CFC CHARGING SYSTEMS

OVER 40 YEARS OF MANUFACTURING INNOVATION.

ERODEX | THE ERODEX GROUP

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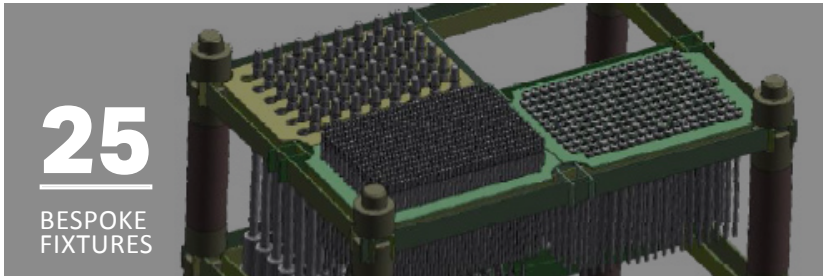

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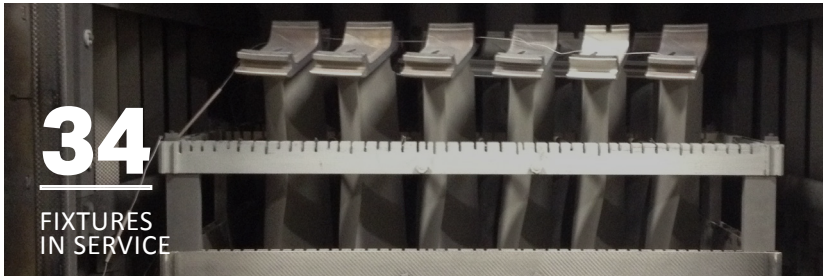

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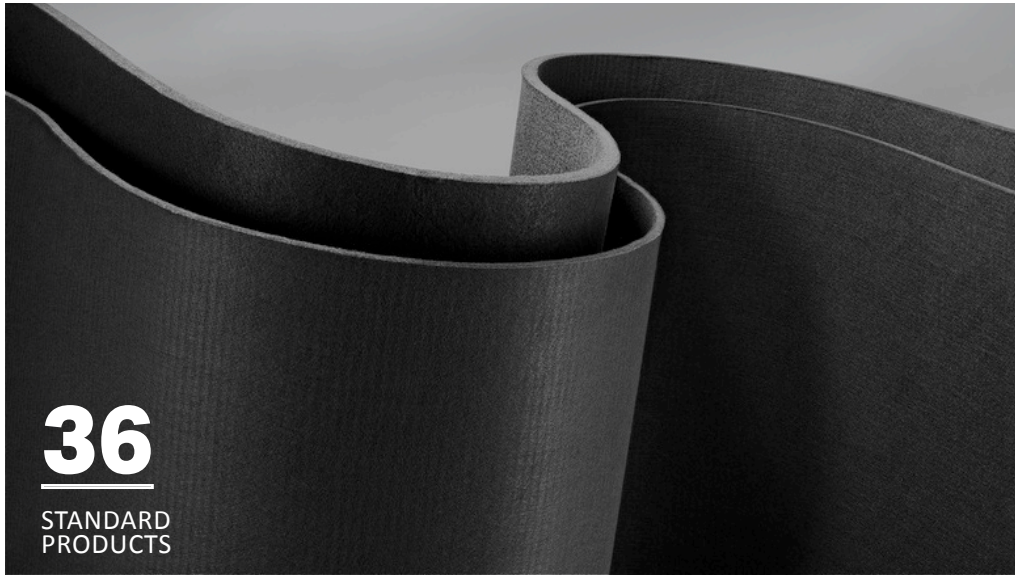
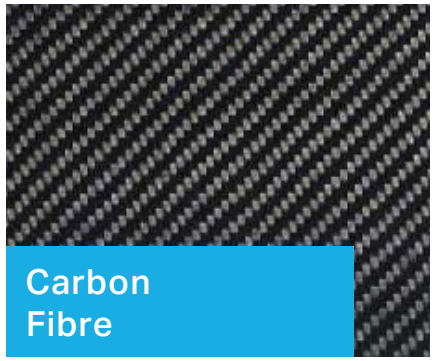


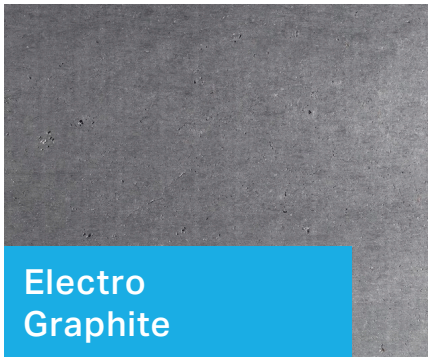
36
STANDARD
PRODUCTS

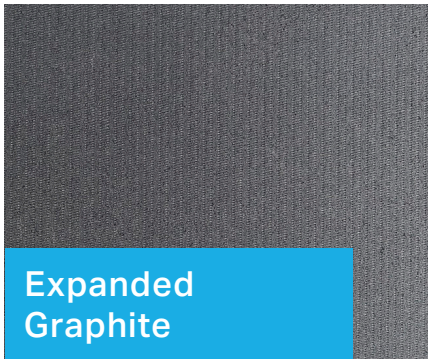
PRODUCT PORTFOLIO

Our product portfolio ranges from carbon and graphite products, to carbon fibres and composite

- Extruded graphite
- Isostatic graphite
- Rigid & soft felts
- Carbon fibres & composites
- Carbon fibre reinforced carbon
- Die molded graphite
- Expanded natural graphite



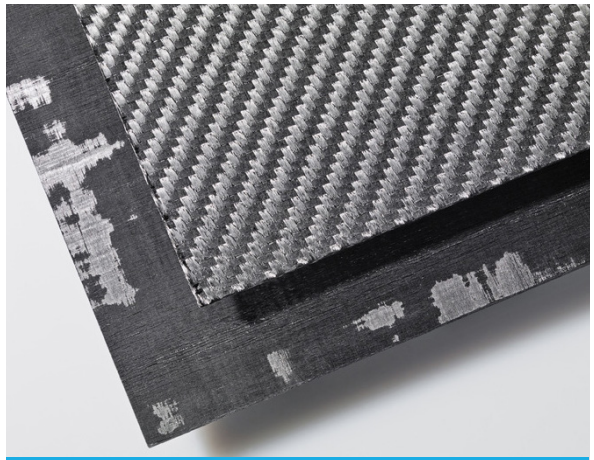




PARTNER Graphite Materials & Systems SGL GROUP THE CARBON COMPANY

Images courtesy of SGL Group

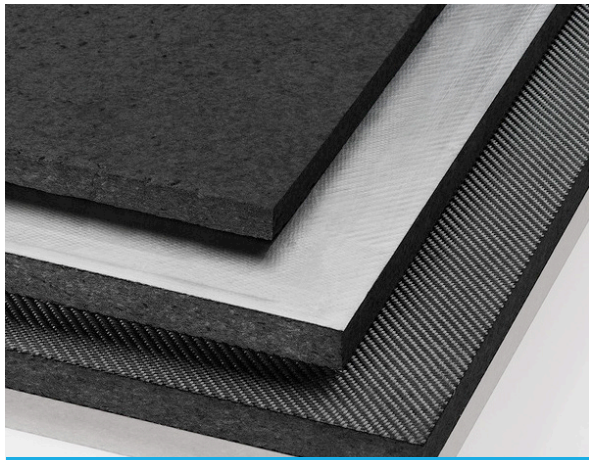
Our CFC and felts are the preferred materials and solutions for high temperature applications



CFC

Optimum material for furnace construction

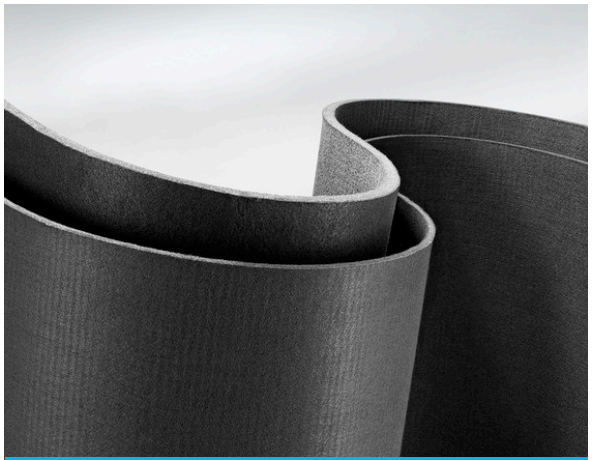
- High strength and stiffness
- High fracture toughness
- Lightweight and low thermal expansion
- High thermal shock resistance



Rigid Felt

Insulation board material

- High temperature resistance
- Low heat conductivity
- Low mass and heat capacity



Soft Felt

Flexible insulation material

- Low thermal conductivity
- Low heat capacity
- High temperature resistance

Product Portfolio

Our CFC Grades;

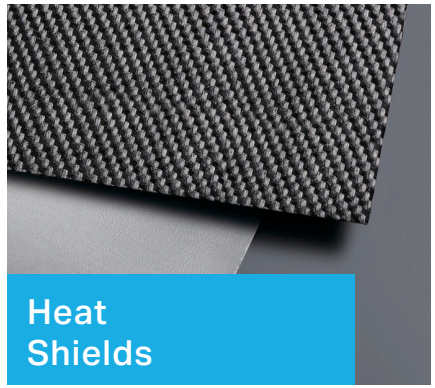
- Standard
  For heating elements and furnace linings
- Premium
  For heating elements and structural components
- Performance
  For charging frames and systems
- Filwound
  For cylinder components
- Mechanical
  Connection elements

Our products for high temperature furnaces: A broad range of materials and solutions

Fields of application and product examples;

Thermal Insulation

Rigid felt cylinder.



Heat Shields

CFC / graphite foil composite.

Heating Elements & Systems

High temperature furnace equipped with graphite heating cage.

Charging Systems

Charging system with performance CFC charging plates.

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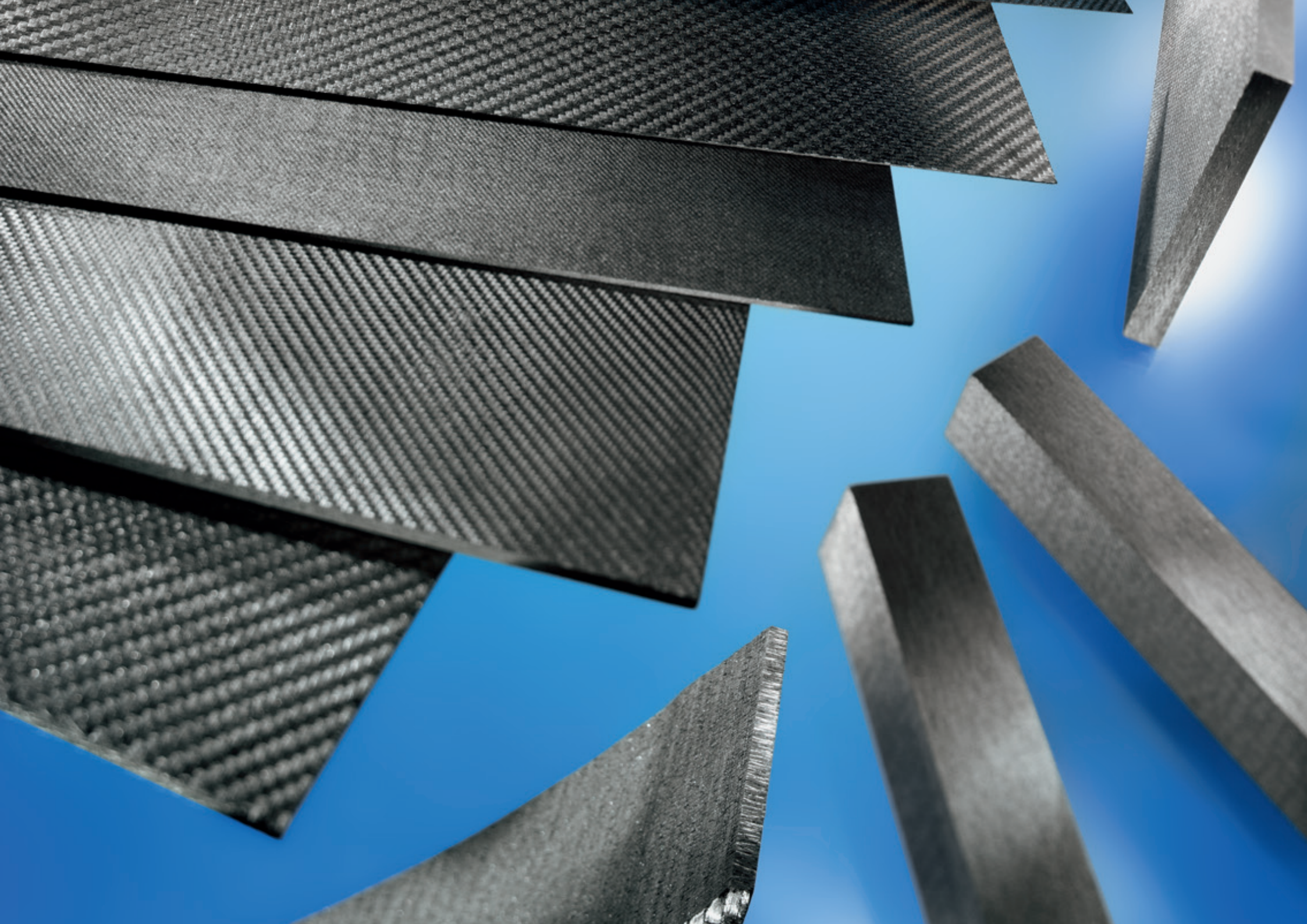


Product Portfolio

Heat Treatment Furnaces & Applications

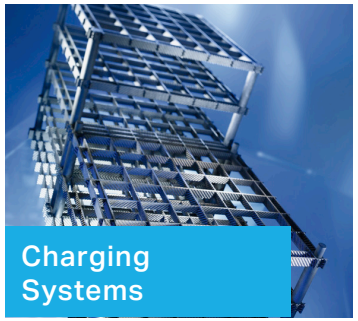
Product Examples

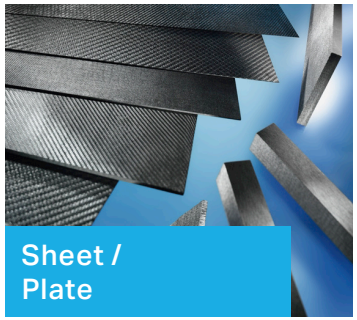
Furnace & Construction Parts for:

- Sintering
- Hardening
- Annealing
- Brazing
- Coating

Special Treatment:

- Anti-Oxidation
- Silicon Carbide
- Edge Protection





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Images courtesy of SGL Group

Product Portfolio

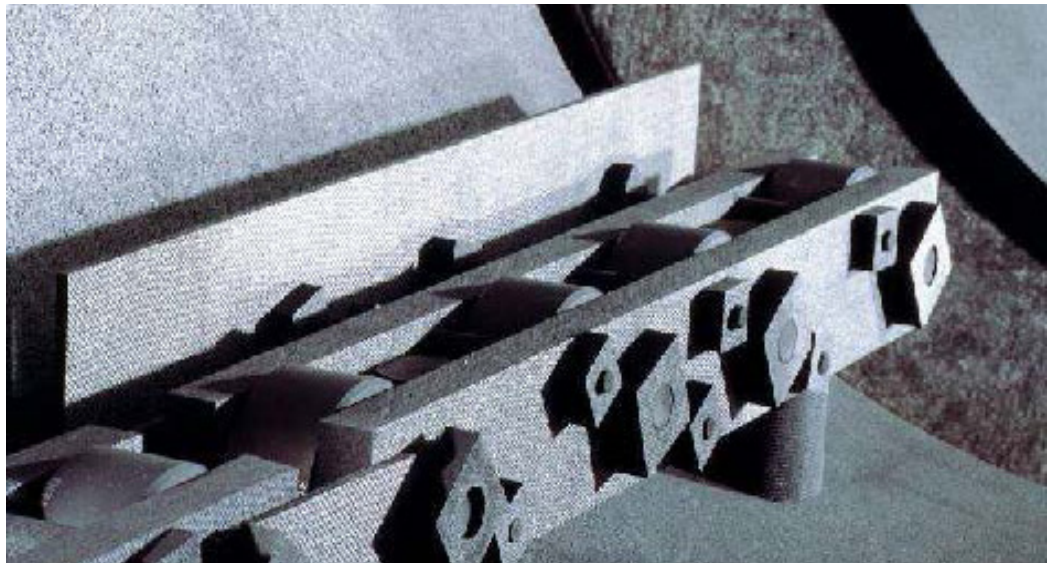
Heat Treatment Furnaces & Applications

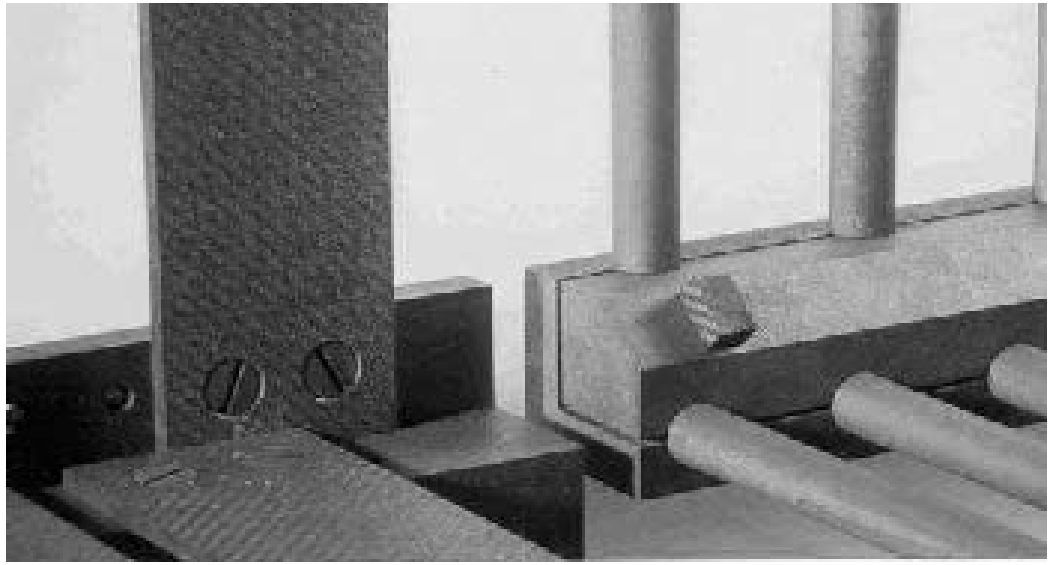
Product Examples

Graphite & CFC Engineered Parts:

- Supporting Parts
- Susceptors
- Charging Fixtures
- Heating Elements
- Roller Constructions

Made from extruded & isostatic Graphite, as well as CFC material

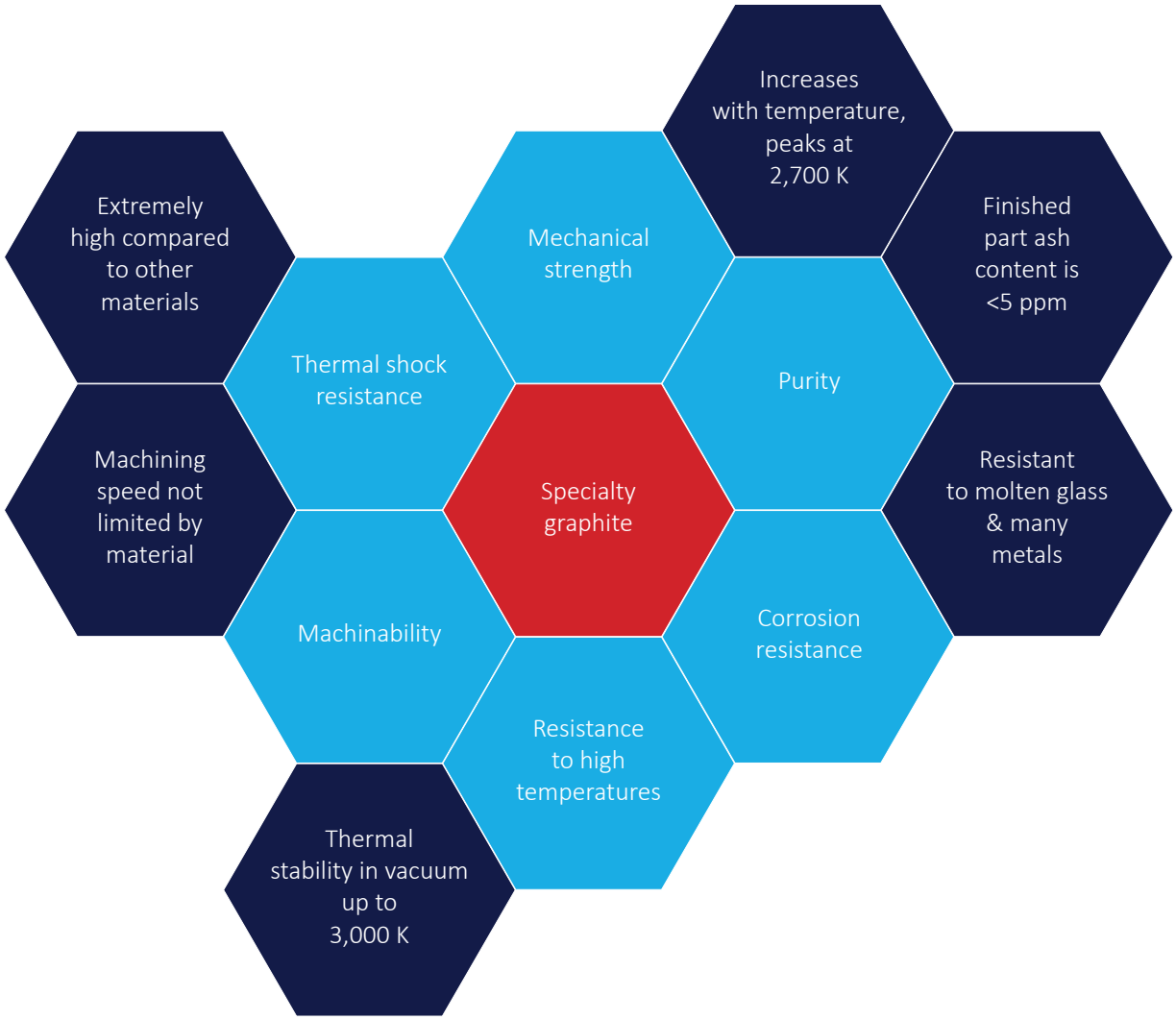




TECHNICAL ADVANTAGES

Specialty graphites come into play where other materials fail.

Main properties of carbon and graphite materials

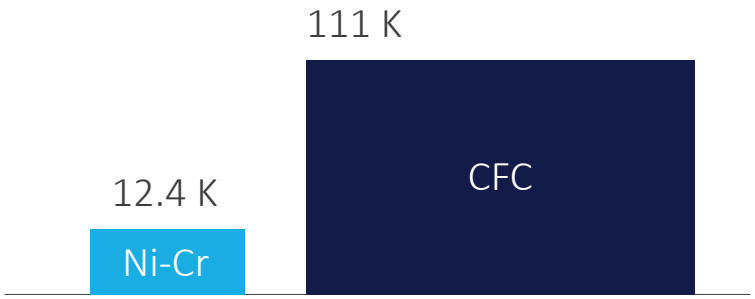


Images courtesy of SGL Group

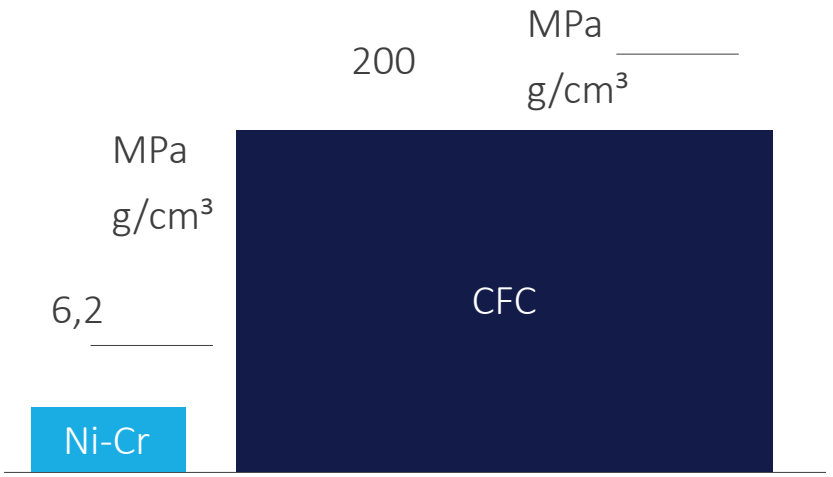
Thermal Stability
And Energy Efficiency of CFC vs Ni-Cr

Properties for 1000°C	Ni-Cr	CFC Performance
3-point flexural strength	50 MPa	300 MPa
Bulk density	8.1 g/cm³	1.5 g/cm³

Specific strength ratios at 1000°C



Flexural strength
Density . Heat capacity



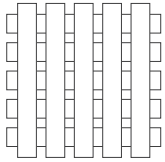
Flexural strength
Density

Technical Advantages

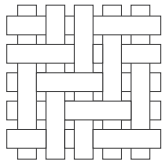
Heat Treatment Furnaces & Applications

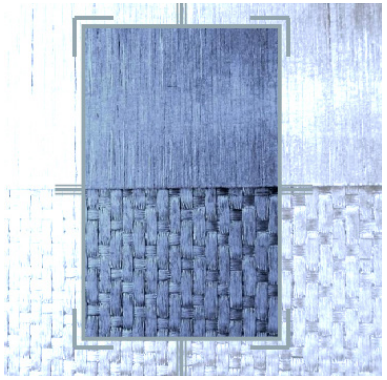
- High rigidity and lower density, resulting in reduced process times
- Higher fibre-content leads to 33% less oil suction, which makes it suitable for oil quenching processes
- New dimensional possibilities up to 2450mm in length
- Stiffness (bending modulus) of performance is ~20% higher than other CFC materials which allows higher loading at the same dimensions

- Performance ~ 70 GPa

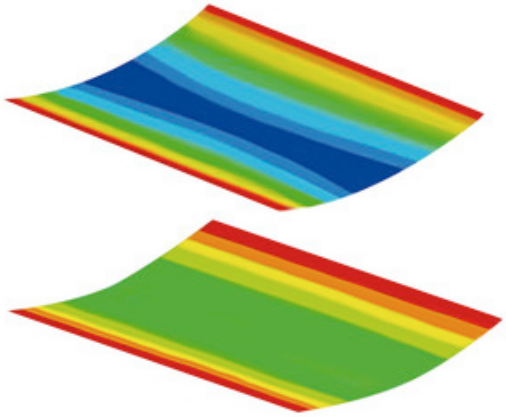


- Standard ~ 60 GPa





Standard



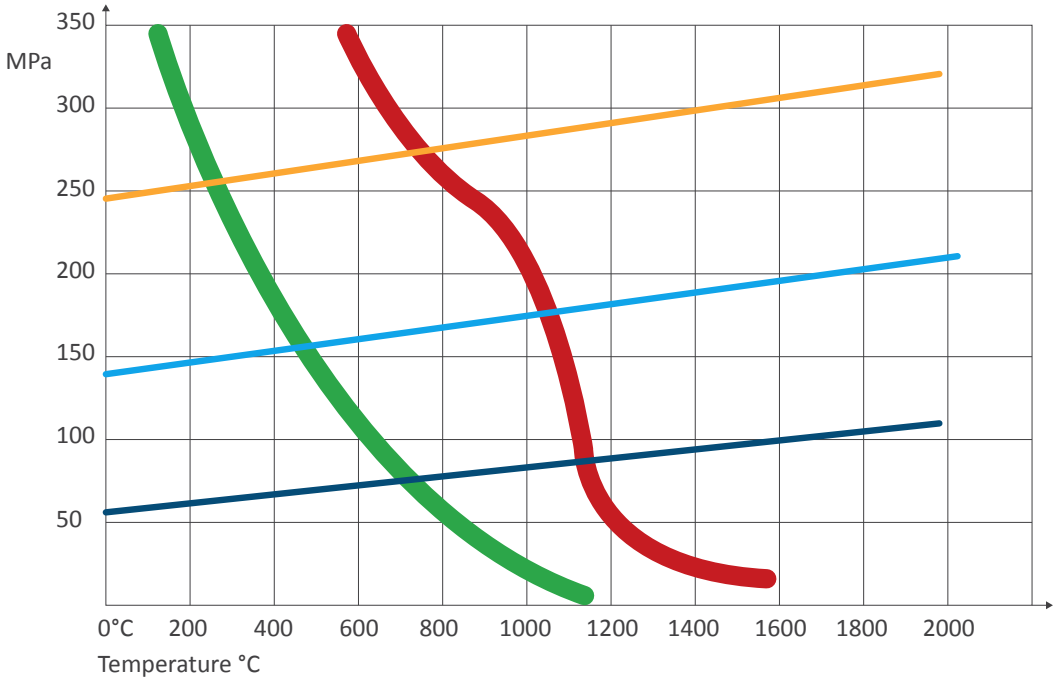
Performance

Images courtesy of SGL Group

Technical Advantages

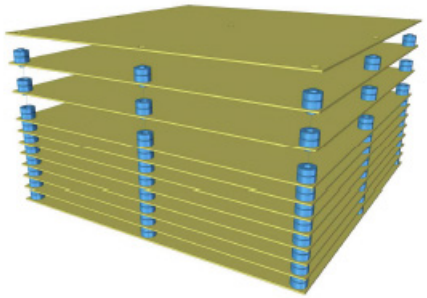
Heat Treatment Furnaces & Applications

Mechanical Strength increases with Temperature



Typical hot bending strength values of various high-temperature Materials

- Premium
- Standard
- ISO graphite
- Steel Casting
- Molybdenum



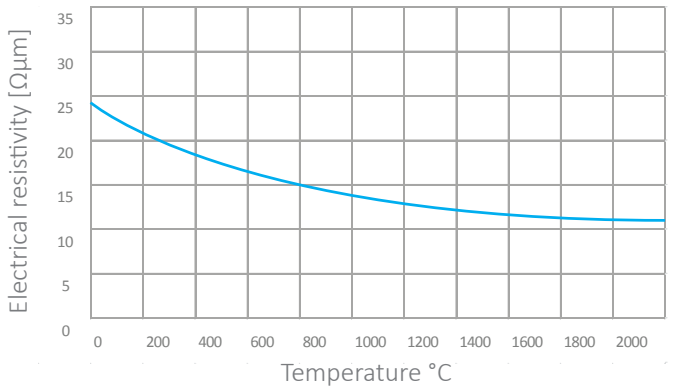
Technical Advantages

Product Specifications

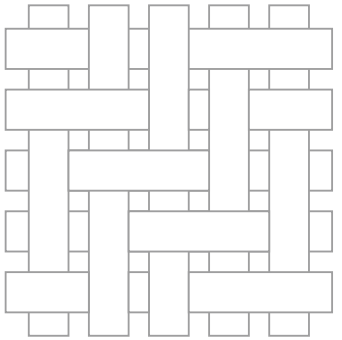
CFC Standard

Type	Performance
Density	1.5 g/cm^3
Flexural strength	150 MPa
Flexural modulus	60 GPa
Tensile strength	350 MPa
Interlaminar shear strength	80 MPa
Ash content	1,000 ppm
Ash content (purified grade)	< 10 ppm
Max. application temperature	2,000°C inert gas atmosphere 2,000°C vacuum

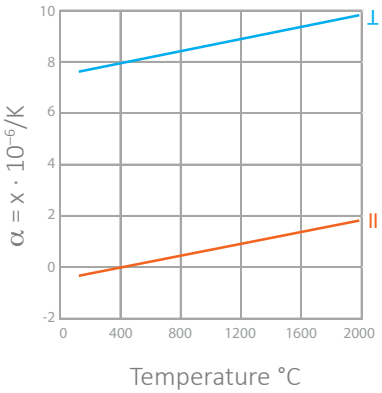
Specific electrical resistivity



CFC Weave



Coefficient of thermal expansion



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Images courtesy of SGL Group

Technical Advantages

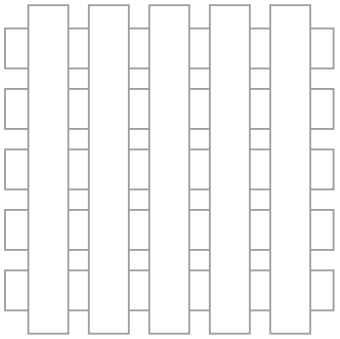
Product Specifications

No electrical data is available as this grade is not suitable for heater products.

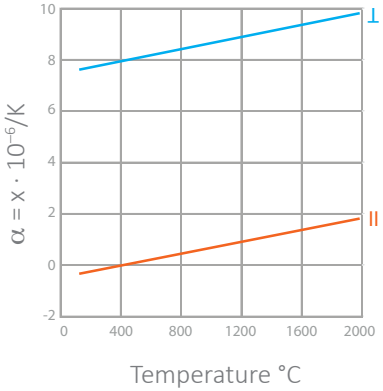
CFC Performance

Type	Performance
Density	1.45 g/cm^3
Flexural strength	200 MPa
Flexural modulus	70 GPa
Tensile strength	380 MPa
Interlaminar shear strength	8 MPa
Ash content	1,000 ppm
Ash content (purified grade)	< 10 ppm
Max. application temperature	2,000°C inert gas atmosphere 2,000°C vacuum

CFC Weave



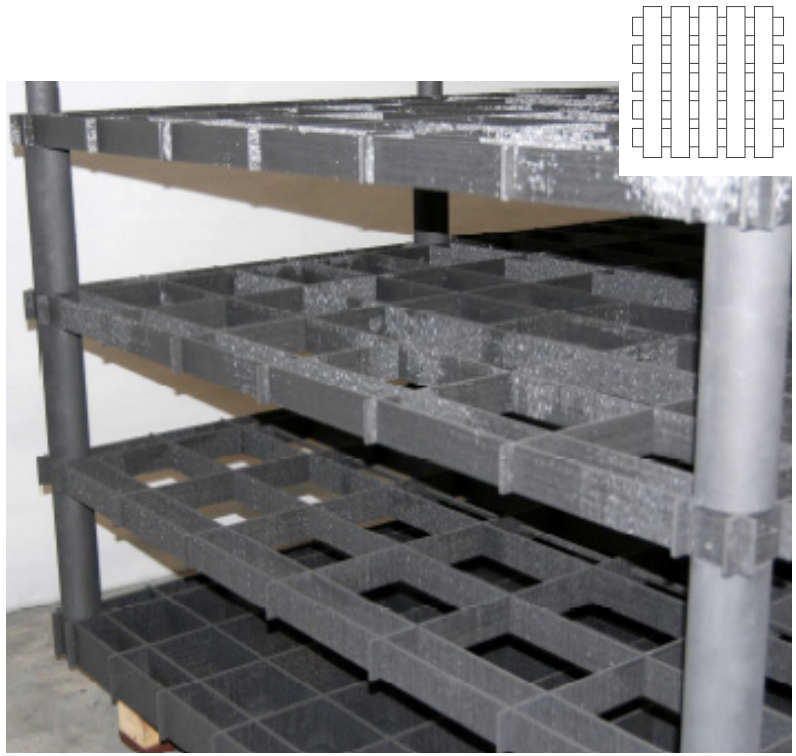
Coefficient of thermal expansion

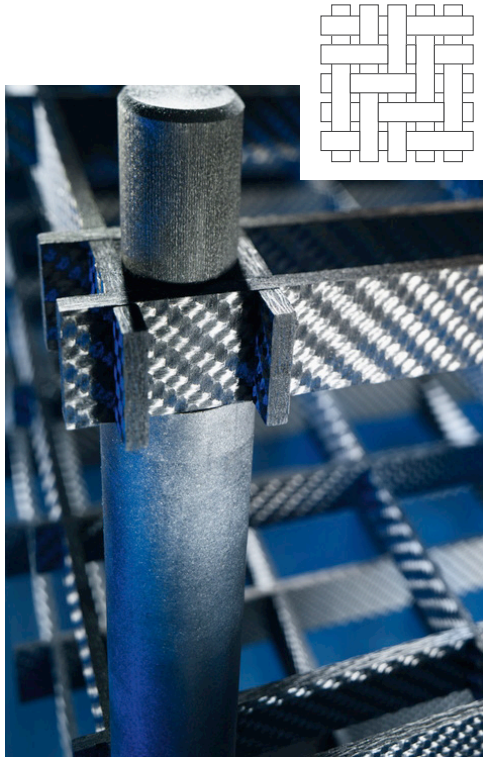


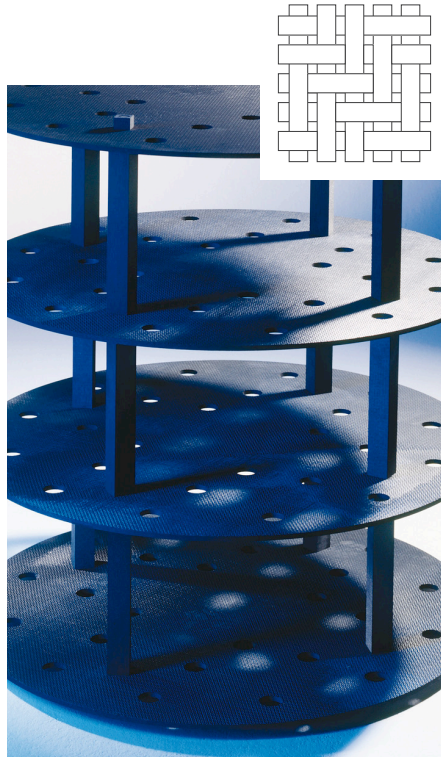
Technical Advantages

Product Specifications

Optical Difference Between Non-Woven and Woven CFC







Images courtesy of SGL Group

OIL
QUENCHING

Components for oil quenching applications.

- Suitable to carry heavy loads (175kg in example to the right)
- Easier to handle due to reduced fixture mass
- Low deflection under temperature due to high bending modulus (70 GPa!)
- Low porosity leads to 33% less oil absorption
- Low thermal mass for maximum furnace efficiency
- Hybrid Solutions combined with existing metal systems → low entrance barrier where customers struggle in terms of initial cost and lag of trust in composite technologies
- Base material for such sheet versions available from stock → short delivery times and favourable pricing position

Heavy duty charging carrier fitted with a 7.5mm performance plate

CERAMIC BARRIERS

Limitations of CFC Material in Charging Systems

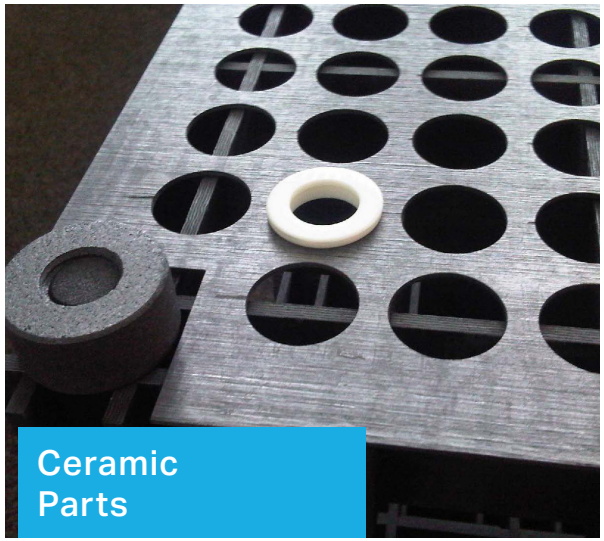
Process atmosphere

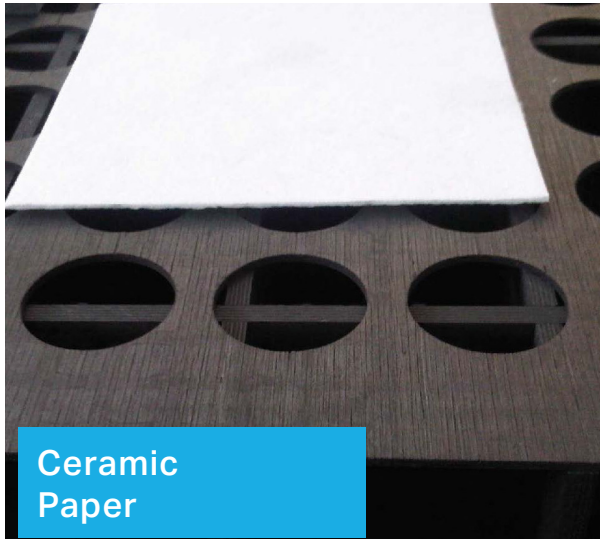
Above 350°C and in the presence of oxygen, CFC gradually starts oxidizing. Under vacuum or in an inert gas atmosphere, CFC and graphite parts are stable up to and beyond 2000°C

Unwanted carburization (CFC contact reaction)

At temperatures exceeding approx. 1050°C, carbon diffuses at a noticeable rate from the CFC into the charge. This results in unwanted changes in material structure (carburization), especially in high-speed steel grades.

As a countermeasure, intermediate layers made, for example, from Al_2O_3 paper may be used between the CFC material and charge. Coating the respective areas with ceramic cement (carborundum), for instance, also helps reduce the problem





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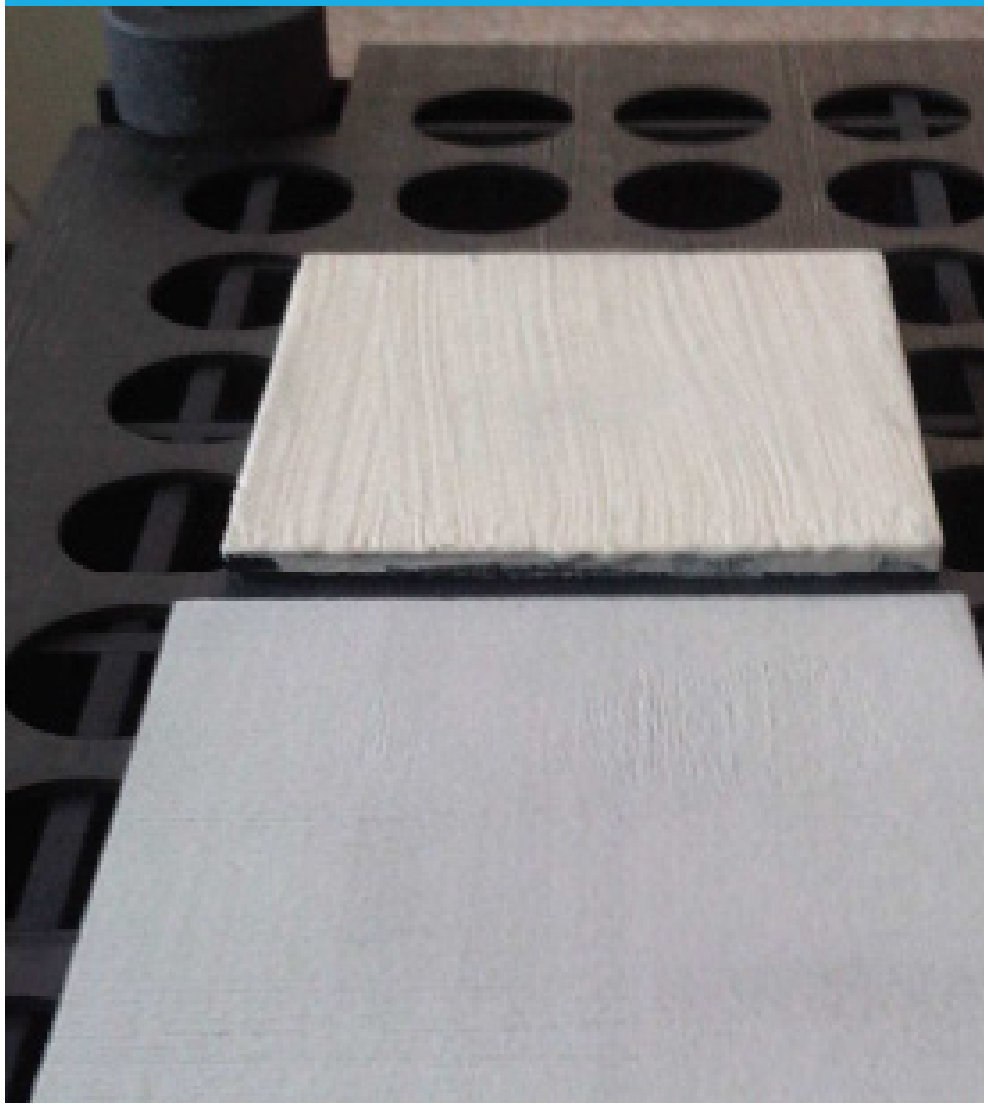
Countermeasure CFC contact reaction

- Intermediate Plates / Parts from Ceramic
- Intermediate Layer from Ceramic Paper
- Ceramic Painting
- Permanent Ceramic ZrC Plasma Coating

Ceramic Painting Plate &
Ceramic Coating Plate

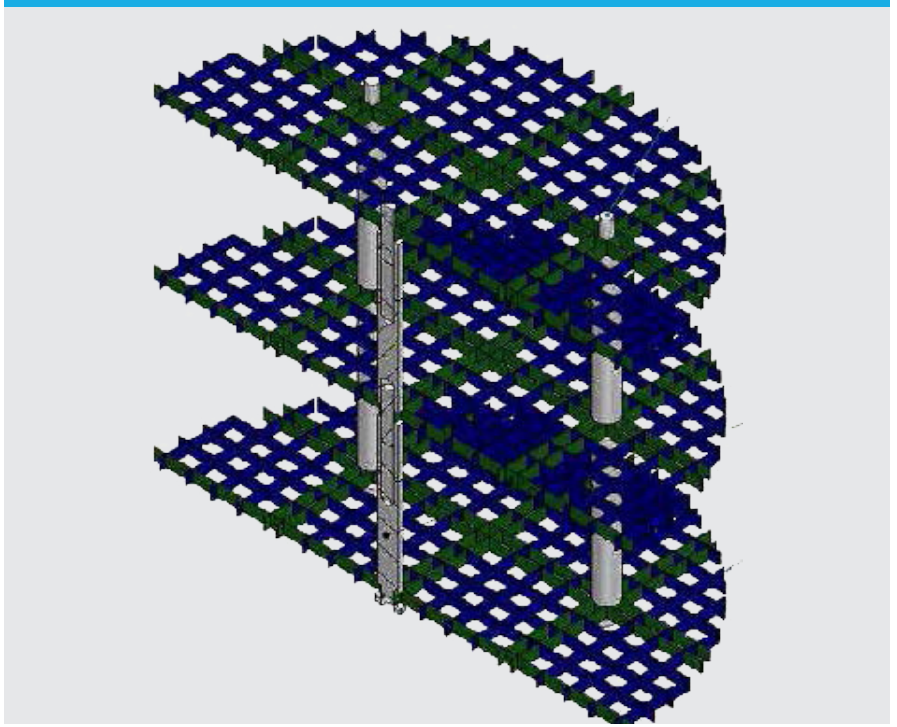


STANDARD
FIXTURES

Charging Systems & Plates

Adaptable Charging System-
CFC Performance

3D-Design of round Charging
Carrier- Modeling & Testing



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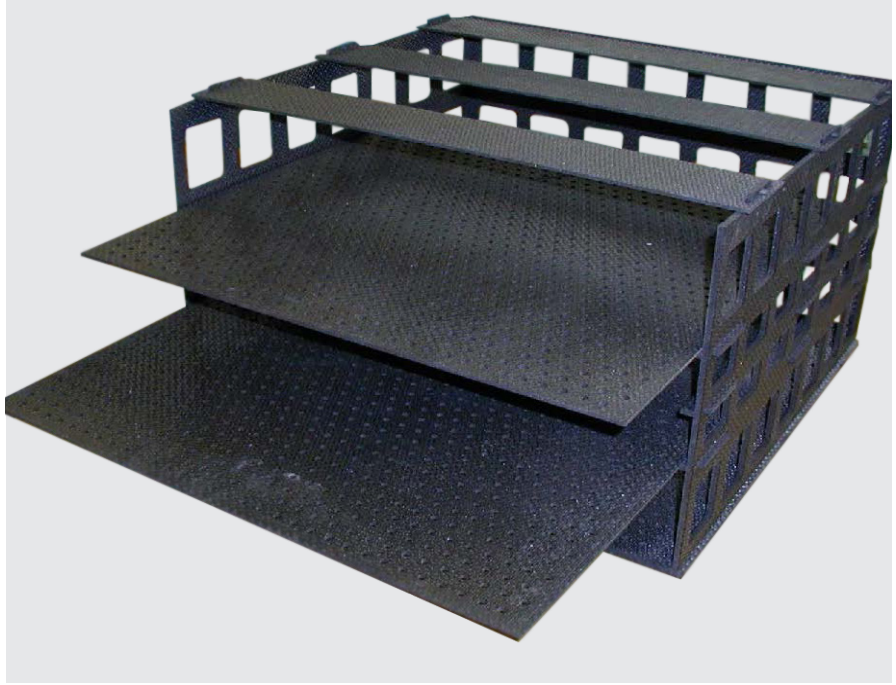
Charging Boxes
& Trays for Heat Treatment

Assembly of Charging Boxes-
CFC Performance

Sintering Plates-
CFC Performance

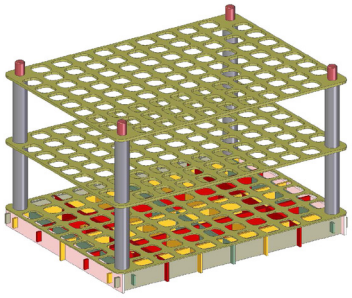


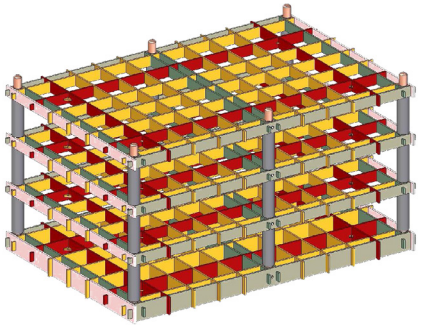
Standard Fixtures

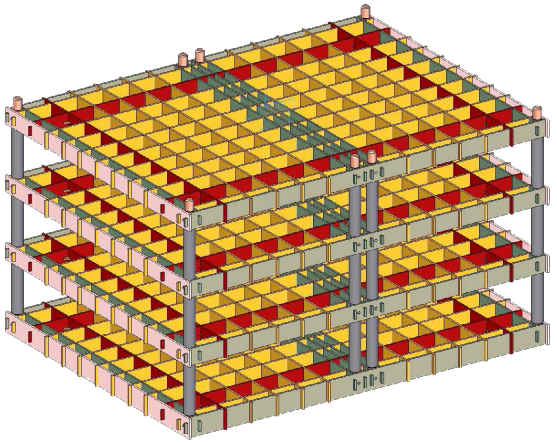
Advanced Modular Charging System

- Three standard dimensions
- Easy load calculation for customer requirements & equipment
- Load up to 1000kg per layer
- Grid & Plate options

- 1200 x 900mm (5 to 70mm height / thickness)
- 900 x 600mm (5 to 70mm height / thickness)
- 600 x 450mm (5 to 70mm height / thickness)







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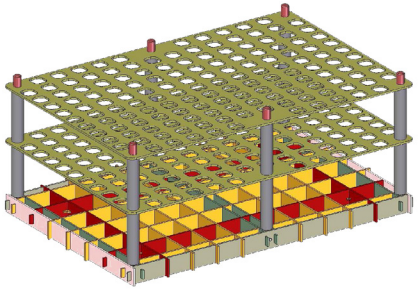
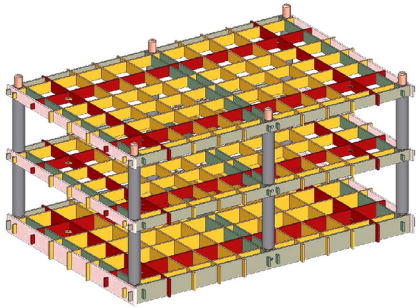
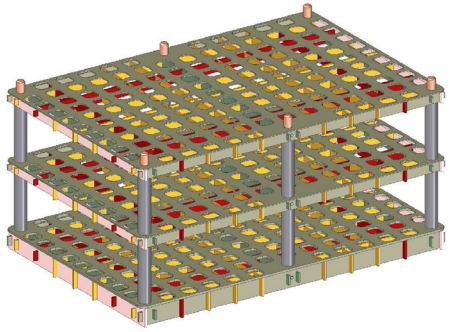
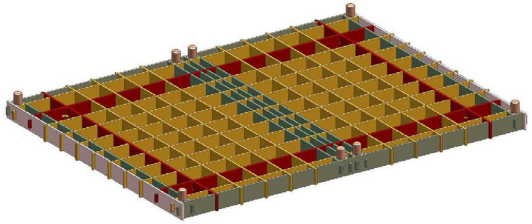
Standard Fixtures

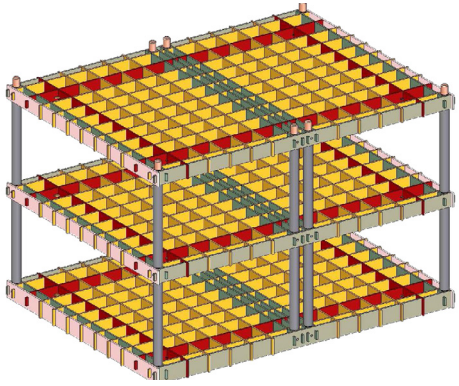
Different Options for Advanced Modular Charging System

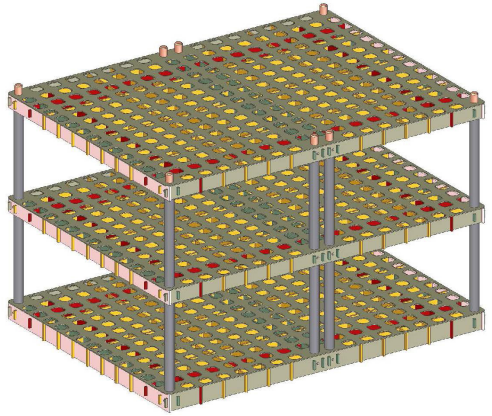












Standard Fixtures

Standard Charging Systems

Charging Systems-
CFC Performance

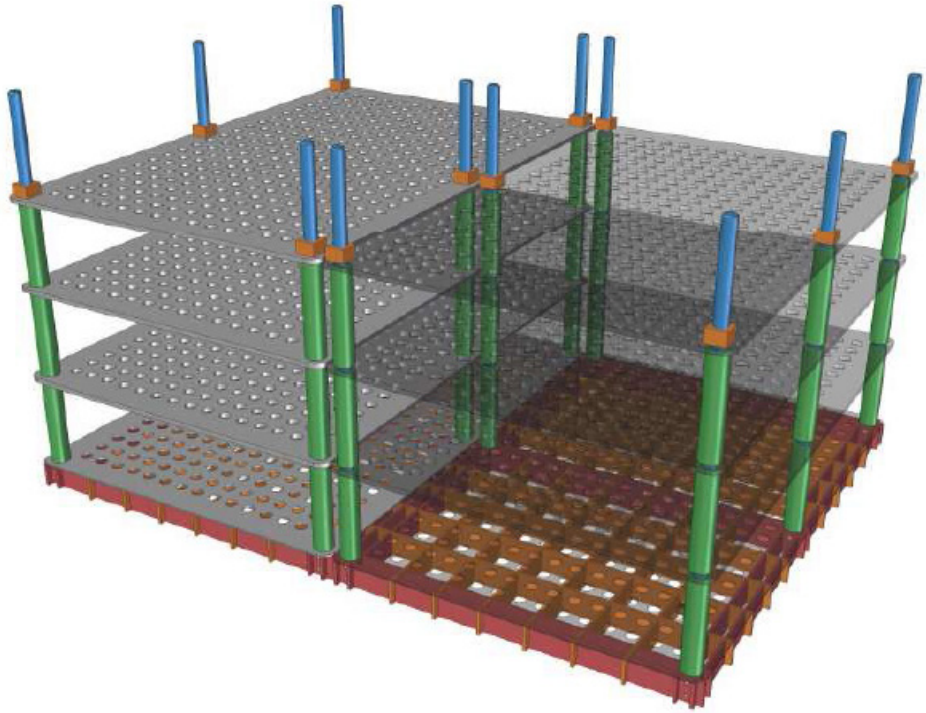
Round Charging System for
Gas Turbine Parts

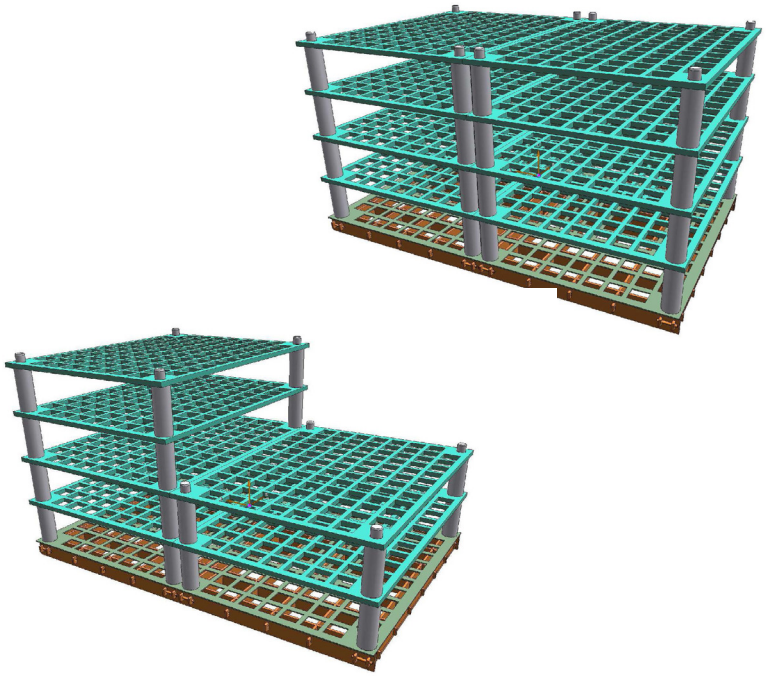
Graphite Materials & Systems
SGL GROUP THE CARBON COMPANY

Images courtesy of SGL Group

BESPOKE
FIXTURES

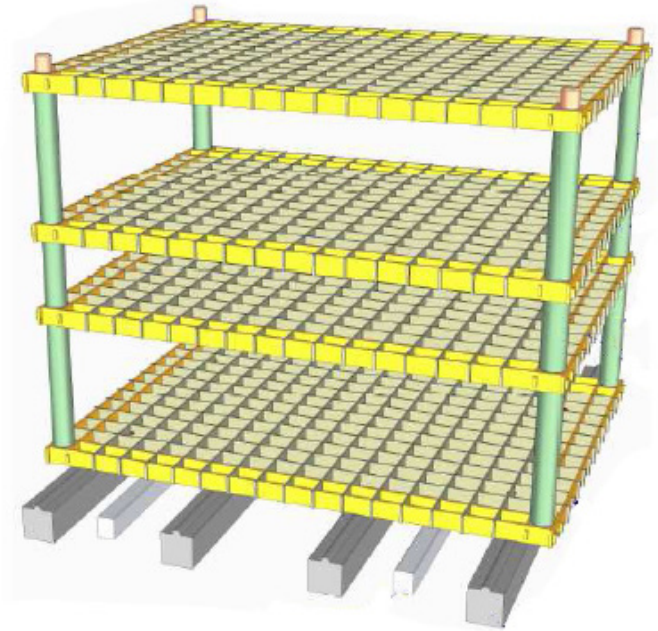
Easily Adaptable

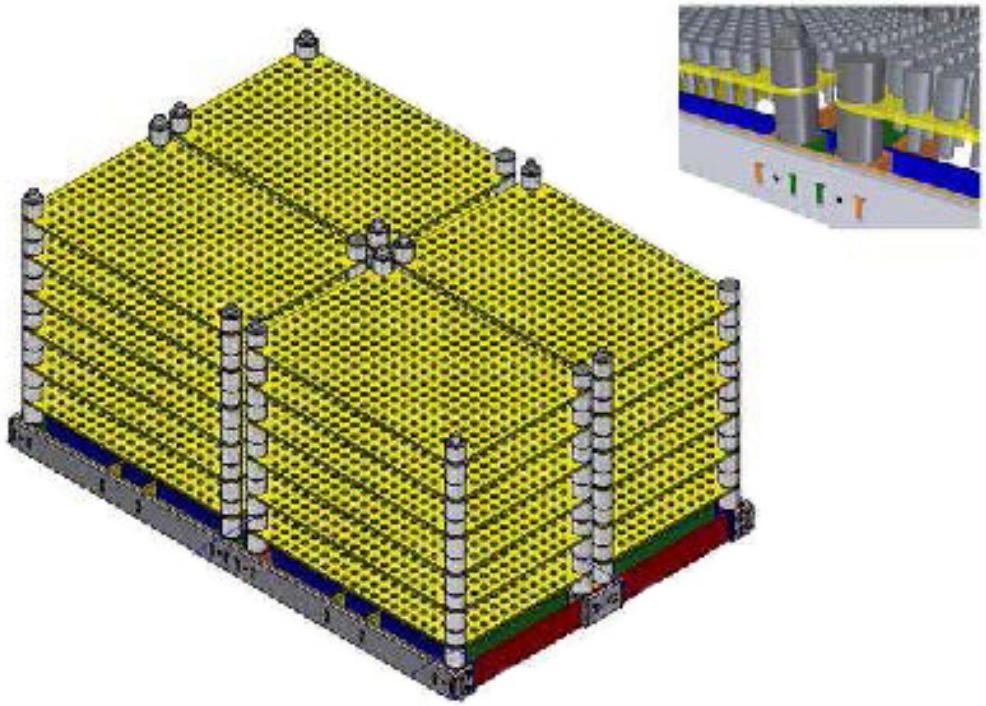




Bespoke Fixtures

Increased Capacity





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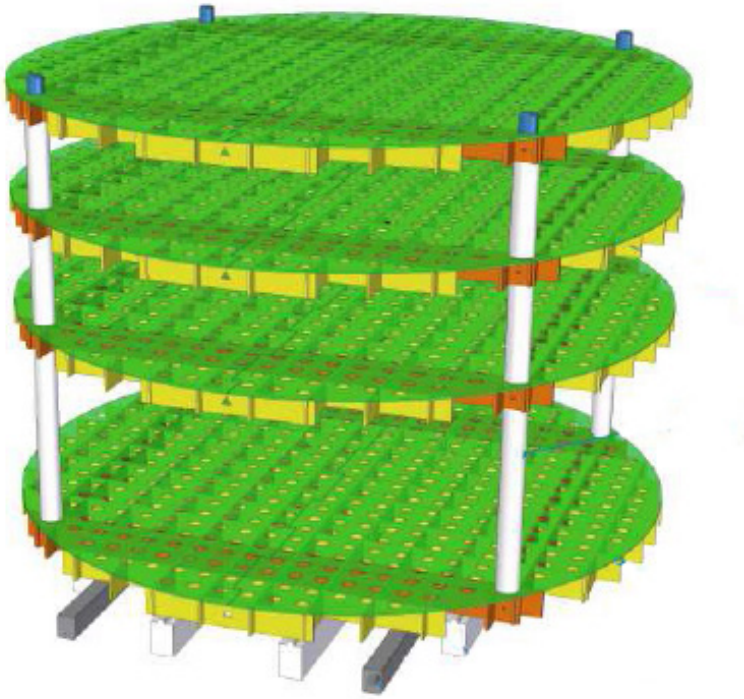
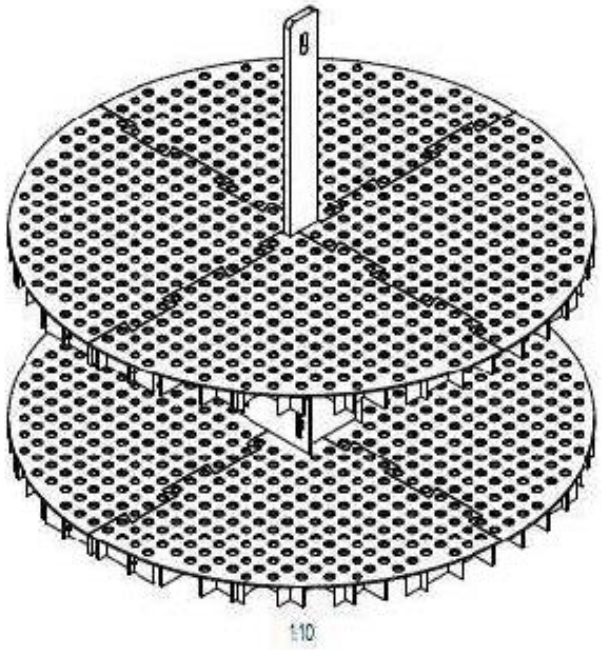
Bespoke Fixtures

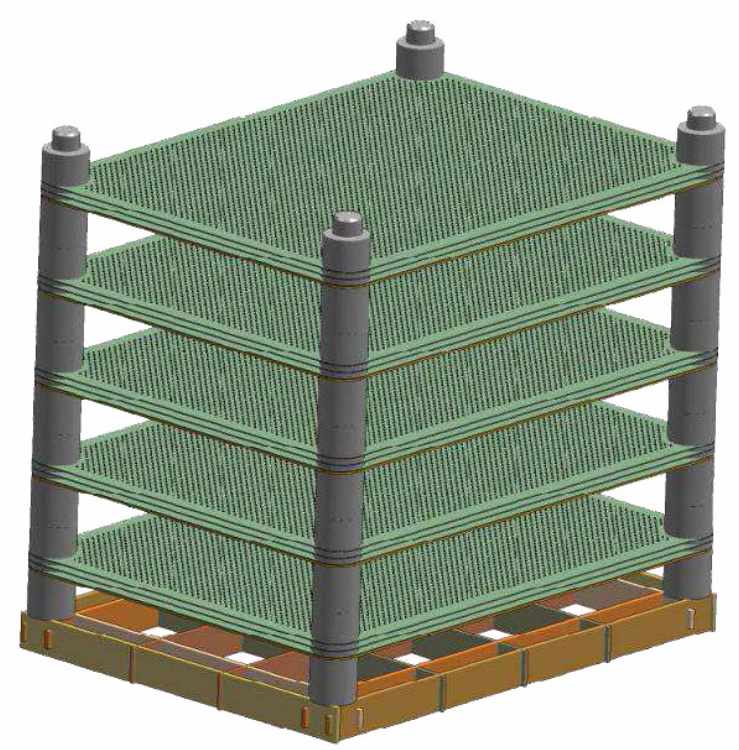
For Crane Lifting

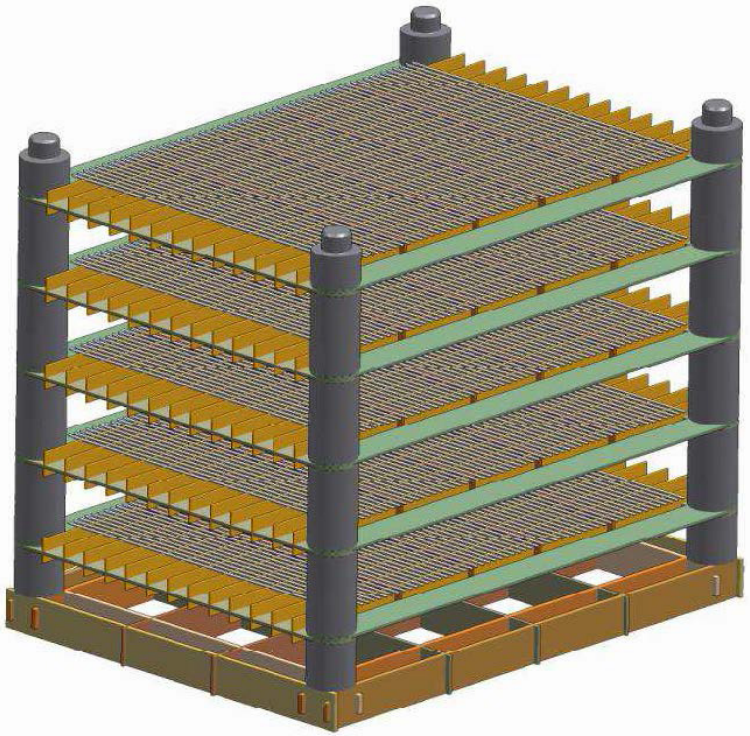




Bespoke Fixtures

Automatic / Robotic Loading





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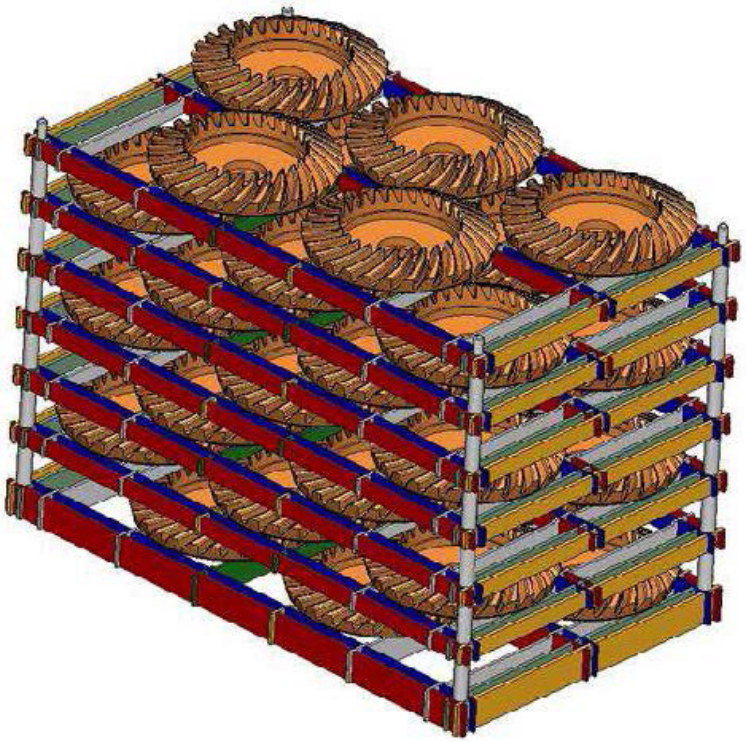
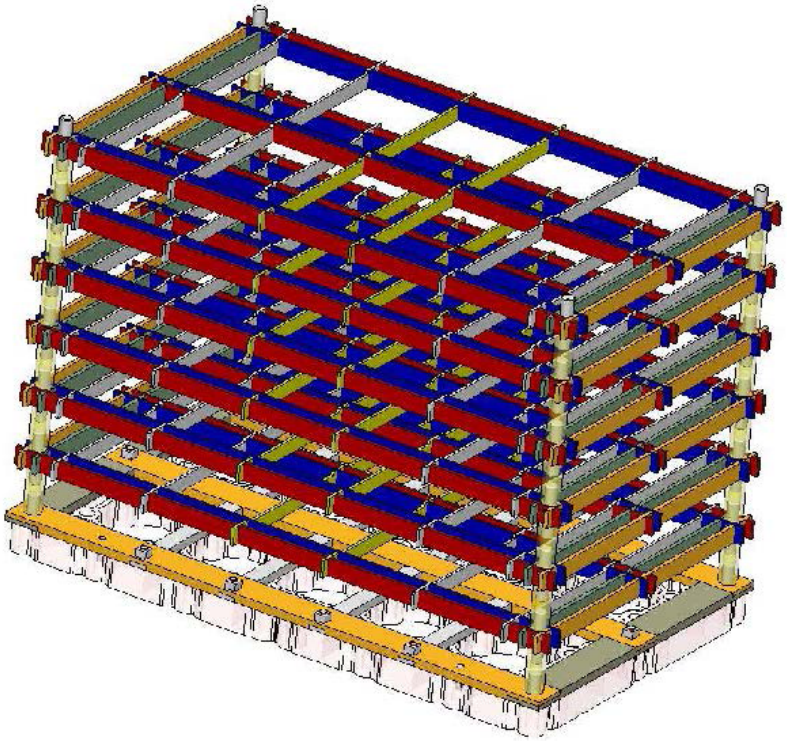
Bespoke Fixtures

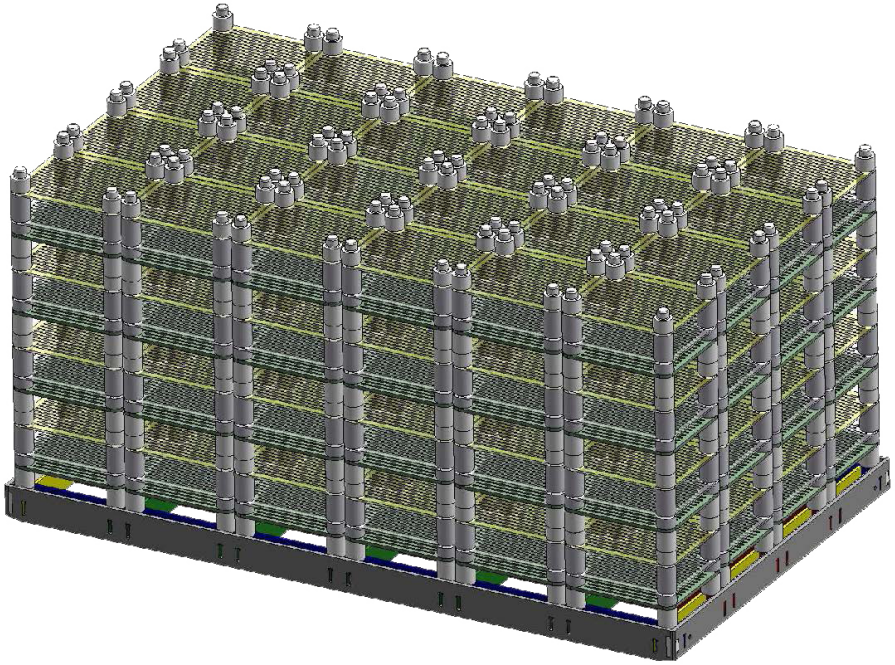
Using an Existing Cast Iron Basegrid

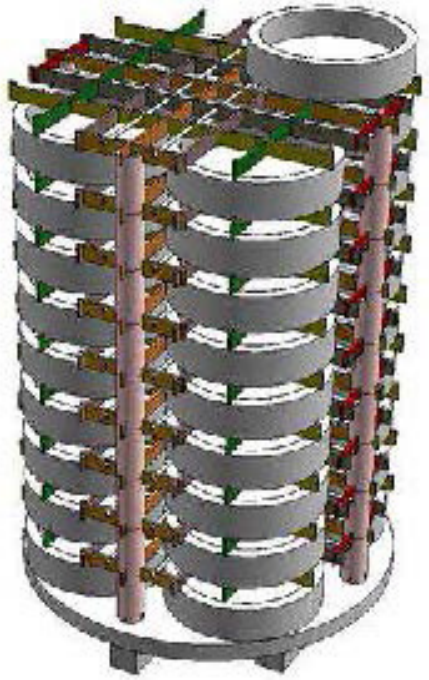




Bespoke Fixtures

Fit a Customer's Existing Products





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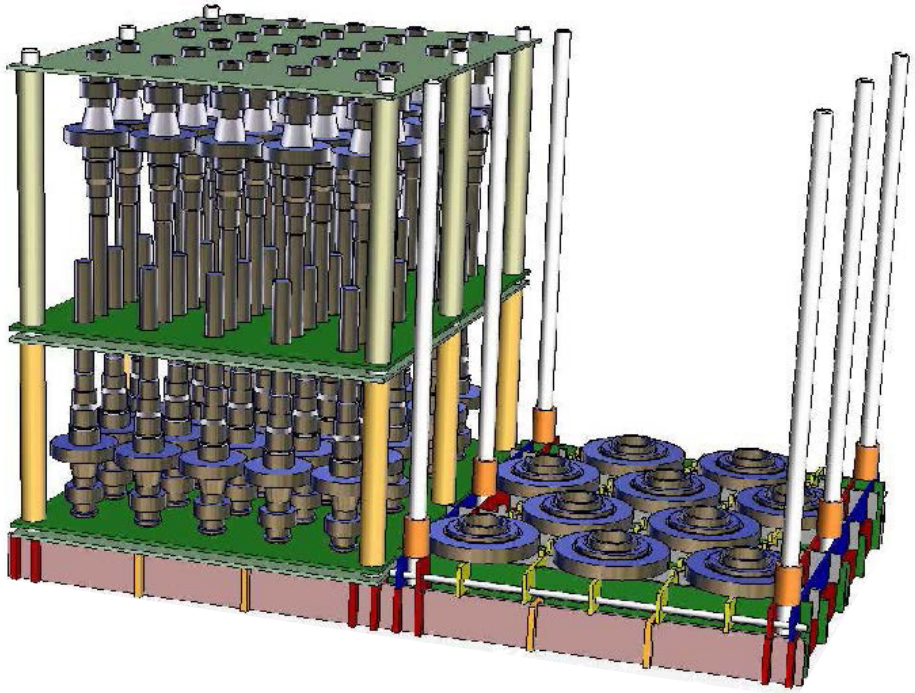
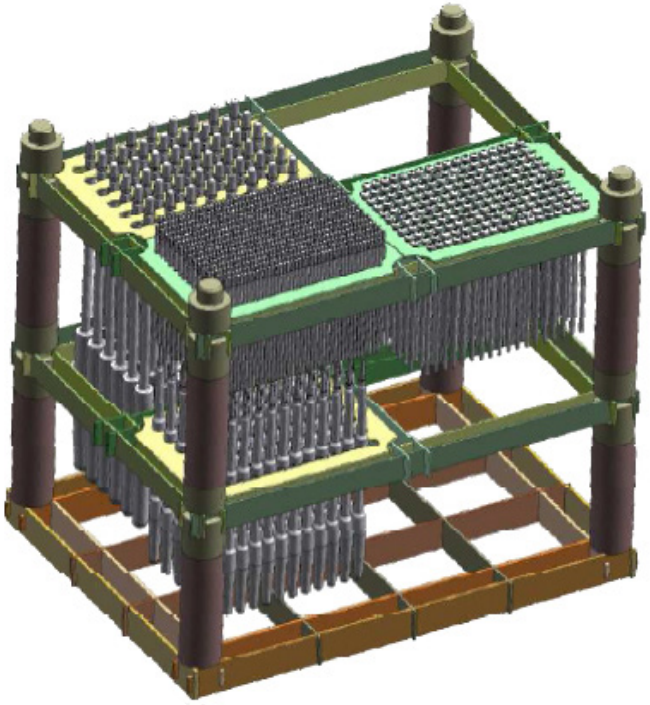
Bespoke Fixtures

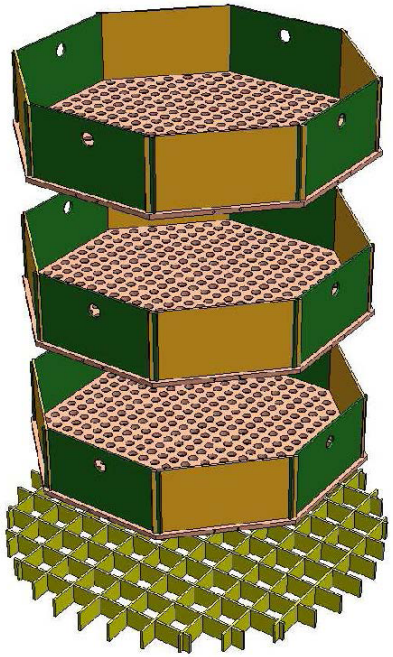
Fit a Customer's Existing Products

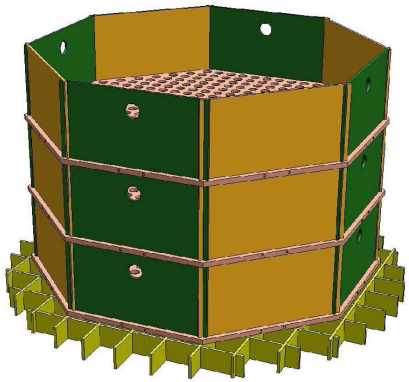


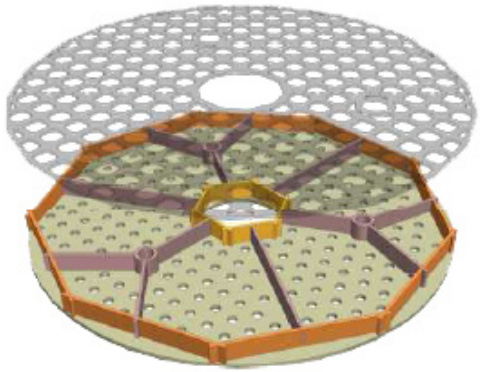


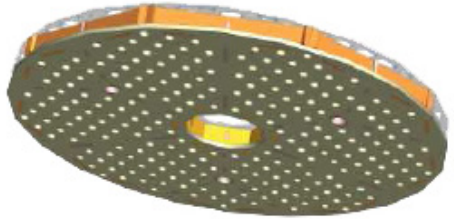
Bespoke Fixtures

For Coating and Powder Treatment









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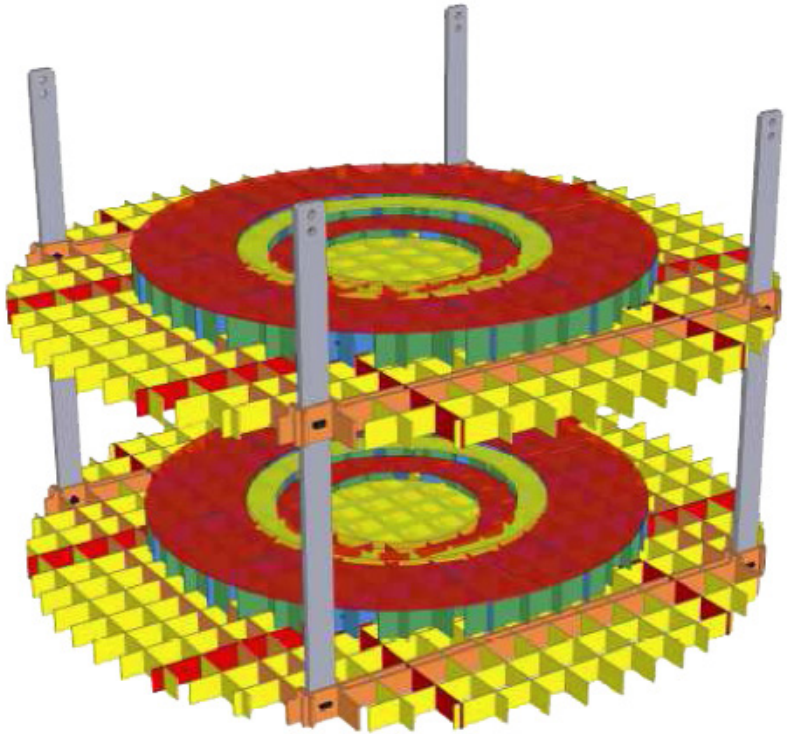
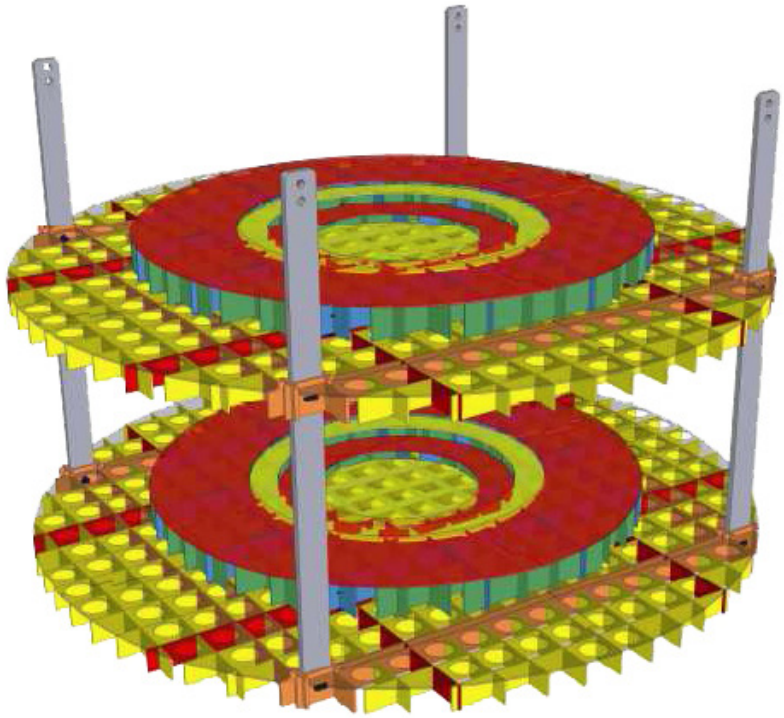
Bespoke Fixtures

For Crane Lifting



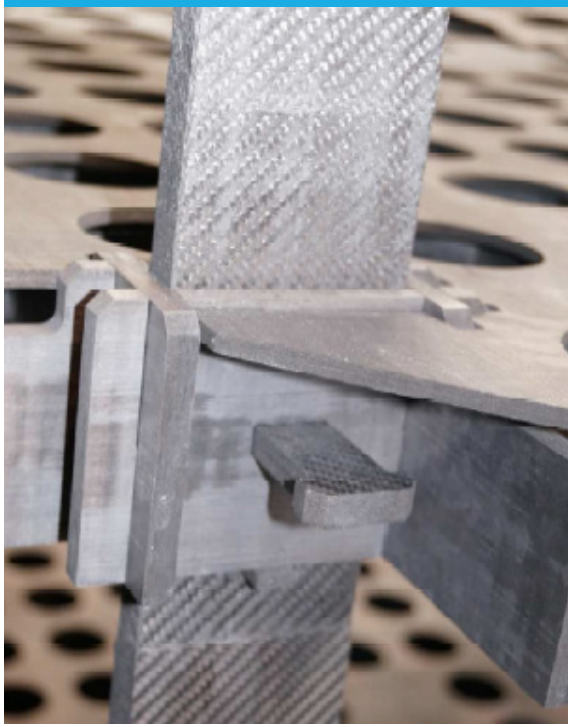


FIXTURES
IN SERVICE

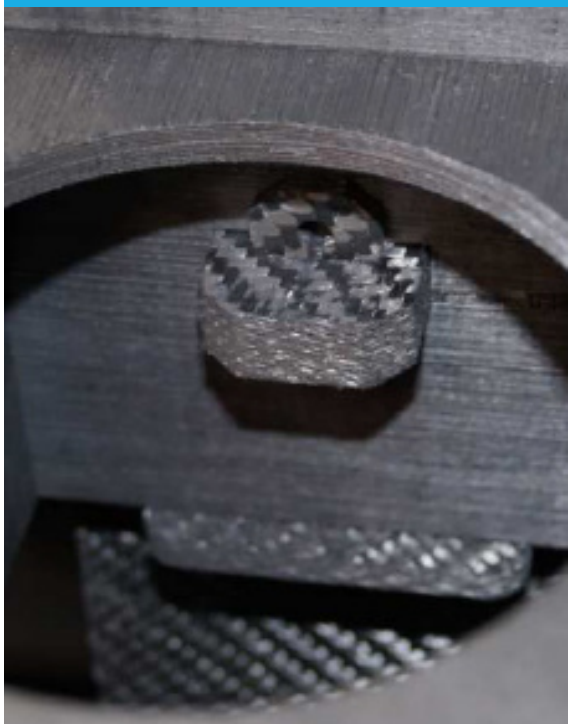
Bespoke Design
For Crane Lifting

Round Charging Fixture

Secure Fixing



Secure Fixing



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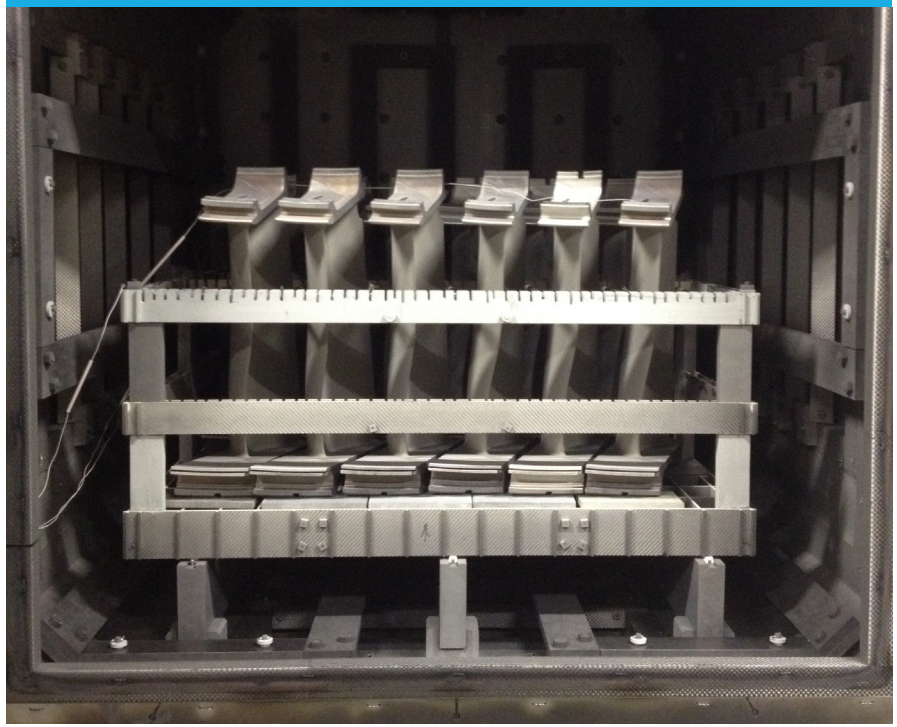
Front
View



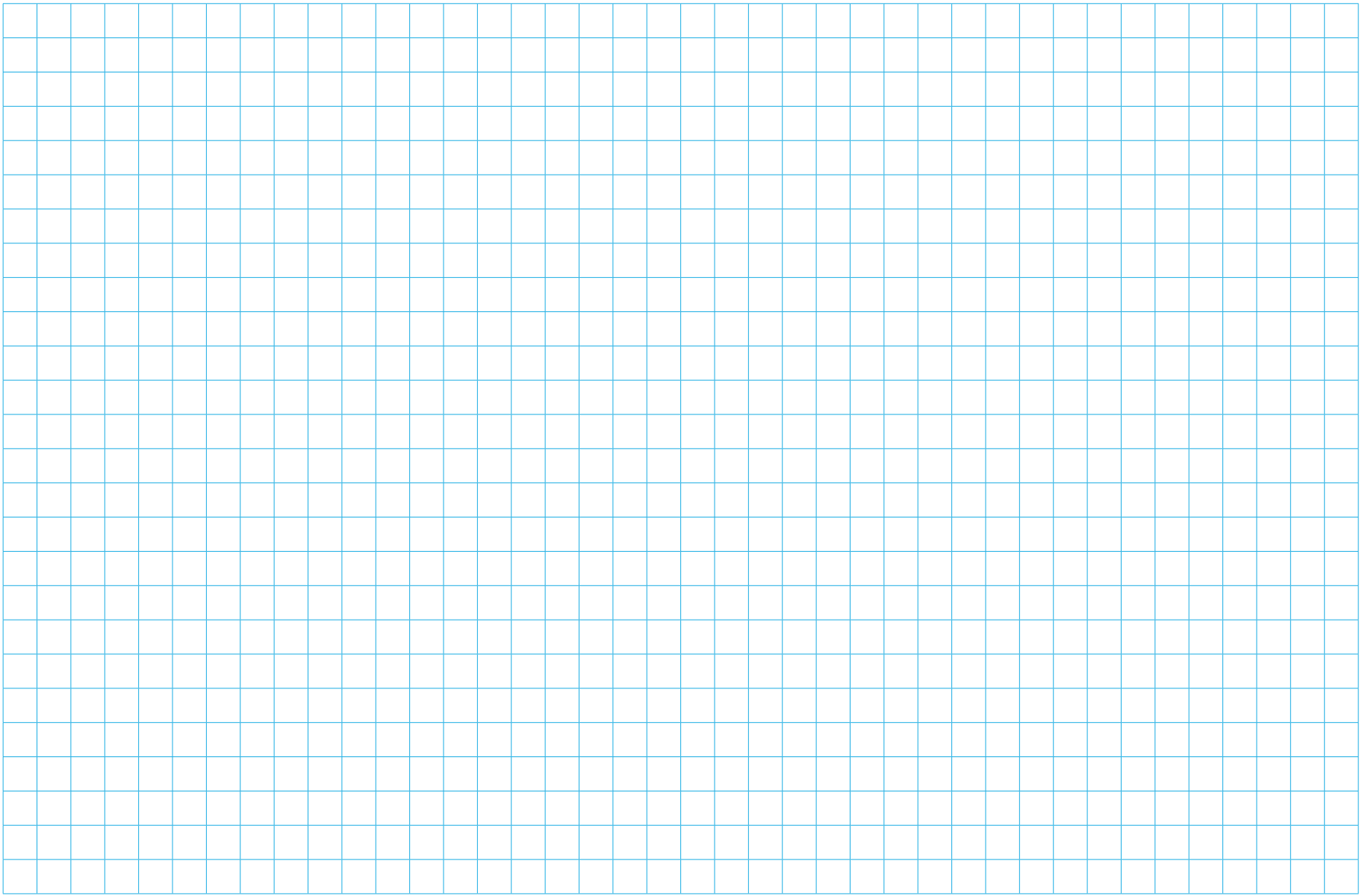
Side
View

STANDARD PRODUCTS

PRODUCT	DESCRIPTION	GRADE	L (mm)	W (mm)	H/Thk (mm)	COMMENTS
Rigid Felt	Insulation Board	MFA	1524	1219	30,40 & 50	Plain un-faced board
Rigid Felt	Insulation Board	MFA-FF	1524	1219	30,40 & 50	Product is Foil-Faced both sides
Rigid Felt	Insulation Board	MFA-CC	1524	1219	30,40 & 50	Product is CFC-Faced both sides
Rigid Felt	Insulation Board	MFA-FCCF	1524	1219	30,40 & 50	Product is CFC-Faced both sides with additional foil layer on one side only.
Soft Felt	Roll	KFA 5	25-30	1.2	6	Carbonised material
Soft Felt	Roll	KFA 10	25-30	1.2	11	Carbonised material
Soft Felt	Roll	GFA 5	25-30	1.2	6	Graphitised material
Soft Felt	Roll	GFA 10	25-30	1.2	11	Graphitised material
CFC	Plate	Standard	1220	1220	See comments	1.2, 2.0, 3.5, 5.5, 7.5, 10.0, 12.5 & 15.0 mm
CFC	Plate	Performance	2000	1000	See comments	2.5, 4.5, 5.5, 6.5, 7.5 & 15.0 mm
CFC	Plate	Premium	1220	1220	See comments	1.2, 2.0, 3.5, 5.5, 7.5, 10.0, 12.5 & 15.0 mm
CFC	Plate	Premium	600	1220	See comments	15.0 & 22.0 mm
CFC Profile	L	Standard	1000 & 2000	65/65	1.3	Limited stock available- To be discontinued
CFC Profile	L	Standard	1000 & 2000	75/75	1.3	
CFC Profile	U	Standard	1000 & 2000	See comments	1.3	60/20/60- 60/30/60- 60/40/60
CFC Profile	U	Standard	1000 & 2000	See comments	1.3	80/20/80- 80/30/80- 80/40/80
CFC Tubes	Tube	FilWound	See comments	See comments	See comments	<1500mm dia x <2500mm long MTO

PRODUCT	DESCRIPTION	GRADE	L (mm)	W (mm)	H/Thk (mm)	COMMENTS
CFC Fasteners	Nuts	Standard	See comments	See comments	See comments	Square nuts M6, M8, M10, M12, M16, M20 & M24
CFC Fasteners	Threaded Rod	Standard	1220	See comments	See comments	Rod M6, M8, M10, M12, M16, M20 & M24
CFC Fasteners	Washers	Standard	See comments	See comments	See comments	Sizes available to suit all standard metric threaded rod
CFC Fasteners	All above as BSF	Standard	See comments	See comments	See comments	All sizes of BSF fixings available MTO
Graphite Tube	Tube	MNC	1000	8	2	Both MNC & MNT extruded graphite tubes offer excellent consistency for use as heating elements and can be used for many other furnace/refractory applications. Other tube dimensions, together with your entire machined graphite needs are available made-to-order on quick turnaround from our dedicated HT machine shop.
Graphite Tube	Tube	MNC	1600	15	5	
Graphite Tube	Tube	MNC	2000	20	10	
Graphite Tube	Tube	MNC	3000	32	22	
Graphite Tube	Tube	MNT	3000	26	15	
Graphite Tube	Tube	MNT	3000	35	22	
Graphite Tube	Tube	MNT	3000	37	25	
Graphite Tube	Tube	MNT	3000	50	37	
Graphite Tube	Tube	MNT	3000	70	50	
Graphite Foil	Sheet/Roll	Sigraflex	Various	<1500	0.15-3.0	96-99.85% Carbon grades available for all applications.
Adhesive	Graphite 2 Pack	C34				Please Call
Paint	Graphite Suspension	Generic				Please Call
Special Coating	Ceramic/Plasma	TCB				Service available upon special request

NOTES
& PLANS



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