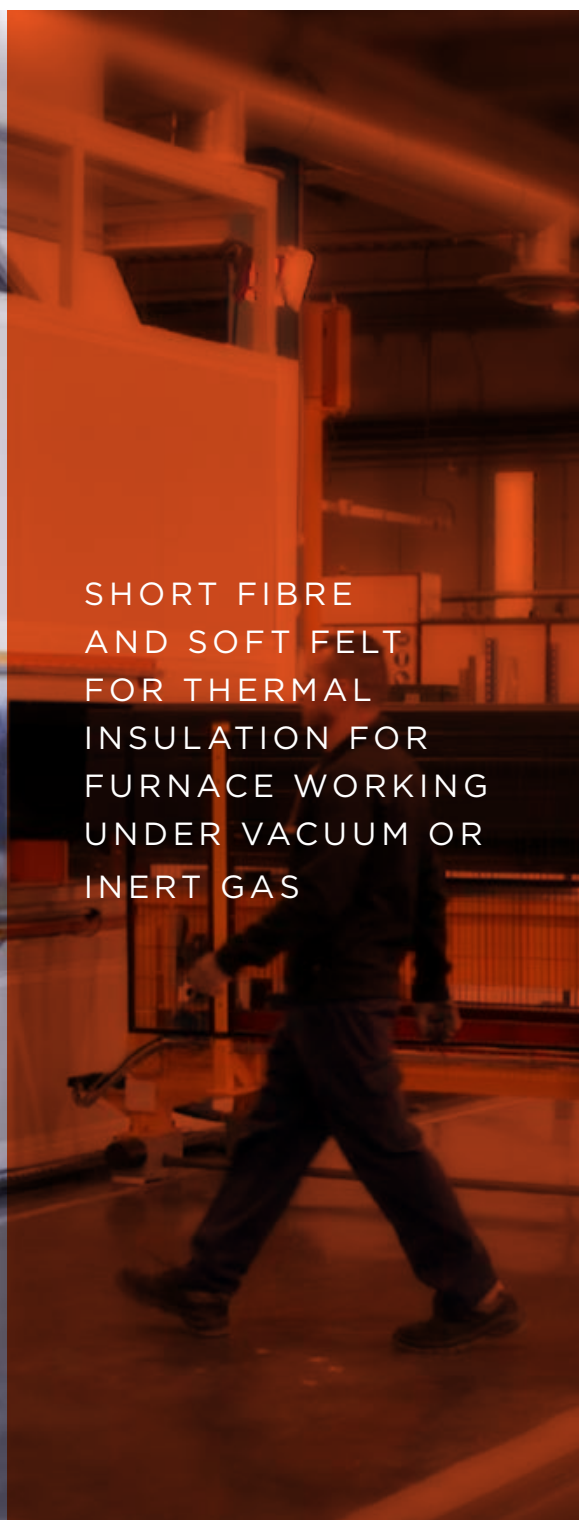
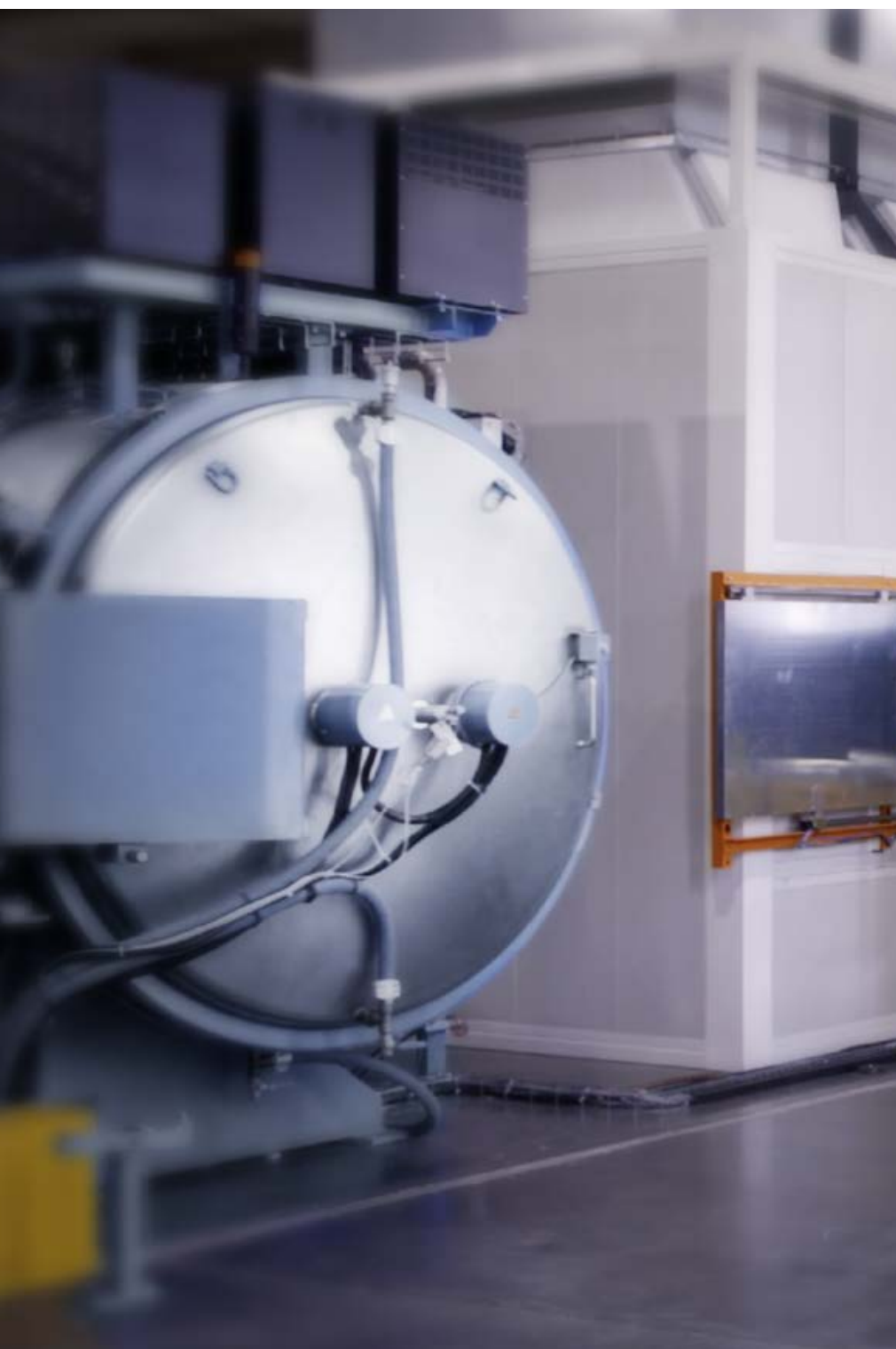




TECHNICAL GUIDE

SHORT FIBRE RIGID INSULATION AND SOFT FELT



SHORT FIBRE
AND SOFT FELT
FOR THERMAL
INSULATION FOR
FURNACE WORKING
UNDER VACUUM OR
INERT GAS



THE RIGHT ENGINEERED
SOLUTION ADAPTED TO
YOUR NEED CAN HELP
YOU TO IMPROVE THE
PERFORMANCE OF YOUR
PROCESS





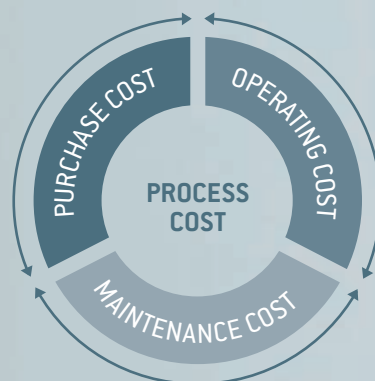
KEY CONCEPTS ON THERMAL INSULATION FOR INDUSTRIAL FURNACES

- Energy savings with faster heat-up processes
- Pollution reduction (by lowering exhaust volumes, lower NOx)
- Increased productivity with shorter running times and no outgassing
- Enhanced heat-treatment process with temperature uniformity – consistent quality within the batch
- Low impurity levels when the process requires it
- Extended service life impacting favorably maintenance spendings and downtime

IN THE HEART OF YOUR PROCESS

High energy consumption, thermal instability impacting production quality, insulation premature wear out, long downtime are factors impacting your performance.

Check out how Mersen can help you.



01

CALCARB® CBCF ENGINEERED SOLUTIONS

Calcarb® insulation enables the perfect protection and regulation for very high-temperature furnaces from 1000°C up to 3000°C. As an expert in composite, graphite refractory materials and high-temperature insulation, Mersen sells “machined to design” solutions, giving turnkey services capability.



EASY TO ASSEMBLE :

Calcarb® CBCF is delivered ready to be mounted and machined to the dimension of your installation. Save time with Calcarb® CBCF solutions.



Calcarb® CBCF (Carbon Bonded Carbon Fibre) is a short fibre insulation originating from rayon CBCF is formed from a slurry of carbon fibre and resin, which is moulded into either a board, cylinder or disc form, to produce a 2D planar-random structure composite.

HIGH THERMAL STABILITY

All Calcarb® Insulation materials supplied by Mersen are heat-treated to a minimum temperature of 2000°C and degassed to 10-1 mbar. This eliminates degassing issues and ensures the insulation is thermal stable to the temperature of operation.

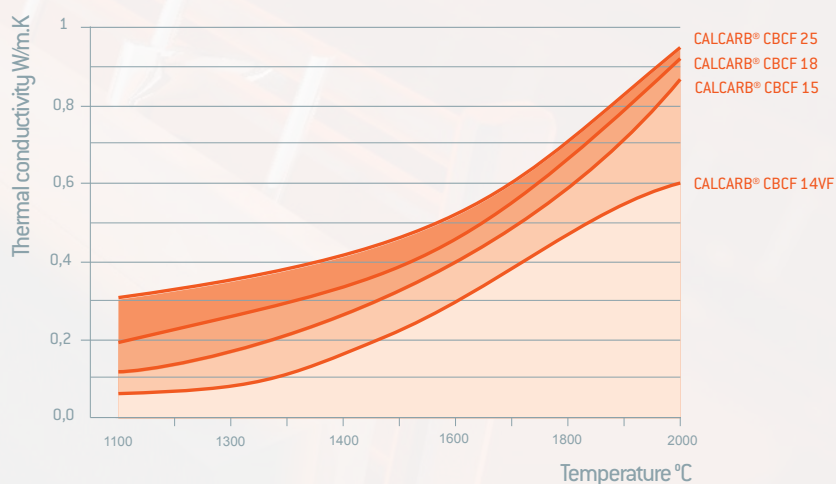
WHEN PURITY MATTERS

Standard CBCF has impurities lower than 50 ppm and can be lowered to below 5 ppm through a purification process when needed.

YOUR BENEFITS

- High thermal stability
- Ease of installation
- Low absorption of gases: decreased evacuation time in vacuum furnaces
- Low coefficient of thermal expansion – high dimensional stability
- Low heat capacity – fast heat up and lower power consumption
- Low thermal conductivity
- No outgassing for faster processes

INSULATION PERFORMANCE* under vacuum

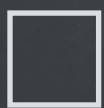


*Thermal conductivity measured with laser flash ; results would be significantly lower with hot plate.

02

CALCARB® CBCF

RIGID CARBON INSULATION
SOLUTIONS FOR SQUARE
AND ROUND HOT ZONES



SQUARED CONSTRUCTION
SOLUTIONS

Calcarb® CBCF boards can be machined to both squared and cylindrical hot zone shapes.



CYLINDER SHAPE SOLUTIONS

Mersen is able to engineer ready to use cylinders based on your process requirement and performance expectations in CBCF or CBCF+soft felt configuration. Foil and coating possible on both sides and in intermediate layer.

Machined to size and customer designs

Uniform insulation properties

Foil and coatings on request for improved performance and life time

From 65 mm to 1600 diameter



CYLINDER CONSTRUCTION SOLUTIONS

Insulation cylinders can either be made as a solid vacuum formed cylinder or as a series of barrel staves.

Machined ready to assemble for an easy setting

Foil and coatings on request for improved performance and life time

Over 1600 mm diameter



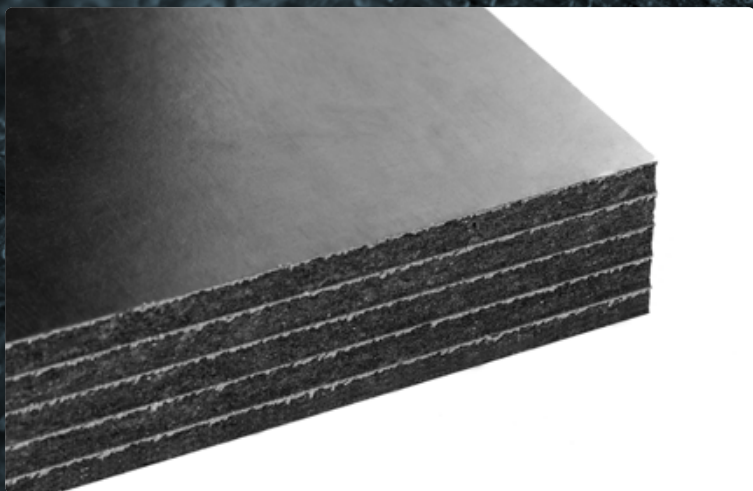
DISK SHAPE SOLUTIONS

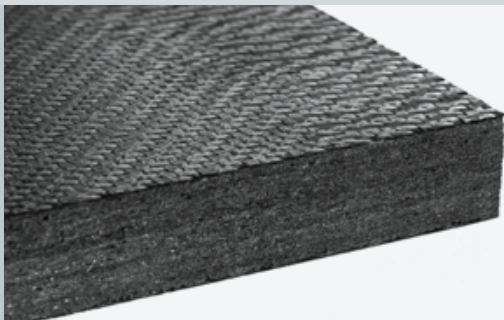
CBCF disks can be machined up to 1854 mm diameter and 254 mm thickness.

03

CALCARB®
CBCF
ENHANCED
SOLUTIONS

MERSEN HAS DEVELOPED A COMPLETE RANGE
OF PROCESSES DESIGNED TO REINFORCE THE
RESISTANCE OF CALCARB® CBCF IN AGGRESSIVE
ENVIRONMENTS

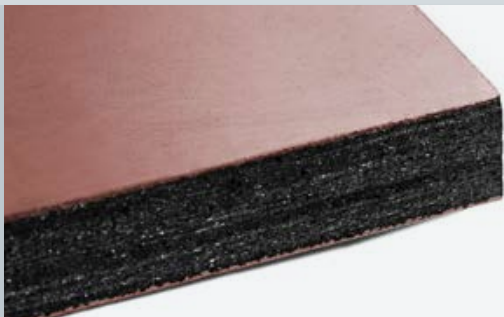




CALCARB® PROTECT

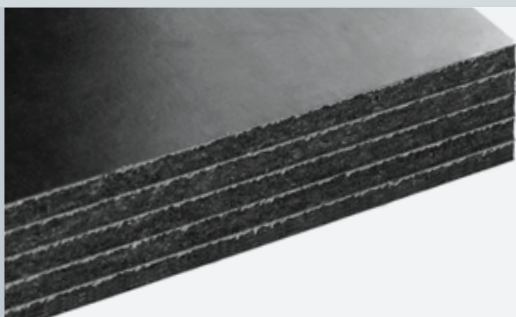
Calcarb® protect is a high purity graphite foil protection that inhibits also dusting, enabling a better temperature uniformity along plane of foil.

High purity long-fibre graphite cloth with foil backing – high fired to provide a flexible CFC shield either as a stand alone or cemented to Calcarb® CBCF.



CALCARB® GRAPHITE PAINT

Calcoat is a standard graphite paint that inhibits dusting by sealing all coated surfaces. It offers a limited erosion resistance.



CALCARB® GRAPHITE FOIL

Provides added spill protection and temperature uniformity along plane of foil. Boards can be foiled one side, two sides or all over.



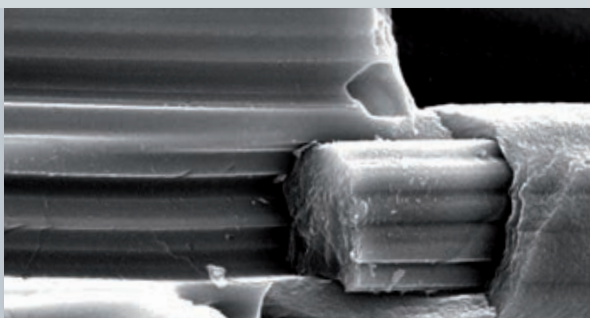
CALCOAT CVD : A PYROCARBON OUTER LAYER

The pyrocarbon outer layer acts as a protection without changing thermal characteristics. It is a dense erosion resistance coating applied by CVD process. Being applied to all finished surfaces of machined parts, it offers beyond the erosion protection, a barrier against impregnation from process vapours.



SILICON CARBIDE (SIC) PROTECTION

In some specific conditions, like hydrogenated atmosphere over 1000°C, carbon fibers are corroded by the medium. As insulation parts are often the critical part of such a process, the silicon carbide infiltration provides an unparalleled advantage, helping to extend insulation service life.



PYROCARBON PROTECTION - CVI

Embedding core fibres into 99.99% pure carbon, the infiltration provides protection in harsh environments with a greater than 50% extended life over standard material.

04

CALCARB® SOFT FELT

Calcarb® soft felt is flexible and easy to cut, making this product easy to adapt with small bend radius possibilities. Soft felt is the ideal solution when vibrations are generated by high gas quenching rates.

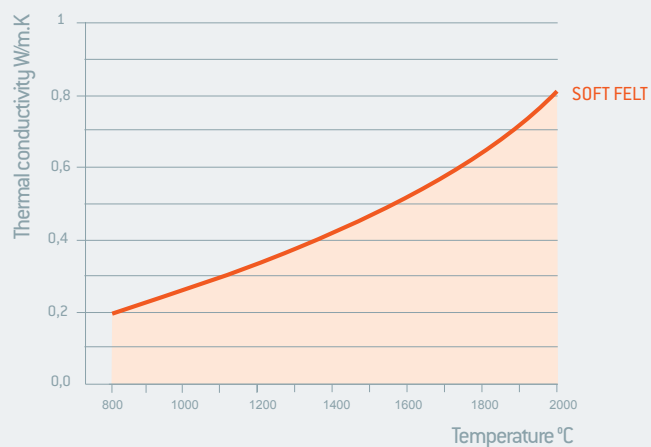


YOUR BENEFITS

- High temperature resistance – up to 3000° C
- High purity
- No electrostatic charging
- Low heat capacity
- Very low thermal conductivity
- Highly flexible

Soft felt can also be combined with rigid insulation for an improved insulation performance.

INSULATION PERFORMANCE* under vacuum



*Thermal conductivity measured with laser flash ; results would be significantly lower with hot plate.

	CBCF 14VF		CBCF 15		CBCF 18		CBCF 25		SOFT FELT	
	BOARD / DISK AND CYLINDER		BOARD /DISK AND CYLINDER		BOARD / DISK AND CYLINDER		BOARD AND DISK			
BULK DENSITY g.cm ³	0,14		0,15		0,18		0,25		BULK DENSITY g.cm ³	0,075 ± 0,01
COMPRESSIVE STRENGTH MPa	1,09		0,80		1,10		2,10		TENSILE STRENGTH MPa	0,051
FLEXURAL STRENGTH MPa	1,65		1,50		1,03		2,70		MODULUS OF ELASTICITY GPa	0,558
COEFFICIENT OF THERMAL EXPANSION 25° TO 1000°C 1000° TO 2000°C	3,0 +/- 0,2 X 10 ⁻⁶ 2,6 +/- 0,2 X 10 ⁻⁶		3,0 +/- 0,2 X 10 ⁻⁶ 2,6 +/- 0,2 X 10 ⁻⁶		3,0 +/- 0,2 X 10 ⁻⁶ 2,6 +/- 0,2 X 10 ⁻⁶		3,0 +/- 0,2 X 10 ⁻⁶ 2,6 +/- 0,2 X 10 ⁻⁶		IMPURITY ppm	< 400
SPECIFIC SURFACE AREAS - m ² .g ⁻¹	22		20		18		11		ASH CONTENT	< 0,06 %
ELECTRICAL RESISTIVITY PARALLEL TO FIBRE ORIENTATION (xy) PERPENDICULAR TO FIBRE ORIENTATION (z)	12,5 X 10 ⁻⁴ 52,1 X 10 ⁻⁴		25,0 X 10 ⁻⁴ 74,0 X 10 ⁻⁴		11,0 X 10 ⁻⁴ 40,7 X 10 ⁻⁴		5,90 X 10 ⁻⁴ 15,93 X 10 ⁻⁴		MINIMUM PROCESS TEMPERATURE	2 000° C
THERMAL CONDUCTIVITY* W/m.K	VACUUM	NITROGEN	VACUUM	NITROGEN	VACUUM	NITROGEN	VACUUM	NITROGEN	CARBON CONTENT (ESTIMATED)	> 99,94 %
400°C	0,05	0,09	0,113	0,159	0,175	0,224	0,298	0,325	SPECIFIC SURFACE AREA	tbd
800°C	0,12	0,19	0,163	0,237	0,22	0,317	0,381	0,415	SPECIFIC HEAT kJ/kg.°C	1,93 at 1 000° C
1200°C	0,255	0,378	0,295	0,409	0,329	0,485	0,48	0,531	THERMAL CONDUCTIVITY* W/m.K	VACUUM
1600°C	0,448	0,579	0,519	0,689	0,551	0,724	0,642	0,723	800°C	0,207
2000°C	0,611	0,878	0,847	1,041	0,911	1,170	0,925	1,080	1000°C	0,257
BOARD SIZE (MAX)	1500 x 1500 mm		1500 x 1500 mm		1500 x 1500 mm		1500 x 1500 mm		1200°C	0,329
BOARD THICKNESS (MAX)	250 mm		250 mm		250 mm		250 mm		1400°C	0,413
DISK DIAMETER	from 635 to 1854 mm		from 635 to 1854 mm		from 635 to 1854 mm		from 635 to 1854 mm		1600°C	0,524
DISK THICKNESS (MAX)	406 mm in diam 635 mm 254 mm in diam 1752 mm		406 mm in diam 635 mm 254 mm in diam 1752 mm		406 mm in diam 635 mm 254 mm in diam 1752 mm		406 mm in diam 635 mm 254 mm in diam 1752 mm		1800°C	0,657
CYLINDER OD (MAX)	1651 mm		1100 mm		1651 mm		N/A		2000°C	0,812
CYLINDER MAX HEIGHT	350 mm		500 mm		880 mm				THICKNESS	6 – 8 – 10 – 12 mm
MAX WALL THICKNESS	40 mm		55 mm above 600 mm diam		55 mm					
PRODUCT ENHANCEMENT	CVI – Pyrocarbon CVD coating CALCOAT paint CALFOIL Calcarb® protect		CVI – Pyrocarbon CVD coating CALCOAT paint CALFOIL Calcarb® protect		CVI – Pyrocarbon CVD coating CALCOAT paint CALFOIL Calcarb® protect		CVI – Pyrocarbon CVD coating CALCOAT paint CALFOIL Calcarb® protect			

Thermal conductivity measured with laser flash ; results would be significantly lower with hot plate.



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Argentina, Chile

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Spain, Turkey, South Africa

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