

Thermal Ceramics
products from
Morgan Advanced Materials
Product data book

THERMAL CERAMICS PRODUCTS OVERVIEW

Our Thermal Ceramics world leading products offer a diverse, strongly branded product range that combines quality with consistency and reliability. Thermal Ceramics leads the way in bringing technical solutions to all problems of heat containment.

Thermal Ceramics supply optimum engineered insulation solutions to a diverse range of markets and end users; we are the market leaders in core products of insulating fibres, insulating Firebricks and monolithics. Our aim is to provide not only the products, but engineered solutions which satisfy your needs.

Superwool® fibre - AES

Superwool® fibre products are special alkaline earth silicate (AES) fibres that have been uniquely engineered to offer advantages in high temperature insulation applications. On account of their low bio-persistence, AES fibres are not classified carcinogenic by IARC or under any national regulations on a global basis. They have no requirement for warning labels under GHS (Globally Harmonised System for the classification and labelling of chemicals). In Europe, Superwool® fibre meets the requirements specified under NOTA Q of European Directive 67/548. All Superwool® fibre products are therefore exonerated from the classification and labelling regulation in Europe.

Polycrystalline Wool - PCW

Polycrystalline fibre is produced by a 'sol-gel method' from aqueous spinning solutions and is suitable for use at application temperatures > 1300°C (2372°F) and in critical chemical and physical application conditions.

Refractory ceramic fibre (RCF)

also known as (ASW) - Alumina Silicate Wool

RCF - man made vitreous fibres (MMVF); chemical constituents are predominantly alumina and silica. Such MMVF's are classified in the EU as category 2 carcinogens. RCF is a highly versatile material which can be spun or blown into bulk and air-laid into blanket, folded into modules, converted into papers, boards, and shapes.

Blanket

These highly versatile Superwool® fibre, refractory ceramic fibre and Polycrystalline Wool blanket products are lightweight, have low thermal conductivity, low heat storage and excellent resistance to thermal shock. They are available in a variety of densities, thicknesses and temperature capabilities.

Bulk

A complete line of low bio-persistent Superwool® fibre, refractory ceramic fibre and polycrystalline wool fibres each of which offers its own unique combination of properties. These bulk fibres are produced by varying composition, fibre length, compressed density, fibre content, fibre diameter and lubricity, available in chopped, un-chopped, lubricated and non-lubricated.

Paper and Felt

Thin sheet products including paper and felt are suitable for a variety of insulation and filtration applications. Many special grades offer properties such as no binder outgassing, low shot content and high strength.

Module, Log, and Bloc

A unique solution to high temperature insulation needs in industrial heaters, boilers and furnaces as well as many other applications. These are easy-to-install, high-temperature, Superwool® fibre and refractory ceramic fibre module systems featuring Pyro-Bloc®, Pyro-Fold™ and Pyro-Stack™ design. Pyro-Bloc® is a proven furnace insulation that installs faster than any other ceramic fibre module on the market.

Vacuum Formed and Board products

Boards and Vacuum Formed shapes (VF) are available as flexible or rigid products in a wide range of compositions (up to 1600°C 2912°F) and a variety of standard dimensions with tolerances which can be adapted to very demanding applications. The formulations are selected to optimise performances in each application and shapes can be produced according to customer design.

Textiles

Textile products are made from highly textured forms of various fibres in both Superwool® fibre and Kao-Tex® using refractory ceramic fibre. Yarn made from bulk fibre and organic binders is converted into a wide variety of woven textile forms including cloth, ropes, packing and sleeving.

Mastics

Mastic insulation from Thermal Ceramics complement our full line of refractory and insulation products. This extensive offering includes pumpables, moldable, cements, and coatings, and is manufactured specifically to aid in efficient furnace, kiln, and boiler operations.

Fire Protection

Our FireMaster® brand of fire protection products are high performance materials that provide high quality fire-safe solutions that do not age, ensuring reliable fire protection when needed.

Microporous insulation

Microporous insulation high temperature products feature a classification temperature up to 1100°C (2012°F). Our Min-K, WDS and BTU brands have gained a solid reputation for the energy savings and design optimisations that are not limited to a certain area of application, but offer a broad range to meet varying demands of many market sectors such as aerospace, power generation and metals.

Firebrick, Insulating Firebrick (IFB) and Mortars

JM™, K®, TC® and TJM™ insulating Firebricks offer superior insulating properties, minimising energy use, combined with the ability to withstand chemical attack and high heat conditions. Both wet and dry mortars are available that are matched for use with the Thermal Ceramics IFB range.

Insulating, Dense and Special Duty Monolithics

Tri-Mor® Monolithics offer a full range of products for applications requiring high resistance to corrosion, abrasion and reducing atmospheres. They are particularly suited to applications where fast turn around of installation and repairs is important.

Silicon Carbide and Fired Refractory Shapes

Silicon Carbide displays excellent performance in highly abrasive applications. We produce two main forms of Silicon Carbide - self bonded and nitride bonded. Individually crafted fired shapes hold up under harsh conditions. With various alumina-silica, high alumina, alumina-silica-zirconia, magnesia, zirconia, mullite, silicon carbide and fused silica compositions, these materials offer excellent hot strengths and resistance to thermal shock and molten metals.

Structural Block insulation

Our structural block insulation offers a wide range of structural insulation products used in many applications within the energy, industrial, automotive, domestic appliance and construction industries.

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Guideline for imperial and metric measurements in this Product Data Book:

In sections 1 - 17 metric measurements are shown first in each section. Imperial measurements follow and are shown on the pages that have grey backgrounds. For further ease of identification, all data pages have titles on the lower left of each page : 'Metric information' and 'Imperial information'.



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Product Data Sheets: for more information on our products, please refer to the 'Product Data Sheet' section on our website : www.morganthermalceramics.com

Product Data Sheets, in other languages, can also be found by visiting our website.

Safety Data Sheet (SDS): are available for our products on our website : www.morganthermalceramics.com and click on the Safety Data Sheets Quick Link on the home page.

Superwool® is a low biopersistent material.
Alphawool® is a Polycrystalline (PCW) wool fibre. Others include Denka* and Maftec**.

* Denka and Alcen are registered trademarks of Denka Kagaku Kogyo Kabushiki Kaisha used under licence by Morgan Advanced Materials PLC.
** Maftec is a registered trade mark of Mitsubishi used under licence by Morgan Advanced Materials PLC.

RCF is a refractory ceramic fibre material, also know as (ASW) Alumino Silicate Wool. Morgan brands include Kaowool® and Cera® Products.

Whilst the values and application information in this Product Data Book are typical, they are given for guidance only. The values and the information given are subject to normal manufacturing variation and may be subject to change without notice. Morgan Advanced Materials - Thermal Ceramics makes no guarantees and gives no warranties about the suitability of a product and you should seek advice to confirm the product's suitability for use with Morgan Advanced Materials - Thermal Ceramics.

SUPERWOOL® is a patented technology for high temperature insulation wools which have been developed to have a low biopersistence (information upon request).

SUPERWOOL® products may be covered by one or more of the following patents, or their foreign equivalents:

SUPERWOOL® PLUS and **SUPERWOOL® HT** products are covered by patent numbers: US5714421 and US7470641, US7651965, US7875566, EP1544177 and EP1725503 respectively.

A list of foreign patent numbers is available upon request to Morgan Advanced Materials plc.

Morgan Advanced Materials plc Registered in England & Wales at
Quadrant, 55-57 High Street, Windsor, Berkshire. SL4 1LP

UK Company No. 286773

PRODUCT OVERVIEW

Material types	Product form
Fibre Alkaline Earth Silicate Fibre (AES) : • Superwool® Refractory Ceramic Fibre (RCF) : • Kaowool®, Cera® Polycrystalline Fibre (PCW) : • Alphawool®, Denka®, Maftec®	Blanket, Bulk, Module, Log, Board, Shape, Paper, Felt, Mastic, Textile
Fired refractory Firebrick Insulating Firebrick (IFB) : • JM™, K® and TJM™	Bricks, Shapes
Monolithics : • Tri-Mor®, Kaolite®, Kaocrete®, Kao-Tuff®	Cast, Gun, Ram, Vibratory
Crucibles Fired shapes	Various chemistries
Structural Block • TR-19™ • TR-20™	Block
Microporous • Min-K® • Porextherm® WDS® • BTU-BLOCK™	Board, Block, Panel, Flexible Liner, Shapes

Thermal Ceramics designs, manufactures and installs a broad range of thermal insulation products that reduce energy consumption and emissions in a variety of high temperature processing applications.

Our product offering is extensive and covers application needs from industrial to commercial markets and is organized into the following categories, with available product forms, typical of the high temperature insulation industry.

Thermal Ceramics high temperature insulation wool (HTIW) from 600°C (1112°F) up to 1300°C (2372°F) includes:

- AES wool (alkaline earth silicates) : **Superwool® fibre**
- RCF wool (aluminosilicates) : **Cera® and Kaowool®**
- PCW wool (Polycrystalline) : **Alphawool®, Denka®, Maftec®**

In use high temperature insulation wool will:

- Reduce greenhouse gas emissions
- Reduce energy usage
- Improve efficiency of furnaces and process equipment

Fibres

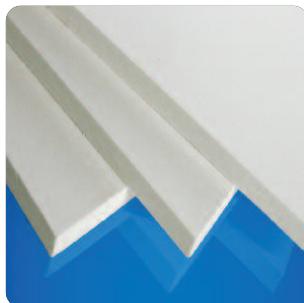
Superwool® fibre

Superwool® fibre is a high-temperature insulating wool composed of man-made vitreous silicate fibres.

Superwool® fibre has been developed to show improved high temperature characteristics required to act as an alternative to RCF where possible. The Superwool® fibre family of products offer a versatile alternative to traditional insulation solutions for commercial, industrial, and transportation applications. Thermal Ceramics Superwool® fibre patented technology is available in a variety of forms including blanket, bulk, board, felt, paper, vacuum-formed, modules and mastic products.

Benefits:

- Excellent thermal stability and insulation properties
- Free of binder or lubricant
- Low thermal conductivity
- Good resistance to tearing
- Low heat storage capacity
- Inorganic - smoke free
- Flexible, resilient and immune to thermal shock
- Good sound absorption
- AES fibres are not classified carcinogenic by IARC or under any national regulations on a global basis. They have no requirement for warning labels under GHS (Globally Harmonised System for the classification and labelling of chemicals). In Europe, Superwool® fibre meets the requirements specified under NOTA Q of European Directive 67/548. All Superwool® fibre products are therefore exonerated from the classification and labelling regulation in Europe.



Refractory Ceramic Fibre (RCF) also known as (ASW) - Alumino Silicate Wool

RCF – man made vitreous fibres (MMVF); chemical constituents are predominantly alumina and silica. RCF is a highly versatile material which can be spun or blown into bulk and air-laid into blanket, folded into modules, converted into papers, boards, and shapes.

Benefits:

- Excellent insulating performance
- Excellent thermal stability: fibres have good resistance to devitrification
- Low heat storage
- The combination of long spun fibres and the needling operation produce tough, resilient and strong blankets, which resist tearing both before and after heating
- Resistance to thermal shock
- Good acoustic properties
- No smoke emission due to binder burn out

Polycrystalline Wool - (PCW)

Polycrystalline fibre is produced by a 'sol-gel method' from aqueous spinning solutions and is suitable for use at application temperatures > 1300°C (2372°F) and in critical chemical and physical application conditions. Key properties are:

Benefits:

- Defined dimensions
- Chemical and thermal stability
- Low linear shrinkage
- Low thermal mass and good insulating properties
- High tensile strength
- Very low shot content < 1%
- Uniform fibre diameters average
- Lightweight
- High resilience

Alphawool®, Denka® and Maftec® are also available from Thermal Ceramics.

Fired Refractory

Firebrick from Thermal Ceramics are available for temperature use up to 1788°C (3250°F) and marketed as SR-90® and SR-99®.

Insulating Firebricks (IFB) are manufactured with very low thermal conductivity and high hot load strengths. JM™, K® and TJM™ branded bricks have the ability to withstand chemical attack and high heat conditions. Both wet and dry mortars are available that are matched for use with our IFB range.

Fired Refractory Crucibles and Shapes are individually crafted as Cerox® and Valcor®. Crucibles and fired shapes hold up under harsh conditions. With various alumina-silica, high-alumina and alumina-silica-zirconia compositions, these materials offer excellent hot strengths and resistance to thermal shock and molten metals.

Monolithics are available in Insulating, Dense and Special Duty Monolithics. World recognized branding, the Tri-Mor® line of Kaocrete® dense monolithic has been proven ideal for applications that require strong, easy to place and economical materials. Tri-Mor Kaolite® insulating monolithics provide low thermal conductivity values, ease of installation and superior performance in petrochemical applications.

The Tri-Mor line of special duty monolithics such as Kao-Tuff®, Plascast / Plasgun®, Kao-Tab®, Firelite® and Firecrete® feature specifically enhanced properties such as resistance to corrosion, abrasion and reducing atmospheres.

Structural Block insulation is marketed under the TR™ product offering manufactured from vermiculite and diatomaceous silica. The product can be made into exact customer specifications as boards or shapes.

Microporous

Microporous insulation is available under the Porextherm®, WDS® Min-K® and BTU-BLOCK™ for transportation, industrial and consumer goods markets. Specially formulated and designed for applications such as ladle liner back-up insulation for Iron and Steel and board back-up insulation in Ethylene crackers. These lightweight, high compressive strength materials are the most thermally efficient insulation available.



About us

MORGAN ADVANCED MATERIALS



MORGAN ADVANCED MATERIALS IS COMMITTED TO BUILDING A SUSTAINABLE COMPETITIVE ADVANTAGE IN ATTRACTIVE MARKETS WITH TRULY DIFFERENTIATED PRODUCTS AND SERVICES UNDERPINNED BY WORLD-LEADING TECHNOLOGY.

The Group produces a wide range of specialist, high-specification materials that have extraordinary attributes and properties.

Engineered into products, they deliver enhanced performance, often under extreme conditions.

The Group's dynamic, highly skilled people are continuously engaged in finding solutions for complex and technologically demanding applications, which are used all over the world.

In short, the Group supplies innovative, differentiated products made from highly technical advanced materials which enable its customers' products and processes to perform more efficiently, more reliably and for longer.



WHAT DIFFERENTIATES US?

- Advanced material science and processing capabilities
- Our applications engineering experience
- A strong history of innovation and reinvention
- Consistent and reliable performance
- A truly global footprint
- We find and invest in the best people

PRINCIPAL PRODUCTS

1 INSULATING FIBRE, BRICK AND MONOLITHICS

Extensive range of high-temperature insulation products used to reduce energy consumption in industrial processes.

2 ELECTRICAL CARBON, LINEAR AND ROTARY TRANSFER SYSTEMS

Used to transfer current and data between stationary and rotating or linear moving parts, in motor, generator, current collector and rotary signal applications within mining, power, transportation and industrial markets.

3 SEALS AND BEARINGS

Providing improved performance, reliability and extended life to pumps and similar equipment used in petrochemical, aerospace and water applications.

4 CERAMIC CORES FOR INVESTMENT CASTING

Consumable products used to create intricate internal cooling cavities in aero engine and industrial gas turbine blades.

5 PIEZOELECTRIC SENSORS AND TRANSDUCERS

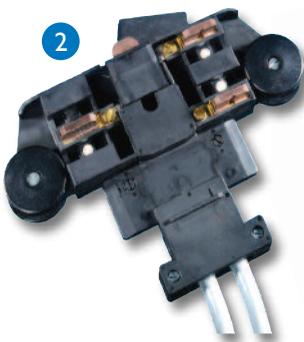
Products for measurement duties including level, flow, vibration and pressure in aerospace, medical, industrial and defence applications.

6 CRUCIBLES FOR METALS PROCESSING

Comprehensive range for optimum performance in non-ferrous metal and alloy melting in foundries, die-casters and metal processing facilities.

7 PERSONNEL BALLISTIC PROTECTION

Lightweight armour systems combining advanced ceramics with high-technology composites to create high-performance products.



THERMAL CERAMICS



ENGINEERING
HIGH
PERFORMANCE
INSULATION
FOR CRITICAL
APPLICATIONS



The Thermal Ceramics business of Morgan Advanced Materials makes a range of fibre and refractory high temperature insulation products used to reduce energy consumption in industrial processes. Its products are also used in passive fire protection applications.

We have extensive experience working with customers all over the world to engineer, design and install high performance insulation in operating environments from 500°C to 1600°C (932°F to 2912°F).

We have a proven track record for helping customers to improve operational efficiency and respond to changing environmental pressures.

The Thermal Ceramics business produces a variety of market leading brands including; Superwool® low bio-persistent insulating fibre, Pyro-Bloc® modules, Min-K®, WDS® and BTU-BLOCK™ microporous and JM™, K® and TJM™ Insulating Firebricks (IFBs).



OUR MARKETS



PETROCHEMICAL

Thermal Ceramics makes critical components for tough assignments in the global petrochemical industry.



TRANSPORTATION

Thermal Ceramics makes high-performance products to exacting standards for aerospace, automotive, marine and rail applications.



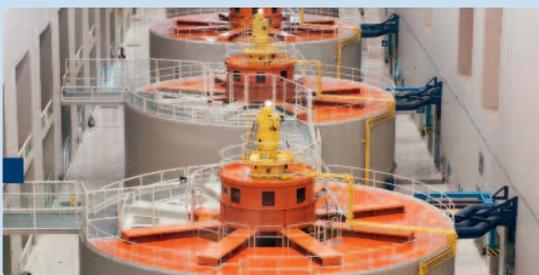
FIRE PROTECTION

Thermal Ceramics makes high performance fire insulation products under the FireMaster® brand for passive fire protection in marine, industrial, road and rail tunnels, petrochemical and offshore and commercial applications.



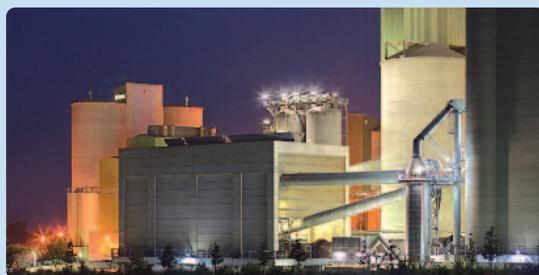
INDUSTRIAL

Thermal Ceramics designs and manufactures products for use in a broad range of challenging process and manufacturing environments.



ENERGY

Thermal Ceramics develops products for power distribution and generation from renewable and traditional sources and insulation materials for heat management.



CEMENT

We manufacture and install a wide range of insulation fibre and monolithic products and work with customers to develop the right solution to extend their kiln's life span or speed with advanced technology to reduce downtime.

OUR MARKETS continued



CERAMICS & GLASS

As a major producer of high temperature insulating products, Thermal Ceramics understands the firing conditions of this industry and the lining requirements placed upon our materials.



IRON & STEEL

Thermal Ceramics is uniquely positioned, technically and geographically, to offer a comprehensive range of advanced refractory engineered solutions for the complete iron and steel process.



ALUMINIUM

Thermal Ceramics play a major role in the production and processing of aluminium, providing the industry with the widest selection of refractories and high temperature insulating materials on the market.



HEALTHCARE

Morgan Advanced Materials produces components used in medical monitoring and diagnostic instrumentation and tools for treatment and surgery.



ELECTRONICS

Morgan Advanced Materials makes components that help the electronics industry in its drive towards higher performance and reliability in smaller, lighter, more robust products.



SECURITY & DEFENCE

Morgan Advanced Materials supplies precision engineered materials, components and assemblies to meet the exacting standards of the international defence and security markets.



Section 01

Blanket products

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Imperial information - Page 15 - 17

Blanket products

AES blankets

- Superwool® Plus
- Superwool® HT
- Superwool® AC2

RCF blankets

- Kaowool®
- Cerablanket®
- Cerachem®
- Cerachrome®

PCW blankets

- Denka®
- Maftec®

Maftec is a registered trademark of Mitsubishi used under licence by Morgan Advanced Materials PLC.

Denka, Alcen are registered trademarks of Denka used under licence by Morgan Advanced Materials PLC.

Thermal Ceramics blankets are available in a wide range of chemistries, densities and dimensions.

Blankets are air laid into a continuous mat and mechanically needled for added strength and surface integrity. The needles are pushed into the mat and withdrawn which produces a coherent blanket. Blanket can be folded, compressed and encapsulated to produce modules.

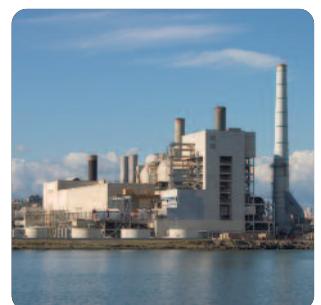
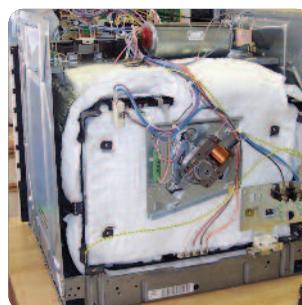
High temperature insulation wool is a material for use in high temperature applications such as the insulating lining of metallurgical ovens and furnaces, petrochemical heaters, and ceramic kilns etc.

In use high temperature insulation wool will:

- Contribute to protecting people and property from excessive heat
- Reduce greenhouse gas emissions
- Reduce energy usage
- Improve efficiency of furnaces and process equipment

Common characteristics are:

- Low thermal conductivity
- Excellent thermal shock resistance
- Low heat storage capacity
- Inorganic - smoke free



Typical applications - for high temperature insulation wool - blankets:

- Power generation especially HRSG duct insulation
- Chimney insulation
- Process heater linings
- Pipe wrap
- Annealing furnace linings
- Furnace and kiln back-up insulation
- Storage heater insulation
- Domestic oven insulation
- Automotive exhaust heat shields
- Aluminium transfer launder covers
- Welding stress relief

Superwool® blanket - grades available:

Superwool® HT fibre : classification 1300°C (2372°F)

Superwool® Plus fibre : classification 1200°C (2192°F)

Benefits:

- Excellent thermal insulation properties
- Free of binder or lubricant
- Thermal stability
- Low thermal conductivity
- Good resistance to tearing
- Low heat storage capacity
- Inorganic - smoke free
- Flexible and resilient
- Immune to thermal shock
- Good sound absorption
- AES fibres are not classified carcinogenic by IARC or under any national regulations on a global basis. They have no requirement for warning labels under GHS (Globally Harmonised System for the classification and labelling of chemicals). In Europe, Superwool® fibre meets the requirements specified under NOTA Q of European Directive 67/548. All Superwool® fibre products are therefore exonerated from the classification and labelling regulation in Europe.

PCW blanket - grades available:

Maftec® : maximum continuous use 1600°C (2912°F)

Denka® : maximum continuous use 1600°C (2912°F)

Benefits:

- Produced from high alumina or mullite fibre
- Lowest possible shot content < 1% shot
- Offers exceptional high-temperature resistance

RCF blanket - grades available:

Cerablanket® : classification 1260°C (2300°F)

Cerachem® : classification 1430°C (2606°F)

Cerachrome® : classification 1430°C (2606°F)

Kaowool® blanket : classification 1260°C (2300°F)

Kaowool® blanket S : classification 1260°C (2300°F)

Kaowool® blanket SZr : classification 1430°C (2606°F)

Benefits:

- Excellent insulating performance
- Excellent thermal stability: fibres have good resistance to devitrification
- Low heat storage
- The combination of long spun fibres and the needling operation produce tough, resilient and strong blankets, which resist tearing both before and after heating
- Resistance to thermal shock
- Good acoustic properties
- No smoke emission due to binder burn out



Blanket products

	Superwool® HT Blanket				Superwool® Plus Blanket				Superwool® Plus AC2 Blanket
Classification Temperature, °C	1300				1200				1200
Colour	white				white				white
Density, kg/m ³	64	96	128	160	64	80	96	128	50
Tensile Strength kg/m ³ , EN 1094-1 kPa									
	128 kg/m ³	30	50	75	95	75			>20
Permanent Linear Shrinkage, %, EN 1094-1									
after 24 hours @ 1000°C	-				-				<1.5
after 24 hours @ 1100°C	-				-				-
@ 1200°C	-				1				-
@ 1300°C	<4				-				-
Thermal Conductivity, W/m•K ASTM C-201									
	96 kg/m ³	128 kg/m ³		64 kg/m ³	80 kg/m ³	96 kg/m ³	128 kg/m ³		50 kg/m ³
Mean Temperature @ 200°C	0.05	0.04		0.06	0.06	0.05	0.05		0.09
@ 300°C	-	-		-	-	-	-		0.14
@ 400°C	0.10	0.08		0.11	0.09	0.09	0.08		0.22
@ 500°C	-	-		-	-	-	-		0.32
@ 600°C	0.19	0.14		0.18	0.15	0.14	0.12		0.44
@ 800°C	0.32	0.23		0.29	0.24	0.21	0.18		0.70
@ 1000°C	0.48	0.34		0.42	0.36	0.29	0.25		0.98
@ 1200°C	0.69	0.48		-	-	-	-		-
Chemical Composition, %									
SiO ₂	70-80				62-68				60-70
CaO	18-25				26-32				25-40
MgO	18-25				3-7				25-40
Al ₂ O ₃	-				-				<0.3
Others	<3				<1				<1
Acoustic Performance, Airflow Resistivity per ASTM C522, rays/m									
	-				-				<15000

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Blanket products

	Cerablanket®	Cerachem® Blanket	Cerachrome® Blanket	Kaowool® Blanket S	Kaowool Blanket SZr	Maftec®		Cerablanket AC1	Cerablanket AC2			
Maximum Continuous Use Temperature, °C	-	-	-	-	-	1600	1600	1177	1177			
Classification Temperature, °C	1260	1425	1425	1260	1425	-	-	1315	1315			
Colour	white	white	blue/green	white	white	white	white	white	white			
Density, kg/m³	64-160	64-160	64-160	64-160	64-160	96	128	48, 64	48, 64			
Tensile Strength, kg/m³ EN 1094-1 kPa												
Blanket Density	64 kg/m ³	30	30	30	39	39	-	-	0.28	0.42		
	96 kg/m ³	70	70	65	78	78	93	-	-	-		
	128 kg/m ³	90	90	85	103	103	-	103	-	-		
	160 kg/m ³	110	110	-	127	127	-	-	-	-		
Permanent Linear Shrinkage, %, EN 1094-1												
after 24 hours	@ 1000°C	1.5	-	1.5	1.5	-	-	-	-	-		
	@ 1100°C	2.2	-	2.2	2.2	-	-	-	-	-		
	@ 1200°C	3.0	1.0	2.7	3.0	1.0	1.0	-	-	-		
	@ 1300°C	-	2.0	3.5	5.5	2.0	2.0	0.3	-	-		
	@ 1400°C	-	3.5	4.0	-	3.0	3.0	0.8	-	-		
	@ 1500°C	-	-	5.0	-	-	-	0.9	-	-		
	@ 1600°C	-	-	-	-	-	-	1.0	-	-		
Thermal Conductivity, W/m·K ASTM C-201	64 kg/m ³	96 kg/m ³	128 kg/m ³	160 kg/m ³	64 kg/m ³	96 kg/m ³	128 kg/m ³	96 kg/m ³	128 kg/m ³	48 kg/m ³	64 kg/m ³	
Mean Temperature	@ 200°C	0.07	0.06	0.06	-	0.07	0.06	0.06	-	-	0.08	
	@ 260°C	-	-	-	-	-	-	-	-	0.08	-	
	@ 300°C	-	-	-	-	-	-	-	-	-	0.125	
	@ 400°C	0.12	0.11	0.10	0.09	0.12	0.11	0.10	0.08	0.08	0.193	
	@ 500°C	-	-	-	-	-	-	0.10	0.09	0.19 (538°C)	0.285	
	@ 600°C	0.20	0.16	0.15	0.13	0.20	0.16	0.15	0.13	0.12	0.23	0.40
	@ 700°C	-	-	-	-	-	-	0.17	0.14	-	-	
	@ 750°C	-	-	-	-	-	-	-	-	-	-	
	@ 800°C	0.30	0.23	0.20	0.18	0.30	0.23	0.20	0.19	0.17	0.36 (816°C)	-
	@ 900°C	-	-	-	-	-	-	0.23	0.20	0.47 (982°C)	-	
	@ 1000°C	0.43	0.32	0.27	0.25	0.43	0.32	0.27	0.27	0.24	0.54 (1093°C)	-
	@ 1200°C	-	-	-	-	-	-	0.39	0.33	-	-	
	@ 1400°C	-	-	-	-	-	-	0.58	0.48	-	-	
Specific Heat Capacity, kJ/kg·K												
	@ 1090°C	1.13	1.13	1.13	1.13	1.13	-	1.25	-	-		
Chemical Composition, %												
SiO ₂	56	50	54.5	56	50	-	-	28	53-55	53-55		
Al ₂ O ₃	44	35	42.7	44	34.9	-	-	72	45-47	45-47		
CaO+MgO	0.05	0.09	0.10	0.05	0.09	-	-	trace	-	<0.08		
Cr ₂ O ₃	-	-	2.8	-	-	-	-	-	-	-		
ZrO ₂	-	15	-	-	15.2	-	-	-	-	-		
Fe ₂ O ₃	0.15	0.15	0.15	-	-	-	-	0.03	-	-		
Na ₂ O+K ₂ O	0.10	0.10	0.10	0.10	0.10	-	-	0.06	-	-		
TiO ₂	-	-	-	-	-	-	-	0.01	-	-		
Leachable Chlorides	-	-	-	-	-	-	-	-	<10	<10		
Others	-	-	-	-	-	-	-	-	0-1	0-1		

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Blanket products - Superwool® AES Grades

Product Name	Superwool® Plus	Superwool® HT
Color	white	
Continuous temperature use limit, °F (°C)	1832 (1000)	2102 (1150)
Classification temperature rating, °F (°C)	2192 (1200)	2372 (1300)
Chemical Analysis, % Weight basis after firing		
Silica, SiO ₂	62 - 68	70 - 80
Calcium Oxide + Magnesium Oxide, CaO + MgO	29 - 39	18 - 25
Other	< 1	< 3
Leachable chlorides	-	
Thermal Conductivity, BTU•in./hr•ft²•°F (W/m•K), ASTM C 201		
measured density, pcf (kg/m ³)	8 (128)	8 (128)
mean temperature @ 500°F (260°C)	0.39 (0.06)	0.41 (0.06)
@ 1000°F (538°C)	0.73 (0.11)	0.83 (0.12)
@ 1800°F (982°C)	1.73 (0.25)	2.11 (0.30)
@ 2100°F (1149°C)	Beyond continuous use limit	2.75 (0.40)

Availability and Packaging

Thickness, in (mm)	Density, pcf (kg/m ³)				Length, in (mm)	Width, in (mm)	ft ² (m ²) / carton for 24 in (610 mm) width rolls
	4 (64)	6 (96)	8 (128)	10 (160)			
1/4 (6)			x		240 (6095)	24, 48 (610, 1220)	160 (14.9)
1/2 (13)		x	x	x	600 (15240)		100 (9.3)
1 (25)	x	x	x	x	300 (7620)		50 (4.6)
1 1/2 (38)	x	x	x		180 (4575)		30 (2.8)
2 (50)	x	x	x		150 (3810)		25 (2.3)

Superwool blankets from Augusta are packaged in cartons and stretch-wrapped onto pallets. Some size and density combination may require a minimum order. Please check with your Thermal Ceramics office for current lead times and availability.

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Blanket products - RCF Grades

Product Name	Kaowool®	Cerablanket®	Cerachem®	Cerachrome®
Color	off white	white	white	blue/green
Continuous temperature use limit, °F (°C)	2000 (1093)	2150 (1177)	2400 (1315)	2500 (1371)
Classification temperature rating, °F (°C)	2300 (1260)	2400 (1315)	2600 (1426)	
Chemical Analysis, %, Weight basis after firing				
Alumina, Al ₂ O ₃	45	46	35	43
Silica, SiO ₂	50 - 55	54	50	54
Zirconia, ZrO ₂	-	-	15	-
Ferric oxide, Fe ₂ O ₃	1.0			
Titanium oxide, TiO ₂	2.2			
Alkalies as NaO ₂	0.2			
		trace		3
Leachable chlorides	1 - 2	trace		
Thermal Conductivity, BTU•in./hr•ft²•°F (W/m•K), ASTM C 201				
measured density, pcf (kg/m ³)	8 (128)	8 (128)		
mean temp. @ 500°F (260°C)	0.44 (0.06)	0.44 (0.06)		
@ 1000°F (538°C)	0.87 (0.12)	0.93 (0.13)		
@ 1500°F (816°C)	1.45 (0.21)	1.60 (0.23)		
@ 2000°F (1093°C)	2.09 (0.30)	2.34 (0.34)		

Availability and Packaging

Thickness, in (mm)	Density, pcf (kg/m ³)				Length, in (mm)	Width, in (mm)	ft ² (m ²) / carton for 24 in (610 mm) width rolls
	4 (64)	6 (96)	8 (128)	10 (160)			
1/4 (6)		□ ▲	□ ▲		240 (6095)	24, 48 (610, 220)	160 (14.9)
1/2 (13)	□ ▲	□ ▲	□ ▲	▲	600 (15240)		100 (9.3)
1 (25)	□ ▲	▲ □ ◇	▲ □ ◇	▲	300 (7620)		50 (4.6)
1 1/2 (38)	▲	▲ □	▲ □		180 (4575)		30 (2.8)
2 (50)	▲	▲ □	▲ □		150 (3810)		25 (2.3)

Key: □ = Kaowool, ▲ = Cerablanket, □ = Cerachem, ◇ = Cerachrome

Kaowool and Cerafiber blankets from Augusta are packaged in cartons and stretch-wrapped onto pallets. Some size and density combinations may require a minimum order. Please check with your Thermal Ceramics office for current lead times and availability.

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Blanket products - PCW Grade

Product Name	Denka® Alcen™ Blanket NBK80	Denka® Alcen™ Blanket NBK95
Color	white	
Classification temperature rating, °F (°C)	2912 (1600)	
Chemical Analysis, %, Weight basis after firing		
Alumina, Al ₂ O ₃	80	95
Silica, SiO ₂	20	5
Leachable chlorides	trace	
Thermal Conductivity, BTU•in./hr•ft²•°F (W/m•K), ASTM C 201		
measured density, pcf (kg/m ³)	6 (96)	-
mean temp. @ 500°F (260°C)	0.38 (0.05)	
@ 1000°F (538°C)	0.74 (0.11)	
@ 1500°F (816°C)	1.30 (0.19)	
@ 2000°F (1093°C)	2.07 (0.30)	
@ 2500°F (1371°C)	3.04 (0.44)	
Linear Shrinkage, % after 24 hours		
@ 2500°F (1371°C)	<1	-
@ 2912°F (1600°C)	1.5	

Availability and Packaging

Thickness, in (mm)	Density, pcf (kg/m ³)		Length, in (mm)	Width, in (mm)	ft ² (m ²)/carton
	6 (96)	8 (128)			
1/2 (13)	□	□	283 (7182)	24 (610)	47 (4.3)
1 (25)	□▲	□			
Key: □ = NBK80, ▲ = NBK95					

Denka Alcen Blankets are packaged in cartons and stretch-wrapped onto pallets. Please check with your Thermal Ceramics office for current lead times and availability.

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Blanket - hardware

Features

- Studs and washers available in 304SS, 310SS, 330SS, and Inconel 601 for use up to 1121°C (2050°F)
- Design of Kao-Lok anchor permits quick installation
- Ceramic cone anchor available as closure to increase use temperatures up to 1260°C (2300°F)

Kao-Lok™ Anchors, Washers and Studs are a combination refractory and stainless steel designed to be used with Thermal Ceramics blanket wallpaper furnace linings.

Kao-Lok Studs in lengths of 89mm (3½ in) and longer have five notches which allow adjustment in compressing the blanket when installing the Kao-Lok Washer or the cone anchor. Stud lengths less than 89mm (3½ in) have only two notches.

Kao-Lok Washers are designed so the washer allows for ease of handling. When properly installed, the washer will remain in place on roofs and in severe vibration applications.

Kao-Lok Ceramic Cone Anchors can be used in lengths of 80 and 100mm (3 and 4 in), with or without plug, to service temperatures up to 1260°C (2300°F). The Cone Anchor is made from a 50% Al₂O₃, 47% SiO composition. The void in the cone anchor is normally packed with a Thermal Ceramics or Moldable product. A 100mm (4 in) diameter washer with a 41mm (15/8 in) I.D. hole with a stress relief slot is available for use with the cone anchors to cover a larger surface area to spread the weight and load of the insulation materials.

Kao-Lok Speed Clips are available in the following metals:

- Carbon Steel
- 304SS
- 310SS
- 330SS
- Inconel 601

These 38mm (1½ in) square 26-ga thick interference fit washers are very useful when installing ceramic fibre linings using Kao-Lok Studs.



Board / blanket lining anchor systems



Section 02

Bulk products

Metric information - Page 21
Imperial information - Page 22 - 24

Bulk products

AES bulk

Superwool®

RCF bulk

Cerafiber®

Cerachem®

Cerachrome®

Engineered fibres

Kaowool®

PCW bulk

Alphawool®

Denka®

Maftec®

Thermal Ceramics bulk fibres serves as the foundation for our entire line of fibre products.

Bulk consists of a loose mass of randomly orientated normally long, fluffy cotton wool like fibres collected after fiberisation and not further altered and can be:

- Needled into a blanket
- Converted into paper boards and shapes
- Woven into yarn to produce rope and cloth
- Blended into liquid binders for coatings and cements

Bulk fibres can be engineered by changing length, fibre diameter, shot content and lubricity. They offer unique solutions to many industrial applications such as expansion joint construction and base seals as well as automotive applications in filtration and acoustical insulation. High temperature insulation wool is a material for use in high temperature applications such as the insulating lining of metallurgical ovens and furnaces, petrochemical heaters, and ceramic kilns etc.

In use high temperature insulation wool will:

- Contribute to protecting people and property from excessive heat
- Reduce greenhouse gas emissions
- Reduce energy usage
- Improve efficiency of furnaces and process equipment

Grades available:

Lubricated bulk 2 grades available:

Extra Long. Long lubricated fibre.

- For packing expansion joints and voids
- For infill in the roofs and walls of certain types of kilns
- For seals around penetrations in furnaces, such as burner tubes, site holes etc, areas in refractory constructions

Un-lubricated bulk 4 grades available:

Extra Long. Long. Medium. Short fibre.

- Un-lubricated fibre is used in vacuum forming processes, mastics, moldables sprays and coatings
- Selection of different fibre lengths controls the properties of the final product



Typical applications - for high temperature insulation wool - bulk:

- Raw material for the manufacturing of finished products such as boards, paper, shapes, yarns etc
- Chimney fill
- Fire door infill
- Kiln car infill
- Packing expansion joints (e.g. carbon baking pits)
- Loose insulating fill for complex spaces and difficult access
- Reinforcement for insulating concretes and cements
- Precursor for engineered fibres

Superwool® bulk - grades available:

Superwool® HT fibre : classification 1300°C (2372°F)

Superwool® Plus fibre : classification 1200°C (2192°F)

Benefits:

- Superwool® bulk is virtually immune to thermal shock
- Low heat storage
- High purity and non-corrosive
- Resilient and also resistant to mechanical damage
- No reaction with alumina based bricks in application in the range of typical use temperature
- AES fibres are not classified carcinogenic by IARC or under any national regulations on a global basis. They have no requirement for warning labels under GHS (Globally Harmonised System for the classification and labelling of chemicals). In Europe, Superwool® fibre meets the requirements specified under NOTA Q of European Directive 67/548. All Superwool® fibre products are therefore exonerated from the classification and labelling regulation in Europe.
- Low biopersistence
- Excellent thermal insulating performance
- Based on patented technology

RCF bulk - grades available:

Cerafibre®: classification 1260°C (2300°F)

Cerachem® : classification 1427°C (2600°F)

Cerachrome® : classification 1427°C (2600°F)

Engineered fibres: classification 1100 - 1425°C (2012 - 2597°F)

Kaowool® bulk fibres: classification 1260 - 1425°C (2300 - 2597°F)

Benefits:

- Excellent resistance to chemical attack
- Unaffected by oil, water or steam
- Very low thermal expansion
- Excellent shock and good corrosion resistance
- Low moisture absorption
- Low electrical conductivity
- Constant coefficient of friction
- Refractoriness: the fibres are stable up to elevated temperatures

PCW fibre bulk - grades available:

Alphawool® HA bulk : classification 1600°C (2912°F)

Alphawool® LA bulk : classification 1500°C (2732°F)

Denka® Alcen™ bulk : classification 1600°C (2912°F)

Benefits:

- Not classified as dangerous under EC Directive 67/548/EEC or according to self-classification guidelines
- Defined dimensions
- Chemical and thermal stability @ 1500°C (2732°F) LA / 1600°C (2912°F) HA
- Low linear shrinkage
- Low thermal mass and good insulating properties
- Low content of “shot” measured 45 micron sieve typically < 1%
- Lightweight
- High resilience



Bulk products

	Superwool® HT Bulk	Superwool® Plus Bulk				Alphawool® Bulk
Classification Temperature, °C	1300	1200				1600 (HA) 1500 (LA)
Colour	white	white				white
Specific Gravity, g/cm ³	2.50	2.65				3.20
Beaker Value (fibre length), ml						
Unchopped	650	-				-
Coarse chopped	200	-				-
Fine chopped	130	-				-
Fibre Diameter, *mean, micron	-	-				-
Specific Heat Capacity, kJ/kg·K						
@ 540°C	-	-				-
@ 1090°C	1.22	-				-
Thermal Conductivity, W/m·k ASTM C-201		64 kg/m ³	96 kg/m ³	128 kg/m ³	160 kg/m ³	
200°C	-	0.06	0.05	0.04	0.05	-
400°C	-	0.10	0.09	0.08	0.08	-
600°C	-	0.17	0.14	0.12	0.11	-
800°C	-	0.26	0.21	0.18	0.16	-
1000°C	-	0.38	0.29	0.25	0.22	-
Chemical Composition, %						
SiO ₂ (*on calcine product)	70-80	62 - 68				3 - 4
Al ₂ O ₃	-	-				96 - 97
CaO + MgO	18-25	26 - 32				-
MgO	-	3 - 7				-
Others	<3	<1				<1

	Cerafibre®	Cerachem®	Cera-chrome®	Engineered Fibres				Kaowool® Bulk Fibre	
				SF	SH	HP	Z	Standard	Zirconia
Classification Temperature, °C	1260	1425	1425	1100	1250	1260	1425	1260	1425
Colour	white	white	blue/green	white to light grey	white	white			
Specific Gravity, g/cm ³	2.65	2.65	2.65	2.5	2.6	2.56	2.65	2.56	2.65
Beaker Value (fibre length), ml	-	-	-	50-650	50-650	50-650	50-650	-	-
Bulk unchopped	-	-	-	-	-	-	-	450	450
Coarse chopped	-	-	-	200	200	200	200	200	200
Medium chopped	-	-	-	150	150	150	150	150	-
Fine chopped	-	-	-	80	80	80	80	80	-
Fibre Index	-	-	-	55-98	55-98	55-98	55-98	-	-
Fibre Diameter, *mean, micron	3.5	3.5	3.5	3.0	3.0	*2.0-3.5	*3.0-3.5	2.3	2.5
Hardness, MOH °C	-	-	-	6	6	6	6	-	-
Tensile Strength, MPa	-	-	-	-	-	1400	1400	-	-
Specific Heat Capacity, kJ/kg·K	-	-	-	1.0	1.0	1.07	1.07	-	-
@ 540°C	1.05	1.05	1.05	-	-	-	-	1.07	1.07
@ 980°C	-	-	-	-	-	-	-	1.07	1.07
@ 1090°C	1.13	1.13	1.13	-	-	-	-	1.13	1.13
Melting Point °C	-	-	-	1500	1500	>1650	>1650	>1650	>1650
Chemical Composition, %									
SiO ₂ (*on calcine product)	56.0	50.0	54.3	65.0	<69.0	53.0	50.0	53.0	50.0
Al ₂ O ₃	44.0	34.9	42.6	trace	trace	47	36	47	36
CaO + MgO	0.5	0.09	0.10	-	-	-	-	<0.08	0.10
Cr ₂ O ₃	-	-	2.8	-	-	-	-	-	-
ZrO ₂	-	15.2	-	-	<10	-	14	-	14
Fe ₂ O ₃	0.15	0.15	0.15	trace	trace	<0.1	<0.06	42.6	<0.08
Na ₂ O + K ₂ O	0.10	0.10	0.10	-	-	-	-	0.4	0.10
TiO ₂	-	-	-	-	-	<0.05	0.25	-	-
Alkali/Alkali Earth	-	-	-	35.0	27-35	<0.25	<0.25	-	-
Leachable Chloride	-	-	-	-	-	-	-	<20	<20
B ₂ O ₃	-	-	-	-	-	-	-	<0.02	<0.02

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Bulk products - Superwool® AES Grades

Product Name	Superwool® Plus	Superwool® HT
Color	white	
Continuous temperature use limit, °F (°C)	1832 (1000)	2102 (1150)
Classification temperature rating, °F (°C)	2192 (1200)	2372 (1300)
Specific Heat, BTU/lb•°F @ 1800°F (kJ/kg•°C @ 982°C)	0.26	
Chemical Analysis, %, Weight basis after firing		
Silica, SiO ₂	62 - 68	70 - 80
Calcium Oxide + Magnesium Oxide, CaO + MgO	29 - 39	18 - 25
Other	< 1	< 3
Leachable Chlorides	trace	-

Availability and Packaging

Brand	Grade	Typical Fibre Index, %	Fibre Length, in (mm)	Lubrication
Superwool Plus Superwool HT	111	45 - 70	up to 10	Yes
	112			
	HM-12	50 - 70	1/2	No
	HM-25		1	
	HM-50		2	
Engineered Fibres	Various	60 - 90	Various	

Thermal Ceramics bulk fibres packaged out of Augusta are in either cartons or bags and stretch-wrapped onto pallets. Standard packaging on lubricated bulk fibres is 25lb (11kg) cartons. Standard packaging on un-lubricated bulk fibres is 40 or 50lb (18 or 23kg) bags. Please check with your Thermal Ceramics office for current lead times and availability.

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Bulk products - RCF Grades

Product Name	Kaowool®	Kaowool HP	Cerafiber®	Cerachem®	Cerachrome®
Color	off white	white			blue/green
Continuous temperature use limit, °F (°C)	2000 (1093)	2150 (1177)		2400 (1316)	2500 (1371)
Classification temperature rating, °F (°C)	2300 (1260)	2400 (1316)		2600 (1427)	
Specific Heat, BTU/lb•°F @ 1800°F (kJ/kg•°C @ 982°C)	0.26 (1.08)				
Chemical Analysis, %, Weight basis after firing					
Alumina, Al ₂ O ₃	45	46		35	43
Silica, SiO ₂	50 - 55	54		50	54
Zirconia, ZrO ₂	-	-		15	-
Ferric oxide, Fe ₂ O ₃	1.0				
Titanium oxide, TiO ₂	2.2				
Alkalies as Na ₂ O	0.2				
Other	-	trace			3
Leachable Chlorides	1 - 2				trace

Availability and Packaging

Brand	Grade	Typical Fibre Index, %	Fibre Length, in (mm)	Lubrication
Kaowool	BN	45 - 55	4 (100)	No
	D			Yes
	A			No
	HM-12	1/2 (13)		
	HM-25	1 (25)		
	HM-50	2 (50)		
Kaowool HP	HY	45 55	1/2 (13)	Yes
	HA		4 (100)	
	A			
Cerafiber Cerachem Cerachrome	111	50	up to 10 (up to 250)	No
	112			
	HM-12		1/2 (13)	
	HM-25		1 (25)	
HM-50	2 (50)			
Engineered Fibres	Various	60-90	Various	

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Bulk products - PCW Grade

Product Name	Denka® Alcen™ B97T4	
Color	white	
Classification temperature rating, °F (°C)	2912 (1600)	
Melting temperature, °F (°C)	3632 (2000)	
Fibre diameter, µm	3 - 5	
Chemical Analysis, %, Weight basis after firing		
	Alumina, Al ₂ O ₃	97
	Silica, SiO ₂	3
	Other	<0.5
Mineral Composition (B97T4), %		
	alpha-Alumina, Al ₂ O ₃	40 - 49
	Mullite	≤10

Availability and Packaging

Brand	Grade	Typical Fibre Index, %	Fibre Length, in (mm)	Lubrication
Denka Alcen	B97T4	<99.5	4 - 6 (102 - 152)	No

Thermal Ceramics Denka Alcen bulk fibres packaged out of Augusta are in cartons and stretch-wrapped onto pallets. Standard packaging is 22lb (10kg) cartons. Please check with your Thermal Ceramics office for current lead times and availability.

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Section 03

Modules, Log and Bloc products

Metric information - Page 27 - 29
Imperial information - Page 35 - 40

Modules, Log and Bloc products

Pyro-Bloc modules

- Pyro-Bloc® Y and Y²
- Pyro-Bloc® M and M²
- Pyro-Bloc® Corner Bloc
- Pyro-Bloc® Burner Bloc
- Pyro-Bloc® HS
- Thermo-Bloc™

Blanket folded and stacked modules

- Pyro-Fold
- Pyro-Stack™
- Z-Blok™ I and 3
- Unibloc

Veneering modules

Pyro-Log and Pyro-Packing

Hardware internal attachment and Coating systems

- Y hardware
- M hardware
- T-Bar hardware
- Unikote™ Coatings
- K-Bond™ coating

For more than 50 years, the Thermal Ceramics Pyro-Bloc modules have been the industry standard for furnace and boiler linings. The Pyro-Bloc module is a versatile choice for many applications.

In the Petrochemical and Power Generation markets Pyro-Bloc modules are thermal insulation solutions in radiant heater sections and HRSG ductwork and auxiliary burners and in the Ceramics and Glass markets Pyro-Bloc modules are located in the kiln lining and base for kiln cars. This installation and design manual will cover the Pyro-Bloc modules, the hardware options, recommended installation instructions and typical lining and design details that are common across many industrial applications in markets from Petrochemical to Iron & Steel to Aluminium. Thermal Ceramics exclusive Pyro-Bloc® products have set the standard for quality and versatility in furnace and boiler lining systems. Modules are manufactured from Pyro-Log™, a monolithic ceramic fibre that is fabricated into modules that offer superior performance and durability.

Modules

A unique solution to high temperature insulation needs in industrial heaters, boilers and furnaces as well as many other applications.

Logs

An uncompressed monolithic mass of fibre. Pyro-Log™ fibre is the basic building block for all Pyro-Bloc® applications. All Pyro-Log™ fibre is produced with a special lubricant that allows the fibre to be intensely needled to attain varying densities. At moderate temperatures this lubricant burns out and the fibre becomes rigid enough to stand on.

Blocs

Made from high temperature fibres, mineral fibres and a small amount of organic binder. Due to the high fibre content, Bloc sheets are strong, lightweight and thermal shock resistant.

Module types versus material

	Pyro-Log	Pyro-Bloc Y	Pyro-Bloc M	Pyro-Bloc T	Pyro-Stack Y	Pyro-Stack M	Pyro-Stack T	Z-Blok I	Z-Blok 3
Superwool® Plus	•	•	•	•	•	•	•	-	-
Superwool HT	•	•	•	•	•	•	•	-	-
RCF I260 (Standard)	•	•	•	•	•	•	•	•	•
RCF I430 (Zirconia)	•	•	•	•	•	•	•	•	•
Maftec®, Alphawool®, Denka®	-	-	-	-	-	•	•	-	-

Typical applications - for high temperature insulation wool - Modules, Log and Bloc:

- **Ceramic and glass** : kiln lining, low mass kiln cars, furnace doors
- **Refining** : distillation heater lining
- **Heat treatment / metal working** : linings
- **Non ferrous** : annealing furnace, heat treating furnace
- **Power generation/boilers** : cogeneration ducts and silencers
- **Iron and steel** : walking beam furnace skid rail insulation, re-heat, strip-annealing, rotary hearth and roller hearth furnaces, carbonizing and lift-off furnaces
- **Petrochemical** : process heaters, reformers, ductwork pyrolysis heaters

Superwool[®], RCF and PCW Modules, Log and Bloc:

Pyro-Bloc[®]

Modules comprise two sections of Superwool[®] fibre slabs in edge-grain orientation which are held in position with two stainless steel tubes mounted transversely through the modules and remote from the hot face. They are anchored to the furnace casing with the patented Pyro-Bloc[®] hardware in any one of four standard versions, Y, M, T and Eye-bolt.

Lightweight with low heat storage providing a durable service with all the advantages of our standard ceramic fibre blanket products in a pre-compressed modular form and offer non-exposed anchoring, economical installation and a positive mechanical attachment.

Pyro-Log[™]:

High density needled monolithic slabs are the only 152mm (6 in) thick needled mass of fibre available in standard uncompressed densities up to 240kg/m³ (15 pcf).

Vertically-fibreised Pyro-Log[™] fibre is of exceptional uniformity of dimensions and of naturally low shot content.

Z-Blok[™] 1 and 3:

Convolute blanket modules made from spun-fibre blanket, folded and pre-compressed to a specified density, and held in position with the T-Bar anchoring system - 2 stainless steel tubes mounted transversely within the module.

Folded modules available in two design configurations; Z-Blok[™] 1 has a slide channel that runs perpendicular to the folds, it slides onto a disc or clip that has been attached to the steel casing. Z-Blok[™] 3 has a C-Channel that runs parallel to the module folds and is typically attached to the steel casing with a welded stud and nut.

Thermo-Bloc[®]: manufactured from two sections of Pyro-Log[™] slabs in edgegrain orientation, installed with a pre-studded, external, side-fixed yoke. The Pyro-Log[™] slabs can be held in position by two additional stainless steel tubes mounted transversely through the modules and remote from the hot face. The side fixed yokes fit in these tubes.

Manufactured from two sections of Pyro-Log[™] slabs in edge grain orientation they are installed with a pre-studded, external, side-fixed yoke. They can be held in position by two additional stainless steel tubes mounted transversely through



the modules and remote from the hot face.

Pyro-Stack[™]:

High quality spun-fibre blanket, compressed and banded with plastic strips, including two stainless steel tubes mounted transversely through the strips remote from the hot face. They can be anchored to the furnace casing in any one of four standard versions, Y, M, T and Eye-bolt.

Unifelt[®]:

Vacuum-Formed from controlled mixtures of Superwool[®] and Kaowool[®] fibres, the ratio of the fibres are adjusted to produce the different temperature grades. Edge-stacked strips of Unifelt sheet, bonded under pressure, with a semi-elastic organic binder.

Benefits:

- High un-compressed densities give low thermal conductivity and a more uniform and faster installation
- Lubricated fibre allows uniform compression and tight joints
- AES fibres are not classified carcinogenic by IARC or under any national regulations on a global basis. They have no requirement for warning labels under GHS (Globally Harmonised System for the classification and labelling of chemicals). In Europe, Superwool[®] fibre meets the requirements specified under NOTA Q of European Directive 67/548. All Superwool[®] fibre products are therefore exonerated from the classification and labelling regulation in Europe.
- Anchorage remote from the hot face protects steel work
- Fast one step installation
- All welds automatically torque tested
- Hardening effect on first firing gives a tough hot face
- Resistant to mechanical damage and gas flow abrasion

Modules, Log and Bloc products

	Superwool HT Z-Blok® Modules	Superwool® Plus Pyro-Bloc® Modules		Superwool® HT Pyro-Bloc® Modules			Superwool® Plus Pyro-Log®		Superwool® HT Pyro-Log®			Superwool® Plus Pyro Board
Classification Temperature, °C	1300	1200		1300			1200		1300			1200
Colour	White	White		White			White		White			White
Density, kg/m ³ (*uncompressed)	160	*160	*192	*160	*192	*240	160	192	160	192	240	192
Specific Heat Capacity, kJ/kg·K												
@ 1090°C	1.22	1.05		1.22			-		1.22			1.05
Loss of Ignition after 2 hours @ 800°C	-	<0-25		<0-25			<0-25		<0-25			-
Perm. Lin. Shrinkage, %, ENV (1094-1)												
after 2 hours heating @ 600°C	-	-		-			-		-			0.15
after 2 hours heating @ 800°C	-	-		-			-		-			0.35
@ 1000°C	-	<1.5		0.2			<1.5		0.2			-
@ 1100°C	-	-		0.5			-		0.5			-
@ 1200°C	-	-		0.8			-		0.8			-
Thermal Conductivity, W/m·K ASTM C-201												
Mean Temperature @ 200°C	-	-	-	0.07	0.07	0.07	-	-	0.07	0.07	0.07	0.06
@ 400°C	0.06	0.11	0.09	0.14	0.12	0.10	0.11	0.09	0.14	0.12	0.10	0.09
@ 600°C	0.12	0.17	0.15	0.21	0.17	0.15	0.17	0.15	0.21	0.17	0.15	0.13
@ 800°C	0.22	0.24	0.21	0.30	0.25	0.22	0.24	0.21	0.30	0.25	0.22	0.18
@ 1000°C	0.36	0.32	0.28	0.40	0.33	0.29	0.32	0.28	0.40	0.33	0.29	-
@ 1200°C	0.56	-	-	0.54	0.44	0.39	-	-	0.54	0.44	0.39	-
Chemical Composition, %												
SiO ₂	-	-		-			62-68		70-80			-
Al ₂ O ₃	-	-		-			-		-			-
CaO+MgO	-	-		-			CaO 26-32 MgO 3-7		18-25			-
Na ₂ O+K ₂ O	-	-		-			-		-			-
Others	-	-		-			<1		<3			-
Module Systems	-	Special Shapes, Y Modules, M and T, Eyebolt Modules		Special Shapes, Y Modules, M and T, Eyebolt Modules			-		-			-

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Modules, Log and Bloc products

	Pyro-Bloc® Modules						Pyro-Log						Z-Blok I Modules			Z-Blok 3 Modules		
	Standard Fibre			Zirconia Fibre			Standard Fibre, R Grade			Zirconia Fibre, H Grade			Kaowool S Cera-blanket®	Kaowool SZr Cera-chem®	Cera-chrome®	Kaowool S Cera-blanket	Kaowool SZr Cera-chem	Cera-chrome
Classification Temperature, °C	1260			1425			-			-			Kaowool S Cera-blanket®	Kaowool SZr Cera-chem®	Cera-chrome®	Kaowool S Cera-blanket	Kaowool SZr Cera-chem	Cera-chrome
Maximum Continuous Use Temperature, °C	-			-			1260			1425			1260	1425	1425	1260	1425	1425
Colour	White			White			White			White			White	White	Blue/Green	White	White	Blue/Green
Density, kg/m ³ (*uncompressed)	*160	*192	*240	*160	*192	*240	*160	*192	*240	*160	*192	*240	160	160	160	128/160	128/160	128/160
Specific Heat Capacity, kJ/kg•K																		
@ 540°C	-			-			-			-			-	-	-	-	-	-
@ 1000°C	-			1.13			-			-			-	-	-	-	-	-
@ 1080°C	-			-			1.13			-			-	-	-	-	-	-
@ 1090°C	-			-			-			-			1.13	1.13	1.13	1.3	1.3	1.3
Loss of Ignition after 2 hours @ 800°C	-			<0-25			<0-25			<0-25			-	-	-	-	-	-
Permanent Linear Shrinkage, %, ENV (1094-7)																		
@ 1000°C	-			-			1.6			0.6			-	-	-	-	-	-
@ 1100°C	-			-			2.3			1.0			-	-	-	-	-	-
@ 1200°C	3			1.6			3			1.6			-	-	-	-	-	-
@ 1300°C	-			-			-			3.2			-	-	-	-	-	-
@ 1400°C	-			3.0			-			3.0			-	-	-	-	-	-
Thermal Conductivity, W/m•K							Blanket - Laid			Edge - Grain			160 kg/m ³	160 kg/m ³	160 kg/m ³	128 kg/m ³	160 kg/m ³	
Mean Temperature @ 400°C	0.11	0.10	0.09	0.11	0.10	0.09	0.08	0.08	0.07	0.11	0.10	0.09	0.11	0.11	0.11	0.12	0.11	
@ 600°C	0.18	0.16	0.14	0.18	0.16	0.14	0.12	0.11	0.10	0.18	0.16	0.14	0.16	0.16	0.16	0.19	0.16	
@ 800°C	0.25	0.23	0.20	0.25	0.23	0.20	0.17	0.15	0.13	0.25	0.23	0.20	0.23	0.23	0.23	0.27	0.23	
@ 1000°C	0.34	0.31	0.28	0.34	0.31	0.28	0.22	0.19	0.17	0.34	0.31	0.28	0.31	0.31	0.31	0.36	0.31	

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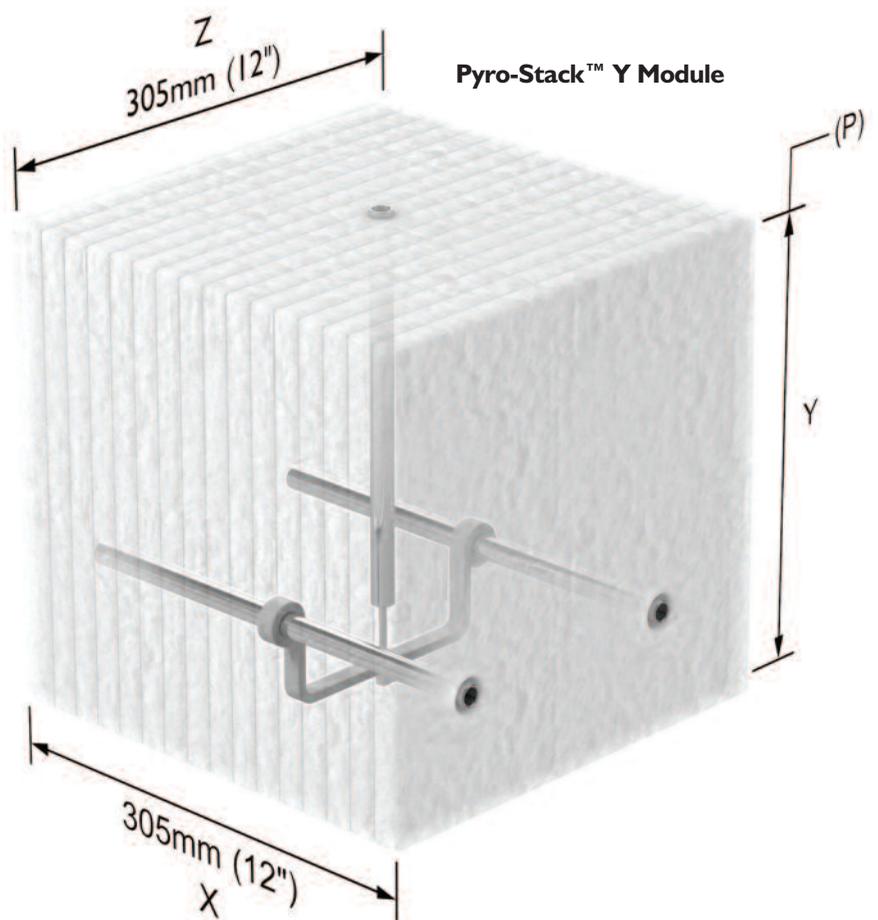
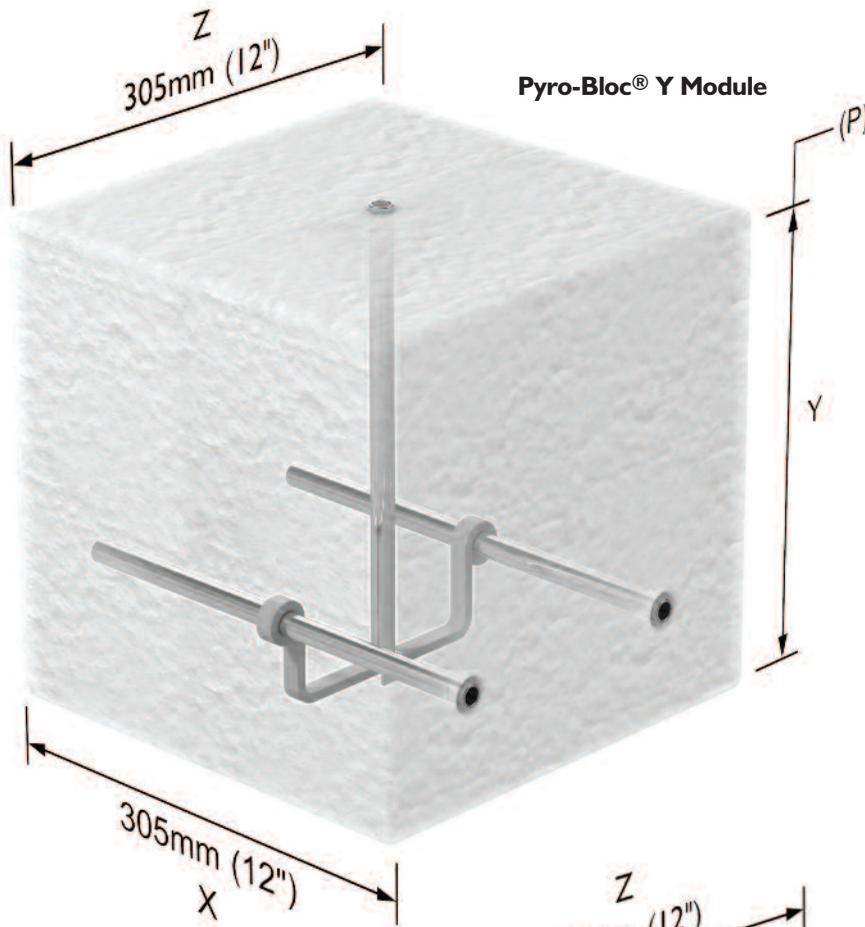
Modules, Log and Bloc products

	Pyro-Stack® Modules						Unifelt® Modules					Thermo-Bloc® Modules		
	Kaowool® S Cerablanket®		Kaowool SZ Cerachem®		Maftec® Blanket		U 13	U 14	U 15	U 16	U 17	RCF	Super-wool® Plus	
Classification Temperature, °C	-	-	-	-	-	-	1260	1425	1500	1600	1700	1260	1100	
Maximum Continuous Use Temperature, °C	1260	1260	1425	1425	1600	1600	-	-	-	-	-	-	-	
Colour	White						White					White		
Density, kg/m ³ (*uncompressed)	128	160	128	160	*128	140	140	125	120	110	100	*160-192	*160-192	
Modules of Rupture MPa	-	-	-	-	-	-	-	-	-	-	-	-	-	
Specific Heat Capacity, kJ/kg*K														
@ 1000°C	-	-	-	-	-	-	-	-	-	-	-	1.13	-	
@ 1090°C	1.13	1.13	1.13	1.13	1.25	1.13	1.13	1.13	1.17	1.20	1.25	-	-	
Loss of Ignition after 2 hours @ 800°C	-						-	-	-	-	-	<0.25		
Permanent Linear Shrinkage, %, ENV (1094-1)														
@ 1100°C	-						-	-	-	-	-	-	<1.5	
@ 1200°C	-						2	-	-	-	-	3.0	-	
@ 1300°C	-						-	2	-	-	-	-	-	
@ 1400°C	-						-	-	2	-	-	-	-	
@ 1500°C	-						-	-	-	2	-	-	-	
@ 1600°C	-						-	-	-	-	2	-	-	
Thermal Conductivity, W/m*K ASTM C-201, kg/m ³	128	160		128	160	-	-	-	-	-	160	192	160	192
Mean Temperature @ 200°C	-	-		-	-	-	-	-	-	-	-	-	-	-
@ 300°C	-	-		-	-	-	-	-	-	-	-	-	-	-
@ 400°C	0.12	0.11		0.08	0.09	-	-	-	-	-	0.11	0.10	0.12	0.11
@ 500°C	-	-		-	-	-	-	-	-	-	-	-	-	-
@ 600°C	0.19	0.18		0.15	0.14	0.15	0.15	0.14	0.14	0.14	0.18	0.16	0.19	0.17
@ 800°C	0.28	0.25		0.23	0.22	0.22	0.21	0.20	0.19	0.19	0.25	0.23	0.27	0.24
@ 1000°C	0.38	0.34		0.32	0.31	0.29	0.30	0.28	0.27	0.25	0.34	0.31	0.37	0.32
@ 1200°C	-	-		-	-	-	0.39	0.39	0.38	0.35	-	-	-	-
@ 1400°C	-	-		-	-	-	-	0.51	0.50	0.48	-	-	-	-

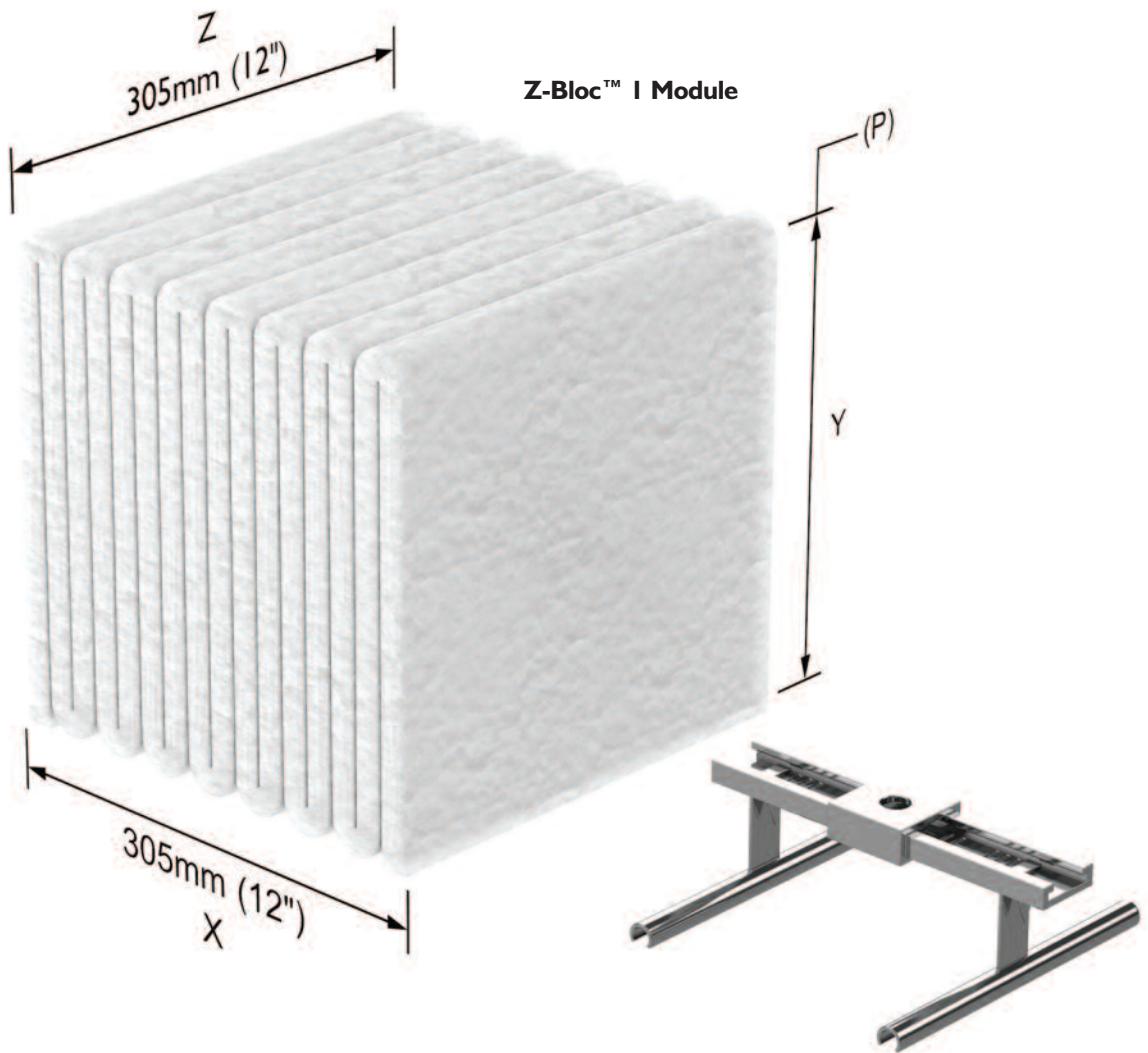
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Types of Modules and internal hardware & attachment systems

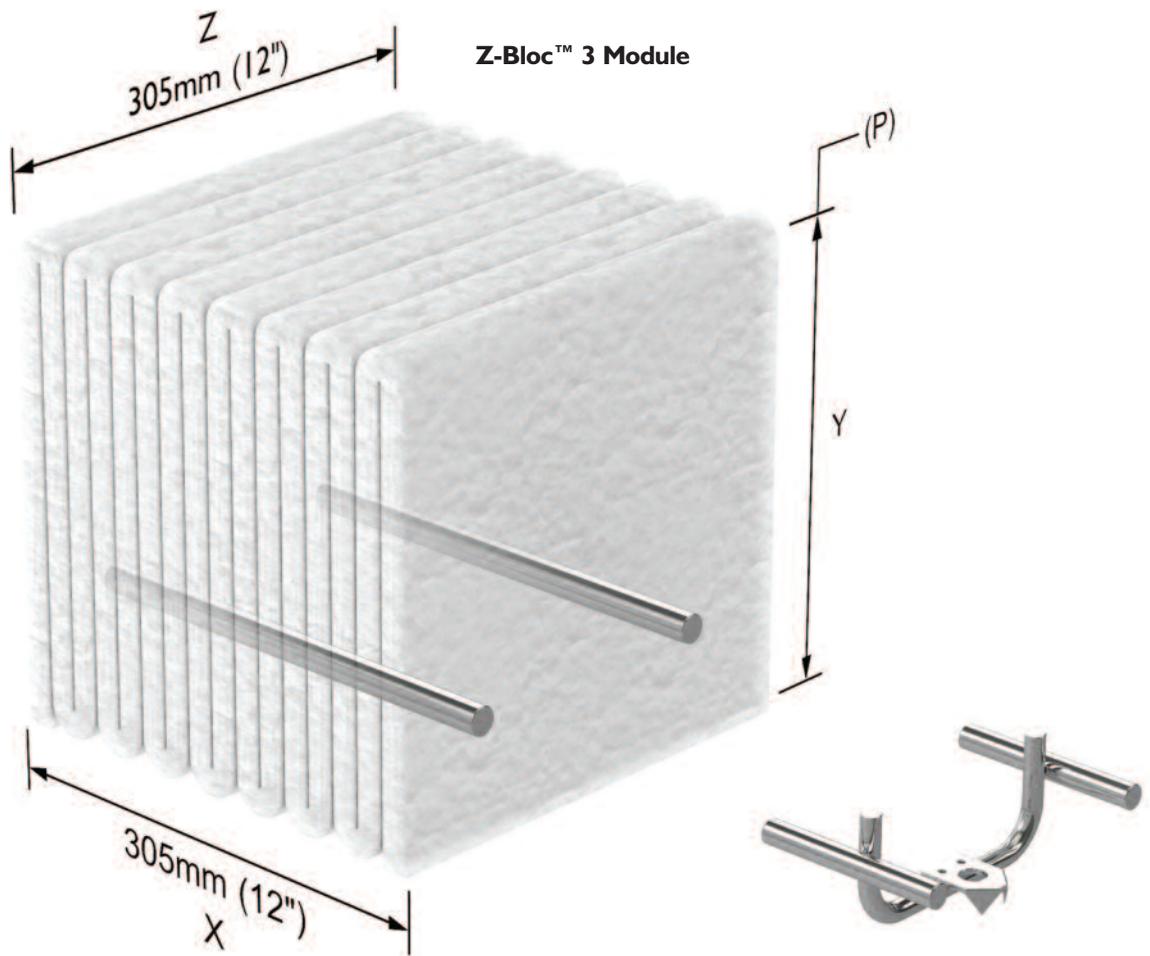


Note: Internal hardware shown are Thermal Ceramics standards

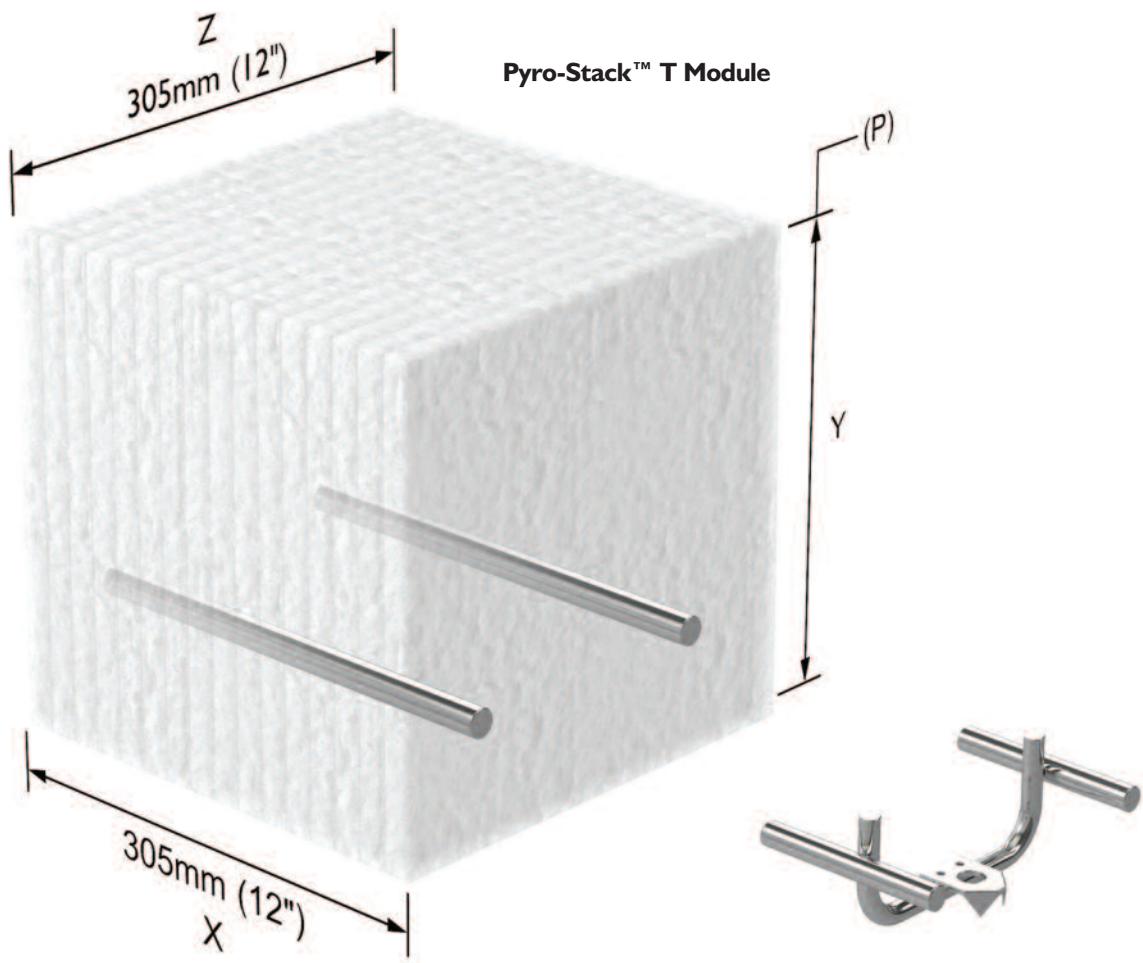


Note: Hardware shown are Thermal Ceramics standards

Types of Modules and internal hardware & attachment systems

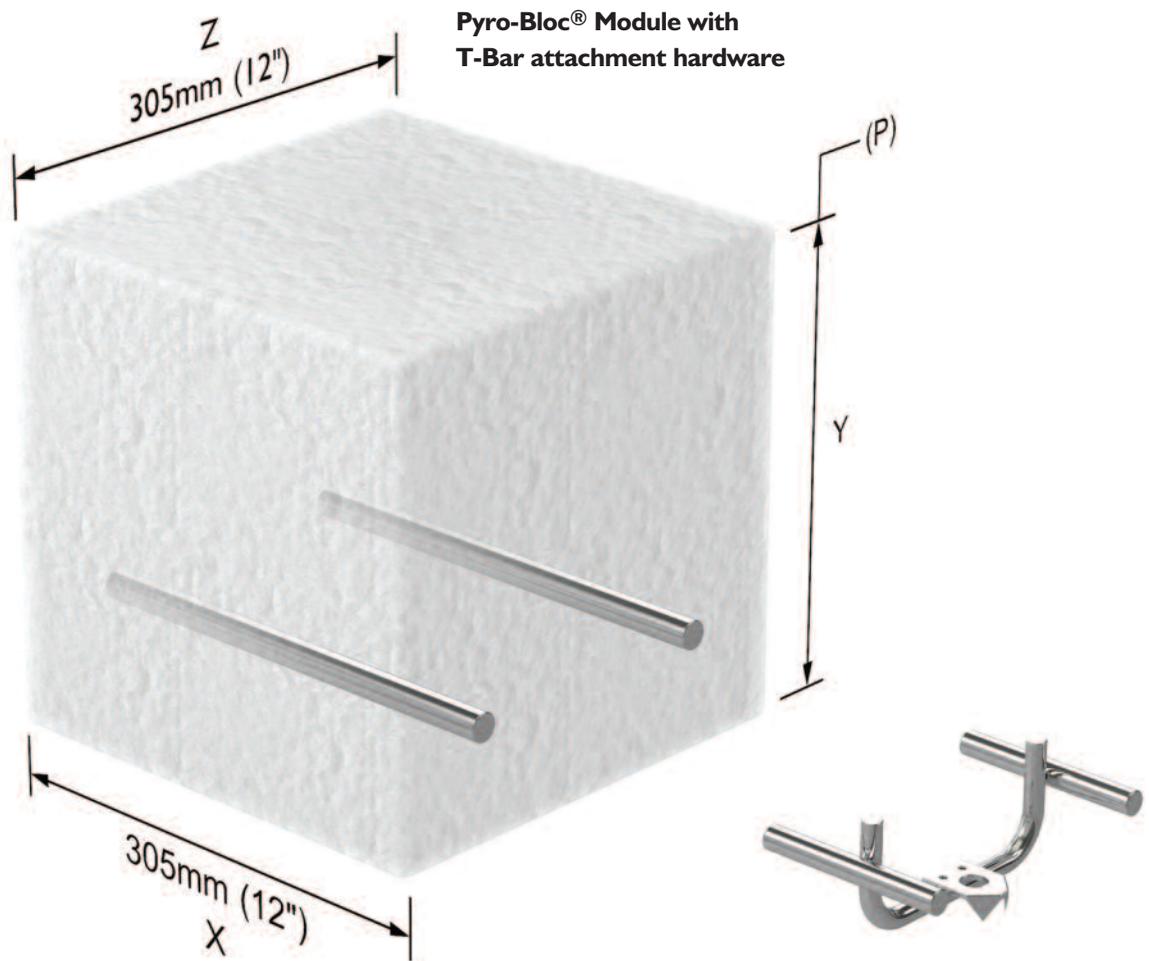


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Note: Hardware shown are Thermal Ceramics standards

Types of Modules and internal hardware & attachment systems



Note: Hardware shown are Thermal Ceramics standards

Modules - Pyro-Bloc® Superwool® AES grades

Product Name	Pyro-Bloc Y, Y ² , M, M ²	
	Superwool® Plus	Superwool® HT
Color	white	
Density, pcf (kg/m ³)	10, 12 (160, 192)	
Thickness, in 1 inch (25 mm) increments	4 - 12 (102 - 305)	
Continuous temperature use limit, °F (°C)	1832 (1000)	2200 (1204)
Classification temperature rating, °F (°C)	2192 (1200)	2300 (1260)
Chemical Analysis, %, Weight basis after firing		
Alumina, Al ₂ O ₃	trace	
Silica, SiO ₂	62 - 68	70 - 80
Calcium Oxide + Magnesium Oxide, CaO+MgO	29 - 39	18 - 25
Other	<3	
Thermal Conductivity, BTU • in./hr • ft ² • °F (W/m • K), ASTM C 201		
measured density, pcf (kg/m ³)	10 (160)	10 (160)
mean temperature, @ 500°F (260°C)	0.48 (0.07)	0.51 (0.07)
@ 1000°F (538°C)	0.84 (0.12)	1.29 (0.19)
@ 1800°F (982°C)	1.55 (0.22)	3.02 (0.44)
@ 2100°F (1149°C)	Beyond continuous use limit	3.89 (0.56)

Availability and Packaging

Please review details for packaging and other availability specifications in the Price Book, Modules and Log section.

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Blanket Modules - folded and stacked Superwool® AES grades

Product Name	Pyro-Fold™, Pyro-Stack™, Unibloc®, Z-Blok®	
	Superwool® Plus	Superwool® HT
Color	white	
Density, pcf (kg/m ³)	8, 9.3, 10.7 (128, 149, 171)	
Thickness, in I inch (25 mm) increments	4 - 12 (102 - 305)	
Continuous temperature use limit, °F (°C)	1832 (1000)	2200 (1204)
Classification temperature rating, °F (°C)	2192 (1200)	2300 (1260)
Chemical Analysis, %, Weight basis after firing		
Silica, SiO ₂	62 - 68	70 - 80
Calcium Oxide + Magnesium Oxide, CaO + MgO	29 - 39	18 - 25
Other	<1	<3
Thermal Conductivity, BTU•in./hr•ft ² •°F (W/m•K), ASTM C 201		
measured density, pcf (kg/m ³)	8 (128)	8 (128)
mean temperature, @ 500°F (260°C)	0.40 (0.06)	0.46 (0.07)
@ 1000°F (538°C)	0.75 (0.11)	0.98 (0.15)
@ 1500°F (816°C)	1.50 (0.23)	2.01 (0.30)
@ 2000°F (1093°C)	Beyond continuous use limit	3.28 (0.49)

Availability and Packaging

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Modules - Pyro-Bloc® RCF grades

Product Name	Pyro-Bloc Y, Y ² , M, M ²			Pyro-Log™			Pyro-Bloc HS
	R Grade	ZR Grade	C Grade	R Grade	ZR Grade	C Grade	HS Grade
Color	white		blue / green	white		blue / green	pale green / white
Density, pcf (kg/m ³)	8*, 10, 12, 15 (128, 160, 192, 240)	10, 12, 15 (160, 192, 240)	12 (192)	8, 10, 12, 15 (128, 160, 192, 240)	10, 12, 15 (160, 192, 240)	12 (192)	23 (368), fired 30 (481) unfired
Thickness, in I inch (25 mm) increments	3 - 12 (76 - 305)			6, 8 (152, 203)		6 (152)	3 - 12 (76 - 305)
Continuous temperature use limit, °F (°C)	2200 (1204)	2450 (1343)	2500 (1371)	2200 (1204)	2450 (1343)	2500 (1371)	2000 (1093)
Classification temperature rating, °F (°C)	2400 (1316)	2600 (1427)		2400 (1316)	2600 (1427)		2200 (1204)
Melting point, °F (°C)	3200 (1760)						-
Chemical Analysis, % Weight basis after firing							
Alumina, Al ₂ O ₃	47	37.5	43	47	37.5	43	-
Silica, SiO ₂	53	47	54	53	47	54	
Zirconia, ZrO ₂	-	15.5	-	-	15.5	-	
Chromium oxide, Cr ₂ O ₃	-	-	3	-	-	3	
Loss on ignition, L.O.I.	trace			-	-	-	
Other	trace						
Thermal Conductivity, BTU•in./hr•ft²•°F (W/m•K), ASTM C 201							
measured density, pcf (kg/m ³)	10 (160)	15 (240)	12 (192)	10 (160)	15 (240)	12 (192)	23 (368)
mean temperature, @ 500°F (260°C)	0.52 (0.07)	0.49 (0.07)	0.50 (0.07)	0.52 (0.07)	0.49 (0.07)	0.50 (0.07)	0.58 (0.08)
@ 1000°F (538°C)	1.04 (0.15)	0.84 (0.12)	0.96 (0.14)	1.04 (0.15)	0.84 (0.12)	0.96 (0.14)	0.98 (0.14)
@ 1500°F (816°C)	1.81 (0.26)	1.43 (0.21)	1.66 (0.24)	1.81 (0.26)	1.43 (0.21)	1.66 (0.24)	1.57 (0.23)
@ 2000°F (1093°C)	2.69 (0.39)	2.19 (0.32)	2.45 (0.35)	2.69 (0.39)	2.19 (0.32)	2.45 (0.35)	2.24 (0.32)

* 8 pcf (128 kg/m³) R Grade are available in only Pyro-Bloc Y modules.

Availability and Packaging

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Blanket Modules - folded and stacked RCF grades

Product Name	Pyro-Fold™, Pyro-Stack™, Z-Blok®, Unibloc®		
	Cerablanket® HP	Cerachem® ZR	Cerachrome® CR
Color	white		blue / green
Density, pcf (kg/m ³)	8, 9.3, 10.7 (128, 149, 171)		9.3, 10.7 (149, 171)
Thickness, in 1 inch (25 mm) increments	4 - 12 (102 - 305)		
Continuous temperature use limit, °F (°C)	2200 (1204)	2450 (1343)	2500 (1371)
Classification temperature rating, °F (°C)	2400 (1316)	2600 (1427)	
Chemical Analysis, %, Weight basis after firing			
Alumina, Al ₂ O ₃	46	35	43
Silica, SiO ₂	54	50	54
Zirconia, ZrO ₂	-	15	-
Chromium oxide, Cr ₂ O ₃		-	3
Other	trace		
Thermal Conductivity, BTU•in./hr•ft ² •°F (W/m•K), ASTM C 201			
measured density, pcf (kg/m ³)	9.3 (149)		
mean temperature, @ 500°F (260°C)	0.52 (0.07)		
@ 1000°F (538°C)	1.00 (0.14)		
@ 1500°F (816°C)	1.66 (0.24)		
@ 2000°F (1093°C)	2.45 (0.35)		

Veneering modules - RCF grades

Product Name	Kaowool®			Pyro-Bloc®			Unifelt®	
	HP Grade	ZR Grade	C Grade	R Grade	ZR Grade	C Grade	3000 (HT)	XT
Color	white		blue / green	white		blue / green	pink	orange
Density, pcf (kg/m ³)	8, 10 (128, 160)			8, 10, 12 (128, 160, 192)	10, 12 (160, 192)	12 (192)	7 (112)	9 (144)
Continuous temperature use limit, °F (°C)	2150 (1177)	2400 (1316)	2450 (1343)	2150 (1177)	2400 (1316)	2500 (1371)	2800 (1538)	2900 (1593)
Classification temperature rating, °F (°C)	2400 (1316)	2600 (1427)		2400 (1316)	2600 (1427)		3000 (1649)	3100 (1704)
Chemical Analysis, %, Weight basis after firing								
Alumina, Al ₂ O ₃	46	35	43	47	37.5	43	72	87
Silica, SiO ₂	54	50	54	53	47	54	28	13
Zirconia, ZrO ₂	-	15	-	-	15.5	-	-	-
Chromium oxide, Cr ₂ O ₃		-	3		-	3		
Loss on ignition, L.O.I.	-	-	-	trace		-	5	5
Other	trace							
Thermal Conductivity, BTU•in./hr•ft ² •°F (W/m•K), ASTM C 201								
measured density, pcf (kg/m ³)	8 (128)	10 (160)		10 (160)	12 (192)		7 (112)	9 (144)
mean temperature, @ 500°F (260°C)	0.57 (0.08)	0.55 (0.08)		0.52 (0.07)	0.50 (0.07)		0.86 (0.12)	0.87 (0.13)
@ 1000°F (538°C)	1.14 (0.16)	0.99 (0.14)		1.04 (0.15)	0.96 (0.14)		1.06 (0.15)	1.01 (0.15)
@ 1500°F (816°C)	1.93 (0.28)	1.66 (0.24)		1.81 (0.26)	1.66 (0.24)		1.45 (0.21)	1.31 (0.19)

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Blanket Modules - stacked PCW grades

Product Name	Pyro-Stack™
	Denka® Alcen™
Color	white
Density, pcf (kg/m ³)	8, 9.3 (128, 149)
Thickness, in I inch (25 mm) increments	4 - 12 (102 - 305)
Continuous temperature use limit, °F (°C)	2912 (1600)
Classification temperature rating, °F (°C)	
Chemical Analysis, %, Weight basis after firing	
Alumina, Al ₂ O ₃	80
Silica, SiO ₂	20
Other	trace
Thermal Conductivity, BTU • in./hr • ft ² • °F (W/m • K), ASTM C 201	
measured density, pcf (kg/m ³)	9.3 (149)
mean temperature, @ 500°F (260°C)	0.74 (0.11)
@ 1000°F (538°C)	1.31 (0.19)
@ 1500°F (816°C)	2.36 (0.34)
@ 2000°F (1093°C)	3.66 (0.53)
@ 2500°F (1371°C)	5.05 (0.73)
@ 2700°F (1482°C)	5.61 (0.81)

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Veneering Modules - PCW grades

Product Name	Denka® Alcen™
Color	white
Density, pcf (kg/m³)	8, 9.3 (128, 149)
Continuous use limit, °F (°C)	2912 (1600)
Chemical Analysis, %, Weight basis after firing	
Alumina, Al ₂ O ₃	80
Silica, SiO ₂	20
Other	trace
Thermal Conductivity, BTU•in./hr•ft²•°F (W/m•K), ASTM C 201	
measured density, pcf (kg/m ³)	9.3 (149)
mean temperature, @ 500°F (260°C)	0.74 (0.11)
@ 1000°F (538°C)	1.31 (0.19)
@ 1500°F (816°C)	2.36 (0.34)
@ 2000°F (1093°C)	3.66 (0.53)
@ 2500°F (1371°C)	5.05 (0.73)
@ 2700°F (1482°C)	5.61 (0.81)

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Section 04

Fibre Board and Shape products

Metric information - Page 43 - 46
Imperial information - Page 47 - 50

Vacuum Formed (VF) products

AES vacuum formed products

- Superwool® Plus VF
- Superwool® Plus Strong VF
- Superwool® Plus Carton
- Superwool® HT VF
- Superwool® HT2 VF
- Superwool® HT LB
- Superwool® HT Unifelt Board
- Superwool® Plus PM
- Superwool® Plus HT PM
- Superwool® I-Plus
- Superwool® I-HT

RCF VF

- | | |
|--------------------|---------------|
| Kaowool® I260 VF | Kaowool® HT |
| Kaowool® Strong VF | Kaowool® 2600 |
| Kaowool® I260 LB | Kaowool® 80 |
| Kaowool® I400 VF | Kaowool® 3000 |
| Kaowool® I600 VF | I-2100 |
| Ceraform® 1400 | I-2300 |
| Kaowool® M | I-2600 |
| Kaowool® PM | I-2800 |
| Kaowool® HP | I-A5 |
| Kaowool® HD | Tennaglo |
| Kaowool® A | |
| Kaowool® HS | |
| Kaowool® HS-45 | |

PCW VF

- Alphawool® VF
- Alphawool® Unifelt

Board products

AES board

- Superwool® Plus Board (75/H/85/LTi/INO/AluBoard)
- Superwool® Plus Blok (800/1000/1100/1100QF/AL)
- Superwool® HT Board
- Superwool® Plus Pyro-Board
- Superwool® HT SB - domestic OEM
- Superwool® HT WB - domestic OEM
- Superwool® HT Millboard
- Superwool® Plus PM
- Superwool® Plus HT PM
- Superwool® I-Plus
- Superwool® I-HT

RCF board

- | | |
|---------------------------|---------------|
| Ceraboard Board 110 & 115 | Kaowool® HT |
| Kaowool® 822 Millboard | Kaowool® 2600 |
| Kaowool® 830 Millboard | Kaowool® 80 |
| Kaowool® M | Kaowool® 3000 |
| Kaowool® PM | I-2100 |
| Kaowool® HP | I-2300 |
| Kaowool® HD | I-2600 |
| Kaowool® A | I-2800 |
| Kaowool® HS | I-A5 |
| Kaowool® HS-45 | Tennaglo |

Thermal Ceramics' has designed a wide range of products using the vacuum forming technology. This versatile process, flexible in batch size, allows the production of products in different geometries according to customer drawings as well as boards with bespoke specifications and dimensions.

Our board and shape vacuum formed products cover an entire temperature and mechanical strength range. They feature excellent insulating performance, superior high temperature strength and can be custom designed for a broad range of uses.

Manufactured from our bulk fibres these products are available in grades:

- Alkaline Earth Silicate Fibres (AES) - Superwool®
- Polycrystalline Fibres (PCW) - Alphawool®
- Refractory Ceramic Fibres (RCF) - Kaowool® Cera®

Organic and inorganic compositions are available and offer:

- Low thermal conductivity and low heat storage
- Excellent thermal shock resistance
- Wide range of mechanical strengths
- Dimensional stability up to 1600°C (2912°F)
- No off-gassing during initial heat up of inorganic products

Boards

- Wide range of standard thicknesses and sizes
- Can be machined for tighter tolerance

Shapes

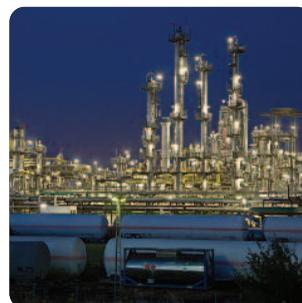
- Custom designed for optimized high temperature performance, utilizing decades of application experience
- Can be one-time use product or integral part of design
- Offer superior insulating performance, excellent molten metal resistance, and high strength
- Expertise in embedding hardware into shapes for integrated mounting, support or process specific benefits
- Post-treatment applications of Alfibond® and Minimox™ for many RCF and AES grades

Burner blocks and peep frames

- Engineered with light-weight, advanced vacuum forming technology
- Inorganic composition for high temperature strength retention
- Offer easy, low cost installation by embedding mounting hardware

Tennaglo® radiant plaques

- Low thermal conductivity and capacity
- Reach surface temperatures of 1600°F (900°C) within 1 minute
- Suitable for use with natural or liquified gases at low or elevated supply pressures



Typical applications - for high temperature insulation wool - Fibre Board and Shape products:

- Expansion joints, back-up insulation, heat shields and mould base insulation
- Riser sleeves for ferrous and non ferrous molten metals
- Ladle shroud gasket
- Nozzle insulation in continuous casting
- Roller inserts in roller hearth furnace
- Glass casting mould
- Tube insulation end in tube fumes boiler
- Insulation for domestic appliance and heating element supports and linings for domestic boilers
- Tap-hole cones and launder linings for non ferrous molten metals
- Doors and combustion chamber linings for boilers
- Furnace sight holes
- Duct and flue linings

AES VF products - grades available:

Superwool® Plus VF : classification 1200°C (2192°F)

Superwool® HT VF : classification 1300°C (2372°F)

Superwool® board - grades available:

Superwool® HT fibre : classification 1300°C (2372°F)

Superwool® Plus fibre : classification 1200°C (2192°F)

Benefits:

- Homogeneous structure
- Low thermal conductivity
- Good erosion resistance and rigidity
- Excellent hardness properties
- Excellent flexural and compressive strength
- Excellent thermal shock resistance
- Low heat storage, lightweight
- Good cycling performance (standard formula)
- Molten iron and steel resistance
- Good handling strength, easy to cut with standard tools
- Flame resistant
- AES fibres are not classified carcinogenic by IARC or under any national regulations on a global basis. They have no requirement for warning labels under GHS (Globally Harmonised System for the classification and labelling of chemicals). In Europe, Superwool® fibre meets the requirements specified under NOTA Q of European Directive 67/548. All Superwool® fibre products are therefore exonerated from the classification and labelling regulation in Europe.

RCF VF products - grades available:

Kaowool® VF : classification 1260 - 1600°C (2300 - 2912°F)

Ceraform® : classification 1260 - 1600°C (2300 - 2912°F)

RCF board - grades available:

Kaowool® classification 1260 - 1600°C (2300 - 2912°F)

Cera®: classification 1260 - 1400°C (2300 - 2552°F)

Benefits:

- Homogeneous structure
- Low thermal conductivity
- Good abrasion and erosion resistance and rigidity
- Excellent thermal shock resistance
- Low heat storage, lightweight
- Flame resistant
- Can be easily machined, cut and shaped
- Rigid, self supporting

PCW VF - products available:

Alphawool® VF : classification 1600°C (2912°F)

Benefits:

- High chemical purity
- Excellent insulating performance
- Low heat storage
- Resistance to thermal shock
- Can be easily cut
- Excellent thermal and chemical stability in industrial process conditions



Fibre Board and Shape products

	Superwool® Plus VF		Superwool® Plus Carton	Superwool® Plus Sealtubes	Superwool® HT VF		Superwool® HT LB	Superwool® HT Unifelt Board	Alphawool® VF Board	Alphawool® Unifelt
	Plus	Strong	Carton	Tubes	HT	HT2	Shape	Unifelt	Board	Unifelt
Classification Temperature, °C	1200	1200	1200	1200	1300	1450	1100	1250	1600	-
Colour	White / tan		White / tan	White	White / tan		-	White / tan	White / tan	White / tan
Density, kg/m³	280	380	290	900 (+/-10%)	320	335	250	190	250	Min 90kg/m ³
Modules of Rupture MPa *unfired	1.15*	2.01*	1.47	-	1.10	1.87	flexible	flexible	0.70	-
fired 15 minutes @ 650°C	0.52	0.9	-	-	-	-	N/A	N/A	0.60	-
Compressive Strength, Mpa										
@ 5%	0.13	0.30	-	-	-	-	-	-	-	-
@ 10%	0.16	0.38	-	-	-	-	-	-	-	-
Loss of Ignition, %	5.7	5.7	-	-	6	4	-	-	<8.0	<5
after 24 hours heating @ 800°C	-	-	7	-	-	-	-	-	-	-
after 24 hours heating @ 1200°C	-	-	-	3	-	-	-	-	-	-
Permanent Linear Shrinkage % ENV (1094-1)										
after 24 hours heating @ 1000°C	-	-	2	-	-	-	-	-	-	-
after 24 hours heating @ 1100°C	2	2	-	-	-	-	-	<1.0	-	-
after 24 hours heating @ 1200°C	-	-	-	<4	1.9	1.6	-	-	-	-
after 24 hours heating @ 1600°C	-	-	-	-	-	-	-	-	<1.5	<2
Thermal Conductivity, W/m•K ASTM C-201										
Mean Temperature @ 200°C	-	-	-	-	0.05	-	0.03	-	-	0.09
@ 400°C	0.08	0.09	0.07	-	0.10	0.08	0.04	0.10	0.08	0.06
@ 600°C	0.12	0.12	0.10	-	0.13	0.12	0.08	0.15	0.10	0.09
@ 800°C	0.16	0.14	0.15	-	0.19	0.18	0.15	0.21	0.13	0.14
@ 1000°C	0.20	0.17	-	-	0.24	0.25	0.24	0.30	0.16	0.21
@ 1200°C	-	-	-	-	0.31	0.33	0.29	-	0.19	0.29
@ 1400°C	-	-	-	-	-	0.38	-	-	-	0.39
Chemical Composition, %										
Al ₂ O ₃	-	-	-	-	-	-	-	-	88 - 90	93-96
SiO ₂	-	-	-	-	-	-	-	-	8 - 10	3-5
Others	-	-	-	-	-	-	-	-	0 - 4	0-2

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Fibre Board and Shape products

	Kaowool® Vacuum Formed Shapes & Boards					Ceraform®	Unifelt® Board					
	1260	Strong	1260 LB	1400	1600		400	1300	1400	1500	1600	1700
Maximum Continuous Temperature, °C	-	-	-	-	-	1260	-	-	-	-	-	
Classification Temperature, °C	1260	1260	1260	1400	1600	-	1260	1400	1500	1600	1700	
Colour	White / tan					Grey	White / tan					
Density, kg/m ³	260	330	200	260	320	390	170	160	150	140	130	
Modules of Rupture MPA	*unfired	1.05	2.37	flexible*	0.99*	0.40	1.6	-	-	-	-	-
	fired 15 minutes @ 650°C	0.58	1.1	N/A	0.35	0.24	-	-	-	-	-	-
Loss of Ignition, %	5 - 7	5 - 7	5 - 7	5 - 7	5 - 7	6	-	-	-	-	-	
Permanent Linear Shrinkage % after 24 hours												
	@ 1100°C	-	-	-	-	-	2.5	<2	-	-	-	-
	@ 1400°C	5-7	5-7	5-7	5-7	5-7	-	-	<2	<2	-	-
	@ 1500°C	-	-	-	-	-	-	-	-	-	<2	<2
	@ 1600°C	-	-	-	-	-	-	-	-	-	-	-
Thermal Conductivity, W/m•K												
Mean Temperature	@ 200°C	0.07	0.06	0.07	0.06	-	0.09	0.075	-	-	-	-
	@ 400°C	0.09	0.09	0.09	0.08	0.06	0.10	0.11	0.11	0.10	0.10	0.10
	@ 600°C	0.11	0.12	0.11	0.10	0.08	0.12	0.15	0.14	0.14	0.13	0.13
	@ 800°C	0.15	0.16	0.15	0.13	0.10	0.16	0.22	0.21	0.20	0.18	0.18
	@ 1000°C	-	-	-	0.18	0.14	0.22	0.31	0.29	0.23	0.27	0.25
	@ 1200°C	-	-	-	0.23	0.20	-	-	0.39	0.38	0.37	0.35
	@ 1400°C	-	-	-	-	0.26	-	-	-	0.50	0.50	0.48
Chemical Composition, %	Al ₂ O ₃	-	-	-	-	-	46.0	47	52	56	62	70
	SiO ₂	-	-	-	-	-	37.0	53	48	44	38	30
	ZrO ₂	-	-	-	-	-	7.6	-	-	-	-	-
	Fe ₂ O ₃ +TiO ₂	-	-	-	-	-	0.5	<0.15	<0.15	<0.15	<0.15	<0.15
	CaO+MgO	-	-	-	-	-	0.2	<0.1	<0.1	<0.1	<0.1	<0.1
	Na ₂ O+K ₂ O	-	-	-	-	-	0.2	<0.1	<0.1	<0.1	<0.1	<0.1

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Fibre Board and Shape products

	Superwool® Plus Board						Superwool® Plus Blok®					Superwool® HT Board	
	75	H	85	LTI	INO	Alu board	800	1000	1100	1100QF	AL	Board	C Board
Classification Temperature, °C	900	900	1000	1100	1100	600	1000	1100	1100	1100	1000	1300	1150
Thickness Range, mm	25 - 50	10 - 25	20 - 50	6 - 15	10 - 20	25	25 - 100	25 - 100	25 - 125	25 - 100	25 - 60	10 - 50	6 - 15
Colour	White/Tan						White/Tan					White/Tan	
Density, kg/m³	320	520	320	350	500	320	320	320	320	320	320	360	480
Modules of Rupture MPa *unfired	0.8	3.5	0.8	1.5	1.2	1.0	0.7	0.8	0.8	0.9	0.8	1.4	1.2
Compressive Strength, Mpa (ASTM C-165)													
@ 10% relative deformation	0.4	1.1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Water absorption after 2 hours													
%	2.0	2.0	2.0	-	-	-	2.0	2.0	2.0	2.0	2.0	-	-
Loss of ignition after 2 hours													
@ 800°C	5.0	10.0	5.0	5.0	5.0	5.5	5.5	5.0	5.0	5.0	5.5	3.0	5.5
Permanent Linear Shrinkage (ASTM C-165)													
Isothermal Heating at Class Temperature	1.0	1.2	0.9	1.0	1.6	1.4	1.4	1.4	1.3	1.3	1.4	1.5	1.3
Thermal Conductivity, W/m•K (ASTM C-201)													
Mean Temperature @ 200°C	-	-	-	-	-	-	0.05	0.06	0.05	0.05	0.05	0.05	0.06
@ 300°C	0.09	0.12	0.07	0.08	0.09	0.05	0.05	0.06	0.06	0.06	-	-	-
@ 400°C	0.07	0.13	0.08	0.09	0.11	0.06	0.06	0.07	0.07	0.07	0.07	0.08	0.09
@ 500°C	0.09	-	0.08	-	-	0.07	0.07	0.09	0.08	0.08	-	-	-
@ 600°C	0.12	0.15	0.11	0.12	0.13	0.08	0.08	0.10	0.09	0.09	0.10	0.11	0.12
@ 800°C	0.13	-	0.12	0.15	0.15	0.12	0.12	0.13	0.12	0.12	0.13	0.15	0.15
@ 1000°C	-	-	0.16	-	-	-	-	-	0.16	0.16	-	0.20	-
@ 1200°C	-	-	-	-	-	-	-	-	-	-	-	0.26	-
Chemical Composition, % (ISO 12677)													
SiO ₂	59.4	70.5	59.5	67.0	63.5	61.2	61.2	59.4	59.5	56.5	-	77.5	73.0
Al ₂ O ₃	15.1	11.2	10.1	4.4	10.6	13.9	13.9	15.1	10.1	16.2	-	1.4	7.9
Fe ₂ O ₃ +TiO ₂	3.8	1.6	1.2	0.6	1.5	3.0	3.0	3.8	1.2	1.3	-	0.1	1.1
CaO+MgO	19.4	15.1	28.2	27.4	23.5	18.3	18.3	19.4	28.2	24.6	-	20.3	16.8
Na ₂ O+K ₂ O	2.3	1.6	1.0	0.6	0.9	3.6	3.6	2.3	1.0	1.4	-	0.7	1.2

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OEM/domestic Board products

	Superwool® HT Board	
	Board HT WB	Board HT SB
Classification Temperature, °C	1150	1150
Thickness Range, mm	6 - 18	20 - 50
Colour	White / Tan	
Density, kg/m ³	480	380
Modules of Rupture MPa *unfired	2.6	1.4
Compressive Strength, Mpa (ASTM C-165)		
@ 10% relative deformation	0.6	0.5
Loss of Ignition, % after 2 hrs heating @ 800°C	5.5	5.5
Permanent Linear Shrinkage % (ASTM C-356)		
Isothermal Heating at Class Temperature	1.3	1.6
Thermal Conductivity, W/m·K		
@ 300°C	0.07	0.07
@ 400°C	0.09	0.09
@ 600°C	0.12	0.12
@ 800°C	0.15	0.15
Chemical Composition, % (ISO 12677)		
SiO ₂	73.0	71.9
Al ₂ O ₃	7.9	6.1
Fe ₂ O ₃ +TiO ₂	1.1	0.9
CaO+MgO	16.8	20.0
Na ₂ O+K ₂ O	1.2	1.1

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Board products

	Ceraboard®	
	100	115
Classification Temperature, °C	1260	1400
Thickness Range, mm	6 - 50	25 - 50
Colour	White / Tan	
Density, kg/m ³	320	320
Modules of Rupture MPa *unfired	1.2	0.7
Compressive Strength, Mpa (ASTM C-165)		
@ 10% relative deformation	0.3	0.3
Loss of Ignition, % after 2 hrs heating @ 800°C	4.5	2.5
Permanent Linear Shrinkage % (ASTM C-356)		
Isothermal Heating at Class Temperature	3.3	3.1
Thermal Conductivity, W/m·K		
@ 300°C	0.07	0.07
@ 400°C	0.08	0.08
@ 600°C	0.11	0.11
@ 800°C	0.15	0.15
@ 1000°C	0.20	0.20
Chemical Composition, % (ISO 12677)		
SiO ₂	60.5	41.7
Al ₂ O ₃	37.4	44.4
ZrO ₂	-	12.9
Fe ₂ O ₃ +TiO ₂	0.8	0.3
CaO+MgO	0.8	0.5
Na ₂ O+K ₂ O	0.5	0.2

Board and Shapes - Superwool® AES organic & inorganic grades

Product Name	Superwool® Organic				Inorganic Superwool®		
	Plus	Plus PM	HT	HT PM	I- Plus	I- HT	
Color	white	beige	white				
Density, pcf (kg/m ³)	20 - 22 (320 - 350)	15 - 17 (240 - 270)	20 - 22 (320 - 350)	14 - 17 (224 - 270)	15 - 17 (240 - 270)	18 (293)	
Continuous temperature use limit, °F (°C)	1832 (1000)		2150 (1177)		1832 (1000)	2150 (1177)	
Classification temperature rating, °F (°C)	2012 (1100)		2372 (1275)		2012 (1100)	2372 (1275)	
Modulus of Rupture, psi (MPa), fired @ 1800°F	300 (2)	200 - 250 (1.4 - 4.7)		175 - 225 (1.2 - 1.6)	-	38 (0.26)	
Compressive Strength, psi (MPa)							
@ 5% deformation	55 (0.38)	15 - 25 (0.10 - 0.17)	60 (0.41)	-		7 (0.05)	
@ 10% deformation	60 (0.41)	23 - 40 (0.16 - 0.28)	70 (0.48)	-		12 (0.08)	
Permanent Linear Shrinkage, %							
24 hrs. @ 1500°F (816°C)	2.0	-	0.25		2.2	0.51	
@ 1800°F (982°C)	2.5	1.0	0.25	0.33	2.3	0.93	
@ 2000°F (1093°C)	-					1.5	
@ 2200°F (1204°C)	-					1.7	
Chemical Analysis, %, Weight basis after firing							
Alumina, Al ₂ O ₃	trace		-		trace		
Silica, SiO ₂	67	70 - 80		70	82		
Calcium oxide + Magnesium oxide, CaO + MgO	27	18 - 25		24	16		
Other	1		<3		<1		
Loss on ignition, L.O.I.	4 - 7	2 - 4	3 - 6	2 - 5	1.3	1.8	
Thermal Conductivity, BTU•in./hr•ft²•°F (W/m•K), ASTM C 201							
mean temperature @ 500°F (260°C)	0.39 (0.06)	0.40 (0.06)		0.39 (0.06)	0.43 (0.06)		
@ 1000°F (538°C)	0.65 (0.09)	0.62 (0.09)		0.66 (0.10)		-	
@ 1500°F (816°C)	1.04 (0.15)	0.99 (0.14)	1.04 (0.16)	1.05 (0.16)	1.01 (0.15)		
@ 1800°F (982°C)	1.35 (0.19)	-		1.33 (0.20)			
@ 2000°F (1093°C)	-		1.51 (0.23)	1.55 (0.23)			

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Board and Shapes - Millboards RCF and Superwool® AES grades

Product Name	Kaowool® MB-822	Kaowool MB-830	Kaowool 1401	Superwool® HT Millboard
Color	white	tan	white	
Density, pcf (kg/m ³)	55 (881)	40 (641)	35 - 40 (560 - 641)	64 (1025)
Continuous temperature use limit, °F (°C)	2000 (1093)			2150 (1177)
Classification temperature rating, °F (°C)	2300 (1260)	2700 (1482), one time	2300 (1260)	2372 (1300)
Melting point, °F (°C)	3200 (1760)			2552 (1400)
Modulus of Rupture, psi (MPa)	650 - 750 (4.48 - 5.17)	400 - 500 (2.76 - 3.45)	650 - 750 (4.48 - 5.17)	567 (3909)
Compressive Strength, psi (MPa)				
@ 5% deformation	50 - 75 (0.34 - 0.51)	-	10 - 20 (0.06 - 0.14)	36 (251)
@ 10% deformation	100 - 125 (0.69 - 0.86)		55 - 70 (0.38 - 0.48)	133 (920)
@ 15% deformation	250 - 300 (1.72 - 2.06)		175 - 200 (1.20 - 1.38)	228 (1570)
Chemical Analysis, %, Weight basis after firing				
Alumina, Al ₂ O ₃	35		36	15
Silica, SiO ₂	63	65	60	75
Other	2	-	4	<2
Loss of Ignition, L.O.I.	5 - 7	12 - 15	9 - 11	12
Thermal Conductivity, BTU•in./hr•ft²•°F (W/m•K), ASTM C 201				
mean temperature @ 500°F (260°C)	0.80 (0.11)	0.53 (0.08)	0.61 (0.08)	0.96 (0.14)
@ 1000°F (538°C)	0.89 (0.13)	0.71 (0.10)	0.81 (0.12)	1.14 (0.16)
@ 1500°F (816°C)	0.98 (0.14)	0.91 (0.13)	1.04 (0.15)	1.42 (0.20)
@ 2000°F (1093°C)	1.08 (0.16)	1.15 (0.16)	1.33 (0.19)	1.79 (0.26)

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Board and Shapes - RCF inorganic grades

Product Name	Inorganic					
	I - 2100	I - 2300	I - 2600	I - 2800	I - A5	
Color	light beige	off white	white	white	white	
Density, pcf (kg/m ³)	17 (272)	17 (272)	16 (256)	16 (256)	16 (256)	
Continuous temperature use limit, °F (°C)	2100 (1149)	2300 (1260)	2600 (1427)	2800 (1538)	2950 (1621)	
Melting point, F (°C)	3200 (1760)					
Modulus of Rupture, psi (MPa)	75 (0.52)	56 (0.39)	72 (0.50)	66 (0.46)	60 (0.41)	
Compressive Strength, psi (MPa)						
@ 5% deformation	9 (0.06)	7 (0.05)	19 (0.13)	10 (0.07)	10 (0.07)	
@ 10% deformation	12 (0.08)	9 (0.06)	25 (0.17)	16 (0.11)	12 (0.08)	
Permanent Linear Shrinkage, %						
24 hrs. @ 1500°F (816°C)	0.8	0.3	-	0.1		
@ 1800°F (982°C)	2.0	1.9	0.3	0.1		
@ 2000°F (1093°C)	3.2	2.7	0.8	0.8	0.3	
@ 2200°F (1204°C)	-	3.4	1.2	0.9	0.2	
@ 2400°F (1316°C)		-	-	1.6	1.2	0.5
@ 2600°F (1427°C)				1.5		
@ 2800°F (1538°C)				-	1.0	0.6
Chemical Analysis, %, Weight basis after firing						
Alumina, Al ₂ O ₃	30	32	35	40	45	
Silica, SiO ₂	68	68	65	60	55	
Other	1.5	< 1				
Loss on ignition, L.O.I.	1.3					
Thermal Conductivity, BTU•in./hr•ft²•°F (W/m•K), ASTM C 201						
mean temp. @ 500°F (260°C)	0.48 (0.07)		0.45 (0.06)	0.44 (0.06)	0.46 (0.07)	
@ 1000°F (538°C)	0.72 (0.10)		0.67 (0.10)	0.64 (0.09)	0.68 (0.10)	
@ 1500°F (816°C)	1.03 (0.15)		1.01 (0.15)	0.93(0.13)	1.02 (0.15)	
@ 2000°F (1093°C)	1.52 (0.22)		1.49 (0.21)	1.34 (0.19)	1.52 (0.22)	
@ 2500°F (1371°C)	-				2.21 (0.32)	

Board and Shapes - RCF grades

Product Name	Kaowool®										
	M	PM	HP	HD	A	HS	HS-45	HT	2600	80	3000
Color	beige	white	beige				white	yellow	blue	white	pink
Density, pcf (kg/m ³)	16 - 18 (256 - 288)	16 (256)	20 - 23 (320 - 359)	26 (416)	28 (449)		42 (673)	22 - 25 (253 - 400)	15 (240)	25 (400)	12 (192)
Continuous temperature use limit, °F (°C)	2000 (1093)	2150 (1177)	2100 (1149)	2300 (1260)	2100 (1149)	2300 (1260)	2400 (1316)	2450 (1343)	2600 (1426)	2950 (1621)	
Classification temperature rating, °F (°C)	2200 (1204)	2300 (1260)		2400 (1316)	2300 (1260)	2400 (1316)	2500 (1371)	2600 (1426)	2700 (1482)	3000 (1649)	
Modulus of Rupture, psi (MPa)	100 - 130 (0.69 - 0.90)	200 - 250 (1.38 - 1.72)	200 (1.38)	150 - 175 (1.03 - 1.21)	250 (1.72)	230 - 260 (1.59 - 1.79)	450 - 550 (3.10 - 3.79)	200 (1.38)	115 (0.79)	75 (0.52)	70 (0.48)
Compressive Strength, psi (MPa)											
@ 5% deformation	20 - 30 (0.14 - 0.21)		75 (0.52)	50 - 70 (0.34 - 0.48)	100 (0.69)	60 - 80 (0.41 - 0.55)	200 - 250 (1.38 - 1.72)	75 (0.52)	30 (0.21)	25 (0.17)	20 (0.14)
@ 10% deformation	30 - 40 (0.21 - 0.28)		100 (0.69)	70 - 90 (0.48 - 0.62)	125 (0.86)	80 - 100 (0.55 - 0.69)	250 - 300 (1.72 - 2.07)	100 (0.69)	40 (0.28)	50 (0.34)	25 (0.17)
Permanent Linear Shrinkage, %, 24 hrs											
@ 1500°F (816°C)	1.2	0.2	0.7	0.1	-	0.8	0.5	-	0.3	-	0.3
@ 1800°F (982°C)	2.2	2.0	1.6	1.4	1.6	1.9	0.7				0.1
@ 2000°F (1093°C)	2.8	2.4	2.8	2.5	2.8	2.1	0.4				0.0
@ 2200°F (1204°C)	3.4	3.4	3.8	2.8	3.8	0.2	0.6	2.3	0.7	1.3	0.4
@ 2400°F (1316°C)	-					+0.3	+0.8	2.6	0.8	1.8	0.5
@ 2600°F (1426°C)						+1.1	3.0	0.1	0.6		
@ 2800°F (1538°C)						-	-	-	+0.3	+1.5	
@ 2900°F (1593°C)						-	-	-	-	+2.5	
Chemical Analysis, %, Weight basis after firing											
Alumina, Al ₂ O ₃	42	44	41 - 43	41	43 - 45	18	55	50 - 52	51	70 - 72	66
Silica, SiO ₂	56		56 - 59	53	54 - 57	81	35	47 - 49	49	25 - 28	34
Other	-	<1	-	<1	-	2	-	<1	-	-	
Loss on ignition, L.O.I.	4 - 7		6 - 8	5 - 8	7 - 9	5 - 8		5 - 7	7 - 9	3 - 5	7 - 9
Thermal Conductivity, BTU•in./hr•ft²•°F (W/m•K), ASTM C 201											
mean temperature @ 500°F (260°C)	0.5 (0.08)	0.4 (0.06)	0.5 (0.08)	0.6 (0.09)	0.5 (0.08)	0.7 (0.10)	1.0 (0.15)	0.5 (0.08)			
@ 1000°F (538°C)	0.7 (0.10)	0.6 (0.09)	0.7 (0.10)	0.8 (0.12)	0.7 (0.10)	0.8 (0.12)		0.7 (0.10)			
@ 1500°F (816°C)	1.0 (0.14)	0.9 (0.13)	1.0 (0.14)	1.1 (0.16)	0.9 (0.13)	1.1 (0.16)	1.2 (0.17)	0.9 (0.13)	1.0 (0.14)	0.9 (0.13)	1.0 (0.14)
@ 2000°F (1093°C)	1.5 (0.22)	1.3 (0.19)	1.4 (0.20)	1.6 (0.23)	1.3 (0.19)	1.6 (0.23)	1.7 (0.25)	1.3 (0.19)	1.5 (0.22)	1.3 (0.19)	1.4 (0.20)

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Section 05

Paper products

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Paper products

AES paper

- Superwool® Plus
- Superwool® Plus Flex-Wrap
- Superwool® HT
- Superwool® 351-E
- Superwool® Plus 351-E
- Superwool® 406-E
- Superwool® Black
- Superwool® Expanding

RCF paper

- Kaowool® 333-E
- Kaowool® Flex-Wrap
- Kaowool® 500
- Kaowool® 700
- Kaowool® 900
- Kaowool® 1260
- Kaowool® 1260 waterproof
- Kaowool® 1400
- Kaowool® 2000
- K-Shield™ BF
- Kaowool® 2600
- Kaowool® 3000
- E.R. glass
- Green glass

Other paper

- 400-LS
- Thermatex 500
- Thermatex 850

PCW paper

- Alphawool® Plus

Thermal Ceramics manufactures a wide range of high temperature rated paper products. We meet requirements ranging from economical mineral wool grades to high purity alumina and alumina-silica grades for demanding applications.

Paper products are specially processed to offer excellent performance in high-temperature applications and offer an alternative to traditional solutions due to its unique properties of high refractoriness and excellent non-wetting characteristics to applications requiring direct contact with molten aluminium and stability and resistance to chemical attack.

Insulating paper conforms easily to complex shapes and can be die-cut and used in a wide range of applications as thermal insulation and are especially suited to use in gaskets and as a parting medium.

Many of our paper products also meet the stringent specification requirements for automotive and aerospace applications.

In use high temperature insulation wool will:

- Contribute to protecting people and property from excessive heat
- Reduce greenhouse gas emissions
- Reduce energy usage
- Improve efficiency of furnaces and process equipment



Typical applications - for high temperature insulation wool - paper:

- Gasketing between aluminum and zinc trough sections
- Aluminum furnace tap-out plug cover and parting agent
- Aluminum distributor pan linings, casting and fabrication
- Gaskets for any high temperature application
- Back up lining for metal troughs
- Refractory back up for aluminum melting and holding furnaces
- Insulating thermal break
- Insulating gaskets and expansion joints
- Parting media
- Die cut gaskets for domestic appliances
- Thermal barriers for vehicles (silencers, catalytic exhausts and heat shields)

Superwool® paper - grades available:

- Superwool® HT paper** : classification 1300°C (2372°F)
- Superwool® Plus paper** : classification 1200°C (2192°F)
- Superwool® Plus Flex-Wrap** : classification 1000°C (1832°F)
- Superwool® Plus 332-E** : classification 704°C (1300°F)
- Superwool® Plus 351-E** : expandable up to 400%, classification 649°C (1200°F)
- Superwool® Plus 406-E** : expandable up to 125%, classification 649°C (1200°F)
- Superwool® Expanding paper** : classification 1200°C (2192°F)
- Superwool® Black paper** : classification 1200°C (2192°F)

Benefits:

- Excellent thermal insulating performances
- Free of binder or lubricant
- Thermal stability
- Low heat storage
- Good resistance to tearing, flexible and resilient
- Immune to thermal shock
- Good sound absorption
- AES fibres are not classified carcinogenic by IARC or under any national regulations on a global basis. They have no requirement for warning labels under GHS (Globally Harmonised System for the classification and labelling of chemicals). In Europe, Superwool® fibre meets the requirements specified under NOTA Q of European Directive 67/548. All Superwool® fibre products are therefore exonerated from the classification and labelling regulation in Europe.
- Exonerated from any use restriction under annexe V number 7.1 of the German hazardous substances regulation (TRGS 905)

RCF paper - grades available:

- Kaowool®** : classification 1176 - 1400°C (2150-2600°F)
- Kaowool® Waterproof** : classification 1260°C (2300°F)
- K-Shield BF** : low shot, classification 1316°C (2400°F)
- Kaowool® 333-E** : expandable up to 400%, classification 1260°C (2100°F)

Benefits:

- Good resistance to tearing
- High flexibility
- Low shot content
- Precise thickness
- Resistant to thermal shock
- Very low thermal conductivity
- Low thermal mass

Glass fibre paper - grades available:

- E.R. Glass**: maximum continuous use 500°C (932°F)
- Green Glass**: maximum continuous use 500°C (932°F)
- Thermatex 500**: maximum continuous use temperature 500°C (932°F)

Mineral fibre paper - grades available:

- Thermatex 850**: maximum continuous use 850°C (1562°F)
- 400-LS**: maximum continuous use 732°C (1350°F)

Alumina paper - grades available:

- Alphawool® paper**: maximum continuous use 1600°C (2912°F)
- Kaowool® 3000** : <1% shot, classification 1648°C (3000°F)



Paper products

	Superwool® HT Paper	Superwool® Plus Paper	Superwool® Plus MD Black Paper	E.R. Glass	Green Glass	Thermatex® 500 Paper	Thermatex® 850 Paper
Maximum Continuous Temperature, °C	-	-	-	500	500	500	850
Classification Temperature, °C	1300	1200	1200	-	-	-	-
Colour	white	white	black	white	green	white	light green
Density, kg/m ³	210	190 - 210	230	150	150	120-150	180-200
Tensile Strength, kN/m ²	>0.45	>0.65	>0.65	6.3	>6.5	500	longitudinal 1.0/ transverse 0.5
Loss on Ignition, %	8	8	12	-	-	8	4.5 - 9.0
Melting Point, °C	-	-	-	720	720	700	> 1000
Permanent Linear Shrinkage, % ENV (1094-1)							
after 24hrs @ 1000°C	-	<2	<2	-	720	-	-
@ 1260°C	<2	-	-	-	-	-	3.5
Linear Shrinkage, %, 4 hours @ 500°C	-	-	<2	<4	<4	-	-
Linear Shrinkage, %, 4 hours @ 1400°C	-	-	-	-	-	-	-
Thickness Measurement Pressure, kPa %	-	-	±10	-	-	3	-
Mean Fibre Diameter, Microns, *Optical Measurement	-	-	-	*11	*4, 6.5	2.3 - 3.2	5.5
Thermal Conductivity, W/m·k ASTM C-201							
Mean Temperature @ 100°C	-	-	-	-	-	-	0.04
@ 200°C	0.04	0.05	0.05	-	-	-	-
@ 300°C	-	-	-	-	-	-	0.084
@ 400°C	0.07	0.07	0.07	-	-	-	-
@ 500°C	-	-	-	-	-	-	0.130
@ 600°C	0.10	0.11	0.11	-	-	-	-
@ 800°C	0.14	0.16	0.16	-	-	-	-
@ 1000°C	0.19	0.23	0.23	-	-	-	-
@ 1200°C	0.25	-	-	-	-	-	-
Chemical Composition, %							
SiO ₂	70-80	-	-	54.4	49.7	65	40
Al ₂ O ₃	-	-	-	14.1	14.6	3.5	21
CaO	-	-	-	17.4	16.6	-	-
Na ₂ O	-	-	-	0.4	1.5	12	-
B ₂ O ₃	-	-	-	8	3.5	6	-
MgO	-	-	-	4.7	8.7	-	-
Fe ₂ O ₃	-	-	-	0.3	3.7	-	6.5
F ₂	-	-	-	0.2	0.1	-	-
TiO ₂	-	-	-	0.5	0.8	-	-
CaO + MgO	18-25	-	-	-	-	9.5	26
Other Oxides	<3	-	-	-	-	<5	8
Acoustic absorption coefficient (BS3638), 2.0mm thickness Frequency (Hz)							
100	-	-	-	-	-	-	0.05
2000	-	-	-	-	-	-	0.21
4000	-	-	-	-	-	-	0.40

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Paper products

	Kaowool® 1400 Paper	Alphawool® 1600 Paper	Kaowool® 1260	Kaowool® 1260 Waterproof	
Maximum Continuous Temperature, °C	-	-	-	-	
Classification Temperature, °C	1400	1600	1260	1260	
Colour	white	white	white	white	
Density, kg/m ³ , (*depending on grade)	210	150	190	210	
Tensile Strength, kN/m ²	750	250	750	750	
Loss on Ignition, %	6	6	8	9	
Melting Point, °C	1760	2000	700	> 1000	
Permanent Linear Shrinkage, %, After 24 hours	-	-	-	-	
Linear Shrinkage, %, 4 hours @ 1400°C	3	-	-	-	
Thickness Measurement Pressure, kPa	10	3	10	10	
Fibre Diameter, Microns	2-3	3	-	2-3	
Fibre Length, mm	-	-	-	-	
Thermal Conductivity, W/m•k					
Mean Temperature	@ 200°C	-	-	0.06	0.058
	@ 300°C	-	-	0.07	0.074
	@ 400°C	0.089	-	0.09	0.090
	@ 500°C	-	0.09	0.11	0.110
	@ 600°C	0.132	-	0.13	0.130
	@ 800°C	0.197	0.11	0.20	0.195
	@ 1000°C	0.293	-	-	-
	@ 1200°C	0.436	0.17	-	-
	@ 1400°C	-	0.26	-	-
	@ 1600°C	-	0.32	-	-
Chemical Composition, %					
	SiO ₂	46-52	9	52	52
	Al ₂ O ₃	48-54	88	47	47
	Na ₂ O	-	-	-	-
	B ₂ O ₃	-	-	-	-
	CaO + MgO	-	-	-	-
	Fe ₂ O ₃	-	-	-	-
	Other Oxides	<5	3	1	1
Acoustic absorption coefficient (BS3638), 2.0mm thickness Frequency (Hz)					
	100	0.05	-	-	-
	2000	0.26	-	-	-
	4000	0.50	-	-	-

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Paper products - Superwool® AES grades

Product Name	Superwool®			
	Plus	Plus Flex Wrap	332-E	HT
Color	white			
Density, pcf (kg/m ³)	11 - 13 (176 - 208)	10 - 13 (160 - 208)	11 - 14 (176 - 224)	
Continuous temperature use limit, °F (°C)	1832 (1000)		1300 (704)	2102 (1100)
Classification temperature rating, °F (°C)	2012 (1100)		-	2372 (1275)
Melting point, °F (°C)	2327 (1275)		1800 (980)	2552 (1400)
Tensile Strength, psi (MPa)	>65	>25	-	>50
Chemical Analysis, %, Weight basis after firing				
Alumina, Al ₂ O ₃	trace		-	trace
Silica, SiO ₂	60 - 70	60 - 70	65	60 - 70
Calcium oxide + Magnesium oxide, CaO + MgO	25 - 35	25 - 35	-	16 - 22
Loss on ignition, L.O.I.	5 - 10	2 - 5	30	5 - 10
Other	I		5	<1
Thermal Conductivity, BTU•in./hr•ft ² •°F (W/m•K), ASTM C 201				
mean temperature @ 500°F (260°C)	0.39 (0.06)		0.35 (0.05)	0.39 (0.06)
@ 1000°F (538°C)	0.65 (0.09)		0.53 (0.08)	0.65 (0.09)
@ 1500°F (816°C)	1.04 (0.15)		-	1.02 (0.15)
@ 1800°F (982°C)	1.35 (0.19)			-
@ 2000°F (1093°C)	-			1.52 (0.22)

Availability and Packaging

Thickness, in (mm)	Width, in (mm)	Sq. Ft./Roll (Sq. M)	Mill Rolls, L. Ft./Roll (L. M)	Products
1/32 (0.8)	12, 24, 48 (305, 610, 1219)	1000 (93)	-	Superwool Plus 332-E
1/16 (1.6)	12, 24, 48 (305, 610, 1219)	500 (46)	750 (229)	Superwool Plus, Flex-Wrap, HT
1/8 (3.175)		250 (23)	375 (114)	Superwool Plus, Flex-Wrap, HT
1/4 (6)		125 (12)	185 (56)	Superwool Plus, Flex-Wrap, HT

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1/4 (6)			x		240 (6095)	24, 48 (610, 1220)	160 (14.9)
1/2 (13)		x	x	x	600 (15240)		100 (9.3)
1 (25)	x	x	x	x	300 (7620)		50 (4.6)
1 1/2 (38)	x	x	x		180 (4575)		30 (2.8)
2 (50)	x	x	x		150 (3810)		25 (2.3)

Paper products - expandable RCF and Superwool® AES grades

Product Name	Kaowool® 333-E	Superwool®		
		351-E	406-E	
Color	gray			
Density, pcf (kg/m ³)	15 - 18 (240 - 288)	16 - 19 (240 - 288)	21 - 25 (336 - 400)	
Continuous temperature use limit, °F (°C)	1350 (732)	1832 (1000)		
Classification temperature rating, °F (°C)	1500 (816)	2012 (1100)		
Melting point, °F (°C)	2000 (1093)	2327 (1275)		
Tensile Strength, psi (MPa)	>40 (0.28)	75 - 100 (0.51 - 0.68)		
Fired Tensile Strength, psi (MPa)	5 - 10 (0.03 - 0.07)			
Chemical Analysis, %, Weight basis after firing				
Alumina, Al ₂ O ₃	42	trace	47	
Silica, SiO ₂	48	55 - 65	53	
Carbon, C	5 - 10	5 - 10	-	
Calcium oxide + Magnesium oxide, CaO + MgO	-	23 - 37		
Organic binder.	6 - 10			
Other	10	trace		
Expansion characteristics, % increase				
Thickness, in (mm)	1/4 (6.35)	1/16 (1.6)	1/8 (3.175)	4/25 (4)
@ 400°F (204°C)	86	132	86	-
@ 1000°F (538°C)	-			82
@ 1004°F (540°C)	419	385	419	-
@ 1200°F (649°C)	-			107
@ 1400°F (760°C)	-			98
@ 1454°F (790°C)	414	503	414	-
@ 1798°F (981°C)	358	530	358	-

Availability and Packaging

Thickness, in (mm)	Width, in (mm)	Sq. Ft/Roll (Sq. M)	Mill Rolls, L. Ft./Roll (L. M)	Products
1/16 (1.6)	24, 48 (610, 1219)	500 (46)	750 (229)	Kaowool 333-E, Superwool 351-E, 406-E
1/8 (3.175)		250 (23)	375 (114)	
1/4 (6.35)		125 (12)	185 (56)	

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Paper products - RCF grades

Product Name	400-LS	Kaowool					K-Shield® BF	Kaowool		
		Flex Wrap	500 Grade	700 Grade	900 Grade	2000 Grade		2600 Grade	3000 Grade	
Color	off white	white								
Density, pcf (kg/m ³)	12 - 15 (192 - 240)	11 - 13 (176 - 208)	12 - 14 (192 - 224)	11 - 13 (176 - 208)	10 - 12 (160 - 192)	11 - 14 (176 - 224)	8 - 10 (128 - 160)	10 - 13 (160 - 208)	7 - 10 (112 - 160)	
Continuous temperature use limit, °F (°C)	1350 (732)	2150 (1176)					2300 (1260)	2450 (1343)	2800 (1538)	
Classification temperature rating, °F (°C)	1500 (816)	2300 (1260)					2400 (1316)	2600 (1426)	3000 (1648)	
Melting point, °F (°C)	2000 (1093)	3200 (1760)						3600 (1982)		
Fibre Index, %	70	50	50	55	70	80	75	55	99	
Tensile Strength, psi (MPa)	40 - 75 (0.28 - 0.52)	>25 (>0.17)	75 - 100 (0.51 - 0.68)				14 - 25 (0.10 - 0.17)	75 - 100 (0.51 - 0.68)	25 - 40 (0.17 - 0.27)	
Fired Tensile Strength, psi (MPa)	5 - 10 (0.03 - 0.07)	2 - 3 (0.14 - 0.20)					15 - 25 (0.10 - 0.17)	2 - 3 (0.14 - 0.20)	-	
Chemical Analysis, % Weight basis after firing										
Alumina, Al ₂ O ₃	15	47	47	47	47	47	51	35	95	
Silica, SiO ₂	43	53	53	53	53	53	49	51	5	
Zirconia, ZrO ₂								14		
Calcium oxide, CaO + Magnesium oxide, MgO	21	-								-
Loss on ignition, L.O.I.	5 - 10	3 - 7	6 - 10				0.5 max	6 - 10		
Other	22	trace								
Thermal Conductivity, BTU • in./hr • ft² • °F (W/m • K), ASTM C 201										
mean temperature @ 500°F (260°C)	0.36 (0.05)	0.39 (0.06)	0.43 (0.06)	0.40 (0.06)	0.38 (0.05)	0.38 (0.05)	0.38 (0.05)	0.37 (0.05)	0.36 (0.05)	
@ 1000°F (538°C)	0.58 (0.08)	0.69 (0.10)	0.69 (0.09)	0.63 (0.09)	0.61 (0.09)	0.56 (0.08)	0.59 (0.09)	0.63 (0.09)	0.53 (0.08)	
@ 1500°F (816°C)	**0.77 (0.11)	0.96 (0.14)	1.07 (0.15)	0.95 (0.14)	0.94 (0.14)	0.80 (0.11)	0.85 (0.12)	1.02 (0.15)	0.80 (0.11)	
@ 2000°F (1093°C)			1.58 (0.23)	1.38 (0.20)	1.40 (0.20)	1.11 (0.16)	1.18 (0.17)	1.57 (0.23)	1.20 (0.17)	
@ 2500°F (1371°C)									-	1.78 (0.26)
@ 2600°F (1426°C)									2.52 (0.36)	-
@ 2800°F (1538°C)									-	2.22 (0.32)

**400-LS paper thermal conductivity is measured at @ 1300°F (704°C)

Availability and Packaging

Thickness, in (mm)	Width, in (mm)	Sq. Ft./Roll (Sq. M)	Mill Rolls, L. Ft./Roll (L. M)	Products
1/32 (0.8)	12, 24, 48 (305, 610, 1219)	1000 (93)	-	K-Shield BF, Kaowool 700, 900, 2000, 3000
1/16 (1.6)		500 (46)	750 (229)	400-LS, K-Shield BF, Kaowool Flex-Wrap, 500, 700, 900, 2000, 3000
1/8 (3.175)		250 (23)	375 (114)	400-LS, K-Shield BF, Kaowool Flex-Wrap, 500, 700, 900, 2000, 3000
1/4 (6.35)		125 (12)	185 (56)	400-LS, K-Shield BF, Kaowool Flex-Wrap, 500, 700, 900, 2000, 3000

Notes: 400-LS and Kaowool 333-E and Kaowool Flex-Wrap are only available in 24 and 48 inch widths.

Kaowool 3000 is available only in 24 inch width.

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Section 06

Felt products

Metric information - Page 61 - 62
Imperial information - Page 63

Felt products

AES felt

- Superwool® Plus felt
- Superwool® Plus clad
- Superwool® HT clad
- Superwool® HT felt
- Superwool® HT Unifelt™

RCF felt

- Cerafelt®
- Kaoclad
- Kaowool® I 260 felt
- Kaowool® Flexi-Felt™
- Ultrafelt®
- Cerachrome® felt
- K-Shield® felt
- K-Shield® felt LS
- K-Shield® felt AG
- Unifelt™ I 300 / I 400 / I 500 / I 600 / I 700

PCW felt

- Alphawool® Unifelt™

Thermal Ceramics insulating felt products, obtained by hot pressing are particularly suitable for die-cutting operations. Semi-rigid, it is neither brittle nor dusty. Felt optimizes the manufacture of complex, die-cut shapes to close tolerances.

Superwool® felt products

Superwool® felt is made from Superwool® fibres, bonded with an organic binder which begins to burn out at 180°C (356°F). This special binder makes Superwool® felt particularly suitable for die-cutting operations. Made from chemically stable fibres, lightweight and very insulating, Superwool® felt is a multi-purpose product.

Alphawool® and Superwool® HT Unifelt™

Unifelt™ demonstrate excellent flexibility with excellent dimensional resilience after compression and make utilization of the felt or cut pieces very easy to handle compared to rigid products. Unifelt™ is supplied in a wide range of thickness minimum 6mm to a maximum 50mm (2 in) (combining light weight, high heat resistance, and low thermal conductivity). Unifelt™ range is produced by vacuum forming.

Cerafelt® and Cerachrome® felt

Cerafelt® and Cerachrome® felt are made in a unique manufacturing process which allows a wide thickness and density range. Both products are recommended for high temperature industrial applications such as expansion joints in kilns, furnaces, and boiler walls. When used as a gasket, Cerafelt® exhibits excellent resistance to penetration from molten metal both ferrous and non-ferrous. This unique property coupled with its ease of fabrication makes it ideal for ingot stool seals and stopper rod gaskets.

K-Shield® felt

The K-Shield® felt range of products are manufactured on the same line as the high temperature paper products. This manufacturing process allows excellent, uniform material density and thickness control. In addition, the lightweight, flexible nature of this product allows it to be packaged in roll form. K-Shield® felts are made from very clean, high purity ceramic fibres.



Typical applications - for high temperature insulation wool - felt:

- Hot Top insulation for steel ingots
- Back-up insulation for furnaces and launder systems
- Insulating wrap for shrouds/stopper rods in steel manufacture
- Gaskets for low pressure casting systems
- Thermocouple tube protection
- Automotive and aerospace heat shields

Superwool® felt - grades available:

- **Superwool® HT fibre** : classification 1300°C (2372°F)
- **Superwool® Plus fibre** : classification 1200°C (2192°F)
- **Superwool® Wet Felt - Superwool Plus and HT Clad** is made from Superwool needled blanket and supplied as a moist sheet
- **Superwool® HT Unifelt™** : classification 1250°C (2282°F)

Benefits:

- High temperature resistance with low thermal conductivity
- Particularly suited to cutting operations
- Flexible or semi-rigid, depending on density selected
- High sound absorption properties
- Precise thicknesses
- Resistant to thermal shock
- Low heat storage
- AES fibres are not classified carcinogenic by IARC or under any national regulations on a global basis. They have no requirement for warning labels under GHS (Globally Harmonised System for the classification and labelling of chemicals). In Europe, Superwool® fibre meets the requirements specified under NOTA Q of European Directive 67/548. All Superwool® fibre products are therefore exonerated from the classification and labelling regulation in Europe.
- Exonerated from any use restriction under annexe V number 7.1 of the German hazardous substances regulation (TRGS 905)

RCF felt - grades available:

- **Cerafelt®** : classification 1260°C (2300°F)
- **Cerachrome Felt** : classification 1427°C (2600°F)
- **Kaowool®** : classification 1260°C (2300°F)
- **Kaowool® Flexi-Felt™** : classification 1250°C (2282°F)
- **Ultrafelt®** : classification 1260°C (2300°F)
- **Unifelt™** : classification 1260 - 1700°C (2300 - 3092°F)
- **K-Shield® Felt** : classification 1260°C (2300°F)

RCF wet felt:

- Kaoclad and Kaowool made with ceramic fibre needled blanket and supplied as a moist felt
- Cera-Pak is as cast Ceraform sheets which can be formed in-situ to any shape desired

Benefits:

- Good resistance to tearing
- High flexibility
- Low shot content
- Precise thickness
- Resistant to thermal shock
- Very low thermal conductivity
- Low thermal mass

Alphawool® felt - products available:

- **Alphawool® Unifelt™** : classification 1600°C (2912°F)

Benefits:

- High chemical purity
- Excellent insulating performance
- Flexibility, good resilience
- Excellent thermal and chemical stability in industrial process conditions
- Low heat storage
- Resistance to thermal shock
- Can be easily cut



Felt products

	Superwool® Plus Clad	Superwool® HT Clad	Superwool® HT Felt					Superwool® HT Unifelt™ Board	Alphawool® Unifelt™
Classification Temperature, °C	1200	1300	1300					1250	1600
Colour	White	White	Yellow					White/tan	White/tan
Density, kg/m³ (*depending on grade)	600-700 (wet) 300 (dry)	700-800 (wet) 300 (dry)	*64 - 288					< 190	Minimum 90
Loss of Ignition, % (*depending on grade)	-	-	*4 - 12					-	<5
Permanent Linear Shrinkage, % (after 24hrs)									
@ 1100°C	-	-	-					<1.0	-
@ 1200°C	<3	-	<2					-	-
@ 1300°C	-	<3	-					-	-
@ 1600°C	-	-	-					-	<2
Modules of Rupture, Mpa									
Dried	-	>0.5	-					-	>0.5
Dried @ 100°C	-	-	-					-	-
After 24 hrs @ 1000°C	-	>0.6	-					-	>0.6
Tensile Strength, kg/m³	60	65	-					-	65
Specific Heat Capacity kJ/kg.K									
@ 1090°C	-	-	1.22					-	-
Thermal Conductivity, W/m.K ASTM C-201	-	-	64kg/m ³	96kg/m ³	128kg/m ³	192kg/m ³	288kg/m ³	-	-
Mean Temperature @ 300°C	-	-	0.07	0.07	0.07	0.06	0.05	-	-
@ 400°C	-	0.04	-	-	-	-	-	0.10	0.06
@ 500°C	-	-	0.16	0.15	0.12	0.09	0.08	-	-
@ 600°C	-	0.07	-	-	-	-	-	0.15	0.09
@ 700°C	-	-	0.28	0.25	0.20	0.14	0.11	-	-
@ 800°C	-	0.12	-	-	-	-	-	0.21	0.14
@ 900°C	-	-	0.45	0.38	0.32	0.21	0.16	-	-
@ 1000°C	-	0.27	0.55	0.45	0.38	0.25	0.19	0.30	0.21
@ 1100°C	-	-	0.66	0.54	0.45	0.30	0.22	-	-
@ 1200°C	-	0.37	-	-	-	-	-	-	0.29
@ 1300°C	-	-	-	-	-	-	-	-	0.34
@ 1400°C	-	-	-	-	-	-	-	-	0.39
Chemical Composition, %									
Al ₂ O ₃	-	-	-					-	93 - 96
SiO ₂ (on calcined products)	-	-	70 - 80					-	3 - 5
CaO+MgO	-	-	18 - 25					-	-
Others	-	-	<3					-	0 - 2

Superwool® Clad available in sizes 915 x 610mm from 5mm to 20mm thickness

Superwool® Felt available in sizes 1220 x 1070mm from 6mm to 25mm thickness

Alphawool® Unifelt™ available in sizes 1000 x 500mm from 6mm to 50mm thickness

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Felt products

	Cerafelt®							Unifelt™ Board					Kaoclad®		Kaowool®	Kaowool®	Ultrafelt®		
								1300	1400	1500	1600	1700	1200	1400	1260 Felt	Flexi-Felt™			
Classification Temperature, °C	1320							1260	1400	1500	1600	1700	1260	1400	1260	1250	1260		
Colour	Yellow							White / tan					White/Buf	White/Buf	White	White	White		
Density, kg/m³ (*depending on grade)	48	64	96	128	160	192	288	384	170	160	150	140	130	-	-	130 - 190	128	96, 128, 160	
Density, kg/m³, Uncompressed																			
as supplied (Wet)	-							-	-	-	-	-	700 - 800	700 - 800	-	-	-	-	
as supplied (Dry)	-							-	-	-	-	-	275	275	-	-	-	-	
Tensile Strength, kN/m² *(Wet) Mpa	-							-	-	-	-	-	*0.12	0.14	>550	550	-	-	
Modules of Rupture, Mpa	-							-	-	-	-	-	0.45	0.45	-	-	-	-	
Loss on Ignition, %	4- 12							-	-	-	-	-	-	-	7	7	-	-	
Melting Point, °C	-							-	-	-	-	-	-	-	1760	1760	-	-	
Permanent Linear Shrinkage, % (after 24hrs)																			
@ 1100°C	-							<2	-	-	-	-	-	-	-	-	-	-	-
@ 1260°C	2.5							-	-	-	-	-	-	-	-	-	-	-	-
@ 1320°C	3							-	-	-	-	-	-	-	-	-	-	-	-
@ 1400°C	-							-	<2	<2	-	-	-	-	-	-	-	-	-
@ 1500°C	-							-	-	-	<2	<2	-	-	-	-	-	-	-
Permanent Linear Shrinkage, %																			
@ 1200°C	-							-	-	-	-	-	<0.3	-	-	-	-	-	-
@ 1300°C	-							-	-	-	-	-	-	<0.4	-	-	-	-	-
Linear Shrinkage, %, 4 hrs @ 1400°C	-							-	-	-	-	-	-	-	3.5	3	-	-	
Specific Heat Capacity, kJ/kg*K																			
@ 540°C	1.13							-	-	-	-	-	-	-	-	-	-	-	-
Mean fibre diameter (microns), *optical measurement	-							-	-	-	-	-	-	-	-	-	2 - 3	-	-
Thermal Conductivity, W/m*k																			
@ Mean Temperature @ 200°C	-	-	-	-	-	-	-	-	0.075	-	-	-	-	-	-	-	-	-	0.05
@ 300°C	0.11	0.10	0.08	0.08	0.07	0.07	0.07	0.06	-	-	-	-	-	-	-	-	-	-	-
@ 400°C	-	-	-	-	-	-	-	-	0.11	0.11	0.10	0.10	0.10	-	-	-	-	-	0.09
@ 500°C	0.20	0.17	0.14	0.12	0.11	0.11	0.10	0.10	-	-	-	-	-	0.10	0.10	-	-	-	-
@ 600°C	-	-	-	-	-	-	-	-	0.15	0.14	0.14	0.13	0.13	-	-	-	-	-	0.13
@ 700°C	0.33	0.27	0.21	0.18	0.16	0.15	0.13	0.13	-	-	-	-	-	-	-	-	-	-	-
@ 750°C	-	-	-	-	-	-	-	-	-	-	-	-	-	0.14	0.14	-	-	-	-
@ 800°C	-	-	-	-	-	-	-	-	0.22	0.21	0.20	0.18	0.18	-	-	-	-	-	0.18
@ 900°C	0.51	0.41	0.31	0.25	0.22	0.20	0.17	0.15	-	-	-	-	-	-	-	-	-	-	0.24
@ 1000°C	0.75	0.59	0.42	0.34	0.29	0.25	0.21	0.18	0.31	0.29	0.23	0.27	0.25	0.20	0.20	-	-	-	-
@ 1200°C	-	-	-	-	-	-	-	-	-	0.39	0.38	0.37	0.35	-	-	-	-	-	-
@ 1400°C	-	-	-	-	-	-	-	-	-	-	0.50	0.50	0.48	-	-	-	-	-	-
Chemical Composition, %																			
SiO ₂	49.7							53	48	44	38	30	-	-	48 - 54	48 - 54	53	-	-
Al ₂ O ₃	35.1							47	52	56	62	70	-	-	46 - 52	46 - 52	47	-	-
Fe ₂ O ₃	0.1							-	-	-	-	-	-	-	-	-	-	-	-
Fe ₂ O ₃ + TiO ₂	-							<0.15	<0.15	<0.15	<0.15	<0.15	-	-	-	-	-	-	-
ZrO ₂	14.7							-	-	-	-	-	-	-	-	-	-	-	-
CaO + MgO	0.05							<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	-	-	-
Na ₂ O + K ₂ O	0.2							<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	-	-	-
Other Oxides	-							-	-	-	-	-	-	-	<0.5	<0.5	-	-	

Cerafelt® available in sizes 1220 x 1070mm from 6mm to 25mm thickness

Unifelt™ available in sizes 1000 x 500mm from 6mm to 50mm thickness

Kaoclad® available in sizes 915 x 610mm from 5mm to 20mm thickness

Metric information

Felt products - RCF and Superwool® AES grades

Product Name	Superwool® HT Felt	Cerafelt®	Cerachrome	K-Shield®	K-Shield LS	K-Shield AG
Color	yellow	cream/tan	blue/green	tan		
Density, pcf (kg.m ³)	4, 6, 8, 10, 12, 18 (64, 96, 128, 160, 192, 288)	4, 6, 8, 10, 12, 18, 24 (64, 96, 128, 160, 192, 288, 385)	6, 8, 12, 24 (96, 128, 160, 385)	6 (96)		
Continuous temperature use limit, °F (°C)	-	2150 (1177)	-	2300 (1260)		
Classification temperature rating, °F (°C)	2372 (1300)	2300 (1260)	2600 (1427)	2400 (1316)		
Fibre Index, %				65 - 70	75 - 80	62 - 70
Tensile Strength, psi (MPa)	-			10 - 20 (0.07 - 0.14)		5 - 10 (0.03 - 0.07)
Fired Tensile Strength, psi (MPa)				5 (0.03)		
Chemical Analysis, % Weight basis after firing						
Alumina, Al ₂ O ₃	-	46	43	51		
Silica, SiO ₂	70 - 80	54		49		
Calcium oxide + Magnesium oxide, CaO + MgO	18 - 25	-				
Loss on ignition, L.O.I.	4 - 12	3 - 9		2 - 5		3
Other	<3	trace				
Thermal Conductivity, BTU•in./hr•ft²•°F (W/m•K), ASTM C 201						
measured density, pcf (kg/m ³)	8 (128)			6 (96)		
mean temperature @ 500°F (260°C)	-	0.46 (0.07)	0.43 (0.06)	0.41 (0.06)	0.39 (0.06)	0.40 (0.56)
@ 572°F (300°C)	0.49 (0.07)	-				
@ 1000°F (538°C)	-	0.94 (0.14)	0.87 (0.13)	0.68 (0.10)	0.65 (0.09)	0.72 (0.10)
@ 1292°F (700°C)	1.39 (0.20)	-				
@ 1500°F (816°C)	-	1.58 (0.23)	1.49 (0.21)	1.15 (0.16)	1.02 (0.15)	1.12 (0.16)
@ 1832°F (1000°C)	2.64 (0.38)	-				
@ 2000°F (1093°C)	-	2.29 (0.33)	2.18 (0.31)	1.82 (0.26)	1.51 (0.22)	1.58 (0.23)
@ 2012°F (1100°C)	3.12 (0.45)	-				

Availability and Packaging

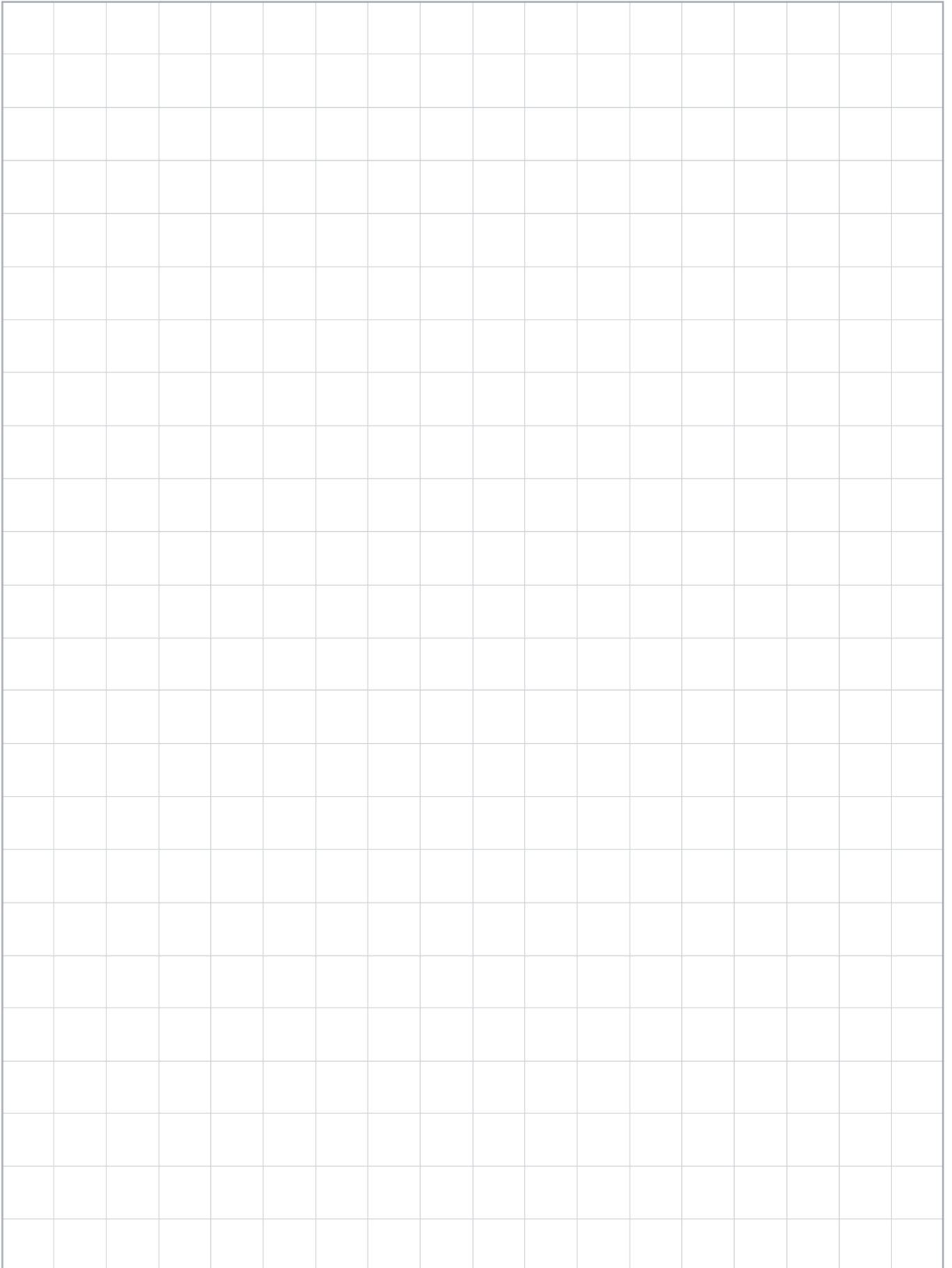
Thickness, in (mm)	Density, pcf (kg/m ³)							Standard Length x Width, in (mm)
	4 (64)	6 (96)	8 (128)	10 (160)	12 (192)	18 (288)	24 (385)	
1/8 (3.13)					•		•	Superwool HT Felt: 48 x 42 (1220 x 1070)
1/4 (6)	∇	∇ •	∇ •	∇ ♦	∇ •	∇	• ♦	
0.39 (10)	∇	∇	∇	∇	∇	∇		Cerafelt and Cerachrome Felt: 96 x 48 (2438 x 1220)
1/2 (13)	∇ •	∇ • ♦	∇ • ♦	∇ •	∇ • ♦	∇	• ♦	
3/4 (19)	∇	∇	∇	∇ •	∇ •	∇		K-Shield Felt, LS, AG: 24 x 300, 24 x 600 (610 x 7620, 610 x 15240) 48 x 300, 48 x 600 (2438 x 7620, 2438 x 15240)
1 (25)	•	∇ • ♦	∇ • ♦	∇ •	∇ •			
1 1/2 (38)	•							
2 (50)	•							

Key: ∇ = Superwool, • = Cerafelt, ♦ = Cerachrome Felt, ▲ = K-Shield Felt, □ = K-Shield Felt LS, ◇ = K-Shield Felt AG

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Notes





Section 07

Mastic, Coating & Cement products

Metric information - Page 67 - 69
Imperial information - Page 70 - 73

Mastic, coating and cement products

Pumpables

- Kaowool® Pumpable
- Kaowool® Pumpable XTP
- Kaowool® Pumpable HT
- Kaowool® Pumpable HS
- Superwool® Pumpable
- Therm-O-Hot® Patch

Moldables

- Kaowool® Moldable
- Kaowool® Moldable AR
- Superwool® Moldable
- Kaofil®

Coatings

- Kaowool® Sealcoat™ HT
- Superwool® Sealcoat™ HT
- Therm-O-Flake™
- Unikote™
- Kaowool® Rigidizer
- Kao-Seal®
- Kao-Seal® AHR Blue

Cements

- Cera-Preg
- JM 2600
- Kaowool Cement B
- Cera-Kote®
- Kaowool White Cement
- Super STIC TITE™
- Therm-O-Stix™ Adhesive

Mastic

- Superwool® Mastic
- Kaowool® Mastic

Hardener

- Kaowool® Hardener
- Superwool® Hardener

Thermal Ceramics has a full product offering of fibre base insulation materials available in pumpables, moldables, coatings and cements.

Manufactured specifically to aid in efficient furnace, kiln and boiler operation, these products eliminate hot spots, provide superior maintenance solutions, and make insulation installation quick and easy.

A complete line of mortars are also available in wet and dry grades. These mortars combine ease of use and high temperature performance.

In use high temperature insulation wool will:

- Contribute to protecting people and property from excessive heat
- Reduce greenhouse gas emissions
- Reduce energy usage
- Improve efficiency of furnaces and process equipment

For use in high temperature industrial applications where patching and filling of voids is required, available as pumpables (with pumps), moldables, air-setting cements and coatings.



Typical applications - for high temperature insulation wool - Mortars, Cements and Mastics:

- Hot or cold repairs of boiler insulation
- Expansion joints and cracks in anode baking pits
- Insulation of furnace penetrations (e.g. tubes, thermocouples)
- General packing applications
- Coating for metal liners
- Brick lining
- Adhering to fibre or other refractory substrates or providing a protective coating
- Grouting around insulating bricks
- Filling cup-locks
- Patching and making good refractory insulating linings
- Patching and repair of refractory fibre
- Launderers and linings of ladles in non-ferrous applications

Superwool® pumpable, moldable, coating, cement grades available:

Superwool® moldables: Low biopersistent fibre based mastic for general patching applications and is non-wetting to molten aluminum.

Superwool® Sealcoat HT: Coating that can be installed by troweling, caulking, or spraying to improve the furnace lining during maintenance or new installation.

Superwool® mastic: A moldable form of Superwool® fibre which can be trowelled, hand molded, or injected from a hand held pressure gun. Drying converts the mastic into a strong, hard yet light weight insulating material. Resistance to cracking and spalling is excellent, and the dried material has strong adhesive properties.

Superwool® hardeners: An inorganic liquid hardening agents which, when applied to blanket, modules or board produces a hard surface finish with increased resistance to mechanical abrasion and to gas flow erosion.

Benefits:

- Ready and easy to use
- Homogeneous structure
- Highly insulating
- AES fibres are not classified carcinogenic by IARC or under any national regulations on a global basis. They have no requirement for warning labels under GHS (Globally Harmonised System for the classification and labelling of chemicals). In Europe, Superwool® fibre meets the requirements specified under NOTA Q of European Directive 67/548. All Superwool® fibre products are therefore exonerated from the classification and labelling regulation in Europe.

RCF pumpable, moldable, coating, cement grades available:

Kaowool® pumpables: The pumpable materials are designed for hot or cold repairs and grades available for strong and abrasive atmospheres. Temperature limits up to 1538°C (2800°F).

Kaowool® Mastic: maximum continuous use 1000°C (1832°F). A moldable form of Kaowool® ceramic fibre which can be trowelled, hand molded, or injected from a hand-held pressure gun.

Kaowool® Sealcoat HT: Coating material designed for improving the lining thermal efficiency during maintenance or new construction.

Kaowool® Rigidizer: A penetrating liquid coating that increases the surface hardness and surface erosion of fibre products. Classification of 1260°C (2300°F).

Kaowool® White Cement: classification 1400°C (2552°F). A high temperature, air setting cement for use mainly as a refractory surface coating.

Kaofil®: classification 1260°C (2300°F). A moldable form of Kaowool ceramic fibre which can be injected into cracks and voids using a hand-held pressure gun. It is very sticky and adheres well to both dense and light-weight substrates.

Kaowool® Hardener: classification 1260°C (2300°F). An inorganic liquid hardening agents which, when applied to blanket, modules or board produces a hard surface finish with increased resistance to mechanical abrasion and to gas flow erosion.

Cera-Preg: classification 1260°C (2300°F). A highly refractory air-setting inorganic surface rigidizer designed for refractory fibre products. It penetrates into the surface of the fibrous body, bonds the fibres together to achieve a harder more abrasive and erosion-resistant surface.

JM 2600: classification 1430°C (2606°F). An air-setting cement developed for use in lower temperature applications, where a high-strength bond is required.

Benefits:

- High temperature stability with low thermal conductivity
- Low heat storage
- Very resistant to thermal shock
- Good erosion resistance
- Good workability, ideal plasticity and water retention
- Low drying and firing shrinkages
- High refractoriness and high bonding strength



Mastic, Coating and Cement products

	Superwool® HT Mastic	Hardener		JM 2600 / Blakite / JM 3300			
		Superwool®	Kaowool®	JM 2600	Blakite	Blakite V	JM 3300
Classification	-	-	-	Medium Duty	Super Duty	Super Duty	Super Duty
Temperature Limit °C	-	-	-	1430	1650	1650	1760
Classification Temperature °C	1300	1260	1260	-	-	-	-
Colour	White	Pink (translucent liquid)	White (translucent liquid)	-	-	-	-
Density, kg/m ³ , Uncompressed	1420	-	-	1700	1900	1900	2000
as supplied (Dry)	730	-	-	-	-	-	-
Solids Content, (by weight)	-	25	28 - 29	-	-	-	-
Modules of Rupture, Mpa							
Dried	1.5	-	-	-	-	-	-
Dried @ 50°C	-	-	-	12	20	20	28
Tensile Strength, kg/m ²	-	-	-	-	-	-	-
Specific Gravity, g/cm ³	-	1.2	1.203	-	-	-	-
Viscosity, (cylinder penetration) mm	-	-	4	30 - 50	14 - 28	8 - 13	15 - 27
pH Value	-	4 - 7	9.7	-	-	-	-
Permanent Linear Shrinkage %							
@ 1100°C	1.0	4 - 7	9.7	-	-	-	-
after 24hrs @ 50°C	-	-	-	-3	-2.4	-2.3	-2
after 24hrs Isothermal heating at classification temperature % @ 1300°C	1.0	-	-	-	-	-	-
Refractoriness (PCE)	-	-	-	23	33	33	34
Chemical Composition %							
Al ₂ O ₃	-	-	-	33.4	43.1	43.1	54.8
SiO ₂	-	-	-	60.7	51.7	51.7	40.6
Fe ₂ O ₃	-	-	-	1.3	1.2	1.2	0.9
TiO ₂	-	-	-	1.2	1	1	0.6
CaO	-	-	-	0.3	0.2	0.2	0.2
Na ₂ O+K ₂ O+MgO	-	-	-	2.8	2.7	2.7	2.3

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Mastic, Coating and Cement products

	Kaowool® Mastic	Kaowool® White Cement	Kaowool® Cement and Veneering Cement	Kaofil®		Cera-Preg Inorganic Refractory Rigidizer
				I380	I260	
Maximum Continuous Temperature, °C	1000	-	-	-	-	-
Classification Temperature °C	-	1400	1260	1260	1260	1260
Colour	White	White	White	White	White	Grey
Density, kg/m ³ , Uncompressed						
as supplied (Wet)	1350	1840 - 1950	1840 - 1950	1380	1440	-
as supplied (Dry)	670	-	-	610	680	-
Estimated Coverage per litre m ²	Brushed	-	-	-	-	1.2
	Sprayed	-	-	-	-	2.4
Solids %	-	-	-	-	-	10
Modules of Rupture, Mpa		-	-	2.25	-	-
	Dried MN/m ²	1.6	-	-	-	-
	After 24 hrs @ 1000°C	1.98	-	-	-	-
Tensile Strength, kg/m ³ *(Wet) Mpa	-	-	-	-	-	-
Compressive Strength, Kpa (@ 5%)	-	45	45	-	-	-
Melting Point °C, after drying	-	1760	1760	-	-	-
Specific Heat Capacity, kJ/kg•K						
100-550°C	-	1.04 - 1.14	1.04 - 1.14	-	-	-
1000°C	-	-	-	-	-	-
Specific Heat (BTU/lb•°C)	-	-	-	-	-	0.24 - 0.27
Shelf Life	-	12 months	-	-	-	6 months
Loss of Ignition, %, After 2 hrs @ 800°C	-	-	-	4.5	5.5	-
Thermal Conductivity, W/m•K						
@ 500°C	-	-	-	-	-	-
@ 750°C	-	-	-	-	-	-
@ 1000°C	-	-	-	-	-	-
Permanent Linear Shrinkage %						
110°C (*dried)	1.0	-	-	*0.8	*1.0	-
1000°C (*fired)	-	2.15	2.15	*2.3	*2.7	-
1200°C	-	-	-	-	-	-
1260°C	-	3.2	3.2	-	-	-
1300°C	-	-	-	-	-	-
after 24 hrs @ 1000°C	2.0	-	-	-	-	-

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Mastic, Coating and Cement products

	Superfil Plus Mastic	Superwool® HT Sealcoat	Sealcoat Alphawool	Superwool® Pumpable
Continuous Use Temperature °C	1350	1427	1530	-
Maximum Temperature Rating °C	1400	182	1600	1093
Solids %	46	46	46	-
Density, kg/m³				
Wet, as received	1200	1200	1210	1200
dried 110°C	700	730	680	550
Modulus of Rupture, MPa				
Dried (110°C) 24 hrs	1.35	1.38	1.8	0.80
24 hrs (815°C)	-	-	-	0.90
24 hrs (1090°C)	-	-	-	1.30
24 hrs (1315°C)	1.10	1.45	-	-
24 hrs (1450°C)	-	-	4.0	-
24 hrs (1530°C)	-	-	5.0	-
24 hrs (1600°C)	-	-	9.0	-
Permanent Linear Change, %				
Dried (110°C) 24 hrs	-	-	-	-0.3
24 hrs (815°C)	-	-	-	-0.4
24 hrs (1090°C)	-	-1.4	-	-1.5
24 hrs (1315°C)	-1.6	-1.4	-	-
24 hrs (1350°C)	-2.2	-	-	-
24 hrs (1427°C)	-	-1.5	-	-
24 hrs (1450°C)	-	-	-1.5	-
24 hrs (1530°C)	-	-	-2.0	-
24 hrs (1600°C)	-	-	-5.0	-
Aluminium Resistant Cup Test				
7075 Alloy, 815°C, 72 hrs	No Penetration	No Penetration	-	-
Thermal Conductivity, BTU•W/m•K, ASTM C417				
@260°C	0.8	0.8	-	-
@538°C	1.0	1.0	-	-
@816°C	1.4	1.4	-	-
@1093°C	2.0	2.0	-	-
Chemical Analysis, % weight based after firing				
SiO ₂	86.0	86.0	69.0	69.0
CaO	12.0	12.0	-	18.0
Al ₂ O ₃	-	-	29.0	10.0
Other	2.0	2.0	2.0	3.0

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Mastic products - Moldables

Product Name	Kaowool® Moldable	Kaowool® Moldable AR	Superwool® Moldable
Continuous temperature use limit, °F (°C)	1900 (1038)	1800 (982)	2000 (1093)
Classification temperature rating, °F (°C)	2000 (1093)		2100 (1149)
Density, pcf (kg/m ³)			
dried	28 - 30 (448 - 480)	55 - 60 (881 - 962)	56 (895)
wet	70 - 75 (1122 - 1202)	100 - 105 (1602 - 1683)	97 (1550)
Compressive Strength, psi (MPa), fired			
5% @ 1800°F (982°C)		300 (2.07)	-
5% @ 1800°F (982°C)			250 (1.7)
Permanent Linear Change, %, ASTM C113			
@ 1000°F (538°C)	-0.1	-2.3	-
@ 1500°F (816°C)	-0.2	-2.3	
@ 2000°F (1093°C)	-2.7	-3.1	-1.3
Thermal Conductivity, BTU•in/hr•ft²•°F (W/m•K), ASTM C417			
mean temperature			
@ 500°F (260°C)	0.5 (0.07)	0.7 (0.10)	-
@ 1000°F (538°C)	0.7 (0.10)	1.0 (0.14)	
@ 1500°F (816°C)	1.0 (0.14)	1.3 (0.19)	
Chemical Analysis, %, Weight basis after firing			
Alumina, Al ₂ O ₃	26 - 30	29 - 32	20
Silica, SiO ₂	67 - 72	64 - 67	65
Calcium oxide + Magnesium oxide, CaO + MgO	-		13
Other	1 - 2	3 - 5	<3
Shelf Life, months, minimum	12	6	12
Quantity per Container, gallon (liter)	1, 5 (4, 19), pail		
ounces (grams)	11, 32 (312, 907) tube		

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Mastic products - Pumpables

Product Name	Kaowool® Pumpable	Kaowool® Pumpable XTP	Kaowool® Pumpable HT	Kaowool Pumpable HS	Therm-O-Hot Patch™	Superwool® Pumpable
Continuous temperature use limit, °F (°C)	1900 (1038)		2400 (1316)	2800 (1538)	1800 (982)	1900 (1038)
Classification temperature rating, °F (°C)	2000 (1093)		2500 (1371)		1900 (1038)	2000 (1093)
Density, pcf (kg/m ³) dried @230°F (110°C)	22 - 26 (352 - 416)	34 - 40 (545 - 641)	23 - 28 (368 - 449)	70 (1121)	22.4 (359)	26 (897)
wet	70 - 75 (1121 - 1201)	70 - 75 (1121 - 1201)	73 - 78 (1169 - 1249)	100 (1602)	60 (961)	75 (1554)
Compressive Strength, psi (MPa), dried @ 230°F (110°C)						
5% @ 1800°F (982°C)	45 (0.31)	75 (0.52)	-	-	-	68 (0.47)
5% @ 2000°F (1093°C)	-	-		280 (1.93)		-
10% @ 1800°F (982°C)	68 (0.49)	-		-		142 (0.98)
Permanent Linear Change, %, ASTM C113						
@ 1200°F (649°C)						-0.3
@ 1500°F (816°C)	-	-1.0	-0.2	-	-1.5	-1.7
@ 1800°F (982°C)	-1.0	-	-			
@ 2000°F (1093°C)	-3.0	-2.5	-	-2.2	-	-2.0
@ 2500°F (1371°C)	-		-2.4	+0.4	-	-
@ 2800°F (1538°C)	-		-	-1.1		
Thermal Conductivity, BTU•in/hr•ft²•°F (W/m•K), ASTM C417						
mean temperature @ 300°F (148°C)	-	0.5 (0.07)	-			-
@ 400°F (204°C)		-	-	-	0.76 (0.11)	
@ 500°F (260°C)	0.5 (0.07)	-	0.5 (0.07)	-	-	-
@ 700°F (371°C)	-	0.7 (0.10)	-		-	
@ 800°F (427°C)	-	-	-		0.97 (0.97)	
@ 1000°F (538°C)	0.7 (0.10)	-	0.7 (0.10)		-	
@ 1100°F (593°C)	-	1.1 (0.16)	-		-	
@ 1200°F (649°C)	-	-	-		1.25 (0.18)	
@ 1500°F (816°C)	1.0 (0.14)	-	1.0 (0.14)		-	
@ 1600°F (871°C)	-	-	-		1.56 (0.22)	
Chemical Analysis, %, Weight basis after firing						
Alumina, Al ₂ O ₃	39 - 43	34	43 - 47	47 - 50	19	5
Silica, SiO ₂	52 - 58	66	50 - 54	47 - 50	46	64
Calcium oxide + Magnesium oxide, CaO + MgO	-			-	19	29
Ferric oxide, Fe ₂ O ₃	-		-	0.4 - 0.7	8.9	-
Other	3 - 5	-	2 - 4		4.4	
Shelf Life, months, minimum	12	6	12	6	12	
Quantity per Container, gallon (liter)	5 (19), pail					

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Mastic products - Cements

Product Name	Kaowool® Cement B	Cera-Kote™	Cera-Kote 322-D	Cera-Kote 624-A	Super Stic-Tite™	Therm-O-Stix® Adhesive	
Continuous temperature use limit, °F (°C)	2200 (1204)	2150 (1177)	2200 (1204)		-	1200 (649)	
Classification temperature rating, °F (°C)	2400 (1316)	2300 (1260)	2400 (1316)		1900 (1038)	1200 (649)	
Melting point, °F (°C)	3250 (1788)	3200 (1760)	3250 (1788)		-		
Color	white	off-white	white				
Density, pcf (kg/m ³), dried	-				27 (432)	15 (240)	
Bonding Strength, psi (kg/m ²)	205 (3284)	180 (2883)	255 (4085)	234 (3748)	-		
Chemical Analysis, % , Weight basis after firing							
Alumina, Al ₂ O ₃	44	39	44	80	-		
Silica, SiO ₂	55	59	55	19			74
Other	2			1			26
Shelf Life, months, minimum	6					12	
Quantity per Container, gallon (liter)	1, 5 (4, 19), pail	1, 5 (4, 19), pail		1, 5 (4, 19), pail 16 (454) oz (g), bottle	50 (23) lb (kg) bag	1, 5 (4, 19), pail	

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Mastic products - Coatings

Product Name	Kaowool® Sealcoat™ HT	Kaowool Rigidizer	Therm-O-Flake™ Coating	Kao-Seal™	Kao-Seal AHR Blue	Unikote® M Coating	Unikote S Coating	Superwool® Sealcoat™ HT
Continuous temperature use limit, °F (°C)	2500 (1371)	-	1600 (871)	200 (93)	-	2500 (1371)	2800 (1538)	2800 (1538)
Classification temperature rating, °F (°C)	2600 (1427)	2300 (1260)	1800 (980)	-	-	2600 (1427)	3000 (1649)	2900 (1593)
Density, pcf (kg/m³)								
dried	32 - 36 (513 - 577)	-	-	-	-	69 (1106)	69 (1106)	32 - 36 (513 - 577)
wet	78 - 82 (1250 - 1314)	75 (1202)	-	-	-	-	-	75 (1200)
Compressive Strength, psi (MPa), fired								
10% @ 2000°F (1093°C)	-						225 (1.55)	
Permanent Linear Change, %, ASTM C113								
@ 2000°F (1093°C)	-1.8	-	-	-	-	-0.3 (2375°F)	-0.3 (2375°F)	-1.4
@ 2400°F (1316°C)	-	-	-	-	-	-0.5 (2550°F)	-	-
@ 2600°F (1427°C)	-2.9	-	-	-	-	-	-0.5 (2650°F)	-1.5
@ 2800°F (1538°C)	-	-	-	-	-	-	-	-1.6
Thermal Conductivity, BTU • in/hr • ft² • °F (W/m • K), ASTM C417								
mean temperature @ 500°F (260°C)	0.6 (0.09)	-	0.88 (0.13) (400°F)	-	-	-	-	0.8 (0.12)
@ 1000°F (538°C)	0.8 (0.12)	-	1.09 (0.16) (800°F)	-	-	-	-	1.0 (0.14)
@ 1500°F (816°C)	1.1 (0.16)	-	1.31 (0.19) (1200°F)	-	-	-	-	1.4 (0.20)
@ 2000°F (1093°C)	1.5 (0.22)	-	1.56 (0.23) (1600°F)	-	-	-	-	2.0 (0.29)
Chemical Analysis, %, Weight basis after firing								
Alumina, Al ₂ O ₃	45 - 48	-	19	-	-	71	76	-
Silica, SiO ₂	51 - 54	-	50	-	-	24		86
Calcium oxide + Magnesium oxide, CaO + MgO	-	-	18	-	-	-		12
Other	1 - 2	-	13	-	-	5	-	2
Shelf Life, months, minimum	12				12			
Quantity per Container, gallon (liter); ounce (gram)	1, 5 (4, 19), pail 11, 32 (312, 907) tube	1, 5 (4, 19), pail	40 (18) lb (kg) bag	5 (19), pail 55 (208) drum	5 (19), pail			1, 5 (4, 19), pail 11, 32 (312, 907) tube

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Mastic installation equipment

Product description

HS-100 Extrusion Pump is a modified piston extrusion pump designed to pump Kaowool® or Superwool® Pumpable and Sealcoat products in a fast efficient manner.

The air-operated HS-100 Extrusion Pump is mounted on a platform with wheels for easy movement. Five gallon pails of the Kaowool or Superwool Pumpable materials are positioned in the pump and the extrusion action delivers the product through the supply hose to the application area.

The Sealcoat® Nozzle assembly is designed to work in conjunction with the HS-100 Extrusion Pump to effectively apply the Sealcoat products. The special nozzle atomizes the Sealcoat material, providing an efficient wet gunning process for delivering the material onto a variety of insulation, refractory, or metal surfaces.

The AO-25 Caulking Gun is an air-operated bulk loaded caulking gun for use with Kaowool or Superwool Pumpable, Moldable and Sealcoat products.

It is capable of delivering products at a rate of ½ to 1½ gallons per minute depending on air pressure and nozzle size.

The gun operates on air pressure of 30 - 90 psi (0.21 - 0.62 MPa)

The CW-1 Caulking Wand attaches to the end of the HS-100 Pump delivery hose for large volume repairs. This is an ideal set-up to apply Pumpable and Sealcoat products to fill gaps in refractory linings and eliminate Hot Spots.

Openings in fibre module linings due to shrinkage are readily and effectively filled.

Features

HS-100 Extrusion Pump/Sealcoat Nozzle

- Easy to operate
- Quick set-up/clean-up
- Operates on compressed air systems (100 psi, 80 cfm ideal)

AO-25 Caulking Gun

- Easy to operate
- Manually loaded from 5 gallon pails

CW-1 Caulking Wand

- Easily attaches to the delivery hose
- ½ - inch nozzle diameter



HS-100 Extrusion Pump (top)
CW-1 Caulking Wand (above left) and Sealcoat Nozzle (above right)
AO-25 Caulking Gun (below)





Section 08

Textile products

Metric information - Page 77
Imperial information - Page 78

Textile products

AES textiles

Superwool® Plus

RCF textiles

Kao-Tex™ 1000

Kao-Tex™ 1800

Kao-Tex™ 2000

Kao-Tex™ Styles 2200 and 2500

Thermal Ceramics high temperature textile products are used in applications such as the insulating lining of metallurgical ovens and furnaces, petrochemical heaters, and ceramic kilns etc.

Cloths, threads, ropes and yarns converted into various forms for specialised applications.

In use high temperature insulation wool will:

- Contribute to protecting people and property from excessive heat
- Reduce greenhouse gas emissions
- Reduce energy usage
- Improve efficiency of furnaces and process equipment

Low thermal conductivity, high tensile strength and excellent abrasion resistance are among the outstanding characteristics of textile products.

- Offered with specialised coatings
- Provide excellent thermal protection
- Heat resistant
- Chemically resistant to most elements

Fabrication with other Morgan Thermal Ceramics products enables custom engineered thermal solutions to be developed to customer specifications.



Typical applications - for high temperature insulation wool - textile:

- Welding curtains in steel fabrication
- Fire blankets for commercial and domestic kitchens
- Smoke and fire curtains in buildings
- Kiln car, expansion joint and door seals in furnaces
- Gaskets in furnaces and domestic appliances
- Flexible expansion compensators in power generation equipment
- Removable, flexible thermal insulation quilts for pipe work and valves in the petrochemical and power generation industry

Superwool® textile - grades available:

Superwool® Plus fibre : classification 1200°C (2192°F)

Benefits:

- Low thermal conductivity
- Flexible and easy to use
- Excellent appearance
- Excellent thermal shock resistance
- Resistant to molten aluminium
- AES fibres are not classified carcinogenic by IARC or under any national regulations on a global basis. They have no requirement for warning labels under GHS (Globally Harmonised System for the classification and labelling of chemicals). In Europe, Superwool® fibre meets the requirements specified under NOTA Q of European Directive 67/548. All Superwool® fibre products are therefore exonerated from the classification and labelling regulation in Europe.

Superwool® textiles and RCF textiles range includes:

Yarn:

Is the base of all the textile range of products. The yarn is reinforced with either a glass filament or a fine inconel wire.

Cloth:

Woven from a glass or inconel wire reinforced ceramic fibre yarn.

Cables rope (high density):

Manufactured from ceramic yarn which is either glass filament or inconel wire reinforced. It is composed of 3 pre-twisted strands each containing a predetermined multiple of fibre yarns which form a flexible, high density rope.

Cables rope (low density):

Manufactured from roving which is glass filament reinforced. It is composed of 3 pre-twisted strands each containing a predetermined multiple of yarns which are twisted together to form a flexible, low density rope.

Rope lagging:

Consists of a strip of fibre blanket that is overbraided with a glass yarn producing a highly insulating rope product of medium density, which is also compressible and flexible. Can also be overbraided with either a cotton yarn or a fine inconel wire.

Twisted rope:

Consists of a multiple of fibre yarn strands which can be either glass filament or inconel wire reinforced. They are twisted together to give the required final product diameter giving a soft rope product that is easily compressed and particularly suitable as a seal between uneven surfaces.

Webbing:

Woven from either glass or inconel wire re-inforced fibre yarn.

Ladder tape:

Woven from either glass or inconel wire reinforced fibre yarn. It has a similar weave to cloth on the outer edges, but an open weave in the centre allowing for ease of installation over studs and is ideal as a gasketing material.

RCF textile - grades available:

Classification up to 1371°C (2500°F)

Benefits:

- High temperature stability
- Lightweight and flexibility in use
- Excellent thermal shock resistance
- Excellent tensile strength
- Excellent corrosive attack resistance
- Steel wire and fibreglass reinforced



Textile products

	Superwool® Plus Textiles			Kaowool Rope and Textiles		
	Superwool® Plus	Glass	Steel	Alumino-Silicate	Glass Filament	Inconel Wire
Classification Temperature, °C	1200	500	1000	1260	550	1100
Availability	Twisted Rope · Round Braided Packing · Rope Lagging Square Braided Packing · Braided Sleeving · Webbing			Yarn · Cloth · Cabled Rope (high density) · Cabled Rope (low density) · Rope Lagging · Twisted Rope · Webbing · Ladder Tape		

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Textile products

Product Name	Kao-Tex® 1000	Kao-Tex® 1800	Kao-Tex® 2000	Kao-Tex® 2200	Kao-Tex® 2500
Color	white	tan	white		coral/white
Fibre Type	fiberglass	leached silica	ceramic fibre	alumina silica boron	
Continuous temperature use limit, °F (°C)	1000 (538)	1800 (982)	2000 (1093)	2200 (1204)	2500 (1371)
Classification temperature rating, °F (°C)					
Melting point, °F (°C)	3000 (1649)		3200 (1760)	3272 (1800)	
Chemical Analysis, %, Weight basis after firing					
Alumina, Al ₂ O ₃	10 - 12	0.1	45 - 48	62	70
Silica, SiO ₂	52 - 60	98	51 - 55	24	28
Boron oxide, B ₂ O ₃	8 - 13	trace		14	2
Calcium oxide + Magnesium oxide, CaO + MgO	16 - 25	trace			
Other	-	1 - 3	0.7 - 1.2	-	

Data presented in table above references cloth product forms only. Please visit our website to view the product datasheets for rope, thread, tubing and sleeving data points. For size availability, please reference the Price Book, Textiles section.



Section 09

Solubility Testing Kit

Solubility Testing Kit

- 2-year shelf life
- Extremely cost effective
- Simple, safe & easy to use
- Able to perform tests in-house
- Fast results
- Clear colour contrast
- Reliable
- Mobile from site to site

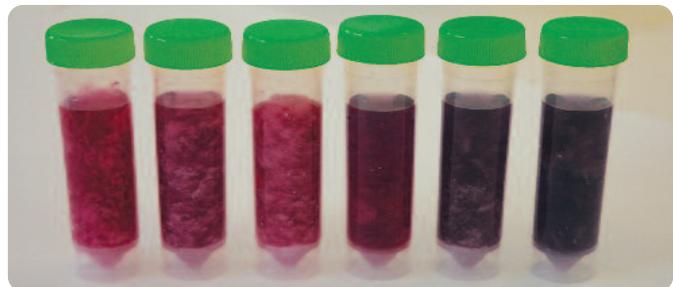
New formulation...

AES v RCF solubility test kit – now with extended shelf life!
Clearly identifies the fibre already installed.

A simple unambiguous colour change test is available which enables you to distinguish between the two main types of high temperature fibre: low bio-persistence products (AES fibres such as Superwool fibres) and RCF based materials. The new formulation now gives you up to 2 years shelf life at no extra cost, giving you more flexibility for your testing requirements.

- **Saves you costs** - determines waste disposal requirements, thus reduces restrictions and your costs
- **Saves time** - no need to send away to labs for days / weeks for fibre analysis identification
- **Flexibility** - allows you to conduct your own test when you want
- **Test on site** - conduct the test on your site, in your labs or wherever, just take the kit with you
- **Clear & fast diagnosis** - clarifies that an exonerated alternative material – (such as Superwool grades) has been installed
- All high temperature insulation fibres unidentified or unrecorded must be treated as though the material is RCF

As a guide the colour changes have been pre-determined as follows:



Tested AES material after the recommended time

If sample is AES material the solution colour will be within this range:



If sample is RCF material the solution colour will be within this range:



RCF fibre must be disposed of at increased cost using a waste disposal site which is either licensed or prepared to accept hazardous waste. Companies are under more pressure to identify what they have installed and record its use whilst protecting their work force from excessive exposure.

Beware of imitations

Do not confuse Thermal Ceramics' reputable products with imitations and false claims currently circulating in the market.

Thermal Ceramics is aware that fibre imports are claiming to have low biopersistence, to conform to current EU H&S regulations and to be identical to Thermal Ceramics' Superwool® material are being offered at highly competitive prices.

Neither a comparison between the outward appearances of fibre products or the feel of the products can be used to distinguish between different fibre products.

When a simple test on a sample which was marked as 'low biopersistent' was made using the latest AES-vs- RCF solubility test kit it was found the claimed low biopersistent product was in fact RCF. It should be emphasised that low biopersistent products are exonerated from EU legislation and RCF is classified as carcinogenic 2(1b).

Further tests using X-ray instrumentation (XRF chemical analysis) determined that the fibre was actually a 1400 grade RCF product. This ultimately constitutes an unethical evasion of H&S regulations in Europe where regulations are becoming very stringent for RCF use.

BEWARE: Look for the brand

Thermal Ceramics has also been made aware of several occurrences in the market where customers have received what was presented to them by other manufactures as 'Superwool®' products, available at competitive prices, tested and able to withstand the temperatures and applications intended as stated on our technical data sheets.

However, once ordered the product received was an 'imitation of Superwool®' and not what they had originally tested.

Thermal Ceramics has pioneered the revolution of high temperature, low biopersistence insulation fibres for almost 20 years with patented technology.

Our programme of continuous development, together with vast experience, knowledge and a great understanding of our products' capabilities, allows us to understand the advantages and limitations of each product form and enables us to advise our customers based on factual testing results.

Thermal Ceramics is the leader... others merely follow.

A simple unambiguous colour change test is available which enables you to distinguish between the two main types of high temperature fibre: low biopersistence products (AES fibres such as Superwool® fibres) and RCF based materials.

For more details visit www.morganthermalceramics.com or contact your local Thermal Ceramics representative.



AES v RCF solubility test kit :
clearly identifies the fibre already installed.



Section 10

Fire protection products

Metric information - Page 83 - 84
Imperial information - Page 85

FireMaster® Fire protection products :

- FireMaster® Marine Plus blanket**
- FireMaster® Marine Plus water repellent blanket**
- FireMaster® Marine Plus faced blanket**
- FireMaster® RES system**
- FireMaster® Cable Wrap system**
- FireMaster® board**
- FireMaster® expanding felt**
- FireMaster® FireBarrier® I35**
- FireMaster® Flexijet**
- FireMaster® FastWrap® XL**

FireMaster® products are used all over the world to protect people and structures against fire. The wide variety of FireMaster fire protection systems are comprehensively certified and extensively tested to meet national and international standards and have approvals valid worldwide for cellulosic, hydrocarbon and jet fire protection, offering our customers the security of global proven fire performance in various market sectors:

- Commercial Buildings, Hotels, Sports Stadiums and Airport Terminals
- Industrial Plants
- Petrochemical plants
- Offshore Platforms and FPSO's
- Cruise Ships, Military Vessels, Mega Yachts and Fast Ferries
- Tunnels and underground construction
- Duct work protection
- Fire doors, OEM and fire stops

Tunnels, construction and industrial

Not only is there a risk to human life but also severe damage to the tunnel structure can occur, requiring extensive repairs or even causing collapse of the tunnel. The resulting disruption of transport links can cause serious economic or social problems such as increased traffic congestion, reduction in tourism or damage to local businesses.

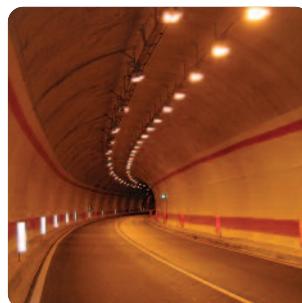
FireMaster® products also offer fire, thermal and acoustical fire protection in the construction and industrial markets and due to the lightweight flexible nature of the material, labor is significantly reduced during installation.

Marine, offshore and petrochemical

FireMaster systems have been providing for offshore platforms and chemical process plants fire protection for over 20 years with references in many major projects.

Ductwork

FireMaster duct wrap products are manufactured using Thermal Ceramics patented low biopersistent Superwool® fibres. FireMaster duct wrap products are completely encapsulated in aluminium foil. It is installed onto ductwork using band straps to provide fire protection for up to two hours.



Typical applications - for FireMaster fire protection products:

- 'A' class and IMO HSC steel, aluminium and PVC composite bulkhead and deck insulation in high speed craft
- Upgrading of fire performance of composite panels to meet IMO room corner test requirements
- 'H' class and 'A' class steel bulkhead and deck fire protection for ships and offshore platforms
- Hydrocarbon and jet fire protection of process pipes & vessels
- Infill to fire doors and cladding panels
- Construction joints
- Cellulosic & hydrocarbon fire protection of structural steelwork
- Ductwork and cable tray fire protection
- Fire protection to concrete tunnel linings
- Structural steel fire protection
- Vessel fire protection

FireMaster® product range includes:

FireMaster® Marine Plus blanket:

A highly insulating blanket especially developed for fire protection applications that are very space or weight sensitive. Lightweight solution for aluminium structures with **weight savings of 20 - 30%** compared to traditional fibre solutions.

Tested and approved for the fire protection of steel, aluminium and composite structures used in the marine industry and offers substantial weight savings over traditionally-used fibre insulation systems. It is also suitable for use where high insulation performance in fires is required in the offshore, petrochemical and construction industries.

FireMaster® Marine Plus water repellent blanket:

A flexible, resilient product that is able to provide effective fire protection in standard, hydrocarbon and jet fire applications whilst limiting water ingress through the use of a special additive treatment. Provides excellent resistance to water ingress due to the water repellent treatment being applied throughout the entire blanket thickness. The small amount of additive used ensures the blanket retains the non-combustibility performance of the base blanket. FireMaster blanket has low density thus allowing even hydrocarbon fire protection standards to be met using thin and light specifications significantly contributing to weight savings.

FireMaster® Marine Plus faced blanket:

A variety of facings designed to give greater flexibility when using blanket in areas where surface protection for the blanket may be required.

- **FireMaster® Alu 20R blanket** - factory-applied covering of scrim-reinforced aluminium foil, approximately 20 micron thick, on one side. The blanket has good handling strength and aesthetic appearance when installed.
- **FireMaster® Alu 40 blanket** - factory-applied covering of non-reinforced aluminium foil, approximately 30 micron thick, on one side. The blanket is an approved non-combustible product.
- **FireMaster® GC blanket** - factory-applied covering of glass cloth applied on one side. The blanket is suitable for applications where aluminium foil would not be appropriate and provides a surface that can be painted if required.

FireFelt™:

Low density offers a flexible form which is compressible yet resilient but still highly insulating. This offers a key advantage in weight critical applications such as high speed craft fire protection offering lower product densities than alternative materials but without the risk of loss of physical integrity or insulation performance in a fire. A semi-rigid board with higher tensile and compressive strength.

Expanding felt:

Immediately expands a minimum of three times its original thickness on heating making it ideal for any application where assured fire protection is required under conditions of movement. Typical applications are construction joint sealing, penetration seals and fire protection applications requiring thin layers of insulation.

FireBarrier™ I35:

Cementitious materials designed for a variety of fire protection applications requiring strong and weather resistant exterior finishes, when mixed with water can be applied by spray equipment to a variety of substrates.

- **FireBarrier™ I35** is suitable for cellulosic and hydrocarbon fires and has been fire tested in high-rise hydrocarbon fires of up to 1350°C (2462°F).



Fire protection products : FireMaster®

	FireMaster® Marine Plus blanket			FireMaster® blanket water repellent					
Colour	white			white					
Density, kg/m³	64	96	128	64	96	128	160	192	
Loss on ignition, % 5hrs 1000°C	-			<0.1					
Silicone content, %	-			<0.5					
Water absorption, %	-			2.5					
Linear shrinkage, % , after 24hrs @ 1000°C	-			<1					
Thermal insulation properties, R value, MK/w									
Blanket thickness	25mm	0.78		0.73					
	30mm	0.94		-					
	35mm	1.09		-					
	38mm	-		1.11					
	40mm	1.25		-					
	50mm	1.56		1.46					
	75mm	-		2.19					
	100mm	-		2.92					
Thermal conductivity, W/m•k									
Mean temperature	@ 200°C	0.06	0.05	0.04	0.07	0.06	0.06	0.06	
	@ 300°C	-	-	-	0.09	0.08	0.08	0.07	
	@ 400°C	0.11	0.10	0.09	0.12	0.11	0.10	0.09	
	@ 500°C	-	-	-	0.17	0.14	0.13	0.12	
	@ 600°C	0.17	0.15	0.13	0.22	0.17	0.16	0.15	
	@ 800°C	0.26	0.21	0.19	-	-	-	-	
	@ 1000°C	0.38	0.29	0.25	-	-	-	-	
Acoustic performance		Class A*	Class B**	Class C***					
Frequency, MHz	125	0.15	0.40	0.45	-	0.79	0.09	-	
	250	0.75	0.95	0.90	-	0.29	0.54	-	
	500	1.00	0.95	0.75	-	0.73	0.86	-	
	1000	1.00	0.85	0.65	-	0.92	0.94	-	
	2000	1.00	0.80	0.65	-	0.96	0.94	-	
	4000	0.75	0.65	0.45	-	0.99	0.96	-	
	Overall sound absorption coefficient	1.00	0.80	0.65	-	0.82	0.82	-	

Class A* (Non-faced no surface covering material used)

Class B** (Faced with glass cloth)

Class C*** (Faced with 30 micron reinforced aluminium foil)

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Fire protection products : FireMaster®

	FireMaster® faced blanket			FireFelt™	Expanding Felt	FireBarrier®	
	ALU 20R†	ALU 40†	GC*			FB 135	FB 10
Maximum continuous use temperature, °C	-			-	-	1350	1100
Colour	†White with silver colour aluminium foil l side *White blanket / white glass cloth facing l side			yellow	-	-	-
Density, kg/m ³	-			48 - 384	230	-	950
Density, kg/m ³ , installed	-			-	-	1550	-
Long Term Density	-			-	-	1180	1050
Dry Density	-			-	-	1100	500
Cold crushing strength, MPa, after 72 hrs curing	-			-	-	3.0	0.4
Dry Density	-			-	-	4.0	1.0
Water to mix	-			-	-	50	-
Maximum Grain Size	-			-	-	-	5
Specific Heat (EN 821-3:2005) J/gK	-			-	-	-	-
@ 50°C	-			-	-	-	0.82
@ 150°C	-			-	-	-	0.86
@ 300°C	-			-	-	-	0.96
Modulus of elasticity, Mpa	as installed	-		-	-	4.05	-
	after curing	-		-	-	4.05	-
Loss on ignition, %	5hrs 1000°C	<0.1		-	-	-	-
Linear shrinkage, %, after 24hrs @ 1000°C	<1			-	-	-	-
Thermal insulation properties, R value, MK/w							
Blanket thickness	25mm	0.73		-	-	-	-
	38mm	1.11		-	-	-	-
	50mm	1.46		-	-	-	-
	75mm	2.19		-	-	-	-
	100mm	2.92		-	-	-	-
Thermal conductivity, W/m•k							
Mean temperature	@ 50°C	-	-	-	-	-	0.267
	@ 100°C	-	-	-	-	-	0.82
	@ 200°C	0.07	0.06	0.06	-	-	0.194
	@ 300°C	0.09	0.08	0.08	-	-	0.137
	@ 400°C	0.12	0.11	0.10	-	-	-
	@ 500°C	0.17	0.14	0.13	-	-	0.169
	@ 600°C	0.22	0.17	0.16	-	-	-
	@ 700°C	-	-	-	-	-	0.172
Acoustic performance							
Frequency, MHz	125	-		-	-	15	-
	250	-		-	-	0.7	-
	1000	-		-	-	1.5	-
Chemical composition, %							
	SiO ₂	-		-	-	28.2	-
	Al ₂ O ₃	-		-	-	43.5	-
	CaO	-		-	-	24.4	-
	Fe ₂ O ₃	-		-	-	1.5	-
	TiO ₂	-		-	-	0.8	-
	MgO+K ₂ O + Na ₂ O ₃	-		-	-	1.6	-

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Fire protection products : FireMaster® fibre & refractory

Product Name	FireMaster					
	Blanket	Marine Blanket	Marine Plus Blanket	Firecrete 85	Firecrete 125	FireBarrier 135
Color	white			-		
Density, pcf (kg/m ³)	6, 8 (96, 128)	4, 6, 8 (64, 96, 128)		84 (1346)	123 (1970)	68.67 (1100)
Maximum fire exposure, 2 hours, °F (°C)	2192 (1200)			2500 (1371)	2600 (1427)	2462 (1350)
Facing options, thickness, mil						
aluminum foil facing	2, 4			n/a		
stainless steel foil facing	2					
Surface Burn Characteristics, ASTM E84						
flame spread	0					
smoke developed						
fuel contribution						
Thermal Conductivity, BTU•in/hr•ft ² •°F (W/m•K)						
mean temperature @ 500°F (260°C)	0.39 (0.06)		2.8 (0.40)	5.9 (0.85)	1.85 (0.27), 122°F (50°C)	
@ 1000°F (538°C)	0.73 (0.11)		3.0 (0.43)	6.2 (0.89)	1.35 (0.19), 392°F (200°C)	
@ 1500°F (816°C)	1.28 (0.18)		3.2 (0.46)	6.5 (0.94)	1.71 (0.25), 932°F (500°C)	
@ 1800°F (982°C)	1.73 (0.25)		-			
@ 2000°F (1093°C)	-		3.5 (0.50)	6.7 (0.97)	-	

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Section II

Microporous products

Metric information - Page 89 - 90
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Microporous products

- Min-K® Flexible
- Min-K® Molded
- Min-K® Board
- Min-K® Shape
- Min-K® Endothermic
- Min-K® Tape
- Min-K® Composite

- BTU-BLOCK™ Board
- BTU-BLOCK™ Laminated Board
- BTU-BLOCK™ Panel
- BTU-BLOCK™ Ladel Liner
- BTU-BLOCK™ Flexible

- WDS® Ultra
- WDS® High
- WDS® High Glass Fabric
- WDS® Shape
- WDS® Pad
- WDS® Flexipor®
- WDS® LambdaFlex®
- WDS® LambdaFlex® Super
- WDS® Flexible Pipe
- WDS® Flexible Contour
- WDS® Flexible Design
- WDS® Granulate
- WDS® Protection G-Plus

Thermal Ceramics microporous insulation material is an engineered mineral matrix insulation.

We offer two grades of industrial grades of microporous insulation for high performance aerospace applications that require specific material compositions and our Industrial microporous products that feature varying manufacturing processes and chemistries.

- Reduced energy waste with lower heat loss through insulation lining
- Reduced temperature variability by retaining heat in critical operations thus providing more consistent final product
- Reduced insulation thickness by improving lining design which increases capacity
- Reduced cold face temperatures which will eliminate hot spots, minimize metal fatigue and increase operational safety

Thermal Ceramics BTU-BLOCK™ line of industrial microporous products are one of the most thermally efficient insulations available. BTU-BLOCK™ is ideal for high temperature industrial and OEM environments.

BTU-BLOCK™ Board

- High compressive strengths relative to standard backup insulation
- Offers exceptional performance where machinability is required

BTU-BLOCK™ Laminated Board

- Easily configured to shape on site with standard cutting tools
- Low dust
- High temperature cloth laminated on top and bottom surfaces with an inorganic adhesive

BTU-BLOCK™ Panel

- Encapsulated with glass cloth
 - Maximizes the flexural strength of the rigid panel
 - Very low density product
- Exceptional performance in compression situations

BTU-BLOCK™ Ladel Liner

- Large sheet size for easy installation
- Parallel-stitched pattern offers flexibility for easy installation
- Hydrophobic grades for cast in-place applications

BTU-BLOCK™ Flexible

- Easily wrapped or bent to conform to unique geometric shapes
- Textile encapsulations available for applications up to 982°C (1800°F)
- Excellent vibration resistance
- Pre-cut kits available for more efficient installation

WDS® microporous high temperature insulation products feature a classification temperature rating up to 1100°C (2012°F).

Microtechnology is the key to the innovative WDS Technology. The basic ingredient for the highly efficient insulation effect of our products is a microdispersed silica. This reduces thermal transfer by possible contact between solids to a large extent. In addition, the created micropores minimize heat transfer by convection. Specially developed infrared opacifiers, reduce heat transport processes by absorption and reflection of radiation.



Typical applications - for Microporous products:

- Heat treatment systems for glass
- Fire protection equipment
- Muffler/Silencer/Manifold within exhaust systems
- Measurement equipment
- Electronic devices and parts
- Heat treatment systems for metals
- Metrology and instrumentation
- Plant construction parts
- Parts in the automotive industry
- Chimneys, pipes and diesel exhaust systems
- Deepwater Oil Production
- District Heat Supply
- Power Plants
- Chemical Plants
- Pipe Insulation

WDS[®] products have gained a solid reputation for the energy savings and design optimizations that are not limited to a certain area of application, but offer a broad range to meet varying demands of many market sectors.

- Specialty encapsulation technology
- Specialty near-net-shape technology
- Best in class industrial insulation technology
- Customized solution for super-efficient pipe insulation

Microporous insulation produced at Morgan's Porextherm site utilises proprietary WDS[®] Technology which is today's benchmark in microporous processing know-how and by far the best direct press technology process ever implemented so far. It is today the only available manufacturing technology that allows, through sharp exclusive processing manufacturing methods, for perfect and consistent control and engineering of both the texture and the distribution of the microporous mineral matrix core. All products, rigid or flexible, are based on the direct press technology process, even those contained in glass cloth.

WDS[®] technology key facts:

- Perfect and consistent mineral matrix distribution
- Optimized porosity of the interconnecting chain
- Superior mechanical properties
- Quantity and distribution of opacifiers
- Microscopic particles sizes
- Safest products with best performances (for EU only)

WDS[®] products have gained a solid reputation for the energy savings and design optimizations that are not limited to a certain area of application, but offer a broad range to meet varying demands of many market sectors.

WDS[®] Ultra

- Classification temperature of 1000°C (1832°F)
- Plain boards or with a variety of surface encapsulation protection

WDS[®] High

- Classification temperature of 1050°C (1922°F)
- Plain boards or with a variety of surface encapsulation protection

WDS[®] High Glass Fabrics

- Encapsulated with fibreglass or S-Glass for abrasion resistance

WDS[®] Shape

- Classification temperature of 950°C (1742°F)

WDS[®] Flexipor[®]

- Classification temperature of 1050°C (1922°F)
- Paper microporous hybrid encapsulated in PE film

WDS[®] LambdaFlex[®] and LambdaFlex[®] Super

- Classification temperature of 1832°F (1000°C) and 2012°F (1100°C) and heat sealed in high density film under vacuum

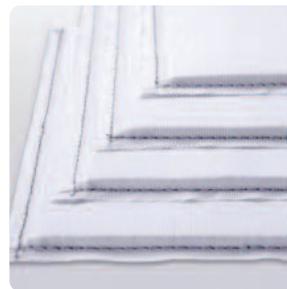
WDS[®] Granulate

- Classification temperature of 950°C (1742°F) this is a pourable, free flowing microporous granulate for filling complex geometries

WDS[®] Flexible Pipe

- Classification temperature of 1000°C (1832°F)
- Flexible pipe insulation design, fully encapsulate, various encapsulation options

*In 2014 Morgan acquired Porextherm[®] and added the WDS[®] brand of microporous insulation materials to a market leading and innovative product portfolio.



Microporous products : WDS®

	WDS® Ultra	WDS® Flexible Pipe	WDS® Flexible Contour	WDS® Flexible Design
Colour	Grey	Grey	White	Grey
Nominal Density, kg/m ³	200 - 250	170 - 210	260 - 520	185 - 250
Classification Temperature, °C	1000	1000	1100	1000
Recommended Temperature of Use, °C	950	950	1000	950
Cold Compressive Strength, N/mm ² ASTM C165	0.417	-	-	-
Compressive Strength, MPa ASTM C165	@ 600°C	0.71	1.029	0.275
350kg/m ³ @ RT	-	-	0.275	-
Shrinkage, % @1000°C for 12hrs exposed on single side AAW 906-00	0.6	0.5	0.4	0.5
Linear Shrinkage, % 24hrs full soak	@ 800°C	-	1.0	-
@ 900°C	1.1	-	-	-
@ 950°C	1.4	-	-	1.5
@ 1000°C	-	4.8	-	3.9
Specific heat capacity, kJ/kg·K DIN 51007	@ 700°C	0.945	0.945	0.958
Thermal Conductivity, (W/Mk) DIN 51046	@ 20°C	-	-	-
@ 100°C	-	-	-	-
@ 200°C	0.022	0.020	-	0.024
@ 400°C	0.027	0.024	-	0.027
@ 600°C	0.034	0.031	-	0.035
@ 800°C	0.044	0.040	-	0.045

	WDS® Pad	WDS® Flexipor	WDS® Shape
Colour	White	White	White
Nominal Density, kg/m ³	300 - 350	280 - 350	300 - 350
Classification Temperature, °C	-	-	1000
Recommended Temperature of Use, °C	-	-	950
Cold Compressive Strength, N/mm ² ASTM C165	-	-	0.342
Compressive Strength, MPa ASTM C165	@ 600°C	-	0.56
350kg/m ³ @ RT	-	-	-
Heat Resistance (Core Material), °C	1000	1050	-
Low Temperature Compressive Strength, N/mm ² DIN 53421	-	1 - 3	-
Hot Temperature Compressive Strength,	@ 700°C	-	1 - 3
Shrinkage, % @1000°C for 12hrs exposed on single side AAW 906-00	0.5	-	0.4
Linear Shrinkage, % 24hrs full soak	@ 800°C	-	0.3 - 0.8
@ 900°C	-	-	-
@ 950°C	1.3	-	1.1
@ 1000°C	2.4	-	2.0
Specific heat capacity, kJ/kg·K DIN 51007	@ 400°C	0.8	1.05
Thermal Conductivity, (W/Mk) DIN 51046	@ 700°C	-	-
@ 20°C	0.021	0.022	-
@ 100°C	-	0.024	0.022
@ 200°C	-	0.024	0.025
@ 400°C	-	0.030	0.031
@ 600°C	-	0.040	0.037
@ 800°C	-	0.056	0.042
@ 1000°C	-	0.078	-

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Microporous products : WDS®

	WDS® High	WDS® High Glass Fabric	WDS® LambdaFlex	WDS® LambdaFlex Super
Colour	White	White	White	Silver
Nominal Density, kg/m ³	250 - 310	250 - 310	300 - 430	300 - 450
Classification Temperature, °C	1100	1050	1100	1100
Recommended Temperature of Use, °C	1000	-	1000	1000
Cold Compressive Strength, N/mm ² ASTM C165	0.386	-	-	-
Compressive Strength, MPa ASTM C165	@ 600°C 1.3	1.029	0.414	1.35
	@ 700°C -	1.3	-	-
Shrinkage, % @1000°C for 12hrs exposed on single side AAW 906-00	0.6	0.5	0.4	0.6
Linear Shrinkage, % 24hrs full soak	@ 800°C -	0.6	-	-
	@ 900°C -	1.3	-	-
	@ 950°C 1.6	-	1.6	1.1
	@ 1000°C 3.5	3.1	3.7	2.0
	@ 1050°C -	-	-	6.1
Specific heat capacity, kJ/kg·K DIN 51007 @700°C	0.963	-	1.0	0.999
Thermal Conductivity, (W/Mk) DIN 51046	@ 20°C -	-	0.021	0.024
	@ 50°C <0.022	0.022	-	-
	@ 100°C -	0.023	-	-
	@ 200°C 0.022	0.025	0.024	-
	@ 300°C -	0.028	-	0.032
	@ 400°C 0.030	0.032	0.028	0.035
	@ 500°C -	0.037	-	-
	@ 600°C 0.043	0.045	0.034	0.044
	@ 700°C -	0.053	-	-
	@ 800°C 0.060	0.064	0.044	0.058

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	WDS® Granulate
Colour	Grey
Nominal Density, kg/m ³	110 - 135
Classification Temperature, °C	1000
Tapped Density, kg/m ³	130 - 160
Vibration Density, kg/m ³	180 - 220
Recommended Temperature of Use, °C	950
Thermal Conductivity, at average temperature of 22.5°C and density 165kg/m ³ (W/mk) with density 200kg/m ³ (W/mk)	@50°C 0.607 @200°C 0.026 0.027 @400°C 0.035 @600°C 0.049 @800°C 0.068

	WDS® Protection G-Plus
Colour (mixed coating liquid)	Light Brown
Density (mixed coating liquid), kg/m ³	1.425 - 1.475
Maximum Temperature Rating, °C	1100
pH Value, (1% Solution)	2.3
Viscosity, (ConeSIMEX8)	
	after 24hrs 9
	after 48hrs 6
Applied Quantity, kg/m ³ (humid)	0.40
Applied Quantity per area, kg/m ³ (dry)	0.22
Applied Thickness, (mm)	0.15 - 0.25
Chloride Content, ASTM F 1277-02 PPM	75

Microporous products : BTU-BLOCK™

Product Name	BTU-BLOCK Board	BTU-BLOCK Laminated Board	BTU-BLOCK Panel	BTU-BLOCK Flexible	BTU-BLOCK Ladle Liner
Density, pcf (kg/m ³)	18, 20, 22, 25 (288, 320, 352, 400)		16 (256)	14, 16 (224, 256)	
Core continuous use limit, °F (°C)	1800 (982)				
Compressive Resistance, psi (MPa), ASTM C 165					
measured density, pcf (kg/m ³)	18 (288)		16 (256)		
10% deformation	156 (1.08)		110 (0.76)	55 (0.38)	
@ 20% deformation	268 (1.85)		182 (1.25)	105 (0.72)	
@ 30% deformation	413 (2.85)		279 (1.92)	155 (1.07)	
@ 40% deformation	670 (4.62)		460 (3.17)	205 (1.41)	
Fired Linear Shrinkage, % ASTM C 356					
24 hrs. @ 1000°F (538°C)			0.3		
@ 1500°F (816°C)			0.6		
@ 1750°F (954°C)			1.3		
Thermal Conductivity, BTU•in./hr•ft²•°F (W/m•K), ASTM C 201					
mean temperature @ 500°F (260°C)	0.16 (0.02)		0.18 (0.03)	0.24 (0.03)	0.22 (0.03)
@ 1000°F (538°C)	0.21 (0.03)		0.23 (0.03)	0.34 (0.05)	0.28 (0.04)
@ 1500°F (816°C)	0.30 (0.04)		0.31 (0.04)	0.53 (0.08)	0.38 (0.05)
@ 1800°F (982°C)	-		-	0.61 (0.09)	0.45 (0.06)

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Microporous products : WDS®

	WDS® Ultra	WDS® High	WDS® Shape	WDS® Flexipor®
Colour	Grey	White	White	White
Nominal Density, pcf	12.91 - 15.76	15.6 - 19.4	18.73 - 21.85	17.48 - 21.85
Classification Temperature, °F	1832	2012	1832	2012
Recommended Temperature of Use, °F	1742	1742	1742	1742
Cold Compressive Strength, N/mm² ASTM C165	0.417	0.386	0.342	-
Compressive Strength, psi (MPa), ASTM C 165	@ 1112°F	0.71	1.3	0.56
	350kg/m³ @ RT	-	-	-
Shrinkage, % for 12hrs exposed on single side AAW 906-00 @1742°F	0.6	0.5	-	-
	@1832°F	-	0.6	0.4
Linear Shrinkage, % 24hrs full soak	@ 1472°F	-	-	-
	@ 1652°F	1.1	-	1.2
	@ 1742°F	1.4	1.6	2.2
	@ 1832°F	-	3.5	-
	@ 1922°F	3.2	-	10.7
Specific heat capacity, kJ/kg·K DIN 51007 @932°F	@ 932°F	0.945	-	-
	@ 1292°F	-	0.963	0.909
Thermal Conductivity, BTU·in./hr·ft²·°F ASTM C177	@ 68°F	-	-	0.15
	@ 122°F	-	<0.15	-
	@ 212°F	-	-	0.15
	@ 392°F	0.15	0.15	0.17
	@ 752°F	0.19	0.21	0.21
	@ 1112°F	0.24	0.30	0.26
	@ 1472°F	0.31	0.42	0.29

	WDS® LambdaFlex	WDS® LambdaFlex Super
Colour	White	Silver
Nominal Density, pcf	18.73 - 26.84	18.73 - 28.09
Classification Temperature, °F	2012	2012
Recommended Temperature of Use, °F	1832	1832
Cold Compressive Strength, N/mm² ASTM C165	-	-
Compressive Strength, MPa ASTM C165	@ 1112°F	1.35
Shrinkage, % @1832°F for 12hrs exposed on single side AAW 906-00	0.4	0.6
Linear Shrinkage, % 24hrs full soak	@ 800°C	-
	@ 900°C	-
	@ 1742°F	1.6
	@ 1832°F	3.7
	@ 1922°F	-
Specific heat capacity, kJ/kg·K DIN 51007 @1292°F	1.0	0.999
Thermal Conductivity, (W/Mk) DIN 51046	@ 68°F	0.15
	@ 392°F	0.17
	@ 752°F	0.19
	@ 1112°F	0.23
	@ 1472°F	0.31

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Section 12

Insulating Firebrick (IFB), Firebrick and Mortar products

Metric information - Page 95 - 99
Imperial information - Page 100 - 102

Insulating Firebrick (IFB) products

- JM™ range
- K® range
- TJM™ range
- Insalcor®
- K33i®
- Insulating roof blocks BV
- Aluminium industry range

Firebrick products

- SR-90®
- SR-99®
- SR-99LS

Mortar products

- High-Temp™
- Blakite®
- Blakite V
- JM3000™
- Smoothset™
- Air-Set™
- K-Bond®
- Mul-Set®
- Coastal® 90
- Coastal 90AS

Market leading brands JM™, K® and TJM™ Insulating Firebricks (IFB), bring unsurpassed performance in a wide variety of markets and offer:

- Geographical manufacturing base
- Extensive range of manufacturing techniques
- Complete range of IFB products
- Network of global distribution
- Experienced team dedicated to IFB technical support in the industry

Firebricks are made from high-purity refractory clays with graduated additions of alumina for the higher temperature products and have carefully graded organic fillers which burn out during manufacture to give a uniform and controlled pore structure.

Insulating roof blocks are designed for use as the hot-face layer in the roofs of furnaces, replacing classic arch roofs in tunnel and other kilns. In addition, a line of high alumina (90+%) dense firebrick SR® is engineered to handle very difficult applications. These high purity bricks have excellent load-bearing strength at temperatures above 1649°C (3000°F) and provide good thermal shock resistance.

Insulating Firebricks, features include:

- Excellent strength at ambient and elevated temperatures
- High compressive strength
- Every brick ground to precise dimensions
- Very low levels of iron and other impurities (especially for resistance to reducing atmosphere conditions)
- Lower heat storage than denser refractories
- Available in custom designed shapes upon request

Insulating Firebricks, benefits include:

- Energy saving benefits
- Lower operating costs
- Lightweight, energy-saving nature results in less heat loss and allows for thinner furnace linings

Insulating Firebricks (IFB's) are well established products for solving many problems of high temperature heat containment in industries ranging from ceramic production kilns to anodes for primary aluminium.



Typical applications - for our Insulating Firebrick, Firebrick and mortar products:

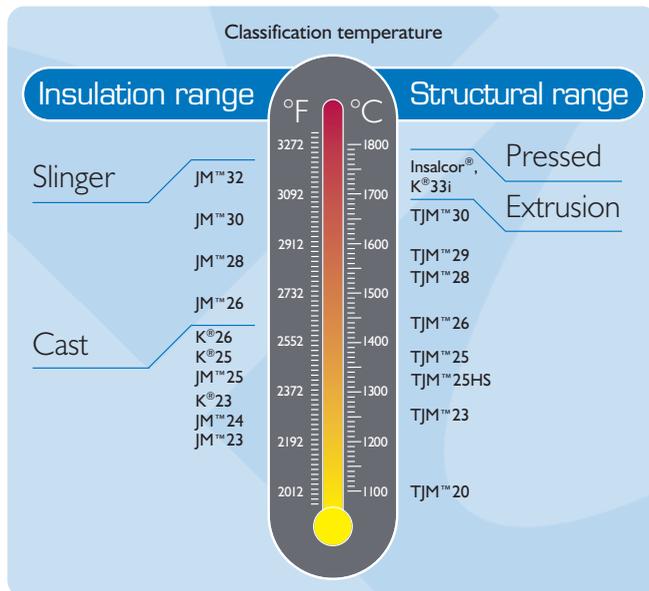
Hot face refractory lining or as back-up insulation in:

- **Aluminium**
Anode bake furnaces and primary electrolytic cells
- **Petrochemical**
Kilns, flues, refining vessels and heaters and reactor chambers

- **Coke and iron making**
Blast furnaces, hot blast stoves, hot blast and bustle mains
- **Ceramics**
Roller, shuttle, tunnel, hobby and laboratory kilns

Insulation range

The 'Insulation Range' comprises both IFB's produced by the **Cast** method at Casalpusterlengo (Italy) and Augusta, Georgia (USA) for service temperatures below 1300°C (2372°F) and those produced by the **Slinger** method at Casalpusterlengo for higher service temperatures. Our Cast IFB's in particular are truly market leading products, offering the lowest thermal conductivity available on the market today for applications above 1000°C (1832°F), delivering big energy savings for customers in the ceramics, petrochemical, aluminium and iron and steel sectors.



Structural range

The 'Structural Range' focuses on the superior physical properties offered by our IFB's manufactured by **Extrusion** at our manufacturing plant in Yixing (China), with products available for a wide range of temperatures, plus our **Pressed** Insalcor® produced at our manufacturing site in Augusta, Georgia (USA) for the very highest temperature applications above 1600°C (2912°F). These products offer superior performance in load bearing applications and in conditions where abrasion from mechanical abuse or flow of hot gases is severe.

Special shapes

In addition to the standard brick sizes, our JM™ and K® insulating firebricks are available in a wide range of special shapes. JM™ in particular can offer joint free large brick and special shapes due to the unique large slab production method. Both JM™ and K® ranges can be mortared together and machined to produce extra large shapes with minimal joints.

Insulating roof block range also includes JM™ 26 – 30 classification 1430 - 1650°C (2606 - 3002°F)

- **Good thermal insulation**
- **Low thermal mass**

- **Simplified engineering**
- **Easy installation**
- **Low maintenance costs**
- **Accurate dimensions**

Mortars and coatings available:

Blakite : classification 1650°C (3002°F). A highly refractory mortar with a high water-retention characteristic. Developed for laying insulating firebricks but is also suitable for use with super-duty and high alumina dense refractory bricks, at operating temperatures up to 1650°C (3002°F).

Blakite V : classification 1650°C (3002°F). Standard product with a harder consistency to be used to glue special refractory shapes and steel plates.

JM 3300 : classification 1760°C (3200°F). A very highly refractory air-setting mortar suitable for laying JM 32 insulating firebricks, and high alumina dense refractory bricks.

High-Temp : is a dry heat-setting mortar. Classification temperature 1649°C (3000°F)

Smoothset™ : mortars are an economical, tacky mortar. Excellent for built-up shapes. Available as wet and dry with classification temperature up to 1593°C (2900°F).

Airset™ : wet and dry version mortars are a tacky 1649°C (3000°F) mortar excellent for built-up shapes of IFB or super duty Firebricks.

K-Bond™ : wet and dry version mortars are an extra smooth and creamy consistency. It has a long shelf life and is good for mortaring IFB and Firebrick linings.

Mul-Set™ F : are a high alumina wet and dry version mortar suited for high temperature IFB linings.

Coastal 90™ and Coastal 90 AS™ : are a wet and dry version of extra high alumina mortar. They are ideal for 90% alumina brick constructions.



Insulating Firebrick products

	Insulation range									
	JM™ 23	JM™ 24	K® 23	JM™ 25	K® 25	K® 26	JM™ 26	JM™ 28	JM™ 30	JM™ 32
ISO 2245 Classification	I25 0.5L	-	-	-	-	-	I40 0.8L	I50 0.9L	I60 1.0L	I70 1.2L
Manufacturing Method	Casting	Casting	Casting	Casting	Casting	Casting	Slinger	Slinger	Slinger	Slinger
Classification Temperature, °C	1260	1300	1315	1350	1370	1430	1430	1540	1650	1760
Density, kg/m³ (ASTM C-134-95)	480	510	513	615	617	617	800	890	1020	1250
Modulus of Rupture, MPa (ASTM C-133-97)	1	0.8	0.79	1.4	0.95	0.9	1.5	1.8	2	2.1
Cold Crushing Strength, MPa (ASTM C-133-97)	1.2	1.0	1	1.8	1.3	1.3	1.6	2.1	2.1	3.5
Permanent Linear Shrinkage, (ASTM C-210) % after 24hrs Soaking										
@1230°C	-0.2	-0.1	0.0	-	-	-	-	-	-	-
@1290°C	-	-0.3	-	-	-	-	-	-	-	-
@1343°C	-	-	-	-	-0.3	-	-	-	-	-
@1350°C	-	-	-	-0.4	-	-	-	-	-	-
@1400°C	-	-	-	-	-	-0.3	-0.2	-	-	-
@1510°C	-	-	-	-	-	-	-	-0.4	-	-
@1550°C	-	-	-	-	-	-	-	-	-	-
@1570°C	-	-	-	-	-	-	-	-	-	-
@1620°C	-	-	-	-	-	-	-	-	-0.8	-
@1730°C	-	-	-	-	-	-	-	-	-	+0.8
Rev. Linear Expansion, (max %)	0.5	0.6	-	0.6	-	-	0.7	0.8	0.8	1.1
Deformation under hot load, % after 90 mins (ASTM C-16)										
1093°C @ 0.069 MPa	-	-	0.1	-	-	-	-	-	-	-
1100°C @ 0.034 MPa	0.1	-	-	-	-	-	-	-	-	-
1100°C @ 0.069 MPa	-	0.1	-	0.1	-	-	-	-	-	-
1200°C @ 0.069 MPa	-	0.2	-	0.2	0.2	0.2	-	-	-	-
1260°C @ 0.069 MPa	-	-	-	-	-	-	0.2	0.1	-	-
1320°C @ 0.069 MPa	-	-	-	-	-	-	-	0.2	0.1	-
1370°C @ 0.069 MPa	-	-	-	-	-	-	-	-	0.5	0.2
CO Attack, (popouts after 200hrs)										
	-	-	-	-	-	-	-	-	-	-
Coefficient of Thermal Expansion, (in/in°Cx10⁻⁶)										
	-	-	5.40	-	5.60	4.80	-	-	-	-
Thermal Conductivity, (ASTM C-182) W/m•K										
@200°C	-	-	-	-	-	-	-	-	-	-
@260°C	-	-	0.13	-	0.15	0.16	-	-	-	-
@400°C	0.12	0.14	-	0.17	-	-	0.25	0.30	0.38	0.49
@538°C	-	-	0.17	-	0.18	0.19	-	-	-	-
@600°C	0.14	0.16	-	0.19	-	-	0.27	0.32	0.39	0.50
@800°C	0.17	0.18	-	0.21	-	-	0.30	0.34	0.40	0.51
@815°C	-	-	0.20	-	0.20	0.21	-	-	-	-
@1000°C	0.19	0.2	-	0.23	-	-	0.33	0.36	0.41	0.53
@1093°C	-	-	0.24	-	0.22	0.24	-	-	-	-
@1200°C	-	-	-	-	-	-	0.35	0.38	0.42	0.56
@1371°C	-	-	-	-	-	0.27	-	-	-	-
@1400°C	-	-	-	-	-	-	-	-	-	0.60
Specific Heat Capacity, kJ/kg•K	@1000°C	1.05	1.05	-	1.07	-	-	1.10	1.10	1.10
Chemical Composition, %										
Al ₂ O ₃	37.0	44.5	38.3	48.3	47.0	48.0	58.0	67.1	73.4	77.0
SiO ₂	44.4	41.2	44.3	37.2	38.0	36.0	39.1	31.0	25.1	21.5
Fe ₂ O ₃	0.7	0.7	0.3	0.54	0.2	0.3	0.7	0.6	0.5	0.3
TiO ₂	1.2	0.9	1.6	1.5	1.4	1.2	0.1	0.1	0.1	Trace
CaO	15.2	11.6	15.0	12.1	13.5	12.3	0.1	0.1	Trace	Trace
MgO	0.3	-	0.1	-	0.1	0.1	0.2	0.1	Trace	0.1
Na ₂ O+K ₂ O	1.1	-	0.4	-	0.4	0.3	1.7	0.9	0.9	0.9
Na ₂ O+K ₂ O+MgO	-	1.1	-	0.36	-	-	-	-	-	-

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Metric information

Insulating Firebrick products

	Structural range								Insulating roof blocks BV		
	TJM™ 20	TJM™ 23	TJM™ 25	TJM™ 26	TJM™ 28	TJM™ 29	TJM™ 30	K® 33i	BV26	BV28	BV30
ISO 2245 Classification	-	-	-	-	-	-	-	180 1.3L	-	-	-
IFB Precursor	-	-	-	-	-	-	-	-	JM 26	JM 28	JM 30
Manufacturing Method	Extrusion	Extrusion	Extrusion	Extrusion	Extrusion	Extrusion	Extrusion	Pressing	-	-	-
Classification Temperature, °C	1100	1260	1350	1430	1540	1580	1650	1790	1430	1540	1650
Density, kg/m³ (ASTM C-134-95)	500	500	800	800	900	1100	1100	1314	800	890	1020
Support Plate Steel	-	-	-	-	-	-	-	-	AISI 321	AISI 321	Depends on application
Plate Thickness, mm	-	-	-	-	-	-	-	-	1.2	1.2	1.2
Modulus of Rupture, MPa (ASTM C-133-97)	0.7	0.7	1.2	1.8	1.8	2.0	2.0	3.1*	1.5	1.8	2.1
Cold Crushing Strength, MPa (ASTM C-133-97)	0.8	1.0	1.8	2.0	2.5	3.0	3.0	6.2*	1.6	2.1	2.2
Permanent Linear Shrinkage, (ASTM C-210) % after 24hrs Soaking											
@1230°C	-	-0.2	-	-	-	-	-	-	-	-	-
@1350°C	-	-	-0.5	-	-	-	-	-	-	-	-
@1400°C	-	-	-	-0.5	-	-	-	-	-	-	-
@1510°C	-	-	-	-	-1.0	-	-	-	-	-	-
@1550°C	-	-	-	-	-	-1.0	-	-	-	-	-
@1570°C	-	-	-	-	-	-	-1.0	-	-	-	-
@1730°C	-	-	-	-	-	-	-	+0.4	-	-	-
Rev. Linear Thermal Expansion, (max %)	0.6	0.6	0.7	0.7	0.8	0.9	0.9	-	0.7	0.8	0.9
Deformation under hot load, % after 90 mins (ASTM C-16)											
1093°C @ 0.069 MPa	-	-	-	-	-	-	-	-	-	-	-
1100°C @ 0.034 MPa	0.1	0.1	0.1	-	-	-	-	-	-	-	-
1100°C @ 0.069 MPa	-	-	-	-	-	-	-	-	-	-	-
1200°C @ 0.034 MPa	-	-	-	-	-	-	-	-	-	-	-
1260°C @ 0.069 MPa	-	-	0.7	0.3	-	-	-	-	-	-	-
1320°C @ 0.069 MPa	-	-	-	-	0.2	0.1	0.1	-	-	-	-
1370°C @ 0.069 MPa	-	-	-	-	-	-	-	-	-	-	-
1450°C @ 0.069 MPa	-	-	-	-	-	-	-	+0.1	-	-	-
CO Attack, (popouts after 200hrs)	0	0	0	0	0	0	0	0	-	-	-
Coefficient of Thermal Expansion, (in/in°Cx10⁶)	-	-	-	-	-	-	-	6.80	-	-	-
Thermal Conductivity, (ASTM C-182) W/m•K											
@200°C	0.15	0.15	0.20	0.28	0.32	0.36	0.36	-	-	-	-
@260°C	-	-	-	-	-	-	-	0.79	-	-	-
@400°C	0.18	0.18	0.25	0.29	0.33	0.38	0.38	-	-	-	-
@538°C	-	-	-	-	-	-	-	0.80	-	-	-
@600°C	0.22	0.22	0.28	0.32	0.34	0.41	0.41	-	-	-	-
@800°C	-	0.27	-	0.35	0.37	-	-	-	-	-	-
@815°C	-	-	-	-	-	-	-	0.91	-	-	-
@1000°C	-	0.32	-	0.39	0.41	-	-	-	-	-	-
@1093°C	-	-	-	-	-	-	-	1.09	-	-	-
@1200°C	-	-	-	0.43	0.46	-	-	-	-	-	-
@1371°C	-	-	-	-	-	-	-	1.33	-	-	-
@1400°C	-	-	-	-	-	-	-	-	-	-	-
Specific Heat Capacity, kJ/kg•K @1000°C	-	-	-	-	-	-	-	-	-	-	-
Chemical Composition, %											
Al ₂ O ₃	45.0	45.0	50.0	55.0	64.0	70.0	73.0	77.0	-	-	-
SiO ₂	50.0	48.0	45.0	41.0	32.0	28.0	25.0	21.0	-	-	-
Fe ₂ O ₃	1.0	1.0	0.9	0.9	0.7	0.7	0.6	0.4	-	-	-
TiO ₂	-	-	-	-	-	-	-	0.6	-	-	-
CaO	-	-	-	-	-	-	-	0.1	-	-	-
MgO	-	-	-	-	-	-	-	0.1	-	-	-
Na ₂ O+K ₂ O	1.0	1.2	1.0	0.9	0.8	0.7	0.7	0.3	-	-	-
Na ₂ O+K ₂ O+MgO	-	-	-	-	-	-	-	-	-	-	-

Insulating Firebrick products

	Aluminium Industry Range			
	TCA 125	TC A 130	JM 23	TC A 26
Classification Temperature, °C	1350	1250	1260	1430
Properties Measured at Ambient Conditions				
Density, kg/m ³ according to ISO 5016 (1997)	1100	600	480	850
Cold Crushing Strength according to NF EN ISO 8895 (2006) Standard. MPa	8	2.2	1.2	2.2
Dimensional Tolerances for the 3 Dimensions, mm	±1	±1	±1	±1
High Temperature Performance				
Refractoriness according to ISO 528 (1983) Standard. °C	1350	1435	1435	1700
Thermal Expansion Between 20°C and 1300°C according to B 40-308 (1986) Standard. %	0.55	0.60	0.56	0.63
Permanent Linear Change, according to ISO 2477:2005 Standard, after 12hrs Soaking at : %				
@1230°C	-	-0.5	-0.2	-
@1350°C	-1	-	-	-
@1400°C	-	-	-	-0.4
Thermal Conductivity, (ASTM C-182-88) at Mean Temperature of : W/m.K				
200°C	0.36	0.14	0.11	-
400°C	0.38	0.16	0.13	0.26
600°C	0.42	0.18	0.15	0.28
800°C	0.44	0.21	0.18	0.31
1000°C	0.46	0.25	0.21	0.34
1200°C	-	-	-	0.36
Chemical Composition				
According to NF EN ISO 21587-1 (2007) and NF EN ISO 21587-2 (2007) Standards. %				
Al ₂ O ₃	38.0	36.5	37.0	57.0
SiO ₂	56.1	45.0	44.0	39.8
Fe ₂ O ₃	1.8	0.7	0.7	0.7
TiO ₂	0.1	1.2	1.2	0.1
CaO	0.1	15.2	15.5	0.3
Na ₂ O+K ₂ O+MgO	0.4	1.4	1.1	2.1

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Insulating Firebrick products

	JM™ 25 HD	JM™ 26 HD	JM™ 28 HD	JM™ 30 HD
Classification, (ASTM C-155-70)	Group 25	Group 26	Group 28	Group30
Temperature Classification, °C	1350	1400	1540	1650
Density, kg/m³ (ASTM C-134)	880	920	1000	1190
Modulus of Rupture, MPa (ASTM C-133)	2.0	2.2	3.2	3.5
Cold Crushing Strength, MPa (ASTM C-133)	2.7	3.5	4.2	5.0
Permanent Linear Change, % (ASTM C-210)				
soaking at temperature 1350°C	-0.2	-	-	-
soaking at temperature 1400°C	-	-0.3	-	-
soaking at temperature 1510°C	-	-	-0.5	-
soaking at temperature 1620°C	-	-	-	-0.6
Thermal Conductivity, W/mK (ASTM C-182)				
at mean temperature of 400°C	0.38	0.33	0.38	0.40
at mean temperature of 600°C	0.39	0.35	0.39	0.41
at mean temperature of 800°C	0.40	0.37	0.40	0.42
at mean temperature of 1000°C	0.41	0.39	0.41	0.43
at mean temperature of 1200°C	0.43	-	0.42	0.44
Chemical Analysis, % (TM MI-CAS-PF 225)				
Al ₂ O ₃	48.0	58.0	67.1	73.4
SiO ₂	49.1	39.1	31.0	25.1
Fe ₂ O ₃	0.7	0.7	0.6	0.5
TiO ₂	0.1	0.1	0.1	0.1
CaO	0.1	0.1	0.1	Trace
MgO+Na ₂ O +K ₂ O	1.9	1.9	1.0	0.9
lg. Loss	Trace	Trace	Trace	Trace

	JM™ 23 ECO	JM™ 26 ECO	JM™ 28 ECO
Classification, (ASTM C-155-70)	Group 23	Group 26	Group 28
Temperature Classification, °C	1260	1430	1540
Density, kg/m³ (ASTM C-134)	500	800	890
Modulus of Rupture, MPa (ASTM C-133)	0.8	1.1	1.6
Cold Crushing Strength, MPa (ASTM C-133)	0.9	1.3	1.6
Permanent Linear Change, % (ASTM C-210)			
after 24hrs soaking at temperature 1230°C	-0.8	-	-
after 24hrs soaking at temperature 1400°C	-	-0.5	-
after 24hrs soaking at temperature 1510°C	-	-	-1.2
Thermal Conductivity, W/mK (ASTM C-182)			
at mean temperature of 400°C	0.13	0.32	0.35
at mean temperature of 600°C	0.15	0.35	0.36
at mean temperature of 800°C	0.18	0.37	0.38
at mean temperature of 1000°C	0.20	0.39	0.40
at mean temperature of 1200°C	-	0.41	0.42
Chemical Analysis, % (TM MI-CAS-PF 225)			
Al ₂ O ₃	35.0	48.0	62.0
SiO ₂	45.4	48.0	35.0
Fe ₂ O ₃	0.7	0.9	0.7
TiO ₂	1.2	0.6	0.2
CaO	16.2	0.2	0.2
MgO+Na ₂ O +K ₂ O	1.4	1.9	1.2
lg. Loss	Trace	Trace	Trace

Insulating Firebrick products

	COATING ZR	TCA 125 10-1	JM™ 23 400	JM™ 25 PH	JM™ 25 SL
Classification, (ASTM C-155-70)	-	-	Group 23	Group 25	Group 25
Maximum Allowance Temperature, °C	1650	-	-	-	-
Temperature Classification, °C	-	1350	1260	1350	1350
Density, kg/m³ (ASTM C-134)	2450	1100	390	750	720
Penetration, (mm) (TM C-MP-CF-221)	14 - 28	-	-	-	-
Linear Change, % (TM C-MP-PF-222) after drying 50°C	-2.3	-	-	-	-
Modulus of Rupture, MPa (TM C-MP-PF-222)					
after drying 50°C	22.0	-	-	-	-
Modulus of Rupture, MPa (ASTM C-133)	-	5.0	0.8	1.4	1.0
Cold Crushing Strength, MPa (ASTM C-133)	-	9.0	0.8	1.5	1.3
Permanent Linear Change, % (TM C-MP-PF-222)					
after 5hrs firing @ 1540°C	-1.5	-	-	-	-
Permanent Linear Change, % (ASTM C-210)					
after 24hrs, temperature 1230°C	-	-	-0.4	-	-
soaking at temperature 1300°C	-	-	-	-	-0.5
soaking at temperature 1320°C	-	-	-	-0.4	-
soaking at temperature 1350°C	-	-0.5	-	-	-
Thermal Conductivity, W/mK (ASTM C-182)					
at mean temperature of 400°C	-	0.38	0.10	0.28	0.22
at mean temperature of 600°C	-	0.42	0.12	0.32	0.25
at mean temperature of 800°C	-	0.44	0.15	0.38	0.29
at mean temperature of 1000°C	-	0.46	-	0.44	0.34
Chemical Analysis, % (TM MI-CAS-PF 225)					
Al ₂ O ₃	33.0	38.0	37.0	47.0	48.0
SiO ₂	48.0	56.1	44.4	47.0	47.0
ZrO ₂	11.0	-	-	-	-
Fe ₂ O ₃	1.0	1.8	0.7	0.9	0.9
TiO ₂	1.0	0.1	0.8	0.5	0.5
CaO	0.2	0.1	15.2	0.8	0.1
MgO+Na ₂ O +K ₂ O	5.0	0.4	1.1	1.9	1.9
lg. Loss	Trace	Trace	Trace	Trace	Trace

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Insulating Firebrick products : low & high temperature

Product Name	K [®] -23	TC™-23	IFB 23 Tile	K-25	K-26	TC-26	JM™-28	JM™-30
Hot Face temperature use limit, °F (°C)	2300 (1260)			2500 (1371)	2600 (1427)		2800 (1538)	3000 (1649)
Melting point, °F (°C)	2750 (1510)			2800 (1538)	3000 (1649)		3190 (1754)	
Density, ASTM C 134								
lbs/9in (kg/229mm) straight	1.93 (0.87)	1.9 (0.85)	2.2 (1.0)	2.3 (1.5)	2.3 (1.1)	2.8 (1.3)	3.2 (1.46)	3.8
pcf (kg/m ³)	31 - 35 (497 - 560)	30 - 36 (480 - 576)	37 (593)	38 - 41 (593 - 641)	40 (640)	48 (770)	55 (890)	65 (1041)
Modulus of Rupture, psi (MPa), ASTM C 133	115 (0.79)	105 (0.72)		135 (0.93)		200 (1.4)	220 (1.5)	250 (1.74)
Cold Crushing Strength, psi (MPa), ASTM C 133	145 (1.0)	130(0.9)		200 (1.38)		270 (1.9)	340 (2.3)	440 (3.05)
Permanent Linear Change, %, ASTM C 210								
fired @ 2250°F (1232°C)	0 to -0.1	0 to -0.2	0 to -0.1	-				
@ 2450°F (1343°C)	-	-	-	-0.3	-			
@ 2550°F (1400°C)				-0.8	-0.1	-		
@ 2750°F (1510°C)				-		-0.5	-	
@ 2950°F (1620°C)				-		-0.7	-	
@ 3150°F (1732°C)				-		-0.4	-	
Deformation Under Hot Load, % @ 10 psi, ASTM C 16								
1 1/2 hrs. @ 2000°F (1093C)	0			-		-		
@ 2200°F (1204°C)	0.3	-	0.1	-		0.2	0.1	-
@2400°F (1315°C)	-			-		-	0.2	0.3
Chemical Analysis, % Weight basis after firing								
Alumina, Al ₂ O ₃	38	38.5	46	48	47	67	70	
Silica, SiO ₂	45	47.5	37.5	37.5	48.6	30.5	28	
Ferric oxide, Fe ₂ O ₃	0.3	0.4	0.3	0.3	0.7	0.5	0.3	
Titanium oxide, TiO ₂	1.6	1.6	1.4	1.2	1.3	0.6	1.2	
Calcium oxide, CaO	15	11	14	13	0.3	0.3	0.2	
Magnesium oxide, MgO	0.1	0.2	0.1					
Alkalies, as Na ₂ O	0.5	0.3	0.4	0.3	2.0	1.0	0.2	
Coefficient of Reversible Thermal Expansion, in./in. • °F • 10 ⁻⁶	3.0	-	3.1	3.1	-	3.4	3.5	
Thermal Conductivity, BTU • in./hr • ft ² • °F (W/m • K), ASTM C 182								
mean temp. @ 500°F (260°C)	0.86 (0.13)	1.0 (0.14)	1.06 (0.15)	1.12 (0.17)	1.6 (0.23)	2.3 (0.33)	2.8 (0.40)	
@ 1000°F (538°C)	1.08 (0.15)	1.3 (0.18)	1.22 (0.18)	1.28 (0.19)	1.9 (0.27)	2.4 (0.34)	2.9 (0.42)	
@ 1500°F (815°C)	1.32 (0.19)	1.6 (0.23)	1.38 (0.20)	1.46 (0.22)	2.2 (0.32)	2.5 (0.36)	3.1 (0.45)	
@ 2000°F (1093°C)	1.57 (0.23)	1.8 (0.25)	1.54 (0.22)	1.65 (0.25)	2.6 (0.37)	2.6 (0.37)	3.3 (0.47)	
@ 2500°F (1371°C)	-			1.88 (0.28)	-	2.7 (0.38)	3.5 (0.49)	
Brick Identifier, printed on brick	23		25	26		28	30	

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Mortar products : dry and wet

Product Name	High-Temp™	Smoothset™		Air-Set™		Air-Set 3000 EG	K-Bond®		Mul-Set® F		Coastal® 90	Coastal 90 AS
	heat setting	wet, air setting	dry, air setting	wet, air setting	dry, air setting	wet, air setting	wet, air setting	dry, air setting	wet, air setting	dry, air setting	wet, air setting	dry, air setting
Classification temperature rating, °F (°C)	3000 (1649)	2850 (1566)	2900 (1593)	3000 (1649)			3200 (1760)		3250 (1788)	3300 (1816)		
Type of Brick	IFB						IFB/Insalcor			Firebrick		
Quantities required, lb (kg)/1000 brick ¹	220 - 250 (100 - 113)	250 - 320 (113 - 145)	180 - 240 (82 - 109)	360 - 400 (163 - 181)	275 - 300 (125 - 136)	250 - 320 (113 - 145)	300 - 360 (136 - 163)	220 - 280 (100 - 127)	300 - 350 (136 - 159)	200 - 300 (91 - 136)	240 - 320 (109 - 145)	450 - 550 (204 - 249)
Lbs required to Brush Coat, 100 sq ft (9 sq m)	26 (12)	22 (10)	20 (9)	22 (10)	20 (9)	22 (10)		20 (9)	22 (10)	20 (9)	-	
Average recommended water, %												
Trowel	26	-	29	-	31	-		20	-	22	-	23
Dip	44	-	50	-	52	-		37	-	33	-	45
Pounds per Bag, lb (kg)	50 (23)	55 (25), drum	50 (23)	55 (25), drum	50 (23)	55 (25), drum	55 (25), drum	50 (23)	55 (25), drum	50 (23)	55 (25), drum	50 (23)
Shelf life, months	12	3 - 6	12	6 - 12	12	6 - 9	>12	12	6 - 12	12	6 - 12	12
Chemical Analysis, % Weight basis after firing												
Alumina, Al ₂ O ₃	45	36	38	46	45	44	47		66		87	
Silica, SiO ₂	50	57	58	47	48	50	47	48	28	24	8	7
Ferric oxide, Fe ₂ O ₃	1.0	0.9	1.0	0.8	1.1	0.8	0.9		1.2		0.3	0.2
Titanium oxide, TiO ₂	2.2	1.7	1.9	1.7	1.9		0.7	1.1	2.2			0.1
Calcium oxide, CaO	0.2			0.1	0.2	0.1		0.5	0.1		trace	
Magnesium oxide, MgO	0.1						0.4	0.1				
Alkalies as Na ₂ O	0.6	4	2.8	2.1	2.2	2.6	4.3	2.1	-			
Boron oxide, B ₂ O ₃	0.7	-										

¹ Amount of mortar used for laying either insulating firebrick or firebrick varies according to masonry practice. A range of quantities is shown for each respective type of brick listed above.

Firebrick products

Product Name	SR-90®	SR-99®	SR-99 LS	Insalcor®
Hot Face temperature use limit, °F (°C)	3100 (1704)	3200 (1760)		3250 (1788)
Melting point, °F (°C)	3480 (1915)	3660 (2016)		3350 (1843)
Density, ASTM C134, lbs/9in (kg/229mm) straight	10.6 (0.07)	11.3 (0.08)	-	4.6 (2.09)
	pcf (kg/m ³)	180 (2880)	193 (3091)	82 (1314)
Modulus of Rupture, psi (MPa), ASTM C 133				
@ room temperature	3600 (24.83)	3800 (26.21)	4200 (28.97)	350 (2.4)
@ 2000°F (1093°C)	4500 (31.03)	2900 (20.00)	-	-
@ 2300°F (1260°C)	4200 (28.97)	1600 (11.03)	2000 (13.79)	-
@ 2600°F (1427°C)	2900 (20.00)	800 (5.52)		-
@ 2800°F (1538°C)	2100 (14.48)	650 (4.48)	-	-
Cold Crushing Strength, psi (MPa), ASTM C 133	9000 (62.05)	8000 (55.16)	9000 (62.05)	1000 (6.9)
Permanent Linear Change, % After 24 hrs, ASTM C 210				
5 hrs @ 3200°F (1649°C)	1.5	-	-	-
24 hrs @ 3200°F (1649°C)	-	-0.1	-	-
72 hrs @ 3200°F (1649°C)	-	-	-0.6	-
Deformation Under Hot Load, % @ 25 psi, ASTM C 16				
1 1/2 hrs @ 2640°F (1449°C)	0	-0.3	-	0.1
1 1/2 hrs @ 2800°F (1538°C)	0.1			-
1 1/2 hrs @ 3000°F (1649°C)		-	-	
1 1/2 hrs @ 3200°F (1760°C)		<0.25	-	-
150 hrs @ 3200°F (1760°C)				
Porosity, % ASTM C 20	18	17	20	
Coefficient of Reversible Thermal Expansion, in./in. • °F • 10⁻⁶ (mm/mm • °C • 10⁻⁶)		-		3.8 (6.8)
Chemical Analysis, % Weight basis after firing				
Alumina, Al ₂ O ₃	90	99.4	99.5	77
Silica, SiO ₂	10	0.4	0.1	21
Ferric oxide, Fe ₂ O ₃	0.2	0.1	trace	0.4
Titanium oxide, TiO ₂	trace	trace		
Calcium oxide, CaO	0.1		0.2	0.1
Magnesium oxide, MgO	trace		trace	
Alkalies as Na ₂ O	0.2	0.1	0.2	0.3
Thermal Conductivity, BTU • in/hr • ft² • °F (W/m • K), ASTM C 182				
mean temperature @ 500°F (260°C)	24.6 (3.55)	38.9 (5.61)		5.5 (0.79)
@ 1000°F (538°C)	21.5 (3.10)	30.7 (4.42)		5.6 (0.80)
@ 1500°F (816°C)	19.4 (2.80)	25.5 (3.68)		6.3 (0.91)
@ 2000°F (1093°C)	17.7 (2.55)	21.6 (3.11)		7.6 (1.09)
@ 2500°F (1371°C)	16.5 (2.38)	19.1 (2.75)		9.2 (1.33)

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Section 13

Monolithic and Castable products

Metric information - Page 105 - 127
Imperial information - Page 128 - 140

Monolithic Tri-Mor products

Insulating : Firelite®, Kaolite®, Tri-Mor® (Blockmix, Coolcast®, Extralite, Insulcast, Insulite)

- Used for the containment of heat within high temperature operating structure and can be used for either hot face working linings or as backing linings behind higher density working linings.

Dense : Firecrete®, Kaocrete®, Tri-Mor® (Midcast, HT, BF Cast, 1800T Guncrete, etc)

- Dense and Conventional grades are bonded by high alumina cements. These grades are easily placed by casting or gunning and offer good performance in most general applications.

Low cement : Tri-Mor® Hicast, Morflo, Higun

- As the name suggests these grades are formulated with low cement, typical 5-7%. They also incorporate fine fillers and dispersants which significantly reduce water demand and enhance physical properties.

Medium cement : Tri-Mor® Vibrotek

- These grades contain cement additions of 10% to 15% and offer easy mixing and installation. They offer excellent resistance to abrasion and thermal shock for general purpose application.

Clay bonded : Tri-Mor® Plastics, Plascast, Plasgun

- The original monolithic materials were clay bonded plastics/ moldables. Grades today can be supplied, with similar properties, which can be cast or gunned.

Aluminum resistance : Tri-Mor® Alcast, Albond, Alumor, Alcoat

- Specifically developed with enhanced resistance to corundum growth which can occur when molten aluminium is in contact with refractory materials.

Special duty : Tri-Mor® Kao-Tuff®

- Grades have been specifically developed for particular applications where abrasion resistance is essential.

Phosphate bonded : Tri-Mor® Morbond

- Compositions bonded with phosphate binders offer excellent resistant to most molten metals and slags. Grades are available which can be installed by ramming, casting or gunning.

Dry vibratory : Tri-Mor® TV90

- This material is installed dry and consolidated by vibration to form a dense lining. On heating the material it forms a sintered, strong lining.

Cements and mortars : Aiset, Blakite, Triset, JM

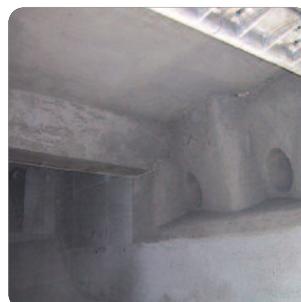
- These are fine grained compositions, which can be supplied dry and ready mixed. They are used for bonding bricks or fibre modules in furnace linings.

Thermal Ceramics produce a range of Monolithic materials which can be placed in-situ by casting, gunning, parging, trowelling or ramming and provide a wide range of innovative solutions for heat-intensive challenges.

Available in different formulations, densities, and installation methods, monolithics can be used as primary or secondary insulation, for repair, or for speciality applications. Particular grades will be selected depending on the structure to be lined. A lining may be installed using a single material or can be a complex selection depending on the environment and operation of the lined structure.

Specific grades have been developed for high temperature insulation, metal contact, slag resistance, abrasion resistance or thermal shock resistance.

Thermal Ceramics offer an extensive range of alumino-silicate and silicon carbide based Monolithic grades.



Typical applications - for Monolithic Tri-Mor® products:

- Heat treatment applications
- Convection section
- Wood fired boilers
- Reheating furnace
- Vibration casting of transfer lines
- Water tube boiler
- Steel ladle safety linings

Monolithic Tri-Mor® products

Benefits:

Linings generally provide lower thermal conductivity results compared to traditional dense brick constructions, achieving greater heat savings.

They are faster to install, resulting in:

- Faster turnaround of repairs and maintenance
- Lower operational costs
- Greater production availability
- Give reduced stock levels of expensive special brick shapes
- Monolithic lining reduced joints
- Easy to repair
- Form complex shapes easily
- Good thermal shock resistance
- Improve thermal efficiency

Applications:

Aluminium

- **Joint free lining**
Reduced joint penetration by molten Aluminium
Reduced mechanical damage and no 'brick pull out'
- **Reduced lining thickness**
Increased furnace capacity
- **Easy to repair**
Easier to patch repair than brick linings
Wide range of compatible repair materials available
- **Fast installation rates**
Materials can be mixed in bulk, at fast installation rates without the need for time served brick layers
- **Higher technology products**
New generation monolithic refractories are out-performing brick linings
- **Elimination of special shapes**
Monolithic linings can be cast to intricate designs without the need for special shapes
- **Material availability**
Monolithics can be supplied at much shorter lead times compared to brick linings

Iron and steel

- Blast furnace repairs
- Remote controlled stack gunning
- Steel ladle safety linings
- Reheating furnace
- Pipe protection and insulation
- Heat treatment applications
- Pre cast shapes

Petrochemical

- Fluid Catalytic Cracking Unit (FCCU)
- Vibration casting of transfer lines
- Process heaters
- Reformers and pyrolysis units
- Convection section
- Side wall convection
- Underfired floor section

Power generations

- Wood fired boilers
- Recovery boiler
- Radiant boiler
- Fluidised bed boiler
- Water tube boiler
- Fire tube boiler

Incineration

Refractory installers Cement



Tri-Mor insulating castable products

	Insulite 2300 VLI	Insulite 2300 LI	Insulite	Insulite LR	Insulite H	Insulite HLI	Insulite 2500 LI	Insulite 2500 HS	Insulite 2600 LI
Bond type	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic
Installation method	Cast	Cast	Cast/Gun	Gun	Cast/Gun	Cast/Gun	Cast	Cast	Cast
Max. service temperature									
°C	1260	1260	1370	1370	1370	1370	1370	1370	1430
Raw material base									
Perlite	x	x	x	x	x	x	x	x	x
Calcined Fireclay	-	-	x	x	x	x	-	-	-
Chamotte	x	x	-	-	-	-	x	x	x
Maximum grain size									
mm	6	6	6	6	6	6	6	6	6
Bulk density, kg/m³									
110°C	1050	1015	1440	1480	1530	1490	1250	1490	1350
Net material required									
kg/m ³	950	930	1350	1380	1420	1380	1140	1350	1250
Cold crushing strength, MPa									
110°C	4.5	3.5	5	4	9	13	5.5	9	10
815°C	2.4	2.7	3.5	3.2	6	6	4	6	5
1000°C	2.0	1.7	3	2	3	6	3	3	5
1260°C	1.8	1.8	-	-	-	-	-	-	-
1370°C	-	-	10	12	15	10	5	12	-
1430°C	-	-	-	-	-	-	-	-	10
Permanent linear change, %									
815°C	-0.2	-0.2	-0.4	-0.4	-0.2	-0.3	-0.3	-0.3	-0.3
1000°C	-0.8	-0.6	-0.5	-0.6	-0.4	-0.7	-0.4	-0.5	-0.4
1260°C	-1.0	-1.0	-	-	-	-	-	-	-
1370°C	-	-	-1.5	-2.0	+/-2.0	-1.5	+/-1.5	-1.0	-
1430°C	-	-	-	-	-	-	-	-	-1.0
Thermal conductivity, W/mK									
600°C	0.27	0.27	0.35	0.37	0.43	0.40	0.31	0.43	0.38
Chemical analysis, %									
Al ₂ O ₃	47	42	35	35	36	40	45	42	52
SiO ₂	40	41	43	43	40	38	37	34	34
CaO	9	11	10	10	12	14	12.5	14	10
Fe ₂ O ₃	0.9	1.4	6.5	6.5	7	2.7	1.4	6	0.8
Water addition									
%	44 - 49	44 - 50	27 - 30	At nozzle	28 - 31	27 - 30	34 - 40	27 - 33	28 - 34
Bag weight									
kg	25	25	25	25	25	25	25	25	25

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Tri-Mor insulating castable products

	Blockmix	Coolcast	Extralite	Insulite 1:2:4	Insulite 2000 HS	Insulcast	Light weight	Medium weight
Bond type	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic
Installation method	Cast	Cast/Gun	Cast/Gun	Cast	Cast	Cast/Gun	Cast/Gun	Cast/Gun
Max. service temperature								
°C	1000	1100	1100	1100	1100	1200	1260	1260
Raw material base								
Vermiculite	x	x	x	x	-	-	-	-
Perlite	-	-	-	-	x	-	x	-
Insulating Aggregate	-	-	x	x	x	x	x	x
Maximum grain size								
mm	3	6	6	6	6	6	6	6
Bulk density, kg/m³								
110°C	465	750	920	1020	1020	1480	1200	1430
Net material required								
kg/m ³	420	720	890	920	940	1380	1160	1330
Cold crushing strength, MPa								
110°C	1.5	2.5	1.9	3.5	3.5	13.0	5	12
815°C	1.0	1.4	1.3	2.0	2.5	9.0	3.5	8
1000°C	0.6	0.5	1.0	1.1	2.5	6.5	3.0	5
1100°C	-	0.9	1.0	1.1	2.5	-	-	-
1200°C	-	-	-	-	-	11.5	2.5	5
1260°C	-	-	-	-	-	-	-	9
Permanent linear change, %								
815°C	-0.7	-1.0	-0.7	-0.3	-0.3	-0.3	-0.3	-0.2
1000°C	-2.0	-1.4	-1.0	-1.0	-0.8	-0.5	-0.7	-0.4
1100°C	-	-1.4	-1.5	-1.0	-1.0	-	-	-
1200°C	-	-	-	-	-	-1.7	-1.4	-0.5
1260°C	-	-	-	-	-	-	-	-1.2
Thermal conductivity, W/mK								
600°C	0.14	0.22	0.25	0.25	0.26	0.46	0.37	0.46
Chemical analysis, %								
Al ₂ O ₃	10	19	30	29	42	34	32	32
SiO ₂	32	39	38	29	40	43	45	45.5
CaO	37	26	13.5	24	12	13	12.1	12
Fe ₂ O ₃	4	3.8	8.5	10	2.5	7	7	7.1
Water addition								
%	134 - 140	69 - 73	56 - 60	47 - 57	44 - 50	25 - 28	35 - 38	25 - 28
Bag weight								
kg	15	25	25	25	25	25	25	25

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Tri-Mor conventional gunning castable products

	Extra HS Cast	Guncrete 130	Guncrete 150 LR	Guncrete BFS	Guncrete BFS LR	Guncrete 160	Guncrete 160 LR	Guncrete 170	Guncrete 170 LR
Bond type	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic
Installation method	Cast/Gun	Cast/Gun	Cast/Gun	Cast/Gun	Gun	Cast/Gun	Gun	Cast/Gun	Gun
Max. service temperature									
°C	1250	1300	1500	1500	1500	1600	1600	1700	1700
Raw Material Base									
Aluminosilicate	-	-	-	-	-	-	-	-	-
Calcined Fireclay	-	x	-	-	-	-	-	-	-
Chamotte	x	-	x	x	x	x	x	x	x
Bauxite	-	-	-	-	-	-	-	x	x
Maximum grain size									
mm	6	6	6	6	6	6	6	6	6
Bulk density, kg/m³									
110°C	2200	1850	2100	2160	2160	2080	2020	2200	2140
Net material required									
kg/m ³	2110	1790	2100	2120	2160	2020	1880	2130	2080
Cold crushing strength, MPa									
110°C	48	19	60	70	75	34	45	20	25
815°C	33	15	33	30	55	27	25	15	15
1000°C	27	13	27	20	-	24	20	12	13
1200°C	-	-	-	-	32	-	-	-	-
1250°C	22	-	-	-	-	-	-	-	-
1300°C	-	15	-	-	-	31	-	15	-
1500°C	-	-	70	70	100	-	-	-	-
1600°C	-	-	-	-	-	34	80	34	60
Permanent linear change, %									
815°C	-0.1	-0.2	-0.3	-0.2	-0.3	-0.2	-0.3	-0.1	-0.2
1000°C	-0.2	-0.3	-0.4	-0.3	-	-0.3	-0.4	-0.2	-0.3
1200°C	-	-	-0.5	-	-0.4	-	-	-	-
1250°C	-0.6	-	-	-	-	-	-	-	-
1300°C	-	-1.3	-	-	-	-0.6	-	-0.5	-
1500°C	-	-	-	+/-1.0	-2.5	-	-	-	-
1600°C	-	-	-2.5	-	-	-1.8	+/-2.0	+/-1.5	+/-0.8
Thermal conductivity, W/mK									
600°C	0.79	0.72	0.9	0.79	0.9	0.79	0.79	0.79	0.79
Chemical analysis, %									
Al ₂ O ₃	44	41	53	52	54	50	50	64	64
SiO ₂	37	43	37	39	36	42	42	27	28
CaO	11.5	8.6	7	7	7	6	6	4.5	3.5
Fe ₂ O ₃	5.6	2.7	0.8	0.8	0.8	1	1	1	1
Water addition									
%	11 - 13	17 - 19	At nozzle	11 - 13	At nozzle	12 - 14	At nozzle	12 - 14	At nozzle
Bag weight									
kg	25	25	25	25	25	25	25	25	25

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Tri-Mor dense castable products

	1350 GP	Standard Cast	BF Cast	Insulbond	Midcast	Mulcast	HT Cast	Philcast T	1800 T
Bond type	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic
Installation method	Cast/Gun	Cast	Cast	Trowel	Cast	Cast	Cast	Cast	Cast
Max. service temperature									
°C	1350	1350	1500	1500	1500	1650	1700	1800	1800
Raw Material Base									
Aluminosilicate	x	-	-	-	-	-	-	-	-
Calcined Fireclay	-	x	-	-	-	-	-	-	-
Chamotte	-	-	x	x	-	-	x	-	-
Mullite	-	-	-	-	-	x	-	-	-
Bauxite	-	-	-	-	x	-	x	-	-
Tabular Alumina	-	-	-	-	-	-	-	x	x
Maximum grain size									
mm	6	6	6	6	6	6	6	3	6
Bulk density, kg/m³									
110°C	2125	1900	2130	1920	2560	2340	2210	2835	2850
Net material required									
kg/m ³	2110	1850	2030	1830	2500	2280	2130	2787	2790
Cold crushing strength, MPa									
110°C	30	8	60	28	45	45	17	34	50
815°C	25	6	35	11	40	30	11	25	40
1000°C	18	5	30	11	23	30	11	23	40
1350°C	20	15	-	-	-	-	-	-	-
1500°C	-	-	60	28	45	-	-	-	-
1600°C	-	-	-	-	-	60	60	34	70
Permanent linear change, %									
815°C	-0.2	-0.1	-0.2	-0.2	-0.1	-0.2	-0.1	-0.1	-0.1
1000°C	-0.3	-0.2	-0.2	-0.3	-0.2	-0.3	-0.2	-0.1	-0.1
1350°C	+/-0.5	-1.5	-	-	-	-	-	-	-
1500°C	-	-	-1.2	-0.4	-1.8	-	-	-	-
1600°C	-	-	-	-	-	1.5	+/-0.5	+/-0.5	+/-0.5
Thermal conductivity, W/mK									
600°C	0.79	0.72	0.79	0.72	1.31	1.1	0.86	2.16	2.16
Chemical analysis, %									
Al ₂ O ₃	53	37	53	51.5	78	61	66	97	97
SiO ₂	33	46.5	38	40	6	32	28	0.1	0.1
CaO	9	6	7	5.9	8.8	2.4	3	2.8	2.8
Fe ₂ O ₃	1.7	5.3	0.8	0.8	4.7	1.3	1.1	0.1	0.1
Water addition									
%	13 - 14	17 - 20	11 - 12.5	18 - 20	11 - 13	8.5 - 9.5	11 - 13	7 - 9	7 - 9
Bag weight									
kg	25	25	25	25	25	25	25	25	25

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Tri-Mor low cement gunning castable products

	Higun 140	Higun 160	Higun 165	Higun 170	Higun 40 SiC	Higun 60 SiC	Higun 80 SiC
Bond type	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic
Installation method	Gun	Gun	Gun	Gun	Gun	Gun	Gun
Max. service temperature							
°C	1400	1600	1650	1700	1450	1450	1450
Raw material base							
Chamotte	x	x	-	x	x	-	-
Andalusite	-	-	x	-	-	-	-
Bauxite	-	-	-	x	-	-	-
Silicon Carbide	-	-	-	-	x	x	x
Maximum grain size							
mm	6	6	6	6	6	6	3
Bulk density, kg/m³							
110°C	2050	2280	2470	2530	2400	2400	2500
Net material required							
kg/m ³	2020	2200	2400	2450	2400	2350	2400
Cold crushing strength, MPa							
110°C	50	95	70	100	70	70	70
815°C	45	75	50	90	70	70	70
1000°C	40	80	50	70	60	70	80
1300°C	-	80	45	80	80	80	80
1400°C	70	-	-	-	-	-	-
1450°C	-	-	-	-	100	100	100
1600°C	-	150	50	110	-	-	-
Permanent linear change, %							
815°C	-0.4	-0.3	-0.1	-0.2	-0.2	-0.3	-0.2
1000°C	-0.5	-0.3	-0.2	-0.3	-0.2	-0.3	-0.3
1300°C	-	-0.5	0.2	-0.3	-0.4	-0.4	-0.3
1400°C	-0.8	-	-	-	-	-	-
1450°C	-	-	-	-	+/-0.5	+/-0.5	+/-0.5
1600°C	-	-1.5	0.2	1.4	-	-	-
Thermal conductivity, W/mK							
600°C	0.9	1.55	1.85	1.85	4.0	6.0	10.0
Chemical analysis, %							
Al ₂ O ₃	52	50	58	67	38 SiC	56 SiC	75 SiC
SiO ₂	39	45	38	26	26	17	7
CaO	4	2.8	1.9	3	3	3	3
Fe ₂ O ₃	2.7	0.8	0.8	1	0.5	0.4	0.2
Water addition							
%	At nozzle	At nozzle	At nozzle				
Bag weight							
kg	25	25	25	25	25	25	25

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Tri-Mor low cement castable products

	Hicast Super	Hicast Extra	Hicast Extra S	LC 140	LC 170	Lo-cast LC 140	Lo-cast LC 155	Lo-cast LC 160	Lo-cast Extra
Bond type	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic
Installation method	Cast	Cast	Cast	Cast	Cast	Cast	Cast	Cast	Cast
Max. service temperature									
°C	1600	1700	1550	1400	1700	1400	1550	1600	1700
Raw material base									
Aluminosilicate	-	-	-	-	-	-	x	x	-
Chamotte	x	-	-	x	-	x	-	x	-
Mullite	-	-	-	-	x	-	-	-	-
Bauxite	-	x	x	-	-	-	-	-	x
Maximum grain size									
mm	6	6	6	6	6	6	6	8	6
Bulk density, kg/m³									
110°C	2300	2850	2680	2440	2500	2370	2330	2350	2600
Net material required									
kg/m ³	2300	2800	2680	2440	2450	2370	2290	2350	2600
Cold crushing strength, MPa									
110°C	80	80	60	100	90	95	90	90	80
815°C	80	100	80	60	-	80	-	-	80
1000°C	90	110	90	75	85	90	110	70	-
1300°C	90	110	90	-	-	-	-	-	-
1400°C	-	-	-	80	-	120	-	-	-
1550°C	-	-	90	-	-	-	200	-	-
1600°C	90	120	-	-	100	-	-	110	85
Permanent linear change, %									
815°C	-0.2	-0.1	-0.1	-0.2	-	-0.2	-	-	-0.3
1000°C	-0.3	-0.2	-0.2	-0.3	-0.3	-0.3	-0.2	-0.3	-
1300°C	-0.3	-0.2	-0.3	-	-	-	-	-	-
1400°C	-	-	-	-1.0	-	-0.5	-	-	-
1550°C	-	-	1.5	-	-	-	-1.7	-	-
1600°C	-0.8	-1.5	-	-	1.3	-	-	+/-1.5	1.2
Thermal conductivity, W/mK									
600°C	1.53	2.19	2.5	1.6	1.65	1.6	1.55	1.5	2.19
Chemical analysis, %									
Al ₂ O ₃	49	80	73 (10 SiC)	52	62	57	48	56	75
SiO ₂	47	13	10	40	32	33	46	37	15
CaO	2	1.8	1.3	3.8	2.5	4	1.7	2.1	1.8
Fe ₂ O ₃	0.8	1.5	1.4	2.5	1.0	2.8	1.4	1.4	1.7
Water addition									
%	5.5 - 6.5	5.5 - 6.5	5.9 - 6.7	6 - 7	5.8 - 6.5	6.8 - 7.5	7 - 7.6	6.4 - 7.4	7.0 - 8.3
Bag weight									
kg	25	25	25	25	25	25	25	25	25

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Tri-Mor easy flow low cement castable products

	Morflo 160	Morflo 165	Morflo 170	Morflo 170 +CR	Morflo 180	Morflo 40 SiC	Morflo 60 SiC	Morflo 80 SiC
Bond type	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic
Installation method	Cast	Cast	Cast	Cast	Cast	Cast	Cast	Cast
Max. service temperature								
°C	1600	1650	1700	1700	1800	1450	1450	1450
Raw material base								
Chamotte	x	-	-	-	-	x	-	-
Andalusite	-	x	-	-	-	-	-	-
Bauxite	-	-	x	x	-	-	-	-
Silicon Carbide	-	-	-	-	-	x	x	x
Tabular Alumina	-	-	-	-	x	-	-	-
Maximum grain size								
mm	6	6	6	6	5	6	6	3
Bulk density, kg/m³								
110°C	2400	2640	2800	2780	3100	2400	2530	2550
Net material required								
kg/m ³	2400	2640	2800	2780	3100	2350	2450	2550
Cold crushing strength, MPa								
110°C	70 - 120	70 - 130	100 - 180	80 - 140	100	50 - 80	50 - 80	50 - 80
815°C	70 - 120	80 - 130	100 - 180	80 - 140	150	70 - 90	70 - 90	70 - 90
1000°C	100 - 150	80 - 130	150 - 200	120 - 200	200	100 - 120	100 - 150	140 - 180
1300°C	120 - 150	80 - 130	150 - 200	120 - 200	200	100 - 150	100 - 150	140 - 180
1450°C	-	-	-	-	-	80 - 120	150 - 200	200 - 250
1600°C	150 - 200	100 - 180	150 - 200	120 - 200	200	-	-	-
Permanent linear change, %								
815°C	-0.2	+/-0.1	-0.2	-0.2	-0.2	-0.3	-0.2	-0.2
1000°C	-0.3	+/-0.1	-0.3	-0.3	-0.3	-0.4	-0.3	-0.2
1300°C	-0.5	+/-0.2	-0.4	-0.6	-0.3	-0.5	-0.5	-0.4
1450°C	-	-	-	-	-	+/-0.5	+/-0.5	0.2
1600°C	-1.0	+/-0.5	-1.5	1.0	-1.5	-	-	-
Thermal conductivity, W/mK								
600°C	1.6	1.85	2.3	2.3	3.5	4.0	6.5	10.0
Chemical analysis, %								
Al ₂ O ₃	55	60	79	79	93	38 SiC	62 SiC	76 SiC
SiO ₂	41	37	14	13	5	28	15	7
CaO	1.9	1.7	1.8	1.8	1.2	2	2	1.9
Fe ₂ O ₃	1	0.8	1.5	1.3	0.1	0.5	0.3	0.2
Water addition								
%	5.2 - 6.4	5.0 - 6.4	5.5 - 6.5	5.7 - 6.7	4.0 - 5.0	5.5 - 6.5	5.0 - 6.5	5.5 - 6.5
Bag weight								
kg	25	25	25	25	25	25	25	25

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Tri-Mor aluminium contact castable products

	Albond	Albond HS	Albond 65 HS C	Alcast Extra HS	Alcast 70 FS	Midal
Bond type	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic
Installation method	Cast	Cast	Cast	Cast	Cast	Cast
Max. service temp.						
°C	1400	1400	1300	1300	1300	1300
Raw material base						
Aluminosilicates	-	-	x	-	-	-
Bauxite	x	x	-	x	-	x
Fused Silica	-	-	-	-	x	-
Maximum grain size						
mm	6	10	15	6	5	6
Bulk density, kg/m³						
110°C	2820	2920	2645	2900	2170	2750
Net material required						
kg/m ³	2800	2890	2590	2900	2020	2720
Cold crush. strength, MPa						
110°C	110 - 160	140 - 160	100 - 140	90 - 140	80	70
815°C	110 - 160	150 - 160	-	100 - 160	80	45
1000°C	140 - 200	160 - 200	80 - 100	90 - 140	80	35
1300°C	140 - 120	150 - 200	90 - 150	90 - 140	90	80
1400°C	140 - 200	150 - 200	-	-	-	-
Permanent linear change, %						
815°C	-0.2	-0.2	-	-0.2	-0.2	-0.2
1000°C	-0.3	-0.3	-0.3	-0.5	-0.3	-0.3
1300°C	-0.8	+/-0.5	1.2	-0.7	1.0	-0.3
1400°C	-1.2	0.7	-	-	-	-
Thermal conductivity, W/mK						
600°C	2.3	2.3	1.44	2.3	0.73	2.2
Chemical analysis, %						
Al ₂ O ₃	81	81	66	77	18	77
SiO ₂	11.5	11.5	27	12	74	7
CaO	2.8	2.8	3.5	1.4	2.2	3.9
Fe ₂ O ₃	1.2	1.2	1	1.1	0.2	1.7
Water addition						
%	5.5 - 6.5	4.7 - 5.2	5.0 - 5.5	5.0 - 5.8	6.0 - 7.0	7.0 - 8.0
Bag weight						
kg	25	25	25	25	25	25

Tri-Mor ramming mix products

	TV90	Lo-vibe 80
Bond type	Heat setting	Heat setting
Installation method	Dry ram	Dry ram
Max. service temperature		
°C	1650	1600
Raw material base		
Bauxite	x	x
Maximum grain size		
mm	6	6
Bulk density, kg/m³		
110°C	2640	2580
Net material required		
kg/m ³	2640	2580
Cold crushing strength, MPa		
110°C	-	-
815°C	>20	>15
1000°C	>30	>25
1600°C	>50	>50
Permanent linear change, %		
815°C	+/-0.2	-0.2
1000°C	-0.4	-0.4
1300°C	-1.5	-1.5
Thermal conductivity, W/mK		
600°C	2.2	2.0
Chemical analysis, %		
Al ₂ O ₃	87	76
SiO ₂	7	13
CaO	0.3	0.3
Fe ₂ O ₃	1.3	1.2
Water addition		
%	Used dry	Used dry
Bag weight		
kg	25	25

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Tri-Mor rammable, casting and gunning materials

	Lo-plas I6C	Plascast Super	Plascast HT	Lo-plas I6G	Plasgun	Plastic Super	Plastic HT	Plasram 85P
Bond type	Ceramo-Hydraulic	Ceramo-Hydraulic	Ceramo-Hydraulic	Ceramo-Hydraulic	Ceramo-Hydraulic	Ceramic	Ceramic	Ceramic
Installation method	Cast	Cast	Cast	Gun	Gun	Ram	Ram	Ram
Max. service temperature								
°C	1600	1600	1700	1600	1700	1600	1700	1700
Raw material base								
Chamotte	x	x	x	x	x	x	x	-
Bauxite	x	-	x	x	x	-	x	x
Maximum grain size								
mm	6	6	6	6	6	6	6	6
Bulk density, kg/m³								
110°C	2260	2200	2300	2120	2170	2200	2380	2750
Net material required								
kg/m ³	2260	2200	2300	2060	2110	2320	2520	2850
Cold crushing strength, MPa								
110°C	6	5	6	10	10	4	4	12
815°C	12	12	12	10	10	15	15	30
1000°C	22	20	22	12	15	18	18	40
1300°C	35	30	30	20	20	20	20	40
1600°C	55	38	38	40	45	25	15	40
Permanent linear change, %								
110°C	-	-	-	-	-	-1.5	-1.5	-1.0
815°C	-0.2	-0.2	-0.2	-0.2	-0.2	-0.1	-0.1	-0.1
1000°C	-0.2	-0.2	-0.2	-0.3	-0.3	-0.2	-0.2	-0.2
1300°C	-0.3	-0.5	-0.3	-0.7	-0.7	-0.4	-0.4	-0.2
1600°C	+/-0.5	+/-1.0	+/-1.0	+/-1.0	+/-1.5	+/-1.0	+/-1.5	-1
Thermal conductivity, W/mK								
600°C	1.01	0.86	1.01	1.01	1.0	0.79	0.85	2.0
Chemical analysis, %								
Al ₂ O ₃	64	52	66	65	66	43	61	89
SiO ₂	30	44	30	28	29	53	33	6
Fe ₂ O ₃	1.7	1	1.1	1.6	1.2	1	1.2	1
Water addition								
%	9.5 - 10.5	8.5 - 9.5	8.5 - 9.5	At nozzle	At nozzle	-	-	-
Bag weight								
kg	25	25	25	25	25	25 CTN	25 CTN	25 CTN

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Tri-Mor chemical bonded castable products

	Morbond AL	Morgun AL	Morgun HT	Morbond 170
Bond type	Chemical	Phosphate	Phosphate	Chemical
Installation method	Cast	Gun	Gun	Cast
Maximum service temperature				
°C	1450	1600	1600	1700
Raw material base				
Aluminosilicates	-	x	x	-
Chamotte	-	-	-	x
Bauxite	x	-	-	x
Maximum grain size				
mm	3	6	6	3
Bulk density, kg/m³				
110°C	2650	2450	2450	2500
Net material required				
kg/m ³	2650	2450	2450	2450
Cold crush strength, MPa				
110°C	30	16	16	30
815°C	30	16	16	30
1000°C	30	16	16	30
1450°C	50	-	-	-
1600°C	-	100	100	65
Permanent linear change, %				
815°C	-0.1	-0.1	-0.1	-0.1
1000°C	-0.1	-0.1	-0.1	-0.1
1450°C	-1.0	-	-	-
1600°C	-	-1.3	-1.3	+/-0.5
Thermal conductivity, W/mK				
600°C	2.42	1.95	1.95	1.95
Chemical analysis, %				
Al ₂ O ₃	87	75	75	75
SiO ₂	3	17	17	15
CaO	1.6	1.4	1.4	2
Fe ₂ O ₃	0.6	0.8	0.8	0.6
Water addition				
%	Accelerator	At nozzle	At nozzle	Accelerator
Bag weight				
kg	25	25	25	25

Tri-Mor aluminium super-structure castable products

	Alumor SH	Alumor 50	Morflo 165 AL
Bond type	Hydraulic	Hydraulic	Hydraulic
Installation method	Cast	Cast	Cast
Maximum service temperature			
°C	1350	1550	1650
Raw material base			
Aluminosilicates	x	-	-
Chamotte	-	x	-
Andalusite	-	-	x
Maximum grain size			
mm	6	8	6
Bulk density, kg/m³			
110°C	2125	2370	2640
Net material required			
kg/m ³	2110	2300	2640
Cold crushing strength, MPa			
110°C	30	130	70 - 130
815°C	25	130	80 - 130
1000°C	20	100	80 - 130
1300°C	-	130	80 - 130
1350°C	20	-	-
1550°C	-	130	-
1600°C	-	-	100 - 180
Permanent linear change, %			
815°C	-0.2	-0.2	+/-0.1
1000°C	-0.3	-0.3	+/-0.1
1300°C	-	-0.4	+/-0.2
1350°C	+/-0.5	-	-
1550°C	-	-0.5	-
1600°C	-	-	+/-0.5
Thermal conductivity, W/mK			
600°C	0.79	1.34	1.85
Chemical analysis, %			
Al ₂ O ₃	50	50	61
SiO ₂	31	44	35
CaO	10.5	3	1.9
Fe ₂ O ₃	1.5	1	0.8
Water addition			
%	13 - 14	6.0 - 7.0	5.0 - 6.4
Bag weight			
kg	25	25	25

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Tri-Mor special application castable products

	Kao-Tuff FS	Kao-Tuff CV	Kao-Tuff C	Kao-Tuff G	Kaocrete HPM 90TR	Kao-Tab 95C	Armourcrete
Bond type	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic
Installation method	Cast	Cast	Cast	Gun	Ram	Cast	Cast
Maximum service temperature							
°C	1300	1315	1540	1540	1760	1870	1500
Raw material base							
Chamotte	-	x	x	x	-	-	-
Bauxite	-	-	-	-	-	-	x
Tabular Alumina	-	-	-	-	x	x	-
Fused Silica	x	-	-	-	-	-	-
Maximum grain size							
mm	5	6	6	6	3	3	3
Bulk density, kg/m³							
110°C	2140	2280	2340	2310	2850	2690	2830
Net material required							
kg/m ³	2080	2210	2220	2200	2840	2550	2760
Cold crushing strength, MPa							
110°C	55 - 90	55 - 69	45 - 62	34 - 55	80	70	200
815°C	55 - 90	55 - 82	45 - 62	41 - 69	90	60	240
1000°C	55 - 90	55 - 59	-	34 - 62	90	40	-
1300°C	55 - 95	48 - 62	-	-	-	-	190
1500°C	-	-	-	-	-	-	190
1540°C	-	-	55 - 76	55 - 69	-	-	-
1600°C	-	-	-	-	-	45	-
Permanent linear change, %							
815°C	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.4
1000°C	-0.3	-0.5	-	-0.3	-0.3	-0.3	-
1300°C	-0.3	-1.7	-	-	-	-	-0.4
1500°C	-	-	-	-	-	-	-1.2
1540°C	-	-	-1.0 to -2.5	-0.5	-	-	-
1600°C	-	-	-	-	-	-0.6	-
Abrasion resistance ASTM C704 cm³							
815°C	<10	7 - 14	8 - 15	10 - 14	4 - 6	<10	<3
Thermal conductivity, W/mK							
600°C	0.7	1.24	1.3	1.05	2.65	1.65	1.85
Chemical analysis, %							
Al ₂ O ₃	21	56	59	57	91	95	82
SiO ₂	76	35.5	33	34	6	0.1	11.5
CaO	2.1	5.5	5.5	6.5	1.9	4.6	2.9
Fe ₂ O ₃	0.2	0.7	0.8	0.6	0.1	0.1	1.0
Water addition							
%	5.8 - 7.5	8.5 - 10	8 - 10	At nozzle	4.5 - 4.8	8 - 10	5.5 - 6.0
Bag weight							
kg	25	25	25	25	25	25	25

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Tri-Mor medium cement castable products

	Vibrotek 42	Vibrotek 48	Vibrotek 50	Vibrotek 54	Vibrotek 54 C	Vibrotek 54 HS	Vibrotek 55 A	Vibrotek 58	Vibrotek 60	Vibrotek 80
Bond type	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic
Installation method	Cast	Cast	Cast	Cast	Cast	Cast	Cast	Cast	Cast	Cast
Max. service temperature										
°C	1400	1500	1500	1500	1500	1500	1600	1600	1600	1650
Raw material base										
Chamotte	x	x	x	x	x	x	x	x	x	-
Andalusite	-	-	-	-	-	-	x	-	-	-
Bauxite	-	-	-	x	x	x	-	x	x	x
Maximum grain size										
mm	6	6	6	6	6	6	6	6	6	6
Bulk density, kg/m³										
110°C	2200	2250	2250	2300	2250	2300	2400	2450	2540	2700
Net material required										
kg/m ³	2150	2200	2200	2250	2200	2250	2400	2400	2480	2700
Cold crushing strength, MPa										
110°C	80	40	45	50	50	60	60	50	75	40
815°C	60	35	35	60	50	70	50	55	55	50
1000°C	60	40	-	-	-	-	-	-	65	-
1300°C	70	-	-	-	40	-	-	-	90	-
1400°C	70	60	55	70	-	-	-	-	-	-
1500°C	-	70	-	-	-	80	-	-	-	-
1600°C	-	-	-	-	-	-	80	70	95	60
Permanent linear change, %										
815°C	-0.3	-0.2	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.2	-0.5
1000°C	-0.3	-0.3	-	-	-	-	-	-	-0.2	-
1300°C	-0.6	-	-	-	0.8	-	-	-	-0.5	-
1400°C	+/-0.5	-0.5	1.0	0.8	-	-	-	-	-	-
1500°C	-	-1.0	-	-	-	0.8	-	-	-	-
1600°C	-	-	-	-	-	-	1.5	1.8	1.8	0.5
Thermal conductivity, W/mK										
600°C	1.4	1.5	1.5	1.5	1.5	1.5	1.6	1.7	1.7	1.9
Chemical analysis, %										
Al ₂ O ₃	42	52	50	53	50	51	55	58	65	85
SiO ₂	50	41	42	38	43	43	40	30	29	8.3
CaO	3.8	3.8	3.9	3.9	4.3	4	1.5	2.5	1.9	1.5
Fe ₂ O ₃	2.2	1	1.7	1.7	2	1.8	0.8	1.5	1	1.7
Water addition										
%	6 - 7.5	7 - 8	7.5 - 8.5	7.5 - 8.5	7.5 - 9	7 - 8.5	4.5 - 6.5	6 - 8	5.5 - 6.5	6 - 8
Bag weight										
kg	25	25	25	25	25	25	25	25	25	25

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Tri-Mor medium cement castable products

	Vibrotek 46 R	Vibrotek 50 R	Vibrotek 60 R	Vibrotek 70 R
Bond type	Hydraulic	Hydraulic	Hydraulic	Hydraulic
Installation method	Vibro casting	Vibro casting	Vibro casting	Vibro casting
Maximum service temperature				
°C	1400	1450	1600	1650
Raw material base				
Maximum grain size				
mm	6	6	6	6
Bulk density, kg/m³				
110°C	2050	2220	2200	2450
Net material required				
kg/m ³	2100	2240	2440	2530
Cold crushing strength, N/mm²				
110°C	60	45	35	35
1000°C	45	50	45	75
1300°C	55	55	60	80
MST	50	50	70	120
Permanent linear change, %				
110°C	n.a.	n.a.	n.a.	n.a.
1000°C	-0.40	-0.20	-0.20	-0.30
1300°C	-0.70	-0.50	-0.50	-0.40
MST	-1.0	+/- 1.0	+/- 1.5	+/- 2.0
Thermal conductivity, W/mK @ mean temperature				
600°C	1.45	1.5	1.65	1.7
Chemical analysis, %				
Al ₂ O ₃	46.0	50.0	57.0	65.0
SiO ₂	43.0	39.0	33.0	25.0
Fe ₂ O ₃	1.5	1.5	1.5	1.5
TiO ₂	n.a.	n.a.	0.9	n.a.
CaO	3.5	3.5	2.0	1.5
MgO	n.a.	n.a.	2.0	n.a.
Na ₂ O + K ₂ O	n.a.	n.a.	0.7	n.a.
Water addition, @% by weight				
%	9 - 11	8.5 - 10.5	11 - 12	8.0 - 10.5
Bag Weight				
kg	25	25	25	25
Pallet size				
kg	1500	1500	1500	1500

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Tri-Mor insulating castable products

	Kaolite 2800 I	TriMor Hicast Super M	Alumor SH I
Classification, (ASTM C-401-84)	-	-	High Strength
Bond type	Hydraulic	-	-
Raw material base	Alumina, Chamotte	-	-
Maximum grain size mm	6	-	-
Maximum service temperature °C	1540	-	> 1260
Bulk density, (TM C-MP-PF 217-218-219 / ASTM C-134)			
dried to 110°C, kg/m ³	1500	2250	2150
after firing @815°C, kg/m ³	-	-	2000
Water addition, %	28 - 32	5.6 - 6.6	-
Net material requirement kg/m ³	1480	-	-
Setting time hours	-	<6	-
Cold crushing strength, MPa (TM C-MP-PF 218 / ASTM C-93)			
after drying @110°C	7.0	80.0	58.8
after 5hrs firing @700°C	-	90.0	-
after 5hrs firing @815°C	5.0	-	35.3
after 3hrs firing @1000°C	-	95.0	-
after 5hrs firing @1200°C	-	-	26.5
after 3hrs firing @1500°C	-	90.0	-
Permanent linear change, % (TM C-MP-PF 219 / ASTM C-210)			
dried to 110°C, kg/m ³	-	80.0	-
after 3hrs firing @700°C	-	-0.2	-
after 3hrs firing @1000°C	-	-0.3	-
after 3hrs firing @1500°C	-	-0.8	-
after 5hrs firing, 815°C	-0.2	-	-0.2
after 5hrs firing, 1200°C	-	-	-0.8
MST	-2.0	-	-
Thermal conductivity, W/mK @ (ASTM C-417-84)			
at mean temperature of 400°C	-	-	0.48
at mean temperature of 600°C	-	1.53	0.50
at mean temperature of 800°C	0.58	-	0.55
at mean temperature of 800°C	-	-	0.72
Chemical analysis, % (TM MI-CAS-PF 225)			
Al ₂ O ₃	55.0	43.0	-
SiO ₂	34.0	50.0	-
Fe ₂ O ₃	1.6	1.1	-
TiO ₂	0.7	-	-
CaO	6.0	2.2	-
MgO	0.3	-	-
MgO+ +K ₂ O	0.8	-	-
Bag weight kg/m ³	30	-	-

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Tri-Mor mortars, cements, repair and coating products

	Bailey Bond	Airset	Triset	Triset D	Alpatch	Alcoat	Zirtex Wash
Bond type	Chemical	Air setting	Air setting	Air setting	Hydraulic	Air setting	Heat setting
Installation method	By hand	Troweling or dipping	Troweling, dipping or brush coating	Troweling, dipping or brush coating	By hand, trowel, tamping or grouting	Painting	Troweling, dipping or brush coating
Maximum service temperature							
°C	1000	1600	1700	1700	1400	1600	1500
Raw material base							
Aluminosilicates	-	-	x	x	-	-	-
Chamotte	-	x	-	-	-	-	-
Bauxite	-	-	-	-	x	-	-
Corundum	x	-	-	-	-	x	-
Zircon	-	-	-	-	-	-	x
Chemical analysis, %							
Al ₂ O ₃	76	38	43	44	72	85	54 ZrO ₂
SiO ₂	16	54	51	49	13	13 B ₂ O ₃	35
CaO	-	-	-	-	1.5	-	4.0 P ₂ O ₅
Fe ₂ O ₃	3	0.9	1.1	1.1	1	-	-
Net material required							
kgs per 1000 Bricks	-	175 / 200kgs	175 / 200kgs	175 / 200kgs	-	-	-
Appearance							
	Ready mix putty	Dry, off white powder	Wet mortar, ready to use	Dry powder	Dry powder	White paste	Fine, buff coloured powder
Water addition							
%	-	22 - 28	-	12 - 16	8.5	-	15 - 25
Bag weight							
kg	25 MD	25	25 PD	25	25	15 PD	20 PD

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Dense castable products

	Dense Concretes - Firecrete®															
	97	95	4X	3X	3X-G	HT	HT-G	STD		STD L.I		2400	2400-G	2400 HS	C2	C2G
Method of application	Cast	Cast	Cast	Cast	Gun	Cast	Gun	Cast	Gun	Cast	Gun	Cast	Gun	Cast	Cast	Gun
Temperature limit, °C	>1800	>1800	1650	1650	1650	1540	1540	1400	1400	1450	1450	1315	1315	1315	1260	1260
Pyrometric cone equivalent	40	40	33	33	33	29	29	16	16	-	-	15	15	15	15	15
Basic raw material																
bubble and tabular alumina	•	•	-	-	-	-	-	-	-	-	-	-	-	-	-	-
chamotte corundum	-	-	•	•	-	-	-	-	-	-	-	-	-	-	-	-
chamotte	-	-	-	-	•	•	•	•	•	-	-	•	•	•	•	•
Maximum grain size, mm	7	3	5	5	5	5	5	5	5	-	-	3	3	3	3	3
Density, kg/m³																
as placed	3030	2830	2430	2410	2350	2220	2250	2260	2280	-	-	2110	2130	2180	2200	2300
oven dried @ 105°C	2850	2620	2210	2190	2150	1980	2000	2090	2090	2140	2130	1850	1910	2050	2000	2090
after 5 hours firing @ 815°C	2780	2550	2160	2150	2050	1900	1910	1970	2010	2050	1980	1750	1810	1900	1850	2000
Cold crushing strength, Mpa																
oven dried @ 105°C	49.0	66.7	39.2	31.4	34.3	19.6	21.6	36.3	39.2	68.6	71.5	22.5	30.4	36.0	58.8	63.7
after 5 hours firing @ 815°C	30.4	60.8	34.3	21.6	30.4	11.8	13.7	27.4	30.4	53.9	56.8	14.7	25.5	25.0	35.3	40.2
1000°C	29.4	60.8	29.4	16.7	22.5	9.8	11.8	22.5	25.5	-	-	14.7	24.5	-	29.4	34.3
1200°C	34.3	59.8	26.5	16.7	20.6	10.8	13.7	17.6	17.8	-	-	18.6	26.5	-	26.5	32.3
1400°C	37.3	58.3	24.5	36.5	-	22.5	25.5	35.3	37.3	-	-	-	-	-	-	-
1600°C	-	51.0	-	52.9	-	-	-	-	-	-	-	-	-	-	-	-
Permanent linear change, %																
after 5 hours @ 815°C	-0.1	-0.1	-0.2	-0.1	-0.2	-0.2	-0.2	-0.2	-0.2	-0.1	-0.1	-0.2	-0.2	-0.2	-0.2	-0.2
1000°C	-0.2	-0.1	-	-0.1	-0.2	-0.2	-0.2	-0.2	-0.2	-	-	-0.2	-0.2	-0.2	-0.4	-0.3
1200°C	-0.2	-0.1	-0.2	-0.2	-0.2	-0.3	-0.3	-0.3	-0.3	-0.2	0.3	-0.4	-0.4	-0.5	-0.8	-0.7
1400°C	-0.3	-0.2	-0.2	-0.4	-0.3	-0.5	-0.5	-0.5	-0.5	-	-	-	-	-	-	-
1600°C	+0.1	-0.3	-	+0.2	-	-	-	-	-	-	-	-	-	-	-	-
Thermal conductivity, (ASTM C-417-84) W/m•k																
Mean Temperature @400°C	-	-	1.02	0.97	0.97	0.64	0.66	0.59	0.59	0.68	0.68	0.56	0.58	0.60	0.47	0.49
@ 600°C	1.89	1.60	1.07	1.02	1.02	0.73	0.75	0.64	0.64	0.74	0.74	0.60	0.62	0.64	0.49	0.50
@ 800°C	1.85	1.45	1.14	1.09	1.09	0.81	0.84	0.71	0.71	0.81	0.81	0.68	0.69	0.71	0.54	0.56
@ 1000°C	1.84	1.35	1.28	1.22	1.22	0.92	0.95	0.81	0.81	0.93	0.93	0.79	0.80	0.82	0.70	0.74
@ 1200°C	1.80	1.30	1.58	1.50	1.50	1.01	1.05	0.93	0.93	1.07	1.07	-	-	-	-	-
Estimated weight of dry material /m³ of construction																
kg	2800	2570	2190	2170	2100	1950	1970	1980	1980	2100	2060	2020	1800	1850	1900	2020
Estimated weight of water/100kg of dry material																
kg	8	10	11	11	12	14	14	14	13	14	14	17	15	18	16	14
Chemical composition, %																
Al ₂ O ₃	96.3	94.1	60.0	53.4	53.4	47.1	47.0	41.6	41.6	50.8	50	31.9	31.8	33.8	34.5	34.6
SiO ₂	<0.1	<0.1	33.1	39.6	38.5	45.3	45.3	40.0	40.0	39.8	39.3	48.9	48.9	44.0	41.9	42.3
Fe ₂ O ₃	0.1	0.1	1.0	1.1	1.3	1.5	1.5	5.2	5.2	1.2	1.2	4.9	4.9	12.6	7.2	7.1
TiO ₂	Trace	Trace	1.1	1.6	1.6	1.4	1.3	1.8	1.8	1.3	1.3	1.4	1.4	6.8	1.4	1.4
CaO	2.5	4.9	3.7	3.3	4.0	4.0	4.0	10.7	10.7	5.8	7.3	9.0	9.0	1.3	13.8	13.4
MgO+K ₂ O+Na ₂ O	<0.5	<0.4	0.55	0.3	0.3	0.4	0.4	0.3	0.3	0.5	0.4	3.5	3.6	1.3	1.2	1.2
Ignition Loss	0.2	0.5	0.3	0.2	0.8	0.2	0.4	0.3	0.3	0.5	0.4	0.3	0.3	0.2	0.1	0.2
Packaging in bags, kg	25	25	25	25	25	25	25	25	25	-	-	25	25	25	25	25

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Dense castable products

	Firecrete 40	Firecrete 60	Firecrete 70	Firecrete 308	Plasgun 60 R
Bond type	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Ceramo, Hydraulic
Installation method	Casting, Trowelling	Casting, Trowelling	Casting, Trowelling	Casting, Trowelling	Gunning
Maximum service temperature					
°C	1350	1400	1450	1350	1600
Raw material base	Calcined Fireclay	Mullite, Chamotte	Mullite, Bauxite	Calcined Fireclay, Allumina	Mullite, Bauxite
Maximum grain size, mm	6	6	6	5	6
Bulk density, kg/m ³ 110°C	2070	2100	2210	2050	2000
Net material required, kg/m ³	2000	2050	2100	1980	2050
Cold crushing strength, MPa					
Curing 48h	-	-	-	40	-
110°C	25	60	30	35 (24h)	7
815°C	16	-	-	20 (5h)	-
1000°C	13	30	18	-	10
1200°C	-	30	-	-	-
1300°C	-	-	19	8 (5h)	12
MST	10	50	30	-	16
Permanent linear change, %					
815°C	-0.1	-	-	-0.1 (5h)	-
1000°C	-0.2	-0.20	-0.20	-	-0.20
1200°C	-	-0.30	-	-	-
1300°C	-	-	-0.60	-0.7 (5h)	-0.50
MST	+/- 2.0	-0.80	-3.00	-	+/- 1
Thermal conductivity, W/mK @ mean temperature					
500°C	-	-	-	0.9	-
600°C	0.76	0.85	1.4.	-	1.01
1000°C	-	-	-	1.3	-
Modulus of rupture, N/mm²					
110°C	-	-	-	-	-
Chemical analysis, %					
Al ₂ O ₃	41.0	56.0	70.0	43.0	55.0
SiO ₂	39.0	32.0	13.0	38.0	41
Fe ₂ O ₃	5.0	1.0	5.0	5.0	1.0
CaO	12.0	6.0	9.0	8.5	2.5
Water Addition, @% by weight					
%	14.0 - 15.0	13.0 - 16.0	14.5 - 16.5	15.0 - 17.0	Add at nozzle for gunning 11.5 - 13.3 trowelling
Bag weight					
kg	25	25	25	25	25
Pallet size					
kg	1500	1500	1500	1500	1500

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Dense castable products

	Firecrete 95 AL	Firecrete 95 Fluid	Firecrete FP	Firecrete FP HT
Classification, (ASTM C-401-84)	-	High Strength	-	-
Maximum allowance temperature °C	> 1500	> 1800	1000	1400
Maximum grain size mm	-	-	1.5	3
Mixing water %	-	-	15 - 18	11 - 13
Net material requirement kg/m ³	-	-	1710	2010
Wet density, (TM C-MP-PF-217-218-219/ASTM C-134) kg/m ³	-	-	-	-
Installed density, (TM C-MP-PF-217-218-219/ASTM C-134) kg/m ³	-	-	-	-
Dry density, (TM C-MP-PF-217-218-219/ASTM C-134) kg/m ³	-	-	-	-
Bulk density, (TM C-MP-PF-217-218-219 / ASTM C-134)				
after drying, kg/m ³	2620	2820	1900	2180
after firing @815°C, kg/m ³	2550	2750	-	1990
after firing @900°C, kg/m ³	-	-	1560	-
Cold crushing strength, MPa (TM C-MP-PF-218 / ASTM C-133)				
curing, kg/m ³	-	-	12.0	50.0
after drying, @ 110°C, kg/m ³	65.0	85.0	52.0	80.0
after 5hrs firing @ 815°C, kg/m ³	60.0	80.0	-	70.0
after 5hrs firing @ 900°C, kg/m ³	-	-	28.0	-
after 5hrs firing @ 1000°C, kg/m ³	-	-	28.0	60.0
after 5hrs firing @ 1200°C, kg/m ³	33.0	-	-	40.0
Permanent linear change %, (TM C-MP-PF-219 ASTM C-113)				
after 5hrs firing @ 815°C	-0.15	-0.1	-	-
after 5hrs firing @ 1200°C	-0.05	-	-	-
after 5hrs firing @ 1300°C	+0.2	-	-	-
after 5hrs firing @ 1400°C	+0.3	-	-	-
after 5hrs firing @ 1600°C	-	+/- 1	-	-
Permanent linear change, % (TM C-MP-PF-219 ASTM C-210)				
after 5hrs firing @ 815°C	-	-	-	-0.2
after 5hrs firing @ 900°C	-	-	-0.5	-
after 5hrs firing @ 1000°C	-	-	-0.6	-
after 5hrs firing @ 1200°C	-	-	-	-0.2
after 5hrs firing @ 1400°C	-	-	-	+/- 0.5
Specific heat, (EN 821-3:2005) J/gK				
@50°C	-	-	-	-0.2
@150°C	-	-	-0.5	-
@300°C	-	-	-0.6	-
Thermal conductivity, W/mK				
at mean temperature of 100°C	-	-	-	-
at mean temperature of 200°C	-	-	0.456	0.55
at mean temperature of 300°C	-	-	-	-
at mean temperature of 400°C	-	-	0.477	0.57
at mean temperature of 500°C	-	-	-	-
at mean temperature of 600°C	-	1.80	0.498	0.59
at mean temperature of 700°C	-	-	-	-
at mean temperature of 800°C	-	1.65	0.519	0.61
at mean temperature of 1000°C	-	1.55	-	-
at mean temperature of 1200°C	-	1.50	-	-
Bending strength, MoR (MPa) (TM C-MP-PF-218/ASTM C-133)				
Curing	-	-	2.2	-
after drying at 110°C	-	-	9.5	-
after 5hrs firing @ 1000°C	-	-	5.2	-
Chemical analysis, % (TM MI-CAS-PF 225)				
Al ₂ O ₃	85.1	94.1	50.0	57.0
SiO ₂	0.1	0.1	36.0	32.0
Fe ₂ O ₃	0.1	0.1	0.5	0.8
TiO ₂	Trace	Trace	-	-
CaO	4.9	4.9	12.0	8.0
BaO	8.0	-	-	-
MgO+Na ₂ O +K ₂ O	0.4	0.40	1.0	-
lg. Loss	Trace	0.50	-	-

Insulating castable products

	Firelite 2500 HS	Firelite 2600 LI HD	Firelite 2700 LI HD	Firelite 2600 LI HD	Firelite 2700 LI HD
Type	Cast	Cast	Cast	Gun	Gun
ASTM classification, C-401-84	Q, R	Q, R	S	Q, R	S
Maximum allowable temperature °C	1370	1430	1480	1430	1480
Maximum grain size mm	6	6	6	6	6
Bulk density, (TM C-MP-PF 217-218-219 / ASTM C-134)					
after drying kg/m ³	-	1380	1430	1420	1550
Bulk density, (TM C-MP-PF 217-218-219 / ASTM C-134)					
after firing @815°C, kg/m ³	1370	1280	1300	1320	1380
Cold crushing strength, MPa (TM C-MP-PF 218 / ASTM C-133)					
after drying, 110°C	12.0	10.5	10.0	11.0	20.0
after 5hrs firing, 815°C	8.0	7.0	8.0	7.5	12.0
Permanent linear change, % (TM C-MP-PF 219 / ASTM C-210)					
after 5hrs firing, 815°C	-0.2	-0.2	-0.2	-0.2	-0.2
after 5hrs firing, 1200°C	-	-0.8	-0.6	-0.8	-0.6
Thermal conductivity, W/mK @ (ASTM C-417-84)					
at mean temperature of 200°C	-	0.37	0.37	0.38	0.38
at mean temperature of 400°C	-	0.38	0.39	0.39	0.40
at mean temperature of 600°C	-	0.39	0.41	0.40	0.42
at mean temperature of 800°C	-	0.40	0.43	0.41	0.44
at mean temperature of 1000°C	-	0.41	0.45	0.42	0.46
Chemical analysis, %					
Al ₂ O ₃	41.4	58.0	60.8	58.0	60.8
SiO ₂	37.6	31.4	28.2	31.4	28.2
Fe ₂ O ₃	5.4	0.7	0.7	0.7	0.7
TiO ₂	1.5	0.5	0.3	0.5	0.3
CaO	11.7	6.8	7.7	6.8	7.7
MgO+Na ₂ O +K ₂ O	1.1	1.4	1.1	1.4	1.1
lg. Loss	1.1	1.8	1.1	1.8	1.1

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Insulating castable products

	Firelite 14 R	Firelite 55	Firelite 80	Firelite 105 L R	Firelite 110	Firelite 124 L R
Bond type	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic
Method of application	Cast	Cast	Cast	Cast	Cast	Cast
Maximum service temperature °C	1000	1000	1100	900	1100	1000
Raw material base	Aggregate	Dust, Perlite	Dust, Perlite	Vermiculite	Dust, Perlite	Aggregate
Maximum grain size						
mm	8	4	1	8	1	8
Bulk density, kg/m³						
110°C	1100	550	890	700	1200	930
Net material required						
kg/m ³	1020	525	820	680	1100	850
Cold crushing strength, MPa						
110°C	8.0	0.45	1.4	1.3	5.5	4.1
600°C	-	-	-	1.2	-	-
815°C	4.0	0.40	1.1	0.5	3.5	2.7
1000°C	-	n.a.	n.a.	-	n.a.	-
MST	1.0	-	-	-	-	1.0
Permanent linear change, %						
600°C	-	-	-	-1.2	-	-
815°C	-0.5	-1.6	-1.4	-1.5	-0.75	-0.8
1000°C	-	-2.0	-1.5	-	-0.90	-
MST	-1.4	-	-	-	-	-1.3
Thermal conductivity, W/mK @ mean temperature						
200°C	0.23	n.a.	n.a.	0.15	n.a.	0.17
400°C	0.26	n.a.	n.a.	0.17	n.a.	0.21
600°C	0.29	n.a.	n.a.	0.19	n.a.	0.23
Chemical analysis, %						
Al ₂ O ₃	28.0	29.0	34.0	24.5	38.0	24.0
SiO ₂	36.0	40.5	35.0	29.0	32.0	39.0
Fe ₂ O ₃	8.0	4.0	3.0	8.0	5.7	8.5
TiO ₂	1.0	0.9	n.a.	1.0	1.3	1.5
CaO	23.0	23.0	23.0	31.0	20.7	22.0
Na ₂ O + K ₂ O	4.0	1.9	n.a.	-	-	5.0
MgO + Na ₂ O + K ₂ O	-	-	-	6.5	1.9	-
Water addition, @% by weight						
%	46	100	60 - 70	85	45 - 55	46
Bag weight						
kg	25	15	15	20	15	25
Pallet size						
kg	1050	630	630	840	630	1050

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Insulating castable products

	Medium Light Weight Insulating Concretes - Firelite®											Low Iron Insulating Concretes						
	2500		LW		LW HS	LW HS-G	1230		14	I4-G	14 HS	95	2800 LI	2700 LI	2600 LI	2600 LI-G	2300 VLI	2300 VLI-G
	Cast	Gun	Cast	Gun	Cast	Gun	Cast	Gun	Cast	Cast	Cast	Cast	Cast	Cast	Cast	Gun	Cast	Cast
Method of application	Cast	Gun	Cast	Gun	Cast	Gun	Cast	Gun	Cast	Cast	Cast	Cast	Cast	Cast	Cast	Gun	Cast	Cast
Temperature limit, °C	1370	1370	1320	1320	1320	1320	1230	1230	1100	1100	1100	1760	1540	1480	1430	1430	1260	1260
Basic raw material																		
bubble and tabular alumina	-	-	-	-	-	-	-	-	-	-	-	•	-	-	-	-	-	-
bubble alumina	-	-	-	-	-	-	-	-	-	-	-	-	•	-	-	-	-	-
insulating aggregate	•	•	•	•	•	•	•	•	-	-	-	-	-	•	•	•	•	•
porous aggregate	-	-	-	-	-	-	-	-	•	•	•	-	-	-	-	-	-	-
vermiculite/insulating aggregate	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Maximum grain size, mm	6	6	6	6	4	4	8	8	8	4	4	5	6	6	6	6	8	6
Density, kg/m³																		
as placed	1860	1930	1740	1760	1610	1680	1700	1750	1490	1580	1520	1690	1820	1760	1720	1760	1480	1660
oven dried @ 105°C	1420	1500	1200	1290	1340	1430	1150	1220	1200	1200	1300	1730	1430	1330	1230	1320	930	1080
after 5 hours firing @ 815°C	1340	1420	1150	1200	1250	1330	1100	1140	1060	1100	1190	1690	1340	1210	1140	1200	860	1020
Cold crushing strength, Mpa																		
oven drive @ 105°C	8.8	10.8	4.3	6.4	9.8	14.7	4.2	6.4	8.8	8.8	15.7	17.6	10.0	9.3	6.3	9.8	3.7	6.9
after 5 hours firing @ 815°C	6.9	8.4	3.2	5.9	7.8	11.8	3.7	6.2	5.9	5.9	9.3	9.8	6.0	6.3	4.5	6.5	2.1	4.9
1000°C	5.1	6.0	2.8	5.4	-	-	2.9	5.9	-	-	7.4	10.8	4.2	-	4.3	6.0	1.9	4.4
1100°C	-	-	-	-	4.9	4.9	5.9	2.7	4.5	3.9	3.9	-	-	-	-	-	-	-
1200°C	5.9	6.5	3.9	4.4	-	-	2.8	4.4	-	-	-	11.8	3.6	4.9	3.9	5.5	1.7	-
1300°C	6.9	7.0	-	-	6.4	6.9	-	-	-	-	-	-	-	-	-	-	-	-
1400°C	-	-	-	-	-	-	-	-	-	-	-	17.6	3.6	5.9	5.3	7.0	-	-
1500°C	-	-	-	-	-	-	-	-	-	-	-	25.5	7.2	-	-	-	-	-
1600°C	-	-	-	-	-	-	-	-	-	-	-	34.3	-	-	-	-	-	-
Permanent linear change, %																		
after 5 hrs. @ 815°C	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.3	-0.3	-0.2	-0.3	-0.2	-0.1	-0.1	-0.2	-0.2	-0.2	-0.1	-0.2
1000°C	-0.3	-0.3	-0.3	-0.3	-	-	-	-	-	-	-	-0.1	-0.2	-	-	-	-	-
1100°C	-0.4	-0.4	-	-	-0.4	-0.4	-0.4	-0.4	-0.2	-0.3	-0.2	-	-	-	-	-	-	-
1200°C	-	-	-0.6	-0.7	-0.6	-0.6	-0.4	-0.4	-	-	-	-0.2	-0.2	-0.6	-0.8	-0.7	-0.3	-0.4
1300°C	-0.7	-0.7	-1.0	-0.8	-0.5	-1.5	-	-	-	-	-	-	-	-	-	-	-	-
1400°C	-	-	-	-	-	-	-	-	-	-	-	-0.2	-0.6	-1.2	-	-	-	-
1500°C	-	-	-	-	-	-	-	-	-	-	-	+0.6	-0.10	-	-	-	-	-
1600°C	-	-	-	-	-	-	-	-	-	-	-	-0.3	-	-	-	-	-	-
Thermal conductivity, (ASTM C-417-84) W/m·k																		
Mean Temperature @200°C	0.34	0.36	0.28	0.29	0.29	0.29	0.31	0.22	0.21	0.23	0.27	0.42	0.35	0.29	0.28	0.29	0.16	0.17
@ 400°C	0.37	0.39	0.30	0.31	0.31	0.33	0.24	0.26	0.24	0.27	0.29	0.49	0.40	0.32	0.31	0.32	0.19	0.20
@ 600°C	0.40	0.42	0.33	0.34	0.34	0.36	0.26	0.28	0.27	0.29	0.31	0.52	0.44	0.35	0.34	0.35	0.21	0.23
@ 800°C	0.42	0.45	0.35	0.36	0.36	0.38	0.28	0.30	-	-	-	0.57	0.48	0.37	0.36	0.37	-	-
@ 1000°C	0.44	0.48	0.38	0.39	0.39	0.41	-	-	-	-	-	0.63	0.53	0.42	0.40	0.42	-	-
@ 1200°C	-	-	-	-	-	-	-	-	-	-	-	0.67	-	-	-	-	-	-
Estimated weight of dry material/m³ of construction																		
kg	1350	1450	1160	1220	1250	1330	1110	1180	1060	1160	1200	1690	1350	1220	1140	1230	860	1050
Estimated weight of water/100kg of dry material																		
kg	28	35	30	45	24	24	53	48	36	36	27	16	38	44	49	43	70	65
Chemical composition, %																		
Al ₂ O ₃	44.4	44.4	46.2	46.2	38.8	40.0	36.8	36.8	31.4	30.9	28.1	94.5	79.7	60.8	58.0	58.7	47.4	47.4
SiO ₂	34.6	34.6	34.3	34.3	37.6	36.2	33.1	33.1	36.0	36.6	39.9	0.2	11.7	28.2	31.4	30.0	31.7	31.8
Fe ₂ O ₃	5.4	5.4	4.7	4.7	6.9	6.8	5.8	5.8	7.2	7.3	7.9	0.1	0.3	0.7	0.7	0.7	0.5	0.5
TiO ₂	1.5	1.5	1.4	1.4	1.1	1.1	1.3	1.3	1.4	1.3	1.3	-	-	0.3	0.5	0.1	0.7	0.7
CaO	11.7	11.7	10.1	10.1	11.8	11.8	20.3	20.3	19.8	19.4	17.0	4.3	6.5	7.7	6.8	7.0	17.6	16.9
MgO+K ₂ O+Na ₂ O	1.1	1.1	1.5	1.5	1.9	1.3	1.5	1.5	3.7	3.9	5.3	0.2	0.9	1.1	1.4	1.6	1.0	0.8
Ignition Loss	1.1	1.1	1.7	1.7	1.9	1.3	1.1	1.1	0.3	0.5	0.3	trace	0.2	1.1	1.8	1.0	1.0	1.6
Packaging in bags, kg	22	22	25	25	30	30	30	30	25	25	25	25	30	30	30	30	25	25

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Insulating castable products

	Light Weight Insulating Concretes - Firelite®											Very Light Weight Insulating Concretes - Firelite						
	LOD 607 HT		20 X	20 X-G	20 XL	20 XL-G	20		124	124-G	124-L	105	105 L	105 L-G	1700	BM		LW RK
	cast	trowel	cast	gun	cast	gun	cast	gun	cast	gun	cast	cast	cast	gun	cast	cast	gun	cast
Method of application	cast	trowel	cast	gun	cast	gun	cast	gun	cast	gun	cast	cast	cast	gun	cast	cast	gun	cast
Temperature limit, °C	1200	1200	1230	1230	1230	1230	1230	1230	1100	1100	1100	1100	1100	1100	1000	870	870	980
ASTM C-401-854 class	-	-	N,O,P	N,O,P	N,O,P	O,P	O,P,Q	O,P,Q	O,P	O,P	O,P	-	-	-	-	-	-	-
Basic raw material																		
insulating aggregate	-	-	•	•	•	•	•	•	•	•	•	-	-	-	-	-	•	-
soluble glass fibre	•	•	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
vermiculite	-	-	-	-	-	-	-	-	-	-	-	•	-	•	-	•	-	-
vermiculite silicate	-	-	-	-	-	-	-	-	-	-	-	-	-	-	•	-	-	-
vermiculite/insulating aggregate	-	-	-	-	-	-	-	-	-	-	-	•	-	-	-	-	-	-
Maximum grain size, mm	10	10	8	8	8	8	8	8	8	8	8	3	8	8	3	8	8	-
Density, kg/m³																		
as placed	1530	1580	1460	1510	1310	1390	1570	1670	1400	1450	1350	1216	1190	1300	990	1020	1050	-
oven dried @ 105°C	980	1040	880	950	850	930	1040	1130	1020	1060	960	720	660	720	550	450	540	600
after 5 hours firing @ 815°C	900	960	820	870	770	850	960	1050	900	920	860	620	570	660	490	400	490	595
Cold crushing strength, Mpa																		
oven dried @ 105°C	1.5	1.7	2.0	2.8	2.9	3.9	4.0	5.4	5.9	5.9	4.5	2.2	1.3	1.6	1.6	0.6	1.0	0.9
after 5 hours firing @ 650°C	-	-	-	-	-	-	-	-	-	-	-	1.8	1.1	1.4	1.2	0.5	0.8	-
815°C	1.2	1.4	1.5	2.3	2.1	3.0	3.3	3.9	4.2	4.2	3.1	1.6	1.0	1.3	1.1	0.4	0.7	0.6
1000°C	-	-	1.2	1.8	-	-	2.9	3.4	2.5	2.5	1.7	-	-	-	-	-	-	-
1100°C	-	-	1.0	1.5	2.0	2.7	-	3.3	-	-	-	-	-	-	-	-	-	-
1200°C	-	-	-	-	-	-	2.8	3.4	-	-	-	-	-	-	-	-	-	-
Permanent linear change, %																		
after 5 hours @ 650°C	-	-	-	-	-	-	-	-	-	-	-	-0.2	-0.2	-0.2	-0.2	-0.7	-0.6	-
815°C	-0.2	-0.2	-0.3	-0.3	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.5	-0.5	-0.5	-0.4	-1.2	-1.0	-1.1
1000°C	-1.0	-1.0	-0.3	-0.3	-0.3	-0.3	-0.2	-0.2	-0.3	-0.3	-0.4	-1.0	-1.1	-1.1	-	-	-	-
1100°C	-1.5	-1.5	-0.4	-0.4	-0.5	-0.5	-0.5	-0.3	-0.6	-0.6	-0.6	-	-	-	-	-	-	-
1200°C	-	-	-0.6	-0.7	-0.6	-0.6	-0.4	-0.4	-	-	-	-	-	-	-	-	-	-
Thermal conductivity, W/m·k																		
Mean Temperature @200°C	0.17	0.18	0.15	0.15	0.15	0.17	0.20	0.22	0.17	0.20	0.16	0.13	0.13	0.14	0.12	0.09	0.11	0.13
@ 400°C	0.20	0.21	0.17	0.17	0.17	0.20	0.21	0.24	0.20	0.21	0.19	0.15	0.15	0.16	0.14	0.12	0.14	0.15
@ 600°C	0.22	0.23	0.20	0.22	0.20	0.22	0.23	0.27	0.22	0.24	0.21	0.17	0.17	0.18	0.16	-	-	0.17
@ 800°C	0.24	0.25	-	-	0.22	0.24	-	-	-	-	-	-	-	-	-	-	-	-
Estimated weight of dry material/ m³ of construction																		
kg	900	960	820	890	780	870	970	1060	900	920	860	640	580	700	500	400	500	590
Estimated weight of water/100kg of dry material																		
kg	70	65	78	75	72	60	62	58	55	50	50	85	90	80	98	165	110	79
Chemical composition, %																		
Al ₂ O ₃	-	-	37.0	35.9	37.1	34.6	39.0	39.0	32.0	31.5	30.6	35.0	33.7	33.7	31.8	24.7	24.7	17.66
SiO ₂	-	-	33.6	32.0	31.0	34.4	28.9	28.9	29.0	30.0	34.7	22.6	23.3	23.3	26.2	32.6	32.6	48.51
Fe ₂ O ₃	-	-	4.5	5.3	6.7	6.4	5.4	5.4	8.9	9.6	9.5	8.8	9.7	9.7	10.0	7.3	7.3	5.17
TiO ₂	-	-	1.2	1.3	1.2	1.1	1.4	1.4	1.4	1.4	1.2	1.5	1.4	1.4	0.1	0.8	0.8	0.58
CaO	-	-	22.0	22.5	21.3	19.6	23.2	23.2	21.8	22.0	18.8	25.2	24.9	24.9	22.8	22.7	22.7	20.24
MgO+K ₂ O+Na ₂ O	-	-	1.2	1.5	1.7	0.1	1.0	1.0	4.9	3.3	5.0	5.7	6.1	6.1	8.3	9.9	9.9	5.97
Ignition Loss	-	-	0.3	0.7	1.0	1.7	1.1	1.1	0.2	0.7	0.2	1.1	0.1	0.1	0.7	2.0	2.0	-
Packaging in bags, kg	25	25	25	25	25	25	25	25	25	20	20	20	20	20	18	16	16	-

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Insulating castable products

	Low lime insulating concretes										Insulating and finishing cements		
	2500		LW		LW HS	LW HS-G	2200 LL		2000 LL	2000 LL-G	JM 500	JM 460	JM 375
	Cast	Gun	Cast	Gun	Cast	Gun	Cast	Gun	Cast	Gun	-	-	-
Max. continuous use temperature, °C	-	-	-	-	-	-	-	-	-	-	980	980	760
Method of application	Cast	Gun	Cast	Gun	Cast	Gun	Cast	Gun	Cast	Gun	-	-	-
Temperature limit, °C	1370	1370	1320	1320	1320	1320	1200	1200	1100	1100	-	-	-
Basic raw material													
insulating aggregate	•	•	•	•	•	•	•	•	•	•	-	-	-
soluble glass fibre	-	-	-	-	-	-	-	-	-	-	-	•	•
vermiculite	-	-	-	-	-	-	-	-	-	-	•	-	-
Maximum grain size, mm	6	6	6	6	4	4	4	4	4	4	-	-	-
Density, kg/m³													
as placed	1860	1930	1740	1760	1610	1680	1510	1560	1300	1300	-	-	-
oven dried @ 105°C	1420	1500	1200	1290	1340	1430	1230	1390	1040	1060	280	470	750
after 5 hours firing @ 815°C	1340	1420	1150	1200	1250	1330	1190	1330	1010	1050	-	-	-
Modules of rupture, Mpa													
oven dried @ 105°C	-	-	-	-	-	-	-	-	-	-	0.4	0.5	0.8
after 5 hours firing @ 650°C	-	-	-	-	-	-	-	-	-	-	-	0.9	1.2
after 5 hours firing @ 815°C	-	-	-	-	-	-	-	-	-	-	0.4	0.8	-
Cold crushing strength, Mpa													
oven dried @ 105°C	8.8	10.8	4.3	6.4	9.8	14.7	9.1	19.6	5.9	9.8	-	-	-
after 5 hours firing @ 650°C	-	-	-	-	-	-	-	-	-	-	-	-	-
815°C	6.9	8.4	3.2	5.9	7.8	11.8	6.2	14.7	3.9	6.9	-	-	-
1000°C	5.1	6.0	2.8	5.4	-	-	-	9.8	-	-	-	-	-
1100°C	-	-	-	4.9	4.9	5.9	-	-	-	-	-	-	-
1200°C	5.9	6.5	3.9	4.4	-	-	-	-	-	-	-	-	-
1300°C	6.9	7.0	-	-	6.4	6.9	-	-	-	-	-	-	-
Permanent linear change, %													
oven dried @ 105°C	-	-	-	-	-	-	-	-	-	-	-3.0	-4.0	-0.5
after 5 hours @ 650°C	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.3	-0.2	-0.3	-	-3.5	-2.5	-2.1
815°C	-0.3	-0.3	-0.3	-0.3	-	-0.6	-0.5	-0.6	-0.5	-	-4.0	-2.8	-
1000°C	-0.4	-0.5	-	-	-0.4	-	-	-	-	-	-	-	-
1100°C	-	-	-0.6	-0.5	0.6	-	-	-	-	-	-	-	-
1200°C	-0.7	-0.7	-1.0	-0.8	-1.5	-	-	-	-	-	-	-	-
Thermal conductivity, W/m·k													
Mean temperature @200°C	0.34	0.36	0.28	0.29	0.29	0.31	0.24	0.29	0.21	0.21	0.12	0.14	0.13
@ 400°C	0.37	0.39	0.30	0.31	0.31	0.33	0.27	0.31	0.23	0.24	0.14	0.16	0.14
@ 600°C	0.40	0.42	0.33	0.34	0.34	0.36	0.29	0.34	0.26	0.27	0.16	0.19	-
@ 800°C	0.42	0.45	0.35	0.36	0.36	0.38	0.33	0.36	-	-	-	-	-
@ 1000°C	0.44	0.48	0.38	0.39	0.39	0.41	-	-	-	-	-	-	-
Estimated weight of dry material/m³ of construction													
kg	1350	1450	1160	1220	1250	1330	1190	1300	1020	1040	250	750	850
Estimated weight of water/100kg of dry material													
kg	25	23	30	27	24	20	27	20	27	25	250	120	100
Chemical composition, %													
Al ₂ O ₃	44.4	44.4	46.2	46.2	38.8	40.0	30.7	30.7	28.0	29.1	15.3	13.2	13.6
SiO ₂	34.4	34.4	34.3	34.3	37.6	36.2	42.9	42.9	45.8	45.2	54.0	59.4	50.0
Fe ₂ O ₃	5.4	5.4	4.7	4.7	6.9	6.8	8.0	8.0	8.4	8.1	5.3	0.76	1.3
TiO ₂	1.5	1.5	1.4	1.4	1.1	1.1	1.4	1.4	1.0	1.0	-	0.2	0.1
CaO	11.7	11.7	10.1	10.1	11.8	11.8	11.8	11.8	10.5	10.3	1.7	20.5	26.9
MgO+K ₂ O+Na ₂ O	1.1	1.1	1.5	1.5	1.9	1.3	3.9	3.9	5.3	4.8	19.1	6.6	4.4
Ignition loss	1.1	1.1	1.7	1.7	1.9	2.3	1.3	1.3	1.0	1.5	-	-	-
Packaging in bags, kg	22	22	25	25	30	-	-	-	-	-	7	18	18

Monolithics products : insulating very lightweight

Product Name	Kaolite® 1600		Kaolite 1800	
	Method of Installation ^{1, 6}	cast	gun	cast
Average lb (kg) required to place 1 ft ³ (0.3 m ³) ²	25 (11)	36 (16)	27 (12)	31 (14)*
Recommended Water, % ³				
casting by vibrating	140 - 160	-	145 - 165	-
pouring	165 - 180	-	170 - 185	-
Temperature use limit, °F (°C)	1600 (871)		1800 (982)	
Density, pcf (kg/m ³)				
dried 24 hrs. @ 220°F (104°C)	30 - 39 (480 - 625)	35 - 46 (561 - 705)	30 - 39 (480 - 625)	26 - 37 (416 - 593)
fired @ 1500°F (816°C)	23 - 32 (368 - 513)	28 - 38 (449 - 609)	23 - 31 (368 - 496)	25 - 35 (400 - 561)
Modulus of rupture, psi (MPa), ASTM C 133				
dried 24 hrs. @ 220°F (104°C)	60 - 125 (0.41 - 0.86)	70 - 150 (0.48 - 1.03)	40 - 70 (0.27 - 0.48)	50 - 80 (0.34 - 0.55)
fired 5 hrs. @ 1500°F (816°C)	20 - 45 (0.14 - 0.31)	30 - 55 (0.21 - 0.34)	30 - 50 (0.21 - 0.34)	40 - 60 (0.27 - 0.41)
fired 5 hrs. @ temperature use limit	25 - 40 (0.17 - 0.27)	35 - 50 (0.24 - 0.34)	25 - 40 (0.17 - 0.27)	
Cold crushing strength, psi (MPa), ASTM C 133				
dried 24 hrs. @ 220°F (104°C)	150 - 300 (1.03 - 2.07)	175 - 350 (1.21 - 2.41)	75 - 150 (0.52 - 1.03)	80 - 150 (0.55 - 1.03)
fired @ 1500°F (816°C)	100 - 200 (0.69 - 1.38)	120 - 250 (0.83 - 1.72)	80 - 150 (0.55 - 1.03)	90 - 175 (0.62 - 1.21)
fired 5 hrs. @ temperature use limit	70 - 120 (0.48 - 0.83)	90 - 160 (0.62 - 1.10)	50 - 90 (0.34 - 0.62)	70 - 150 (0.48 - 1.03)
Permanent linear change, %, ASTM C 113 ⁴				
fired 5 hrs. @ 220°F (104°C)	0 to -0.3		0 to -0.3	
fired 5 hrs. @ 1500°F (816°C)	-1.0 to -2.0		-0.8 to -1.8	
fired 5 hrs. @ temperature use limit	-1.5 to -2.5		-1.5 to -2.5	
Chemical analysis, % weight basis after firing ⁵				
Alumina, Al ₂ O ₃	9.9		27	
Silica, SiO ₂	31		39	
Ferric oxide, Fe ₂ O ₃	7.4		6.8	
Titanium oxide, TiO ₂	1.1		1.6	
Calcium oxide, CaO	39		15.5	
Magnesium oxide, MgO	8.2		5.8	
Alkalies, Na ₂ O, K ₂ O	3.4		3.6	
Thermal conductivity, BTU•in/hr•ft ² •°F (W/m•K), ASTM C 417				
mean temperature @ 500°F	0.87 (0.13)	1.03 (0.15)	0.79 (0.11)	0.74 (0.11)
@ 1000°F	1.02 (0.15)	1.11 (0.16)	0.95 (0.14)	0.90 (0.13)
@ 1500°F	1.16 (0.17)	1.20 (0.17)	1.11 (0.16)	0.95 (0.14)
@ 2000°F	-	-	-	-
Pounds per bag, lb (kg)	20 (9)			
Shelf life, months	12			

* For overhead gunning applications, pounds required to place one ft³ should be increased to 40 - 50 %. Does not include rebound loss.

- Properties indicated are for vibratory cast materials only unless specified otherwise.
- Guniting installation may require 10-30% more material due to compaction and rebound loss.
- Water requirements indicated are offered as a guide. Actual water required may be subject to field conditions. Consult Thermal Ceramics installation advisor for assistance.
- Fired linear change values reflect samples taken from a dried to fired state.
- Chemical analysis % for CaO in parenthesis indicates the % of reactive CaO present if less than the total. The balance is CaO from the anorthite aggregate.
- Kaolite 2000-HS and Kaolite 2200 may be guniting, with care. The rebound will be significantly higher and the difficulty greater than with the respective grades.

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Monolithics products : insulating lightweight

Product Name	Kaolite 2000	Kaolite 2000-HS	Kaolite 2000-HS Gun	Kaolite 2200	Kaolite 2200 Gun	Kaolite 1:2:4
Method of Installation ^{1, 6}	cast/gun	cast	gun	cast	gun	cast/gun
Average lb (kg) required to place 1 ft ³ (0.3 m ³) ²	32 (15)	61 (27)	62 (28)	61 (27)	62 (28)	57 (25)
Recommended Water, % ³						
casting by vibrating	125 - 145	45 - 53	-	45 - 53	-	55 - 65
Temperature use limit, °F (°C)	2000 (1093)			2200 (1204)		2000 (1093)
Density, pcf (kg/m ³), fired						
@ 220°F (104°C)	32 - 40 (513 - 641)	59 - 69 (945 - 1105)	61 - 72 (977 - 1153)	59 - 69 (945 - 1105)	61 - 72 (977 - 1153)	53 - 65 (849 - 1041)
@ 1500°F (816°C)	27 - 36 (432 - 577)	55 - 65 (881 - 1057)	57 - 68 (913 - 1089)	55 - 65 (881 - 1057)	57 - 68 (913 - 1089)	51 - 61 (801 - 961)
Modulus of rupture, psi (MPa), ASTM C 133						
dried 24 hrs. @ 220°F (104°C)	45 - 90 (0.31 - 0.62)	90 - 175 (0.62 - 1.21)	85 - 150 (0.59 - 1.03)	90 - 175 (0.62 - 1.21)	90 - 150 (0.62 - 1.03)	125 - 200 (0.86 - 1.38)
fired 5 hrs. @ 1500°F (816°C)	50 - 100 (0.34 - 0.69)	100 - 225 (0.69 - 1.55)	110 - 225 (0.76 - 1.55)	100 - 225 (0.69 - 1.55)	110 - 225 (0.76 - 1.55)	80 - 175 (0.55 - 1.21)
fired 5 hrs. @ temperature use limit	60 - 100 (0.41 - 0.76)	90 - 160 (0.55 - 1.10)	130 - 250 (0.90 - 1.72)	80 - 160 (0.55 - 1.10)	130 - 250 (0.90 - 1.72)	75 - 150 (0.52 - 1.03)
Cold crushing strength, psi (MPa), ASTM C 133						
dried 24 hrs @ 220°F (104°C)	120 - 250 (0.83 - 1.72)	350 - 750 (2.1 - 5.2)	300 - 700 (2.1 - 4.8)	350 - 650 (2.4 - 4.5)	300 - 500 (2.06 - 3.5)	300 - 500 (2.06 - 3.5)
fired 5 hrs. @ 1500°F (816°C)		350 - 800 (2.1 - 5.2)	350 - 800 (2.1 - 5.2)	350 - 800 (2.4 - 5.2)	400 - 900 (2.76 - 6.2)	250 - 450 (1.7 - 3.1)
fired 5 hrs. @ temperature use limit	100 - 200 (0.69 - 1.38)	450 - 900 (3.1 - 6.2)	250 - 450 (1.7 - 3.1)			
Permanent linear change, %, ASTM C 113 ⁴						
dried 24 hrs. @ 220°F (104°C)	0 to -0.2					
fired 5 hrs. @ 1500°F (816°C)	-0.6 to -1.5	-0.2 to -0.55	-0.2 to -0.65	-0.2 to -0.55	-0.2 to -0.65	-0.4 to -1.0
fired 5 hrs. @ temperature use limit	-1.5 to -2.5	-0.3 to -1.0	-0.3 to -0.8	-0.3 to -1.0	-0.3 to -0.8	-
Chemical analysis, % weight basis after firing ⁵						
Alumina, Al ₂ O ₃	33	38	36	38	36	27
Silica, SiO ₂	35	38	42	38	42	37
Ferric oxide, Fe ₂ O ₃	4.0	2.0	1.6	2.0	1.6	11
Titanium oxide, TiO ₂	1.7	1.5	1.4	1.5	1.4	1.4
Calcium oxide, CaO	18	19 (12)	17 (10)	19 (12)	17 (10)	17
Magnesium oxide, MgO	4.6	0.2	0.2	0.2	0.2	3.4
Alkalies, Na ₂ O, K ₂ O	3.1	1.1	1.4	1.1	1.4	2.6
Thermal conductivity, BTU • in/hr • ft ² • °F (W/m • K), ASTM C 417						
mean temperature @ 500°F (260°C)	0.73 (0.11)		1.48 (0.21)		1.45 (0.22)	
@ 1000°F (538°C)	0.88 (0.13)		1.63 (0.23)		1.60 (0.24)	
@ 1500°F (816°C)	0.98 (0.14)		1.79 (0.26)		1.85 (0.28)	
@ 2000°F (1093°C)	-		1.96 (0.28)		-	
Pounds per bag, lb (kg)	20 (9)		40 (18)		50 (23)	
Shelf life, months	12					

1. Properties indicated are for vibratory cast materials only unless specified otherwise.

2. Gunite installation may require 10-30% more material due to compaction and rebound loss.

3. Water requirements indicated are offered as a guide. Actual water required may be subject to field conditions. Consult Thermal Ceramics installation advisor for assistance.

4. Fired linear change values reflect samples taken from a dried to fired state.

5. Chemical analysis % for CaO in parenthesis indicates the % of reactive CaO present if less than the total. The balance is CaCl₂ from the anorthite aggregate.

6. Kaolite 2000-HS and Kaolite 2200 may be gunited, with care. The rebound will be significantly higher and the difficulty greater than with the respective grades.

Monolithics products : insulating medium weight

Product Name	Kaolite® 2200-HS	Kaolite 2200-HS Gun	Kaolite 2500-HS	Kaolite 2500-HS Gun	Kaolite 2500-EXHS	Kaolite Super HS Gun
Method of installation ¹	cast	gun	cast	gun	gun	gun
Average lb (kg) required to place 1 ft ³ (0.3 m ³) ²	76 (34)	76 (34)	83 (38)	83 (38)	86 (39)	78 (35)
Recommended Water, % ³						
casting by vibrating	38 - 44	-	29 - 35	-	-	
Temperature use limit, °F (°C)	2200 (1204)		2500 (1371)		2400 (1315)	
Density, pcf (kg/m ³), fired						
@ 220°F (104°C)	79 - 90 (1265 - 1442)	79 - 90 (1265 - 1442)	86 - 97 (1377 - 1554)	86 - 97 (1377 - 1554)	87 - 99 (1394 - 1586)	80 - 90 (1281 - 1458)
@ 1500°F (816°C)	69 - 80 (1105 - 1281)	70 - 80 (1121 - 1281)	79 - 89 (1265 - 1425)	79 - 89 (1265 - 1425)	81 - 91 (1298 - 1458)	73 - 83 (1154 - 1330)
Modulus of rupture, psi (MPa), ASTM C 133						
dried 24 hrs. @ 220°F (104°C)	225 - 350 (1.6 - 2.4)	250 - 400 (1.72 - 2.76)	250 - 400 (1.72 - 2.76)	250 - 400 (1.72 - 2.76)	300 - 550 (2.07 - 3.79)	450 - 900 (3.10 - 6.21)
fired 5 hrs. @ 1500°F (816°C)	150 - 300 (1.03 - 2.07)	200 - 350 (1.38 - 2.41)	225 - 375 (1.38 - 2.41)	250 - 500 (1.72 - 2.76)	275 - 500 (1.90 - 3.44)	350 - 600 (1.38 - 4.14)
fired 5 hrs. @ temperature use limit	200 - 300 (1.38 - 2.07)	250 - 500 (1.72 - 3.44)	300 - 550 (2.07 - 3.79)	350 - 600 (2.41 - 4.14)	375 - 650 (2.59 - 4.48)	500 - 1000 (3.44 - 6.9)
Cold crushing strength, psi (MPa), ASTM C 133						
dried 24 hrs @ 220°F (104°C)	850 - 1600 (5.86 - 11.03)	900 - 1600 (6.20 - 11.03)	900 - 1500 (6.20 - 10.34)	900 - 1500 (6.20 - 10.34)	1000 - 1600 (6.89 - 11.03)	2200 - 5000 (15.1 - 34.5)
fired 5 hrs. @ 1500°F (816°C)	800 - 1600 (5.86 - 11.03)	900 - 1700 (6.20 - 1700)	850 - 1600 (5.86 - 11.03)	900 - 1600 (6.20 - 11.03)	950 - 1700 (6.55 - 11.72)	1800 - 3500 (12.4 - 24.1)
fired 5 hrs. @ temperature use limit	750 - 1400 (5.17 - 9.65)	800 - 1500 (5.52 - 10.34)	900 - 1500 (6.21 - 10.34)		1100 - 1800 (7.58 - 12.41)	2500 - 5000 (17.2 - 34.5)
Permanent linear change, % ASTM C 113 ⁴						
dried 24 hrs. @ 220°F (104°C)	0 to -0.2					
fired 5 hrs. @ 1500°F (816°C)	-0.1 to -0.5	-0.2 to -0.55	-0.1 to -0.4	-0.2 to -0.5		-0.1 to -0.4
fired 5 hrs. @ temperature use limit	-0.3 to -1.0	-0.5 to -1.5	-1.5 to +1.5	-1.0 to +0.5		-0.5 to -1.5
Chemical analysis, % Weight basis after firing ⁵						
Alumina, Al ₂ O ₃	44	41	42	40	42	28
Silica, SiO ₂	27	31	37		38	53.5
Ferric oxide, Fe ₂ O ₃	3.2	3.0	2.4	2.2		2.6
Titanium oxide, TiO ₂	1.8	1.5	1.6	1.4	1.3	1.2
Calcium oxide, CaO	22 (17)		16 (12)	15 (11)	16 (11)	11.5
Magnesium oxide, MgO	0.4	0.2				0.7
Alkalies, Na ₂ O, K ₂ O	0.9		0.7		0.8	2.3
Thermal conductivity, BTU•in/hr•ft ² •°F (W/m•K), ASTM C 417						
mean temperature @ 500°F (260°C)	1.71 (0.25)		2.8 (0.40)		2.7 (0.39)	
@ 1000°F (538°C)	1.83 (0.26)		3.0 (0.43)		2.9 (0.42)	
@ 1500°F (816°C)	2.01 (0.29)		3.2 (0.46)		3.0 (0.43)	
@ 2000°F (1093°C)	2.23 (0.32)		3.4 (0.51)		3.2 (0.46)	
@ 2500°F (1371°C)	-		3.5 (0.53)		-	
Pounds per bag, lb (kg)	50 (23)					
Shelf life, months	12					

- Properties indicated are for vibratory cast materials only unless specified otherwise.
- Gunit installation may require 10-30% more material due to compaction and rebound loss.
- Water requirements indicated are offered as a guide. Actual water required may be subject to field conditions. Consult Thermal Ceramics installation advisor for assistance.
- Fired linear change values reflect samples taken from a dried to fired state.
- Chemical analysis % for CaO in parenthesis indicates the % of reactive CaO present if less than the total. The balance is Calcia from the anorthite aggregate.

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Monolithics products : insulating low iron

Product Name	Kaolite® 2000-LI	Kaolite 2300-LI	Kaolite 2300-LI Gun	Kaolite 2500-LI	Kaolite 2500-LI Gun	Kaolite 2600-LI	Kaolite 2600-LI Gun
Method of installation¹	cast/gun	cast	gun	cast	gun	cast	gun
Average lb (kg) required to place 1 ft³ (0.3 m³)²	39 (18)	61 (28)	62 (29)	70 (31)	71 (32)	83 (38)	84 (38)
Recommended Water, %³							
casting by vibrating	78 - 90	46 - 54	-	38 - 47	-	29 - 35	-
Temperature use limit, °F (°C)	2000 (1093)	2300 (1260)		2500 (1371)		2600 (1427)	
Density, pcf (kg/m³), fired							
dried 24 hrs. @ 220°F (104°C)	36 - 45 (577 - 737)	62 - 73 (993 - 1169)	61 - 73 (977 - 1169)	71 - 82 (1138 - 1314)		84 - 95 (1346 - 1522)	83 - 94 (1329 - 1506)
fired @ 1500°F (816°C)	31 - 42 (513 - 657)	55 - 66 (881 - 1057)	56 - 67 (897 - 1073)	65 - 75 (1041 - 1201)		79 - 89 (1250 - 1410)	
Modulus of rupture, psi (MPa), ASTM C 133							
dried 24 hrs. @ 220°F (104°C)	60 - 120 (0.41 - 0.83)	120 - 200 (0.83 - 1.38)		175 - 275 (1.21 - 1.90)		250 - 400 (2.07 - 3.45)	300 - 500 (2.07 - 3.44)
fired 5 hrs. @ 1500°F (816°C)	55 - 110 (0.38 - 0.76)	110 - 200 (0.80 - 1.38)	110 - 225 (0.80 - 1.55)	125 - 250 (0.86 - 1.72)		250 - 350 (1.38 - 2.41)	225 - 400 (1.72 - 2.76)
fired 5 hrs. @ temperature use limit	75 - 150 (0.52 - 1.03)	150 - 250 (1.03 - 1.72)	150 - 300 (1.03 - 2.07)	200 - 350 (1.38 - 2.41)	250 - 400 (1.72 - 2.75)	400 - 800 (2.75 - 5.52)	500 - 900 (3.45 - 6.21)
Cold crushing strength, psi (MPa), ASTM C 133							
dried 24 hrs. @ 220°F (104°C)	225 - 400 (1.55 - 2.76)	350 - 600 (2.41 - 4.13)		600 - 1200 (4.14 - 8.28)	600 - 1200 (4.14 - 8.28)	850 - 1600 (5.86 - 11.03)	950 - 1700 (6.55 - 11.7)
fired 5 hrs. @ 1500°F (816°C)	175 - 350 (1.21 - 2.41)	350 - 900 (2.41 - 6.21)				900 - 1600 (6.20 - 11.0)	
fired 5 hrs. @ temperature use limit	200 - 375 (1.38 - 2.59)	400 - 1000 (2.76 - 6.89)		800 - 1400 (5.52 - 9.65)	700 - 1300 (4.83 - 8.97)	1200 - 2000 (8.28 - 13.79)	1100 - 2000 (7.58 - 13.79)
Permanent linear change, % ASTM C 113⁴							
dried 24 hrs. @ 220°F (104°C)	0 to -0.2						
fired 5 hrs. @ 1500°F (816°C)	-0.6 to -1.3	-0.1 to -0.5	-0.2 to -0.6	-0.1 to -0.4	-0.2 to -0.5	-0.1 to -0.4	-0.2 to -0.5
fired 5 hrs. @ temperature use limit	-1.5 to -3.0	-1.0 to -2.0		-0.5 to -1.5			
Chemical analysis, % Weight basis after firing⁵							
Alumina, Al ₂ O ₃	30	40	37	44	41	47	45
Silica, SiO ₂	46	38	42	36	39	36	38
Ferric oxide, Fe ₂ O ₃	1.4	0.9				1.0	
Titanium oxide, TiO ₂	1.0	1.4				1.5	1.8
Calcium oxide, CaO	16	18 (10)	17 (9)	17 (11)	16 (11)	13 (10)	
Magnesium oxide, MgO	0.5	0.2					
Alkalies, as Na ₂ O, K ₂ O	4.5	1.2		1.0		0.8	
Thermal conductivity, BTU•in/hr•ft²•°F (W/m•K), ASTM C 417							
mean temperature @ 500°F (260°C)	1.1 (0.14)	1.48 (0.21)		1.86 (0.27)		2.7 (0.39)	2.9 (0.42)
@ 1000°F (538°C)	1.3 (0.19)	1.62 (0.23)		2.05 (0.30)		2.9 (0.42)	
@ 1500°F (816°C)	1.5 (0.22)	1.77 (0.26)		2.25 (0.32)		3.0 (0.43)	
@ 2000°F (1093°C)	-	1.92 (0.28)		2.46 (0.35)		3.2 (0.46)	
Pounds per bag, lb (kg)	20 (9)	40 (18)		50 (23)			
Shelf life, months	12						

1. Properties indicated are for vibratory cast materials only unless specified otherwise.
 2. Gunite installation may require 10-30% more material due to compaction and rebound loss.
 3. Water requirements indicated are offered as a guide. Actual water required may be subject to field conditions. Consult Thermal Ceramics installation advisor for assistance.
 4. Fired linear change values reflect samples taken from a dried to fired state.
 5. Chemical analysis % for CaO in parenthesis indicates the % of reactive CaO present if less than the total. The balance is Calcia from the anorthite aggregate.

Monolithics products : insulating low iron

Product Name	Kaolite® 2800 Cast	Kaolite 2800 Gun	Kaolite 3000	Kaolite 3300
Method of installation ¹	cast	gun	cast	cast
Average lb (kg) required to place 1 ft ³ (0.3 m ³) ²	102 (47)	97 (44)	102 (47)	98 (44)
Recommended Water, %³				
casting by vibrating	17 - 23		14 - 20	11 - 13
Temperature use limit, °F (°C)	2800 (1538)		3000 (1649)	3300 (1816)
Density, pcf (kg/m³), fired				
fired @ 1500°F (816°C)	96 - 108 (1538 - 1731)	90 - 102 (1442 - 1635)	98 - 111 (1570 - 1778)	94 - 105 (1505 - 1682)
Modulus of rupture, psi (MPa), ASTM C 133				
dried 24 hrs. @ 220°F (104°C)	400 - 800 (2.76 - 5.52)	350 - 600 (2.07 - 3.45)	250 - 550 (1.55 - 3.79)	500 - 900 (3.44 - 6.21)
fired 5 hrs. @ 1500°F (816°C)	350 - 600 (2.07 - 3.45)	300 - 500 (2.06 - 3.44)	175 - 350 (1.21 - 2.41)	400 - 700 (2.76 - 4.82)
fired 5 hrs. @ temperature use limit	800 - 1500 (5.52 - 10.34)	600 - 1200 (4.14 - 8.27)	400 - 800 (2.76 - 5.52)	900 - 1700 (3.44 - 11.72)
Cold crushing strength, psi (MPa), ASTM C 133				
dried 24 hrs. @ 220°F (104°C)	1600 - 3500 (11.0 - 24.1)	1100 - 2200 (7.58 - 15.2)	900 - 1700 (6.21 - 11.7)	2000 - 3500 (13.8 - 24.1)
fired 5 hrs. @ 1500°F (816°C)	1400 - 3000 (9.65 - 20.7)	1000 - 2200 (6.89 - 15.2)	800 - 1500 (5.51 - 10.34)	1500 - 3000 (10.3 - 20.7)
fired 5 hrs. @ temperature use limit	1500 - 5000 (10.3 - 34.5)		1200 - 2200 (8.27 - 15.2)	2500 - 4000 (17.2 - 27.6)
Permanent linear change, % ASTM C 113⁴				
dried 24 hrs. @ 220°F (104°C)	0 to -0.2			
fired 5 hrs. @ 1500°F (816°C)	-0.4 to -0.9		-0.1 to -0.3	
fired 5 hrs. @ temperature use limit	-0.1 to +1.0	-0.1 to +1.5	-1.0 to -2.5	0 to -0.6
Chemical analysis, % weight basis after firing⁵				
Alumina, Al ₂ O ₃	57	54	57	94
Silica, SiO ₂	36		35	0.5
Ferric oxide, Fe ₂ O ₃	0.7	0.9	1.0	0.1
Titanium oxide, TiO ₂	1.5	1.8	2.0	-
Calcium oxide, CaO	3.9	5.9	4.5	4.6
Magnesium oxide, MgO	0.1	0.2		0.1
Alkalies, as Na ₂ O, K ₂ O	1.0	1.1	0.8	0.4
Thermal conductivity, BTU • in/hr • ft² • °F (W/m • K), ASTM C 417				
mean temperature @ 500°F (260C)	3.5 (0.5), estimated	3.4 (0.49)	3.6 (0.52) estimated	9.9 (1.43)
@ 1000°F (538°C)	3.8 (0.55)	3.7 (0.53)	3.8 (0.55)	8.2 (1.18)
@ 1500°F (816°C)	4.0 (0.58)	3.9 (0.56)	4.0 (0.58)	7.4 (1.07)
@ 2000°F (1093°C)	4.3 (0.62)	4.2 (0.61)	4.3 (0.62)	7.5 (1.08)
@ 2500°F (1371°C)	4.8 (0.69)	4.5 (0.64)	4.8 (0.69)	8.0 (1.15)
Pounds per bag, lb (kg)	50 (23)			
Shelf life, months	12			

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- Fired linear change values reflect samples taken from a dried to fired state.
- Chemical analysis % for CaO in parenthesis indicates the % of reactive CaO present if less than the total. The balance is Calcia from the anorthite aggregate.

Safety Data Sheet (SDS): are available for all our products. Data sheets, in other languages, can also be found by visiting our website. Please visit our website www.morganthermalceramics.com and click on the Safety Data Sheets Quick Link on our home page.

Whilst the values and application information in these datasheets are typical, they are given for guidance only. The values and the information given are subject to normal manufacturing variation and may be subject to change without notice. Morgan Advanced Materials - Thermal Ceramics makes no guarantees and gives no warranties about the suitability of a product and you should seek advice to confirm the product's suitability for use with Morgan Advanced Materials - Thermal Ceramics.

Monolithics products : dense

Product Name	Kaocrete® B	Kaocrete 2600 B	Kaocrete D	Kaocrete HS	Kaocrete 26	Kaocrete 28-LI	Kaocast®	Kaocrete 30	Kaocrete 32-CM
Method of installation¹	gun/ram	gun/ram	cast	cast	cast/gun	cast/gun	cast/gun	cast	cast
Average lb (kg) required to place 1 ft³ (0.3 m³)²	107 (49)		130 (59)		126 (57)	127 (58)	128 (58)	138 (63)	149 (67)
Recommended Water, casting by vibrating, %³	-		10 - 12	9 - 11	10 - 12		12 - 14	8 - 9.5	
Temperature use limit, °F (°C)	2000 (1093)	2600 (1427)	2500 (1371)	2600 (1427)		2800 (1538)	3000 (1649)		3200 (1760)
Density, pcf (kg/m³), fired @ 1500°F (816°C)	100 - 112 (1602 - 1794)	102 - 114 (1634 - 1826)	124 - 136 (1986 - 2179)	123 - 135 (1970 - 2163)	121 - 132 (1938 - 2114)	122 - 133 (1954 - 2130)	123 - 134 (1970 - 2146)	134 - 146 (2146 - 2340)	144 - 155 (2323 - 2483)
Modulus of rupture, psi (MPa), ASTM C 133									
dried 24 hrs. @ 220°F (104°C)	200 - 500 (1.4 - 3.4)	300 - 700 (2.1 - 4.8)	1000 - 1500 (6.9 - 1.3)	1100 - 1600 (7.6 - 11.0)	500 - 900 (3.4 - 6.2)		500 - 1000 (3.4 - 6.9)		450 - 900 (3.1 - 6.2)
fired 5 hrs. @ 1500°F (816°C)	175 - 350 (1.2 - 2.4)	175 - 350 (1.2 - 2.4)	400 - 800 (2.8 - 5.5)	450 - 900 (3.1 - 6.2)	250 - 450 (2.1 - 3.4)	300 - 500 (2.1 - 3.4)	275 - 500 (1.9 - 3.4)	325 - 550 (2.2 - 3.8)	350 - 600 (2.4 - 4.1)
fired 5 hrs. @ temperature use limit	200 - 400 (1.4 - 2.8)	250 - 500 (1.7 - 3.4)	800 - 1400 (5.5 - 9.7)	950 - 1400 (6.5 - 9.7)	800 - 1500 (5.5 - 10.3)		500 - 900 (3.4 - 6.2)	1000 - 1800 (6.9 - 12.4)	1200 - 2000 (8.3 - 13.8)
Cold crushing strength, psi (MPa), ASTM C 133									
dried 24 hrs. @ 220°F (104°C)	1000 - 1800 (6.9 - 12.4)	1500 - 2700 (10.3 - 18.6)	5000 - 8000 (34.5 - 55.2)	5500 - 9000 (37.9 - 62.0)	2500 - 4000 (17.2 - 27.6)	2800 - 4500 (19.3 - 31.0)	2100 - 3500 (14.5 - 24.1)	3000 - 7000 (20.7 - 48.3)	3000 - 6000 (20.7 - 41.4)
fired 5 hrs. @ 1500°F (816°C)	700 - 1500 (4.8 - 10.3)	1100 - 2000 (7.6 - 13.8)	3500 - 6500 (24.1 - 44.8)	4000 - 7500 (27.6 - 51.7)	2000 - 3500 (13.8 - 24.1)	2300 - 4000 (15.9 - 27.6)	1800 - 3000 (12.4 - 20.7)	2600 - 5000 (17.9 - 34.5)	2500 - 5500 (17.2 - 31.0)
fired 5 hrs. @ temperature use limit	400 - 800 (2.8 - 5.5)	1200 - 2500 (8.3 - 17.2)	3000 - 6000 (20.7 - 41.4)	3500 - 7000 (24.1 - 48.3)	2800 - 4000 (19.3 - 27.6)	3500 - 7000 (24.1 - 48.3)	2000 - 4000 (13.8 - 27.6)	4000 - 8000 (27.6 - 55.2)	5000 - 9000 (34.5 - 62.0)
Permanent linear change, % ASTM C 113⁴									
dried 24 hrs. @ 220°F (104°C)	0 to -0.2								
fired 5 hrs. @ 1500°F (816°C)	-0.8 to -2.0	-0.3 to -0.7	-0.1 to -0.3						
fired 5 hrs. @ temperature use limit	-1.0 to -2.5	-0.7 to +0.7	-0.4 to -1.0		-0.5 to -1.5		-0.2 to -1.0		-0.2 to -0.7
Chemical analysis, % weight basis after firing									
Alumina, Al ₂ O ₃	39	48	45	48	47	50	68	60	67
Silica, SiO ₂	46	41	40		43	41	24	34	28
Ferric oxide, Fe ₂ O ₃	1.3	1.0	2.3	1.0	1.1	0.9	1.0	0.8	0.9
Titanium oxide, TiO ₂	1.6	1.7	2.1	1.8	2.4	2.0	2.3	1.7	1.8
Calcium oxide, CaO	8.5	7.8	9.8	8.3	6.4	5.6	4.7	3.2	2.4
Magnesium oxide, MgO	0.3	0.2	trace	0.1					
Alkalies as Na ₂ O			0.3	0.2	0.1		0.2		
Thermal conductivity, BTU•in/hr•ft²•°F (W/m•K), ASTM C 417									
mean temperature @ 500°F (260°C)	3.3 (0.47)	-	6.2 (0.89)	5.9 (0.85)	5.6 (0.81)	6.0 (0.86)	8.1 (1.17)	9.7 (1.40)	11.6 (1.67)
@ 1000°F (538°F)	3.5 (0.50)		6.6 (0.95)	6.2 (0.89)	6.0 (0.86)	6.3 (0.91)	7.8 (1.12)	9.6 (1.38)	11.1 (1.60)
@ 1500°F (816°C)	3.8 (0.54)		6.8 (0.98)	6.5 (0.94)	6.3 (0.91)	6.6 (0.95)	7.7 (1.11)	9.6 (1.38)	10.9 (1.57)
@ 2000°F (1093°C)	4.1 (0.59)		6.9 (0.99)	6.7 (0.97)	6.4 (0.92)	6.7 (0.97)		9.7 (1.40)	10.4 (1.50)
Pounds per bag, lb (kg)	55 (25)								
Shelf life, months	12								

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 2. Guniting installation may require 10-30% more material due to compaction and rebound loss.
 3. Water requirements indicated are offered as a guide. Actual water required may be subject to field conditions. Consult Thermal Ceramics installation advisor for assistance.
 4. Fired linear change values reflect samples taken from a dried to fired state.

Monolithics products : dense gunning

Product Name	Kaogun® 26	Kaogun 28	Kaogun 30	Kaogun 32
Method of installation ¹	gun			
Average lb (kg) required to place 1 ft ³ (0.3 m ³) ²	121 (55)		135 (61)	150 (67)
Temperature use limit, °F (°C)	2600 (1427)	2800 (1538)	3000 (1649)	3200 (1760)
Density, pcf (kg/m ³), fired @ 1500°F (816°C)	117 - 126 (1875 - 2019)	117 - 127 (1875 - 2034)	130 - 142 (2082 - 2275)	142 - 156 (2275 - 2499)
Hot modulus of rupture, psi (MPa), ASTM C 583				
dried 24 hrs. @ 220°F (104°C)	350 - 700 (2.41 - 4.83)	350 - 700 (2.41 - 4.83)	500 - 950 (3.45 - 6.55)	400 - 700 (2.76 - 4.83)
fired 5 hrs. @ 1500°F (816°C)	200 - 400 (1.38 - 2.76)	250 - 450 (1.72 - 3.10)	400 - 800 (2.76 - 5.52)	350 - 600 (2.41 - 4.10)
fired 5 hrs. @ temperature use limit	600 - 1000 (4.14 - 6.89)	750 - 1450 (5.17 - 10.0)	600 - 950 (4.14 - 6.55)	600 - 1000 (4.14 - 6.89)
Cold crushing strength, psi (MPa), ASTM C 133				
dried 24 hrs. @ 220°F (104°C)	1900 - 3000 (13.1 - 20.7)	2200 - 3150 (15.2 - 21.7)	3000 - 6500 (20.7 - 44.8)	3000 - 6500 (20.7 - 44.8)
fired 5 hrs. @ 1500°F (816°C)	1300 - 2300 (9.0 - 15.9)	1300 - 2500 (9.0 - 17.2)	2500 - 6000 (17.2 - 41.4)	3000 - 6000 (20.7 - 41.1)
fired 5 hrs. @ temperature use limit	2200 - 3500 (15.2 - 24.1)	2500 - 4000 (17.2 - 27.6)	3500 - 7000 (17.9 - 48.3)	4500 - 8000 (31.0 - 55.2)
Permanent linear change, % ASTM C 113⁴				
dried 24 hrs. @ 220°F (104°C)	0 to -0.2			
fired 5 hrs. @ 1500°F (816°C)	-0.1 to -0.4		-0.1 to -0.3	
fired 5 hrs. @ temperature use limit	0 to +1.0	-0.3 to +0.5	-0.5 to -1.2	0 to -2.0
Chemical analysis, % weight basis after firing				
Alumina, Al ₂ O ₃	47	49	61	-
Silica, SiO ₂	43	42	32	
Ferric oxide, Fe ₂ O ₃	1.8	0.9	0.9	
Titanium oxide, TiO ₂	2.0	2.1	2.2	
Calcium oxide, CaO	5.7	6.0	4.1	
Magnesium oxide, MgO	0.2	0.1		
Alkalies as Na ₂ O	0.4			
Thermal conductivity, BTU•in/hr•ft²•°F (W/m•K), ASTM C 417				
mean temperature @ 500°F (260°C)	5.2 (0.75)	5.3 (0.76)	7.6 (1.10)	-
@ 1000°F (538°F)	5.4 (0.78)	5.5 (0.79)		
@ 1500°F (816°C)	5.7 (0.82)	5.8 (0.83)	7.7 (1.10)	
@ 2000°F (1093°C)	5.8 (0.83)	6.1 (0.88)	7.6 (1.10)	
Pounds per bag, lb (kg)	55			
Shelf life, months	12			

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Monolithics products : low cement vibratory cast

Product Name	Kaocrete® 249C	Kaocrete 250C	Hicast® Super	Hicast Super R	Hicast 90	Hicast 90TR
Average lb (kg) required to place 1 ft² (0.3 m²)¹	138 (63)	150 (68)	140 (645)	145 (66)	182 (83)	179 (82)
Recommended Water, casting by vibrating, %²	5.6 - 6.3	5.6 - 6.2	5.4 - 6.2	4.7 - 5.5	4.4 - 5.0	4.0 - 4.8
Temperature use limit, °F (°C)	2800 (1538)	3200 (1760)	2800 (1538)	3100 (1704)	3400 (1871)	3200 (1760)
Density, pcf (kg/m³), fired @ 1500°F (816°C)	134 - 143 (2146 - 2292)	143 - 156 (2339 - 2515)	134 - 144 (2146 - 2307)	139 - 145 (2224 - 2368)	178 - 189 (2851 - 3027)	173 - 185 (2772 - 2963)
Hot modulus of rupture, psi (MPa), ASTM C 583						
dried 24 hrs. @ 220°F (104°C)	800 - 1200 (5.5 - 8.3)	1600 - 2600 (11.0 - 17.9)	1200 - 2000 (8.27 - 13.79)		1600 - 2400 (11 - 17)	-
fired 5 hrs. @ 1500°F (816°C)	800 - 1300 (5.5 - 9)	2100 - 3700 (14.5 - 25.5)	1200 - 2000 (8.27 - 13.79)		1500 - 2100 (10 - 14)	
fired 5 hrs. @ temperature use limit	1600 - 2300 (11.0 - 15.9)	3000 - 4500 (20.7 - 31.0)	-			
Hot modulus of rupture, psi (MPa), ASTM C 583						
@ 1500°F (816°C)	1300 - 1700 (9.0 - 17.9)	2500 - 3300 (17.2 - 23)	1500 - 2500 (10.3 - 17.2)		-	
@ 2000°F (1093°C)	1100 - 1600 (7.6 - 11.0)	1900 - 2600 (13.1 - 17.9)	2000 - 3100 (13.8 - 21.4)			
@ 2250°F (1232°C)	800 - 1200 (5.5 - 8.3)	1000 - 1600 (6.9 - 11.0)	700 - 1300 (4.8 - 9.0)			
@ 2500°F (1371°C)	300 - 500 (2.1 - 3.4)	500 - 900 (3.4 - 6.2)	600 - 1050 (4.1 - 7.2)			
Cold crushing strength, psi (MPa), ASTM C 133						
dried 24 hrs. @ 220°F (104°C)	6000 - 9000 (41.4 - 62.1)	8000 - 12000 (55.2 - 82.7)	8000 - 11000 (55 - 76)		10000 - 14000 (69 - 97)	11000 - 19000 (76 - 131)
fired 5 hrs. @ 1500°F (816°C)	6500 - 9500 (44.8 - 65.5)	8500 - 12500 (58.6 - 86.2)	8500 - 13000 (59 - 90)		11000 - 18000 (76 - 124)	13000 - 21000 (90 - 145)
fired 5 hrs. @ temperature use limit	9000 - 13000 (62.1 - 89.6)	7000 - 12500 (48.3 - 86.2)	10000 - 14000 (69 - 96)		13000 - 20000 (90 - 138)	-
Deformation under hot load, % @ 25 psi (MPa), ASTM C 16						
dried 24 hrs. @ 220°F (104°C)	1.9	0.5	1.4		-0.6, dried @ 2640°F (1449°C)	-
fired 5 hrs. @ 1500°F (816°C)		1.4				
fired 5 hrs. @ temperature use limit	-	1.9				
Permanent linear change, % ASTM C 113³						
dried 24 hrs. @ 220°F (104°C)	0 to -0.2					0 to -0.1
fired 5 hrs. @ 1500°F (816°C)	-0.1 to -0.3					
fired 5 hrs. @ temperature use limit	-0.2 to -0.6	-2.5 to -3.5	-0.5 to -1.5		-0.5 to +0.5	
Abrasion Loss, cc's, fired @ 1500°F (816°C)						
	8 - 14	5 - 11	8 - 12	7 - 11	5 - 8	4 - 6
Chemical analysis, % weight basis after firing						
Alumina, Al ₂ O ₃	50	65	50		92	91
Silica, SiO ₂	46	30	45		6.2	5.9
Ferric oxide, Fe ₂ O ₃	0.8		0.9		0.1	0.2
Titanium oxide, TiO ₂	1.5	2.2	1.6		-	
Calcium oxide + Magnesium oxide, CaO + MgO	2.0	1.8	2.0		1.2	1.9
Alkalies, as Na ₂ O	1.3		0.5		0.4	
Thermal conductivity, BTU•in/hr•ft²•°F (W/m•K), ASTM C 417						
mean temperature @ 500°F (260°C)	9.9 (1.43)	12.6 (1.8)	11.3 (1.63)		28.3 (4.08)	-
@ 1000°F (538°F)	10.4 (1.5)	12.1 (1.7)	11.6 (1.67)		23.0 (3.32)	
@ 1500°F (816°C)	10.9 (1.6)	12.0 (1.7)	11.9 (1.72)		20.0 (2.88)	
@ 2000°F (1093°C)	11.3 (1.7)	12.3 (1.8)	12.1 (1.74)		18.5 (2.67)	
Pounds per bag, lb (kg)	55 (25)					
Shelf life, months	12		6			

1. Gunite installation may require 10-30% more material due to compaction and rebound loss.
 2. Water requirements indicated are offered as a guide. Actual water required may be subject to field conditions. Consult Thermal Ceramics installation advisor for assistance.
 3. Fired linear change values reflect samples taken from a dried to fired state.

Monolithics products : low cement gun

Product Name	Morflo® 160	Morflo 165X	Morflo 170	Higun® 160	Higun 170	Higun 175X
Method of installation ¹	vibratory cast			gun		
Average lb (kg) required to place 1 ft ³ (0.3 m ³) ²	151 (68)	165 (75)	178 (81)	137 (62)	153 (69)	161 (73)
Recommended water, casting by vibrating, % ³	5.5 - 6.5	5.2 - 6.2	5.0 - 6.0	added at nozzle	added at nozzle	added at nozzle
Temperature use limit, °F (°C)	2912 (1600)	3000 (1650)	3092 (1700)	2912 (1600)	3092 (1700)	3182 (1750)
Density, pcf (kg/m ³), fired @ 1500°F (816°C)	146 - 157 (2339 - 2515)	161 - 172 (2579 - 2755)	174 - 186 (2787 - 2979)	142 (2280)	158 (2530)	168 (2691)
Cold crushing strength, psi (MPa), ASTM C 133						
dried 24 hrs. @ 230°F (110°C)	8000 - 13000 (55 - 90)	9500 - 14000 (66 - 97)	11000 - 15000 (76 - 103)	9000 - 14000 (62 - 97)	11000 - 14000 (76 - 97)	-
fired 5 hrs. @ 1500°F (816°C)	9000 - 14000 (62 - 97)	9500 - 14000 (66 - 97)	12000 - 18000 (83 - 124)	8000 - 10000 (55 - 97)	8500 - 11000 (59 - 76)	8500 - 11000 (59 - 76)
fired 5 hrs. @ 1832°F (1000°C)	11000 - 16000 (76 - 110)	10000 - 16000 (69 - 110)	13000 - 20000 (90 - 138)	10500 - 14000 (72 - 97)	10000 - 13500 (69 - 93)	10000 - 14000 (69 - 97)
fired 5 hrs. @ 2912°F (1600°C)	12000 - 17000 (93 - 117)	14000 - 21000 (97 - 145)	15000 - 22000 (103 - 152)	11000 - 18000 (76 - 124)	11000 - 16000 (76 - 110)	11000 - 15000 (76 - 103)
Permanent linear change, % ASTM C 113						
dried 24 hrs. @ 230°F (110°C)	0.0 to -0.2			0 to -0.2		
fired 5 hrs. @ 1500°F (816°C)	-0.1 to -0.3			-0.3	-0.2	
fired 5 hrs. @ 1832°F (1000°C)	-0.1 to -0.4	-	-0.1 to -0.4	-0.3		
fired 5 hrs. @ 2912°F (1600°C)	-0.5 to -1.5	-0.5 to +1.5	-0.5 to -1.5	-1.5	+1.4	-0.4
Abrasion Loss, cc's, ASTM C 704	8 - 13	7 - 12	5 - 11	8 - 14	8 - 13	7 - 12
Chemical analysis, % weight basis after firing						
Alumina, Al ₂ O ₃	52	60	82	47	66	81
Silica, SiO ₂	42	34	11	48	27	13
Ferric oxide, Fe ₂ O ₃	0.8	1.1	1.2	0.5	1.0	1.0
Titanium oxide, TiO ₂	3.2	3.1		-		
Calcium oxide, CaO	1.5		1.7	2.9		2.8
Alkalies, as Na ₂ O	0.5			-		
Thermal conductivity, BTU•in/hr•ft²•°F (W/m•K), ASTM C 417						
mean temperature @ 1112°F (600°C)	11.0 (1.6)	-	15.9 (2.3)	10.75 (1.55)	12.3 (1.9)	13.2 (1.90)
Pounds per bag, lb (kg)	55 (25)					
Shelf life, months	9			6		

- Properties indicated are for vibratory cast materials only unless specified otherwise.
- Gunite installation may require 10-30% more material due to compaction and rebound loss.
- Water requirements indicated are offered as a guide. Actual water required may be subject to field conditions. Consult Thermal Ceramics installation advisor for assistance.
- Fired linear change values reflect samples taken from a dried to fired state.

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Monolithics products : low cement molten aluminum resistance

Product Name	Alcast® Extra HS	Albond®
Method of installation	vibratory cast	
Average lb (kg) required to place 1 ft ³ (0.3 m ³)	180 (82)	174 (79)
Recommended water, casting by vibrating, % ³	5.0 - 5.8	5.5 - 6.5
Temperature use limit, °F (°C)	2370 (1299)	2550 (1399)
Density, pcf (kg/m ³), fired @ 1500°F (816°C)	176 - 184 (2819 - 2947)	170 - 178 (2723 - 2851)
Cold crushing strength, psi (MPa), ASTM C 133		
dried 24 hrs. @ 220°F (104°C)	9500 - 14000 (66 - 97)	9000 - 13000 (62 - 90)
fired 5 hrs. @ 1500°F (816°C)	10000 - 17000 (69 - 117)	9500 - 14000 (66 - 97)
fired 5 hrs. @ temperature use limit	12000 - 18000 (83 - 124)	11000 - 17000 (76 - 117)
Permanent linear change, % ASTM C 113		
dried 24 hrs. @ 220°F (104°C)	0.0 to -0.2	
fired 5 hrs. @ 1500°F (816°C)	-0.1 to -0.3	
fired 5 hrs. @ temperature use limit	-0.2 to -0.6	-0.2 to -0.5
Chemical analysis, % weight basis after firing		
Alumina, Al ₂ O ₃	77	82
Silica, SiO ₂	12	11
Ferric oxide, Fe ₂ O ₃	1.1	1.2
Calcium oxide, CaO	1.4	1.8
Thermal conductivity, BTU • in/hr • ft² • °F (W/m • K), ASTM C 417		
mean temperature @ 1000°F (538°C)	15.9 (2.4)	
Pounds per bag, lb (kg)	50 (23)	
Shelf life, months	6	

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Monolithics products : clay bonded plastics

Product Name	Plascast® 60	Plasgun® 60	Plascast HT	Plasgun HT	Plascast 90	Plasgun 90
Method of installation	cast	gun	cast	gun	cast	gun
Average lb (kg) required to place 1 ft ³ (0.3 m ³)	145 (66)	139 (63)	145 (66)	140 (64)	147 (67)	141 (64)
Recommended water, casting by vibrating, %	8.5 - 10.0	-	8.5 - 10.0	-	8.5 - 10.0	-
Temperature use limit, °F (°C)	3000 (1649)		3100 (1704)		3200 (1760)	
Density, pcf (kg/m ³), fired @ 1500°F (816°C)	139 - 150 (2227 - 2403)	134 - 144 (2146 - 2307)	140 - 149 (2243 - 2387)	136 - 145 (2179 - 2323)	142 - 153 (2275 - 2451)	137 - 147 (2195 - 2355)
Cold crushing strength, psi (MPa), ASTM C 133						
dried 18-24 hrs. @ 220°F (104°C)	500 - 900 (3.45 - 6.21)	500 - 900 (3.45 - 6.21)	500 - 800 (3.45 - 5.52)	450 - 800 (3.10 - 5.52)	500 - 800 (3.45 - 5.52)	450 - 800 (3.10 - 5.52)
fired 5 hrs. @ 2000°F (1093°C)	1500 - 3000 (10.3 - 20.7)	1400 - 2800 (10.34 - 19.3)	1500 - 3000 (10.3 - 20.7)	1500 - 2500 (10.3 - 17.2)	2000 - 3500 (13.8 - 24.1)	1200 - 2000 (8.3 - 13.8)
fired 5 hrs. @ 2800°F (1538°C)	4000 - 7000 (27.6 - 46.3)	3000 - 5000 (20.7 - 34.5)	-	-	-	-
fired 5 hrs. @ temperature use limit	-	-	4000 - 6000 (27.6 - 41.1)	3000 - 5000 (20.7 - 34.5)	3500 - 6000 (24.1 - 41.1)	3000 - 5000 (20.7 - 34.5)
Permanent linear change, % ASTM C 113						
dried 18-24 hrs. @ 220°F (104°C)	0.0 to -0.2		0 to -0.2		0.0 to -0.2	0 to -0.2
fired 5 hrs. @ 2000°F (1093°C)			-0.1 to -0.4			
fired 5 hrs. @ 2800°F (1538°C)	-1.5 to -3.0				-	
fired 5 hrs. @ temperature use limit	-		-1.0 to +1.0		-1.0 to +1.5	
Chemical analysis, % weight basis after firing						
Alumina, Al ₂ O ₃	60	59	65	66	89	89
Silica, SiO ₂	36	37	31	28	6.7	6.4
Ferric oxide, Fe ₂ O ₃	1.0	1.2	1.5	1.7	1.4	1.5
Titanium oxide, TiO ₂	2.3	2.2	1.8			
Calcium oxide, CaO	0.8		0.7	1.1	0.7	0.9
Alkalies, as Na ₂ O			0.6		0.2	
Thermal conductivity, BTU•in/hr•ft²•°F (W/m•K), ASTM C 417						
mean temperature @ 500°F (260°C)	5.8 (0.87)		8.9 (1.28)	6.3 (0.91)	11.5 (1.73)	8.9 (1.28)
@ 1000°F (538°C)	6.3 (0.95)		9.0 (1.30)	6.5 (0.94)	11.0 (1.70)	9.0 (1.30)
@ 1500°F (816°C)	6.7 (1.01)		9.1 (1.31)	6.6 (0.95)	10.4 (1.57)	9.1 (1.31)
@ 2000°F (1093°C)	7.0 (1.06)		8.8 (1.27)	6.6 (0.95)	9.8 (1.48)	8.8 (1.27)
Pounds per bag, lb (kg)	55 (25)					
Shelf life, months	9				6	9

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Monolithics products : special duty

Product Name	Kao-Tab® SR	Kao-Tab 95	Kao-Tab EF	Kao-Tab 95 Gun	Kao-Tab HDHS-98
Method of installation	gun/hand ram	cast	cast	gun/hand ram	cast
Average lb (kg) required to place 1 ft ³ (0.3 m ³)	165 (75)	159 (72)	161 (73)	161 (73)	180 (82)
Recommended water, casting by vibrating, %					
casting by vibrating	-	8 - 10		-	5 - 6.2
ramming	6 - 8	-	-	5 - 8	-
Temperature use limit, °F (°C)	3000 (1649)	3400 (1871)			
Density, pcf (kg/m ³), fired @ 1500°F (816°C)	160 - 170 (2564 - 2724)	154 - 165 (2467 - 2643)	155 - 166 (2480 - 2659)	156 - 167 (2499 - 2675)	175 - 186 (2803 - 2979)
Modulus of rupture, psi (MPa), ASTM C 133					
dried 24 hrs. @ 220°F (104°C)	1000 - 1400 (7 - 10)	1200 - 2000 (8.3 - 13.8)	1200 - 1800 (8.3 - 12.4)	1400 - 2000 (10 - 14)	700 - 1200 (4.8 - 8.3)
fired 5 hrs. @ 1500°F (816°C)	900 - 1500 (6.2 - 10)	950 - 1700 (6.5 - 11.7)	950 - 1700 (6.5 - 11.7)	1200 - 2000 (8.3 - 13.8)	600 - 1000 (4.1 - 6.2)
fired 5 hrs. @ temperature use limit	1200 - 2200 (8.3 - 15)	1200 - 1900 (8.3 - 13)	1200 - 1800 (8.3 - 12.4)	1400 - 2000 (10 - 14)	1000 - 1400 (7 - 9.7)
Cold crushing strength, psi (MPa), ASTM C 133					
dried 24 hrs. @ 220°F (104°C)	5000 - 9000 (34 - 62)	6500 - 10000 (45 - 69)	6000 - 9500 (41 - 66)	6500 - 10000 (45 - 69)	4700 - 6500 (32.4 - 45)
fired 5 hrs. @ 1500°F (816°C)	5500 - 8500 (38 - 59)	7000 - 13000 (48 - 90)	6500 - 12500 (45 - 86)	7000 - 13000 (48 - 90)	4000 - 8000 (27.6 - 55)
fired 5 hrs. @ temperature use limit	6000 - 9000 (41 - 62)	6000 - 11000 (41 - 62)	6000 - 11000 (41 - 62)	6000 - 11000 (41 - 62)	6000 - 9000 (41 - 62)
Permanent linear change, % ASTM C 113					
dried 24 hrs. @ 220°F (104°C)	0 to -0.2				
fired 5 hrs. @ 1500°F (816°C)	-0.1 to -0.3				0 to -0.3
fired 5 hrs. @ temperature use limit	-	0 to -1.5			-0.2 to -1.0
Abrasion loss, cm ³ , ASTM C 704, fired 5 hrs. @ 1500°F (816°C)	7 - 14	6 - 13	7 - 14		6 - 13
Chemical analysis, % weight basis after firing					
Alumina, Al ₂ O ₃	88	95	94	95	98
Silica, SiO ₂	0.2	0.1	0.1	0.2	0.1
Ferric oxide, Fe ₂ O ₃	7.1	0.1	0.1	0.2	-
Titanium oxide, TiO ₂	-	trace	trace	trace	-
Calcium oxide, CaO	4.2	4.5	4.6	4.2	1.8
Magnesium oxide, MgO	-	0.1	0.2	trace	-
Alkalies, as Na ₂ O	0.4	0.4	0.4	0.3	0.1
Thermal conductivity, BTU • in/hr • ft ² • °F (W/m • K), ASTM C 417					
mean temperature @ 500°F (260°C)	12.7 (1.8)	16.6 (2.4)		18.1 (2.6)	21.4 (3.1)
@ 1000°F (538°C)	11.6 (1.7)	13.8 (2.0)		15.3 (2.2)	17.4 (2.5)
@ 1500°F (816°C)	11.0 (1.6)	12.2 (1.8)		13.3 (1.9)	15.2 (2.2)
@ 2000°F (1093°C)	9.7 (1.4)	11.3 (1.6)		12.1 (1.7)	13.1 (1.9)
@ 2500°F (1371°C)	9.2 (1.3)	10.7 (1.5)		11.2 (1.6)	-
Pounds per bag, lb (kg)	50 (23)				
Shelf life, months	12		3 - 6		12

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Monolithics products : special duty

Product Name	Kao-Tuff® C	Kao-Tuff CV	Kao-Tuff G	Kao-Tuff 110C	Kao-Tuff 110FF	Kao-Tuff 110G	Kao-Tuff FS	Kao-Tuff FS Gun
Method of installation	vibratory cast	cast	gun/ram	vibratory cast	free flow /vibratory cast	gun/ram	vibratory cast	gun/ram
Average lb (kg) required to place 1 ft³ (0.3 m³)	136 (62)	138 (63)	135 (61)	110 (50)	112 (51)	111 (50)	126 (58)	124 (57)
Recommended water, casting by vibrating, %	7.8 - 9.2	7.5 - 9.0	9 - 10.5 (testing purposes)	13.5 - 15.5	14 - 15.5 /13 - 15	13.5 - 15.5 (testing purposes)	5.5 - 6.5	-
Temperature use limit, °F (°C)	2800 (1538)			2400 (1316)				
Density, pcf (kg/m³), fired @ 1500°F (816°C)								
dried @ 220°F (104°C)	137 - 148 (2195 - 2371)		138 - 149 (2211 - 2387)	113 - 124 (1810 - 1986)		112 - 123 (1794 - 1970)	124 - 134 (1986 - 2162)	121 - 130 (1906 - 2082)
fired 5 hrs. @ 1500°F (816°C)	131 - 141 (2100 - 2259)	132 - 143 (2114 - 2291)	132 - 142 (2114 - 2275)	106 - 116 (1698 - 1858)	107 - 117 (1714 - 1874)	106 - 116 (1698 - 1858)	121 - 131 (1938 - 2098)	118 - 129 (1891 - 2067)
Modulus of rupture, psi (MPa), ASTM C 133								
dried @ 220°F (104°C)	1100 - 2000 (7.58 - 13.80)			1000 - 1800 (6.90 - 12.41)	750 - 1200 (5.17 - 8.27)	800 - 1300 (5.51 - 8.96)	700 - 1200 (4.83 - 8.27)	600 - 1100 (4.13 - 9.76)
fired 5 hrs. @ 1500°F (816°C)	900 - 1400 (6.21 - 9.66)		1000 - 1800 (6.90 - 12.41)	800 - 1400 (5.15 - 9.65)	650 - 1000 (4.48 - 6.89)	700 - 1100 (5.17 - 7.58)	600 - 1000 (4.14 - 6.89)	500 - 900 (3.45 - 6.21)
fired 5 hrs. @ temperature use limit	1200 - 2000 (8.27 - 13.80)		1200 - 1900 (8.27 - 13.10)	850 - 1400 (5.52 - 9.65)		750 - 1200 (5.17 - 8.27)	-	-
Cold crushing strength, psi (MPa), ASTM C 133								
dried @ 220°F (104°C)	6000 - 10000 (41.4 - 68.9)	7000 - 11000 (48.3 - 75.9)	7000 - 11000 (48.3 - 75.9)	6000 - 9500 (41.4 - 65.5)	-	6500 - 10000 (44.8 - 68.9)	6000 - 9500 (41.4 - 65.5)	5000 - 8500 (34.5 - 58.6)
fired 5 hrs. @ 1500°F (816°C)	6000 - 11000 (41.4 - 75.8)	6000 - 11000 (41.1 - 75.8)	6500 - 12000 (44.8 - 82.7)	7000 - 12500 (48.3 - 86.2)	6000 - 11000 (41.4 - 75.9)	6500 - 11000 (44.8 - 75.9)	5000 - 9000 (34.5 - 62.0)	4500 - 8000 (31.0 - 55.2)
fired 5 hrs. @ temperature use limit	8000 - 12000 (55.2 - 82.7)	7500 - 12000 (51.7 - 82.7)	7000 - 12000 (48.3 - 82.7)	6000 - 10000 (41.4 - 68.9)	6000 - 10000 (41.4 - 68.9)	7000 - 11000 (48.3 - 75.9)	6000 - 10000 (44.8 - 68.9)	-
Permanent linear change, % ASTM C 113								
dried @ 220°F (104°C)	0 to -0.2							
fired 5 hrs. @ 1500°F (816°C)	-0.1 to -0.3							
fired 5 hrs. @ temperature use limit	-1.0 to -2.0		-1.0 to -1.8	-0.6 to +0.4			0.2 to -0.5	
Abrasion loss, cm³, ASTM C 704	8 - 15	7 - 14	8 - 15	7 - 13	9 - 15	7 - 14	12 - 22	13 - 23
Chemical analysis, % weight basis after firing								
Alumina, Al ₂ O ₃	59		57	47	49		21	22
Silica, SiO ₂	33		34	35	33		75	74
Ferric oxide, Fe ₂ O ₃	0.8		0.6	1.6	1.7	1.5	0.2	0.4
Titanium oxide, TiO ₂	1.3		1.4	0.8	0.7	0.8	0.4	
Calcium oxide, CaO	5.5		6.5	14			2.3	2.5
Magnesium oxide, MgO	0.2			0.4			0.1	
Alkalies, as Na ₂ O	1.2		1.3	1.2	1.3			
Thermal conductivity, BTU•in/hr•ft²•°F (W/m•K), ASTM C 417								
mean temperature @ 500°F (260°C)	8.9 (1.28)	9.0 (1.30)	7.3 (1.05)	5.3 (0.80)		5.0 (0.72)	8.4 (1.27)	
@ 1000°F (538°C)	9.0 (1.30)	9.2 (1.33)	7.4 (1.07)	5.4 (0.81)		5.1 (0.74)	9.3 (1.40)	
@ 1500°F (816°C)	8.9 (1.28)	9.0 (1.30)	7.5 (1.08)	5.5 (0.83)		5.2 (0.77)	9.8 (1.48)	
@ 2000°F (1093°C)	8.7 (1.25)	8.8 (1.27)	7.7 (1.11)	5.6 (0.84)		5.3 (0.80)	9.9 (1.49)	
Pounds per bag, lb (kg)	55 (25)							
Shelf life, months	12						9	

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Section 14

Silicon Carbide products

Metric information - Page 143 - 144

Silicon Carbide products

Nitride bonded pressed
Nitride bonded cast
Ramming cements
Castable cements
Laying cements
SB 020
SB 019
CBF
CBC

The base of all Silicon Carbide (SiC) refractories is refractory grade alpha silicon carbide, produced in large electrical resistance furnaces at approximately 2400°C (4352°F) from a mixture of silicon, carbide, salt and sawdust.

These refractory crystals are then classified, crushed and graded for use as grog or aggregate in bricks or shapes. The alpha silicon carbide crystals impart high thermal conductivity and refractoriness, low thermal expansion and outstanding abrasion/erosion resistance. The bonds in self bonded refractors have been carefully formulated to give specific properties and subsequent performance criteria in any specific application.

Self bonded

Many bonding systems are available that inter-connect the alpha silicon carbide grains and in the case of self bonded refractories, it is mainly in a matrix of silicon and aluminium-silicon glass. The bonds in self bonded refractories have been carefully formulated to give specific properties and subsequent performance criteria in any specific application.

Nitride bonded

The silicon nitride bond phase in these refractories is the key to their superior performance in demanding applications.

The Morsil™ nitride bonding system allows nitride bonded refractories to out-perform other silicon carbide based refractories using silicate, alumina silica, and silicon oxynitride and beta silicon carbide bond systems.

- The alpha silicon carbide crystals impart high thermal conductivity and refractoriness, low thermal expansion and outstanding abrasion/erosion resistance.

To manufacture Morsil™ nitride bonded, graded alpha or electric furnace silicon carbide crystals and fine silicon are formed into shape, and fired in a pure nitrogen atmosphere at approximately 1420°C (2588°F). The result is a refractory consisting of a mixture of alpha silicon carbide grain in a matrix of alpha and beta silicon nitride, with minor amounts of residual silicon and silicon oxynitride. Due to the fact that the bond phase grows within existing porosity, there is little to no dimensional change upon firing and a net weight gain occurs. This bond is mainly responsible for the extremely high modulus of rupture and outstanding oxidation and corrosion resistance of Morsil™ nitride bonded silicon carbide.



Typical applications - for Silicon Carbide products:

- Aluminium reduction cells
- Copper remelt furnaces
- Thermocouple sheaths
- Hearth tiles
- Refining and assaying muffles
- Radiant tubes
- Boiler brick
- Burner blocks
- Combustion chambers
- Incinerators

Silicon Carbide:

Clay Bonded -

Our clay bonded silicon carbide enable thick walled components to be manufactured as it features high mechanical strength and excellent thermal conductivity. These properties make this material excellent for outer protection tubes for temperature measurement up to 1200°C (2192°F) in light and heavy metal smelts.

HaSiC -

Our HaSiC range is generally used for kiln furniture due to its properties which include:

- Withstanding temperatures up to 1600°C (2912°F)
- Compact SiC matrix
- Corrosion resistance

The properties above make this material an excellent choice for manufacturing large components. Our engineers have the skills, knowledge and capacity to work with you to select the right material for your product in your application.

MORSIL™ Silicon Carbide -

Ramming cements

MORSIL™ Nitride Bonded Silicon Carbide -

Pressed and cast

Benefits:

- High strength and wear resistance, even at high temperatures
- High decomposition temperature
- Oxidation resistance even at very high temperatures
- Corrosion resistance
- Thermal shock resistance due to the strength of the Silicon Nitride bond and the low thermal expansion coefficient
- Very low thermal expansion
- High thermal conductivity
- Good tribological properties

Typical applications:

Aluminium reduction cells:

Converting alumina to aluminium by the electrolytic reduction process for carbon and graphite walls in aluminium reduction cells.

Non-ferrous:

Copper remelt furnaces - high purity, high density Morsil™ gives long trouble free service in re-melt and holding furnaces producing copper wire bar.

Thermocouple sheaths - high thermal conductivity, resistance to thermal spalling, high hot strength and erosion resistance of Morsil™ gives accurate, reliable temperature measurement sometimes under extreme and corrosive furnace operating conditions.

Foundry:

Hearth tiles - can resist abuse from heavy loads in heat treatment furnaces. Oxidation resistance and abrasion resistance grades are available depending on furnace operations.

Precious metals:

Refining and assaying muffles - readily transmit heat to the charge and are often used to contain corrosive fuels that will reduce the life of furnace refractories and electric heating elements.

Radiant tubes - ensures fuels efficiency while the high density and corrosion resistance prolongs service life.

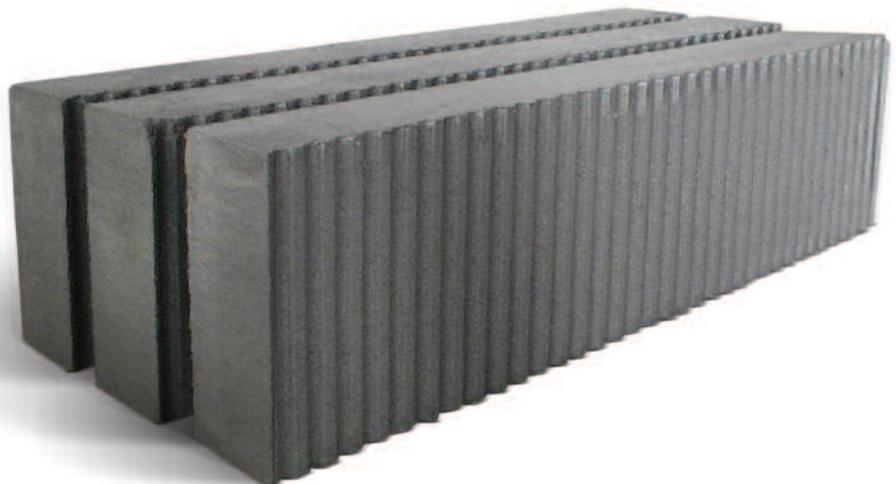
Steam generation:

Boiler brick - excellent spall resistance and high conductivity coupled with high density which protects the sidewall and grate from slag and clinker.

Petrochemical:

Burner blocks / combustion chambers - can withstand very high temperature, resist corrosive gases and endure the severe heat shock experienced by burner blocks and combustion chambers.

Incinerators - successfully used in door linings and arches to balance the overall life in industrial incinerators that have spall problems in these areas.



Silicon Carbide products

	Nitride Bonded Pressed	Nitride Bonded Cast	Ramming Cements				Castable Cements
			CFR 0100 (1)	CFR 0110 (2)	CFR 0120 (3)	CFR 0130 (4)	
Bond type	Silicon Nitride	Silicon Nitride	-	-	-	-	-
Maximum hot face temperature, °C	1700	1650	-	-	-	-	-
Modulus of rupture, ASTM 133							
MPa @ 20°C	40	49	-	-	-	-	-
MPa @ 1350°C	40	-	-	-	-	-	-
Bulk density, ASTM 134, gm/cm³	2.62	2.62	-	-	-	-	-
Apparent porosity, %	17	15	-	-	-	-	-
Hot load contractions, % of lengths	-	-	-	-	-	-	-
Thermal expansion coefficient, Cm/cm°Cx10⁶	4.7	4.7	-	-	-	-	-
Thermal conductivity, ASTM C 202, W/m•K							
@ 1477°C	16.3	16.4	-	-	-	-	-
Relative thermal shock	excellent	excellent	-	-	-	-	-
Specific heat, 1400°C, cal/gm°C	0.28	0.28	-	-	-	-	-
Relative abrasion resistance, 1400°C	excellent	exceptional	-	-	-	-	-
Spall resistance, %	100	100	-	-	-	-	-
Compressive strength, kg/cm², MPa	> 137	> 160	-	-	-	-	-
Permeability, ccof air/min/in/m²/in WG press	3.0	nil	-	-	-	-	-
Electrical characteristics	semi-conductor	semi-conductor	-	-	-	-	-
Application range, °C	-	-	100 - 1500	1100 - 1750	300 - 1650	100 - 1350	20 - 1480
Set	-	-	heat	heat	low temp heat	air	hydraulic
Particle size, mm	-	-	2.8	3.4	3.4	3.4	3.4
Required quantity, kg/m³	-	-	2240	2240	2240	2240	2320
Water to be added before use - litre/25kg	-	-	1.4 - 1.5	1.4 - 1.5	dry or 1.5	dry or 1.5	4.5
How shipped	-	-	dry	dry	ready mix	dry	dry
Pack size, kg	-	-	25	25	25	25	25
Chemical composition							
SiC	75.0	73.0	76	89	89	4	83
Si ₃ N ₄	23.4	21.0	-	-	-	-	-
SiO ₂	0.5	3.0	13	7	7	80	2.0
Al ₂ O ₃	0.3	2.7	10	3	3	10	12.0
Fe ₂ O ₃	0.3	0.3	0.7	0.5	0.5	0.5	0.5
CaO	0.2	-	-	-	-	-	-
Trace Elements	0.3	-	-	-	-	5.5	0.3

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Silicon Carbide products

	Laying Cements				SB 020 SB 019	CBF CBC
	CFL 0130 (1)	CFL 0140 (2)	CFL 0150 (3)	CFL 0160 (4)		
Bond type	-	-	-	-	Direct Silicate Bonded SiC	Silicate Bonded SiC
Maximum hot face temperature, °C	-	-	-	-	1700	1500
Modulus of rupture, ASTM I33						
MPa @ 20°C	-	-	-	-	20	20
MPa @ 1350°C	-	-	-	-	15	15
Bulk density, ASTM I34, gm/cm³	-	-	-	-	2.55	2.50
Apparent porosity, %	-	-	-	-	18	18
Hot load contractions, % of lengths	-	-	-	-	0.0	0.5
Thermal expansion coefficient, Cm/cm/°Cx10⁶	-	-	-	-	4.7	4.7
Thermal conductivity, ASTM C 202, W/m•K						
@ 1477°C	-	-	-	-	15.7	15.7
Relative thermal shock	-	-	-	-	very good	good
Specific heat, 1400°C, cal/gm/°C	-	-	-	-	0.285	0.285
Relative abrasion resistance, 1400°C	-	-	-	-	excellent	excellent
Spall resistance, %	-	-	-	-	100	100
Compressive strength, kg/cm², MPa	-	-	-	-	> 140	> 140
Permeability, ccof air/min/in/m²/in WG press	-	-	-	-	3.5	3.4
Electrical characteristics	-	-	-	-	semi-conductor	V
Application range, °C	1100 - 1750	500 - 1200	320 - 1600	100 - 1350	-	-
Set	heat	heat	air	air	-	-
Particle size, mm	0.4	0.4	0.4	0.4	-	-
Required quantity, kg/m³	0.3	0.3	0.3	0.3	-	-
Water to be added before use - litre/25kg	3.8 - 4.5	3.8 - 4.5	0.25	3.8 - 4.5	-	-
How shipped	dry	dry	dry	dry	-	-
Pack size, kg	25	25	25	25	-	-
Chemical composition						
SiC	86	84	83	80	89.6	87.9
Si ₃ N ₄	-	-	-	-	-	-
SiO ₂	9	9	4	10	8.5	9.6
Al ₂ O ₃	3	4	3.3	4	0.70	1.60
Fe ₂ O ₃	0.8	0.9	1.5	0.5	0.70	0.80
CaO	-	-	-	-	0.20	0.10
Trace Elements	-	-	8.0	5.5	0.30	-

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Section 15

Fired refractory shapes products Imperial information - Page 147 - 148

Fired refractory shapes products

Cerox®
Valcor®

Thermal Ceramics fired refractory shapes are used in a wide range of critical, heat intensive applications.

High alumina, silicon carbide, fused silica and alumina-zirconia-silica (AZS) compositions are thixotropically cast to precise customer specifications. These products feature superior hot strengths, thermal shock Thermal Ceramics refractory fired shapes are used in a wide range of critical, heat intensive applications.

Fired refractory shape product range includes:

Cerox®

Cerox fired refractory shapes are thixotropically cast using a dispersion agent, which allows the Cerox mix to flow when vibrated without requiring a high water content.

These manufacturing techniques, combined with precisely controlled firing and 100% product inspection, produce high-quality components suited to the most arduous of high temperature environments.

- Variety of available compositions using high-alumina, fused zirconia mullite, and silicon carbide
- Excellent chemical attack resistance
- Excellent thermal shock resistance
- Low gas permeability
- Tight tolerance capability

The Cerox cast fired shapes are used in a variety of super alloy melt-pour systems. The cast manufacture process meets the tight tolerance specifications required by end users. Precise tooling and detailed product inspection provide the user with a high quality, dimensionally accurate refractory shape.

- Variety of available compositions in high alumina, mullite and fused silica
 - Tight tolerance capabilities
 - Good non-wetting characteristics
 - Excellent mechanical strength
 - Proven performance in super alloy, and investment casting
- Thermal Ceramics refractory fired shapes are used in a wide range of critical, heat intensive applications



Typical applications - for fired refractory shapes products:

- Vacuum induction melting industry
- Furnace spouts
- Distribution boxes (often referred to as hot tops)
- Samplers and 'Metamic' (metal-ceramic composite) thermocouple sheaths for the VIM market
- Muffles, ladle liners, saggars, sealed quench furnace muffle assemblies and other special shapes
- Glass contact refractories, particularly glass feeder ware consumables

Valcor®

Valcor fired refractory shapes, available in two compositions:

- G - high alumina mix
- G-AZ - AZS premium grade and has a proven track record in molten glass contact applications.

The shapes are engineered to meet precise customer specifications and are individually inspected.

- Years of proven performance in molten glass contact applications
- Very smooth surface finish
- Individual part inspection



Fired refractory shapes : Cerox®

Product Name	Cerox 100	Cerox 120	Cerox 200	Cerox FC 200	Cerox 700	Cerox 720	Cerox 730	Cerox 1000	Cerox 1200	Cerox 1300	Cerox 1400
Chemical analysis, % weight basis after firing											
Alumina, Al ₂ O ₃	47	51	74		90	90	90	93	>99	64	35
Silica, SiO ₂	50	46	22		10	9	10	5	0.4	12	5
Zirconia, ZrO ₂	-	-	-		-	-	-	-	-	23	-
Silicon carbide, SiC	-	-	-		-	-	-	-	-	-	59
Ferric oxide, Fe ₂ O ₃	1.0	0.6	1.0		0.2			0.5	0.1	0.2	0.2
Titanium oxide, TiO ₂	1.9	1.5	2.3		0.1			0.7	trace	0.1	0.1
Magnesium oxide, MgO	0.1	trace									
Alkalies, as Na ₂ O	0.1	0.3	0.2				trace	0.2	0.1	0.2	0.2
Bulk density, pcf (kg/m ³) ASTM C 134	154 (2468)	136 (2179)	161 (2580)	157 (515)	173 (2772)	176 (2820)	172 (2456)	179 (2869)	183 (2933)	190 (3045)	161 (2580)
Apparent porosity, % ASTM C 20	20		23	19	16	19	17	21	17	21	
Permeability, ft/hr•ft ² •in., psi (MPa)	4 (0.03)	3 (0.02)	4 (0.03)					6	4 (0.03)		
Modulus of rupture, psi (MPa), ASTM C 583											
@ 75°F (24°C)	1200 (8.28)	1600 (11.03)	1500 (10.34)	1600 (11.03)	2400 (16.55)	1300 (8.97)-	1600 (11.03)	5000 (34.48)	3000 (20.69)	1800 (12.41)	
@ 2300°F (1260°C)	2400 (16.55)	2000 (13.79)	1800 (12.41)	2400 (16.55)	4800 (33.10)	2200 (15.17)		2600 (17.93)			
@ 2600°F (1426°C)	1000 (6.89)	1100 (7.59)	1000 (6.89)	1900 (13.10)	3700 (25.52)	1000 (6.89)		1400 (9.65)	2300 (15.86)	1000 (6.89)	
@ 2800°F (1538°C)	600 (4.14)	800 (5.51)	700 (4.83)	1000 (6.89)	1600 (11.03)	700 (4.83)		1400 (9.66)	500 (3.44)		
Cold crushing strength, psi (MPa), ASTM C 133											
@ 2800°F (1538°C)	--	7000 - 10000 (48 - 69)	5000 - 8000 (34 - 55)	8000 - 10000 (55 - 69)	9000 - 10000 (62 - 76)	-	8000 - 11000 (55 - 76)	-			
Permanent linear change, % ASTM C 113											
5 hrs. @ 3000°F (1648°C)	-	-3.3	-	-	-	-3.3	-				
5 hrs. @ 3200°F (1760°C)	-	-	-1.3	-0.4	-1.0	-	-1.3	-0.4	-1.0		
Deformation under hot load, % @ 25 psi (0.17 MPa), ASTM C 16											
1 1/2 hrs. @ 2640°F (1448°C)	-	0.4	-	-	0.0	-	0.0	-	0.0	-	
1 1/2 hrs. @ 2800°F (1538°C)	-	-	-	-	-	-	0.2	1.6			
1 1/2 hrs. @ 2850°F (1566°C)	-	-	6.0	0.2	0.3	-	3.6				
1 1/2 hrs. @ 3000°F (1760°C)	-	-	0	-	1.3	-	0.5				
Abrasion loss, cm ² , ASTM C 704	-	10.0	7.0	6.5	4.5	-	5.0	4.5	4.0	5.0	
Coefficient of reversible thermal expansion, in./in. •°F • 10 ⁻⁶	-	3.3	4.3	4.0	3.7	4.7	5.8	3.4	3.3		
Spall resistance, relative	good	very good			good	very good	fair	low	excellent	very good	

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Fired refractory shapes : Cerox® pre-fired refractory shapes

Product Name	Cerox 90V	Cerox FS-99V	Cerox 90P	Cerox 95P	Cerox FS-85P
Method of forming	thixotropic cast		pressed	pressed	pressed
Chemical analysis, % weight basis after firing					
Alumina, Al ₂ O ₃	91	0.7	90	95	14
Silica, SiO ₂	8	99	8.6	4.0	85
Ferric oxide, Fe ₂ O ₃	0.15	0.1	0.4		0.3
Titanium oxide, TiO ₂	0.1	trace	0.2	-	0.7
Calcium + Magnesium oxide, CaO + MgO	0.04	0.1	0.1		0.15
Alkalies, Na ₂ O + K ₂ O	0.15		0.3		0.45
Bulk density, pcf (kg/m ³) ASTM C 134	176 (2820)	113 (1811)	178 (2853)	188 (3013)	109 (1510)
Apparent porosity, % ASTM C 20	20	12	23	20	22
Classification temperature rating, °F (°C)	3090 (1699)	2800 (1538)	3090 (1699)	3100 (1704)	2750 (1510)
Modulus of rupture, psi (MPa), ASTM C 583	2500 (17.2)	1150 (7.9)	4000 (27.6)	4100 (28.3)	510 (3.5)
Coefficient of thermal expansion, in./in. • °F	4.1	0.2	4.2	4.5	3.2
Thermal conductivity, BTU • in./hr • ft ² • °F (W/m • K), ASTM C 417					
mean temperature @ 2000°F (1093°C)	16.0 (2.3)		22.0 (3.2)	10.6 (1.5)	9.5 (1.37)

Fired refractory shapes : Valcor®

Product Name	Valcor G	ValcorG-AZ
Chemical analysis, % weight basis after firing		
Alumina, Al ₂ O ₃	93	64
Silica, SiO ₂	5	12
Zirconia, ZrO ₂	-	23
Ferric oxide, Fe ₂ O ₃	0.5	0.2
Titanium oxide, TiO ₂	0.7	0.1
Magnesium oxide, MgO	trace	
Alkalies, as Na ₂ O	0.2	
Bulk density, pcf (kg/m ³), ASTM C 134	179 (2868)	190 (3045)
Apparent porosity, % ASTM C 20	17	
Permeability, ft/hr • ft ² • in., psi (MPa)	4	
Melting point, °F (°C)	3560 (1960)	3200 (1760)
Hot modulus of rupture, psi, ASTM C 583		
@ 75°F (24°C)	1600 (11)	
@ 2300°F (1260°C)	3000 (21)	
@ 2600°F (1426°C)	900 (6.2)	
@ 2800°F (1538°C)	700 (4.8)	
Permanent linear change, %, ASTM C 113		
5 hrs. @ 3000°F (1648°C)	-	-0.4
5 hrs. @ 3200°F (1760°C)	-1.9	-
Deformation under hot load, % @ 25 psi, ASTM C 16		
1 1/2 hrs. @ 2640°F (1448°C)	3.6	0.2
Coefficient of reversible thermal expansion, in./in. • °F • 10 ⁻⁶	4.7	3.4

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Section 16

Heat shield products

Heat shield products

- Shell Tech
- Integrated Tech
- Flexible Tech
- Rigid Box Tech

By employing a range of materials the Thermal Ceramics business of Morgan Advanced Materials can provide heat shields and microporous insulation in a wide variety of demanding environments across different industries and sectors.

Our heat shields and microporous insulation are used frequently within mobile applications and are often incorporated into shipping, aeronautical and automotive design.

Depending on the specific application, our material engineers can develop and implement a high performance solution that meets your requirements. This is done by taking the unique properties of ceramics to produce heat shields and microporous insulation that is highly adept in extreme environments, whilst retaining characteristics such as light weight and robustness.

Having worked extensively with shipping, aerospace and automotive industries in both commercial and defence spheres, we are ideally placed to provide you with heat shields and microporous insulation that is on budget, without sacrificing performance.

Common insulation materials used in our heat shields:

- Glass Fibre
- Silica Fibre
- Microporous insulation

Common materials used for encapsulation:

- Austenitic and ferritic stainless steel
- Inconel
- Titanium





Shell Tech (picture 1)

Designed to follow the shape of your equipment, our lightweight Shell Technology provides an elegant fitted solution to your thermal protection needs. Our Shell Technology is made using Superwool® Plus insulating fibre, FireMaster® fibre, silica, glass fibre or microporous insulation material completely encapsulated in stainless steel and custom-shaped to fit your application requirements. This ensures the possibility for the customer to manage the final assembly on site. Shell Technology is made of corrugated SS in a thickness from 0.05 to 0.3mm. Ideal where space is at a premium, Shell Technology is easy to fit, and easy to remove for maintenance or other reasons for applications including:

- Aerospace: thrust reverser
- Automotive: exhaust catalyst
- Passenger vehicles: exhaust manifold
- Off-Road vehicles: turbocharged
- Marine & power generation: exhaust manifold

Our heat shields made from our shell technology offer the following benefits to our customers:

- Elegant, fitted, lightweight solution
- Effective lifetime insulation
- Easy to fit and to remove

Integrated Tech (picture 2)

For the insulation of large or complex equipment, our integrated technology solutions are custom designed. Our integrated technology is made using Superwool® Plus insulating fibre, FireMaster® fibre, silica, glass fibre or microporous material, completely encapsulated in stainless steel and custom-shaped to fit your application requirements. This ensures that the assembly is made in Morgan Thermal Ceramics, Ecrans Thermiques with the part provided by the customer.

Integrated technology is made of corrugated SS in a thickness from 0.05 to 0.3mm and provides excellent lifetime insulation for applications including:

- Aerospace: helicopter turbine
- Automotive: exhaust catalyst
- Passenger vehicles: exhaust manifold
- Marine & power generation: exhaust manifold

Flexible Tech (picture 3)

Our flexible technology provides an effective and versatile solution for thermal protection in a wide range of industrial and other applications. Made from silica or glass fibre encased in silicone and stainless steel fabric, our flexible technology offers heat shielding in continuous operating temperatures up to 600°C. A fully flexible jacket, it is lightweight and easy to fit, and to remove if necessary even in a restricted space.

Our flexible technology solutions are suitable for a wide range of applications including:

- Automotive: exhaust manifold
- Passenger vehicles: exhaust manifold
- Marine & power generation: exhaust manifold
- Oil & gas: valves & actuators

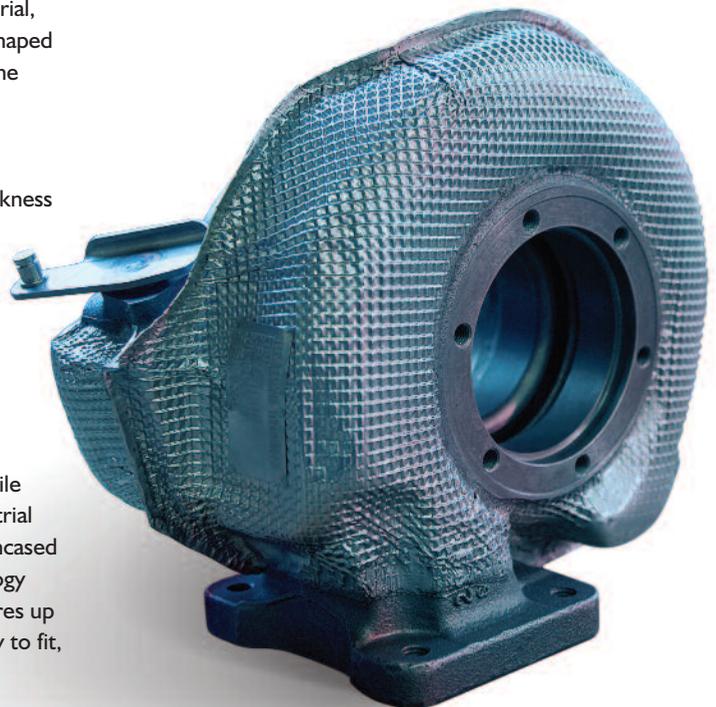
Rigid Box Tech (picture 4)

Our rigid box technology offers effective thermal and fire protection for all types of equipment, in an easy-to-use, SOLAS-approved and jet and hydrocarbon fire approved system.

Rigid box enclosures are custom-built to suit each application using FireMaster® Marine Plus blanket or silica or glass fibre insulation material which is completely encapsulated in austenitic or ferritic stainless steel at our advanced manufacturing facility. Rigid box technology is made of SS in a thickness from 1 to 5 mm.

Our rigid box technology provides customers with the following benefits:

- SOLAS approved, lifetime insulation
- Jet and hydrocarbon fire approved
- Easy to fit and to remove
- No contact with insulation material
- No tooling required





Section 17

Structural block insulation products Imperial information - Page 152

Structural block insulation products

- TR™-19 Block
- TR™-19HS Block
- TR™-20 Block
- TR™-2000-SL Block

Our TR™-19 and TR™-20 block insulation products offer economical and efficient solutions to your insulation needs. These products feature significantly improved temperature and weight characteristics when compared with traditional products.

TR-19 and TR-19 HS are vermiculite based products and TR-20 is a diatomaceous silica product. These materials offer excellent energy saving efficiencies, good strength and minimal shrinkage.

TR-19 Block and TR-19HS Block

- Manufactured from vermiculite granules and high temperature bonding materials
- TR-19 features lower thermal conductivity than competitive vermiculite boards
- TR-19HS offers high compression strength
- Operates in temperatures up to 1038°C (1900°F)
- Exhibits good strength and minimal shrinkage up to use limit temperature
- Provides excellent resistance to aluminum cryolite attack

TR-20 Block

- Very good resistance to breakage
- Long, maintenance-free service and maximum operating efficiency
- Low conductivity and high stability
- Superior high-temperature block insulation
- Made from diatomaceous silica with a hydraulic binder
- Suitable for use up to 1093°C (2000°F)

TR-2000-SL Block

- Minimal shrinkage at top temperature limits
- Will not decompose at their maximum service temperature
- Calcium silicate composition
- Very low thermal conductivity
- Lightweight
- Good high temperature strength

TR block products are traditionally found in many Aluminium applications such as Carbon Bake Ovens, PotCells, Melting and Holding Furnaces.

- TR block insulation products can be used as both general insulation or back-up insulation in roofs, walls and floors
- General back-up insulation use with Morgan Thermal Ceramics' monolithics, firebricks, refractory plastics, and ceramic fibre products

Structural block insulation products

Product Name	TR™-19	TR™-19 HS	TR™-20	TR-2000 SL
Color	beige		off - white	white
Density, pcf (kg/m ³)	25 (400)	35 (561)	29 (465)	17.5 (280)
Continuous temperature use limit, °F (°C)	1900 (1038)		2000 (1093)	1922 (1050)
Modulus of rupture, psi (MPa), dried	110 (0.8)	175 (1.2)	110 (0.8)	155 (1.07), ambient
fired 24 hours @ 1900°F (1038°C)	100 (0.7)	-	105 (0.7)	-
Cold crushing strength, psi (MPa)				
dried	175 (1.2)	250 (1.7)	180 (1.2)	-
fired 24 hours @ use limit	65 (0.5)	-		215 (1.48)
Linear shrinkage, %				
fired 24 hrs. @ 1900°F (1038°C)	2.0	1.5	-	1.0
fired 24 hrs. @ 2000°F (1093°C)	-	-	4	-
Chemical analysis, % weight basis after firing				
Alumina, Al ₂ O ₃	12	-	4.3	-
Silica, SiO ₂	38	-	80	49
Calcium oxide, CaO	22	-	11	46
Magnesium oxide, MgO	12	-	0.8	-
Ferric Oxide, Fe ₂ O ₃	9.5	-	1.6	-
Other	6.5	-	2.5	5
Thermal conductivity, BTU•in./hr•ft²•°F (W/m•K), ASTM C 201				
mean temperature @ 500°F (260°C)	0.72 (0.11)	1.10 (0.16)	0.68 (0.09)	0.55 (0.08)
@ 1000°F (538°C)	0.83 (0.13)	1.16 (0.17)	0.79 (0.11)	0.72 (0.10)
@ 1500°F (816°C)	0.99 (0.15)	1.20 (0.17)	0.96 (0.14)	
@ 1900°F (1038°C)	1.14 (0.17)	1.35 (0.20)	-	
@ 2000°F (1093°C)	-	-	1.16 (0.17)	1.12 (0.16), 1800°F (980°C)

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MEASUREMENTS, CONVERSIONS & FORMULAS

TEMPERATURE - Conversion formula

Celsius to Fahrenheit

[Celsius degrees] x 9/5 + 32 = °F

Fahrenheit to Celsius

[Fahrenheit degrees] - 32 x 5/9 = °C

THERMAL CONDUCTIVITY

Conversion formula - USA

Btu • in/h • ft² • °F

Conversion formula - EUROPE

W/m • K or kcal/m • h • °C

To convert W/m • K to Btu :
multiply 6,93 or in Kcal by 0,86

To convert MPa in kg/cm², multiply by 10,2

AREA - Conversion formula

Metric	Imperial
1 square centimetre	= 0.1550 square inches
1 square metre	= 1.1960 square yards
1 hectare	= 2.4711 acres
1 square kilometre	= 0.3861 square miles

Imperial	Metric
1 square inch	= 6.4516 square centimetres
1 square foot	= 0.0929 square metres
1 square yard	= 0.8361 square metres
1 acre	= 4046.9 square metres
1 square mile	= 2.59 square kilometres

LENGTH - Conversion formula

Metric	Imperial
1 millimetre	= 0.0394 inches
1 centimetre	= 0.3937 inches
1 metre	= 1.0936 yards
1 kilometre	= 0.6214 miles

Imperial	Metric
1 inch	= 2.54 centimetres
1 foot	= 0.3048 metres
1 yard	= 0.9144 metres
1 mile	= 1.6093 kilometre

VOLUME - Conversion formula

Metric	Imperial
1 cubic centimetre	= 0.0610 cubic inches
1 cubic decimetre	= 0.0353 cubic feet
1 cubic metre	= 1.3080 cubic yards
1 litre	= 1.76 pints
1 hectolitre	= 21.997 gallons

Imperial	Metric
1 cubic inch (in ³)	= 16.387 cubic centimetres
1 cubic foot (ft ³)	= 0.0283 cubic metres
1 fluid ounce (fl oz)	= 28.413 millilitres
1 pint (pt)	= 0.5683 litres
1 gallon (gal)	= 4.5461 litres

WEIGHT - Conversion formula

Metric	Imperial
1 milligram	= 0.0154 grains
1 gram	= 0.0353 ounces
1 kilogram	= 2.2046 pounds
1 tonne	= 0.9842 tons

Imperial	Metric
1 ounce (oz)	= 28.35 grams
1 pound (lb)	= 0.4536 kilograms
1 stone	= 6.3503 kilograms
1 hundredweight (cwt)	= 50.802 kilograms
1 ton (t)	= 1.016 tonnes

DEFINITIONS EXPLAINED

A

Alkaline Earth Silicate (AES) Wool

AES wools consist of amorphous fibres produced by melting a combination of CaO, MgO and SiO₂. Key features of AES products are low thermal conductivity, low linear shrinkage and low biopersistence. Products made from AES wools are generally used at application temperatures >600°C (1112°F) in industrial equipment, fire protection, automotive exhaust systems and domestic appliances.

Alumino Silicate Wool (ASW)

Alumino Silicate Wools, also known as "refractory ceramic fibre" (RCF), are amorphous fibres produced by melting a combination of Al₂O₃ and SiO₂. Key features of ASW products are low thermal conductivity, high chemical stability, and low linear shrinkage. Products made from ASW are generally used at application temperatures >900°C in industrial equipment such as furnaces and kilns, in fire protection, and in automotive exhaust systems.

B

Binder (organic)

Organic binders such as starch or polymer latex are added to fibres when making boards, vacuum formed shapes, paper or felt. The organic binder adds strength in the green state, which is valuable for handling, cutting or application.

At high temperature the organic binder is burnt out and is no longer present in the fired product.

Biopersistence

The characteristic of a fibre to persist in the lung, involving or implying resistance to both dissolution and mechanical breakage. Biopersistence can only be directly measured in in vivo test systems, i.e. following inhalation, instillation or injection in experimental animals.

The rate of removal of fibres is typically expressed as "half life" - the time it takes for the number of fibres in the lungs to be reduced by 50%. Man Made Vitreous Fibres (MMVF; see below) have low biopersistence compared with most natural mineral fibres. Understanding the biological significance of biopersistence has resulted in the development of materials such as AES wools that have very low biopersistence.

C

C.A.S. number

Registry number given to a substance by the Chemical Abstract Service (CAS).

CARE Programme

Standing for "Controlled and Reduced Exposure", CARE is a cross-industry industrial hygiene programme initiated by ECFIA in 1996. It comprises exposure monitoring and risk assessment for all HTIW. Workplace control methods are evaluated and personal concentrations of fibrous dust monitored in both manufacturing and user company sites. The programme forms the basis for the production of 'best practice' guidance documents. See the Exposure Control / CARE section of the website for more information.

Classification temperature

The classification temperature is determined by following the test procedure in one of the accepted norms, such as ENVI094-3. It corresponds to the temperature for which the product has a

permanent linear shrinkage not exceeding a given value (depending on the product): 2% for boards and vacuum formed products 4% for blankets, felts, mats, and papers.

CLP Regulation

The Classification Labelling and Packaging Regulation (CLP-Regulation (EC) No 1272/2008) on the classification, labelling and packaging of substances and mixtures aligns existing EU legislation to the United Nations Globally Harmonised System (GHS). It replaces the former Dangerous Substances and Preparations EU Directives.

Cristobalite

Cristobalite is a type of crystalline silica that can form when MMVFs devitrify following heating to sufficiently high temperatures for a sufficient duration (depending on chemical composition). See Devitrification.

Crystalline silica

Crystalline silica is found in industrial applications mostly as quartz. Crystalline silica is known to produce silicosis and has been classified as a human carcinogen by the WHO's International Agency for Research on Cancer (IARC).

Crystallization

See Devitrification.

D

Devitrification

The process by which prolonged high temperatures can alter the physicochemical properties and crystalline structure of amorphous HTIW (AES and ASW), resulting in reduced resiliency and mechanical strength. Various crystalline phases can be formed by devitrification, including mullite, enstatite, wollastonite and cristobalite (a form of crystalline silica, see above). Crystalline phases produced when heating polycrystalline wools at high temperature 1400°C - 1600°C (2552°F - 2912°F) are mullite (main phase) and corundum (secondary phase). Crystalline silica (including cristobalite) is not formed on heating PCW.

Diameter

While this may seem a simple concept, the diameter of fibres in mineral wools is complex. Mineral wools contain fibres with a wide range of diameters; if these are to be measured in any type of microscope the mineral wool must usually be ground, milled or broken up in some other way. When this is done the thin fibres tend to break more easily than thick ones. This also happens when working with mineral wools, so that in workplace dusts length and diameter are correlated, with finer diameter fibres tending to be shorter than coarser fibres. If the diameter of a number of fibres is measured and a simple mean diameter calculated, then this figure will depend on how many thin fibres are created which, in turn, depends on the way the fibres have been handled. Therefore to obtain a meaningful and reproducible measure of mineral wool fibre diameter, independent of the preparation method, the so called length weighted geometric mean diameter (LWGMD) concept has been devised. As the diameters usually vary so that their logarithms are normally distributed then the geometric mean should be used; 50% of the total length of fibres present will be less than the LWGM. This value is also close to the median diameter.

The vast majority of man-made mineral fibres are fairly coarse, with most fibres having LWGMD well above 1µm.

Dimension

Fibre dimension is critical in terms of possible health effects as only fibres of a certain size can reach the lungs. Mineral fibres with a diameter $> 3\mu\text{m}$ are regarded as essentially “non respirable” in humans. While respirability is determined predominantly by fibre diameter, fibre length is also important.

Short fibres can be cleared by the normal mechanisms of phagocytosis by lung macrophages, but long fibres (e.g. $> 20\mu\text{m}$) can frustrate this mechanism and are also more biologically active.

E**ECFIA**

ECFIA represents the European High Temperature Insulation Wool (HTIW) industry in matters relating to health and safety. www.ecfia.eu

EU Directive 97/69/EC

A technical amendment to the Dangerous Substances Directive 67/548 EU concerning the hazard classification and labelling of man-made vitreous (silicate) fibres as carcinogens. It exonerates thick fibres (see Note R) and then divides the rest into two groups according to their alkaline and alkaline earth oxide composition.

Those containing more than 18% alkaline and alkaline earth oxides by weight are called mineral wools and may be exonerated from classification and labelling if certain bioassays guarantee either their low biopersistence or lack of pathogenicity (see Note Q).

Exposure

Specifically in this context, exposure is the measure of airborne fibrous dust or other material that reaches the deep lung in exposed persons (or animals in the case of bioassays). Exposure is not the same as airborne fibre concentration, which is often evaluated according to the WHO definition of fibres.

F**Fibre**

A fibre is any particle longer than it is wide. Material scientists normally call objects fibres when their length is more than 10 times their width (i.e. their ‘aspect ratio’ > 10), although the WHO definition of a fibre refers to an aspect ratio of 3. To be useful in most applications, fibres must have aspect ratios very much greater than this. See also Diameter and Length and WHO Fibres.

G**GHS**

The Globally Harmonized System of Classification and Labelling of Chemicals, or GHS, is an internationally agreed system set to replace the various different classification and labeling standards used in different countries.

H**High Temperature Insulation Wool (HTIW)**

High Temperature Insulation Wools are synthetic mineral wools used in high-temperature industrial applications, typically in the range 600°C to 1800°C (1112°F - 3272°F).

They include three different types of wool: Polycrystalline Wools (PCW), Aluminium Silicate Wools (ASW/RCF) and Aluminium Earth Silicate (AES) wools. HTIW are specialist materials and account for only about 2% of the total synthetic mineral wool production in Europe.

High Temperature Insulation Wools Coalition (HTIWC)

HTIWC is the US and Canada association representing the high temperature insulation wool industry.

I**International Agency For Research on Cancer (IARC)**

A major goal of the IARC is the identification of causes of cancer, so that preventive measures may be adopted against them. IARC does not deal in the formulation of policies or legislation aiming at controlling carcinogens.

L**Labelling**

In the past, classification and labelling of hazardous substance and preparations had to be done following Directive 67/548/EEC and 1999/45/EEC. In order to harmonise classification and labelling regulation, the European Union decided to adopt and adapt the Global Harmonised System (GHS) proposed by the United Nations. As a consequence, a new Regulation (EC) No 1272/2008 has been published aiming at replacing the former above listed Directives.

Substances and mixtures will have to be labelled according to these new European regulation CLP-rules. In addition to the labelling of classified substances, ECFIA members are voluntarily labelling articles made of these substances.

Length

Another simple variable describing fibre dimension that conceals a degree of necessary complexity (c.f. Diameter). The length of fibres in mineral wools is highly variable, ranging from a few micrometers to some centimetres e.g. 25cm (1”). When fibres are handled, dust liberated into the air will include some non-fibrous particles as well as fibres with lengths up to some tens of mm.

Fibre length is a key determinant of hazard. See also Fibre and Dimension.

Length-Weighted Geometric Mean Diameter (LWGMD)

See Diameter.

M**Man made vitreous fibres (MMVF)**

The class of materials including all the glassy fibres such as rockwool, glass wool, slagwool, AES and ASW/RCF-wools. The European Union added the term (silicate) in Directive EU/97/69 to identify a subset of these fibres. The term Synthetic Vitreous Fibres (SVF) is now often used instead of MMVF. Conglomerates made from MMVFs are called Man Made Vitreous Wools (MMVWs).

Non-vitreous synthetic mineral fibres, such as PCW, are described generically as Man Made Mineral Fibres (MMMF) or Synthetic Mineral Fibres (SMF). See also Wool

Maximum continuous use temperature

This term is used by Thermal Ceramics to advise on the temperature at which its products can be expected to work for extended periods of time without adverse effects. In some applications, where a short or one shot exposure is expected, this application temperature may be exceeded. It is always advisable to seek applications advice from Morgan Thermal Ceramics in such a case.

N**National Institute for Occupational Health and Safety (NIOSH)**

NIOSH is the federal agency in the US responsible for conducting research and making recommendations for the prevention of work-related injury and illness. NIOSH is part of the Centers for Disease Control and Prevention (CDC) in the Department of Health and Human Services.

Note Q

A note in Directive EU/97/69 (q.v.) stating the conditions that may be used in Europe to exonerate some man-made vitreous (silicate) fibres from classification as carcinogens under this Directive.

P**Polycrystalline Wool (PCW)**

Polycrystalline Wool is made predominantly of aluminum oxide (typically 72-99%), with the remainder consisting of silicon. It is manufactured using sol-gel technology and high temperature firing to produce fibres of well-defined dimensions. PCW is produced in relatively small quantities for very specific applications, typically from 600°C - 1700°C (1112°F - 3092°F).

PSP Product Stewardship Program

In 2002, the Occupational Safety and Health Administration (OSHA) endorsed a five year voluntary product stewardship program called PSP 2002. On May 23, 2007, HTIW Coalition's predecessor, RCF, and its member companies renewed this voluntary product stewardship agreement with OSHA. On April 16, 2012, HTIW Coalition renewed this five year program, called PSP 2012. PSPS 2012 is a highly acclaimed, multi-faceted strategic risk management initiative designed specifically to reduce workplace exposures to refractory ceramic fibre (RCF).

R**REACH****(Reach, Evaluation, Authorization and Restriction of Chemicals)**

REACH is a European Union Regulation introduced in December 2006. REACH addresses the production and use of chemical substances and their potential impacts on both human health and the environment inviting producers, importers and to a lesser extend users to provide extensive information on their substances, mixtures and products. REACH entered into force in June 2007, with a phased implementation over the next decade.

Refractory Ceramic Fibres (RCF)

Also (preferably) referred to as Aluminium Silicate Wool (ASW), which better describes the material's composition.

T**Thermal conductivity**

This is the ability of a material to transmit heat. The lower the thermal conductivity the better the product is at resisting the flow of heat through it. The thickness of a furnace lining necessary to give a known cold face temperature can be calculated using the thermal conductivity. It is normally independent of size or shape of the tested material. Thermal conductivity is measured in Watts per meter per degree Kelvin $W/m \cdot K$ ($BTU \cdot in/hr \cdot ft^2 \cdot ^\circ F$).

V**Vitreous (Amorphous) Glassy Fibres**

Vitreous fibres are amorphous rather than crystalline. They have no cleavage planes and when handled they break transversely rather than splitting into thinner fibres as asbestos does. This term has the same meaning as MMVF (see above).

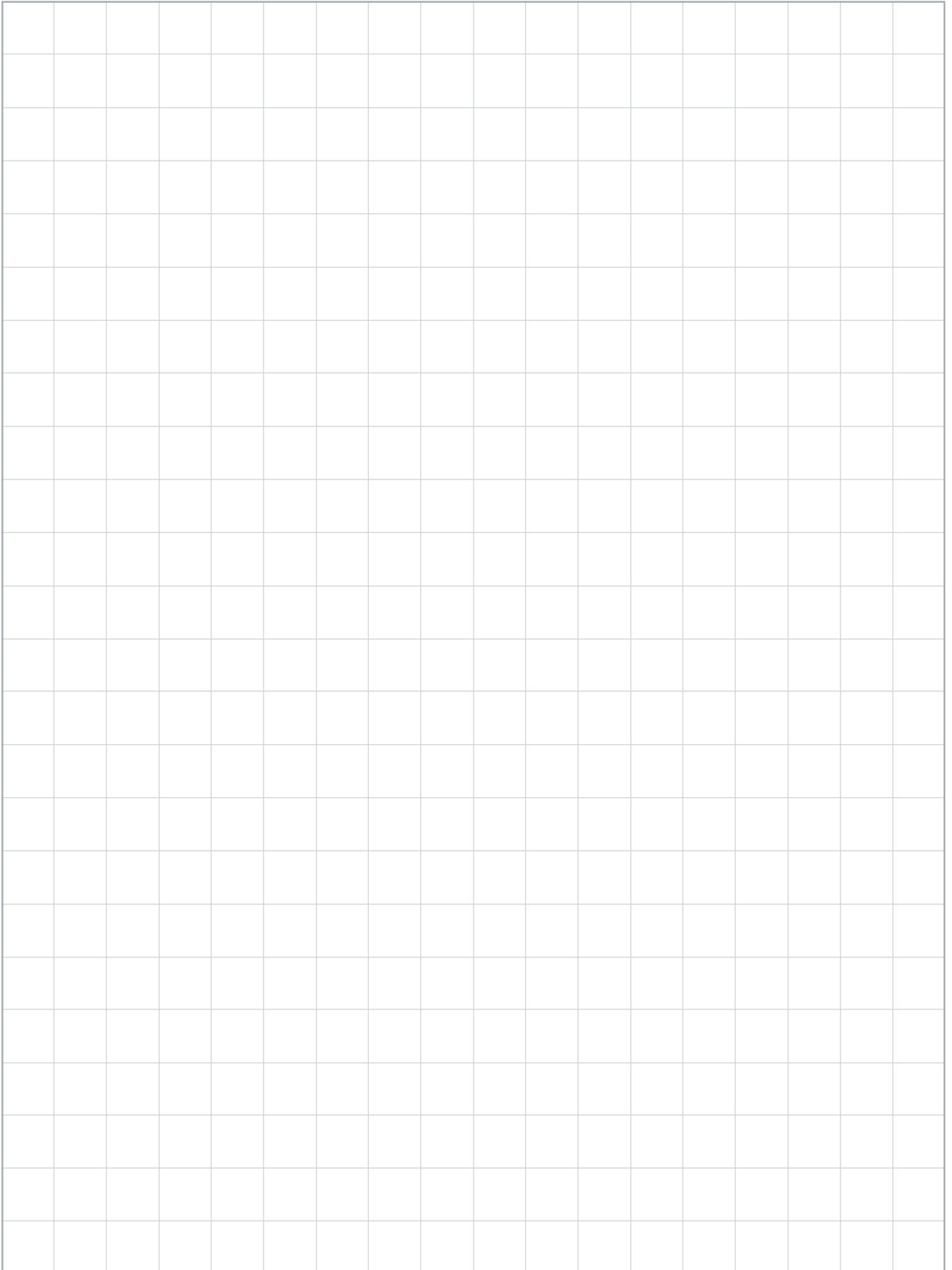
W**WHO-Fibres**

For the purpose of harmonising optical fibre counting, the World Health Organization has adopted a convention to define fibre dust size. To evaluate workplace fibre concentrations, only airborne fibres with diameter less than $3\mu m$, length greater than $5\mu m$, and an aspect (length to diameter) ratio greater than 3 are to be counted. Such so-called 'WHO Fibres' are not all equally respirable; fibres with diameter $< 1\mu m$ are far more likely to reach the deep lung than those of $3\mu m$ diameter. See also Dimension.

Wool

Wool is the term used to describe an unordered mass of fibres of different lengths and diameters (EN 1094-1).

Notes



ABOUT MORGAN ADVANCED MATERIALS



Morgan Advanced Materials is a global engineering company offering world-leading competencies in materials science, specialist manufacturing and applications engineering.

We focus our resources on the delivery of products that help our customers to solve technically challenging problems, enabling them to address global trends such as energy demand, advances in healthcare and environmental sustainability.

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