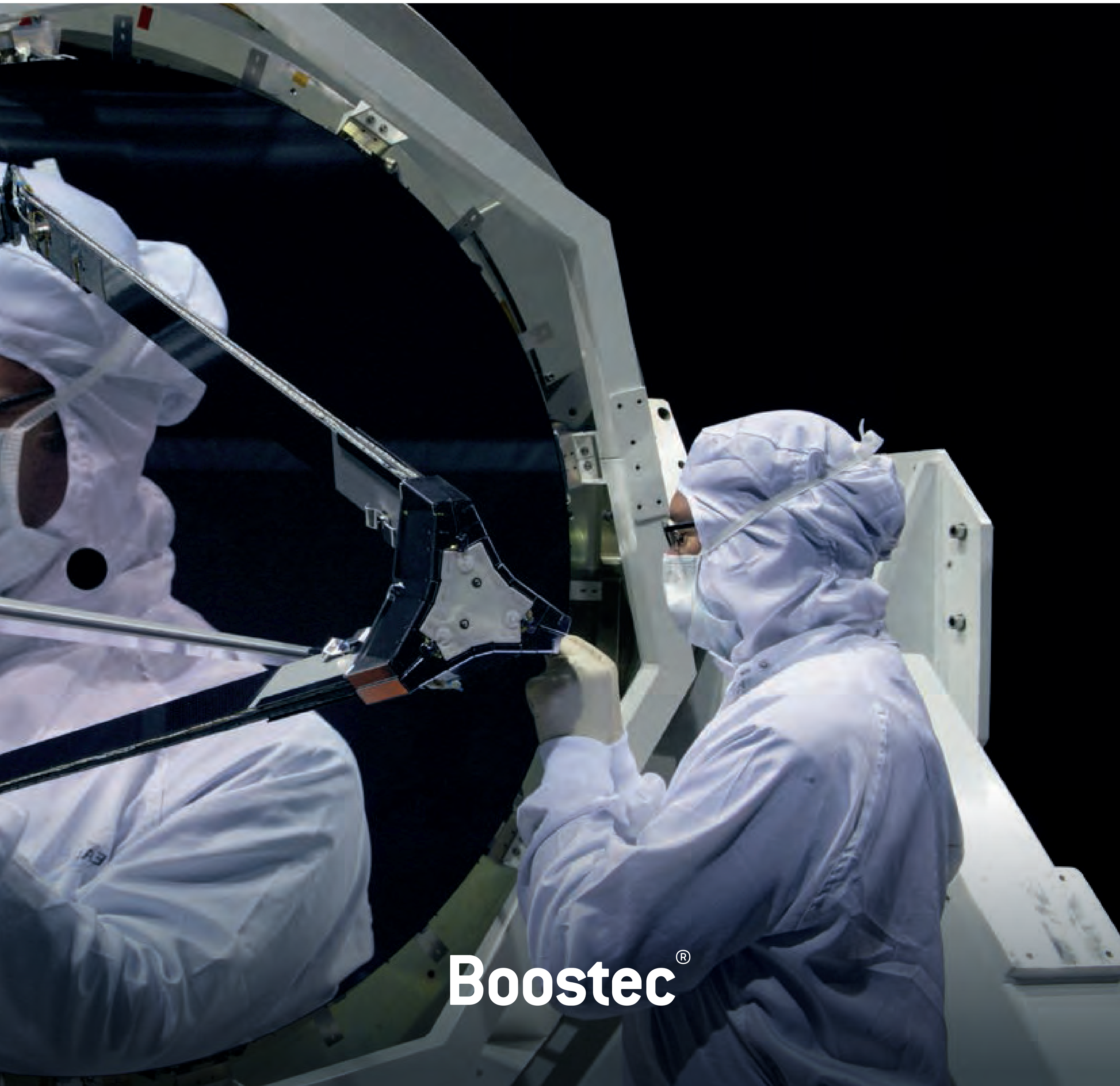
Expertise, our source of energy

BOOSTEC® SiC
SILICON CARBIDE MATERIAL

SOLUTIONS FOR SPACE, ASTRONOMY, LASERS PROCESSES, SEMICONDUCTOR & OPTO-MECHANICS OEMS AND CHEMICAL INDUSTRIES



BOOSTEC® SiC
An outstanding material

Boostec®SiC is a polycrystalline technical ceramic of α SiC type, obtained by pressureless sintering. This process leads to a silicon carbide that is completely free of non-combined silicon.

Did you Know ?

- The very strong covalent Si-C bond gives Boostec® SiC exceptional physical properties that are particularly reproducible and stable over time,
- Unlike glasses, glass-ceramics and oxide ceramics, Boostec®SiC does not present a phenomenon of sub-critical cracking.
- Unlike toughened ceramics (silicon nitride, stabilised zirconia), Boostec®SiC shows no sensitivity to mechanical fatigue.
- Boostec®SiC mechanical properties (bending strength, modulus of elasticity, toughness) hardly change with temperature, from cryogenic environments close to absolute zero up to 1450 °C.
- Boostec® SiC is a non-magnetic material.
- Boostec® SiC is an excellent radio-frequency (RF) absorber.

Extended design know-how and capabilities

Mersen Boostec offers assistance to its customers for the design of their SiC parts to ensure better feasibility, mitigate risks and also reduce costs and lead times

BOOSTEC MANUFACTURING EXPERTISE

From the manufacturing of monolithic ceramics to the production of complex solutions, Mersen Boostec has developed over the years a unique expertise.

	CAPACITY
MONOLITHIC CERAMICS	Ø 1.30m x 0.60m 1.65m x 1.30m x0.60m
CVD SIC COATING	up to Ø 1.50 m
BRAZED SIC/SIC	up to Ø 3.50 m
OPTICAL POLISHING	

	AVAILABLE ASSEMBLIES
OTHER SiC/SiC OR SiC/METAL SOLUTIONS	Epoxy gluing Bolting Shrink fitting

01

SPACE & ASTRONOMY

Mersen Boostec provides SiC mirrors, SiC stable structures and also SiC focal plane hardware for telescopes to be used in space or on ground.

Application requests

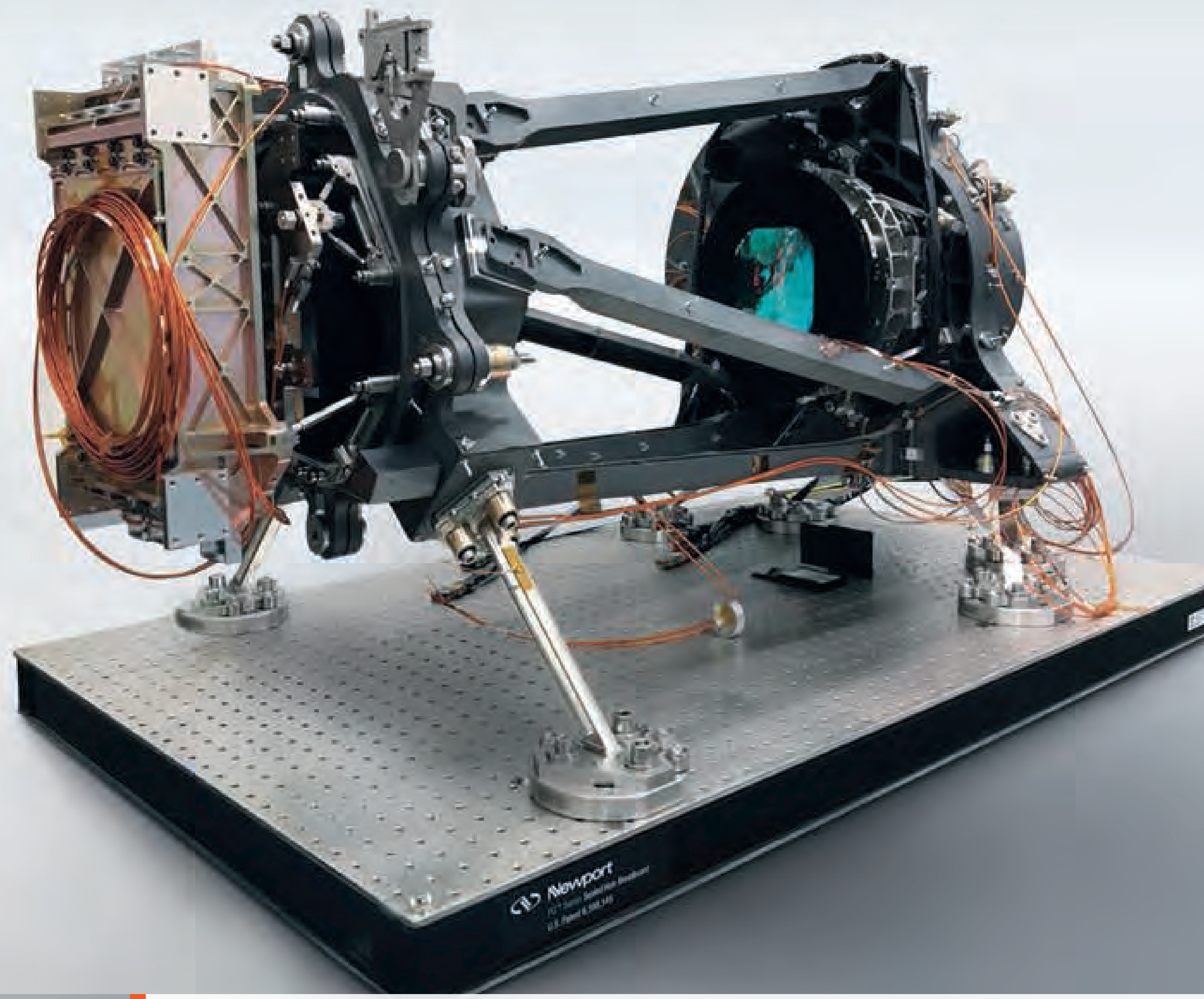
mechanical and thermal ultra-stable optics

ESO ELT - image courtesy of ESO

BOOSTEC® SiC SOLUTION

- High specific stiffness
- High thermal stability
- Qualification for space applications down to 30 K

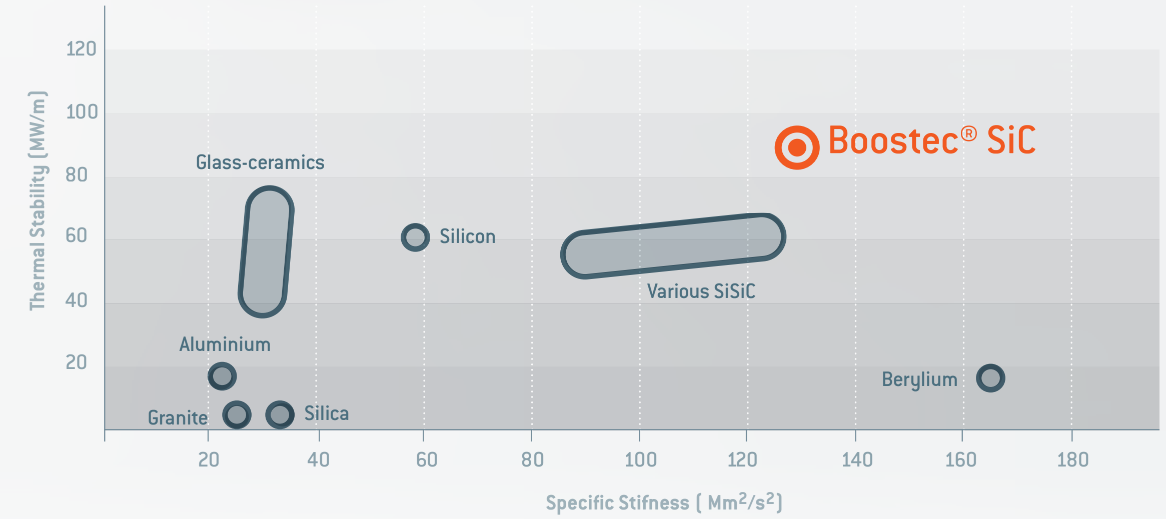
WITH ITS AIRBUS DEFENCE AND SPACE PARTNERSHIP, MERSEN BOOSTEC IS THE WORLD LEADER FOR SiC SPACE OPTICS.



EUCLID NISP INSTRUMENT - IMAGE COURTESY OF LAM

AMONG OUR SUCCESSES

- HERSCHEL, GAIA AND EUCLID MISSIONS ON UNIVERSE SCIENCES
- SENTINEL-2 AND AEOLUS ESA MISSIONS FOR EARTH OBSERVATIONS
- NIRSPEC LARGE SPECTROGRAPH FOR NASA JAMES WEBB SPACE OBERVATORY
- A WIDE RANGE OF KORSCH TELESCOPES FOR EARTH OBSERVATION AT EXPORT
- ESO EXTREMELY LARGE TELESCOPE: THE REFERENCE STRUCTURE OF ITS M4 ADAPTIVE OPTIC AND ALSO ITS FAST TIP/TILT M5 FOLDING MIRROR



02

LASER PROCESSES

LASER GALVO SCANNING MIRRORS

Mersen Boostec provides standard and custom active mirrors from 10 to 500 mm apertures, with a range of high reflective coatings. In particular, standard generic XY laser galvo-scanning mirrors from 10 to 100 mm aperture are provided in pairs. Glued mounts are also proposed for all standard shaft sizes. These products are distributed under the trademark optoSiC®.

SiC REPLACES BERYLLIUM, WHOSE TOXICITY PROBLEMS ARE WELL KNOWN

KEY ADVANTAGE OF OPTOSIC® OPTICS

- Low moment of inertia
- Low dynamic flatness Peak-to-Valley (PV)
- High resonance frequency
- Fast thermal stabilization
- Lightweight
- Integrated mechanical fasteners
- Standard and custom designs
- Corrosion and wear resistant
- Optically finished to state of the art surface specifications
- Outstanding optical surface quality
- Customized coating service

MARKET SEGMENTS FOR OPTOSIC® HIGH-END SCANNING MIRRORS

LASER FOR MATERIAL PROCESSING

- Welding
- Cutting, Drilling
- Marking, Microlithography
- Additive manufacturing

LASER FOR INSTRUMENTATION

- Tracker systems
- Scanner systems, Lidars
- Military application
- Biomedical (ophthalmology)
- Imaging, Laser show

03

SEMICONDUCTOR AND OPTO-MECHANICS OEMs

Mersen Boostec provides the silicon carbide ultra-stable structures that are now required by the semi-conductor and optomechanical equipment.

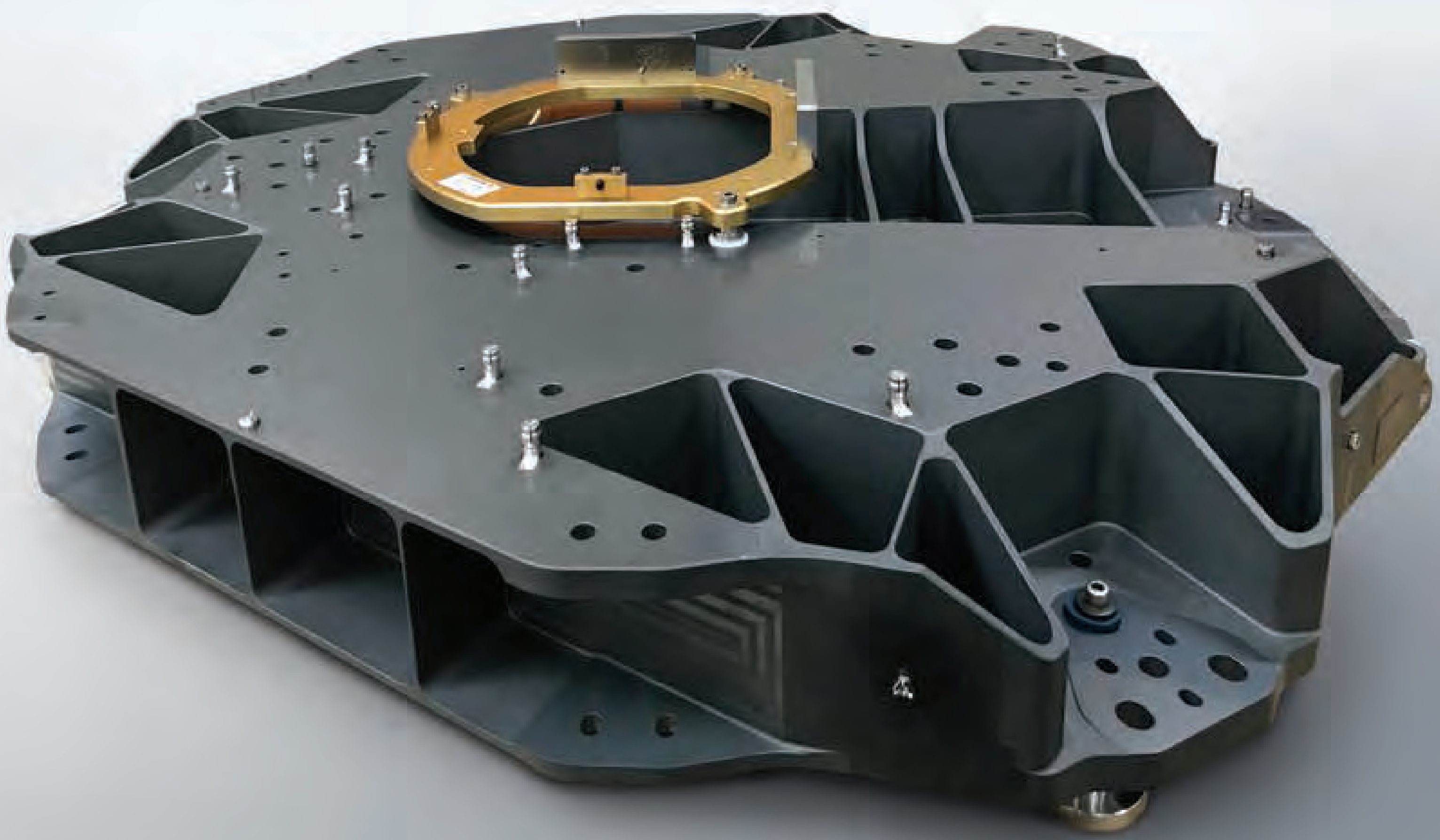
Application requests:

HIGH SPECIFIC STIFFNESS
(Young's modulus / Density)

HIGH THERMAL STABILITY
(Thermal Conductivity / Coefficient of Thermal Expansion)

BOOSTEC® SiC SOLUTION

- High mechanical strength and absence of mechanical fatigue
- Perfect isotropy of the SiC material
- Flawless polishable finish which can be used as optical reference
- Perfect stability over time
- Water and gas tight, no outgassing, no moisture absorption
- Wear resistance
- Excellent chemical inertia



BOOSTEC EXPERTISE IN MANUFACTURING & DESIGN

- Unique experience in manufacturing 3-meter class ultra-stable structures.
- Possibility of integrated solution on a single part: air bearing system, cooling with internal channels, mirror.
- From monolithic SiC parts to possibly complex assemblies, Mersen Boostec manufactures highly stable benches, baseplates, beams, sliding structures for fast and accurate positioning, chucks.

BOOSTEC® SiC SOLUTIONS ARE USED WHERE ULTRA-PRECISION IS REQUIRED, IN:

- Semiconductor industry processes
- EUV lithography machines
- Advanced measuring instruments for optical surfaces
- Ultra-high vacuum
- Scientific equipment

04

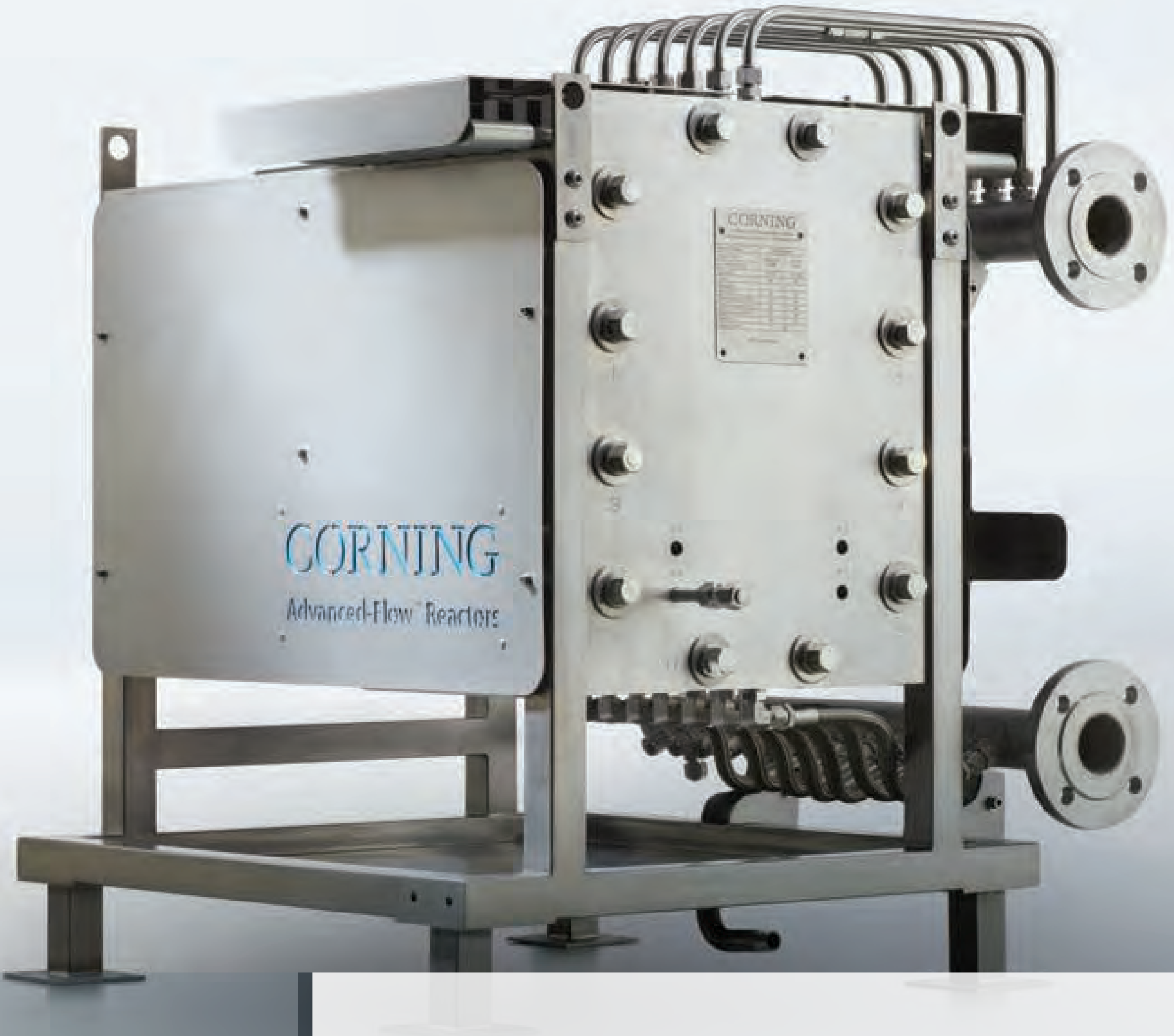
CONTINUOUS FLOW REACTORS FOR THE CHEMICAL INDUSTRY

SiC modules for continuous flow reactor is a technological breakthrough in the chemical industry

Mersen Boostec develops and manufactures high-technology chemical reactors for continuous flow systems in cooperation with Corning SAS.

KEY BENEFITS

- Production steps reduced for higher productivity and increased safety
- Improved chemical reactions
- Smaller footprint than traditional reactors
- Cost competitive solution



CORNING G4 REACTOR - IMAGE COURTESY OF CORNING SAS

TECHNICAL SPECIFICATIONS

- FLOW RATE 2 TO 8000 ml/min
- TEMPERATURE -60°C TO 200°C
- PRESSURE UP TO 18 BAR
- OPTIONS: ATEX CERTIFICATIONS, FDA, CGMP COMPLIANCE

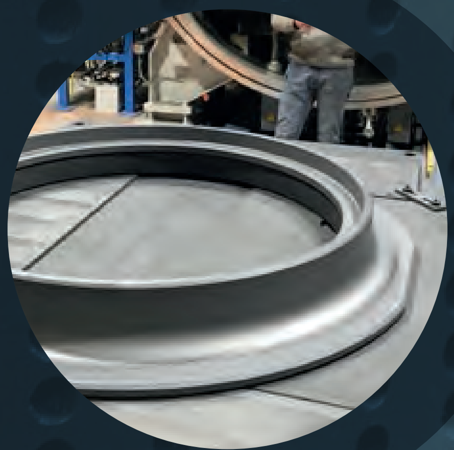
Corning's global team helps customer design systems for a vast array of utilizations including lab applications, pilot processing and industrial production development for current processes and new chemical routes.

05

HEAT EXCHANGERS FOR THE CHEMICAL INDUSTRY

SiC heat exchangers lead to optimized performance and are the first choice for applications in the pharmaceutical and fine chemicals industry.

It is a key solution for processes with high corrosion and for processes with high service rates (less maintenance). SiC heat exchangers are assembled as a stack of single elements which are then inserted into a metallic shell. Seals are placed between the individual blocks.



KEY BENEFITS

- No particle emission, no contamination for high purity applications
- Most compact heat exchanger
- Solution suitable for extreme environment
- Easy maintenance

OTHER EQUIPMENT

- SPECIFIC INJECTION TUBES AND NOZZLES FOR HIGH TEMPERATURE AND HIGH ABRASIVE MEDIA AND PROCESSES
- QUENCH RINGS FOR HIGH TEMPERATURE REACTORS
- SPECIFIC PROTECTION TILES, RINGS AND PARTS

KEY MARKETS FOR BOOSTEC® SiC HEAT EXCHANGERS :

- Hydrofluoric acid, bromine
- Fine chemicals, specialty chemicals, condensers for API
- Enhanced processes
- Abrasive products inside a corrosive stream
- Extreme environment (Temperature, Pressure)
- Flash or forced evaporators, thermosyphons
- Heat recovery units

PROPERTIES BOOSTEC® SILICON CARBIDE

Property		Temperature	Typical value	Unit
Theoritical density		20°C	3.21	10^3 kg/m^3
Bulk density		20°C	3.15	10^3 kg/m^3
Total porosity (fully closed)		20°C	1.5	%
Coeffcient of Thermal Expansion		-200°C	0.08	10^{-6} /°C
		20°C	2.2	10^{-6} /°C
		500°C	4.8	10^{-6} /°C
		1000°C	6.0	10^{-6} /°C
Thermal conductivity		-200°C	163	W/m.K
		20°C	180	W/m.K
		500°C	66	W/m.K
		1000°C	39	W/m.K
Specific heat		-200°C	42	J/kg.K
		20°C	680	J/kg.K
		500°C	1040	J/kg.K
		1000°C	1180	J/kg.K
Maximum thermal shock (ΔTc)			325	°C
Maximum temperature of use	In air		1450	°C
	in inert atmosphere		1800	°C
Vickers hardness (500g load)		20°C	22	GPa
Bending strength (DIN EN 2188-1 & 5)	Mechanical strength	20°C	400	MPa
	Weibull modulus	20°C	11	MPa
Tensile strength		20°C	210	MPa
Compressive strength		20°C	3000	MPa
K_{1C} toughness (SENB method)		20°C	4	MN.m$^{-3/2}$
Young's modulus		-200°C to 1 000°C	420	GPa
Shear modulus		-200°C to 1 000°C	180	GPa
Poisson's ratio		-200°C to 1 000°C	0.16	
Electrical resistivity	– 0,01 V/mm	20°C / 200°C	10^5 / 10^3	Ω.m
	– 100 V/mm	20°C	10^3	Ω.m
Emissivity		-200°C to 300°C	0.7	
Outgassing (ESA EC SS-Q-70-02A)	TML (Total Mass Load)	20°C / 200°C	0. 01	%
	CVCM (Collected Volatile Condensable Materials)		0.0	%

TYPICAL CHEMICAL COMPOSITION

SiC	B	free C	SiO_2	free Si	Fe	Al	Ca	K	Mg	Na
>98,5%	<0,5%	<0,2%	<500 ppm	<500 ppm	<500 ppm	<400 ppm	<30 ppm	<1 ppm	<1 ppm	<1 ppm

Boostec® SiC manufacturing process

MERSEN
Expertise, our source of energy

GLOBAL EXPERT IN ELECTRICAL
POWER AND ADVANCED MATERIALS

AMERICAS

MERSEN USA
Bay City, MI
Greenville, MI
St Marys, PA
Columbia, TN

MERSEN MEXICO
Monterrey

MERSEN ARGENTINA
Buenos Aires

MERSEN CHILE
Santiago

MERSEN COLOMBIA
Bogota

MERSEN BRAZIL
Sao Paulo

EUROPE & AFRICA

MERSEN BENELUX
Schiedam

MERSEN GERMANY
Suhl & Munich

MERSEN FRANCE
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