HPFS® 8655 Fused Silica

HPFS® 8655 fused silica is an extremely pure synthetic glass with very low water content which leads to an exceptionally stable and predictable dynamic behavior under deep ultraviolet (DUV) laser exposures. It is a compaction only material, showing no expansion, with a much greater resistance versus the well-known standard compaction curve resulting in the lowest possible induced wave front distortion.

Glass Code 8655 is commonly utilized to manufacture optical lenses for use in state-of-the-art microlithography due to its minimized induced absorption and low polarization birefringence behaviors. In addition to its performance under DUV laser exposures, HPFS® 8655 fused silica meets microlithography’s lowest static birefringence, absorption and uniform refractive index homogeneity specifications. Data and literature are available upon request.

Quality Grade Selection Chart

<table>
<thead>
<tr>
<th>Inclusion Class</th>
<th>Homogeneity [ppm]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Grade</td>
</tr>
<tr>
<td>Class</td>
<td>Total Inclusion Cross Section [mm]</td>
</tr>
<tr>
<td>0</td>
<td>≤0.03</td>
</tr>
<tr>
<td>1</td>
<td>≤0.10</td>
</tr>
<tr>
<td>2</td>
<td>≤0.25</td>
</tr>
</tbody>
</table>

1. Defines the sum of the cross section in mm² of inclusions per 100 cm³ of glass. Inclusions with a diameter ≤ 0.10 mm are disregarded.
2. Refers to the diameter of the largest single inclusion.
3. Index homogeneity: the maximum index variation (relative), measured over the clear aperture of the blank.
4. Index homogeneity is certified using an interferometer at 632.8 nm. The numerical homogeneity is reported as the average through the piece thickness. Blanks with a diameter up to 450 mm can be analyzed over the full aperture. Larger parts can be analyzed using multiple overlapping apertures. The minimum thickness for index homogeneity verification is 20 mm. For thinner parts, the parent piece is certified.

Mechanical and Thermal Properties

Unless otherwise stated, all values @ 25 °C

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
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<tbody>
<tr>
<td>Elastic (Young’s) Modulus</td>
<td>73 GPa</td>
</tr>
<tr>
<td>Shear Modulus</td>
<td>31 GPa</td>
</tr>
<tr>
<td>Modulus of Rupture, abraded</td>
<td>52.4 MPa</td>
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<tr>
<td>Bulk Modulus</td>
<td>35.9 GPa</td>
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<tr>
<td>Poisson’s Ratio</td>
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<tr>
<td>Density</td>
<td>2.2 g/cm³</td>
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<tr>
<td>Knoop Hardness (100g load)</td>
<td>489 kg/mm²</td>
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<tr>
<td>Tensile Strength</td>
<td>54 MPa</td>
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<tr>
<td>Compressive Strength</td>
<td>1.14 GPa</td>
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<tr>
<td>Specific Heat</td>
<td>0.770 J/(g K)</td>
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<tr>
<td>Thermal Conductivity</td>
<td>1.38 W/(m K)</td>
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<tr>
<td>Thermal Diffusivity</td>
<td>1.0075 cm²/s</td>
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<tr>
<td>Metallic Impurities</td>
<td>&lt; 10 ppb</td>
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Internal Transmittance:

HPFS® 8655 Grade meets high $T_i \geq 99.75 \%$/cm @193 nm.

Typical initial absorption $k_0 \leq 0.0005$ ppm/cm at 193 nm.

Higher transmittance is available upon request.
Refractive Index and Dispersion

Conditions: 22 °C, 760 mm Hg, N₂

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<tr>
<th>Wavelength [Vacuum] λ [nm]</th>
<th>Refractive Index n</th>
<th>Thermal Coefficient Δn/ΔT [ppm/K]</th>
<th>Sellmeier Dispersion Equation Constants, 22 °C</th>
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Other Optical Properties

<table>
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<tr>
<th>Property</th>
<th>Value</th>
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<tr>
<td>Vₚ</td>
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<tr>
<td>nF²-nC²</td>
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<tr>
<td>Stress Coefficient</td>
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<tr>
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<td>10110-4 Class 5 (None)</td>
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<tr>
<td>Birefringence</td>
<td>≤ 1 nm/cm, lower specifications available</td>
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*1 Sellmeier Equation: n²-1 = A₁ λ²/(λ² - B₁) + A₂ λ²/(λ² - B₂) + A₃ λ²/(λ² - B₃) + A₄ λ²/(λ² - B₄) with λ in μm

*2 Δn/ΔT Equation: Δn/ΔT [ppm/K] = D₁ λ² + D₂ λ⁴ + D₃ λ⁶ + D₄ λ⁸ with λ in μm

The above Sellmeier Dispersion Equation for SiO₂ was used to fit the refractive indices of 35 wavelengths from 2326 nm to 185 nm.
Worldwide Accessibility

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f: 00800.5.267.64.64 or
49.611.7366.143
e-mail: Cigermany@corning.com

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