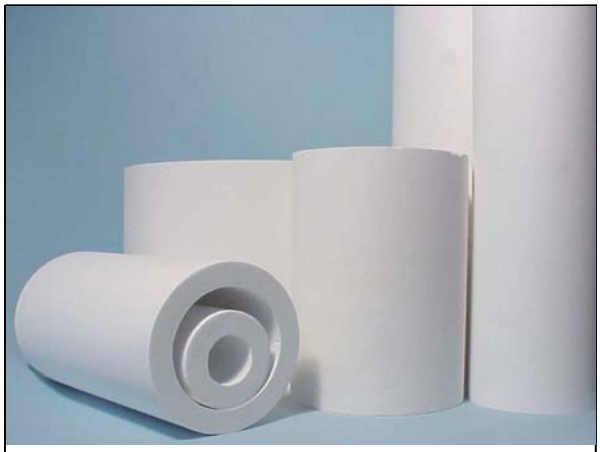
Zircar Zirconia, Inc.
"Manufacturer of the original ZIRCAR products" ©

ZIRCONIA CYLINDERS
TYPE ZYC



Zirconia Cylinders Type ZYC

FEATURES

- **Rigid and Machinable**
- **Silica Bond for Thermal Shock Resistance**
- **Our Most Economical ZrO_2 Cylinder**
- **Fibers Stabilized with ~10 wt% Yttria**
- **Low Thermal Conductivity**
- **Can be Cemented with Zircar Zirconia Cement Type ZR-CEM**
- **Can be Surface Hardened with Zircar Zirconia Rigidizer Type ZR-RIG**
- **Pre-fired and Organic Free**

Zircar Zirconia Cylinders Type **ZYC** are rigid, free standing refractory structures composed of yttria stabilized zirconia fibers that are bonded with silica. The material is evenly bonded, allowing intricate shapes to be machined with tight tolerances. Type **ZYC** Cylinders possess low thermal conductivity and good resistance to thermal shock and are ideally suited for thermal insulation and protection applications under conditions of ultra-high temperatures and severe environments.

ZYC is dimensionally stable to 1650°C although it can be used at higher temperatures in areas where additional sintering can be tolerated or as back-up insulation. It has good hot strength up to 1400°C. **ZYC** is resistant to attack by most molten metals and has a high resistance to reaction with other oxide materials.

ZYC Cylinders are phase stabilized with yttria and therefore do not undergo the usual phase transitions associated with zirconia. Electrical conductivity at elevated temperatures is also minimized with low density Zirconia fibers whereas dense Zirconia is an effective conductor at elevated temperatures. **ZYC** does not couple with radio frequency (RF) radiation used in induction heating, but does couple with microwave energy.

ZYC has no organic binders and will produce no smoke or odor when heated.

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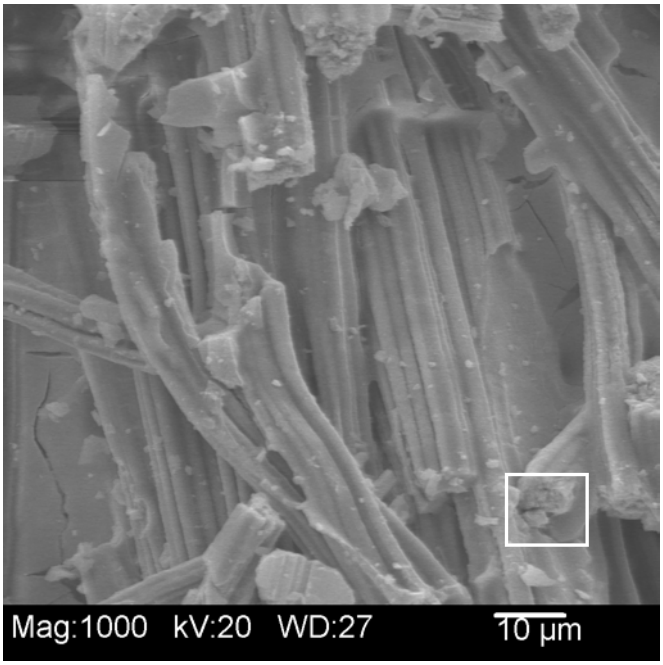
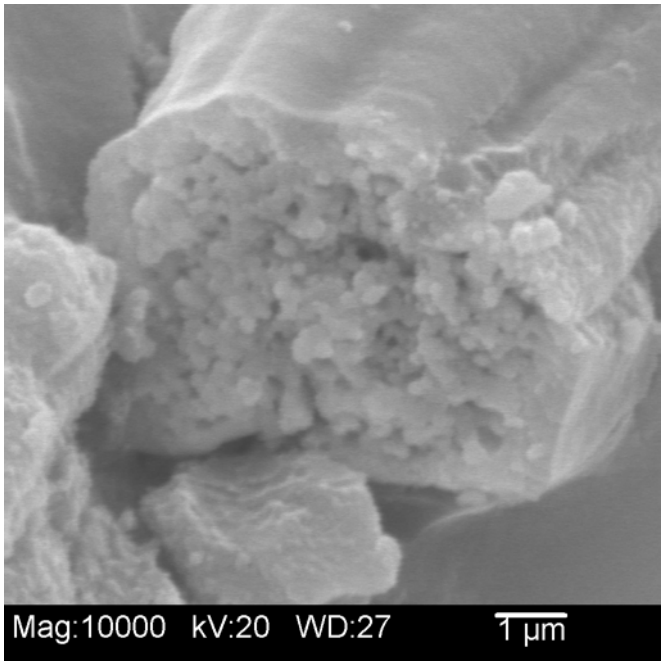
Shown below are SEM micrographs of a Zirconia Cylinder Type **ZYC** that show the silica binder and porous structure of the material .

The micrograph on the left illustrates the **ZYC** fiber's serrated surface structure that is characteristic of all of our Zirconia fibers and fiber products. The **ZYC's** silica binder is also visible in the micrograph and appears as the solid cracked matrix behind the fibers. The parallel fiber orientation that results from the **ZYC** vacuum forming process is also evident in the photo.

The micrograph on the right is an enlargement of the end of the fiber which is boxed in white in the picture on the left. The fiber measures approximately 7.5 microns across and is composed of grains that measure approximately 0.2 microns. The interior of the fiber is made of individual sub micron grains. The silica binder has coated the surface of the fiber and has penetrated several grains deep into the fiber structure. Some porosity internal to the fiber can also be seen in this view.





ZIRCONIA CYLINDERS
TYPE ZYC

CHEMICAL COMPOSITION

Zircar Zirconia's Type **ZYC** is nominally 85 wt% ZrO_2 + HfO_2 and 10 wt% Y_2O_3. 1 - 2 wt% hafnia, HfO_2, occurs naturally with zirconia, ZrO_2, and does not affect performance. Only the highest purity starting materials are used to make Type **ZYC** minimizing trace oxides.

Trace Oxide	Typical Wt%
SiO_2 (binder)	5
TiO_2	0.14
CaO	0.09
MgO	0.03
Fe_2O_3	0.04

Trace Oxide	Typical Wt%
Al_2O_3	0.01
Na_2O	0.01
SnO_2	0.001
Cr_2O_3	0.0005
Ag_2O	0.0005

MACHINING INFORMATION

Zirconia Type **ZYC** has the consistency of soft chalk and can be cut or machined with a very wide range of tooling. For manual cutting, place the **ZYC** part on a smooth clean surface and hold it in place with gentle finger pressure. When close tolerances are not required and the amount of cutting is limited, small holes can be drilled by hand with a standard high speed steel twist drill rotated between the fingers and boards can be cut with a back saw. If closer tolerances are needed, holes can be drilled using a drill press and boards can be cut with a radial arm saw. Table saws are not recommended without a carrier board since the motion of the material over the saw bed will tend to abrade away the material. For very close tolerances and large amounts of cutting, CNC machining with solid carbide or carbide tipped tooling is recommended. While quite soft, Type **ZYC** is very abrasive and will cause rapid wear of high speed steel tooling which over time could result in an out of tolerance condition. **ZYC** boards can be held in place for CNC machining with a vacuum hold down set up. Hot glue can also be used to fixture **ZYC** but will generally form a very strong bond that will pull away material from the machined part. Crystal Bond ™ which burns away cleanly when heated has also been used to fixture **ZYC.**

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PROPERTIES & CHARACTERISTICS

Bulk Density, g/cc (pcf)	0.48 (30)
Porosity, %	91
Melting Point, °C (°F)	2200 (3992)
Continuous Maximum Use Temperature, °C (°F)	1650(3002)
Intermittent Maximum Use Temperature, °C (°F)	1700(3092)
Flexural Strength, (Parallel to thickness) MPa (psi)	0.55 (81)
Compressive Strength, (Parallel to thickness) MPa (psi) @ 10% Compression	0.21 (31)
Outgassing in Vacuum	Nil
Dilatometric Softening Temperature, °C (°F) at 10psi	950 (1740)
Thermal Expansion Coefficient RT - 950°C (1740°F) (Perpendicular to thickness)	9 x 10^{-6}/°C (5 x10^{-6}/°F)
Linear Shrinkage (Perpendicular to thickness) , %	
1 hour at 1650°C (3002°F)	2.5
24 hours at 1650°C (3002°F)	4
Thermal Conductivity, (Parallel to thickness)	
W/mK (BTU/hr ft^2 °F/inch) at 400°C (752°F)	0.08 (0.6)
W/mK (BTU/hr ft^2 °F/inch) at 800°C (1472°F)	0.11 (0.8)
W/mK (BTU/hr ft^2 °F/inch) at 1100°C (2012°F)	0.14 (1.0)
W/mK (BTU/hr ft^2 °F/inch) at 1400°C (2552°F)	0.19 (1.3)
W/mK (BTU/hr ft^2 °F/inch) at 1650°C (3002°F)	0.23 (1.6)

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APPLICATION INFORMATION

- **ZYC** is used in both resistance heated and induction furnaces. It is particularly suited for insulation in hot pressing, crystal growing and annealing furnaces.
- **ZYC**, as well as other ZIRCAR flexible and rigid insulating products, find use in a variety of research and development high temperature applications.
- **ZYC** is used as radiation shielding in vacuum furnaces, replacing five or six metal shields without loss of insulation value. In processes where carbon contamination cannot be tolerated, Zircar Zirconia's products are used instead of graphite felts and carbon black as insulation.
- **ZYC** is excellent insulation for pipes or molten metal transporting and feed tubes.
- For cylindrical applications where silica is undesirable our zirconia bonded fiber materials **ZYFB-3**, **ZYFB-6** and/or **FBD** are recommended.

ORDERING INFORMATION

Zircar Zirconia Insulation Type **ZYC** is available in standard sized Cylinders which are listed on page 6 with their ordering item number. Please contact our Sales Department for pricing and availability.

- **To order** one of our standard sized Cylinders specify the Quantity you wish to order , the Item Number and Size.
  For example: 12 each, Item # AG512, ZYC, 6" ID x 7" OD x 12"L.
- **Custom sizes are available on request.** Our forming process and machining capabilities allow a wide variety of custom shapes and sizes to be made. Please contact us with your special requirements and we'll be happy to provide you with a quotation.

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Standard Sizes	Item Number
Cylinder, 1" ID x 2" OD x 6" LG	AG501
Cylinder, 1" ID x 2" OD x 12" LG	AG502
Cylinder, 2" ID x 3" OD x 6" LG	AG503
Cylinder, 2" ID x 3" OD x 12" LG	AG504
Cylinder, 3" ID x 4" OD x 6" LG	AG505
Cylinder, 3" ID x 4" OD x 12" LG	AG506
Cylinder, 4" ID x 5" OD x 6" LG	AG507
Cylinder, 4" ID x 5" OD x 12" LG	AG508
Cylinder, 5" ID x 6" OD x 6" LG	AG509
Cylinder, 5" ID x 6" OD x 12" LG	AG510
Cylinder, 6" ID x 7" OD x 6" LG	AG511
Cylinder, 6" ID x 7" OD x 12" LG	AG512
Cylinder, 7" ID x 8" OD x 6" LG	AG513
Cylinder, 7" ID x 8" OD x 12" LG	AG514
Cylinder, 8" ID x 9" OD x 12" LG	AG515
Cylinder, 9" ID x 10" OD x 12" LG	AG516
Cylinder, 10" ID x 11" OD x 12" LG	AG517
Cylinder, 11" ID x 12" OD x 12" LG	AG518
Cylinder, 12" ID x 13" OD x 12" LG	AG519

Standard Cylinder Tolerances: +/- 1/16" on ID and OD, +/- 1/16" on Length

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