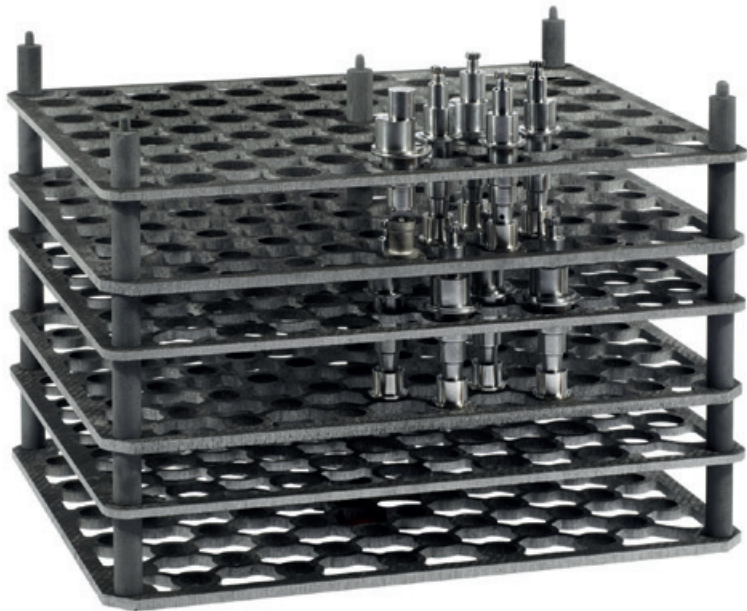
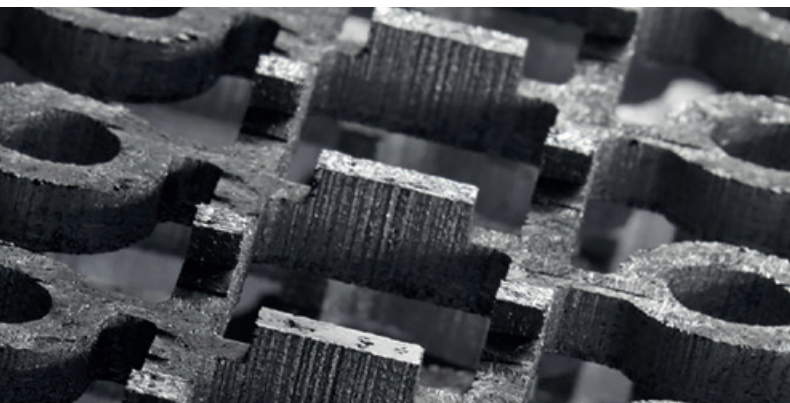


AIRBUS SAFRAN LAUNCHERS

SEPCARB®
3D CARBON/CARBON
COMPOSITE



HEAT TREATMENT
FIXTURES



PRODUCTS
EQUIPMENTS
& SERVICES

OUR DNA

Airbus Safran Launchers was created from the desire of the Airbus and Safran Group to take the European space industry to the highest possible level.

Airbus Safran Launchers develops and supplies innovative and competitive solutions for civil and military space launchers. Prime contractor for the Ariane 5 and Ariane 6 launcher families, as well as for the missiles in the French oceanic deterrent force, the company's expertise encompasses state-of-the-art launch and propulsion system technologies.

Leveraging its core business technologies and competences, Airbus Safran Launchers also offers a wide range of derived products, equipments and services for numerous sectors, such as automobile, aerospace, defense and nuclear engineering.

Airbus Safran Launchers is a joint venture equally owned by Airbus Defence and Space and Safran.

For more than 40 years, Airbus Safran Launchers has developed and manufactured a broad range of high-temperature composite materials for the aerospace, energy, automotive and other industries.

Sepcarb® is our high-performance 3D carbon/carbon composite material. Sepcarb® tooling is used for high-temperature processing of aerospace and automotive components. Over 1000 tons of Sepcarb® are produced annually in European and North American plants.

Sepcarb® is the ideal tooling material for brazing, annealing, carburizing and quenching of high-performance metals in vacuum or inert atmosphere furnaces.

Airbus Safran Launchers is your partner in the design and fabrication of tooling and equipment for high-temperature applications.

Choose Sepcarb® to improve your productivity.

8 000
employees

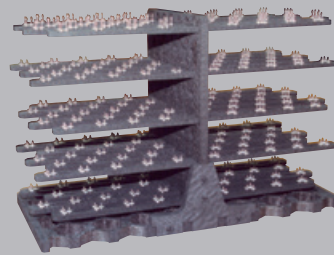
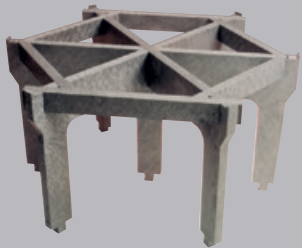
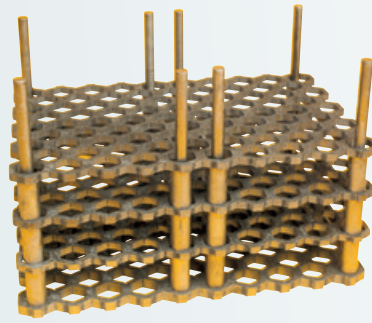
Integrated
network
in France and
in Germany

11 subsidiaries
and affiliates

€2.5bn
estimated sales
in 2016

SEPCARB®

3D CARBON/CARBON
COMPOSITE



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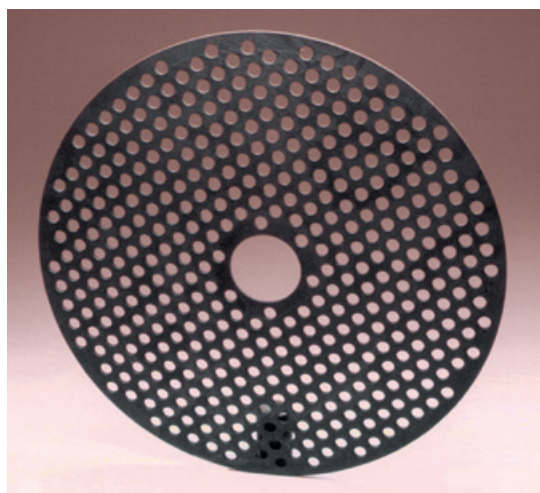
└ THERMAL SOLUTIONS

The exceptional characteristics of Sepcarb® carbon/carbon composite make it the ideal material for tooling used in heat treatment, low-pressure carburizing, annealing and brazing applications of metals.

Sepcarb® significantly outperforms graphite and refractory alloys in these very demanding thermal processes.

SEPCARB® EQUIPMENT PROVIDES THESE MAJOR BENEFITS:

- Higher-efficiency and more secure processing
- Reduction of rejected parts and production quality improvements
- No tooling deformation, allowing robotic automation
- Zero creep, providing extended service life
- High temperature capability, allowing higher processing temperatures and shorter cycle times
- Reduced maintenance costs
- High resistance to fatigue and to mechanical and thermal shock
- Low mass for easier handling
- Low thermal inertia, reducing power consumption and cycle duration, and decreasing production costs
- High resistance to corrosive chemicals
- Large range of dimensions available



One-piece plate up to Ø 2300mm/90"

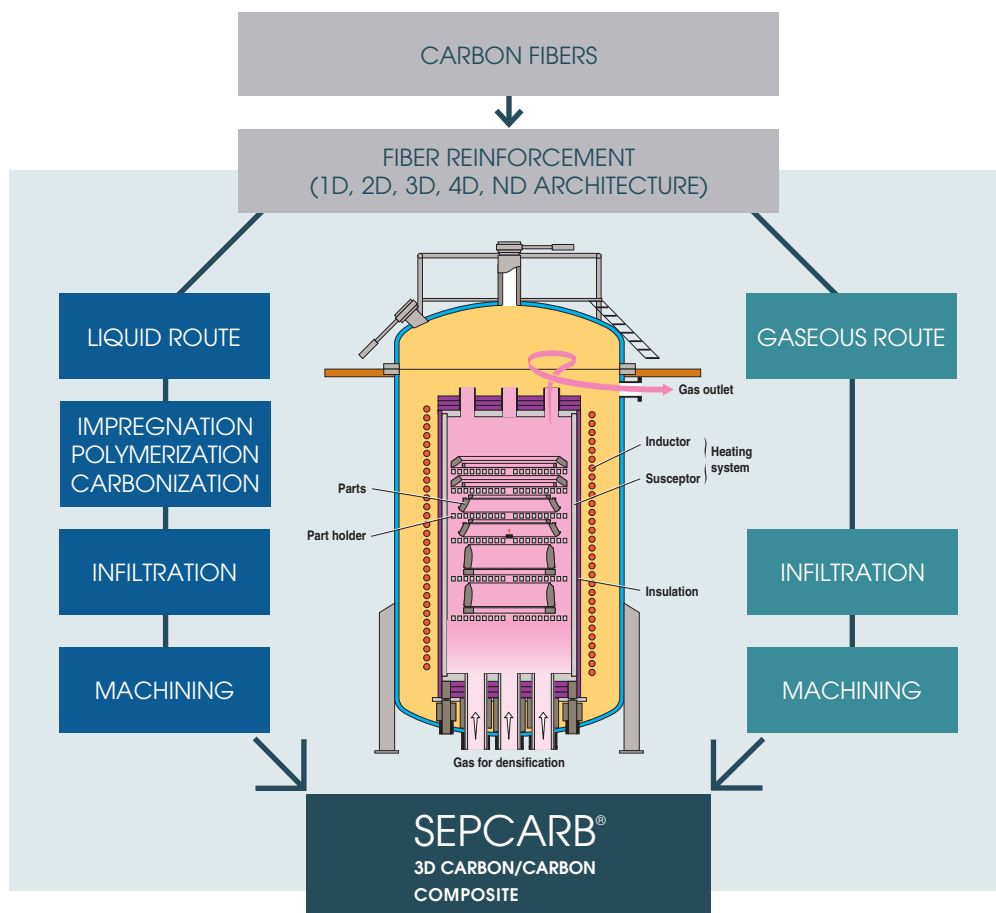
TECHNOLOGY

Sepcarb® is a composite of carbon fibers and a carbon matrix which bonds the fibers together and distributes the load evenly. Both the carbon fibers and the carbon matrix are resistant to extremely high temperatures. The precise distribution and combination of these components provides Sepcarb® with exceptional lightness, outstanding resistance to thermal shock, and stability of mechanical properties at temperatures up to 2700°C. The result is perfectly consistent operational behavior, unmatched reliability and extended service life. These properties make Sepcarb® the ideal tooling material for a very wide range of applications.

In contrast with 2-dimensional (2D) carbon/carbon products, **Sepcarb® H01 is highly delamination-resistant**. This results from its patented 3D architecture, combined with the chemical vapor infiltration (CVI) process used in its manufacture.

The CVI process enables the formation of **an extremely pure and homogeneous carbon matrix** within the fiber architecture. This process yields an optimal matrix-to-fiber cohesion, providing excellent mechanical properties and thermal stability. Materials and parts are manufactured using proven industrial processes. Manufacturing capabilities exceed 2 meters x 3 meters (80" x 120"). A wide variety of geometries can be fabricated including (but not limited to) plates, cylinders, tubes, discs, cones and beams, as well as complex shapes with thicknesses of less than one millimeter to several centimeters.

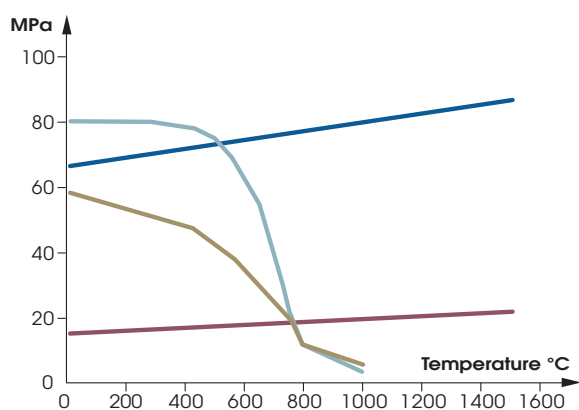
With an average density of 1.5, Sepcarb® is the ideal material for heat treatment fixturing to be used in vacuum and inert atmosphere furnaces operating up to 1300°C (2370° F) or higher.



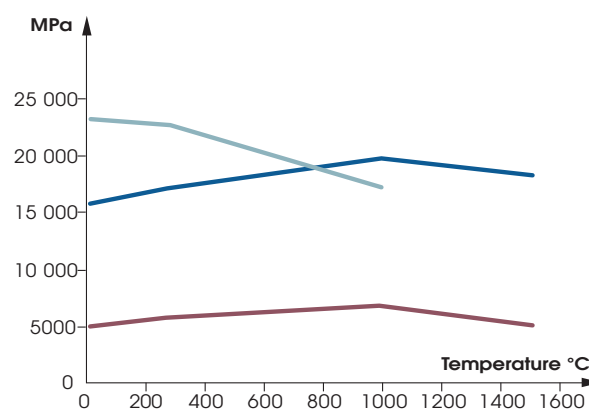
PROPERTIES

- The main properties of Sepcarb® include its exceptionally low density, outstanding resistance to thermal shock and corrosion, stability of mechanical properties at temperatures up to 2700°C (4890° F), high resistance to fatigue and total absence of creep.
- The following tables compare the mechanical properties of Sepcarb® with those of graphite and refractory alloy.

COMPARATIVE TABLE OF SPECIFIC ULTIMATE STRENGTH (ULTIMATE STRENGTH / DENSITY)



COMPARATIVE TABLE OF SPECIFIC YOUNG'S MODULUS (YOUNG'S MODULUS / DENSITY)



— Sepcarb® — Graphite ATJ — ASTM A297-HT — Inconel 600

- The properties of standard-grade Sepcarb® 3D carbon/carbon material are provided below as indicative values.

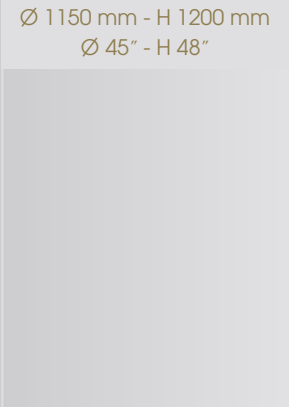
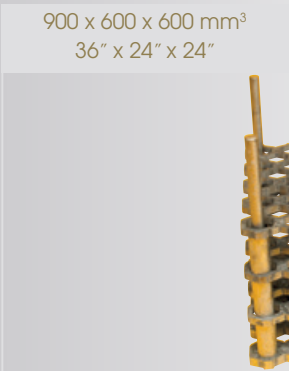
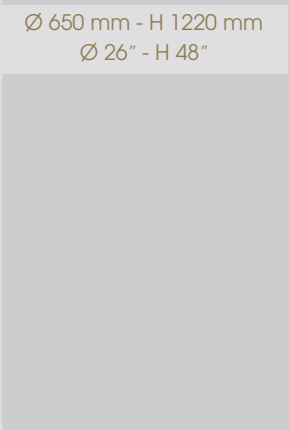
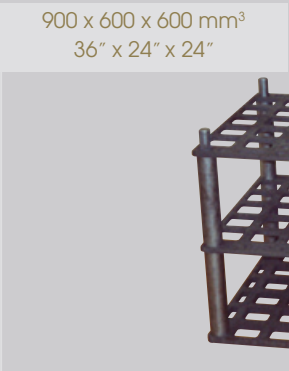
Density		1.5		
Temperature	°C	25	1000	1500
Tensile strength	$\sigma_{t,r}$ (MPa)	100	120	120
	$\epsilon_{t,r}$ (%)	0.6	0.5	0.5
	E_o (GPa)	30	30	30
Interlaminar shear strength	T_r (MPa)	22	30	31
	V (%)	1.3	1.1	1.1
	G (GPa)	5	5	5
Thermal expansion	(%)		0.2	0.3
Heat capacity	(J.Kg ⁻¹ .K ⁻¹)	800	1900	2100

BENEFITS

- The following table provides a qualitative comparison of SepCarb® carbon/carbon, graphite, and refractory alloy. In addition to usage guidelines, the table illustrates the benefits and advantages of carbon/carbon.

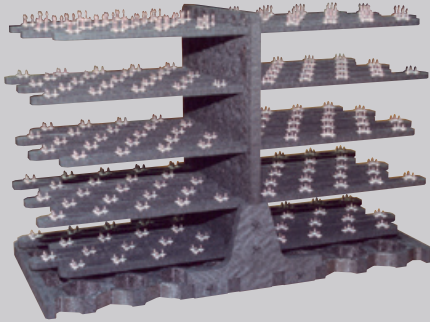
	Sepcarb® carbon/carbon	Graphite	Refractory metal	Carbon/carbon benefit
Weight	Density 1.5	Density 1.8	Density 5 to 10 times higher than c/c	<ul style="list-style-type: none"> - Easy handling, - Increased worker safety, - Easier storage , - Lighter loads yield reduced maintenance costs, less down-time.
Thermal resistance	Excellent	Excellent (but mechanical strength is 4 times less than c/c)	Performance characteristics reduced at 1000°C (1832° F); completely lost above 1100°C (2012° F)	Permits a lighter, more robust design.
Creep	Excellent	Excellent	Poor	No deformation – permits robotic automation of loading / unloading.
Thermal shock resistance	Excellent	Fair	Poor	Stands up to shorter heat/quench cycles; increases productivity.
Mechanical shock resistance	Very Good	Very Poor	Excellent	Due to its composite make-up, c/c is not brittle (as are graphite and ceramic). It is therefore very suitable for intensive use.
Energy saving	Excellent	Fair	Poor	Carbon/carbon fixturing has much less thermal inertia than graphite and metal. Up to 3 times less energy is required for heating. Heating and cooling cycles are shortened.
Safety	Excellent	Fair to Poor	Fair to Poor	Lighter carbon/carbon fixturing makes handling easier, faster and safer.
Protecting the environment	Excellent	Poor	Poor	Less energy used = reduced environmental impact.

HEAT TREATMENT FIXTURES

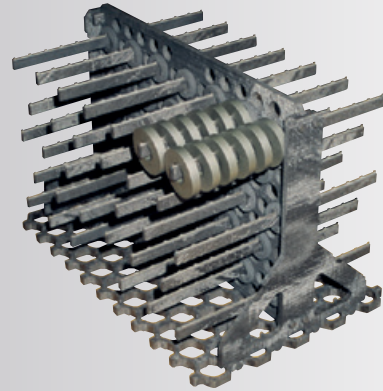


CARBURIZING FIXTURES

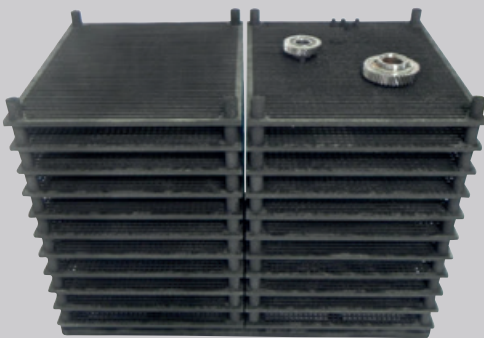
600 x 450 x 600 mm³
24" x 18" x 24"



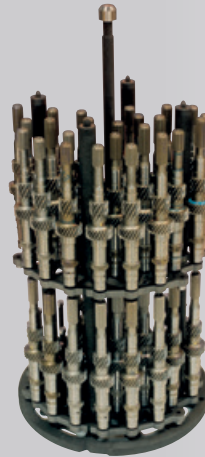
900 x 600 x 600 mm³
36" x 24" x 24"



1000 x 600 x 600 mm³
40" x 24" x 24"



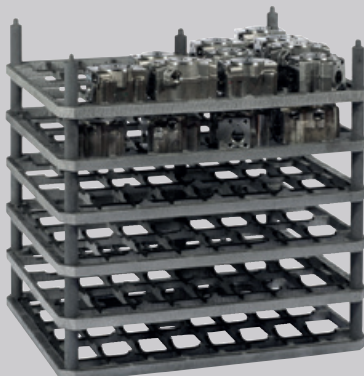
Ø 500 mm - H 900 mm
Ø 20" - H 36"



Ø 500 mm - H 900 mm
Ø 20" - H 36"



500 x 600 x 600 mm³
20" x 24" x 24"

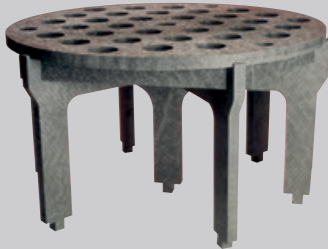


1000 x 600 x 600 mm³
40" x 24" x 24"

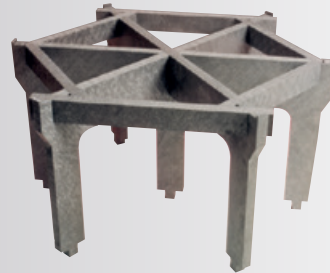


FURNACE BASES

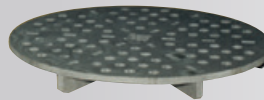
Ø 600 mm / 24"



Ø 600 mm / 24"



Ø 1200 mm / 47"



Additional applications, designs, geometries and dimensions upon request

SPECIALIZED HARDWARE

Spring shapers



Bolts & nuts



Temperature Uniformity
Survey (TUS) fixture



Ø 1500 mm - H 1500 mm
Ø 60" - H 60"

Additional applications, designs, geometries and dimensions upon request

DISCLAIMERS

1 - BROCHURE CONTENTS DISCLAIMER

All information in this brochure is based on Airbus Safran Launchers data that were currently available at the time of production. The brochure provides general information on Airbus Safran Launchers products and product applications.

The product data given in this brochure are typical values and are not guaranteed.

The product applications in this brochure are examples only. In addition to using your own discretion and judgment, please consult with Airbus Safran Launchers in order to establish the appropriateness of our products for your applications before use, and follow up with an assessment of product performance, behavior and safety.

The information in this brochure is subject to change without notice, based on the judgment of Airbus Safran Launchers.

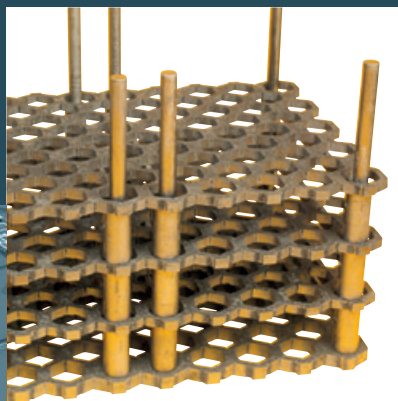
2 - INTELLECTUAL PROPERTY RIGHTS DISCLAIMER

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3 - PRODUCT USAGE DISCLAIMER

Before using our products, please read the corresponding Material Safety Data Sheet issued by Airbus Safran Launchers.



PRODUCTS EQUIPMENTS & SERVICES

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