



## ALUMINA COMPOSITES

Types RS-100, RS-200, RS-1200,  
RS-101, RS-201 and RS-202

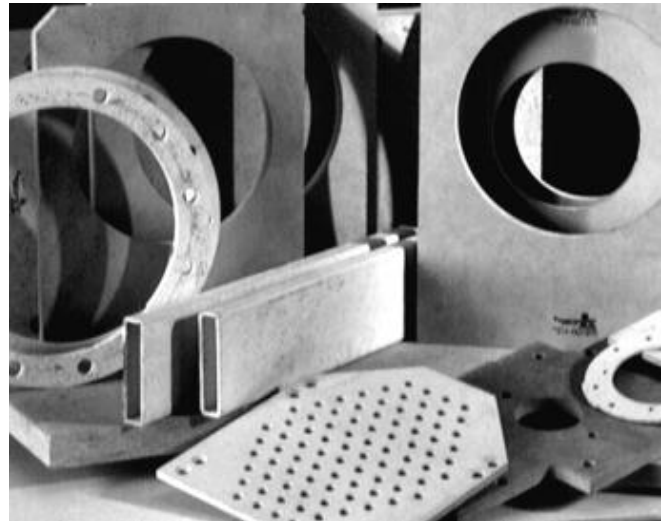
ZIRCAR Refractory Composites, Inc. produces a comprehensive range of advanced high-performance ceramic-ceramic composites and related products. Our materials are used around the world in demanding thermal, structural and electrical insulating applications at temperatures from 600°C(1112°F) to 1650°C(3002°F). For over twenty-five years we have been a problem solver working with many industries to resolve their thermal management problems. We have developed materials that have become industry standards for induction melting, forging and heat-treating applications, investment casting, glass processing, hot pressing, as well as many high temperature electrical applications.

### Refractory Sheet Types RS-100 and RS-200 boards

are fiber reinforced structural Alumina composites with useful properties in **thermal, structural and electrical insulation applications to 1260°C(2300°F)**. Type RS-100 has compressive and flexural strengths in the range of high temperature reinforced plastics, such as G-10 laminates, but retains its strength and utility to levels far exceeding the maximum use temperatures of plastics. Mechanical properties of Type RS-100 sheet far exceed those of asbestos-cement materials and is an excellent replacement for these rigid asbestos-containing products. Therefore, Type RS-100 not only makes an excellent replacement for rigid asbestos-containing products, but it can also be employed at much higher temperatures. Type RS-100 is 100% inorganic, non-flammable and contains no asbestos. It's high Alumina content makes it highly resistant to many environments, including molten aluminum, and it undergoes no out-gassing upon heating. It is not brittle and has high impact resistance. Type RS-100 may be cut and machined with standard tooling.

Type RS-200 boards have all the properties of Type RS-100 but exhibit higher strength due to a finer reinforcement structure. This makes Type RS-200 ideal for applications where intricate machining detail is needed. It is not brittle and has high impact resistance. Type RS-200 may be cut and machined with standard tooling.

**ZIRCAR Refractory Sheet Type RS-1200 boards** are made from a combination of strong reinforcing fibers tightly bound in an alumina ceramic matrix. Type RS-1200 exhibits slightly lower compressive and flexural strength than RS-100. Type RS-1200 is completely inorganic and contains no asbestos or RCF fibers. It also exhibits greater refractoriness and homogeneity than other reinforced alumina matrix composite products and can be readily machined to tight tolerances with conventional carbide tooling.



### SUGGESTED APPLICATIONS

- Induction Furnace Components such as Coil Support Posts, Coil Liners, Furnace Tops, Crucible Bases, Front and Back Plates
- Electrical Terminal Blocks and Supports for Electrical Resistor Grids Operating in High Temperature Environments
- Exterior Structural Insulation in High Temperature Electrically Heated and Gas Fired Furnaces
- Hot Face Structural Insulation in Glass Tempering and Annealing Furnaces
- Brazing Separators and Fixtures
- General Protective Heat Shielding in Foundry Environments
- Insulation in High Pressure Molding Presses
- Hearth plates and Furnace Shelving

### ZIRCAR Refractory Composites, Inc.

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# ALUMINA COMPOSITE MATERIALS

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**ZIRCAR Refractory Sheet Type RS-101, RS-201 and RS-202** are fiber reinforced ceramic laminate cylinders with useful properties to 2300°F(1260°C). These high temperature products offer high strength, moderate thermal conductivity and excellent electrical insulation. They retain their strength and utility to levels far exceeding maximum use temperatures of reinforced plastics and asbestos cement replacements. They are 100% inorganic, non-flammable and contain no asbestos. Their high alumina content makes them resistant to many environments including molten aluminum. They undergo little or no outgassing on heating, are not brittle, and may be cut and machined with standard tooling. Type RS-101 can be made into large cylinders with thick strong walls. Compared to ZIRCAR Refractory Sheet Type RS-101 Cylinders, Type RS-201 has the following attributes:

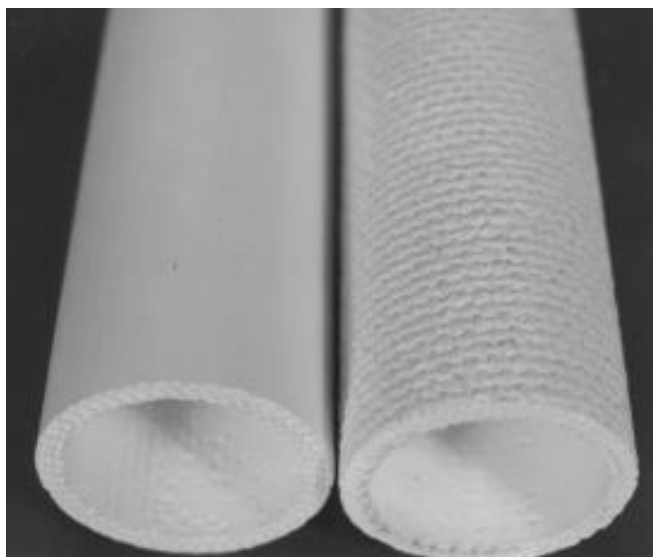
- Finer reinforcement structure which allows for machining of intricate detail
- Less tendency to delaminate when machined
- Higher strength

Type RS-201 has a highly burnished outside surface which is ideal when the OD is crucial for liner placement. Type RS-202 has an as formed surface. They are available in both standard and custom size cylinders and are useful as induction coil liners, induction furnace components, and molten metal transport tubes.

ZIRCAR Refractory Sheet Cylinders are ideal when used in place of mullite tubing in high thermal shock applications.



*Type RS-101 Cylinders are available in many sizes.*



*Type RS-201 (left) has a smooth burnished outside surface, Type RS-202's exterior texture reflects the weave of its reinforcing material.*

## SUGGESTED APPLICATIONS

- Induction Coil Liners in Induction Melting Furnaces
- Molten Metal Splash Guards in Induction Furnaces
- Direct Replacement for Asbestos Cement Products
- Fireproof Structural Insulation
- Electrical Insulation, Terminals and Supports
- Induction Furnace Components
- Electrical Insulation for Aluminum Pot Room Ducting Systems



*Type RS-101 Induction Coil Liner used in channel induction melting furnace*



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# ALUMINA COMPOSITE MATERIALS

| TYPE  | RS-100   | RS-1200  | RS-200   | RS-101   | RS-201 AND<br>RS-202                                       |
|---|--|--|--|--|--|
| Nominal Composition, wt%                                      |  |  |  |  |  |
| Al <sub>2</sub> O <sub>3</sub>                                | 75   | 82   | 65   | 65   | 65   |
| SiO <sub>2</sub>  | 16   | 12   | 21   | 21   | 21   |
| Other Metal Oxides  | 9  | 6  | 14   | 14   | 14   |
| Organic content   | 0  | 0  | 0  | 0  | 0  |
| Density, gm/cc(pcf)   | 2.1(130)   | 2.16(135)  | 2.1(130)   | 1.6(100)   | 2.1(130)   |
| Porosity, %   | 35   | 31   | 30   | 35   | 30   |
| Color   | White to tan   | White  | White to tan   | White to tan   | White to tan   |
| Max. Use Temp. *, °C(°F)                                      | 1260(2300)   | 1300(2370)   | 1260(2300)   | 1260(2300)   | 1260(2300)   |
| Modulus of Rupture**, MPa(psi)                                |  |  |  |  |  |
| as received   | 55(8000)   | 31(4500)   | 69(10,000)   | 16.6(2400)   | 69(10,000)   |
| after 24 hrs at 600°C(1112°F)                                 | 36(5200)   |  | 31(4500)   |  |  |
| after 24 hrs at 1010°C(1850°F)                                |  |  |  |  | 21(3000)   |
| Compressive Strength**, MPa (psi)                             |  |  |  |  |  |
| at 10% compression  | 69(10,000)   | 55(8000)   | 90(13,000)   | 69(10,000)   | 90(13,000)   |
| Specific Heat, J/kg°K(BTU/lb°F)                               |  |  |  |  |  |
| at 600°C(1100°F)  | 1172(0.28)   | 1172(0.28)   | 1172(0.28)   | 1172(0.28)   | 1172(0.28)   |
| Flammability  | Nil  | Nil  | Nil  | Nil  | Nil  |
| Thermal Conductivity,<br>W/m°K(BTU/hr. ft <sup>2</sup> °F/in) |  |  |  |  |  |
| 204°C(400°F)  | 0.62(4.3)  | 0.62(4.3)  | 0.62(4.3)  | 0.62(4.3)  | 0.62(4.3)  |
| 427°C(800°F)  | 0.65(4.5)  | 0.65(4.5)  | 0.65(4.5)  | 0.65(4.5)  | 0.65(4.5)  |
| 649°C(1200°F)   | 0.66(4.6)  | 0.66(4.6)  | 0.66(4.6)  | 0.66(4.6)  | 0.66(4.6)  |
| 1010°C(1850°F)  | 0.68(4.7)  | 0.68(4.7)  | 0.68(4.7)  | 0.68(4.7)  | 0.68(4.7)  |
| Thermal Expansion,<br>RT-400°C(752°F)                         | 6.0 x 10 <sup>-6</sup> /°C<br>(3.3 x 10 <sup>-6</sup> /°F) | 9.0 x 10 <sup>-6</sup> /°C<br>(5.0 x 10 <sup>-6</sup> /°F) | 8.0 x 10 <sup>-6</sup> /°C<br>(4.4 x 10 <sup>-6</sup> /°F) | 8.0 x 10 <sup>-6</sup> /°C<br>(4.4 x 10 <sup>-6</sup> /°F) | 8.0 x 10 <sup>-6</sup> /°C<br>(4.4 x 10 <sup>-6</sup> /°F) |
| Linear Shrinkage <sup>‡</sup> , %                             |  |  |  |  |  |
| after 4 hrs. at 1200°C(2200°F)                                | 1 - 2  | 0.7 - 1  | 0.7 - 1  | 2  | <1   |
| Moisture Content, % at 105°C(220°F)                           | 0 - 2  | 0 - 2  | 0 - 2  | 0 - 2  | 0 - 2  |
| Loss on Ignition, % at 982°C(1800°F)                          | 1 - 2  | 1 - 2  | 1  | 1  | <1   |
| Hardness, Durometer "D"                                       | 90   | 85   | 98   | 90   | 98   |
| Electrical Properties   |  |  |  |  |  |
| Volume Resistivity, ohm-cm                                    | 7.2 x 10 <sup>11</sup>                                     |  | 1.7 x 10 <sup>12</sup>                                     | 9.6 x 10 <sup>9</sup>                                      | 1.0 x 10 <sup>10</sup>                                     |
| Surface Resistance, ohms                                      | 2.3 x 10 <sup>11</sup>                                     |  | >1.3 x 10 <sup>13</sup>                                    | >1.3 x 10 <sup>13</sup>                                    |  |
| Dielectric Strength, Volts/mil                                | 71   |  | 26   | 26   | 26   |
| Breakdown Voltage, KV   |  |  |  |  |  |
| (1/8" thick piece)  | 7.3  |  |  |  |  |
| (1/2" wall thickness)   |  |  |  | 14.1   |  |
| Arc resistance, sec.  | >420   | >420   | >420   | >420   | >420   |

\* Maximum use temperature is dependent on variables such as stresses, both thermal and mechanical, and the chemical environment that the material experiences.

\*\* Properties expressed parallel to thickness.

‡ Properties expressed perpendicular to thickness.



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# ALUMINA COMPOSITE MATERIALS

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## AVAILABILITY

| Item # | Description                |
|--------|----------------------------|
| AS01   | RS-1200, 24" X 24" X 1/8"  |
| AS02   | RS-1200, 24" X 24" X 3/16" |
| AS03   | RS-1200, 24" X 24" X 1/4"  |
| AS04   | RS-1200, 24" X 24" X 3/8"  |
| AS05   | RS-1200, 24" X 24" X 1/2"  |
| AS06   | RS-1200, 24" X 24" X 3/4"  |
| AS07   | RS-1200, 24" X 24" X 1"    |
| AS08   | RS-1200, 24" X 24" X 2"    |
| AS20   | RS-1200, 24" X 48" X 1/8"  |
| AS21   | RS-1200, 24" X 48" X 3/16" |
| AS22   | RS-1200, 24" X 48" X 1/4"  |
| AS23   | RS-1200, 24" X 48" X 3/8"  |
| AS24   | RS-1200, 24" X 48" X 1/2"  |
| AS25   | RS-1200, 24" X 48" X 3/4"  |
| AS26   | RS-1200, 24" X 48" X 1"    |
| AS27   | RS-1200, 24" X 48" X 2"    |
| AS50   | RS-1200, 36" X 36" X 1/4"  |
| AS51   | RS-1200, 36" X 36" X 3/8"  |
| AS52   | RS-1200, 36" X 36" X 1/2"  |
| AS53   | RS-1200, 36" X 36" X 3/4"  |
| AS54   | RS-1200, 36" X 36" X 1"    |
| AS55   | RS-1200, 36" X 36" X 2"    |

| Item # | Description               |
|--------|---------------------------|
| CS01   | RS-200, 18" X 24" X 1/16" |
| CS02   | RS-200, 18" X 24" X 1/8"  |
| CS03   | RS-200, 18" X 24" X 1/4"  |
| CS04   | RS-200, 18" X 24" X 1/2"  |
| CS20   | RS-200, 24" X 36" X 1/16" |
| CS21   | RS-200, 24" X 36" X 1/8"  |
| CS22   | RS-200, 24" X 36" X 1/4"  |
| CS23   | RS-200, 24" X 36" X 1/2"  |

Custom boards, shapes and preparations are available on request. Our forming processes, large inventory of custom tooling and state of the art machining techniques allow a wide variety of sizes and shapes to be made. Special geometries such as disks, rings and custom-machined shapes can be fabricated. Tight tolerance machining, compositional variations and the application of surface rigidizers and hardening agents are available. Please contact us with your special requirements.

Our forming process allows a wide range of cylinders to be made. Type RS-101 cylinders can be made from inside diameter of 3/4" with lengths to 72", to inside diameter of 36" with lengths to 36". Types RS-201 and RS-202 cylinders can be made from inside diameter of 1/2" with lengths to 72", to inside diameter of 36" with lengths to 36".

| Item # | Description               |
|--------|---------------------------|
| BS01   | RS-100, 24" X 24" X 1/8"  |
| BS02   | RS-100, 24" X 24" X 3/16" |
| BS03   | RS-100, 24" X 24" X 1/4"  |
| BS04   | RS-100, 24" X 24" X 3/8"  |
| BS05   | RS-100, 24" X 24" X 1/2"  |
| BS06   | RS-100, 24" X 24" X 3/4"  |
| BS07   | RS-100, 24" X 24" X 1"    |
| BS20   | RS-100, 24" X 48" X 1/8"  |
| BS21   | RS-100, 24" X 48" X 3/16" |
| BS22   | RS-100, 24" X 48" X 1/4"  |
| BS23   | RS-100, 24" X 48" X 3/8"  |
| BS24   | RS-100, 24" X 48" X 1/2"  |
| BS25   | RS-100, 24" X 48" X 3/4"  |
| BS26   | RS-100, 24" X 48" X 1"    |
| BS30   | RS-100, 24" X 48" X 2"    |
| BS50   | RS-100, 36" X 36" X 1/4"  |
| BS51   | RS-100, 36" X 36" X 3/8"  |
| BS52   | RS-100, 36" X 36" X 1/2"  |
| BS53   | RS-100, 36" X 36" X 3/4"  |
| BS54   | RS-100, 36" X 36" X 1"    |

| Item # | Description                       |
|--------|-----------------------------------|
| FS01   | RS-101, 2" ID X 2 1/2" OD X 36" L |
| FS02   | RS-101, 3" ID X 3 1/2" OD X 36" L |
| FS03   | RS-101, 4" ID X 5" OD X 36" L     |
| FS04   | RS-101, 5" ID X 6" OD X 36" L     |
| FS05   | RS-101, 6" ID X 7" OD X 36" L     |
| FS06   | RS-101, 7" ID X 8" OD X 36" L     |

| Item # | Description                       |
|--------|-----------------------------------|
| GS01   | RS-201, 1" ID X 1 1/4" OD X 36" L |
| GS02   | RS-201, 1" ID X 1 1/2" OD X 36" L |
| GS03   | RS-201, 2" ID X 2 1/4" OD X 36" L |
| GS04   | RS-201, 2" ID X 2 1/2" OD X 36" L |
| GS05   | RS-202, 1" ID X 1 1/4" OD X 36" L |
| GS06   | RS-202, 1" ID X 1 1/2" OD X 36" L |
| GS50   | RS-202, 2" ID X 2 1/4" OD X 36" L |
| GS51   | RS-202, 2" ID X 2 1/2" OD X 36" L |



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