

Technology

## Cutting the Deep and Narrow

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### *OSG EXOCARB® WXS® End Mill Series Provide Reliable Alternative for Deep Cavity Machining*

#### **Magnus Hoyer, OSG Germany**

A number of challenges, such as poor chip evacuation, vibration, chatter, tool instability and poor tool life, are commonly associated with the machining of deep cavities. In deep applications, the side walls of the workpiece become barriers for proper chip removal. Chip evacuation would only worsen the deeper into a part a cutter proceeds. Moreover, tool holders and adapters may collide with the workpiece due to the high contour and narrow web environment. With standard cutting tools, the cutting edges are fully engaged with the workpiece, resulting in lateral cutting forces that can trigger vibration, chattering and thus tool failure. Electrical discharge machining (EDM) is often used as an alternative for deep cavity machining, but it is highly time consuming and costly.

Meissner AG, a German manufacturer of prototypes, production tooling and molds, was experiencing such a challenge when working with the production of water jacket core tools that require the processing of tight pockets, narrow webs and high contours. As a manufacturer that is always in sync with the latest production equipment and technologies, Meissner has discovered that even with the utilization of 5-axis machining, optimal performance cannot be achieved for this type of work.

Founded in 1922 and headquartered in Biedenkopf-Wallau, Germany, Meissner offers services including the development, design and manufacturing of prototypes and production tooling and molds for clients around the world. Product tooling may include tools for the casting of engine blocks, cylinder heads, car rim parts from various materials, blow molds for fuel tanks and filler pipes, and more.

Meissner has a total of 340 employees, out of which approximately 50 are engineers. Meissner places great emphasis on product excellence, reliability, and continuous innovation. Meissner employs modern equipment and technology with virtually all automotive industry-wide CAD systems and a CAD-based data management to enable effective and efficient communication with its clients.

Meissner is one of the first companies in Germany to introduce 5-axis machining. The reduction in cycle time and the increase in precision are two major advantages of 5-axis CNC machining centers. However, product engineers at Meissner have discovered more and more frequently that, for certain components, it does not always make sense to rely on 5-axis machining.

According to Christoph Schwarz, Group Leader of Mechanical Production at Meissner, the inability to fully maximize the potential of a 5-axis machining center is especially apparent in the machining of water jacket core tools.

“With these tools, we have tight areas, tight pockets, narrow webs and high contours,” Schwarz said. “Limits are placed on the swiveling movements of machines, which reduces the speeds and feeds.”

According to Schwarz, the rotational movements also place more stress on the tools. Thus, depending on the geometry of the workpiece, 5-axis machining center may not always make sense. Meissner has

also been processing deep cavity workpieces with EDM, but it is time consuming and costly.

“With the right tooling, our comparisons have shown that for certain workpieces, we are much faster with a 3-axis machining center,” said Schwarz.

Deep and narrow cavities usually require very long and thin tools. The deflection of the tool is a common issue during processing. For this reason, Meissner has been seeking an alternative, as it neither wanted to mill at an angle in 5-axis nor opt for EDM.

With the 2-flute toroidal and ball end mills from **OSG**, a solution appears to have been found, particularly for contour roughing and finishing of core tools for water jackets. The idea of using OSG’s toroidal and ball end mills in conjunction with a 3-axis machining center came about at the beginning of the year from another project. The toroidal and ball end mills from OSG’s **WXS®** series have been chosen for many reasons, Schwarz explains.

“First, it was the positive experience. OSG always showed willingness in response to inquiries, delivery times were short and the advice was competent,” Schwarz said. “More importantly, however, it was the result obtained from these cutting tools.”



OSG's WXS-LN-EBD Type 1 end mill

While the milling cutters in the WXS® and WXS-C series originate from OSG’s headquarters in Japan, tooling from the EPL series are manufactured at the OSG Germany facility in Göppingen. The WXS® end mill series is engineered with a super-hard coating with nanotechnology for high heat resistance. It is designed to excel in work materials above 50 HRC. The OSG original WXL® coating has a 1,300°C oxidation temperature to permit greater spindle speeds and longer tool life, even in high-speed or dry machining. Its unique tool geometry enables high-quality, high-precision milling even in difficult machining conditions. In addition to the WXS® end mill, the WXS-CRE is a 5-flute high-performance carbide end mill with a super radius and is designed to accommodate materials up to 65 HRC. Last but not least, the EPL is a 2-flute, high-performance, long neck and ball nose end mill series designed to excel in materials of 45 HRC and up to 60 HRC.

Machining trials were carried out on the water jacket core tool with deep cavities using 3-axis milling. Tools from different manufacturers were put to the test under identical conditions. According to Matthias Bassler, Divisional Manager Production at Meissner, the decision was made in favor of OSG.

“We are not looking to the last second, but time is also an important factor for us,” Bassler said.

“We have very many, very time-consuming finishing operations. Quality, tool life, and the reliability of the process are of enormous importance. Any rework that may be necessary – for whatever reason – would have an enormous effect on the costs. Our tests have shown that, with this material, we had to run an additional step when using tools from other manufacturers. With OSG, on the other hand, everything went well,” Bassler said.

In addition to productivity, Meissner also has strict requirements for dimensional accuracy as well as

surface finish. Core tools are pre-finished with an optimum machining allowance of 0.3mm. After finishing, tolerances at all levels must lie within the specified tolerance range of 0.03mm. Such results naturally would require appropriate programming.

"To do the job right, it is necessary to first determine the tool sequence," said Christoph Rothenpieler, CAM programmer at Meissner.

"The tools for roughing and pre-finishing should be chosen in such a way that as little deflection as possible occurs later during finishing. This is the only way to prepare an optimum contour," Rothenpieler added.

Prerequisites for achieving such precision are highly dependent on the machining center and the cutting tools. In this case, machining centers from Hermle provide the best results. Eighty percent of finishing work is carried out on these machines. In terms of cutting tools, OSG Sales Manager Uli Blöcher knows what really matters.

"The differences between tools are determined primarily by the choice of carbide, the geometry of the cutting edges, the stiffness of the tapers, and most important of all, by the substrate or how the tool works at the cutting edges," said Blöcher.

OSG's EXOCARB® WXS® series offers unique cutting tool geometries that are designed to enable faster cycle times with deep applications. The spiral gash technology of the cutting geometry helps minimize vibration and chatter, thereby enabling stable contour milling.

***Check out this short video to see a comparison of heat generation between OSG's EXOCARB® WXS® and a competitor end mill in D2 tool steel:***

Meissner's quest for an alternative processing solution has enabled them to revive a number of 3-axis machining centers while allowing their 5-axis machining centers to be in full production with other jobs.

With the right tooling, a 3-axis can outperform a 5-axis machining center to maximize profitability. OSG's tooling demonstrates that cutting the deep and narrow on a 3-axis is possible with minimal chatter, cycle time and setup time, while at the same time, increase removal rate and tool life. Sometimes questioning an established method may be the first step toward progress.

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