ZYF
High Temperature Yttria Stabilized Zirconia Felt

ZYF is the Flagship Product of Zircar Zirconia, Inc.

Three Nominal Thicknesses
• ZYF-50 (50 mils)
• ZYF-100 (100 mils)
• ZYF-150 (150 mils)

ZYF Features
• Temperature Rating to as High as 2000 °C
• Phase Stabilized with 10 wt% Yttria
• High Purity
• Low Thermal Conductivity (K)
• 100% Inorganic, No Off-Gassing or Odors
• Excellent in Corrosive, Oxidizing & Reducing Atmospheres
• Flexible to 1350 °C
• High Porosity
• Very Light Weight
• Wrappable
• Easy to Cut
• Machinable
• Can be Die Cut
• Can be Cemented or Rigidized with ZR-CEM or ZR-RIG

Thin... Flexible... Foldable... Wrappable...
Fibrous ZrO₂ ceramic felt insulation that can withstand temperatures in excess of 2000 °C.

Product Information

Zircar Felt Type ZYF is an excellent all-purpose high temperature insulation that can be used as a separator, wrapper, fixture, gasket, cushion, pillow, pad, barrier, cover, layering or packing material in high temperature applications. More specific applications for ZYF are in the Czochralski method of crystal growing as iridium and platinum crucible insulation, and precious metal condensate reclamation material. ZYF is a ceramic textile made using the original ZIRCAR Process at our plant in Florida, NY, USA. ZYF is a flexible, light weight, porous, needled felt comprised of 4 to 6 micron diameter fibers and is nearly 100% zirconia phase stabilized with yttria. The fibers are mechanically interlocked and retain their flexible nature up to 1350 °C. ZYF is a general use insulation with properties that excel at extremely high temperatures and in severe environments such as corrosive, oxidizing and reducing atmospheres.

We use the highest purity materials in our products. The products contain only minimal trace oxides and no organics that off-gas when heated. Because Zircar zirconia fibers are yttria stabilized, they do not undergo the disruptive phase transition of pure zirconia. ZYF is non-reactive to alkali vapors, salts or strong hot solutions and is not wet by most molten metals. ZYF has low adsorption surface area and vapor pressure, making it useful in high vacuum.

ZYF-50 is 50 mil thick*
ZYF-100 is 100 mil thick*
ZYF-150 is 150 mil thick*

*nominal

For more information, phone: (845) 651-3040
e-mail: sales@zircarzirconia.com
website: www.zircarzirconia.com
The notable difference between ZYF-50, ZYF-100, and ZYF-150 is the thickness. The three types of Zircar zirconia felt are ZYF-50, nominally 0.05 inches, ZYF-100, nominally 0.1 inches, and ZYF-150, nominally 0.15 inches thick. The thickness affects how bendable the material is and has to be considered when choosing the product if you plan to wrap, bend, or fold the material in any way.

![ZYF-50, ZYF-100, and ZYF-150 stacked on top of one another showing the difference in thickness of the three felts. ZYF-50 is on top with ZYF-150 on the bottom.]

## Properties & Characteristics

<table>
<thead>
<tr>
<th>Properties (Nominal)</th>
<th>ZYF-50</th>
<th>ZYF-100</th>
<th>ZYF-150</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thickness, inch</td>
<td>0.05</td>
<td>0.1</td>
<td>0.15</td>
</tr>
<tr>
<td>Bulk Porosity, %</td>
<td>96</td>
<td>96</td>
<td>96</td>
</tr>
<tr>
<td>Bulk Density, lb/ft³ (g/cm³)</td>
<td>15 (0.24)</td>
<td>15 (0.24)</td>
<td>15 (0.24)</td>
</tr>
<tr>
<td>Tensile Strength, lb/in width</td>
<td>0.6</td>
<td>1.6</td>
<td>2.0</td>
</tr>
<tr>
<td>Melting Point, °C (°F)</td>
<td>2593 (4700)</td>
<td>2593 (4700)</td>
<td>2593 (4700)</td>
</tr>
<tr>
<td>Maximum Use Temperature, °C (°F)</td>
<td>2000 (3632)</td>
<td>2000 (3632)</td>
<td>2000 (3632)</td>
</tr>
<tr>
<td>Minimum Wrapping Diameter Before Breaking, inch</td>
<td>0.25</td>
<td>0.75</td>
<td>3</td>
</tr>
<tr>
<td>Vapor Pressure @ 2500 °F, Torr</td>
<td>8 x 10⁻¹²</td>
<td>8 x 10⁻¹²</td>
<td>8 x 10⁻¹²</td>
</tr>
<tr>
<td>Linear Shrinkage, 1 hr. @ 1650 °C Isothermal Soak, %</td>
<td>5</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Specific Heat BTU / lb - °F</th>
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<tbody>
<tr>
<td>@200 °F</td>
<td>.13</td>
<td>.13</td>
<td>.13</td>
</tr>
<tr>
<td>@4300 °F</td>
<td>.18</td>
<td>.18</td>
<td>.18</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Chemical Composition (Nominal)</th>
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<th></th>
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</thead>
<tbody>
<tr>
<td>Oxide</td>
<td>ZrO₂(1)</td>
<td>89+</td>
<td>89+</td>
</tr>
<tr>
<td></td>
<td>Y₂O₃</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Al₂O₃</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td></td>
<td>SiO₂</td>
<td>&lt;0.02</td>
<td>&lt;0.02</td>
</tr>
</tbody>
</table>

(1) Maximum use temperature is dependent on variables such as chemical environment and stresses; both thermal and mechanical.

(2) 1-2 wt% hafnia occurs naturally with zirconia and does not affect performance.
What Makes Our Zirconia Unique?

All zirconia has very low specific heat, half as much as alumina. Zircar zirconia provides the additional benefit of being highly porous and pure. The 4-6 micron diameter yttria stabilized zirconia fibers are mechanically interlocked requiring no binders that would add contaminants and diminish purity and functionality. The serrated fiber cross section produced through the ZIRCAR Process is unique to all Zircar zirconia fibers. The serration provides additional porosity making our zirconia the lowest thermal conductivity insulation available, for service over 1000 °C.

At high temperatures, heat transfer by radiation dominates over conduction and convection. Zircar zirconia fibers are the best in the industry at reflecting and radiating heat while not storing it. They facilitate steep temperature gradients and outperform all others when challenged with extreme temperatures and severe environments.

Our unique zirconia fiber products are available in many forms in addition to felt.

Product Micrographs

![Micrographs showing the serrated structure and mechanical interlock of ZYF fibers. The micrograph on the left is magnified by 100x while the micrograph on the right is magnified by 1000x.](image)

Facts About Our Zirconium Oxide

- Zircar ZrO₂ fibrous ceramics are manufactured using the original ZIRCAR Process which was developed by Bernie H. Hamling (BHH) while at Union Carbide Corp. in Sterling Forest, NY. In 1974 BHH purchased the patents for the process and began ZIRCAR Products, Inc. Over the years the name ZIRCAR became synonymous with high quality advanced fibrous ceramics. In July 2000 Zircar Zirconia, Inc. purchased Bernie’s zirconia business and to this day still uses his original process. Although Bernie is no longer with us, we think of him often and are grateful for the opportunity to continue his legacy in the ceramics industry. Thank you BHH.

- At very high temperatures in vacuum and inert or reducing atmospheres, zirconia loses a small amount of oxygen. The reaction results in a color change from white to gray but most other properties remain essentially unchanged and insulation effectiveness is not impaired.

- 1 to 2% hafnium oxide, HfO₂, occurs naturally with zirconium oxide. Hafnia is sometimes referred to as zirconia’s twin because of structural similarities.
Facts About Our Zirconium Oxide (cont.)

- Zirconia has the lowest thermal conductivity of any commercial refractory and is one of the most studied ceramic materials in the world.

**Thermal Conductivity of Zircar Type ZYF in Various Atmospheres**

<table>
<thead>
<tr>
<th>Temperature °F (°C)</th>
<th>Vacuum</th>
<th>Argon</th>
<th>Air</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 (260)</td>
<td>0.5 (.07)</td>
<td>1.0 (.14)</td>
<td>1.5 (.22)</td>
</tr>
<tr>
<td>500 (260)</td>
<td>1.0 (.14)</td>
<td>1.5 (.22)</td>
<td>2.0 (.29)</td>
</tr>
<tr>
<td>1000 (540)</td>
<td>1.5 (.22)</td>
<td>2.0 (.29)</td>
<td>2.5 (.36)</td>
</tr>
</tbody>
</table>

- Upon heating unstabilized zirconia undergoes disruptive phase changes. At room temperature unstabilized ZrO₂ adopts a monoclinic crystal structure and transitions to tetragonal and cubic at higher temperatures. The volume expansion caused by the cubic to tetragonal to monoclinic transformation induces large stresses which cause cracking on cooling. The addition of yttria eliminates the phase transitions by stabilizing the tetragonal and cubic phases. Zircar ZrO₂ is phase stabilized with 10 wt% Y₂O₃.

**Applications**

**ALL-PURPOSE**

ZYF is an excellent all-purpose high temperature insulation that can be used as a separator, wrapper, fixture, gasket, cushion, pillow, pad, barrier, cover, layering or packing material.

**HIGH TEMPERATURE SETTER**

ZYF is used in powder metal sintering in vacuum and hydrogen atmospheres, quartz glass melting and hot working operations.

**HIGH TEMPERATURE SHIELD/Cover**

Molydiscilicide elements in rapid cycle furnaces will shed aggressive silica glass during high temperature heat treatment. Routine use of ZYF will protect your silica susceptible ware from the damage molydiscilicide elements cause.

**HIGH TEMPERATURE INSULATION**

Used between layers of refractory metal heat shields to improve insulation performance in vacuum furnaces and hot isostatic presses.

**CRYSTAL GROWTH**

ZYF acts as thermal insulation and a cushioning barrier as well as a platform for iridium recovery in the Czochralski method of oxide crystal growing. In this method an iridium crucible is often used to contain the melt. Iridium, a precious metal in the platinum group vaporizes at high temperature. A layer of ZYF wrapped around the iridium crucible creates a physical barrier between the fragile crucible and the backup insulation. The steep thermal gradient across the ZYF causes condensation of the iridium into the felt from which it can then be easily segregated and recovered.

**ELECTROLYTIC CELL GASKET**

ZYF is unaffected by long term exposure to KOH and is used as a separator/gasket in batteries and fuel cells using alkali electrolytes.

**Cutting & Machining Instructions**

For manual cutting, place the part on a smooth clean surface and hold it in place with gentle pressure. Felt can be cut with a utility knife or die cut. For very close tolerances and large amounts of cutting, CNC machining with very small diameter, down cutting spiral, solid carbide, carbide tipped or diamond tipped tooling is recommended. Slow feeds and high tool rotation rates are best. Vacuum hold down is best. Zircar welcomes our customers to take advantage of our machining department’s expertise for all your custom machining needs.
Standard Product Sizes & Ordering

Felt Type ZYF is available in standard sized sheets which are listed below. ZYF can not manufactured as a continuous roll.

Please contact our Sales Department for pricing and availability.

To Place an Order
Call: 845-651-3040
email: sales@zircarzirconia.com

| Type ZYF
<table>
<thead>
<tr>
<th>Size</th>
<th>Item Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZYF-50</td>
<td>ZYF-100</td>
</tr>
<tr>
<td>12&quot;x 18&quot;</td>
<td></td>
</tr>
<tr>
<td>18&quot;x 24&quot;</td>
<td>CA001</td>
</tr>
<tr>
<td>18&quot;x 27&quot;</td>
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</tr>
</tbody>
</table>

ZYF Custom Capabilities

ZYF can be customized for your application. Contact our Sales Department to discuss your unique requirements.

- Custom Sheet Sizes
- Die Cut Parts
- Rigidized with Zirconia or Alumina
- Layered/Sintered/Laminated Configurations

- Powder Loaded
  - Silica ZYF-S
  - Zirconia ZYF-Z
  - Alumina ZYF-A
  - Lanthanum Strontium Manganite ZYF-LSM
  - Custom Powder

Layered and Laminated into a Custom Curve

Die Cut into Custom Shapes and Sizes
Product Samples

FREE SAMPLES
Call: 845-651-3040
e-mail: sales@zircarzirconia.com

<table>
<thead>
<tr>
<th>Product Type</th>
<th>Item #</th>
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<tbody>
<tr>
<td>ZYF-50</td>
<td>SAMPLE-CA</td>
</tr>
<tr>
<td>ZYF-100</td>
<td>SAMPLE-CB</td>
</tr>
<tr>
<td>ZYF-150</td>
<td>SAMPLE-CBA</td>
</tr>
</tbody>
</table>

Samples measure 1.8” x 2.8”

Other Products & Capabilities

Customers who order ZYF also order:
- ZR-RIG
- ZR-CEM
- ZYFB and FBD
- Rare Earth Oxide Felts, Cloth and Fiber Boards

welcomes our customers to take advantage of our machining department’s expertise for all your custom machining needs.

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