td>&lt;10</td>
<td>&lt;10</td>
<td>&lt;10</td>
<td>n.s.</td>
<td>&lt;10</td>
<td>n.s.</td>
<td>&lt;10</td>
<td>n.s.</td>
<td>1350</td>
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</table>
* OH content can be reduced by additional annealing.

Technical Properties (typical values)

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

<table>
<thead>
<tr>
<th>Thermal Data</th>
<th>electrically fused</th>
<th>flame fused</th>
<th>synthetic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Softening temperature °C</td>
<td>1710</td>
<td>1660</td>
<td>1600</td>
</tr>
<tr>
<td>Annealing temperature °C</td>
<td>1220</td>
<td>1160</td>
<td>1100</td>
</tr>
<tr>
<td>Strain temperature °C</td>
<td>1125</td>
<td>1070</td>
<td>1000</td>
</tr>
<tr>
<td>Max. working temp. continuous °C</td>
<td>1660</td>
<td>1110</td>
<td>950</td>
</tr>
<tr>
<td>Short-term °C</td>
<td>1300</td>
<td>1250</td>
<td>1200</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mean specific heat J/kg K</th>
<th>0 … 100 °C</th>
<th>772</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0 … 500 °C</td>
<td>964</td>
</tr>
<tr>
<td></td>
<td>0 … 900 °C</td>
<td>1052</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Heat conductivity W/m·K</th>
<th>20 °C</th>
<th>1.38</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100 °C</td>
<td>1.47</td>
</tr>
<tr>
<td></td>
<td>200 °C</td>
<td>1.55</td>
</tr>
<tr>
<td></td>
<td>300 °C</td>
<td>1.67</td>
</tr>
<tr>
<td></td>
<td>400 °C</td>
<td>1.84</td>
</tr>
<tr>
<td></td>
<td>950 °C</td>
<td>2.68</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mean expansion coefficient K³</th>
<th>0 … 100 °C</th>
<th>5.1 x 10⁻⁷</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0 … 200 °C</td>
<td>5.8 x 10⁻⁷</td>
</tr>
<tr>
<td></td>
<td>0 … 300 °C</td>
<td>5.9 x 10⁻⁷</td>
</tr>
<tr>
<td></td>
<td>0 … 600 °C</td>
<td>5.4 x 10⁻⁷</td>
</tr>
<tr>
<td></td>
<td>0 … 900 °C</td>
<td>4.8 x 10⁻⁷</td>
</tr>
<tr>
<td></td>
<td>-50 … 0 °C</td>
<td>2.7 x 10⁻⁷</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Electrical resistivity in Ω·cm</th>
<th>20 °C</th>
<th>10¹⁰</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>400 °C</td>
<td>10¹⁰</td>
</tr>
<tr>
<td></td>
<td>800 °C</td>
<td>6.3 x 10⁶</td>
</tr>
<tr>
<td></td>
<td>1200 °C</td>
<td>1.3 x 10⁷</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dielectric strength in kV/mm</th>
<th>20 °C</th>
<th>25 … 40</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>500 °C</td>
<td>4 … 5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dielectric loss angle (µF)</th>
<th>1 Hz</th>
<th>5.0 x 10⁻⁴</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 MHz</td>
<td>1.0 x 10⁻⁴</td>
</tr>
<tr>
<td></td>
<td>3 x 10¹⁰ Hz</td>
<td>4.0 x 10⁻⁴</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dielectric constant (ε)</th>
<th>26 °C, 0 … 10° Hz</th>
<th>3.70</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>23 °C, 9 … 10° Hz</td>
<td>3.77</td>
</tr>
<tr>
<td></td>
<td>23 °C, 3 … 10° Hz</td>
<td>3.81</td>
</tr>
</tbody>
</table>

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