



Schunk Carbon Technology

# Heat Treatment

Innovative solutions for  
thermal applications

# Schunk Carbon Technology

A worldwide success. Always at your side.



## High Temperature Applications: Innovative materials competence for Heat Treatment

You can rely on our premium carbon solutions in almost all thermal applications: in heat treatment, medical and analysis technology and the glass industry. Schunk offers a broad range of materials and components for these applications made from graphite, carbon fiber-reinforced carbon, ceramics, oxide fiber-reinforced oxide ceramics as well as carbon and graphite felts. You can profit from our customized range of products and services for high temperature applications.

Schunk is a global leader in the development, manufacturing and application of carbon and ceramic solutions. No other company can match Schunk when it comes to combining innovation and technological expertise with an exceptional service orientation, to produce a spectrum of services that is unique in the market.

In Schunk, you will find a partner that offers you all the technological capabilities of a globally-active company who can realize your ideas pragmatically, and specifically tailor them to your needs - for high-volume industrial markets and highly-specialised niche markets.

### The Schunk Group

Enabling, idea-driven, cooperative to partnership - this is how the Schunk Group has made a name for itself as a globally-active technology group since 1913. Enabling, because we build bridges for our customers to help them develop better products and conquer new markets with innovative technologies. Idea-driven, because innovations are a significant aspect of our company culture.

Cooperative to partnership, because every employee of the Schunk Group is focused on the customer.

The Schunk Group is a globally operating technology company with a global business unit structure. The company is a leading supplier of products made of high-tech materials - such as carbon, technical ceramics and sintered metal - as well as machines and systems - from environmental simulation and air conditioning to ultrasonic welding and optical machines. The Schunk Group has more than 8,500 employees in 29 countries and achieved sales of €1.28 billion in 2018.



### Maintain total control over your thermal processes

We have developed a product portfolio in the field of heat treatment that sets standards in terms of technological development. All over the world, our customers benefit from the advantages offered by our furnace components, insulation materials, charge carrier systems, burning aids and temperature measurement solutions. With our comprehensive expertise in the field of materials and applications, we provide innovative solutions for our customers. Solutions include patented parts for the maintenance of your heating chamber and siliconized material solutions with intelligent charge carrier designs. This creates successful solutions that are cost-effective, energy-efficient and long-lasting.

### Answers that help you stay one step ahead

We understand the requirements of your market. It's important for you to know that we have the expertise to provide answers to your questions using technology. As one of the world's leading specialists in high temperature applications, Schunk provides sophisticated solutions and ideas with added value for every market.

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## Use your energy more efficiently with individual C/C workpiece carriers

In many high temperature applications, traditional cast metal grids are still used as charge carrier systems. As processes become increasingly complex, these traditional grids reach their performance limits leading to recurring failures, reducing their cost-effectiveness. Our carbon fiber-reinforced carbon (C/C) workpiece carriers are great for use beyond these limits thanks to the technologically sophisticated material and customized design.

Charge carrier systems are not only the basis of your workpieces in the heat treatment process but they also create the foundation for ensuring quality, efficiency and uniformity. This means that perfectly tailoring this foundation to your requirements is extremely beneficial for you. Schunk can help you with this thanks to its many years of experience, comprehensive materials expertise and large product portfolio. Our engineers will be happy to work together with you to develop a customized charge carrier system to meet all your requirements, from the initial idea up to the introduction into ongoing series production.

The starting point is carbon fiber-reinforced carbon (C/C), which offers a number of advantages in comparison with high-alloy cast materials. By working with us, you will also benefit from FEM calculations, our large range of component dimensions, the production of special parts, individual finishes, full documentation and also our global sales network and after-sales service.

Your contact for our charge carriers:

✉ [heat-treatment.skt@schunk-group.com](mailto:heat-treatment.skt@schunk-group.com)

## Our service is unique

You will be involved in the development of your charge carrier systems right from the very start. Our customer service continues even long after the finished components have been delivered. We are at your side in terms of after-sales, using our extensive experience to help you. Thanks to our global presence, we can be there for you in person too in most cases.

As one of our customers, you can always rely on getting real added value from our comprehensive customer service. We will be there for you every step of the way throughout the development processes for your customized charge carrier system, and after having integrated the system successfully into your production processes, we make sure that you are absolutely with how everything is working.

As one of the world's leading providers with many years of experience and a global network of sales organisations, we understand what our customers need. That's why we've put together six steps that form the basis for each workpiece carrier development process: Contact, design proposal, conclusion of negotiations, manufacturing, delivery with SPEC (Specification for Carbon Fixtures) and after-sales service.

## A comparison of the advantages

### Disadvantages of cast metal grids:

- Distortion of the workpiece carriers after just a few furnace cycles as a result of insufficient creep strength
- Can lead to the distortion of the workpieces being treated
- Prevents automated loading and unloading, reducing cost effectiveness
- Heavy weight, high density and the associated high thermal capacity can lead to poorer hardening results, longer processing times and increased costs
- Short service life due to increasing brittleness

### Advantages of C/C workpiece carriers:

- High level of strength
- No distortion, even when subjected to rapid temperature changes
- Less distortion of parts and less reworking
- More consistent hardness of parts
- Low density - reduction in weight and thermal mass
- Optimum ratio of workpiece carrier weight to weight of parts
- Increased energy efficiency and decreased operating costs
- Increased productivity thanks to greater furnace loads, higher capacity, faster quenching and reduction in the cycle time
- Optional automated loading and unloading
- Very long service life



**1** We document the status quo, gain an understanding of your requirements and clarify the framework conditions. We are happy to visit your premises at this stage.

**2** We use the information we have obtained and your requirements to develop our design. We then review our design with you and carry out an FEM calculation after this.

**3** You approve the design. We prepare a quotation for you and you instruct us to proceed with production.



**4** We produce workpiece carriers using our own materials, which enables us to ensure that our quality assurance is consistent.

**5** You will receive a SPEC (Specification for Carbon Fixtures) with your product. This contains all the relevant information, for example form and function, FEM calculations, technical facts, explanatory notes for loading situations, use information and much more.

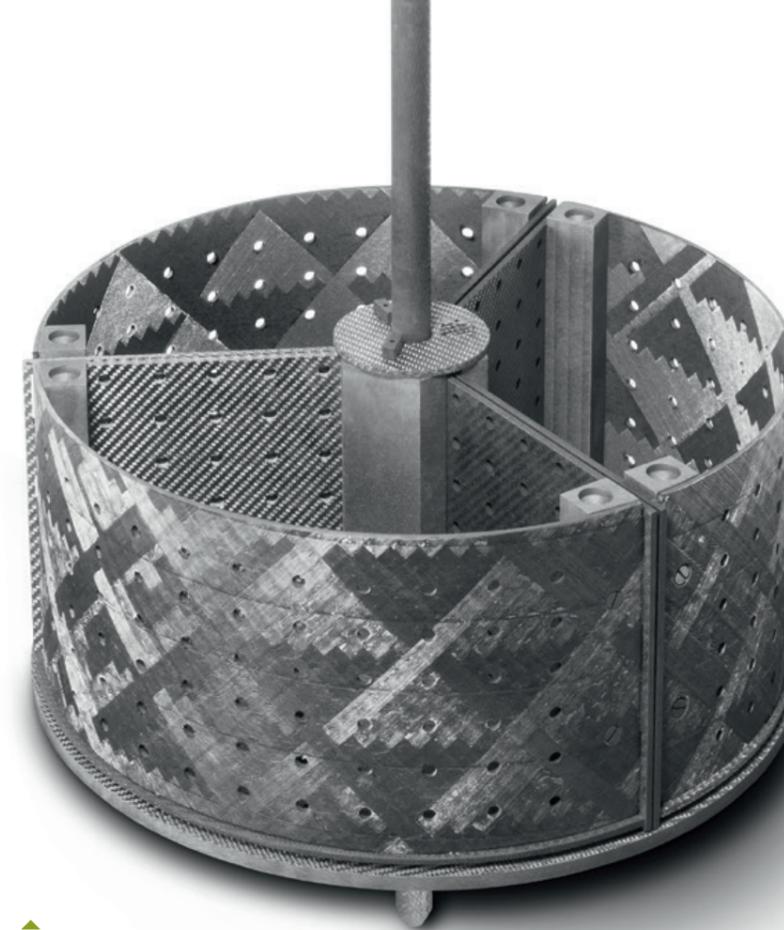
**6** We are still always there for you after your purchase and we are at your side to provide help and advice. If you wish, we can visit your premises after a certain period of time to re-evaluate your processes.

## Interlocked and water jet cut C/C grids

Both of these versions of our C/C workpiece carriers have specific properties that offer particular advantages. We will work together with you to determine which of these properties best meets your requirements and we will use this information to develop the optimum solution for your application's purpose.

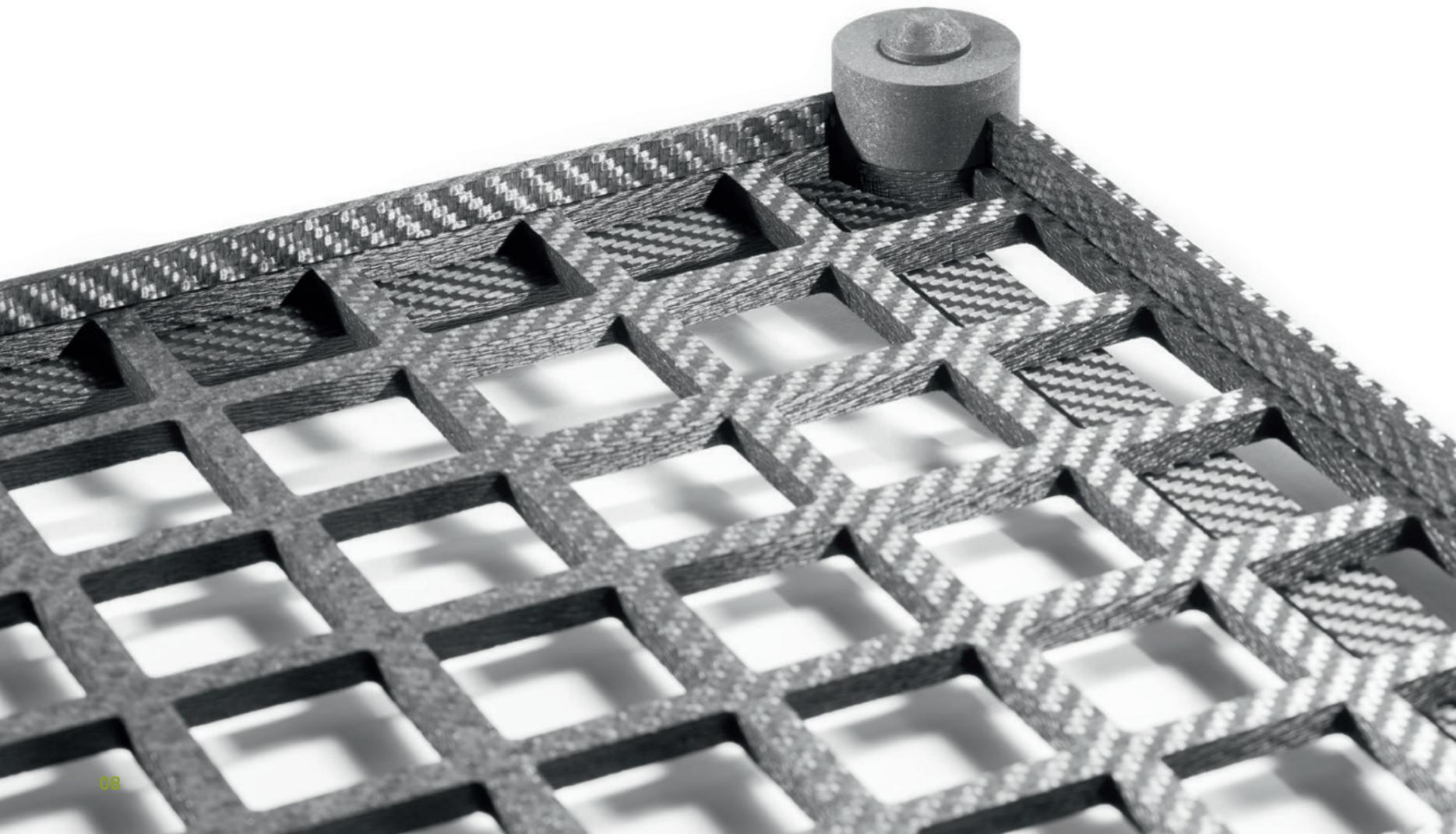
Interlocked grids made from C/C allow for a flexible design. The rigidity of the grid can be adjusted precisely using the web height. These workpiece carriers are particularly well suited for high weight loads and minimal deflection.

Water jet cut C/C grids are ideal for low to medium weight loads. The water jet cutting technology enables precise and cost-effective processing and even detailed structures can be created.



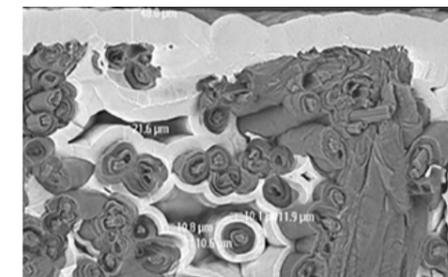
▼  
C/C grid made from water jet cut components

▲  
Individual customer solution



## Surface modifications for special requirements

The surfaces of all C/C workpiece carriers can be modified using various processes if required. This means that wear resistance can be increased by siliconising the surface and the service life of the grids can be extended. Furthermore, we offer coatings based on pyrocarbon (PyC) - this purest form of graphite improves the material binding and also exhibits a high degree of chemical resistance.



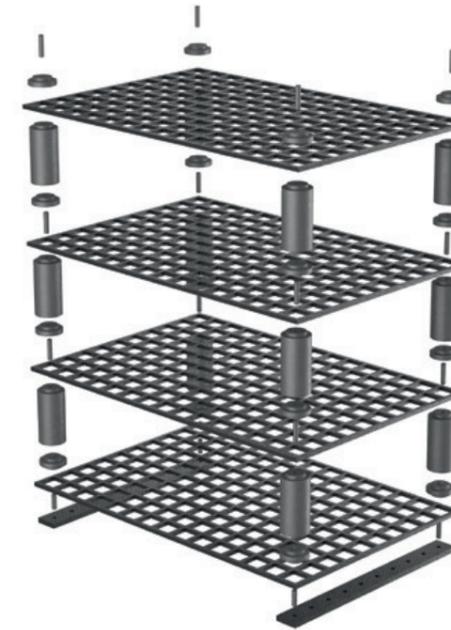
Pyrocarbon-infiltration and -deposition of C/C

## UniGrid® - unique, modular, cost-effective

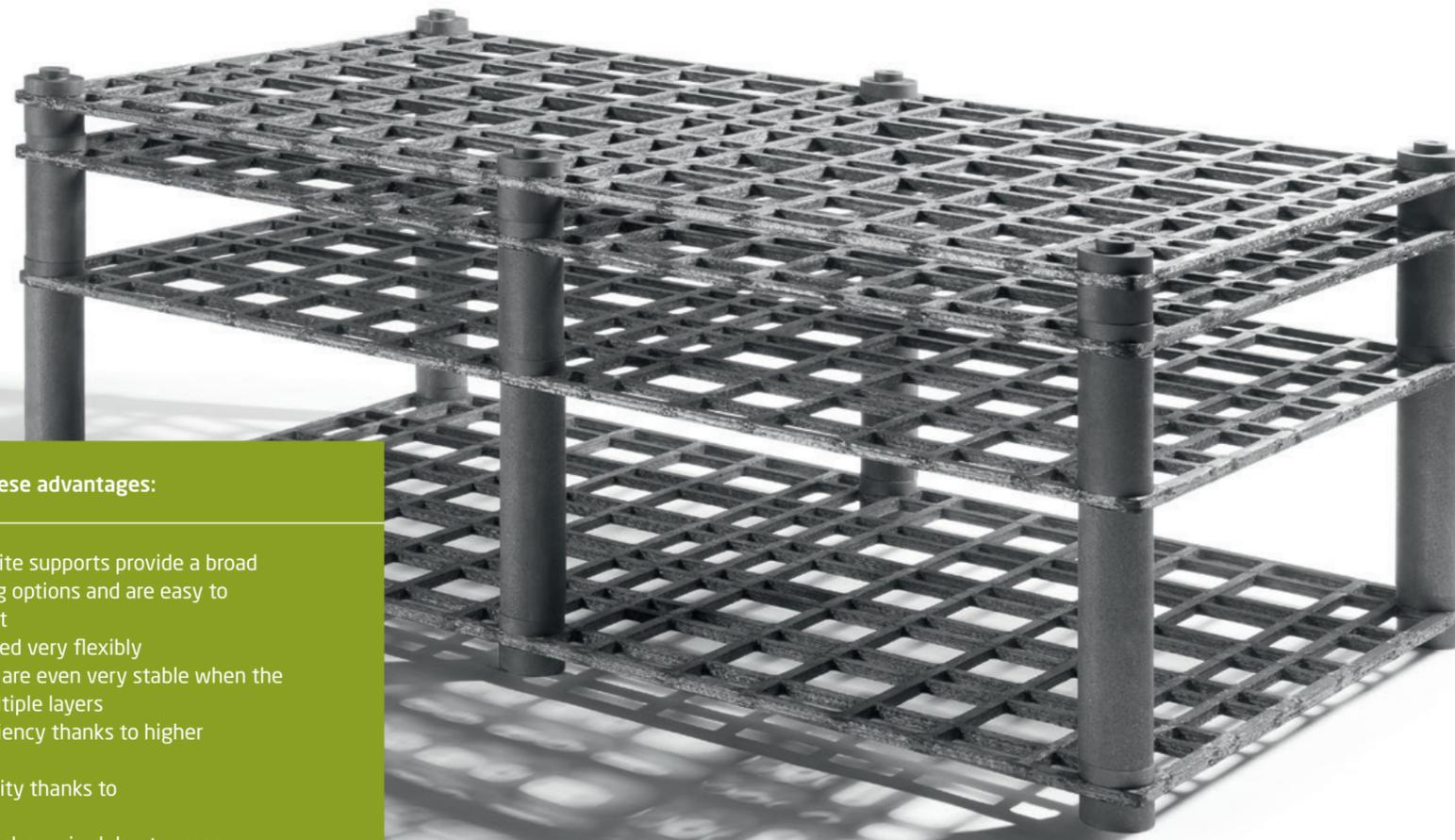
With UniGrid®, Schunk offers not only customer-specific charge carriers but also standardised solutions for C/C grids. Unlike machined or water jet cut grids, these integrally and patented grids have a continuous fibre structure and have no joints. The closed frame structure ensures that handling is easy and simple at high levels of rigidity and strength.

The modular charge carrier system provides a broad range of possibilities for positioning graphite supports. This allows you to achieve maximum flexibility when loading the grids. Our graphite supports are self-centring, both within our UniGrid® and between grids. This makes them easy to assemble and position. The graphite supports can be stacked and provide excellent stability for multi-layered structures.

▼  
UniGrid® MT (1,000x600 mm<sup>2</sup>)



▲  
Modular, easy to assemble



### Make the most of these advantages:

- Self-centring graphite supports provide a broad range of positioning options and are easy to assemble and adjust
- Grids can be equipped very flexibly
- Can be stacked and are even very stable when the structures have multiple layers
- Increased cost efficiency thanks to higher furnace loading
- Increased productivity thanks to faster quenching
- No straightening work required due to wear
- Automated loading and unloading
- Reduction in carrier diversity

## CarboGard - Protects against contact reactions

At application temperatures of over 1,050°C, contact reactions (carburisation) can occur between the hardening stock and the UniGrid®. Our ceramic CarboGard accessories are a lightweight, thermal shock resistant option for protecting your hardening stock from unwanted carburisation.

The CarboGard standard parts fit perfectly into the openings in the UniGrid® system. This means that CarboGard plates can be used to provide the necessary flexibility to meet your requirements, whilst also minimising the thermal mass.

CarboGard ►  
web profile



CarboGard ►  
standard plate



You can find our standard parts list here!



## Oxide fiber-reinforced oxide ceramics

Oxide ceramic composite materials, or Ox/Ox for short, can resist thermomechanical stress in a highly corrosive or oxidising atmosphere. These materials are our most innovative form of protection against carburisation. Thanks to the unique concept of oxide ceramic high-performance fibres and a nanoporous matrix, they can even withstand the harshest of conditions. The industrial manufacturing processes that we have developed mean that it is now cost-effective to use Ox/Ox products.

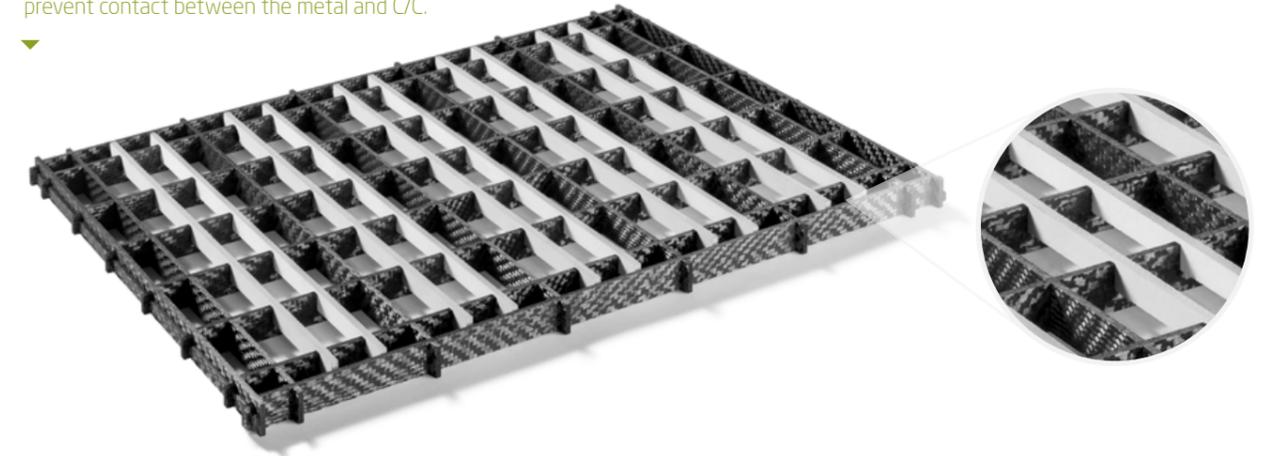
At temperatures above approx. 1,050°C, many steels react with carbon, which leads to carburisation. This is triggered by an eutectic reaction that reduces the melting temperature of the metal. This means that contact reactions between metal and carrier material can take place at process temperatures that are required to heat treat the metal. The consequences of this include possible impurities in the customer's product as a result of material disintegration and the customer's components may even melt. This does not only damage the parts or carrier but often also damages the interior of the furnace, which then needs to be inspected.

Ceramics or ceramic layers are therefore used to form a necessary barrier between the steel and carbon. What is, however, disadvantageous is the high weight and fracture susceptibility of all-ceramic materials as well as the limited durability of the ceramic layers. Ox/Ox is now available to you as a high-performance and cost-effective alternative. This is a fiber-reinforced ceramic that can be created in a much slimmer design than traditional ceramics thanks to the fibre reinforcement, while also being resistant to thermal shock. A major advantage is also the significantly decreased susceptibility to fracture. In accordance with customer-specific requirements, more complex component geometries can be manufactured.

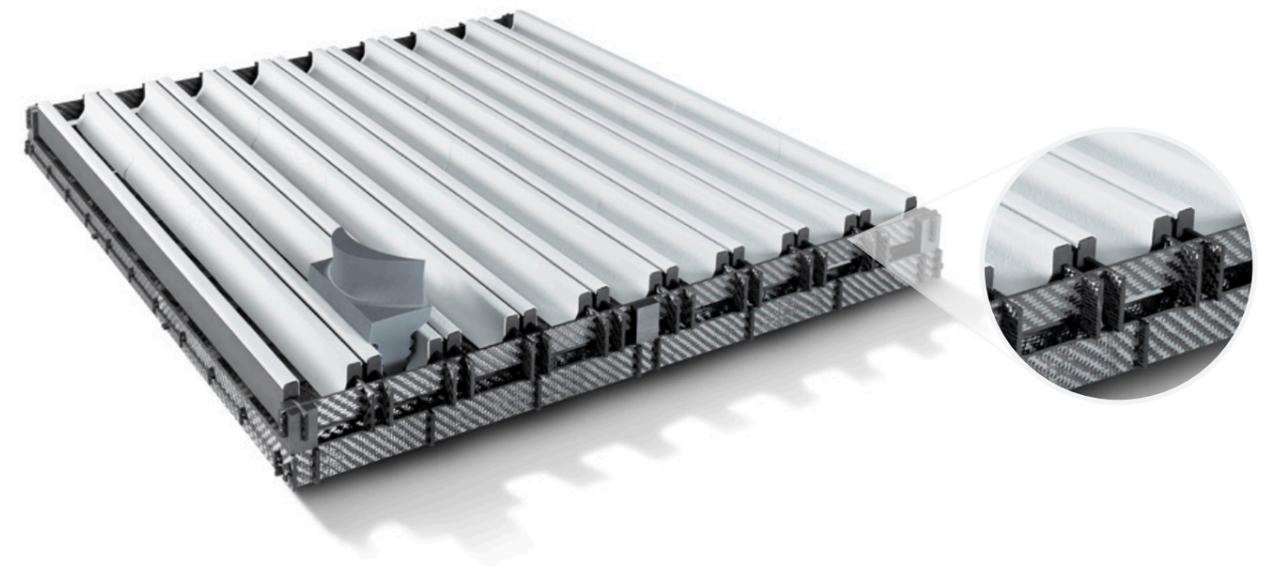
### Make the most of these advantages:

- Innovative material that is also highly durable
- Provides highly-effective protection against carburisation
- Significantly lighter than solid ceramics (more cost-effective burning processes)
- Significantly increased service life thanks to resistance against oxidation and corrosion
- Highly resistant to heat and thermal shock
- No problems with fast heating and cooling (quicker processing)
- Low heat conductivity
- High damage tolerance (ductile fracture behaviour)
- Electrical insulator
- No wear under thermo-cyclical stress (improvement in quality)
- Ideal for automated loading of charge carriers

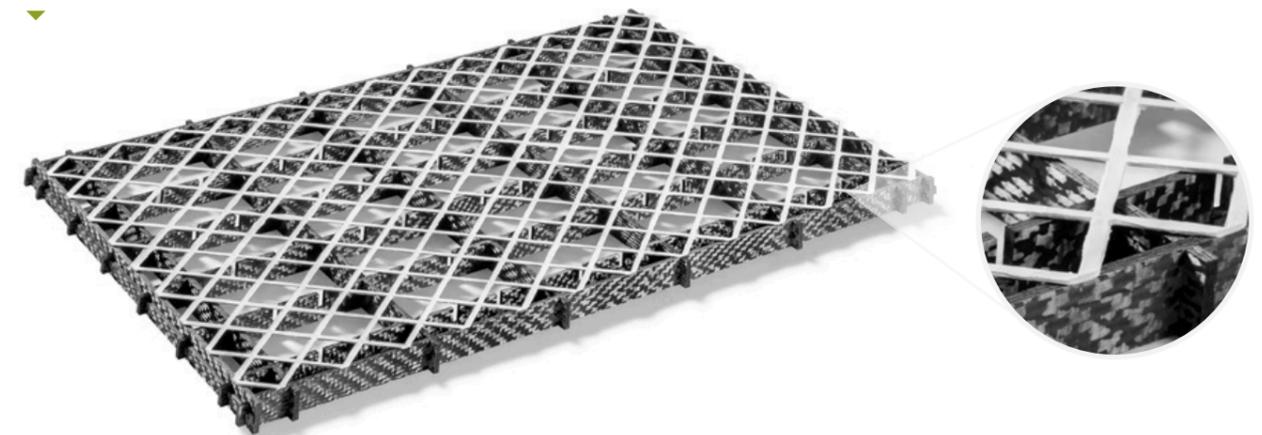
C/C for stability, Ox/Ox for carburisation protection: Machined hybrid system with raised Ox/Ox bars that prevent contact between the metal and C/C.



Also a hybrid solution made from weight-bearing C/C and protective, patented Ox/Ox profiles. This fixture is specially designed for the heat treatment of turbine blades.



With regard to angle, thickness and comb size, customized hybrid racks made of C/C and Ox/Ox are feasible. Grinding is also possible in order to achieve a smooth and level surface.





## To ensure that you are always happy with the performance of your furnace

A furnace system is the key component for heat treatment, which is why you should ensure this is made from the best materials. We can provide you with everything you need to do this. Equip your entire furnace system with premium-quality Schunk components. You can also profit from our extraordinary expertise in the field of materials and our international presence. This enables you to achieve optimum process reliability.

Vacuum furnaces with gas quenching are subject to a number of chemical and mechanical stresses. The harsh conditions may damage the furnace insulation and therefore significantly reduce the service life of the heating chamber. The furnace may even malfunction entirely due to insulation damage and repairing this is an expensive process involving long and costly periods of downtime. It is therefore strongly recommended that you ensure regular maintenance is carried out and high-quality insulation materials are installed. Schunk can provide you with technologically-advanced materials solutions for doing this: MechTherm® has very good mechanical properties and InsuTherm® has excellent insulating properties.

We endeavor to not only supply you with the best possible materials. But we also want to ensure that you get maximum performance from your furnace: Our experts will be happy to help you select the best materials for your needs and will work closely with you to develop individual solutions for improving the functionality of your furnace. Our materials can significantly improve the temperature homogeneity, efficiency and service life of your system.

Your contact for our oven spare parts:

 [heat-treatment.skt@schunk-group.com](mailto:heat-treatment.skt@schunk-group.com)

## Insulation materials and fixing elements for optimum efficiency and service life

Carbon offers a number of advantages for use in high-temperature furnaces, such as extraordinarily high temperature resistance in an inert atmosphere and outstanding thermal shock resistance. It should therefore not come as a surprise that our components made from carbon fiber-reinforced carbon (C/C) are setting new standards for insulation and fixing.

### Graphite coating powder reduces maintenance requirements

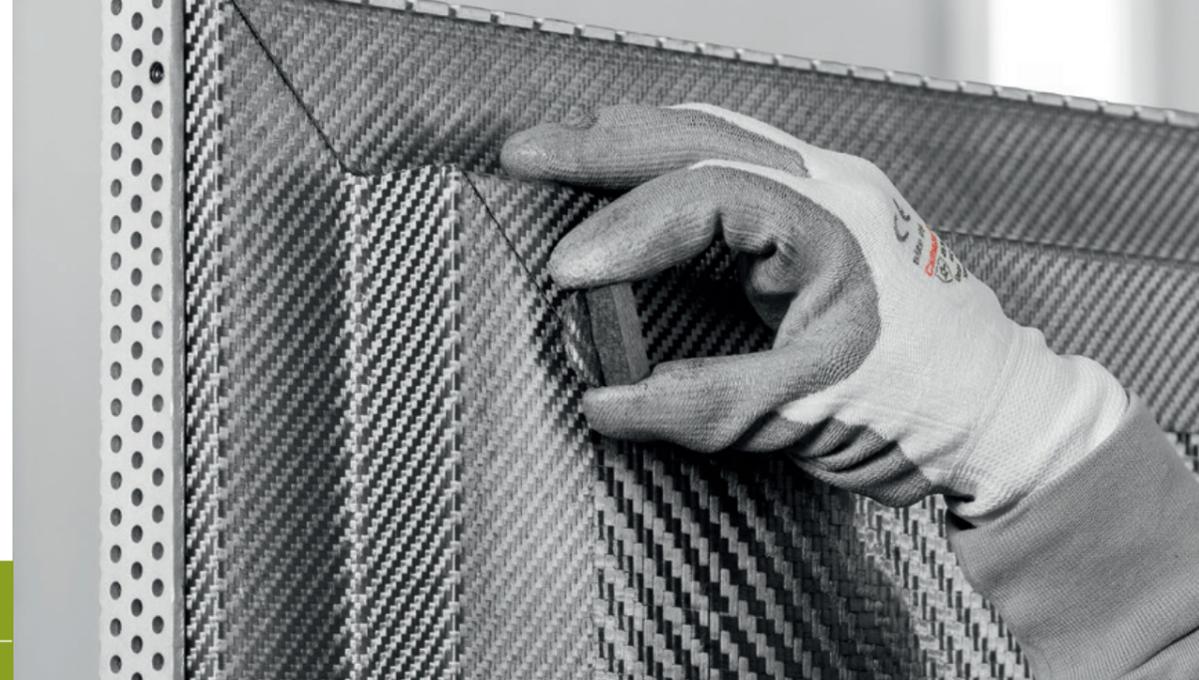
Hard-felt can be effectively protected against gas erosion using a graphite coating. With our FU12146 coating powder, it is really easy and extremely cost-effective for you to mix up this coating and apply it yourself. You can also select the quantity and viscosity to suit your particular requirements. In addition, the powder is not a hazardous substance, which means it can be stored at room temperature and shipped normally.

Graphit coating powder FU12146



### Make the most of these advantages:

- Increases the service life of hard felt by up to 200%
- Decreases storage costs by up to 90%
- Decreases shipping costs by up to 70%



C/C fixing elements

### Robust C/C fixing elements reduce the need for expensive repair work

Insulation in high-temperature furnaces is often secured using molybdenum screws as standard. However, molybdenum becomes brittle and breakable, even after the first heating process. The consequences: The screws break off, the insulation loses stability and the charges may be damaged. The replacement of the molybdenum fixing elements that then becomes necessary is very expensive and leads to unnecessary periods of downtime.

This problem is prevented by using our robust C/C fixing elements. C/C provides consistent mechanical properties throughout the entire product life cycle. The hot zone also does not need to be removed during maintenance. Maintenance takes place inside the hot zone, which makes this process significantly easier and quicker.



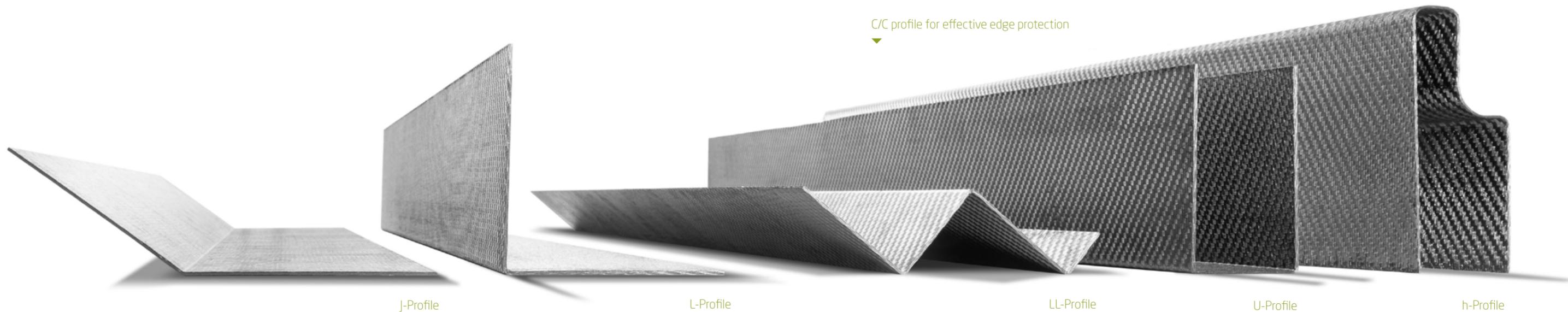
Standard C/C fixing elements

### Make the most of these advantages:

- Maximum chemical resistance
- Outstanding thermal shock resistance
- Improved temperature homogeneity
- Longer service life
- Easy to replace during servicing
- Standard dimensions available off the shelf
- Customer-specific special shapes can be produced

You can find our standard parts list here!





## Design perfect heating chambers

Our broad range of flexible profiles and foils made from C/C make it easy for you to protect the insulation of your furnace. This means that you can also profit from the unparalleled material properties of carbon fiber-reinforced carbon and our expertise in perfectly tailoring these properties to your requirements.

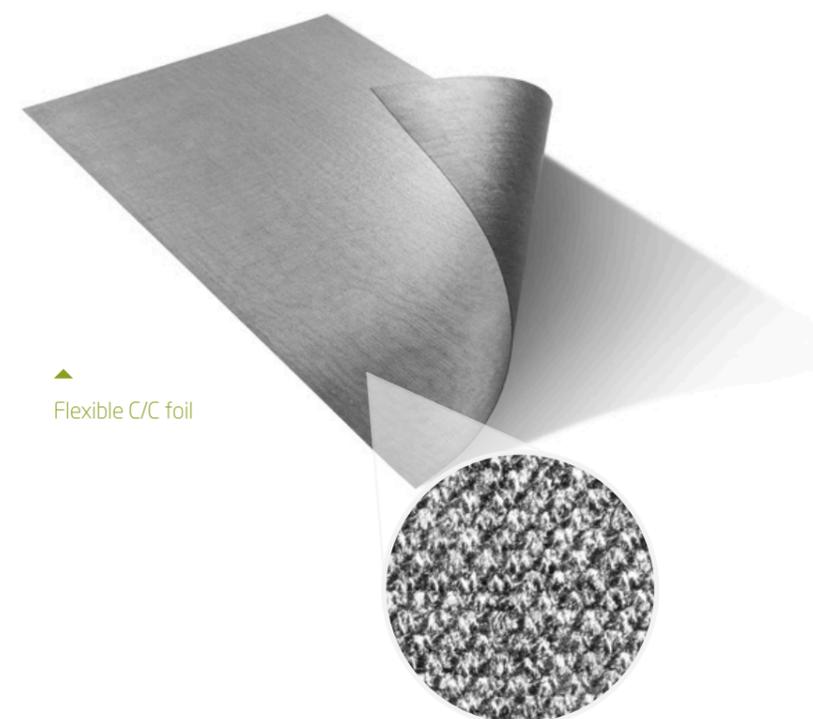
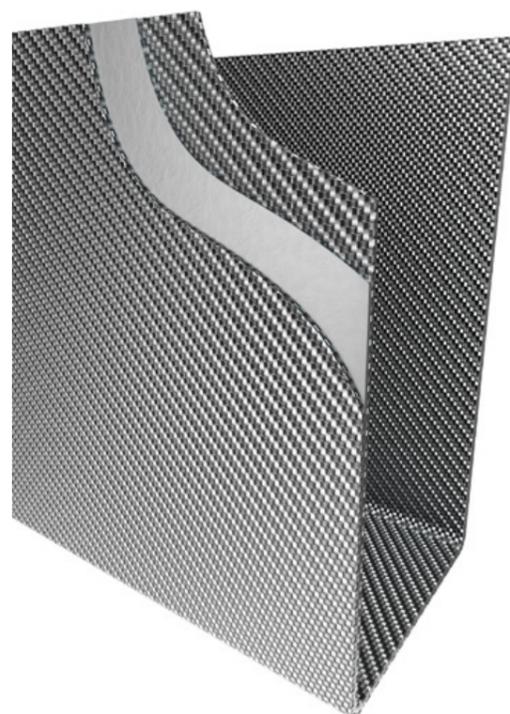
Regardless of which shape you choose, with or without foils, our C/C profiles provide protection against gas erosion and mechanical damage, prevent the formation of thermal bridges, create improved temperature homogeneity, double the service life of the insulation, significantly reduce the scrap rates and reduce the downtime that results from maintenance and repairs.

The **J-profile** is well suited for use in combination with convection fans. The profile reduces the flow resistance in the door area and guides process gases directly to the fan blades.

Our **double-L-profile** is an innovative solution for increasing the service life of the door insulation. Since abrasive and mechanical wear primarily affect the insulation in the door area, we have developed a two-tier profile that provides perfect protection for the door edges. We cover the door insulation similarly to a picture frame. This means that the insulation is permanently held in the correct position and the sealing surfaces are completely protected.

The **U-profile** includes 40 mm hard-felt plates together with a C/C plate or graphite film as a sacrificial layer. C/C profiles lined with graphite film offer effective protection against gas erosion throughout the useful life of the equipment.

Our **C/C-foils** provide excellent surface protection for cylindrical insulations, and with a thickness of 1.7 mm they are also flexible and pliable.



Protection for cylindrical insulations thanks to C/C L rings

Our C/C profiles with interior graphite foils are new. This is practically a composite inside a composite material.

Flexible C/C foil

You can find our standard parts list here!





## Innovative partner for the sintered and hard metal industry

Extreme temperatures, high gas pressures and some extreme atmospheres - standard tools are often insufficient for heat treatment in the sintered and hard metal industry. Special adaptations are required for these tasks. Benefit from individual solutions that we create together with you.

Make the most of our expertise with materials and development! Whether you wish to use C/C, graphite, insulation materials or special finishes, our product portfolio for the sintered and hard metal industry contains everything you need to be successful with furnace system components, charge and process aids. And if we don't have what you need, we are happy to work with you to develop it.

Our own materials manufacturing creates the foundation required to ensure the highest level of process reliability. This means that we can guarantee you high-quality processing and consistent quality control. Our products are characterized by outstanding customized physical properties. These are achieved by manufacturing our materials using cutting-edge methods. When selecting the manufacturing method to be used, we always keep the end application in mind.

You can see the results in the form of increased cost-effectiveness. For example, you can achieve cost savings by reusing high-quality, expensive parts, by increasing output thanks to design adaptations and thanks to the longer service life of our C/C products. New finishing techniques also create an additional reduction in handling costs.

We focus on providing individual support. That is why customising and full service provision are key aspects of what we do. From a broad range of products and finishes and accessories that you can get quickly off the shelf, to customer-specific adaptations by our team of engineers, right up to our global sales network and comprehensive after-sales service.

Your contact for powder metallurgy:

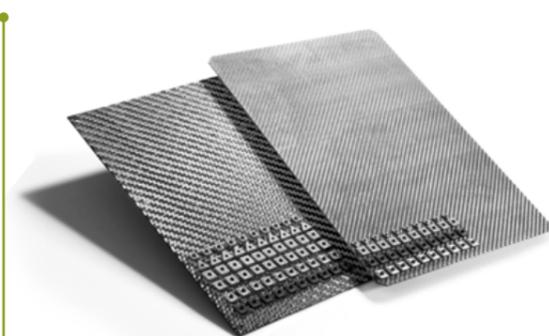
✉ [heat-treatment.skt@schunk-group.com](mailto:heat-treatment.skt@schunk-group.com)

## Sinter plates for all your requirements

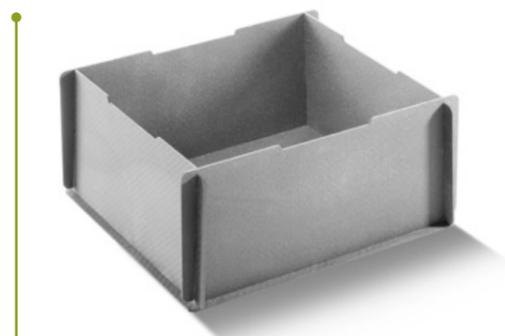
Whether for use with bars, drills or indexable inserts, we have the perfect sinter plate for each of your products.

Depending on your requirements, we will provide you with various sinter plates made from **graphite** or **C/C**. We can also provide a broad range of geometries, whether you require a contoured or even surface. We will work to ensure that we meet your exact requirements and that your processing quality is consistent.

Using C/C, which is a very lightweight and stable material, also provides significant advantages in comparison to using graphite for sinter plates and boxes. We would be happy to advise you on switching from graphite to C/C sinter plates. Using an FEM (finite element method) calculation, we will find the optimum plate strength for your requirements to increase your productivity. You can use C/C plates, boxes and other batch-carrier accessories both in continual and batch-based processes.



C/C sinter plates



C/C box for the heat treatment of powders

## Replacement parts - we provide you with fast assistance

In order to ensure that your sintering furnace continues to function properly in the future, we keep a broad range of replacement parts in stock for you:

- Insulation material
- C/C plates and profiles
- C/C or graphite foils
- Screws, nuts and other fixing materials

## C/C support rings for axial hot pressing

C/C support rings by Schunk set new standards thanks to their long service life and outstanding dimensional stability. In order to ensure that ceramic powder is pressed and sintered at high temperatures and under high pressure in accordance with the best quality standards, we offer you wrapped C/C sintering support rings.

- In tremendous wall strengths
- In large diameters
- Tailored to your requirements



## Graphite and C/C components for CVD coating

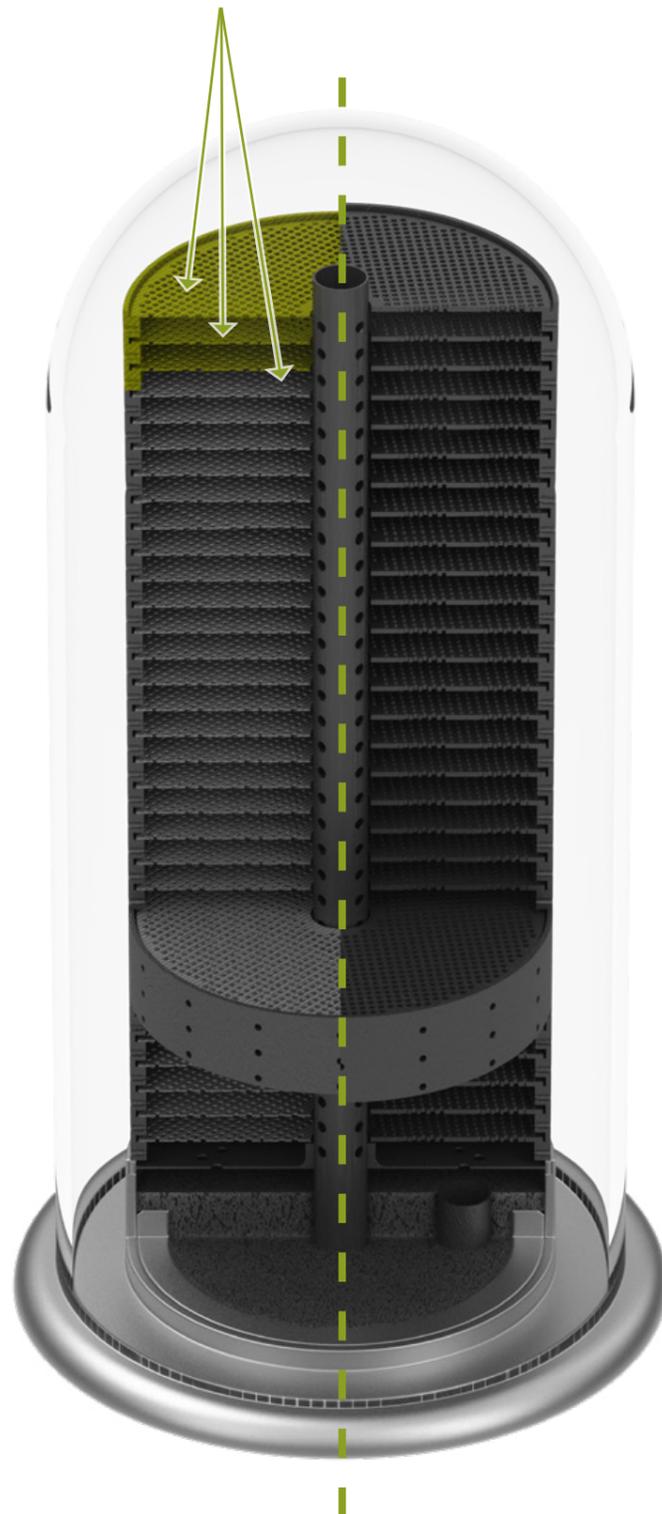
Schunk supplies all the systems equipment for CVD processes: all components for gas flow as well as for batch loading. We make all the components from graphite or C/C materials. These have been tried and tested in application and are best suited to the challenges of CVD coating.

We ensure that we provide consistently high quality with our graphite parts for every dimension you wish to use, from simple to highly complex designs.

For **charging plates**, using C/C provides particular benefits thanks to the positive material properties:

- Increase in productivity per production batch
- No brittleness and tendency to break, therefore no loss
- Longer service life
- Reuse by removing the CVD layers

+ 3 levels = + 10% productivity



C/C charging plates

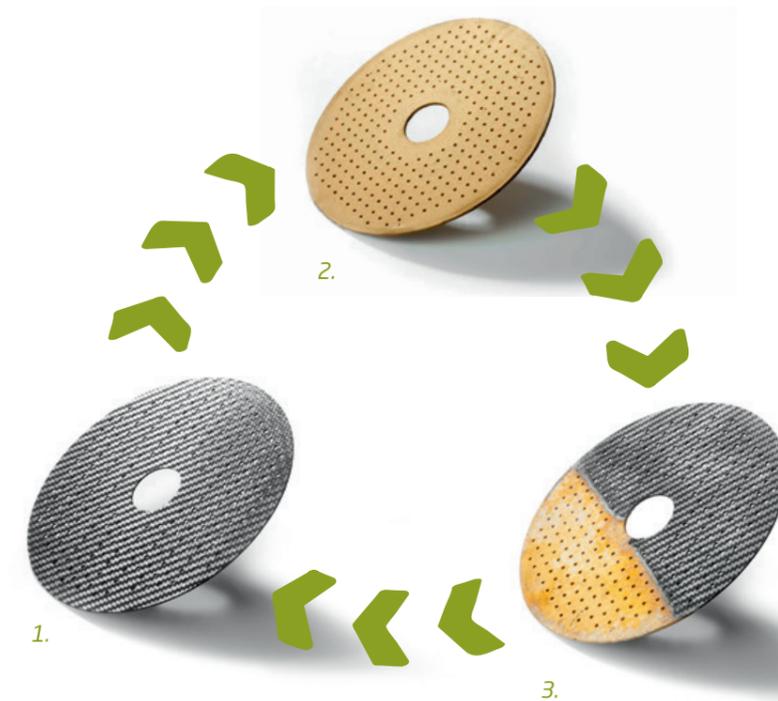
By substituting graphite plates with C/C charging plates, productivity can, for example, be increased by 10%. ▶

## Decoating - the innovative solution

Whenever you coat your parts, you automatically also coat your carrier components. As soon as layers begin to flake (particle release), the service life of these components ends so as to prevent damage to the batch of finished parts.

With professional **decoating** for carrier components, we have created a method for treating the components and reusing them which saves resources and is cost-effective. Above all, decoating is as well suited to **C/C components** as it is cost-effective.

Graphite charging plates only have one period of use due to possible hairline cracks and the material's brittleness and tendency to break. This means that cost-effective decoating is not really possible, with the exception of some parts, such as very large graphite support rings. Conversely, C/C charger plates last for several and thus considerably longer periods of use, due to their decoating.

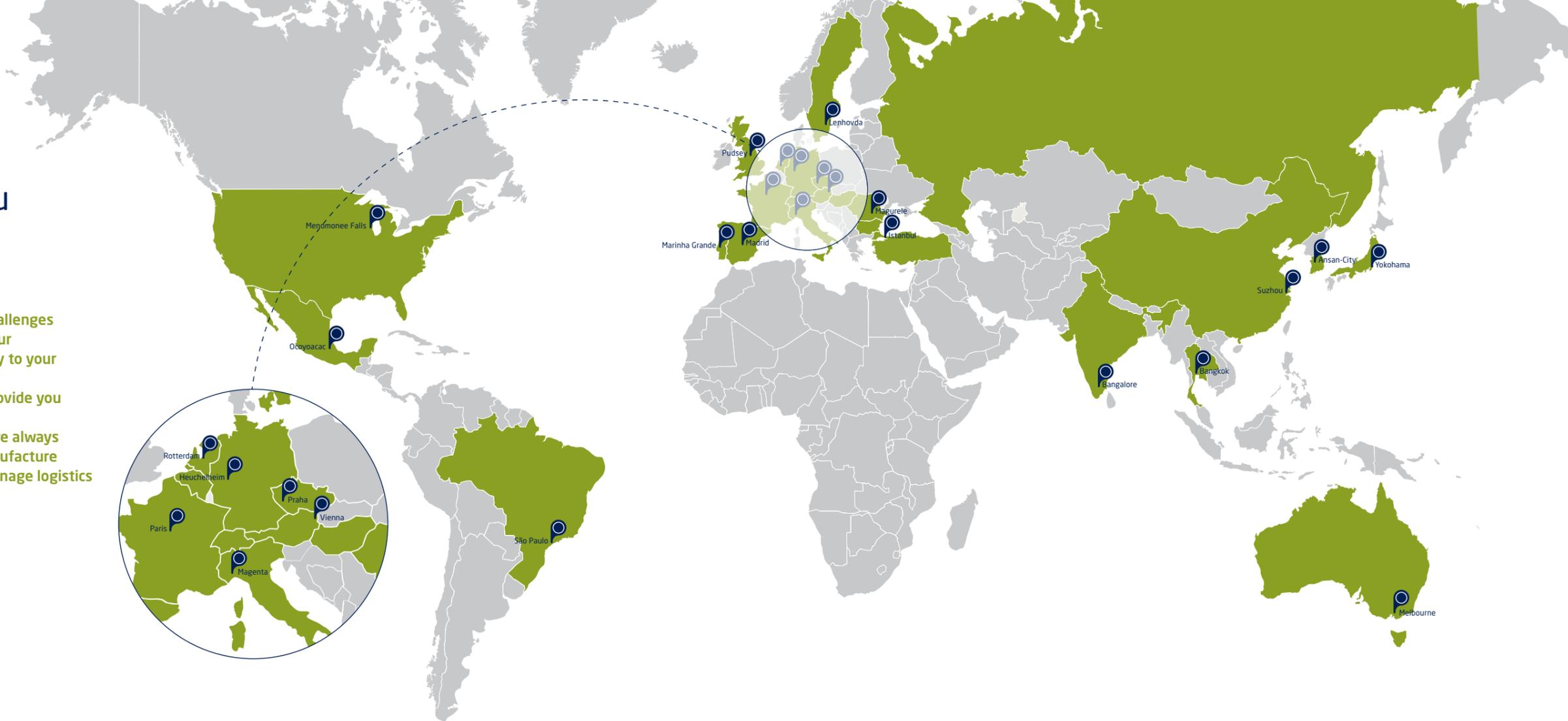


1. New and decoated C/C charging plate
2. C/C charging plate after many periods of use
3. C/C charging plate during decoating

## LOCATIONS

We are there for you where you need us

We are keeping up with the increasing challenges posed by globalisation and are tailoring our decentralised company structure precisely to your markets and application fields. At our 21 locations, our specialists can provide you with their comprehensive expertise. Thanks to our global sales network, we are always really close to you all over the world, manufacture products, provide on-site supplies and manage logistics for you in lots of countries.



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