



MACHINE TOOLS

# HIGH-PERFORMANCE CFRP TOOLS

# MAKING QUANTUM LEAPS

## POSSIBILITIES IN THE CARBON FIBER GENERATION

Faster, higher, stronger. Are these your requirements and those of your customer? We can't reinvent the wheel, however, we can make leaps in development and push modern technologies forward. Our material is carbon fiber.

### Limits were Yesterday

In times of strong competition and price erosion, topics such as automation and efficiency are becoming more and more important to machine tool manufacturers and their customers. These developments have led to the point that traditional materials, such as steel and hard metals, have been taken to their physical limits and are still insufficient. The unique material properties of fiber composites, especially CFRP, offer real possibilities to go beyond these boundaries and increase profitability

### Focussed Knowledge

CFRP is a material, which in and of itself, does not necessarily lead to economical and technical advantages. In order to take full advantage of the performance spectrum of the material, the component must have the right concept. We concentrate on fiber composite-friendly construction designs while focussing our attention on the requirements of the customer application

### Shifting the Natural Frequency

The material properties of fiber composites make possible the shifting of a component's natural frequency in order to suit it to specific service conditions. The high specific stiffness of a carbon fiber laminate, i.e. the stiffness in relation to the density, can be used through precise winding placement of the fibers to raise or lower the bending and torsional natural frequencies. And this can be done to components so that their natural frequencies are no longer excited by frequencies in their working environment.

### Higher RPMs, Smaller Milling Tools

Due to the high specific stiffness, a CFRP spindle can have a much higher natural frequency than a steel spindle. This leads to a much wider range of vibration-free RPMs available, which enables the use of smaller milling tools for finer finishing.

### Adjusting the Coefficient of Thermal Expansion

Carbon fibers become shorter when warmed. This enables carbon composites to be produced with very different coefficients of thermal expansion. Depending on the fiber orientation this can lie between  $-2 \times 10^{-6}$  and  $+40 \times 10^{-6}$  K. These advantages be especially useful in applications that require high precision from components. Dynamic applications where temperature influences exist are the ideal setting for thermally stable composites, i.e. an expansion of zero.

### Thermally Stable Bridging Tools

During the development of a bridging tool for the fine finishing of bores with a diameter of over 500 mm, the heat produced in the application became a problem which could not be solved with conventional designs. The warmth which was produced during turning led to a thermal expansion in the tool itself. The change in the tool length produced an undesired conical bore in the workpiece, which would then need to be removed with a control cut afterward. The use of CFRP offered an elegant passive solution: a thermally stable bridging tool. Thus dissatisfying post-processing becomes superfluous and time-consuming production steps are saved.



SOURCE: MAPAL Dr. Kress AG



Carbon tools provide for precise cuts.

# ACTION. REACTION. INNOVATION.

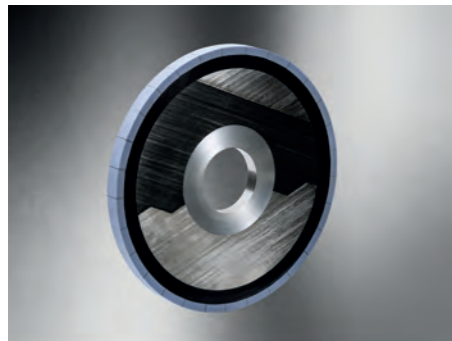
## HIGH-PERFORMANCE COMPONENTS BRING EFFICIENCY AND PROFITABILITY

In the end, the only thing that counts is the bottom line. Carbon machine tools can often lead to faster cutting parameters thus increasing the performance of the entire production line.



### Less is More

The positive material properties of CFRP bring substantial improvements compared to steel products. With the same cross-section, a fiber composite can have the same or an even higher stiffness than its steel counterpart, while offering a weight savings of 80%. The significant weight difference leads to lower inertia and, in the end, to energy savings and the protection of resources. The reduction of mass shortens retooling times, eases handling and often eliminates the need for a crane.



Composite Tools are used for higher speeds and loads.

### Oscillation

We developed a CFRP drive shaft with a 60 Hz oscillating motion, because the inertia of a steel shaft could not have achieved the necessary tact. This component needed the same torsional stiffness as the steel shaft so that attached tools would move synchronously across the entire machine length. The thermal expansion along the axis needed to be close to zero, so that the distance between the individual machine elements would remain constant even under fluctuating temperature influences. Thanks to the adjustability of the material properties in CFRP, an optimal carbon shaft was created for the application; one that would not have been possible with traditional materials.

# BE FREE!

## FORGING NEW PATHS TOGETHER

Make yourself free from all of the constraints that burdened your development of new ideas in the past. Think new, think out of the box, think radically – with an experienced and reliable partner at your side.

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