Thermal Conductivity

The graphical data shown in this leaflet is derived from tests based on ASTM C201 method, which is the recommended test method, for fibrous products by the European Federation of manufactures of refractory products. Non-Air atmospheres can exert a marked influence on the effective conductivity. We therefore recommend influence on the effective conductivity. We there fore recommend that the use of Cerafiber / INDWOOL in special atmospheres is discussed with our sales / application engineers.

An interesting feature is the trend of decreasing conductivity with increasing fibre density for the same grade of ceramic fibre. This holds up to a density of about 300 kg/m^3, remaining constant to around 400 kg/m^3. The explanation lies in the fact that measured values are total conductivities representing the combined heat transfer from radiation, convection, and conduction (of fibre and air) through the highly porous material. The relative importance of individual modes varies both with temperature and fibre density.

Continuous Service Ratings

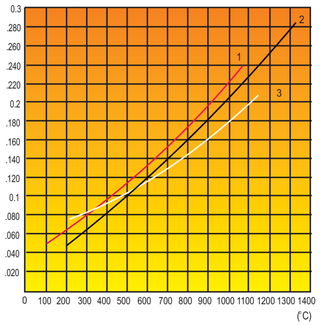
The normal continuous service temperatures are approximately 100 °C below classification temperature in air or oxidising atmospheres and approximately 200 °C lower in highly reducing atmospheres. However, the upper temperature limit depends on requirements of specific applications. Practical experience is likely to provide the final recommendation. The figures quoted as continuous service temperatures are given as a guide, taking into account likely changes in properties such as resiliency and shrinkage, resulting from diversification on the individual fibres.

Our sales/applications engineers will be glad to advise in specific cases.

Thermal Conductivity

(Based on ASTM C 201 - the 1978 PRE recommended method)

(W/mK)



1.Blanket(Standard) 128 Kg/m^3 2.Blanket (Zirconia) 128 Kg/m^3

3.Board and Shapes 1260

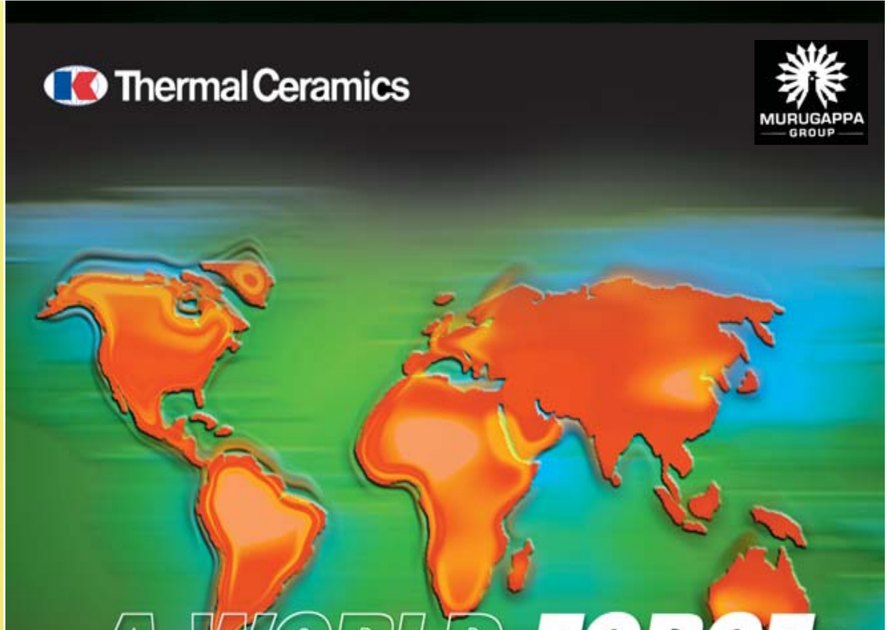
For data on Cerablanket and Cerachem blanket, refer to product information sheet

What MMTCL can offer you

- Energy savings solutions for your specific thermal management problems.
- A range of options in ceramic fibre insulation product forms, dimensions, and properties.
- Custom built modules and vacuum formed shapes.
- A range of accessories-Metallic anchors, ceramic cup locks, mastics and cements, to provide a total product package for your furnace linings. Advisory service on anchors selection.
- Passive fire protection systems for ducts, cables, steel structures, marine applications, and buildings.
- Heat transfer calculations and lining designs to provide cost effective furnace linings.
- Application engineering services to customise products to your needs.
- Product application support and installation supervision, to ensure quality in furnace lining.

Thermal Ceramics

MURUGAPPA GROUP



Morgan
Thermal Ceramics

MMTCL

Murugappa Morgan Thermal Ceramics Ltd. (MMTCL) pioneered the manufacture and marketing of ceramic fibre products in India, since 1984, with INDWOOL ceramic fibre, made by 'BLOWN' process. Over the years, MMTCL has added new products, developed new applications, and expanded usage of ceramic fibre products within and outside India.

By commissioning a new plant in 1996 to manufacture internationally known Cerablankets, MMTCL has joined few companies worldwide producing both BLOWN and SPUN Ceramic fibre products.

With state of the art manufacturing facilities and vast experience in providing energy savings solutions to process industries, MMTCL is the acknowledged leader in thermal insulation products in India.

MMTCL is a joint venture company between Thermal Ceramics Division of Morgan Crucible Co. plc., UK and Carborundum Universal Ltd., of Murugappa Group, India. Thermal Ceramics Worldwide – world leaders in ceramic fibre and other insulating products, have manufacturing plants in 21 countries. With a clutch of global brand names – Kaowool, Cerablanket, Z-Bloc, Plyro-Bloc, JM and K insulating fire bricks, they are in the forefront of new product and technology development in refractory insulating products.

Cerafiber and INDWOOL

Ceramic fibre is an asbestos free spun or blown alumino-silicate fibre made from blends of high purity alumina, and silica. A unique combination of physical and refractory properties makes this an outstanding material for use in high temperature applications. The basic fibre, which is white and non-crystalline, can be converted into a wide range of product forms to suit many different applications throughout the broad spectrum of industry particularly where not processes are involved.

Classification Temperature

Cerafiber / Standard - 1260°C

Cerachem fiber / Zirconia - 1425 °C

Key Properties

Key Properties of all Cerafiber, Cerablankets and INDWOOL products are

- Very low thermal conductivity – about one third that of insulating refractory bricks, meaning thin but effective insulation.
- Extremely low heat storage due to low density. In furnace applications this means faster heat up and cool down times, hence higher productivity and fuel savings.
  Light weight – one sixth the weight of insulating bricks. Furnace steel structure is hence much lighter, and costs less.
- Easy to install and maintain, saves time.
- Resistant to thermal shock. No matter how fast they are heated or cooled, the product forms will not crack or spall.

Good acoustic properties enable Cerafiber and INDWOOL to be used for noise reduction in high temperature environments. An attendant benefit is vibration reduction.

Cerafiber / INDWOOL is chemically pure, and has very low chloride content, special handling techniques can be employed to further limit leachable chloride levels to less than 10 ppm, for use in contact with stainless steel in special applications.

Cerafiber and INDWOOL are completely inorganic and binder free Bulk fiber, blanket and moist felt, are therefore incombustible. Vacuum formed products contain a small quantity of temporary inorganic binder which burns off in service.

Chemical Properties

Cerafiber and INDWOOL are resistant to chemical attack except by hydroflouric and phosphoric acids and strong alkalies. The high chemical purity of Cerafiber / INDWOOL products allows them to be used for controlled chloride content applications such as in fertilizer plants. Against special orders, MMTCL can supply blankets with less than 5 ppm chloride levels.

Typical Properties

CERAFIBER	Cera Grade	Cerachem Grade
Classfication temp.	1260°C	1425°C
Continuous maximum * operating temp.	1175°C	1325°C
Fibre Diameter (Arthmetic mean)	3 - 4 microns	3 - 4 microns
Specific Heat Capacity KJ/KGK at 1090°C	1.13	1.13
Tensile Strength (Kpa) (for 128 Kg/M³blanket)	60 min.	60 min.
Linear shrinkage (% after 24 hrs firing)	3% max at 1200°C	3.5% max at 1400°C
Leachable Chloride Content	< 10 ppm	< 10 ppm
INDWOOL	Standard Fibre	Zirconia Fibre
Classification temp.	1260°C	1425°C
Continuous maximum * operating temp.	1175°C	1325°C
Fibre Diameter (Arthmetic mean)	1.5 - 3.0 microns	1.5 - 3.0 microns
Specific Heat Capacity * (kj/kg°K at 980°C)	1.07	1.07
Tensile Strength (kpa) (for 128 kg/m³ blanket)	30 min	30 min
Linear shrinkage (% after 24 hrs firing)	lessthan 3.2 at 1200°C	less than 3.5 at 1400°C
Leachable Chloride Content	< 10 ppm	< 10 ppm

Chemical Analysis - CERAFIBER & INDWOOL

	Cerafiber	INDWOOL Standard
Al_2O_3	42-46%	43-47%
SiO_2	54-58%	53-57%
Others	Traces	Traces
	Cerachem	INDWOOL Zirconia
Al_2O_3	33-37%	32-36%
SiO_2	48-52%	44-48%
ZrO_2	13-17%	16.5-19.5%
Others	Traces	Traces

Data derived from average results of tests conducted under standard procedures subject to variation, and should not be used for specification purposes.

For data on all the above products, please refer to product information sheet.

* Varies with the applications. For details, please contact MMTCL office

	PRODUCTS	GRADES	CLASSIFICATION Temperature (°C)	THICKNESS (mm)	DIMENSIONS (mm)	DENSITY (kg/m³)	THERMAL CONDUCTIVITY (W/mK) (at mean temperature of 600 °C depending on density)	APPLICATION AREAS (More information is available in product data sheets and application sheets)
	BULK FIBRE	(1) Cerafiber, Standard (2) Cerachem Fiber, Zirconia	(1) 1260 (2) 1425	N.A.	N.A.	N.A.	N.A.	Expansion joints, packing & sealing, fillers for other materials, secondary processing to vacuum formed products.
	INDWOOL BLANKET	(1) Standard, (2) Zirconia	(1) 1260 (2) 1425	(1) 12 & 25 (2) 12 & 25 Other thickness such as 6, 38, 50 etc. on request	(1) & (2) 610 x 7300 – Roll size, Other sizes on request	(1) 64, 96 & 128 (2) 96 & 128 160 on request	(1) 0.126 - 128 kg/m³ (2) 0.130 - 128 kg/m³	Furnace, Kiln and Heater, Low Thermal Mass linings for fuel savings, easy installation and maintenance benefits. High temperature pipe-wrap applications. Passive fire protection and high temperature acoustic installation. INDWOOL Firemaster – 'UL' registered & 'CBRI' approved for Cable tray, Structural Steel, Pipe, Duct, Deck & Bulkhead Fire protection.
	CERABLANKETS / CERACHEM BLANKETS	(1) Cera (2) Cerachem	(1) 1260 (2) 1425	(1) 13,25, 38, 50 (2) 13,25, 38, 50 Other thickness on request	(1) & (2) 610 x 7300 – Roll size. Other sizes on request	(1) & (2) 96, 128 Other densities on request	(1) 0.150 - 128 kg/m³ (2) 0.150 - 128 kg/m³	Furnace, Kiln, Fired Heaters, Hydrogen Reformer linings, Also insulation of Steam and Gas Turbines, Investment casting moulds, reusable insulation for field stress relieving, fire protection and acoustic insulation at high temperatures.
	SABER BLOCS/ PYROFOLD/ Z-BLOK MODULES	(1) Cera, Standard (2) Cerachem, Zirconia	(1) 1260 (2) 1425	(1) 150, 200, 250, 300 (2) 200, 250, 300 Other thickness on request	(1) & (2) 305 x 305	(1) & (2) 128, 160, 190	(1) 0.149 (2) 0.139	High Temperature Furnace, Kiln and Heater linings where modular construction is preferred. Quick installation and easy maintenance are the advantages of using modules.
	VENEERING MODULES	(1) Cera (2) Cerachem	(1) 1260 (2) 1425 (3) 1500 & 1600 on request	(1) & (2) 50 Other thickness on request	(1) & (2) 300 x 300 Other sizes on request	(1) & (2) 160		Hot face veneering for existing furnaces, kilns and heaters where the lining is in a reasonably good condition and does not require immediate replacement. Veneering offers reduction in heat loss, leading to fuel savings. Further, the life of refractory lining is extended due to protection offered by ceramic fibre.
	MOIST FELT	(1) Standard	(1) 1260	6, 12	610 x 915 Other sizes on request	Wet – Min 900 Dry – Min 386		Hot face layers where gas velocities are encountered in furnaces, heaters and kilns, Launder linings in aluminum plants. Hot face linings in duct work carrying gases. Note: The product has a normal shelf life of 6 months if not exposed to atmosphere, and is therefore supplied in airtight packing.
	BOARDS & SHAPES	(1) 1260 (2) "Strong" (3) 1400 (4) 1600 (5) HS – 45 (6) SS 800	(1) 1260 (2) 1260 (3) 1400 (4) 1600 (5) 1260 (6) 1260	(1) 5,10, 15, 20, 25, 38 & 50 (2) 5,10, 15, 20, 25, 38 & 50 (3) 5,10, 15, 20, 25, 38 & 50 (4) 15, 25 (5) 5,10, 15, 20, 25, 38 & 50 (6) 5,10, 15, 20, 25, 38 & 50 Other sizes on request	500 x 1000, 600 x 1000 Other sizes on request	(1) 260 (2) 330 (3) 230 (4) 200 (5) 720 (6) 800 Above densities are minimum	(1) 0.113 (2) 0.125 (3) 0.102 (4) 0.079 (5) 0.147 (6) 0.147	Hot face linings in laboratory type and other small Furnaces & Kilns. Hot face linings of LTM Kiln cars. Combustion chamber linings. Molten aluminum handling applications. Back up insulation in glass tanks, aluminum furnaces and ceramic kilns. Backup installation in steel ladles.
	TEXTILES	(1) Fiber Glass Reinforced (2) S.S. wire Reinforced	(1) 1260 (2) 1260	Cloth – 2, 3 mm. Rope is available in diameters 6, 12, 19, 25, 38 & 50. Other diameters on request. Tape – 3mm. Available in 25, 50, 75, 100, 125, 150 mm width. Other widths on request.	Cloth – 1 mtr. Wide, 10 mtr. long. Rope & Tape – 25 mtr. Coils.	Cloth & Tape 1.1 kg/m² - Rope 330 kg/ Depending on diameter		Cloth is used as thermal curtains, welding curtains, Tape and rope are used for inspection door seals, gaskets, flange seals, expansion joints, pipe lagging, cable protection, Gas turbine insulation.
	PAPER	(1) Cerafiber, Standard (2) Cerachemfiber, Zirconia	(1) 1260 (2) 1400 (3) 1600 on request	(1) 3, 5, 6, 8, 10 (2) 3, 5, 6, 8, 10 (3) On special request (4) Lower thickness available on specific request.	500 x 1000 1000 x 1000 Other sizes on specific request.	Min 150		Gaskets. Induction furnace coil back-up insulation. Thermocouple insulation and packing. Replacement for asbestos paper. Ceramic Ferrule separator.
	1. VENEERING CEMENT 2. MASTIC		(1) 1450 C	(1) & (2) Supplied in 5, 10, 25 & 50 kgs		(1) Wet – Min 1500, Dry – Min 386 (2) Wet – Min 1300, Dry - Min 700		(1) Bonding Ceramic Fibre modules with the existing refractory linings (2) Expansion joints packing & seating and cuplock filing Note: The product has a normal shelf life of 6 months if not exposed to atmosphere