

## 5MS.013

# ZYC and ZYZ Zirconium Oxide Fibre Composites

### Summary

### Overview

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#### ZYC

#### ZYZ

#### TECHNICAL DATA

#### AVAILABLE PRODUCTS

Physical variables included in this documentation are provided by way of indication only and do not, under any circumstances, constitute a contractual undertaking. Please contact our technical service if you require any additional information.

Final Advanced Materials Sàrl  
4 avenue de Strasbourg  
68350 Didenheim – France  
Tel : +33 (0) 3 67 78 78 78

Final Advanced Materials GmbH  
Basler Strasse 115  
79115 Freiburg – Deutschland  
Tel: + 49 (0) 761 47 87 336

[www.final-materials.com](http://www.final-materials.com)

Zirconium Oxide Boards Type ZYZ and ZYC are rigid, refractory structures composed of yttria stabilized zirconia fibres that are bonded with silica. This unique composition provides ZYZ insulation with the low thermal conductivity of zirconia fibres combined with the strength and machinability of a silica bonded material. ZYZ is evenly bonded, allowing it to be machined to tight tolerances and intricate shapes.

#### Manufacturing

ZYBF fibre is the result of the Zircar Process which transforms an organic fibre into a ceramic one. The new fibre usually has a diameter of 6 to 10 µm and a serrated outer surface.

All zirconia bulk fibres are made of nearly 100 % zirconia phase stabilized with 10 % yttria. The yttria stabilizes the tetragonal / cubic structure by preventing the monoclinic to tetragonal crystal transformation that occurs at 1,170 °C in pure un-stabilized or insufficiently stabilized zirconia. This undesirable transformation causes an 11 % volume change in the crystal unit cell size that can cause micro-cracking and reduced physical strength in the bulk solid.

Yttria stabilized zirconia is an electrical semiconductor at elevated temperatures. This conductivity arises from the different valences of ionic  $Zr^{4+}$  and  $Y^{3+}$ . Electricity is conducted at elevated temperatures (700-800 °C) as oxygen ions are induced to flow through the stabilized zirconia structure. This phenomenon forms the basis of zirconia oxygen sensors.

[info@final-materials.com](mailto:info@final-materials.com)



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### Applications

- Induction ovens
- Electric ovens
- Radiation shielding
- High temperature insulation

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### ZYC

Zirconium oxide cylinders type ZYC are firm, rigid, free standing refractory structures composed of yttria stabilized zirconia fibers evenly bonded with amorphous silica, allowing intricate shapes to be machined to tight tolerances. These products do not require organic binders and will produce no smoke or odor when heated.

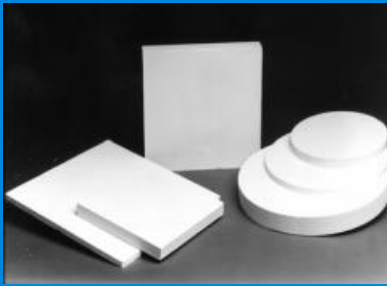
ZYC cylinders possess low thermal conductivity and good resistance to thermal shock. ZYC is manufactured using a proprietary vacuum forming technique. It is dimensionally stable to 1,650 °C.

ZYC is resistant to attack by most molten metals and has a high resistance to reactions with other oxide materials.

### General Characteristics

- Made of ZYBF fibre
- Dimensionally stable to 1,650 °C
- Very good hot tensile strength at 1,350 °C
- Phase stabilized with 10 wt % yttria
- High purity
- No organic binders, no odor, no smoke
- Low thermal conductivity
- Excellent in corrosive, oxidizing and reducing atmospheres

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### ZYZ

ZYZ boards are rigid and refractory in nature. Their composition includes yttria-stabilised zirconia fibres and a silica binder. Like all products in this range, they have low thermal conductivity and can be machined into complex shapes to high tolerances. ZYZ is resistant to 1,400 °C and remains dimensionally stable up to 1,650 °C. The material is ideal for oven racks with loads twice its weight.

ZYZ boards are available at two different densities:

- **ZYZ-3** is our lowest density product at 0.48 g/cm<sup>3</sup> and benefits of an extremely low thermal conductivity.
- **ZYZ-6** is medium density product at 0.96 g/cm<sup>3</sup> and has a better mechanical strength than ZYZ-3 products.

### General Characteristics

- Made of ZYBF fibre
- Dimensionally stable to 1,650 °C
- Very good hot tensile strength at 1,400 °C
- Phase stabilized with 10 wt % yttria
- High purity
- No organic binders, no odor, no smoke
- Low thermal conductivity

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## ZYC and ZYZ Zirconium Oxide Fibre Composites

### Technical Data

Property		Unit	ZYC	ZYZ-3	ZYZ-6
Nominal Composition	ZrO <sub>2</sub> *	Wt. %	85	85	85
	Y <sub>2</sub> O <sub>3</sub>		10	10	10
	SiO <sub>2</sub>		5	5	5
Colour			white	white	white
Bulk Density		g/cm <sup>3</sup>	0,48	0,48	0,96
Porosity		%	91	91	85
<b>Thermal Properties</b>					
Operating Temperature**		°C	1,650	1,650	1,650
Peak Temperature		°C	1,700	1,700	1,700
Melting Point		°C	2,200	2,200	2,200
Dilatometric Softening Temperature at 10 psi		°C	950	1,250	1,275
Thermal Conductivity	400 °C	Wm <sup>-1</sup> .K <sup>-1</sup>	0.08	0.08	0.16
	800 °C		0.11	0.11	0.20
	1,100 °C		0.14	0.14	0.23
	1,400 °C		0.19	0.19	0.25
	1,650 °C		0.23	0.23	0.27
<b>Mechanical Properties</b>					
Flexural Strength		MPa	0.55	0.28	1.74
Compressive Strength at 10 % compression		MPa	0.21	0.39	0.92
Thermal Expansion Coefficient (20 – 1,425 °C)		10 <sup>-6</sup> .K <sup>-1</sup>	9	9	9
Linear Shrinkage (⊥ to thickness)	1 hr at 1,650 °C	%	2.5	1.7	1.6
	24 hr at 1,650 °C		4	2.3	2.6
<b>Chemical Properties</b>					
Outgassing in Vacuum			Nil	Nil	Nil

\*1-2 % weight hafnia (HfO<sub>2</sub>) occurs naturally with zirconia (ZrO<sub>2</sub>) and does not affect performance.

\*\*Maximum use temperature is dependent of variables such as chemical environment and stresses; both thermal and mechanical.

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### Available Products

#### ZYC Zirconium Oxide Cylinder

	Length	Inner and Outer Diameter	
		mm	inch
Cylinder	152.4 mm 304.8 mm	25.4 x 50.8 mm	1" x 2"
		50.8 x 76.2 mm	2" x 3"
		76.2 x 101.6 mm	3" x 4"
		101.6 x 127.0 mm	4" x 5"
		127.0 x 152.4 mm	5" x 6"
		152.4 x 177.8 mm	6" x 7"
		177.8 x 203.2 mm	7" x 8"
		203.2 x 228.6 mm	8" x 9"
		228.6 x 254.0 mm	9" x 10"
		254.0 x 279.4 mm	10" x 11"
		279.4 x 304.8 mm	11" x 12"
		304.8 x 330.2 mm	12" x 13"

**The dimensions depend on the article number.  
Customized designs are available on request.**

#### ZYZ Zirconium Oxide Board

	Dimension	Thickness
Board	304.8 x 304.8 mm	12.7 mm
		19.0 mm
		25.4 mm
		38.1 mm

**The dimensions depend on the article number.  
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