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Made in the USA

Customer Service Culture
In the larger world of ceramics, we’re a mid-sized firm located in Vermont. We pride ourselves on providing direct access to our key team members and quick response times for our customers.

Total Process Control
The performance of a ceramic component is dependent on the consistency and quality of its material properties. That’s why we control every aspect of manufacturing; from raw material through to finished component. Powder preparation, forming, green machining, sintering and diamond grinding are all governed by the same principles of total quality management.

Ceramic Engineering Insight
We bring 120 years of ceramics engineering experience to our customers. Our engineers’ expertise provides guidance in material selection, design-to-manufacture geometry and cost effective production.

Engineering, Partnership, Solutions.
We specialize in providing highly technical, custom solutions for oil & gas equipment components. We are able to offer our customers deep expertise in the specific material properties of given ceramic materials, and matching them to specific applications. Please contact us to discuss your unique challenges.

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Applications Engineer, Oil & Gas
bggleason@ceramics.net
(802) 527-5844

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WWW.CERAMICS.NET

Proven Performance in Extreme Operating Environments
Technical Ceramics are well suited for challenging operating conditions due to their unique properties, which include:

High Temperature Resistance — important in oil field settings as temperatures continue to rise downhole and thermal shock can be an issue.

Toughness — including impact and vibration resistance

Hardness — providing wear and erosion resistance

Chemical Resistance — to both acidic and basic environments.

Advanced Ceramic Solutions for the Oil & Gas Industry
Superior Technical Ceramics (STC) offers the oil and gas industry a variety of ceramic materials to meet the increasingly severe service requirements for petroleum and gas upstream processing. As conventional and unconventional wells become more extreme operating environments, with higher pressures, temperatures and extreme pH, our engineers continue to collaborate with you to find the best material solutions for your specific challenges.

The Cost Effective Choice
Experience in oil & gas settings has shown that technical ceramics often provide better performance than traditional materials in high temperature, corrosive, wear and chemical environments - resulting in overall cost savings for our customers.

Downhole Tool Components
- Poppets
- Electrode Insulators
- Seal Carriers
- Retainer Ring
- Artificial Lift Components
- Poppet Seats
- Guide Plug
- Directional Drilling Components

Wear-Resistant Product Applications
- Chokes and Valves
- Desanders
- Mechanical Seals
- Downhole Sensor Parts
- Wear Plates
- Hanger Bearings
- Hydrocyclone Liners
- Shaft Seals
- Downhole Wear Parts
- Nozzles, Sandblast Spray

Pump Applications
- Seal Components
- Casing Rings
- Impellers
- Impeller Rings
- Artificial Lift Components
- Caps
- Mechanical Seals
- Liners
- Shafts
- Wear Plates
- Sleeves
- Suction Pipes
- Suction Side Plates
- Extension Rods
- Valve Seats
- Valve Seats

Ceramic Plungers, Valves & Packing Applications
### Technical Ceramic Solutions for the Oil & Gas Industry

We have developed deep experience in working with technical ceramics materials, including Zirconia (YTZP, MSZ, CSZ), Zirconia Toughened Alumina (ZTA), Alumina (74-99.96%) and Silicon Nitride (Si3N4). The unique attributes of each material allow our engineers to solve individual industry challenges, all while providing cost effective solutions.

### A Broad Spectrum of Ceramic Material Solutions

<table>
<thead>
<tr>
<th>Property</th>
<th>ASTM Method</th>
<th>Units</th>
<th>Alumina</th>
<th>High Purity Alumina</th>
<th>Zirconia Toughened Alumina</th>
<th>Zirconia</th>
<th>Nitride</th>
<th>Carbide</th>
<th>Other Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>--</td>
<td></td>
<td>Ivory</td>
<td>White/Purple</td>
<td>Off White</td>
<td>Ivory</td>
<td>Yellow</td>
<td>Black</td>
<td>--</td>
</tr>
<tr>
<td>Gas Permeability</td>
<td>atm-cm/sec</td>
<td></td>
<td>gas light &lt; 10^-10</td>
<td>gas light &lt; 10^-10</td>
<td>gas light &lt; 10^-10</td>
<td>gas light &lt; 10^-10</td>
<td>gas light &lt; 10^-10</td>
<td>gas light &lt; 10^-10</td>
<td>gas light &lt; 10^-10</td>
</tr>
<tr>
<td>Density</td>
<td>C 20-97</td>
<td>g/cc</td>
<td>3.65</td>
<td>3.71</td>
<td>3.78</td>
<td>3.88</td>
<td>3.91</td>
<td>3.96</td>
<td>4.17</td>
</tr>
<tr>
<td>Hardness</td>
<td>Vickers 500 gm</td>
<td>GPA (kg/mm²)</td>
<td>1.15 (1175)</td>
<td>1.27 (1300)</td>
<td>1.27 (1300)</td>
<td>1.43 (1459)</td>
<td>1.45 (1470)</td>
<td>1.44 (1470)</td>
<td>1.40 (1470)</td>
</tr>
<tr>
<td>Fracture Toughness</td>
<td>Notched Beam</td>
<td>MPa(1/2)</td>
<td>3.4</td>
<td>4.5</td>
<td>4.5</td>
<td>4.5</td>
<td>5.4</td>
<td>5.6</td>
<td>6.0</td>
</tr>
<tr>
<td>Flexural Strength (MOR)</td>
<td>F417-87</td>
<td>MPa (psi x 10^3)</td>
<td>310 (45)</td>
<td>358 (52)</td>
<td>393 (57)</td>
<td>338 (49)</td>
<td>379 (55)</td>
<td>344 (50)</td>
<td>500 (73)</td>
</tr>
<tr>
<td>Tensile Strength @ RT</td>
<td>--</td>
<td>MPa (psi x 10^3)</td>
<td>151 (22)</td>
<td>220 (29)</td>
<td>221 (32)</td>
<td>172 (25)</td>
<td>200 (29)</td>
<td>259 (38)</td>
<td>344 (50)</td>
</tr>
<tr>
<td>Compressive Strength @ RT</td>
<td>--</td>
<td>MPa (psi x 10^3)</td>
<td>1827 (260)</td>
<td>2068 (300)</td>
<td>2241 (325)</td>
<td>2137 (310)</td>
<td>2240 (325)</td>
<td>2413 (350)</td>
<td>2759 (400)</td>
</tr>
<tr>
<td>Elastic Modulus</td>
<td>C498</td>
<td>GPA (psi x 10^3)</td>
<td>303 (44)</td>
<td>310 (45)</td>
<td>345 (50)</td>
<td>379 (55)</td>
<td>379 (55)</td>
<td>358 (52)</td>
<td>338 (49)</td>
</tr>
<tr>
<td>Poisson’s Ratio</td>
<td>C498</td>
<td>--</td>
<td>0.22</td>
<td>0.23</td>
<td>0.23</td>
<td>0.23</td>
<td>0.23</td>
<td>0.23</td>
<td>0.23</td>
</tr>
<tr>
<td>C.T.E. 25 - 100°C</td>
<td>C372-96</td>
<td>x 10^-6</td>
<td>6.1</td>
<td>6.0</td>
<td>6.0</td>
<td>6.3</td>
<td>6.5</td>
<td>6.7</td>
<td>6.9</td>
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<tr>
<td>C.T.E. 25 - 500°C</td>
<td>C372-96</td>
<td>x 10^-6</td>
<td>7.7</td>
<td>7.5</td>
<td>7.6</td>
<td>7.6</td>
<td>8.1</td>
<td>8.8</td>
<td>10.0</td>
</tr>
<tr>
<td>Thermal Conductivity @ RT</td>
<td>C408</td>
<td>W/m.K</td>
<td>19</td>
<td>23</td>
<td>29</td>
<td>30</td>
<td>30</td>
<td>27</td>
<td>24</td>
</tr>
<tr>
<td>Max Use Temp</td>
<td>--</td>
<td>°C</td>
<td>1650</td>
<td>1700</td>
<td>1700</td>
<td>1675</td>
<td>1675</td>
<td>1500</td>
<td>1500</td>
</tr>
<tr>
<td>Dielectric Strength (125° Thick)</td>
<td>D 149-9TA</td>
<td>V/m</td>
<td>250</td>
<td>250</td>
<td>260</td>
<td>270</td>
<td>290</td>
<td>230</td>
<td>250</td>
</tr>
<tr>
<td>Dielectric Constant @ 1 MHz</td>
<td>D 150-98</td>
<td>--</td>
<td>9.0</td>
<td>9.1</td>
<td>9.5</td>
<td>9.8</td>
<td>9.8</td>
<td>10.5</td>
<td>12.5</td>
</tr>
<tr>
<td>Dielectric Loss @ 1 MHz</td>
<td>--</td>
<td>--</td>
<td>0.0006</td>
<td>0.0004</td>
<td>0.0006</td>
<td>0.0002</td>
<td>&lt; 0.001</td>
<td>0.0003</td>
<td>0.0006</td>
</tr>
<tr>
<td>Volume Resistivity, 25°C</td>
<td>D 257</td>
<td>ohms-cm</td>
<td>&gt; 1 x 10^14</td>
<td>&gt; 1 x 10^14</td>
<td>&gt; 1 x 10^14</td>
<td>&gt; 1 x 10^14</td>
<td>&gt; 1 x 10^14</td>
<td>&gt; 1 x 10^14</td>
<td>&gt; 1 x 10^14</td>
</tr>
<tr>
<td>Volume Resistivity, 50°C</td>
<td>D 1629</td>
<td>ohms-cm</td>
<td>&gt; 1 x 10^15</td>
<td>&gt; 1 x 10^15</td>
<td>&gt; 1 x 10^15</td>
<td>&gt; 1 x 10^15</td>
<td>&gt; 1 x 10^15</td>
<td>&gt; 1 x 10^15</td>
<td>&gt; 1 x 10^15</td>
</tr>
<tr>
<td>Acid / Base Resistance*</td>
<td>--</td>
<td>--</td>
<td>Good</td>
<td>Poor</td>
<td>Poor</td>
<td>Good</td>
<td>Poor</td>
<td>Good</td>
<td>Poor</td>
</tr>
</tbody>
</table>

*These are general guidelines for reference only. Actual chemical resistance is dependent on the specific application environment.

### Alumina Provides Durability and Cost Effectiveness

Alumina materials are a cost effective alternative to other materials where hardness is required for wear and corrosion resistance. Alumina also provides high compressive strength and is an excellent electrical insulator. Alumina is often used in turbine discs, wear liners, pump plungers, hydrocylones and electrical insulators.

### Zirconia Toughened Alumina for Greater Strength & Durability

Zirconia Toughened Alumina is an excellent choice for applications requiring greater toughness and higher strength than Alumina alone, while maintaining the corrosion resistance of Alumina. This material is used in similar applications as Alumina, but where the pressures and wear conditions demand greater material strength and durability.

### Other Zirconia Materials Provide Extended Life Performance

The Zirconia family of materials provides impact and toughness in extreme environments that often require extended life performance. YTZP offers superior strength, MSZ excellent toughness, and CSZ is a tough material similar to MSZ but with proven chemical resistance in both extreme acidic and basic environments. Zirconia is often used in MWD/LWD tooling components, artificial lift components, and frac plug buttons.

### Silicon Nitride Provides Added Thermal Advantages

Silicon Nitride offers superior strength and thermal performance for applications that require thermal shock resistance combined with overall material strength. At a lower density than the Zirconia materials, it is a lighter weight alternative while still providing excellent strength, corrosion and wear resistance.