Quality in CFRP milling increases with manufacturing demands

Jointly developed by Hufschmied and CemeCon, the new HEXACUT® 058 milling cutter impresses with maximum process reliability and outstanding service life when machining CFRP for aircraft construction

Greater process reliability and cost efficiency for aircraft construction: CemeCon and Hufschmied collaborate to design new tool

When milling carbon fiber reinforced plastics, the aviation industry in particular demands maximum quality of the machined surfaces and the highest process reliability. Hufschmied Zerspanungssysteme GmbH and CemeCon have been working closely together to set new standards for this important industry of the future. A jointly developed premium tool combines geometry, substrate, and diamond coating to create an optimal solution.

The machining of carbon fiber reinforced plastics, or CFRP for short, which are particularly advantageous for lightweight construction, is one of the greatest challenges in the machining industry. Even more demanding variants of these composite materials are used in aircraft construction. At the same time, there is an absolute focus on maximum component quality, which completely rules out compromises and demands the highest performance from the milling tools used. This is because the high-strength fibers must be cleanly divided, despite their different orientations within the matrix. Otherwise, fiber protrusions or delaminations occur, which require at least time-consuming manual reworking.

The manufacture of large aircraft parts, such as shells or segments for the fuselage, presents aircraft

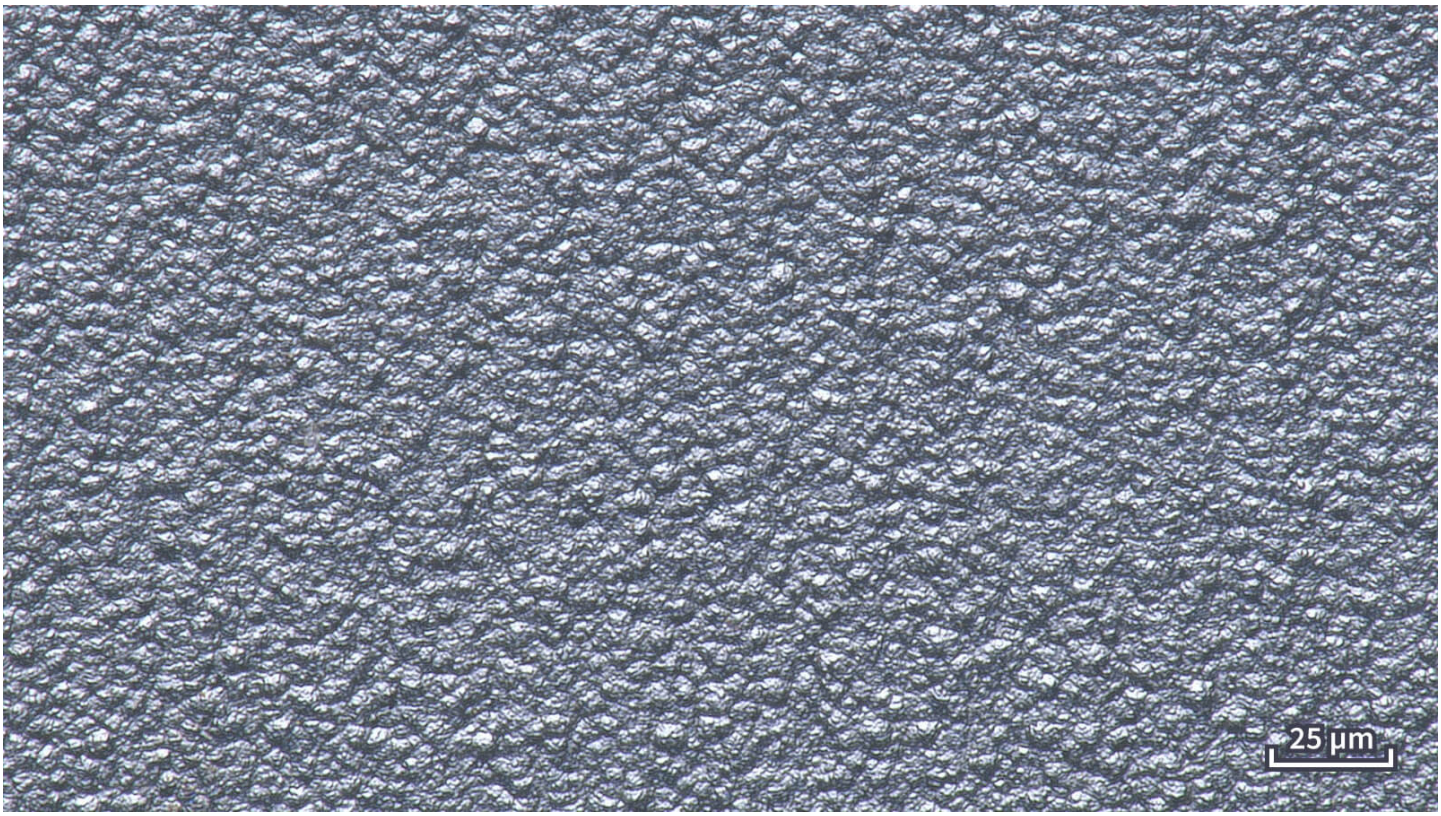
manufacturers and suppliers with a very specific problem: the wall thicknesses here often range from a few millimeters to several centimeters. Enormous transverse forces act on the milling tool at the transitions. In the worst case, it can break and fragments can get inside the component—resulting in costly production interruptions or even the loss of entire components. The use of copper mesh as lightning protection poses a further challenge during machining. The aim is to achieve a component edge that requires no reworking—without any copper protrusions.

These are precisely the challenges that development partners Hufschmied and CemeCon have set themselves. The Bavarian tool manufacturer and the coating specialist worked together to design a new milling tool that significantly increases process reliability in CFRP milling and at the same time extends its service life by more than 50 percent compared to tools used in the same application.

A structured path to the new premium tool

“Our customers in the aviation industry repeatedly emphasize this in discussions: When machining components made of fiber-reinforced composites, process reliability is the top priority, as even the smallest component deviations can be very expensive. This has inspired us to develop a significantly improved solution to win over users in this field,” says Fabian Lindinger, Head of Application Technology at Hufschmied. The foundation was laid for the groundbreaking HEXACUT® 058 milling cutter specifically designed for CFRP aircraft components.

On the way there, the existing tool geometry was first re-examined and revised at the Hufschmied development center near Augsburg, Germany. In addition to optimum process reliability, the new tool had to meet another requirement: the cutting quality had to be guaranteed over a period of use as long as possible.



The diamond coating adapted for the new premium tool—shown here magnified 1,000 times—ensures a

very uniform wear pattern and guarantees a clear, smooth cutting edge at a consistently high level throughout the entire service life of the tool

Perfect coordination of tool parameters

The rest of the process showed how a strong partnership in innovative technology can make all the difference: essential to achieving an ideal overall result was, of course, the customized coating, which was tailored to the tool geometry developed by Hufschmied and the innovative substrate. To this end, the coating experts at CemeCon specified a diamond coating material for the new tool, which already achieved absolutely outstanding quality in tests. “It was extremely fascinating to observe how the optimal pairing of carbide substrate and coating material gradually emerged,” recalls Javier Fuentes. The Head of Coating and Cutting Material Development at Hufschmied emphasizes: “Through productive teamwork, we were finally able to achieve a homogeneous wear pattern that allows us to achieve a clear, smooth milling edge at a consistently high level throughout the entire tool life. And coating spalling or even tool breakage simply no longer occurred in the product tests.”

Marco Furrer, Sales Manager at CemeCon, explains: “We specifically adapted the proven CemeCon coating material CCDia®AeroSpeed® for the new Hufschmied tool. This enabled us to achieve exceptional adhesion to the carbide selected by Hufschmied despite the high coating thickness. The impressive result: the new HEXACUT® 058 from Hufschmied offers users consistently high cutting quality, maximum process reliability, also due to substantially less vibration, and a significantly longer service life.”

Strong partners working on an equal footing

The entire project benefited greatly from the professional cooperation between the parties involved, as the partnership between Hufschmied and CemeCon has long gone beyond a mere supplier-customer relationship. Working closely together, they worked out important details such as edge preparation, cutting radii, layer thickness, and layer architecture. “By combining our expertise, we were able to optimize all parameters until we had achieved a solution that was consistent in every respect,” explains Michael Woda, Manager Development Diamant at CemeCon.

The companies are also continuing to work together in the series production of the HEXACUT® 058. The premium milling cutters of the new type are coated at CemeCon's headquarters in Würselen, in the world's largest diamond coating center, and subjected to comprehensive quality control. Independently of this, Hufschmied rechecks relevant criteria, such as homogeneous layer thickness distribution—for end customers, this means additional process reliability.

“This project, like our other collaborations with CemeCon, some of which have been going on for many years, makes an important contribution to establishing Hufschmied worldwide as a synonym for first-class machining solutions,” says Managing Director Christel Hufschmied, delighted with the development success. “The new diamond tool and the joint effort with CemeCon to bring it to industrial maturity are helping us to achieve our goals in the long term.”

Hufschmied Zerspanungssysteme GmbH

Hufschmied Zerspanungssysteme GmbH, founded in 1991 and headquartered in Bobingen near Augsburg, Germany, develops process-optimized precision tools for machining and friction stir welding. As a specialist in machining plastics as well as glass and carbon fiber materials, Hufschmied is one of Europe’s leading developers of solutions for new materials. The company’s high-performance tools are particularly valued in the automotive and aerospace industries as well as in medical technology.

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