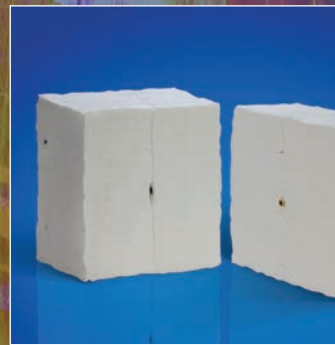


Thermal Ceramics Solutions

Fibre, Refractory & Microporous Insulation



Bringing technical solutions to all problems of thermal management

Contents

Thermal Ceramics products	4-5
Product materials	6-7
Fibre product overview	8
Bulk fibres	9
Blankets	10
Modules and Logs	11
Papers	12
Felts	13
Boards and Shapes	14
Mastics	15
Textiles	16
Refractory product overview	17
Insulating Firebrick, Firebrick	18-19
Monolithics	20
Structural Block	21
Crucibles and Shapes	22
Microporous product overview	23
Heat Shield products	24-25
Fire Protection products	26-27



The Thermal Ceramics business of Morgan Advanced Materials makes a range of fibre, refractory and microporous high temperature insulation products used to reduce energy consumption in demanding industrial processes.

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 1750°C (932°F to 3200°F). We have a proven track record for helping customers to improve operational efficiency and respond to changing environmental pressures.

Thermal Ceramics produces a variety of market-leading brands including: Superwool® low biopersistent (LBP) insulating fibre, Pyro-Bloc® modules, WDS® and Min-K® microporous and JM™, K® and TJM™ insulating firebricks, Tri-Mor® monolithics and FireMaster® passive fire protection products.



Wherever you are in the world, our geographical coverage and engineering expertise ensures that you will be provided the highest levels of service and support, throughout the development and purchasing of your insulation solutions.

- **We deliver intelligently engineered insulation solutions to a wide variety of industries and market sectors**
- **Integrated approach, incorporating design, manufacture and installation**

Morgan is committed to expansive research and development ensuring that our products remain at the technical edge and continue to push boundaries.

Global Footprint

Thermal Ceramics has sales and operations in more than 30 countries and employs approximately 3,300 people.

Our extensive network of sales and distribution partners allows Thermal Ceramics to serve the global market with well supported regional personnel.

Thermal Ceramics offers products and engineered systems for high-performance thermal management applications in a variety of industries world-wide



Our products

Thermal Ceramics manufactures advanced ceramic materials, products and systems for thermal insulation in high-temperature environments.

Systems are designed for the safety of people and equipment in demanding applications, while products help customers, especially those operating energy-intensive processes, to reduce energy consumption, emissions and operating costs.

Thermal Ceramics products are used in high-temperature industrial processing of metals, petrochemicals, cement, ceramics and glass, and by manufacturers of equipment for aerospace, automotive, marine and domestic applications.

One of Thermal Ceramics' core strengths is the ability to address individual customer problems, using materials and application expertise to design, manufacture and install optimal thermal solutions.



Blanket

These highly versatile high temperature insulating fibre products are lightweight, have low thermal conductivity, low heat storage and excellent resistance to thermal shock. They are available in a variety of densities, chemistries, thicknesses and temperature capabilities.

Bulk

A complete line of 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.

Module and Log

A unique solution to high temperature insulation linings in industrial heaters, boilers and furnaces as well as many other applications. Blanket folded and stacked module systems are also available.

Board and Shapes

The entire vacuum formed fibre line of Boards and Shapes are available as flexible or rigid products in a wide range of compositions and a variety of standard dimensions with tolerances which can be adapted to very demanding applications. The formulations are selected to optimize performances in each application and shapes can be produced according to customer design.

Paper and Felt

Thin sheet products including millboard, 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.

Textiles

Textile products are made from highly textured forms of various fibres in both Superwool® fibre and Kao-Tex® using refractory ceramic fibre. Fibre yarns and other organic binders are 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, cost-effective fire-safe solutions that do not age, ensuring reliable fire protection when needed.

Microporous insulation

Min-K®, and WDS® microporous high temperature insulation products for applications in aerospace, advanced technology and industrial.

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. Mortars are available that are matched for use with the Thermal Ceramics IFB range.

Insulating, Dense and Special Duty Monolithics

Tri-Mor®, Kaolite®, Firelite®, Kaocrete®, Firecrete® monolithics are market leaders in 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.

Fired Refractory Shapes

High alumina, silicon carbide, fused silica and alumina-zirconia-silica compositions display excellent performance in highly abrasive applications. 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 and aluminium industries.

Thermal Ceramics world leading products offer a diverse, strongly branded product range that combines quality with consistency and reliability

Product materials

Material types	Product form
Fibre Low Biopersistent Fibres: • Superwool®, FireMaster® Refractory Ceramic Fibre (RCF): • Kaowool®, Cera® Polycrystalline Fibre (PCW): • Denka®	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®, Firelite®, Kaocrete®, Firecrete®, Kao-Tuff®	Cast, Gun, Ram, Vibratory
Crucibles Fired shapes	Various chemistries
Structural Block • TR-19™ • TR-20™	Block
Microporous • Min-K® • WDS®	Flexible, Panel, Rigid

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.

In use high temperature insulation will:

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

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 to 1600°C (1112°F up to 2912°F) includes:

- Low Biopersistent fibre: **Superwool**
- Refractory Ceramic fibre: **Kaowool and Cera**
- Polycrystalline fibre: **Denka**

Fibres

Low Biopersistent fibres (LBP) - Superwool

Low biopersistent 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, boards, shapes, felt, paper, modules and mastic products.

Benefits:

- Excellent thermal stability and insulation properties
- Low thermal conductivity
- Flexible, resilient and immune to thermal shock
- Good resistance to tearing
- Low heat storage capacity
- Good sound absorption
- Exonerated from carcinogen classification within Europe and not classified as hazardous by IARC or under any national regulations on a global basis
- No requirement for warning labels under Globally Harmonized System for the classification and labeling of chemicals (GHS)



Refractory Ceramic Fibre (RCF)

RCF, also known as Alumino-Silicate Wools, 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.

Thermal Ceramics fibre blanket products are available in a wide range of chemistries, are air laid into a continuous mat and mechanically needled for added strength and surface integrity.

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 sol-gel technology from aqueous spinning solutions and is suitable for use at application temperatures > 1300°C (2372°F) and in critical chemical and physical application conditions.

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

Fired Refractory

Thermal Ceramics high temperature insulation refractories from 650°C to 1870°C (1200°F up to 3400°F) includes:

- Firebrick and IFB: SR, K, JM, TJM
- Monolithics: Tri-Mor, Kaolite, Firelite, Kaocrete, Firecrete, Kao-Tuff
- Crucibles and Shapes: Cerox, Valcor
- Structural Block: TR

Firebricks 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, silicon carbide, 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 recognised 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

Thermal Ceramics high temperature microporous insulation from 900°C to 1200°C (1650°F up to 2200°F) includes:

- Aerospace, Advanced Technology, Critical Data Recorders: Min-K
- Industrial, Transportation, Commercial: WDS

Microporous insulation is available under Min-K®, WDS® for technologically advanced applications in aerospace to industrial 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.



Fibre grades

Thermal Ceramics' three grades of high temperature insulation fibres are:

- Low Biopersistent Fibres:**
 - Superwool® Plus - Classification temperature 1200°C (2192°F)
 - Superwool HT - Classification temperature 1300°C (2372°F)
 - Superwool XTRA - Classification temperature 1450°C (2600°F)
- Refractory Ceramic Fibres:**
 - Kaowool® - Classification temperature 1260°C (2300°F)
 - Cerablanket® - Classification temperature 1315°C (2400°F)
 - Cerachem® - Classification temperature 1426°C (2600°F)
 - Cerachrome® - Classification temperature 1426°C (2600°F)
- Polycrystalline Wool Fibres:**
 - Denka® Alcen®* - Classification temperature 1600°C (2912°F)

* Denka and Alcen are registered trademarks of Denka Kagaku Kogyo Kabushiki Kaisha used under licence by Morgan Advanced Materials PLC.

Superwool fibre is a high-temperature insulating wool composed of man-made vitreous silicate fibres. Each fibre grade features its own unique attributes and benefits to meet the demands of your application. Our low biopersistent, alkaline earth silicate and potassium aluminosilicate, marketed as Superwool insulating fibres have been engineered to offer advantages in high temperature insulation applications.

Traditional Refractory Ceramic Fibre (RCF) is a highly versatile material. It can be spun or blown into the product forms as seen in the table.

Our polycrystalline fibres (PCW) are made from high alumina (>95% alumina) or mullite fibres (85% alumina) using the Sol-Gel process. These fibre solutions are ideally suited for many challenging atmospheres and feature a temperature rating up to 1600°C (2912°F) with very low linear shrinkage and excellent resistance to alkali and chemical attack.



Superwool® XTRA™

delivers the strength that industrial applications need, both in terms of its resistance to high temperatures and pollutants, but also its improved EHS credentials

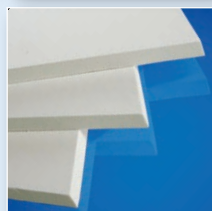


Increasing application capability

Lifetime vs fibre choice



Product form	Temperature range, °C (°F)
Bulks	1000°C – 1427°C (1832°F – 2600°F)
Blankets	1000°C – 1600°C (1832°F – 2912°F)
Modules and Logs	1000°C – 1600°C (1832°F – 2912°F)
Papers	1000°C – 1649°C (1832°F – 3000°F)
Felts	1000°C – 1427°C (1832°F – 2600°F)
Boards and Shapes	1000°C – 1649°C (1832°F – 3000°F)
Mastics (wet fibres)	982°C – 1593°C (1800°F – 2900°F)
Textiles	482°C – 1371°C (900°F – 2500°F)



Bulk fibres

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, 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 fibre 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

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

Extra Long - Long - Medium - Short fibre

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



Bulk fibres

Physical characteristics

- Classification temperature up to 1600°C (2912°F)
- Excellent insulating performance
- Low heat storage
- Fibre diameter and length control variables

Applications

- Thermal and acoustical insulation
- Primary material in mastics and vacuum formed boards and shapes
- Expansion joints

Brands

- Kaowool®
- Cerafibre®
- Cerachem®
- Cerachrome®
- Superwool® Plus
- Superwool® HT
- Denka®

Blankets

Physical characteristics

- Classification temperature up to 1600°C (2912°F)
- Excellent insulating performance
- Excellent thermal shock resistance
- Low heat storage capacity

Applications

- Furnace, boiler and kiln insulation linings
- Thermal barriers
- Fire Protection
- Field stress relieving
- Steam and gas turbine insulation

Brands

- Kaowool®
- Cerafibre®
- Cerachem®
- Cerachrome®
- Superwool® Plus
- Superwool® HT
- Superwool® XTRA
- FireMaster®
- Denka®*

* Denka and Alcen are registered trademarks of Denka Kagaku Kogyo Kabushiki Kaisha used under licence by Morgan Advanced Materials PLC.

Blankets

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. A needling process results in a forced matrix of bulk fibres to produce a coherent blanket without the use of chemical binders.

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 fibre 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

Modules and Logs

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.

Pyro-Bloc Modules and Pyro-Log are available in low biopersistent Superwool® Plus, Superwool HT and our newest technology, Superwool XTRA. Refractory Ceramic Fibre grades are also available.

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.

At moderate temperatures this lubricant burns out and the fibre becomes rigid enough to stand on. This feature, unique to Pyro-Log fibre, assists during installation and provides the durability and toughness necessary for long life.

Folded or Stacked Blanket Modules

Our Pyro-Fold and Pyro-Stack™ blanket module systems are available using our market leading blankets.



Modules and Logs

Pyro-Bloc modules

Physical characteristics

- Classification temperature up to 1427°C (2600°F)
- Exceptional insulating performance
- Excellent thermal shock resistance
- Low heat storage capacity
- Monolithic ceramic fibre composition

Applications

- Furnace, boiler and kiln insulation linings
- Burner blocks
- Furnace and boiler doors
- Harsh and corrosive environments
- High air velocity environments

Brands

- Pyro-Bloc
- Pyro-Log

Papers

Physical characteristics

- Classification temperature up to 1650°C (3000°F)
- Excellent tensile strength
- Low thermal conductivity
- Thickness availability of 0.8 up to 38 mm (1/32 up to 1in)

Applications

- High temperature gaskets and seals
- Refractory back-up insulation
- Filtration
- Separating media

Brands

- Kaowool®
- K-Shield™
- Superwool® Plus
- Superwool® HT
- Superwool® XTRA

Papers

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 aluminum 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 strict automotive, aerospace, and industry specifications.

In use high temperature insulation fibre will:

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



Felts

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.

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.

Felts

Physical characteristics

- Classification temperature up to 1427°C (2600°F)
- Flexible, lightweight
- Low thermal conductivity
- Thickness availability of 3 to 25 mm (1/32 to 1/2 in)

Applications

- High temperature gaskets and seals
- Expansion joints
- Molten metal resistant insulation

Brands

- Cerafelt®
- Cerachrome®
- K-Shield™
- Superwool® Plus
- Superwool® HT
- Superwool® Felt

Board and Shapes

Physical characteristics

- Dimensional stability up to 1650°C (3000°F)
- Excellent thermal shock resistance
- Low heat storage
- Low thermal conductivity
- Range of mechanical strengths

Applications

- Furnace and kiln hot face linings
- Combustion chambers for boilers and heaters
- Appliance and heat processing insulation
- Hot tops, riser sleeves
- Burner blocks

Brands

- Kaowool®
- Inorganic I-series
- Superwool®
- Superwool® HT

Board and Shapes

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:

- Low Biopersistent Fibres (LBP) - Superwool
- Refractory Ceramic Fibres (RCF) - Kaowool
- Polycrystalline Wool Fibres (PCW) - Denka®

Organic and inorganic compositions are available and offer:

- Low thermal conductivity and low heat storage
- Excellent thermal shock resistance
- 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
- Post-treatment applications of Alfibond® and Minimox™ for many RCF grades

Shapes

- Custom designed for optimized high temperature performance, utilising 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

Mastics, Coatings, Cements

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 fibre 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.

Mastics, Coatings, Cements

Mastic - Pumpables

- Classification temperature use up to 1540°C (2800°F)
- Non-wetting to molten aluminium

Applications

- Furnace, boiler and kiln hot spot repair
- Back-up insulation

Brands

- Kaowool®
- Superwool®
- Therm-O-Hot Patch™

Moldables

- Classification temperature use up to 1430°C (2600°F)

Applications

- Trough linings and hot face linings
- Back-up insulation
- Patching mix for fibre products or linings

Brands

- Kaowool®
- Superwool®

Coatings

- Classification temperature use up to 1650°C (3000°F)
- Good abrasion resistance

Applications

- Grout refractory joints and gaps
- Seals furnace lining cracks
- Furnace maintenance and emergency repairs

Brands

- Sealcoat HT
- Unikote®
- Therm-O-Flake™

Cements

- Classification temperature use up to 1316°C (2400°F)
- Develops strong bond upon drying
- Increases surface hardness and resistance to erosion

Applications

- Surface treatment for vacuum formed boards and shapes to increase surface hardness
- Adhesive to apply various materials to fibre and insulation for joining fibre or heating elements

Brands

- Kaowool® Rigidiser
- Cera-Kote®
- Super Stic-Tite™
- Kao-Seal®
- Therm-O-Stix™



Textiles

Physical characteristics

- Classification temperature up to 1370°C (2500°F)
- Exceptional tensile strength
- Cloth, rope, chord, thread, sleeving, tubing and tape available
- Excellent thermal shock and corrosive attack resistance

Applications

- Expansion joints
- Gaskets and seals
- Stress relieving blankets
- Fire and heat barriers

Brands

- Kao-Tex™
- Superwool®

Textiles

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 fibre 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 Thermal Ceramics products enables custom engineered thermal solutions to be developed to customer specifications.



Refractory product overview

Thermal Ceramics high temperature refractory products - fired, pressed, cast - are used as primary lining and back-up linings in critical applications for Petrochemical to furnace doors in Iron and Steel to pot cells in Aluminium to troughs and ladles in heat treating.

Firebrick

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

Insulating Firebrick (IFB)

Our K® IFB are manufactured with very low thermal conductivity and high hot load strengths. JM® IFB have the ability to withstand chemical attack and high heat conditions.

Mortars

Wet and dry mortars are available that are matched for use with our Firebrick and IFB.

Monolithics

Monolithics are available in Insulating, Dense and Special Duty Monolithics. World recognised branding, the Tri-Mor® line of Kaocrete® and Firecrete® dense monolithics has been proven ideal for applications that require strong, easy to place and economical materials. Tri-Mor Kaolite® and Firelite® 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® and Kao-Tab® feature specifically enhanced properties such as resistance to corrosion, abrasion and reducing atmospheres.

Fired Crucibles and Shapes

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

Structural Block

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. These products are ideally suited and available as a kit for many aluminum pot cell applications.



Engineering high performance refractory insulation for critical applications

Product form	Temperature range, °C (°F)
IFB, Firebrick	1260°C - 1788°C (2300°F - 3250°F)
Monolithics	871°C - 1871°C (1600°F - 3400°F)
Fired Refractory Crucibles and Shapes	649°C - 1871°C (1200°F - 3400°F)
Structural Block	1038°C - 1093°C (1900°F - 2000°F)

Insulating Firebrick (IFB)

Physical characteristics

- High temperature use limit up to 1650°C (3000°F)
- Extremely low thermal conductivity
- Low densities and heat storage
- Excellent resistance to alkali attack
- High purity
- Good strengths
- Low shrinkage
- Suitable for use up to 1650°C (3000°F)

Applications

- Backup insulation furnaces and kilns
- Linings for furnaces and kilns

Brands

- K[®]
- TC[™]
- JM[™]
- TC[™]-26
- JM[™]-23
- JM[™]-26
- JM[™]-30

Ease of installation

- Excellent surface for mortaring
- Can be easily cut into shape

Insulating Firebrick (IFB) & Firebrick

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

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

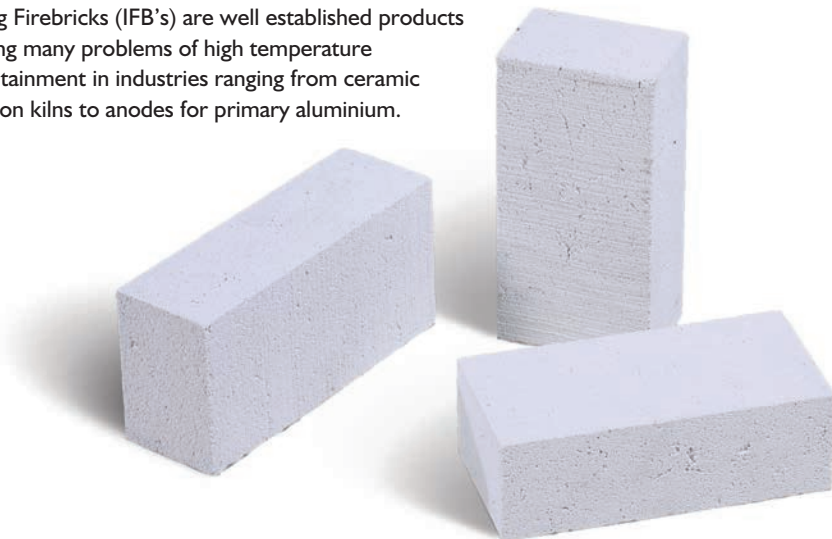
Firing, benefits include:

- Two high brick stack provides even heat penetration into brick
- 1350°C – 1370°C (2460°F - 2500°F) for K-23 and up to 1400°C (2550°F) for K-25/K-26
- Stable Anorthite Phase formed
- Superior against alkali attack – Na and K
- Thermally stable at very high temperatures
- High hot strengths

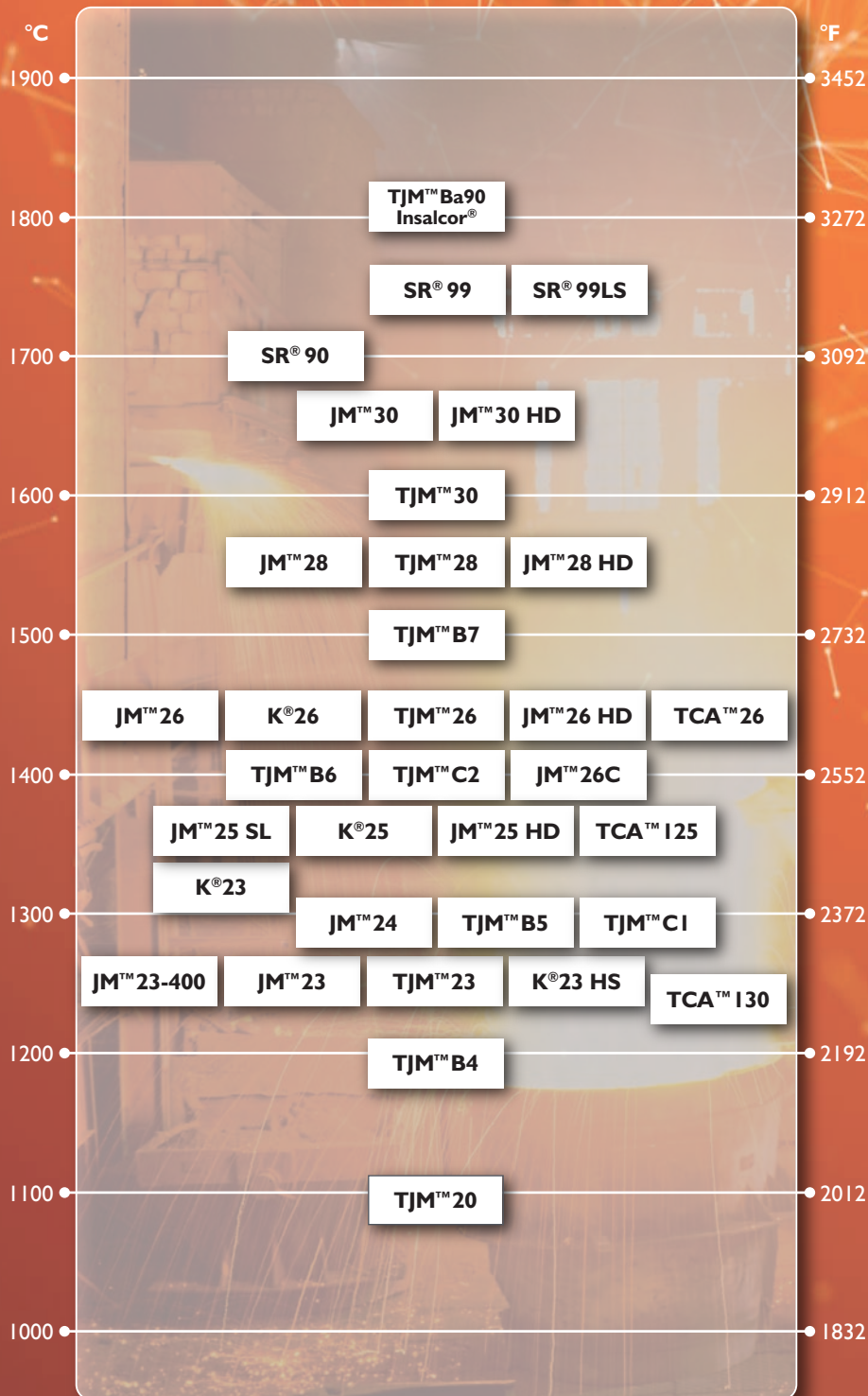
Insulating Firebricks, benefits include:

- 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.



Temperature rating chart



Firebrick

Physical characteristics

- High temperature use limit up to 1800°C (3250°F)
- Excellent strength and thermal stability
- Good thermal shock resistance
- Low SiO₂ contents for use in Hydrogen atmospheres

Applications

- Kiln linings
- Removable furnace doors
- Sulphur recovery units
- Secondary ammonia reformers

Brands

- SR®
- Insalcor®

Firebricks

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 1650°C (3000°F) and provide good thermal shock resistance.

Monolithics

Insulating: Kaolite®, Tri-Mor®

- 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: Kaocrete®, Kaocast®, Kaogun®, Tri-Mor®

- 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: Kaocrete®, Hicast®, Higung®, Morflo®, Alcast®, Tri-Mor®

- 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: Plascast®, Plasgun®, Tri-Mor®

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

Aluminium resistance: Albond®, Alcast®, Tri-Mor®

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

Special duty: Kao-Tab®, Kao-Tuff®, Tri-Mor®

- 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 resistance 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: Airstet®, 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.

Monolithics

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 having different 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.



Structural 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

- 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 aluminium cryolite attack

TR-20 Block

- Very good resistance to breakage
- 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
- 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 Thermal Ceramics' monolithics, firebricks, refractory plastics, and ceramic fibreproducts



Structural Block

Physical characteristics

- Continuous use limits up to 1090°C (2000°F)
- Low thermal conductivity
- Low shrinkage at use limits
- Resistant to cryolite vapors
- Reduced manufacturing costs
- High compression strength
- Minimal shrinkage at continuous use limit
- Excellent resistance to aluminium cryolite attack

Applications

- Side and end wall insulation in carbon baking pits
- Backup insulation for:
 - aluminium pot cells, reheat and pusher furnaces
 - copper reverb furnaces
 - Oil-fired water tube boilers
- Interior and exterior bustle or hot air pipes
- Pair with WDS® Microporous to reduce lining thickness and shell operating temperatures

Brands

- TR™

Crucibles and Shapes

Material compositions

- High alumina
- Silicon carbide
- Fused silica
- Alumina-zirconia-silica

Physical characteristics

- Excellent chemical attack resistance
- Excellent thermal shock resistance
- Low gas permeability
- Hundreds of standard molds in stock
- Tight tolerance capability

Applications

- Crucibles
- Tundish boxes and distribution plates
- Combustion components
- Nozzles

Brands

- Cerox®
- Valcor®

Crucibles and Shapes

For over 60 years, Morgan has been producing a range of fired refractory shapes for an extensive range of critical, heat intensive applications.

Using traditional and state of the art manufacturing techniques, fired shapes can be designed specifically for your application. These techniques would include our products manufactured in US by thixotropic and chemical casting. The silicon carbide products offered in Germany, South Africa and China are offered as self-bonded, nitride bonded and clay bonded.

Our fired shapes are manufactured using a wide range of materials:

- High alumina
- Silicon carbide
- Sillimanite
- Fused silica
- Alumina-zirconia-silica (AZS)
- Zirconia
- Zircon
- Mullite

Cast compositions can be made to precise customer specifications. Thixotropic casting uses a dispersion agent, which allows the mix to flow when vibrated without requiring 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.

Common features of crucibles and shapes:

- Superior hot strength
- Excellent chemical attack resistance
- Excellent thermal shock resistance
- Low gas permeability
- Tight tolerance capability

Typically, these fired shapes are for the vacuum induction melting (VIM) of super alloys and nickel-based steel alloys. Designs would include crucibles, tundishes and launder systems. A world leader in the design, manufacture and installation of pouring refractories for the vacuum induction melting industry, we also supply furnace spouts, distribution boxes (often referred to as hot tops), samplers, and "Metamic" (metal-ceramic composite) thermocouple sheaths for the VIM market, along with muffles, ladle liners, saggars, sealed quench furnace muffle assemblies and other special shapes for other markets.



Microporous

For more than 50 years, Thermal Ceramics has provided Min-K Microporous thermal insulation to the aerospace market. The critical applications require material solutions for vibration resistance, extremely low thermal conductivity and space saving, lightweight products. In the industrial and transportation markets we offer WDS® Microporous that offer similar features.

Min-K Microporous is the industry leading standard for aerospace applications. From thrust reverser insulation to Auxillary power units to critical data recorders, the lightweight, vibration resistant materials meet the challenges of these critical, demanding applications.

WDS Microporous products are specially formulated and designed for applications such as ladle liner back-up insulation for Iron and Steel, board back-up insulation in Ethylene crackers and flexible pipe solutions for many industrial processes.

WDS microporous high temperature insulation products feature a classification temperature rating up to 1100°C (2000°F). Microtechnology is the key to the innovative WDS Technology. This unique manufacturing technology, creates micropores that minimise heat transfer by convection. Specially developed infrared opacifiers, reduce heat transport processes by absorption and reflection of radiation.

Material compositions

- High alumina
- Silicon carbide
- Fused silica
- Alumina-zirconia-silica

Physical characteristics

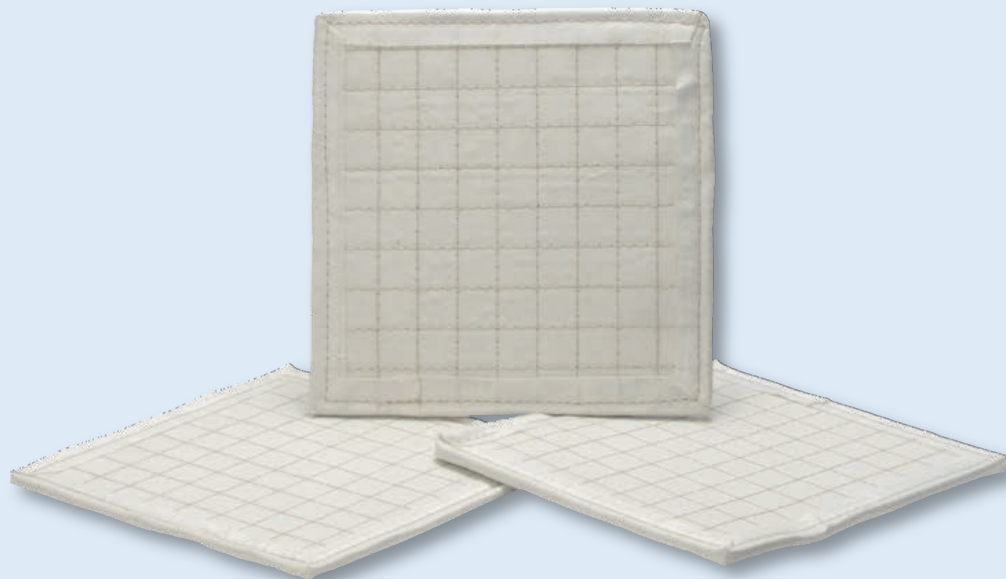
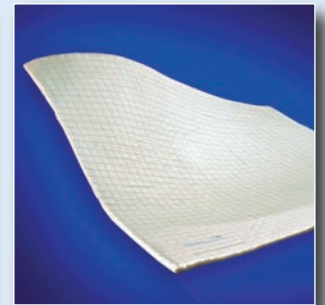
- Perfect and consistent mineral matrix distribution
- Optimised porosity of the interconnecting chain
- Superior mechanical properties
- Quantity and distribution of opacifiers
- Microscopic particles sizes

Applications

- Heat treatment systems for metals and glass
- Fire protection equipment
- Power plants
- Chemical plants
- Pipe Insulation
- Parts in the Automotive Industry
- Chimneys, pipes and diesel exhaust systems
- Deepwater oil production

Brands

- Min-K®
- WDS®



Heat Shield products

Available products

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

Heat Shield products

By employing a range of materials, Thermal Ceramics can provide heat shields in a wide variety of demanding environments across many markets and demanding applications.

Our Heat Shields are used within transportation 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 high temperature insulation like ceramic fibres and microporous to produce heat shields that are 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 that is on budget, without sacrificing performance.

Common insulation materials used in our Heat Shields:

- Superwool low biopersistent fibres (LBP)
- Glass Fibres
- Microporous materials

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. 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 0.3 mm. 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 0.3 mm 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

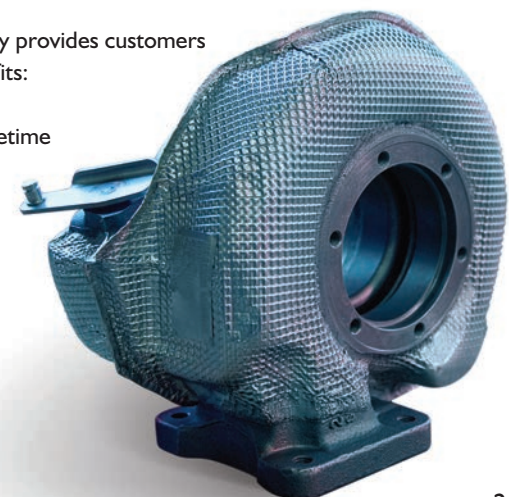
Rigid Box Tech (picture 4)

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



FireMaster® Fire protection products

Available products

- FireMaster Marine Plus Blanket
- FireMaster Marine Plus Water Repellent Blanket
- FireMaster Marine Plus Faced Blanket
- FireMaster RES System
- FireMaster MP Panel
- FireMaster MarineFlex™ N
- FireMaster MP Shell
- FireMaster FastWrap XL
- FireMaster Cable Tray Wrap system
- FireMaster DryerWrap
- FireMaster Paper
- FireMaster Board
- FireMaster Expanding Felt
- FireMaster FireFelt
- FireMaster FireBarrier™ 135
- FireMaster Flexijet

Passive fire protection products

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

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.

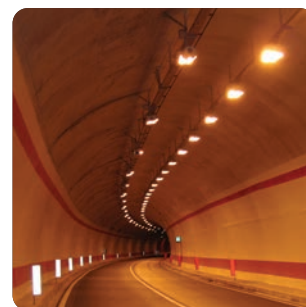
Ductwork

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.

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.



FireMaster® product range includes:**FireMaster Marine Plus Blanket**

Lightweight fire insulation designed for weight sensitive applications. Weight savings up to 30% are typical compared to standard FireMaster blanket and alternative insulation solutions. Systems are available for composite, steel and aluminium structures.

FireMaster Marine Plus Water Repellent Blanket

FireMaster Marine Plus blanket is available with a water repellent treatment through the entire blanket thickness to inhibit water ingress.

FireMaster Marine Plus Faced Blanket

FireMaster Marine Plus blanket is available with surface coatings of aluminium or glass cloth.

FireMaster RES system

A rigid metallic enclosure for jet fire protection of valves, actuators and flanges.

FireMaster Paper

A thin, non-combustible and flexible fire insulation material is ideal for use as a fire resistant gasket or similar uses in critical fire protection applications where a non-combustible product must be used, such as IMO A-Class fire rated constructions.

FireMaster Board

Three different grades of FireMaster board are available to offer designers a choice of products most suitable to their application. Now includes FireMaster 200 board developed especially for solid core fire doors.

FireMaster Expanding Felt

Expands to 3 times its original thickness to seal gaps, joints and penetration seals.

FireMaster FireFelt

Compressible felt suitable for applications where very low weight and good resilience are required.

FireMaster FireBarrier 135

Sprayed refractory cement solutions for fire protection of steelwork, vessels and floating floors in ships.

FireMaster FlexiJet

Flexible jacket system for fire protection of process equipment and structures.

FireMaster CableTray Wrap

FireMaster blanket totally encapsulated in aluminium foil. Approved by Factory Mutual for hydrocarbon fire protection of instrument and control cables.

FireMaster FastWrap XL

Fully foil encapsulated flexible blanket wrap system for fire protection of commercial kitchen grease extraction or ventilation ducts. A UL and ULC Listed and ICC-ES Approved. Meets code requirements of NFPA 96, IMC, UMC, CMC, NBCC.

FastDoor XL

A UL Listed, fire tight per UL1978 with liquid tight gasket and features fast installation on new or retrofit ducts.

FireMaster DryerWrap

A flexible, 13 mm (1/2in) thick UL & ULC listed for 1hr protection inside rated wood frame construction. For use on dryer vents in multifamily housing projects.

FireMaster PlenumWrap+

Flexible, 13 mm (1/2in) thick single layer tested to NFPA 262 (UL 910) and UL 1887 Intertek (OPL) listed systems to reduce flame spread and smoke development of PVC, CPVC, PB, PE, PP, PV, PVDF, and ABS pipes and coated electrical cables in return air plenums.

Applications

- 'A' class and IMO HSC steel, aluminium and PVC composite bulk head 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®

Morgan Advanced Materials

Morgan Advanced Materials is a global engineering company.

We apply world-class materials science and manufacturing expertise to solve technical challenges that our customers face everyday.

We work in the electronics, energy, healthcare, industrial, petrochemical, security and transport markets, forming close collaborative relationships with our customers.

Morgan is a global leader in materials science and application engineering.

For all enquiries, please contact our specialist sales and marketing offices:

Europe

Morgan Advanced Materials
Thermal Ceramics UK Ltd
Tebay Road, Bromborough
Wirral, Merseyside
CH62 3PH
United Kingdom
T +44 (0) 151 334 4030
marketing.tc@morganplc.com

Americas

Morgan Advanced Materials
Thermal Ceramics Inc
2102 Old Savannah Road
Augusta
Georgia 30906
USA
T +1 (706) 796 4200
marketing.tc@morganplc.com

Asia

Morgan Advanced Materials
Morgan Ceramics Asia Pte Ltd
150 Kampong Ampat
05-06A, KA Centre
368324
Singapore
T +65 6595 0000
asiasales@morganplc.com