3M Advanced Materials Division

3M™ Boron Carbide

Typical Material Properties *(Not for specification purposes)*

<table>
<thead>
<tr>
<th>Material Properties</th>
<th>Standard</th>
<th>Symbol / Unit</th>
<th>3M™ Boron Carbide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>DIN EN 623-2</td>
<td>$\rho$ (g/cm$^3$)</td>
<td>&gt;2.48</td>
</tr>
<tr>
<td>Porosity</td>
<td>DIN EN 623-2</td>
<td>P (%)</td>
<td>&lt;0.5</td>
</tr>
<tr>
<td>Mean Grain Size</td>
<td></td>
<td>$\mu$m</td>
<td>&lt;10</td>
</tr>
<tr>
<td>Phase Composition</td>
<td></td>
<td></td>
<td>$\text{B}_4\text{C, C}$</td>
</tr>
<tr>
<td>Vickers Hardness</td>
<td>DIN EN 843-4</td>
<td>HV 1 (GPa)</td>
<td>26</td>
</tr>
<tr>
<td>Knoop Hardness</td>
<td>DIN EN 843-4</td>
<td>HK 0.1 (GPa)</td>
<td>27</td>
</tr>
<tr>
<td>Young’s Modulus</td>
<td>DIN EN 843-2</td>
<td>E (GPa)</td>
<td>410</td>
</tr>
<tr>
<td>Weibull Modulus</td>
<td>DIN EN 843-5</td>
<td>m</td>
<td>15</td>
</tr>
<tr>
<td>Flexural Strength, 4-pt Bending</td>
<td>DIN EN 843-1</td>
<td>$\sigma_b$ (MPa)</td>
<td>460</td>
</tr>
<tr>
<td>Compressive Strength</td>
<td>DIN 5104</td>
<td>$\sigma_b$ (MPa)</td>
<td>&gt;2,800</td>
</tr>
<tr>
<td>Poisson Ratio</td>
<td>DIN EN 843-2</td>
<td>$\nu$</td>
<td>0.18</td>
</tr>
<tr>
<td>Fracture Toughness (SENB)</td>
<td></td>
<td>$K_{\text{IC}}$ (MPa $\times$ m$^{0.5}$)</td>
<td>5</td>
</tr>
<tr>
<td>Coefficient of Thermal Expansion</td>
<td>DIN EN 821-1</td>
<td>$\alpha$ (10$^{-6}$/K)</td>
<td>4.5</td>
</tr>
<tr>
<td>25°C – 500°C (77 – 932°F)</td>
<td></td>
<td></td>
<td>4.5</td>
</tr>
<tr>
<td>500°C – 1,000°C (932 – 1,832°F)</td>
<td></td>
<td>$\alpha$ (10$^{-6}$/K)</td>
<td>6.3</td>
</tr>
<tr>
<td>Specific Heat at 25°C (77°F)</td>
<td>DIN EN 821-3</td>
<td>$c_p$ (J/gK)</td>
<td>0.94</td>
</tr>
<tr>
<td>Thermal Conductivity at 25°C (77°F)</td>
<td>DIN EN 821-2</td>
<td>$\lambda$ (W/mK)</td>
<td>36</td>
</tr>
<tr>
<td>Thermal Stress Parameters</td>
<td>calculated</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$R_1 = \frac{\sigma_b (1-\nu)}{(\alpha \times E)}$</td>
<td>(K)</td>
<td>204</td>
<td></td>
</tr>
<tr>
<td>$R_2 = R_1 \times \lambda$</td>
<td></td>
<td>(W/mm)</td>
<td>7</td>
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<tr>
<td>Specific Electrical Resistance at 25°C (77°F)</td>
<td>DIN EN 50359</td>
<td>$\rho$ (Ω cm)</td>
<td>1</td>
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</tbody>
</table>
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