



**VULCAN SHIELD
GLOBAL PTE. LTD.**

SHAPE THE FUTURE WITH ADVANCED MATERIALS

A globally leading advanced manufacturing enterprise
specializing in high-temperature-resistant materials

**Technological Innovation · Forge Ahead
Eyes on the World · Aspire to Global Impact**



MISSION & VISION

Fueling Sustainable Growth through Advanced Materials Innovation

We envision a future where revolutionary material science powers unprecedented progress to transform industries globally.

Backed by an in-depth understanding of materials and their potential to shape a sustainable world, our vision is to empower widespread accessibility to cutting-edge heat-resistant materials across myriad industries worldwide.

With limited material availability and exorbitant costs often curtailing the widespread adoption of advanced materials, we are steadfast in challenging this status quo by streamlining availability and enhancing affordability.

We ignite newfound opportunities offered by advanced materials, so enterprises can benefit from better performance, sustained resilience and greater cost efficiencies — to design better solutions for tomorrow's challenges.

Industry and Market Applications

Military Defence

VSG products from Alumina PMCs, CMCs to MMCs, bolster national defense efforts by enhancing efficiency and performance to meet high-temperature, high-speed and other extreme specifications:

- o Alumina MMC material ensures optimal performance under high-temperature and high-speed rotation instances
- Applications include high-load mechanical components in helicopters, including other high-temperature and high-speed rotation components
- o Alumina fibers can be used as insulating material for nuclear reactors and aerospace vehicles, reinforcing material for lightweight alloys, and thermal-insulation material for high-temperature components in aviation jet engines and more
- Applications include:
 - Manufacturing of solid rocket engine nozzle, simplifying design by cutting parts and weight by 50%
 - As insulation material for nuclear reactors, aerospace vehicles, rocket engine combustion chambers, nozzle exit cones, and other related components
 - As reinforcing material for lightweight alloys (such as polycrystalline ceramic alumina fiber) for applications in nuclear power and space missiles
 - For thermal insulation connection between connection chamber and nozzle, and other high-temperature components in aviation jet engines
- o MMCs empower military innovation
- Applications include:
 - Reinforcement for tank engine and armored vehicle pistons
 - Manufacture of tank track shoes, with the capability to significantly reduce their weight from 544kg of cast steel to between 262 and 363kg



Ferrous Metallurgy

Address end-to-end steel manufacturing process with comprehensive range of advanced refractory engineering solutions. Provide comprehensive advanced refractory materials' engineering solutions' for the steel manufacturing process, offering high-temperature resistance, thermal insulation and sealing capabilities. Applications include thermocouples and critical wiring systems in extreme high-temperature conditions.



Petrochemical

Supply fire resistance and insulation systems for petrochemical enterprises. Applications include process heaters and furnace reformers, internal and external tube seals and expansion joints, heat shields for radiant coils.



Aerospace

Provide a wide range of ASD9100D-certified thermal, acoustic, and fire protection insulation solutions. Applications include high-temperature sealing, electrical insulation for aircraft wiring, structural reinforcement for ceramic matrix composite exhaust components, firewalls, fan cowl, engine struts, black boxes, heat shields for thrust reversers, and pipelines, among others.



Textile

Provide innovative materials that can be flexibly mixed with other organic fibers. Applications include protective clothing, high-resistant ropes, fireproof coating materials, heat shields, pads and ties for firefighting, chemical, cable, labour protection and other fields.



Automotive

Supply systems and devices aimed at improving vehicle safety, performance, energy efficiency and comfort. Applications include thermal shields, exhaust aftertreatment devices to advanced fiber composite products for new electric vehicle lithium battery modules.



Ceramic and Glass

Provide heat-resistant lining to improve strength and heat insulation performance. Applications include all types of kiln-fired ceramic and glass products. VSG Alumina fiber woven sleeves can be used on roller kilns to avoid damaging glass products during transportation.



Construction

Develop new building materials and cement from alumina fibers that are sintered at high temperature to overcome low bending and compressive strength of foam glass to enable heat insulation and sound absorption in the construction of high-rise and assembly buildings. Applications include reinforced foam glass, lightweight refractory bricks.



Energy and Power

Offer full range of highly turnkey materials for high gas-fired infra-red heating solutions for extreme temperature industrial usage. Applications include high temperature cables, alumina fiber blankets, heat-insulating lightweight refractory bricks, combustion chamber materials of power generation gas turbines.



Reference Manual

for Alumina Fiber and Products

Naming Method

1.Fiber type:

F-F72 (alumina content $\geq 72\%$); P-P80 (alumina content $\geq 80\%$)

C-C85 (alumina content $\geq 85\%$); M-M99 (alumina content $\geq 99\%$)

The product specification parameters, 270-denier plain woven fabric has a surface density of 270 g/m²

Product type:

W- Plain woven fabric	P- Plain tape
B- Braided sleeve	R- Braided rope
S- Sewing thread	N- Needled blanket

Naming explanation: W-F100B1-270

W- F 100 A 1 - 270
① - ② ③ ④ ⑤ - ⑥

- ① Product type, W-plain woven fabric
 - ② Fiber type, F-F72
 - ③ Yarn, 100-100Tex
 - ④ Twisting, A-twisted, B-untwisted
 - ⑤ Number of yarns
 - ⑥ Product specification, The area density of the plain woven fabric is 270 g/m² .
- Plain woven fabric: Area density g/m²
- Plain tape: Weight per meter g/m
- Braided sleeve: Diameter mm
- Sewing thread: Yarn fineness Tex
- Braided rope: Outer Diameter mm
- Needled blanket: Classification temperature °C.

Alumina Continuous Fiber

Alumina continuous fibers can withstand long-term use at temperatures of approximately 1200-1300°C. The diameter of individual fibers ranges from approximately 7 to 14μm, and they are devoid of organic components, thus posing no risk to human health. The primary products encompass woven fabrics, tapes, braided ropes, sleeves, sewing threads, and various other textiles. Applications include fireproof and heat-insulating soft pads, as well as ceramic matrix and metal matrix composites. Alumina continuous fibers exhibit high-temperature resistance, high strength, and oxidation resistance, making them essential materials for manufacturing the next generation of advanced equipment.

At high temperatures, alumina continuous fibers maintain excellent strength, exhibit low thermal conductivity, resist thermal shock, and demonstrate stable chemical properties and corrosion resistance, enabling their long-term performance under various harsh and extreme conditions.

Characteristics and Applications of Continuous Alumina Fibers

Product Features

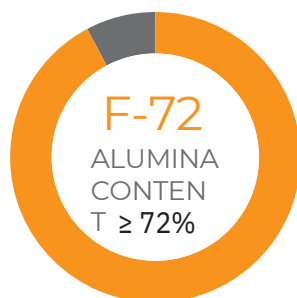
- High melting point
- Soft and elastic, making it ideal for sealing purposes
- Low thermal conductivity
- High temperature strength, insulating, oxidation-resistant, corrosion-resistant, with low shrinkage at high-temperature, making it an ideal as a reinforcement for ultra-high temperature composite materials.



Product Applications

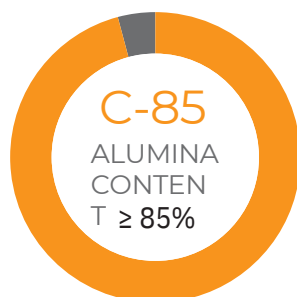
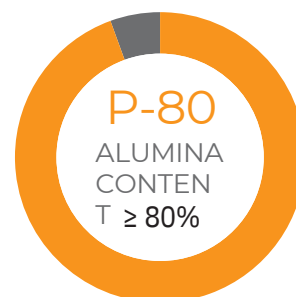
- High-temperature furnace linings
- Oilstone abrasive tools
- High-temperature insulating curtains
- High-temperature sintering gaskets
- Molten alloy filtration
- Tempered glass production line roller sleeves
- Thermocouple wires, cables, and electrical wire fire resistance, insulation, and heat insulation
- Semiconductor manufacturing crystal growth furnace insulating sealing rings (discs and shaft rings)
- Fireproof materials for generators and aerospace engine combustion chambers
- Electrical insulators and thermal insulators for fuel engine particulate filter systems
- Other applications

Continuous alumina fibers are categorized into four classes based on their composition :



With 72% alumina content, this fiber has a soft texture conducive to textile manufacturing. Once woven and stitched, it can be fashioned into various shapes of heat-insulating seals and is also suitable for use in composite reinforcement materials.

Containing 80% alumina, these fibers exhibit good toughness and excellent weaving properties. They can endure long-term use in high-temperature environments, making them ideal for producing heat-resistant fabrics of various shapes, as well as for forming high-temperature resistant composites with resins and ceramics.



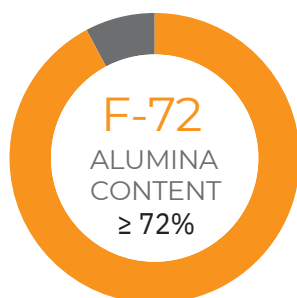
With an alumina content of 85%, this fiber can withstand long-term use at 1300°C without losing strength. It is especially suited for ceramic matrix composite applications. Ceramic products made from this material offer the best resistance to high-temperature thermal shock and creep, allowing for long-term use in high-temperature, oxygen-rich environments.

The 99% alumina content makes this fiber suitable for metal matrix composite applications. It has the best room temperature strength, and the high alumina content effectively controls interfacial effects in materials. It combines well with reactive metals, and products made from this fiber using filament winding or lay-up methods are lightweight and high-strength metal matrix composites.



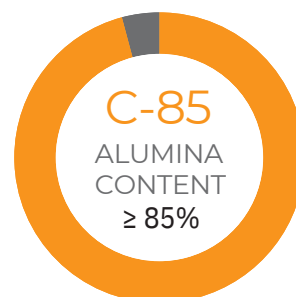
Property	Unit	F-72	C-85	M-99
Chemical Composition	Wt.%	72% Al ₂ O ₃ + 28% SiO ₂	85% Al ₂ O ₃ + 15% SiO ₂	>99% Al ₂ O ₃
Melting Point	°C	1800	1850	2050
Continuous Use Temperature	°C	1300	1400	1000
Single Filament Diameter	μm	7-10	10-12	12-14
Tex/Number of Filaments	g/1000m	60-90/400 100/500	150/500	160/750 140/400
Crystal Phase	/	γ-Al ₂ O ₃	α-Al ₂ O ₃ + Mullite	α-Al ₂ O ₃
Density	GPa	2.9	3.1	3.5
Single Filament Tensile Strength (Gauge Length 25.44mm)	GPa	1.9	2.2	2.6
Single Filament Modulus	GPa	184	235	330

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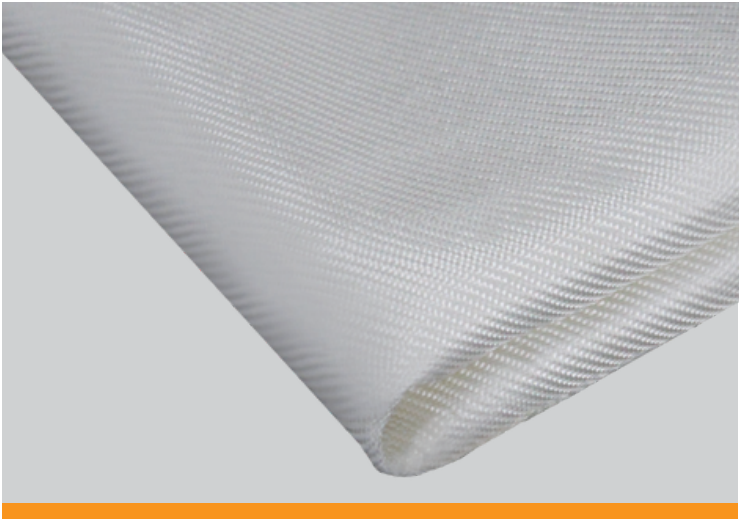


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Melting Point	°C	1800	1850	2050
Continuous Use Temperature	°C	1300	1400	1000
Single Filament Diameter	μm	7-10	10-12	12-14
Tex/Number of Filaments	g/1000m	60-90/400 150/750 200/1048	150/500	160/750 140/400
Crystal Phase	/	γ-Al ₂ O ₃ +Amorphous	α-Al ₂ O ₃ + Mullite	α-Al ₂ O ₃
Density	GPa	2.9	3.1	3.5
Single Filament Tensile Strength (Gauge Length 25.44mm)	GPa	1.8	2.2	2.6
Single Filament Modulus	GPa	190	235	330

Alumina Continuous Filament Flexible Products

Woven Fabric



Can be pre-treated at high temperatures ranging from 200 to 1000°C to ensure no shrinkage or deformation under high-temperature usage conditions.
The fabric weavings include plain, twill, and satin.

Product Model	Weave Type	Weight (g/m2)	Thickness (mm)	Length per roll (m)
W-F100B1-180	Mesh Plain	170	0.15	25/50
W-F100B1-240	Plain/Twill/Satin	235	0.18	25/50
W-F100B1-270	Plain/Twill/Satin	265	0.22	25/50
W-F100B2-320	Plain/Twill/Satin	315	0.30	25/50
W-F100A2-400	Plain/Twill/Satin	395	0.40	25/50
W-F100A2-480	Twill/satin	475	0.48	25/50
W-F100A2-560	Twill/satin	550	0.54	25/50
W-F100A4-640	Twill/satin	630	0.62	25/50
W-F100A4-840	Twill/satin	830	0.75	25/50
W-C150B1-340	Twill/satin	325	0.28	25/50
W-C150A2-540	Twill/satin	530	0.51	25/50
W-C150A2-600	Twill/satin	600	0.62	25/50
W-C150A3-810	Twill/satin	810	0.78	25/50

* In accordance with client specifications, flat-woven products ranging in width from 0.80m to 1.5m and an areal density between 200 g/m² and 1000 g/m² may be customized.

* Tailored to customer needs, three-dimensional (3D) woven products with thicknesses ranging from 1mm to 10mm may be customized.

Woven Tape

The alumina continuous fiber plain woven tape is made from high-strength alumina continuous fibers. It can be manufactured with different yarn specifications and weaving techniques to meet customers' requirements under various temperatures and conditions of use. The tape can continuously withstand temperatures of approximately 1200-1300°C and has good resistance to erosion by molten metals. It is suitable for thermal insulation, heat preservation, sealing, electrical insulation, sound absorption, filtration, etc., in high-temperature environments.



Product Model	Weaving type	Width (mm)	Thickness (mm)	Weight (g/m)	Length per roll (m)
P-F100A2-10	Plain/Twill	25	0.28	10	20/50
P-F100A2-24	Plain/Twill	50	0.45	24	20/50
P-C150A2-15	Plain/Twill	25	0.38	15	20/50

* Woven tapes, customizable in width from 15mm to 50mm and grammage from 10 g/m to 50 g/m, can be tailored to meet customer specifications.

* Based on customer demands, braided straps can be produced with a customizable width ranging from 15mm to 50mm.

Braided Sleeve

The aluminum oxide fiber braided sleeve is made from continuous alumina fiber yarn through an optimized braiding process. It features a lightweight, low thermal capacity, excellent insulation and high-temperature resistance, good fireproofing performance, chemical stability, corrosion resistance, and oxidation resistance. It also possesses superior characteristics such as high-pressure resistance, high-temperature endurance, and electrical insulation. This product is used for thermal protection and heat sealing of various types of pipelines and can be combined with other materials to create gland sealing components. With good ductility, it can be produced with different rates of expansion based on the strength of the yarn and the textile process to produce insulating sleeves with varying degrees of stretchability.



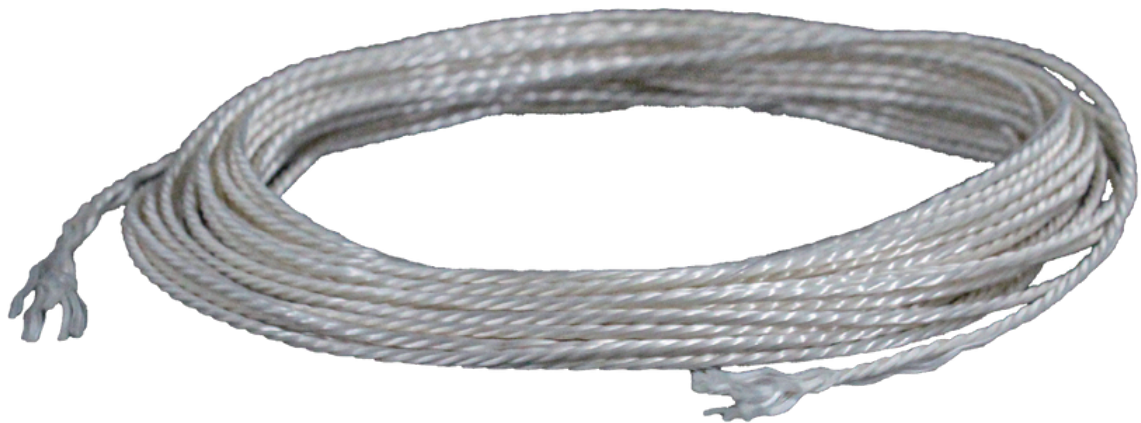
Product Model	Outer Diameter (mm)	Weight (g/m)	Length per roll (m)
B-F80B1-1	1.4	1.6	25/50/100
B-F100A2-4	4	16	25/50/100
B-F100A2-10	10	20	25/50
B-F100A2-15	15	36	25/50
B-F100A2-20	20	48	25/50
B-F100A2-35	35	90	25/50
B-F100A2-50	50	135	25/50
B-F100A2-60	60	175	25/50

* Based on customer requirements, we can customize braided sleeving with diameters ranging from 1.5mm to 80mm, or with weights from 1.6 g/m to 180g/m.

* According to customer needs, the braided sleeving can be designed with a biaxial structure or a biaxial triaxial structure.

Sewing thread and braided Rope

Made from untwisted fibers that are plied and twisted together, these materials are suitable for textile weaving, including various forms such as woven fabrics, tapes, and braided sleeves. The fabric can be processed into different products such as soft gaskets, expansion joints, and thermal insulating pads, according to design requirements, through coating and stitching processes.



Product Model	Yarn (Tex)	Diameter (mm)	Twists (/m)	Knot Strength (N)
S-F67A6-400	400	0.45	180	23
S-F67A8-550	400	0.54	180	42
S-F67A9-610	400	0.60	180	62

* Sewing threads with a diameter of 0.3mm to 0.7mm can be customized according to customer requirements.

* Sewing threads coated with special coatings or reinforced with organic fibers can be customized based on customer needs.

Product Model	Outer Diameter (mm)	Weight (g/m)	Length per roll (m)
R-F100B1-1	1	1.7	50/100
R-F100A2-2	2	3.7	50/100
R-F100A2-3	3	5.4	50/100

* Braided sleeves can be customized with an outer diameter ranging from 1.5mm to 80mm or a grammage of 1.6 g/m to 180 g/m according to customer requirements.

* According to customer needs, braided sleeves can have a bi-axial structure or a triaxial structure on two axes.

Alumina Short Fiber



Bulk Fiber

Alumina short fibers are one of the new types of ultralight high-temperature insulating materials. They are produced using the "sol-gel" method, where a specially formulated spinning sol is blown at high speed to create fibrous embryos, which are then dried and heat-treated at medium to high temperatures to form polycrystalline fibers.



Needled Blanket

The alumina fiber needled blanket is made by optimizing the laying of alumina short fibers and needle-punching them with our self-developed equipment. It undergoes complete physical processing without containing any organic components. Double-sided needle punching strengthens the binding force between fibers, ensuring the tensile strength of the finished needle-punched blanket. It can be used for extended periods at temperatures up to 1500°C,

with a maximum use temperature of 1600°C. It retains toughness, strength, softness, and fiber structure when subjected to these temperatures over a long period in an oxidizing atmosphere, neutral atmosphere, or weak reducing atmosphere. The alumina fiber blanket has outstanding thermal insulation properties, does not require special atmospheric protection; it can withstand high temperatures and resists acid and alkali erosion.

Fiber Mesh

Alumina fiber mesh is a lightweight two-dimensional network product formed after the high-temperature sintering of alumina short fibers. It features uniform mesh, good strength, lightweight, and softness, containing no organic components. It won't smoke or catch fire under high temperatures, offering excellent processability and great market potential in the field of high-temperature composite materials.

Mesh Mat

The alumina fiber mesh mat is a product obtained by pre-needling multi-layers of alumina fiber mesh. It has the advantages of uniform and soft texture, high fluffiness, low bulk density, and good processability, also free from any organic components. It has great market potential in the field of high-temperature composite materials.

It can be used for extended periods at temperatures up to 1500°C, with a maximum use temperature of 1600°C. Even when exposed to these temperatures over a long period in an oxidizing atmosphere, neutral atmosphere, or weak reducing atmosphere, it maintains its toughness, softness, and fiber structure.

Alumina Short Fiber Series

Product Model	Weave Type	Thickness / Bulk Density (m/K/m ³)	Weight (g/m ²)	Length (mm) ×Width (mm)			
N-F-1600	Needled Blanket	8/96	768	3600 × 610	7200 × 610	10000 × 610	12000 × 610
N-F-1600	Needled Blanket	8/128	1024	3600 × 610	7200 × 610	10000 × 610	12000 × 610
N-F-1600	Needled Blanket	10/128	1280	3600 × 610	7200 × 610	10000 × 610	12000 × 610
N-F-1600	Needled Blanket	10/150	1500	3600 × 610	7200 × 610	10000 × 610	12000 × 610
N-F-1600	Needled Blanket	12.5/96	1200	3600 × 610	7200 × 610	10000 × 610	12000 × 610
N-F-1600	Needled Blanket	12.5/128	1600	3600 × 610	7200 × 610	10000 × 610	12000 × 610
N-F-1600	Needled Blanket	12.5/150	1875	3600 × 610	7200 × 610	10000 × 610	12000 × 610
N-F-1600	Needled Blanket	25/96	2400	3600 × 610	7200 × 610	/	/
N-F-1600	Needled Blanket	25/128	3200	3600 × 610	7200 × 610	/	/
N-F-1600	Needled Blanket	50/96	4800	3600 × 610	7200 × 610	/	/
N-F-1600	Needled Blanket	50/128	6400	3600 × 610	7200 × 610	/	/
NT-F-1600	Mesh Mat	/	200	1000 × 1500	20000 × 1500	30000 × 1500	/
NT-F-1600	Mesh Mat	/	380	1000 × 1500	20000 × 1500	30000 × 1500	/
NW-F-1600	Fiber Mesh	/	32	1000 × 1500	20000 × 1500	30000 × 1500	/
M-F-72	Fiber Cotton	/	/	/	/	/	/

Needled Blanket Performance Parameters

Product Model		N-F-1600		
Classification Temperature		1600°C		
Long-term Service Temperature		1500°C		
Chemical Composition (%)	Al ₂ O ₃	72±1		
	SiO ₂	28±1		
	Al ₂ O ₃ +SiO ₂	>99		
Density(kg/m ³)	96	128	150	
Thermal Conductivity (W/(m·K))	600°C	0.095	0.068	0.074
	800°C	0.137	0.099	0.096
	1200°C	0.3	0.226	0.2
24-Hour Heat Shrinkage (%)	1300°C	0.4	0.2	0
	1500°C	0.7	1.2	0.2
Specific Heat (kJ/(kg·K))	1090°C			1.315
Fiber Diameter (μm)		5-7		
Bulk Density (kg/m ³)		96,128,150		

* According to customer requirements, we can customize needled blankets with a thickness ranging from 3mm to 100mm and a density from 96 kg/m³ to 150 kg/m³.

Product Performance

- Excellent high-temperature stability
- Minimal permanent line change upon heating
- Low slag ball content, outstanding refractory insulation performance
- Excellent heat reflection performance
- Low heat storage, low thermal conductivity
- Uniform fiber diameter, high tensile strength
- Strong resistance to erosion
- Good high-temperature flexibility, excellent resistance to thermal shock and mechanical vibration
- Stable chemical performance, strong corrosion resistance

Product Applications

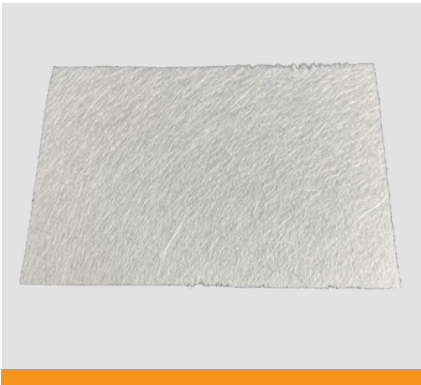
- Kiln lining and furnace lining
- High-temperature filtration medium
- High-temperature sealing gasket
- Automotive catalytic converter pad
- Sound insulation material



Alumina Fiber Paper

The fibers are electrospun and laid into a uniform network. Then, the fibers are mechanically entangled and reinforced to form an inorganic fiber paper product. It is lightweight, soft, and does not contain any organic components, thus it does not smoke or ignite during high-temperature processes.

Alumina fiber paper can be used at temperatures up to 1500°C for long periods, with a maximum usage temperature of 1600°C. It can maintain its original toughness, strength, flexibility, and structure when exposed to these temperatures in oxidizing, neutral, or slightly reducing atmospheres. The thickness of the fiber paper ranges from 0.4 to 1mm, and it exhibits excellent processability, making it have great market potential in the field of high-temperature composite materials.



Product Features

- (1) Excellent high-temperature stability
- (2) Minimal permanent line change upon heating
- (3) Low slag ball content, outstanding refractory insulation performance
- (4) Excellent heat reflection performance
- (5) Low heat storage, low thermal conductivity
- (6) Uniform fiber diameter, high tensile strength
- (7) Good high-temperature flexibility, excellent resistance to thermal shock and mechanical vibration
- (8) Stable chemical performance, strong corrosion resistance

Product Applications

- a. High-temperature tapes
- b. Resin and ceramic-based composite materials
- c. Thermal protection materials for aerospace engines and spacecraft
- d. Fireproof isolation for battery casings and module
- e. Sound insulation materials
- f. High-temperature sealing and filtering materials

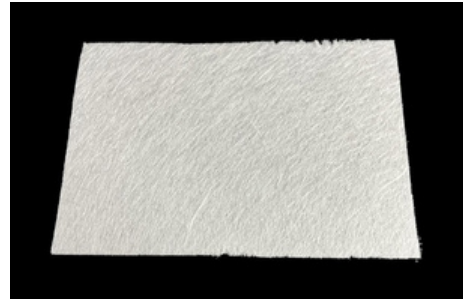
Technical Specifications

Alumina Fiber Paper		
Product Model	1600 Alumina Fiber Paper	
Chemical Composition (%)	Al ₂ O ₃	70-85
	SiO ₂	15-30
	Al ₂ O ₃ +SiO ₂	99.5
Classification Temperature (°C)	1200	
Long-Term Service Temperature (°C)	1200	
Fiber Diameter(μm)	5	
Thickness (mm)	0.4-1	
24-Hour Heat Shrinkage (%)	1300°C	0.52
	1500°C	0.98
Thermal Conductivity (W/(m·K))	600°C	0.16
	800°C	0.20
	1000°C	0.32
	1200°C	0.46
Weight (g/m ²)	50-150	



Alumina Fiber Paper Product Series

The production process of alumina fiber paper belongs to the non-woven process. It uses a method of spraying and electrospinning to form a uniform fiber web. Then, through mechanical methods, the fibers in the fiber web are entangled and reinforced to form inorganic fiber paper products. These products are light, soft, and free of any organic components, ensuring that they do not smoke or catch fire during high-temperature processes.



Alumina fiber paper can operate continuously at temperatures up to 1500°C and can withstand a maximum temperature of 1600°C. Even when exposed to oxidative atmospheres, neutral atmospheres, or slightly reducing atmospheres for extended periods, it retains its original toughness, strength, softness, and fiber structure. With a thickness ranging from 0.2 to 1 mm, this fiber paper has excellent processability and holds significant market potential in the field of high-temperature composite materials.

Why VSG

Your Trusted Advanced Materials Partner

As your trusted materials turnkey solutions and services partner, VSG works alongside you to address your core materials challenges and maximize your business potential. Being pioneers at the forefront of advanced materials innovation, we are here to help you continuously push the boundaries of business possibilities. Leverage VSG's wealth of expertise to accelerate your business growth with sharpened competitive differentiation. It is time to pivot and embrace the fullest potential of cutting edge advanced materials to achieve sustainable growth. Experience the difference with VSG as your materials solutions partner today.



**VULCAN SHIELD
GLOBAL PTE. LTD.**

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