IMPULSE

MAPAL TECHNOLOGY MAGAZINE | EDITION 76

Cover story:
A multi-stage fine boring tool
for the highest precision

Dear business partners and readers,

The world is changing and we too are in a state of change. However, our core remains the same.

Although in the past MAPAL was known for process solutions in the automotive industry and for machining cylinder heads and blocks in particular, this has fundamentally changed in recent years. MAPAL was quick to recognise the shift in technology and was one of the first companies to bring tool solutions for e-mobility to market, always with a focus on the wide variety of manufacturer requirements. Leading concepts for almost all types of manufacturing processes of stator housings thus emerged and were widely introduced in the market.

However, also all new parts for electrified mobility, the so-called auxiliary units, can be machined precisely using MAPAL tools. For parts familiar from conventional vehicles, such as brakes, steering housings or swivel bearings, we bring years of experience and correspondingly sophisticated tool concepts to the table in order to develop the most economical machining process depending on machine concepts.

In addition to the automotive industry, we've certainly been involved in other sectors for quite some time, for which MAPAL is not particularly known. In the aerospace industry, where we primarily focused on assembly in the past, we have suitable tool concepts for parts production. For components in the hydraulics sector, where a very high degree of accuracy is required, we can also provide cost-effective solutions with high-precision tools.

As well as exploiting new sectors, in recent years we have developed an extensive product portfolio of standard tools ranging from solid carbide drills and milling cutters to chucks in order to offer our customers a complete portfolio. Here we have tapped into our complete knowledge of applications as well. I'm particularly proud of our new UNIQ series hydraulic chucks. Not only are they unique in terms of technology, haptics and ergonomics, they also help save resources from a sustainability perspective as no energy has to be used on complex shrinking processes.

As you can see, we are in a state of change. There's a lot going on. The focus is on new markets and new parts. Despite all these changes, one thing remains the same: we want to ensure your success with our tools and solutions.

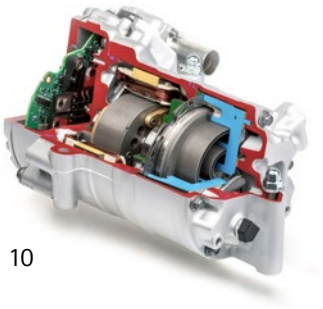
Have a good read!

Yours,

Dr Jochen Kress

CONTENTS

FROM THE COMPANY

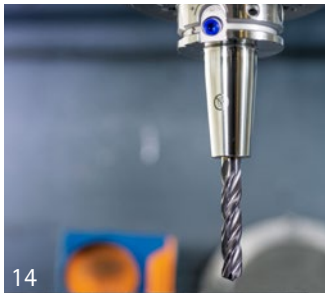


10

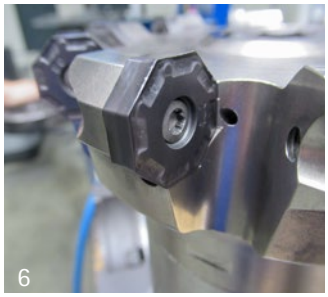
36

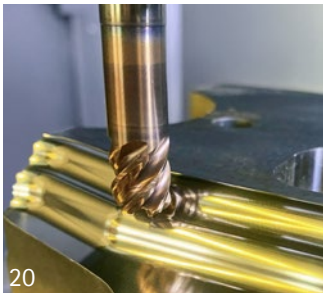
24

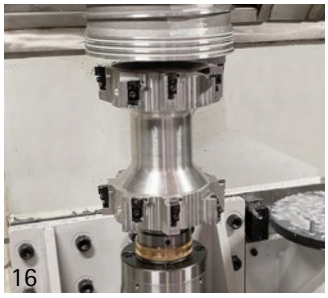
TECHNOLOGY HIGHLIGHTS



PRACTICE REPORTS







IMPRINT

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Publisher: MAPAL Präzisionswerkzeuge Dr. Kress KG
P.O. Box 1520 | D-73405 Aalen | Phone +49 7361 585-0 | Fax +49 7361 585-1029 | info@mapal.com | www.mapal.com

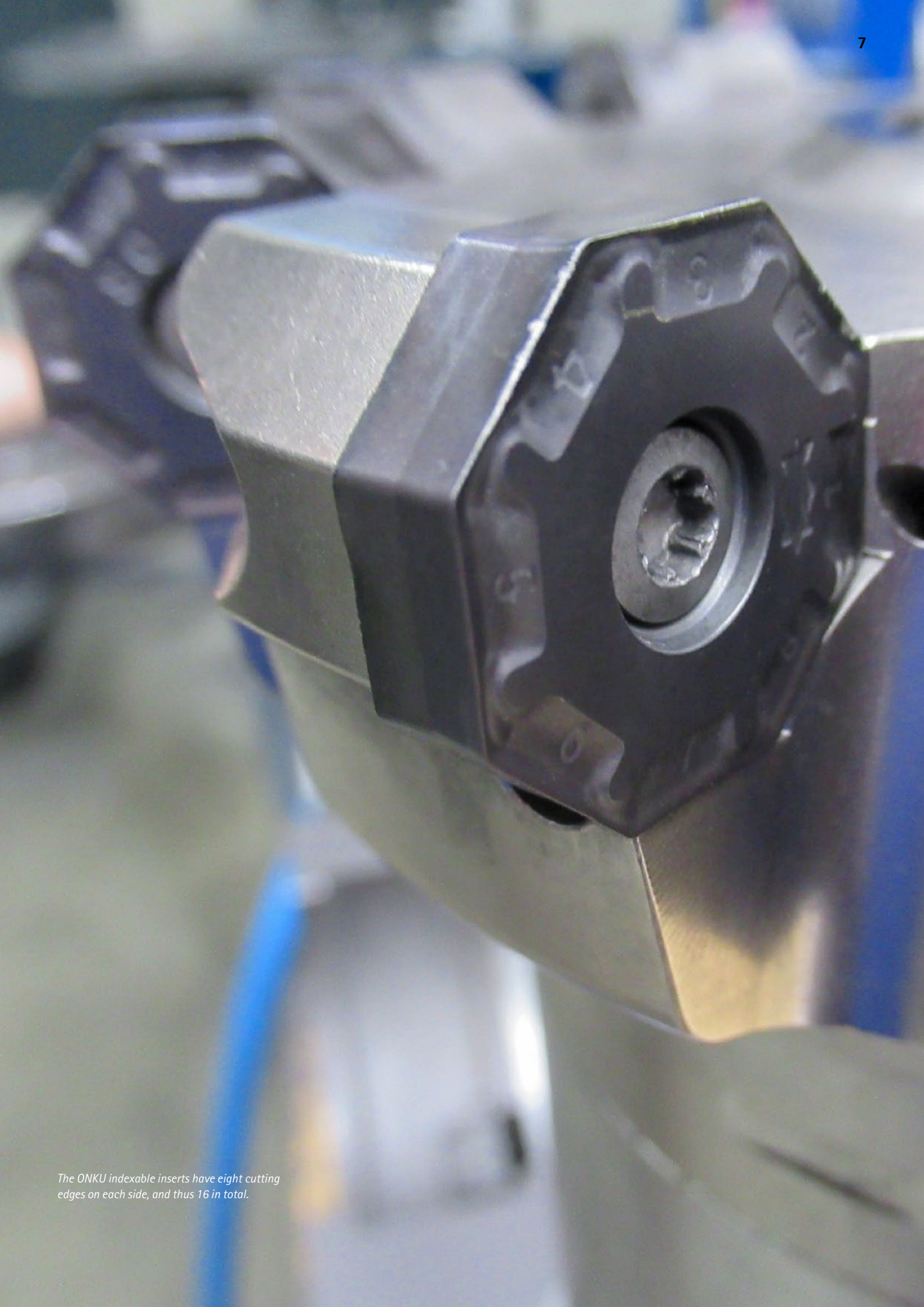
Print: VVA, Austria | Circulation: 18.000 German, 9.500 English

MAPAL's tools are convincing in standard applications

PERFORMANCE BOOST WITH NEOMILL FACE MILLING CUTTER

The family-owned company BOGE Kompressoren with its headquarters in Bielefeld, Germany, is a world-renowned technology and market leader in units for generating compressed air. Apart from the performance, quality and cost-effectiveness of the products, one of the most important declared goals is the increase of efficiency and safety in the manufacturing process. When producing screw compressors, MAPAL's high-performance tools achieve convincing results. ➔

Successful together: Mario Birkner (Production Manager for Organisation & Projects) and Kevin Schmidt (Project Handling of Prototypes in Production) from the BOGE plant in Großenhain with Application Engineer Heiko Süss and Area Sales Manager André Ranke from MAPAL (from left to right).



The ONKU indexable inserts have eight cutting edges on each side, and thus 16 in total.

"We at BOGE are the centre of competence in supplying readily assembled and inspected compressor stages for screw compressors", explains Mario Birkner, Production Manager for Organisation and Projects at the BOGE plant in Großenhain. The progressive company manufactures mechanical components for screw compressors. In Großenhain, around 40 employees produce very accurately machined rotors and housings in highly automated machining centres. During assembly, they are turned into functionally tested mechanical units, which are then delivered to the main plant in order to be completed with drives as well as measuring and control technology. During manufacturing, the focus is on optimum cost-effectiveness. The manufacturing costs for new products are already defined to a large extent during the design stage, in line with the global market standard. Therefore, the corresponding department is located in close proximity to the production. The developers can thus easily communicate with the production specialists. This helps designing products which are immediately ready for production and on time.

FROM DESIGN TO OPTIMISED PROCESS

"After development, I take care of coordinating the machining operations for the components, so that we can achieve stable, safely controllable and cost-optimised processes", explains Kevin Schmidt, responsible for project handling of prototypes in production. The cast-iron rotors and housings are machined separately, each on a highly automated production line or island. For new products, the tools and machining parameters suitable for optimal results need to be determined first. Further essential aspects are other general conditions, such as runtime limits or the expenses for maintaining or changing the tools. In addition, there is the design and production of suitable clamping devices and fixtures as well as the definition of test equipment, test fixtures and test plans to ensure the desired high level of quality. Finally, the plant also has test stations for examining the behaviour of units under real-life conditions.

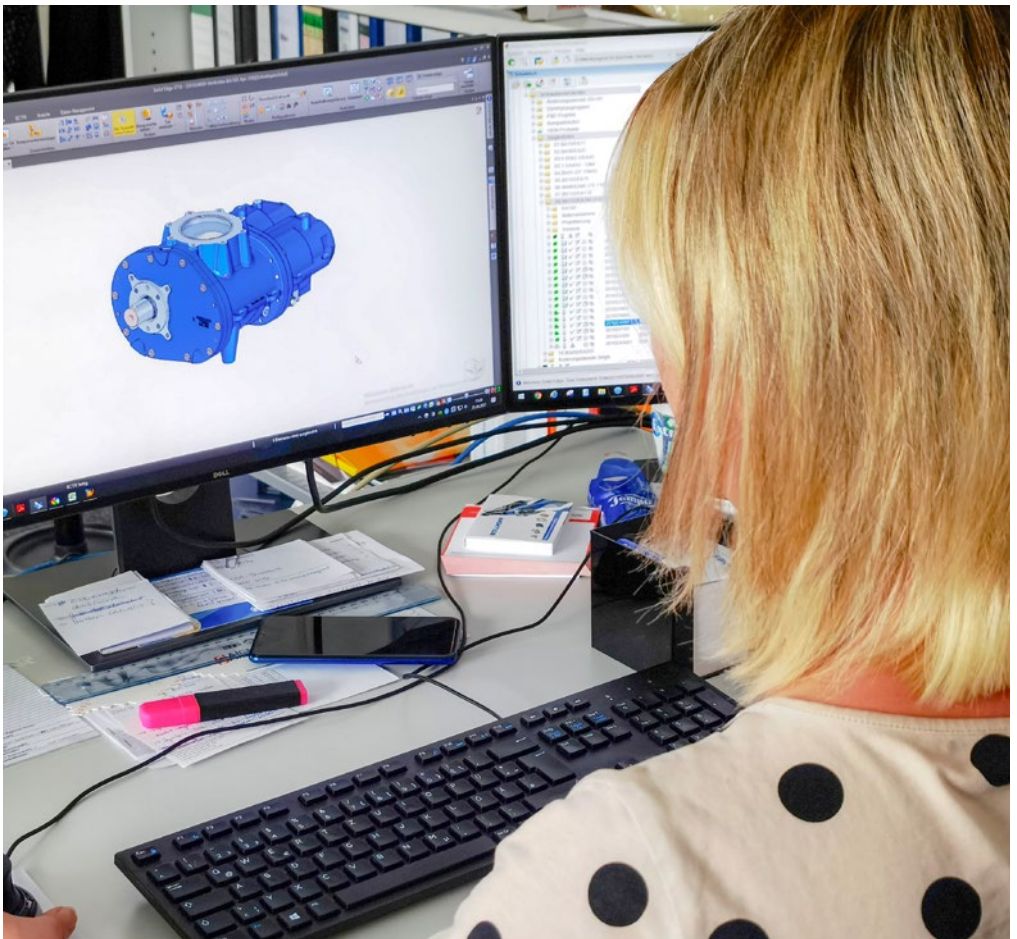
THE LONG-STANDING DEVELOPMENT PARTNERSHIP WITH MAPAL...

"There are many critical machining processes for housings, e.g. position bores or the bearing areas in rotors," knows MAPAL's application engineer Heiko Süss. Often, strict IT6 or IT7 precision requirements have to be met. This is where fine boring tools from MAPAL, designed exactly for these tasks, come into play. Not only is maximum precision important here – machining times must also be as short as possible. Well-designed multi-stage tools often result in low material removal rates that are sufficient to carry out several machining steps. Moreover, the custom tools achieve considerably closer tolerances and better surface qualities while maintaining the same high process reliability. In this area, BOGE and MAPAL have had a close partnership in development cooperation for a long time.

In the early phase of new projects, Heiko Süss already receives an inquiry from BOGE regarding the tool concept to be used for optimal machining of the new components. The machining solution suggested by MAPAL is then elaborated on within the team and validated in tests.

The new NeoMill face milling cutter has a diameter of 125 mm and is fitted with ten indexable inserts.

Exchange of experience over the shortest of distances: the design department is right next door to production.



...IS NOW ALSO PROVING TO BE EFFECTIVE FOR MILLING CUTTERS WITH INDEXABLE INSERTS

"In our discussions, other questions always arise in addition to the actual topic of conversation", says Kevin Schmidt. One of these conversations with Heiko Süss was about the unsatisfactory performance of the previously used face milling cutters from a market competitor for roughing thrust bearing caps. These milling cutters were fitted with indexable inserts and had a diameter of 160 mm. However, their machining performance in roughing was insufficient, so that two or sometimes even three cuts were necessary in order to remove the required material thickness. Süss made Schmidt aware of the new NeoMill face milling cutters with radial indexable inserts and recommended a NeoMill-16-Face face milling cutter with a diameter of 125 mm for this task. The tool is fitted with ten indexable inserts, each of them with eight cutting edges on both applicable sides, and was used in production for tests lasting several weeks.

A SWEEPING SUCCESS

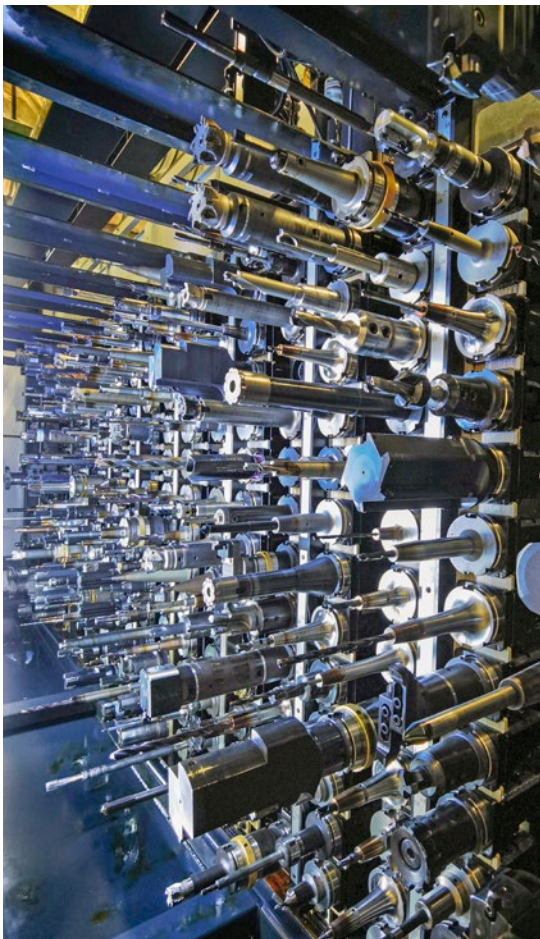
"With these new tools, we were able to achieve really impressive success," Mario Birkner is pleased to say. The material removal rate, increased from two to four millimetres, already made it possible to reduce the required machining time by half. Furthermore, it was possible to double the feed due to the softer cut and thus lower power consumption of the machine, so that the machining time decreased by more than 60 percent.

The tool life per cutting edge of the indexable inserts resulted in further time and cost advantages: 60 instead of the previous 45 minutes. In addition, the costs per cutting edge were reduced as well. This is because the octagonal (ONKU) indexable inserts from MAPAL's NeoMill range, which are now being used, have a negative basic shape, can therefore be put in on both sides and have 16 cutting edges each in total. Thus, full replacement of the insert set is only necessary after 16 hours of use instead of the previous six hours, with corresponding positive effects on expenses for changing tools as well as on handling costs. In direct comparison with the previously used milling cutter, 45 machining hours can be saved when machining 1,200 parts.

However, these advantages could only be used to their full potential within the framework of a machine software optimisation: previously, an adaptive feed regulation automatically reduced the feed rates specified by the NC programme according to certain parameters. This automatic system proved to be too slow for the rapid machining of the NeoMill milling cutter. MAPAL's face milling cutter was only able to realise its full performance potential after this function was deactivated. According to Mario Birkner, MAPAL will also be contacted for further machining processes in future projects. ■

Partially assembled screw compressor assembly, consisting of two rotors and the bearing cover painted blue.

The tool magazine of the milling machining centre provides space for around 300 tools.



Guest article from MAV 7/8-2021, Konradin Verlag

E-mobility: interview with Dr Jochen Kress

CHANGE IN DRIVE TECHNOLOGY

E-fuels, hybrid technology, fuel cells or battery-powered electric mobility? MAV spoke to Dr Jochen Kress, President of MAPAL, about how future transportation could look like and which solutions the precision tool manufacturer offers for this.
The interview was conducted by Frederick Rindle.

At MAPAL, how do you react to the change in drive technology and the trend towards e-mobility?

Kress: Developments have always played a major role for us as a company. That's why we became involved with e-mobility even before there were any concrete enquiries from our customers. Our farsighted approach has paid off. Today, we feel very well prepared for the requirements of e-mobility and we already have a suitable tool solution on offer for a very wide range of machining situations.

But didn't you find the speed with which e-mobility has to be implemented across Europe surprising?

Of course, it was and still is unpredictable for us to which extent, at which speed and at which time e-mobility will become established in which region. However, it was absolutely clear to us that it was coming. Basically, we specialise in machining drive parts for the automotive industry and we plan to keep expanding this core competence in the future.

E-mobility will significantly reduce the number of parts that need to be machined compared to an internal combustion engine. How will you at MAPAL react to this reduction?

It is true that fewer parts need to be machined per drive. This means that there will be less machining and, consequently, less tool consumption. However, there are also countervailing developments. For one, some sources still refer to studies that are now a good ten years old. Since then, a lot has happened in the development of electric motors. As a consequence, the drive units have also become more complex and the parts need higher precision during machining. As a result, there is more mechanical manufacturing involved in the creation of these parts.

Secondly, the focus was on machining operations per drive unit at that time. The number of drive units installed wasn't taken into account at all. However, today's technology means that two electric motors are installed in four-wheel-drive vehicles, for example. Similarly, powerful electric vehicles often have two drive units.

We must also keep an eye on the number of units produced in the automotive industry as a whole. After all, this is the most important criterion if you want to estimate the future market volume of machining in drive systems and components.

How do you think the production figures of the OEMs will develop?

In this regard, predictions vary massively. If the figures from the last VDMA study, which was carried out jointly with FEV Consulting, are correct, this would mean for MAPAL that we will see a slight increase in this area up to the year 2030 – with the same market shares. The figures from the current VDMA study are the most detailed up to date, so this study is somewhat informative. However, most of all, it's becoming clear that machining won't go away when the combustion engine does.

Of course, when it comes to e-mobility, we shouldn't underestimate the fact that all developments in this area are strongly influenced by politics. E-mobility still isn't self-sufficient yet and it's still heavily dependent on subsidies. ➔

Are there regional differences in the introduction of e-mobility?

For me, Europe is currently the fastest in terms of development. In my opinion, the EU is also the strongest driver here. China still has a head start, but Europe is catching up fast.

What do you think about the chances for hybrid vehicles?

Whether hybrid vehicles can establish themselves depends on the developments in battery technology, and, even more decisively, on the subsidies. Only plug-in hybrid cars are currently subsidised. All other concepts are at a severe disadvantage – even though the other hybrid concepts can have very low fuel consumption. For example, there are vehicles in the compact class that consume only 4 to 4.5 litres per hundred kilometres. However, since these vehicles aren't subsidised by the state, they're likely to disappear from the market very quickly.

The fuel cell is another energy source for the mobility of the future. What do you think of the market opportunities for such vehicles?

A vehicle with a fuel cell is basically an electric vehicle with two energy storage units: a smaller battery and a hydrogen tank. For the hydrogen, you also need a complex refuelling system. That's why, in my point of view, the fuel cell is not particularly suitable for shorter journeys of around 100 to 200 kilometres.

Moreover, all the time we are talking about e-mobility without discussing the absolute amount of electrical energy available. In the future, mobility will be in direct competition with other areas of application that will increasingly rely on electricity as an energy source, like the use of heat pumps for heating. So, the question remains: do we even have enough electricity to produce hydrogen? Or is it more efficient to use the energy directly? From this point of view, there's a lot to be said for purely battery-powered vehicles.

However, what I can imagine, initially as a bridging technology, is the use of hydrogen as an energy carrier to burn it directly in truck engines.

Despite the public focus on e-mobility, there will also be other possible uses in the future, at least as a bridge technology, in which the fuel cell and e-fuels are superior to battery-powered e-mobility. In my opinion, it doesn't make much sense to install a battery in a tractor that has to be used for ten hours in a row. So, for uses other than personal mobility over short and medium distances, we'll always need to assess which technology is best suited for these purposes.

Will e-mobility be the predominant form of mobility in the passenger car sector in the future?

I'm convinced that it will. The drive of the future will be electric. The only question remaining is what the energy storage system will look like.

How do the parts for e-mobility differ from those of conventional combustion engines?

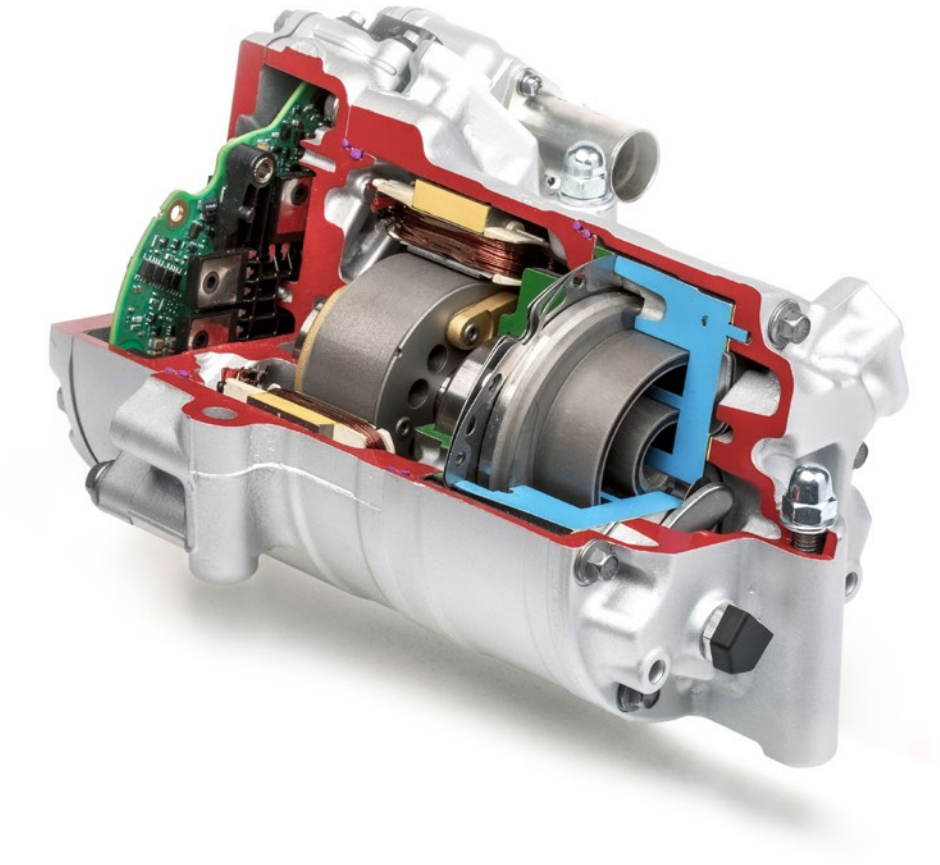
For a lot of parts, you can't see many differences between conventional and electric ones. A stator housing, for example, is not unlike a transmission housing. Basically, we're dealing mainly with aluminium parts in e-mobility. The classic steel and cast parts, like connecting rods, crankshafts or pistons, won't be around in the future.

Structural parts, like the battery tray, are new to the automotive sector. When it came to machining them, we appreciated the fact that our aerospace experts were able to contribute their expertise on the special features of thin webs and how vibrations can be prevented. With these parts, which merely appear to be new, we can often benefit from the specific sector expertise in-house.

One of the most important new requirements is noise development. Since the noise of the combustion engine is eliminated in electric vehicles, even the quietest noises can be heard at low speeds. This means that gear wheels in particular have to be machined very precisely. However, even with parts that were previously inconspicuous in terms of noise, such as axle joints, we now have to pay attention to possible noise development. Another argument in favour of higher component precision is that it reduces friction, which in turn increases the range of the vehicles.

E-mobility also means that parts with completely new dimensions have to be machined. Do the suppliers have to purchase new, larger machines for this?

At MAPAL, we've got tool solutions on offer that can be used to precisely machine a stator bore with an HSK-63 machine. These can generally be used on the existing machines. This way, a lot of our customers can avoid expensive new invest-



ments. These tool solutions are a cost-effective alternative for the smaller quantities, especially right now at the beginning.

E-mobility has really disrupted the previous structure of suppliers. How does this affect MAPAL?

The pack is being reshuffled and companies, which were previously less important, are coming to the fore now. However, for me, what's most striking is who is now having which parts manufactured where and by whom. It's happening all over the world. In this new situation, our global network is even more helpful. This enables us to offer our customers the same comprehensive MAPAL service almost anywhere in the world.

We're also scoring more and more points with our customers with our very broad machining know-how. After all, we don't just supply the tool, but a complete machining solution. If it's a customer's desire, we also supply the fixtures or the programming. These services are also very well received. For example, our turnover in tool management has doubled in the last seven years. I'm quite sure we'll keep gaining market share with our comprehensive range of machining solutions, especially in the field of e-mobility. ■

CLAMPING WITH **UNIQ**(UE) GEMS

Starting from a design study, MAPAL launched products with unique appearance and properties in November last year. Now, the high-gloss hydraulic chucks have also been given their own product name: under the name UNIQ, they represent the premium segment of MAPAL clamping technology.

Part of the concept is that the new products not only look good, but that each design element also offers added technical value. "In developing the UNIQ chucks, MAPAL has focused on people as well as the process", emphasises Dennis Minder, who has been responsible for the clamping technology segment as Product Manager since the beginning of this year. A lower torque when tightening the actuator screw, clearly recognisable controls and reduced risk of accidents when handling the hydraulic chucks benefit the worker first and foremost.

GOOD FOR THE PEOPLE AND GOOD FOR THE PROCESS

How the operator deals with the tool on the machine is also reflected in technical factors such as higher productivity, more process reliability and lower production costs. Added to this are improved product properties, which MAPAL has achieved with UNIQ. The contours bring more stability and higher accuracy to the overall system. Micro-vibrations are minimised and the temperature in the tool stays lower. In addition to the visually recognisable features, the UNIQ tool adapters also incorporate a completely revised and patented chamber system. This has made it possible to redirect the tensile forces so that they act as an additional clamping force on the tool. Tests show that this results in an extreme stability, a higher machining volume, better surface finishes and a high long-term strength.

According to Dennis Minder, the feedback from customers has been unanimously positive: "Improvements have been made across the board. The new chucks achieve a higher level of efficiency of the clamped tools and are delivering very good results, plus the workers enjoy handling these chucks." The sectors are very heterogeneous. In the aerospace industry, hydraulic chucks are used for machining workpiece materials such as CFRP and titanium. In the automotive industry, for example, they are used in manufacturing brakes. The first customers from the die & mould sector have reported significant improvements in process reliability.

DIFFERENT COUNTRIES SET DIFFERENT PRIORITIES

International markets play an important role for UNIQ, with varying properties of the chucks being particularly appreciated there. Their simple operation is particularly popular in places where the expertise of the employees is less pronounced. Customers from the Asian region particularly like the visual appearance. In countries where "Made in Germany" is appreciated and cars from German premium manufacturers are popular, the shiny tool adapters are also making a very good impression in the production hall.

In certain other countries, people are also delighted with the smooth contours, but for a different reason. Here, for example, hydraulic clamping technology is used for heavy machining of castings. Machining leaves greasy deposits on the chucks, which are very dirty after a day's work. Thanks to the smoothed surface, the operator just takes the chuck out of the machine, wipes over it once, and it looks as good as new. A specially developed manufacturing process produces high-gloss surfaces that also increase the surface hardness. This makes it less susceptible to scratches, chips or knocks that it takes in hard use. The promise of high corrosion resistance is also confirmed in this harsh production environment.

For the time being, MAPAL has launched the two hydraulic chucks UNIQ Mill Chuck and UNIQ DReaM Chuck 4.5° with diameters of 12 mm and 20 mm respectively because customer demand for these sizes is highest. Announced product extensions are also based on customer requirements and will extend the portfolio in terms of continuity. The first of these will be the additional diameters of 6, 8, 10 and 16 mm for HSK-A63 at the EMO. From January 2022, both chucks will also be available from stock in the same sizes with BT30 tool adapters. ■

1

Spotlight on cost-per-part in machining stator housings

A NEW TURN FOR **E-MOBILITY**

When a machine tool manufacturer and a tool manufacturer known for boring and fine boring tools get together for a joint project, extraordinary results are guaranteed. NILES-SIMMONS and MAPAL have come together to develop a process that dramatically reduces the machining time of stator housings for electric motors in the e-mobility sector and also features innovative details.

NILES-SIMMONS-HEGENSCHEIDT

(NSH Group) is a global machine engineering group. The group operates in five different sectors: rail and metro, general machining, aerospace, automotive and truck and die & mould. As well as manufacturing individual machines, NSH Group also designs and produces turnkey solutions for complex production lines. Major production sites in Germany include NILES-SIMMONS Industrieanlagen GmbH in Chemnitz and HEGENSCHEIDT-MFD in Erkelenz.

The shift from conventional combustion engines to electric drives in the automotive industry is becoming increasingly clear. NILES-SIMMONS is facing up to this change and targeting parts production for the e-mobility sector with highly efficient manufacturing processes – with the aim of seamlessly following on from the golden era of crankshaft manufacture.

The majority of machines built by NILES-SIMMONS in Chemnitz are used for the machining of rotationally symmetrical workpieces. While turning plays a key role here, MAPAL as a tool manufacturer focuses primarily on cubic parts which are drilled, reamed and milled. In light of this, it's little surprise that there had been few points of contact between the two companies in the past. That changed at the EMO 2019 trade show. At MAPAL's stand, NILES-SIMMONS discovered an exhibit identified as a turning workpiece: a sta-

1 *Machining the stator housing includes internal machining with various sections, machining the smaller centre bore and machining the outside with its cooling ribs.*

2 | 3 *The workpiece is clamped to the upper spindle and moved to the machining stations one after another in one clamping setup.*

4 *The first step is roughing the inside of the housing.*

Image source: NILES-SIMMONS-HEGENSCHEIDT GmbH

tor housing for electric motors. By then, MAPAL had established fine boring tools for machining parts on milling centres as a highly efficient and ultra-precise process in the industry.

A BENEFICIAL BLEND OF TURNING AND BORING OR FINE BORING

Soon, both sides had the impression that a combination of drilling, boring and fine boring could take machining this key component for e-mobility to a new level. Following the trade show, they set up a joint development project. NILES-SIMMONS rebuilt a machine for the project and MAPAL supplied tools for pre-, semi- and fine machining.

Pot-shaped parts like stator housings are a frequently used design for electric motors in the automotive industry. The thin-walled aluminium housing features ribs on the outside for the cooling circuit and is installed in the larger motor housing. "Here, we have a rotational workpiece with a rear-side imbalance that can be turned, but, due to the high level of diameter accuracy and the shape and position tolerance required by the market, must be bored and fine bored," says MAPAL's Area Sales Manager André Ranke, describing the starting point for the partnership. A customer workpiece was not used for the tests carried out at NILES-SIMMONS with MAPAL technicians as part of the project. Instead, MAPAL designed a dummy that featured all production-ready requirements. The inner diameters vary between 220 mm and 231 mm, and the outer diameters between 250 mm and 260 mm. Inner and outer fit tolerances in the IT6 range and cylindrical forms between 20 and 30 µm are required. The concentricity between the different diameters is limited in some cases to 0.05 mm.

ALL OF THE TOOLS ARE ALREADY IN THE MACHINE

For the development project, NILES-SIMMONS selected a DZS 315-type pick-up lathe from NSH subsidiary RASOMA, also based in Saxony. The machine has a modular design and can therefore be configured precisely to suit the relevant machining process. The test set-up featured a vertical workpiece spindle at the top, a workpiece spindle underneath, a tool console and a tool revolver. Generally speaking, additional machining units can be built into the machine, meaning all necessary tools can be housed in the machine, reducing set-up and non-productive time. The upper spindle picks up the workpiece and moves it to the stations one after another in a single clamping setup with the lathe slide.

There are advantages to vertical machining. One of these is the space-saving interlinked setup of individual machining units, optimum transport of chips and processing agents, and a compact design with a small installation area, including a pick-up system.

"The pick-up is a standard solution for turning, as it is already widely used today for comparable parts. This loading solution is perfectly designed for automated mass production of stator housings," says Thomas Lötzsch, Sales Manager at NILES-SIMMONS.

The key benefit of the newly developed process is the potential boost in productivity. From the outset, part production time has already been cut by 50 percent in the combined turning and boring process compared to the conventional turning process. Daniel Pilz, who managed the project at NILES-SIMMONS, describes how time is saved in each individual step, which, as the case may be, may involve the turning of the workpiece, of the tool or of both. ➔

NEW WAYS TO USE TRIED-AND-TESTED TOOLS

The first station turns the process previously used by MAPAL on its head. Instead of roughing the part with a rotating tool, the tool sits still in the machine, and it's the workpiece coming from above that turns. As MAPAL's tool is equipped with four blades, unlike a conventional turning tool, only around a quarter of the time is needed to completely pre-rough the various inner diameters on the part.

In the second machining step, a bell-shaped tool developed by NILES-SIMMONS is used for the outer contour, while a MAPAL ISO boring tool is used for semi-finishing the inner diameter. The inside and outside of the workpiece are machined at the same time. "What's special is that a stationary, vertical external machining tool is attached to the spindle housing. The spindle drives the internal machining tool," says Daniel Pilz, describing the setup. The workpiece dips into the annular gap formed by these two tools. All diameters are produced with one single feed movement – for this specific part, this amounts to three inner and three outer diameters. Four blades are used for each diameter. "As well as being able to machine the inside and outside simultaneously, altogether we take just an eighth of the time we would need for conventional turning," says Pilz. Other benefits include the following:

- Due to the counteracting cutting forces of the internal and external machining, a lower torque must be maintained on the workpiece clamping device.
- Vibrations in the thin-walled part during machining are absorbed by the simultaneous cutting action of the inserts on the inside and outside.

In this test, simultaneous internal and external machining took place with a cutting speed of 700 m/min. Machining using the sandwich method with the workpiece in the middle ensures that the part is stabilised during machining, as the inserts are cutting on both sides at the same time and thus guiding the part. Complex clamping technology with vibration dampening is not required, which has a noticeable impact on costs. While industry already uses MAPAL's tool on horizontal machining centres for the internal machining of stator housings, the bell-shaped external tool from NILES-SIMMONS was newly developed and a patent was filed for the innovative process.

The subsequent fine machining process uses an already tried-and-tested MAPAL fine boring tool with guide pads, which is ultimately used to fully finish the centre bore for the stator bearing, including all stages. MAPAL produces the fine boring tool used in various designs. A welded design with blades and guide pads made from PCD was used for the tests in Chemnitz. The diameter can be adjusted in the µm range.

Project team (from left): Sales Manager Thomas Lötzsch, Technology Development Engineer Christian Winkler, Project Manager Daniel Pilz (all from NILES-SIMMONS), Area Sales Manager André Ranke, Technical Consultant Axel Schwarze and Application Engineer Heiko Süss (all from MAPAL). In the foreground, the inner machining tools from MAPAL for (from left) pre-roughing, roughing, centre bore machining, finishing, and the workpiece.

5 *The semi-finishing tool for inner machining is clamped in the lower spindle. It is surrounded by the bell-shaped outer tool, which is securely mounted.*

6 *In simultaneous machining, the workpiece is moved into the annular gap between the outer tool and the inner tool from above. Plenty of cooling lubricant is used for machining.*

7 *Fine machining of all inner diameters is done with a fine boring tool.*

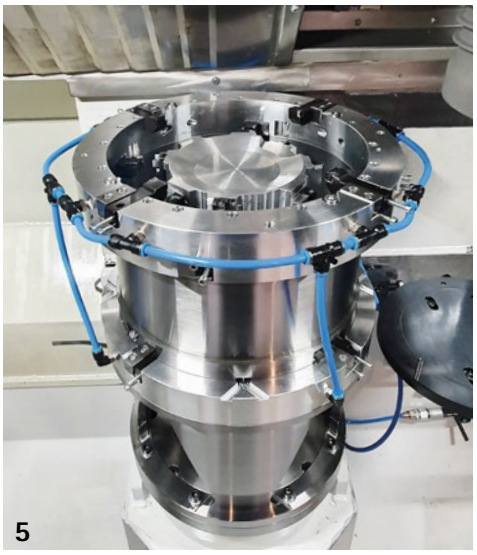
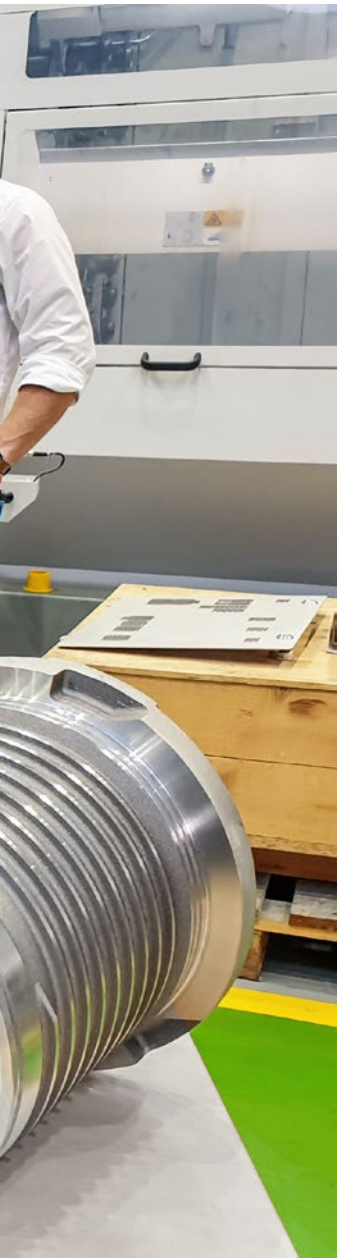


Image source: NILES-SIMMONS-HEGENSCHEIDT GmbH



THE STATOR HOUSING IS THE NEW CRANKSHAFT

NILES-SIMMONS expects the manufacturing of stator housings to become as important to electric mobility as crankshafts were to combustion engines in the past. The expected quantities, cycle times and costs are in a comparable range. "Enquiries for these parts amount to 250,000 parts per year," says CEO Klaus Kräher. By 2030, there may be demand for as many as 20 to 50 million parts worldwide. "A 50 percent time saving is a huge statement, especially as there is definitely more potential in our new process," says Kräher.

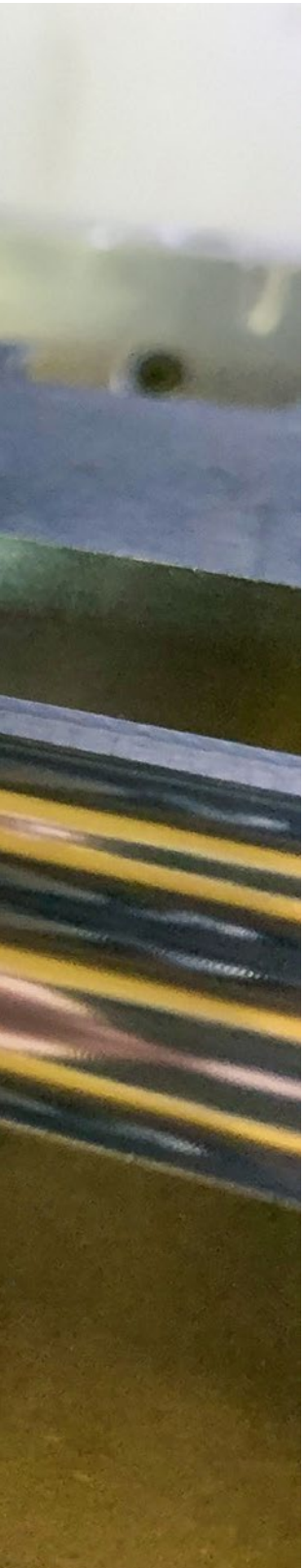
In addition to the successfully implemented vertical concept, NILES-SIMMONS is also investigating the possibility of refitting existing horizontal machines. The Chemnitz-based company has over 300 turn-broaching and crankshaft milling machines currently in use in car manufacturers' crankshaft production lines worldwide. Both the innovative process and MAPAL's tools can also be integrated into a horizontal version of the concept. MAPAL also offers the possibility of using additively-manufactured tools in which weight savings are not the sole focus and coolant outlets can be geared even more specifically towards the cutting edge.

Apart from the machining of stator housings, the process can also be used for other workpieces from a wide range of sectors, such as cooling elements for hybrid engines, pipe and flange couplings for the oil and gas industry, bearing and housing components for general machining, and workpieces for the plastics industry. This makes this process relevant for a very wide range of different workpieces with tube- and pot-shaped geometry requiring tolerances less than or equal to IT6 and with ultra-precise shape and position tolerance. ■

PROBLEM SOLVER EVEN FOR TRICKY CASES

Finishing a mould insert made of powder metallurgical high-speed steel with a hardness of 65 HRC was a great challenge for HaGeForm. With the new Opti-Mill-3D-CR-Hardened corner radius milling cutter from MAPAL, the machining was accurate down to the µ.

Department Manager Maik Seibt (right) and Cutting Machine Operator Alessandro Haase at the five-axis DMU 65 Monoblock.



Sometimes coincidence plays a role when it comes to convincing new customers of the benefits of a tool manufacturer's products. A product specialist from MAPAL visited HaGeForm Sachsen GmbH at precisely the time when the machinists there were getting stuck on a tricky task – and he also happened to have the right tools with him. Since then MAPAL has been called in time and time again to solve problems.

HaGeForm was founded in 1992 as a branch of a company from North Rhine-Westphalia in Lößnitz in the Erzgebirge. Following a change of ownership, the company established a new site in Stollberg in Saxony. In 2012, Sebastian Baier and his father took over the business together. Since 2018, he has managed HaGeForm Sachsen with its 15 employees as Technical Managing Director along with his sister Stefanie Baier, who serves as Commercial Managing Director.

Around 90 percent of their customers are located within a radius of 50 kilometres. This proximity is a big plus for the manufacturer, since fast delivery times are becoming more and more crucial. „We do a lot of things on demand," explains Baier. „We usually bring the parts to the customer by car, so there are no long haulage routes." In addition to parts for the Die & Mould sector, components for general machining and all sorts of other industries are being produced in Stollberg as well.

FROM TOOTHBRUSHES TO FORMULA 1

The region's automotive suppliers make up a large part of its broad spectrum of customers. The parts produced by HaGeForm are mostly used in forming, cutting or spray-coating sheet metal. Often they're one-off productions, sample parts, prototypes and small batches. The orders have included everything from moulds for toothbrushes to parts for Formula 1. Even when the scientists at the Technology Campus of Chemnitz University of Technology come up with „crazy new things", as Baier says, his company, which has extensive experience in fulfilling special customer requests, is called upon to provide the manufacturing expertise. The required tolerances are usually in the hundredths range, but accuracies of 5 µm are also feasible in Stollberg.

The manufacturing department has a variety of technologies at its disposal. In addition to four wire erosion machines, two die-sinking erosion machines and a grinding machine, there are three milling centres with three, four and five axes available. Parts that are to be machined by both milling and EDM are shifted to the respective areas depending on the workload. To reduce process times, the company strives to mill as much as possible, since die-sinking erosion takes much longer, making the process also more expensive. Milling currently accounts for almost half of the orders, and the trend is rising. Parts that until recently had to be eroded can now also be milled. HaGeForm's partnership with MAPAL has also contributed to this.

SUCCESSFULLY TESTED PROTOTYPE

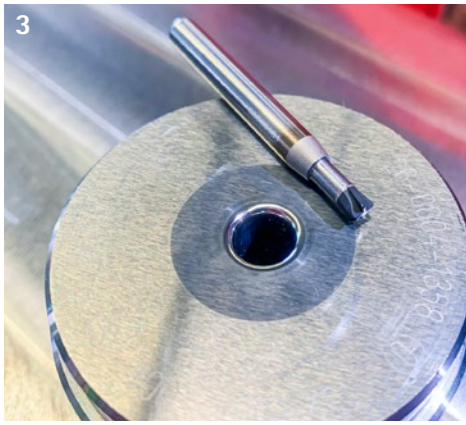
When Felix Wendler, Product Specialist at MAPAL, came to Stollberg a good two years ago, he had one mission: to test new tools for the Die & Mould sector, which had been trialled in the MAPAL Test Centre, on real parts at users' premises under realistic conditions.

At the time of Wendler's visit, HaGeForm had just encountered a tough nut to crack in the hard machining of mould inserts made of powder metallurgical steel with 65 HRC. Maik Seibt, Department Manager Milling at HaGeForm Sachsen, describes the situation: „We were not able to machine certain inserts for a part to be cylindrical. The pocket for the insert was always too big at the top and too narrow at the bottom. It just wouldn't fit." Without further ado, the prototype tool brought along by Wendler was put to a test and the result was impressive right away. The machining

1 *Discussing the optimum machining of the cutting punch (from left): Department Manager Maik Seibt, Cutting Machine Operator Alessandro Haase (both HaGeForm) and Product Specialist Felix Wendler (MAPAL).*

2 *After trochoidal roughing with an OptiMill-Tro-H in the hard material, finishing of the cutting contour of a cutting punch takes place with an OptiMill-3D-CR-Hardened.*

3 *Carbide challenge: the shrunk core of this die is made of carbide G50. It could be machined with MAPAL's newly developed PCD full-head milling cutter, for which a diameter of 4 mm was selected in this case.*



succeeded at making perfectly cylindrical inserts down to the last µ. „That was right at the limit of our IR measuring device," confirms Seibt. MAPAL has now included this tool, the OptiMill-3D-CR-Hardened corner radius milling cutter, in its standard range in various designs.

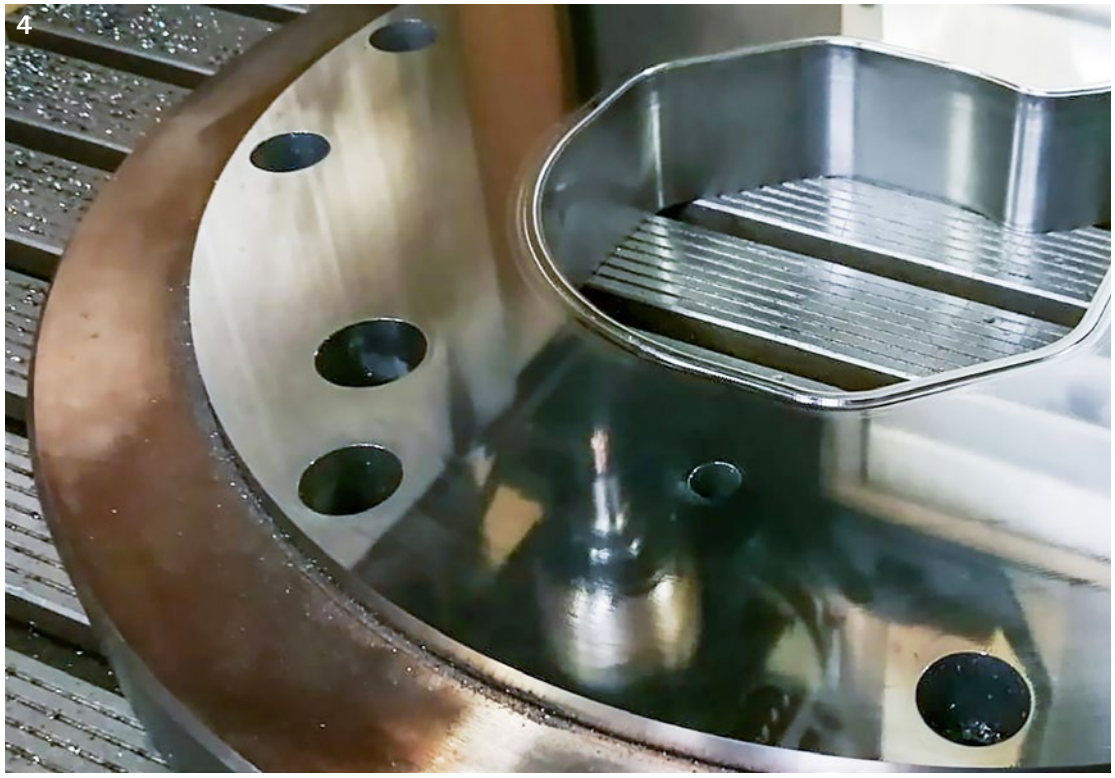
BETTER OFF MILLING QUICKLY THAN SPENDING A LONG TIME ERODING

MAPAL's product specialist was also able to help when there was a bottleneck on the grinding machine. Milling instead of grinding was the name of the game. Wendler demonstrated that milling down several millimetres from a large plate with a hardness of 62 HRC within a very short time is possible in order to be able to re-set the broken-out ring tooth. Eventually, HaGeForm set about replacing EDM with milling for certain workpieces. Previously, the parts had been clamped in the afternoon and then cavity sunk by EDM by the morning. What used to take all night can now be done in two hours. „The customer can be much more flexible here as they can choose between cavity-sunk EDM and milling for more parts," Wendler notes. If orders need to be processed as quickly as possible, milling is the better choice.

For some parts, the transition to complete machining was successful. For example, a fineblanking die made of powder-metallurgical metal used to be removed from the machine after milling for subsequent vertical erosion of small corner radii with shoulders. „We couldn't imagine doing it any other way," admits Seibt. „Now we can cover all that with milling, which is quite an innovation." In the meantime, the OptiMill-3D-HF-Hardened high-feed milling cutter and the OptiMill-3D-BN-Hardened ball nose milling cutter are also regularly used for hard machining at HaGeForm. The trochoidal milling cutter OptiMill-Tro-Hardened is used for two-dimensional roughing directly in the hard material. This allows full utilisation of the cutting edge length, which always corresponds to 3xD with this tool, for machining material hardnesses up to 65 HRC without any problems and guarantees maximum cost-effectiveness through the highest stock removal rates in the shortest possible time.

MAPAL has come to be appreciated as a problem solver. For very complex titanium parts, a possible machining strategy was mulled over for a long time. In the end, MAPAL was called. Felix Wendler came to Stollberg with the right milling cutters for titanium and also stayed until a suitable programme for the complicated part was created and the machining was up and running. Complex shapes combined with special materials always place new demands on the manufacturers. „We receive really great support from MAPAL in this respect," praises Maik Seibt. „When we encounter problems, all it often takes is a phone call. It's good to have a competent contact person to ask."

4 *Brilliant result without grinding: to re-set a broken-out ring tooth of a large part made of hardened tool steel, HaGeForm created a perfect surface by roughing with the OptiMill-3D-HF-Hardened and finishing with the OptiMill-3D-HF-Hardened. The ring tine was finished with an OptiMill-3D-CR-Hardened.*



SOLID PCD FOR CARBIDE

In this area, HaGeForm also ventured into something completely new: the machining of carbide. A customer wanted to deploy this material to create dies that would achieve significantly longer tool lives than steel. Once again Felix Wendler got lucky, because a project for a full-head PCD end milling cutter was just starting at MAPAL's PCD Tools Centre of Competence in Pforzheim. For this tool, a PCD ronde is fully brazed onto the face of the tool holder, and the individual cutting edges are then machined out of this by disc erosion and are finished afterwards. „We really have pure PCD here in 1xD, and currently in diameters from 2.00 mm to 6.00 mm," Wendler explains. In addition to the material of the milling cutter, its geometry is of importance as well when it comes to machining carbide. Other dimensions and geometries are currently under development.

This PCD tool was also a winner at HaGeForm. It produced absolutely smooth surfaces and still looked like new after a few uses, which already suggested a long tool life. Felix Wendler sees market advantages for the Saxon manufacturers: „Very few companies are currently able to machine carbide reliably and, most of all, economically. HaGeForm is really good at that."

The partnership is set to be maintained. The next step will be thread milling cutters for hardened material, because HaGeForm had complained that the tools from the previous supplier did not last long enough. MAPAL's aim is now to use a newly developed milling cutter to reliably insert as many threads as possible at material hardnesses of up to 65 HRC. ■

MAPAL Precision Tools for Finland

MAANTERÄ – PARTNER TO THE METAL INDUSTRY SINCE 1941

Maanterä is one of the largest trading companies for tools and tool systems in Finland. The company has been working successfully with MAPAL for 30 years. In an interview, Product Manager Timo Patersson explains what makes the collaboration so successful and how the Finnish market is developing.

From left Ilkka Eriksson (Managing Director) and Timo Patterson (Produktmanager)

Maanterä was founded in 1941 as a trading company for steel and tools in Helsinki. The company was family-owned until the end of the 1980s. Then, a group of employees took over, and since 1997, Maanterä has been part of the Swedish industrial group Indutrade, which brings together some 200 industrial and technology companies under its umbrella. Maanterä has established itself as one of Finland's leading trading companies with precision tools and other products, such as saws, brushes, abrasives and drilling and grinding machines.

The company is centrally located near Helsinki-Vantaa Airport, which gives it a logistical advantage. The region around the capital and the south of the country is generally an active economic region – the centre of the paper industry, general machining, wood and metal processing as well as host to other sectors and industries. Among others, in the northern parts of the country, Maanterä serves a smaller number of customers which are geographically widely dispersed and are active in the mining sector. Five experienced customer advisors work in the field, each taking care of one sales area. This means that a personal contact person is available in all parts of the country. In the back office, the product managers provide support with their technical expertise, as does the internal sales team. Timo Patersson is Precision Tools Product Manager and contact person for MAPAL products. The IMPULSE editorial team spoke to him about the Finnish market, current developments in the machining industry and Maanterä's future strategy.

Mr Patersson, what's Maanterä's core business area?

We're primarily a partner to the general machining and pulp and paper industries. We work with several steel producers and manufacturers of finished metal parts. These producers have special requirements and they're happy to take advantage of our many years of experience. For example, one of our biggest customers is the Agco Group, which manufactures diesel engines and tractors. However, we also work with the steel manufacturer Ovako and with ASSA Abloy, whose locking and security systems have made the company internationally successful.

Tell us something about your cooperation with your customers.

We've had some exciting projects with MAPAL tools in recent years. One of the most interesting ones for me was a project with ASSA Abloy. Abloy was setting up a new production line to produce door locking systems. They decided to use an Italian machine tool manufacturer. Most of the machining was done with MAPAL tools.

Which tools are particularly in demand in Finland?

MAPAL is particularly well known in Finland for its excellent fine boring tools. These tools have created a high level of trust in the brand. MAPAL's drill reamers are also popular products. One of the biggest customers for these tools is a manufacturer of agricultural machinery.

What's driving Maanterä at the moment?

We launched our web shop this year. For now, it's a basic version with a selection of common standard products and the related data. We want to give customers quick and easy access to our products. We'll see how this develops. We're planning to expand our web presence. More in the standard area, however. We still rely on personal contact for more demanding machining tasks. The best solution can always be found when you have direct conversation with the customer. Unfortunately, it's been difficult to hold face-to-face meetings since spring 2020. At the moment, we communicate almost exclusively via digital channels. Therefore, we're already looking forward to the post-pandemic period, when we'll be able to spend more time on site with our customers.

Which developments are shaping the Finnish market for precision tools?

We're noticing that the market is becoming more and more polarised. The price sensitivity is increasing. However, price doesn't play as much of a role for products that meet special technical demands. In these cases, it's just one of several factors which influence the customer's decision. As a company with high technical expertise, we see Maanterä's position as being primarily represented in solution-based markets. However, of course we also have to hold our own in the competitive market for price-sensitive basic products if we want to be successful in the long term.

How do you assess the technological developments in precision tools?

Huge strides have been made in the past few years. Machining processes have been significantly optimised and the tools have become more and more powerful. What's more: alternative manufacturing processes have replaced conventional ones in some areas. 3D printing is booming, and for tools with special design features it really is a great method for small series. Still, we don't believe that it will replace conventional manufacturing in the long run.

What goals has Maanterä set for the future?

We're striving for more growth and are successively expanding our products and services. Customers' needs are changing and we need to keep up with these developments. That's why we attach so much importance to offering innovative products and being a reliable partner. Due to the high level of expertise that MAPAL has in machining technology, we're sure we'll manage to stay one step ahead of the competition in the future.

How would you describe the cooperation with MAPAL?

Our cooperation has proven its worth over the past 30 years. Tradition and innovation are the key to our success. Our customers trust us to provide them with professional support for their machining tasks. The experts at MAPAL have always provided us with good solutions that have impressed our customers. What connects MAPAL and Maanterä? Well, we're passionate about the quality of the products and we're staying close to the customers! ■

WELCOME TO THE

EMO MILANO 2021

Consistent focus on core sectors

The EMO, the world's largest trade fair for metalworking, will take place in Milan again this year. For the first time on site again, MAPAL is going to present its broad portfolio of precision tools, clamping technology and setting, measuring and dispensing devices – all that from 4th to 9th October 2021.

The focus will be on many attractive innovations and highlights for individual applications and strategic sectors. Here's a small selection:

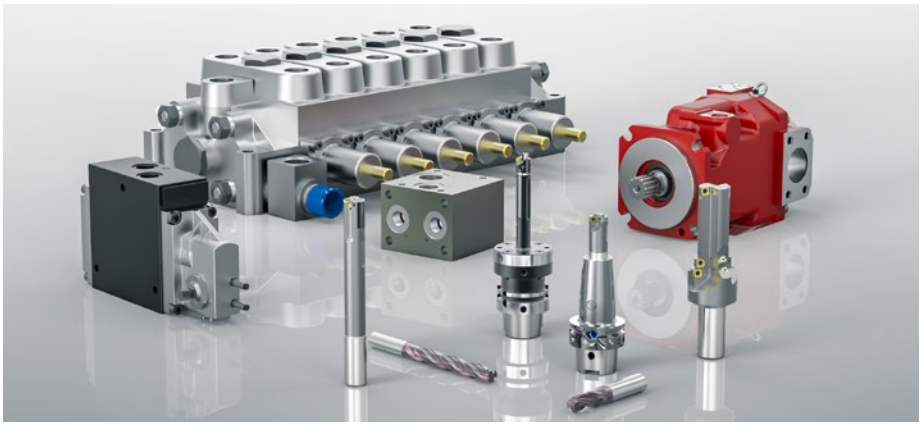
You can find us
IN HALL 2, BOOTH F16/ G15.

Innovations at the EMO – a selection

All innovations and highlights are featured in our 2022 Innovations Brochure and on www.mapal.com.

1 TITANIUM MACHINING TAKES OFF

New drills and milling cutters made of solid carbide and milling cutters with indexable inserts stand for high cutting values and sophisticated heat dissipation for machining titanium: the MEGA-Speed-Drill-Titan reaches a cutting speed of 40 m/min. The new OptiMill-Titan-HPC solid carbide milling cutter performs highly reliable roughing and finishing cuts in titanium. The range is rounded off by the NeoMill-Titan milling cutters with a completely new cutting material concept.



2 HIGH-PRECISION AND VERY RELIABLE MACHINING OF VALVE HOUSINGS FOR FLUID TECHNOLOGY

MAPAL supplies a comprehensive tool package for machining valve housings. Precisely adjustable fine boring tools from MAPAL are a guarantee of reliable and accurate results, especially for machining the low-tolerance spool bore.

3 SUPREME DISCIPLINE IN ELECTRIC MOBILITY: ENTIRE PROCESS FOR MACHINING POT-SHAPED STATOR HOUSINGS

Stator housings require special attention when machining the components for electric motors. The extremely thin-walled housings, especially those of the pot-shaped versions, pose a challenge since they must be machined extremely accurately on the inside and outside. At the EMO, MAPAL will present the entire machining process for use at machining centres.

New module from c-Com: Machining Analytics Solution

THE DIGITAL TWIN IS SHOWING ITS TEETH

To detect problems in manufacturing quickly and guarantee quality, c-Com bundles all available data concerning the machine, tool and workpiece for analysis with artificial intelligence (AI). The new module Machining Analytics Solutions (MAS) supports the production process with a digital twin and will be available at the EMO especially for gear-cutting tools.

Tool breakage rarely happens out of the blue. Before a tooth of a gear hob snaps, the mishap is often heralded in advance by a combination of characteristic values. For trend analyses, the Machining Analytics Solutions (MAS) module from c-Com evaluates the data in real time and warns the user that something is going wrong in the production process. Based on this information, machining can be stopped in time, the expensive milling cutter can be saved from damage, and the workpiece can be preserved.

The adaptive programme builds on two other c-Com modules, Digital Tool Management (DTM) and Life Cycle Management (LCM). In MAS, c-Com has incorporated the positive findings from the first two modules and enriched them with AI. The starting point is the digital twin of the tool.

DATA EXCHANGE ACROSS COMPANY BOUNDARIES

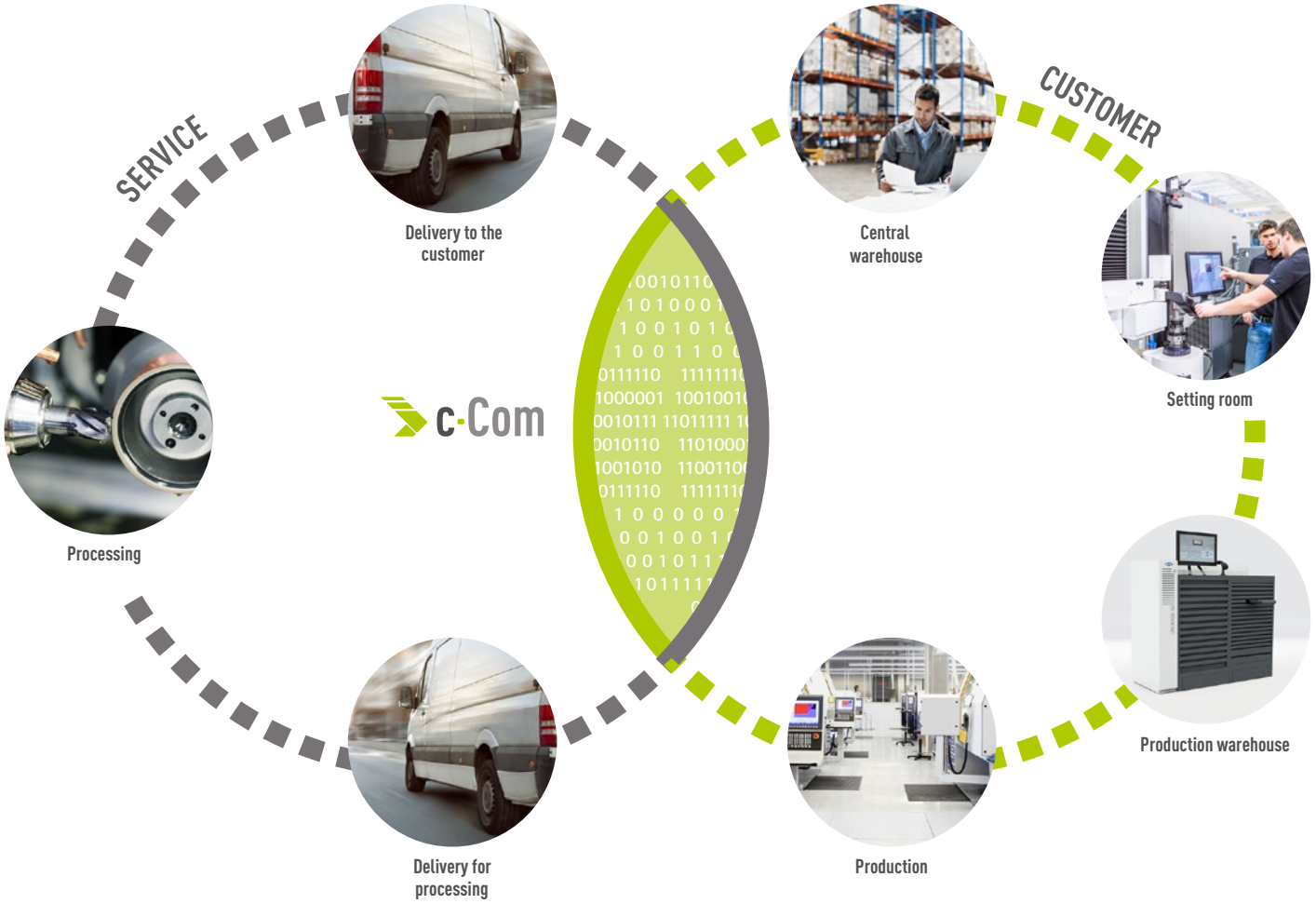
C-Com tracks the process flow and records which path the tool takes, where it is used, and who works with it. This captures the entire life cycle in its depth. The platform makes it possible to share the digital twin across company boundaries as well. A gear-cutting tool passes through numerous stations in a preparation process. It passes repeatedly through regrinding, coating, the integrator and back to the customer. "By making the central digital twin available, we guarantee that everyone involved in the process always has access to the real-time data for the tool," emphasises Bernhard Schuster, Team Leader Project and Application Support.

Ideally, c-Com is integrated, so that the data are gathered in the background. "We're able to set up the data structure to suit the specific customer," explains Business Development Manager Matti Maier. "There are core parameters for each tool, but beyond that, customers have a wide range of individual data and parameters that we can incorporate very flexibly without changing existing structures." ➔

By means of a DMC code, c-Com digitally stores data on a tool.

The c-Com software supports the manufacturing staff in their daily work and ensures higher productivity through valuable information.

iStock | Panuwat (Balls) | retouching MAPAL



The c-Com platform tracks the process flow and records which path the tool takes, where it is used, and who works with it. This captures the entire life cycle in its depth.

There are some 70 different parameters for a large gear-cutting tool. Typing them manually into a table or a controller is time-consuming and fraught with errors. In addition, the ERP systems of the companies usually only contain the stocks of tools, but no information about their respective status. This makes it difficult to plan production capacity. Since delivery times of up to 20 weeks are not uncommon for gear-cutting tools, unnecessarily large contingency stocks are often created, tying up capital.

ENTIRE LIFE CYCLE MAP FOR EACH TOOL

c-Com creates greater transparency by including application data. Among other things, tool tracking records how many tools are in circulation, how they have already been used, how long their residual tool life is and how often they have already been reconditioned. "With our solution, we document the history completely and can say, for example, how many parts the existing production capacity is still sufficient for," says Bernhard Schuster. If premature tool breakage occurs, or the tool's performance falls short of expectations, the digitised gear cutting process provides explanations. The aggregation of the data for entire tool groups provides further information. For example, if a tool life changes on average, the trend analysis reveals a problem in the process.

During validation at a large car manufacturer, it became clear what the AI in the MAS module is capable of. Engineers there had tried in vain for a year to find the cause of a quality problem on a workpiece. Within four weeks, c-Com's analysis led to a solution. With multi-dimensional correlations, AI clearly shows its superiority over humans. ■

c-Com

is a subsidiary of the tool manufacturer MAPAL. The core product is an independent cross-company software platform based on the SAP Business Technology Platform, which tracks tools throughout their entire life cycle from their creation on the drawing board to their final utilisation. The collaborative approach (linking supplier data such as tool drawings or geometric data and mapping the processes surrounding tool optimisation and reconditioning) is the unique selling point. C-Com responds openly to the market with its solutions, which also work with the tools of other manufacturers.

PARTICULARS

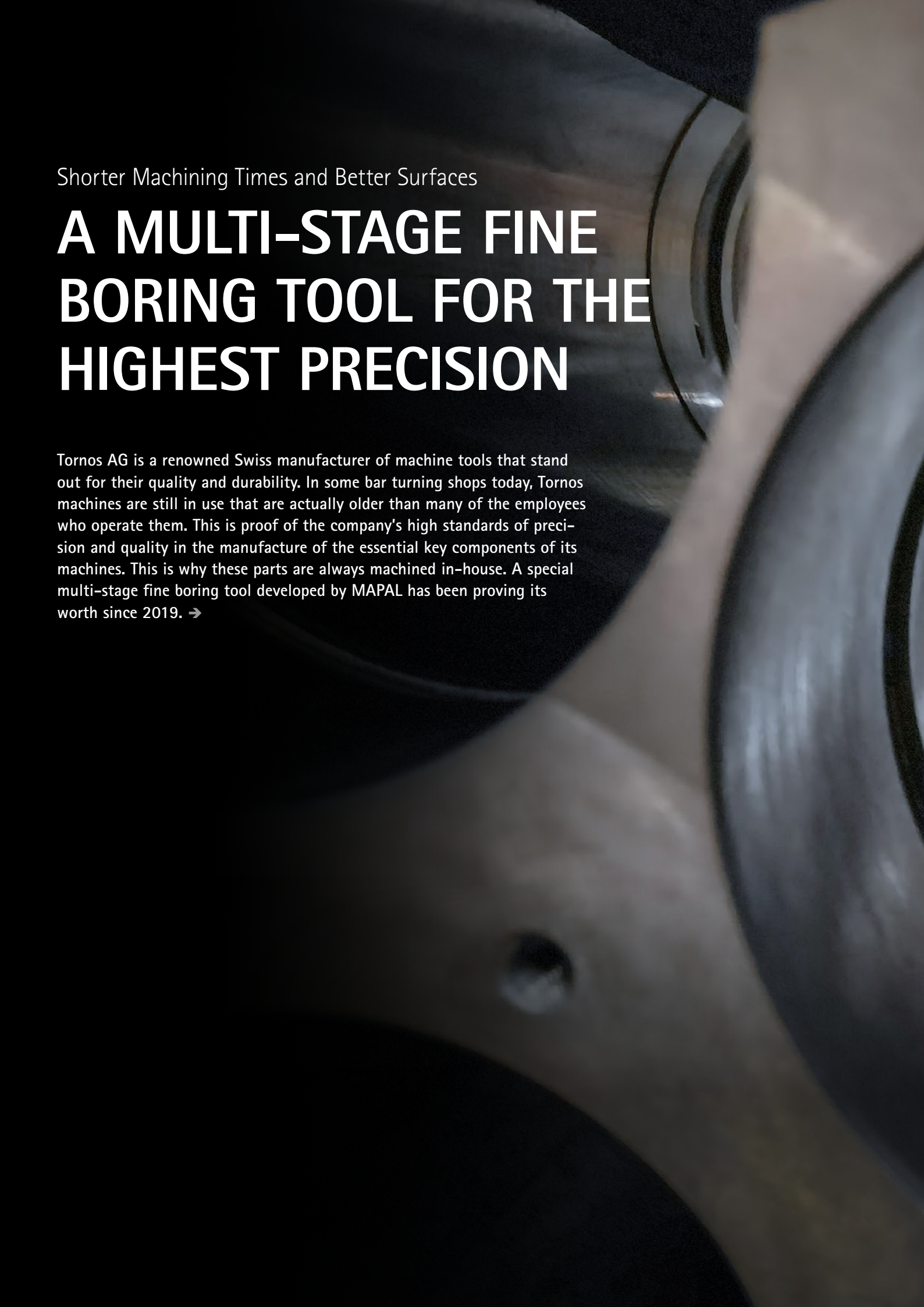
ULRICH KRENZER | AMBASSADOR FOR INNOVATIONS AND EXPERT SYSTEMS | MAPAL AALEN

Ulrich Krenzer, former Managing Director of MAPAL's subsidiary MILLER in Altenstadt, takes over the area of new developments as Ambassador for Innovations and Expert Systems on 1st August 2021. He will be moving to the headquarters in Aalen to become even more intensively involved in the further development of the entire product range. Krenzer is a renowned machining expert and so far has very successfully initiated new developments in the field of solid carbide tools. In his new role, Ulrich Krenzer reports directly to the CTO of the MAPAL Group, Jacek Kruszynski.

MATHIAS GERSTENECKER | MEMBER OF THE EXECUTIVE BOARD | CENTRE OF COMPETENCE FOR MULTI-BLADED REAMERS WINTERLINGEN

As a new member of the Executive Board, Mathias Gerstenecker has been responsible for production at the Centre of Competence for multi-bladed reamers since July. The process engineer joined the company in September 2018 and most recently has been production manager.

Gerstenecker is well versed in lean management and the development of efficient manufacturing processes. He is now bringing this knowledge to his new position. Gerstenecker has also set himself the goal of driving forward the digitalisation of production processes to give the Centre of Competence a modern and future-proof makeover.



Shorter Machining Times and Better Surfaces

A MULTI-STAGE FINE BORING TOOL FOR THE HIGHEST PRECISION

Tornos AG is a renowned Swiss manufacturer of machine tools that stand out for their quality and durability. In some bar turning shops today, Tornos machines are still in use that are actually older than many of the employees who operate them. This is proof of the company's high standards of precision and quality in the manufacture of the essential key components of its machines. This is why these parts are always machined in-house. A special multi-stage fine boring tool developed by MAPAL has been proving its worth since 2019. ➔

Jean-Luc Maurer (Process Manager at Tornos AG, left) and Andreas Mollet (MAPAL Area Sales Manager Switzerland) have been working together with much success for many years.

Image source: Klaus Vollrath

"For certain key components of our products, the precision requirements are so high that we generally only carry out their machining ourselves," says Jean-Luc Maurer, Process Manager at Tornos SA in Moutier (Switzerland). The traditional company is a manufacturer of several technologies for the highly productive manufacturing of parts in large series. The machines must meet the highest expectations in terms of productivity, product quality and durability. The machining and control of the key components manufactured in the parent company are also carried out with the same level of care.

This also applies to a family of parts made of spheroidal graphite cast iron 40, into each of which a series of cylindrical bores must be made with extremely strict specifications regarding dimensional accuracy, concentricity and surface quality. The operations are carried out on a high-precision machining centre in compliance with exceptionally precise regulations, also with regard to the thermal conditions of the part, machine and measuring room. The correspondingly long machine occupancy times of ten hours or more resulted in high costs. For this reason, those responsible looked for ways to reduce the machining times by using a special tool.

LONG-TERM INNOVATION PARTNERSHIP WITH MAPAL

"We've been working closely with Tornos for almost 20 years on a wide range of projects," recalls Andreas Mollet, MAPAL Area Sales Manager in Switzerland. On the one hand, this relates to the development of machining solutions for Tornos customers who wish to acquire complete technology solutions, including tools and the machining process, to go with their machine tools. On the other hand, Tornos employees always come to MAPAL when certain demanding machining tasks cannot be solved with the usual standard tools, or come with disadvantages in terms of productivity or quality. During the course of this long-standing development partnership, a solid basis of trust has grown. This is how the request for a solution proposal landed on Andreas Mollet's desk for the task described in this report. The initial talks on the project began in autumn 2018.

SPECIFICS DETAILS OF THE TASK

"The part to be machined has six bores, each with three merging cylindrical areas with diameters of 100, 99 and 98 mm," explains Jean-Luc Maurer. The concentricity deviation of all three bores must not exceed 10 µm, despite the considerable overall length of just under 345 mm. For this purpose, there's a groove in the first area where an H5 diameter must be ensured. This causes an interrupted cut with corresponding effects on the deflection and the vibrational response of the fine boring tool used.

In the subsequent bore with a diameter of 99 mm, a machining tolerance of 0.05 mm is required. Finally, the requirements become almost extreme in the last area, where a tolerance of -0 to +15 µm must be maintained with a target diameter of 98 mm and several interrupted cuts as a result of annular grooves. Another requirement is a surface roughness R_a of less than 1.2 µm.

TIME LOSSES AND QUALITY RISKS CAUSED BY INDIVIDUAL TOOLS

"Until 2018, the final machining operations were carried out with three different turning tools," Andreas Mollet shares his knowledge. This resulted in time losses not only due to the tool changes, but also due to the fact that the diameter and surface roughness in the bore had to be checked after each machining step. On top of this, minimal deviations in the positioning in the machine occurred during the changeover. Given the length of the tools and the extraordinarily tight tolerance specifications, this caused additional scrap risks. When considering the high value of the part, which has already been largely machined, this represents a high cost risk for Tornos AG.

OBJECTIVE: ONE TOOL FOR THE WHOLE JOB

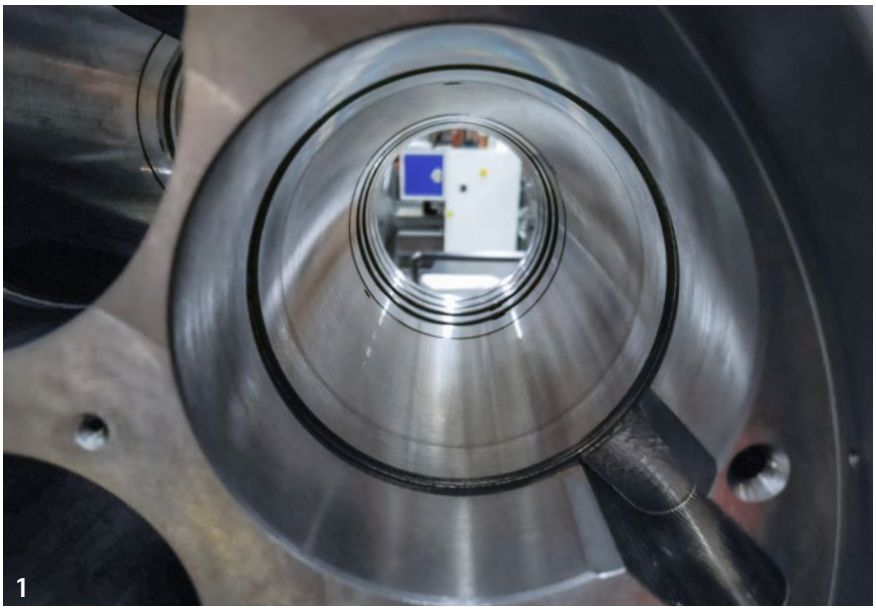
"This is why Tornos wanted us to develop a special tool with which all tasks could be completed in just one clamping setup," reports Andreas Mollet. Initially, there were some concerns about the required length and the corresponding weight. It was also necessary to ensure that there were no positioning errors due to possible axial deviations of the roughing tools used previously. The developers at MAPAL therefore decided on a design as a fine boring multi-stage tool. It has a BT 50 FC interface for use on the machining centre. A total of five guide pads made of polycrystalline diamond (PCD) in each of the three stages ensure precise guidance even with interrupted cutting. The tool is designed according to the proven MAPAL principle and has a coated carbide indexable insert with two cutting edges for each of the three diameter ranges. It can be finely adjusted both radially and from the back taper. Any deviations from the previous machining will be corrected as long as they are smaller than the remaining allowance. This is made possible by a small protrusion of the cutting edges to the guide pads. This is how the MAPAL tool follows its own path over the entire length of the workpiece.

VERY SATISFIED WITH THE RESULT

"The tool developed by MAPAL has now been in use since July 2019. We're very satisfied with the results," Jean-Luc Maurer sums up. Compared to the previous way of working, the MAPAL tool reduces the machining time for fine boring of the six passes by 20 to 25 percent, so that machining can be completed on the boring mill over a single shift. A surface roughness R_a of 1.0 to 1.2 µm is achieved.

The extra care that Tornos takes to ensure top quality is also a reason why working on the machine takes a long time: the diameter and surface roughness of each bore are checked manually on the machine. Finally, a skilled worker checks the entire part on a high-precision coordinate measuring machine with an accuracy of 3 µm.

From Tornos' perspective, the use of indexable inserts is also positive, as is MAPAL's supply of a special setting fixture that enables the cutting edges to be adjusted in several dimensions with a resolution of 1 µm. Thanks to the indexable inserts, a total of six to eight workpieces can now be machined with each set of inserts, and cutting material costs are significantly reduced compared to the previous way of working. ■



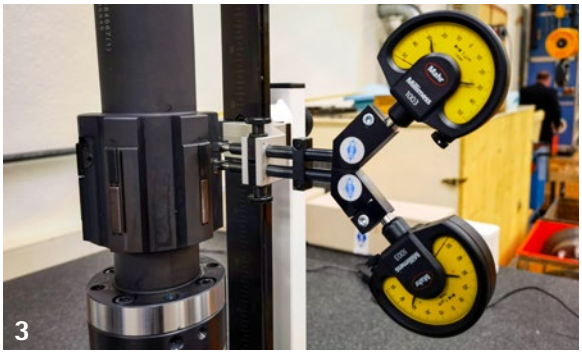


Image source: Klaus Vollrath

1 *The bores have three different diameters and must be machined with high precision.*

2 *Head of Department Charles Flück and Machine Operator Laurent Dreier from Tornos (from left) with MAPAL Application Engineer Umut Ünlü next to the setting fixture specifically made for the new tool for setting the inserts.*

3 *The setting fixture enables the radial position and angle of the inserts to the direction of the longitudinal axis to be checked and set using highly accurate dial gauges.*

4 *The multi-stage tool developed by MAPAL for this application has a total of three indexable inserts and 15 guide pads.*

5 *In the front area, the tool has two indexable inserts for the diameters 99 and 98 mm. Both inserts can be set radially and at an angle to the longitudinal axis.*

PRESS CONFERENCE – **LIVE!**

30 journalists and trade editors came to the press conference at the headquarters in Aalen in July. Strict coronavirus regulations were in place to protect the participants. ➔

At last, another live event! MAPAL's announcement inviting journalists to an in-person press conference has already triggered a widespread enthusiastic response from representatives of the press and the media. It was planned with optimism at the height of the pandemic, but the sharp decline in the coronavirus cases in the following weeks was the right signal for the organisers, meaning a „Plan B" was not necessary and the event could take place on 15th July at the headquarters in Aalen. With 30 trade and local journalists from Germany, Austria and Switzerland, the turnout was almost as high as at the MAPAL press conferences before the pandemic. Over the day-long event, the press representatives were brought up to date with the latest developments. The joy everyone felt upon seeing one another again as well as the personal encounters created a good atmosphere throughout the entire press day.

EXCLUSIVE INSIGHTS INTO PRODUCT INNOVATIONS AND FUTURE PROJECTS

As always, the presentation and exhibition programme was packed with exciting topics. To start off the day, Dr Jochen Kress provided information about the course of business over the past year and gave an outlook on new projects as well as an assessment of the situation in the company's target markets. MAPAL's and c-Com's product specialists and CTO Jacek Kruszynski presented innovative tool and process solutions. They also gave exclusive insights into the new products that will be officially presented at the trade fairs in autumn. During a tour of the Research and Development Centre, the journalists were able to see the new products up close and in action on the machine. For example the complete machining of a pot-shaped stator housing on a machining centre or the new tool programme for titanium machining. The journalists made extensive use of the opportunity to talk to the specialists as well as discuss new trends and products.

The day ended with a relaxed atmosphere as the participants enjoyed a barbeque around the MAPAL Casino.

A comprehensive protection and hygiene concept was developed for the press conference to avoid exposing the participants to the virus. All participants, including those who had been vaccinated or had recovered from the coronavirus, had to undergo a rapid antigen test. ■

WIDE FIELD OF APPLICATIONS FOR **PCD TOOLS**

The innovative PCD tools from MAPAL reliably meet the high quality requirements of different industries/applications.

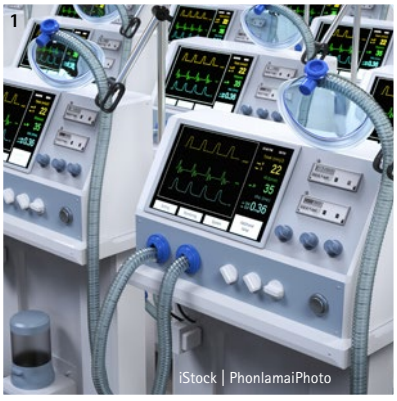
PCD tools are the first choice for highly productive machining of aluminium parts within the automotive industry. And yet the polycrystalline diamond lends itself to a wealth of other applications. MAPAL uses its extensive experience and the know-how on applications that ideally fit the strengths of PCD tools to develope individual solutions for optimum machining processes – together with the customer.

When materials other than aluminium are machined and new parts with special requirements are involved, MAPAL carries out basic work and develops target-oriented processes together with the customers. In some cases, experience from automotive engineering can be transferred directly to other sectors with appropriate modifications.

ABS AS A BLUEPRINT FOR VENTILATOR

At first glance, ventilators bear little resemblance to a car. It's only when you look closer you find a parallel: The valve housing installed in the medical devices looks extremely similar to the ABS housing in the vehicle. Both parts are made of aluminium with a low silicon content, and the machining process is also comparable. The tools used from MAPAL are the same in terms of design, but differ in the specification of the cutting edges.

"The quality requirements in medical technology are often higher than in automotive production," says Carsten Lehmann, Managing Director of Sales, Product Management and Development at the Centre of Competence for PCD tools in Pforzheim, addressing the differences. "We specifically design our tools with different cutting edge geometry for the respective machining task." In automotive production, the focus is on



1 iStock | PhonlamaiPhoto

high productivity. PCD is used for medical devices since the cutting material is a process-safe and highly accurate solution. And it produces the high surface quality that's more important here than high cutting values. Specifically designed pre-cuts ensure that there is no burr that can come loose later.

Another example comes from a completely different sector. Perfect surfaces are also required when manufacturing key cylinders for door locks if the lock is to operate cleanly for a long time. High-quality models can be finely adjusted so that the door closes gently and does not close with a jerk. Complex multi-stage tools from MAPAL are used for milling the aluminium parts.

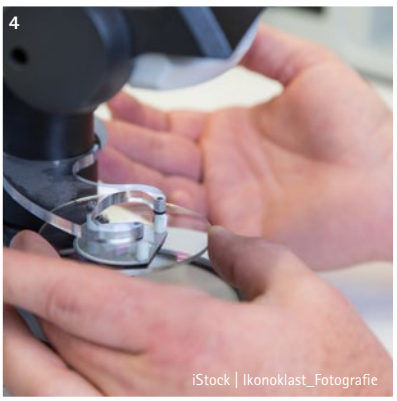
HIGH VOLUME MACHINING AND CLEAN BORES

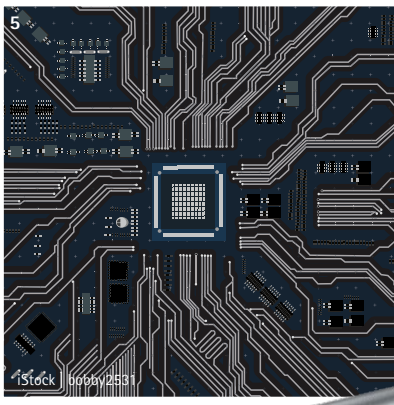
In addition to automotive production, the aerospace industry has become a strong pillar for MAPAL. In the field of PCD tools, the focus is on two very different applications, namely high volume machining of large parts and bores in carbon fibre reinforced plastic (CFRP materials).

When wings or structural parts are milled out of large aluminium blocks on portal milling machines, often only 20 percent or less of the starting material remains. With the strong growth of the aerospace industry, the pressure grew to become faster in production with longer tool lives and better cutting data. What used to be a stronghold for carbide tools with indexable inserts a few years ago is now a field of application for mono PCD tools such as an SPM milling cutter from MAPAL. At 15,120 mm/min, its cutting speed is twice as high as that of the carbide cutter, and its tool life is up to nine times longer.

High process reliability is also important for the bores. An aircraft door requires up to 4,000 bores. CFRP, with its tendency to fray, places special demands on machining. MAPAL has developed special cutting edge geometries for this purpose in order to avoid delamination when exiting the material.

Printed circuid boards in the electronics industry are also machined with face milling cutters from MAPAL. The blanks consist of several thin ➔





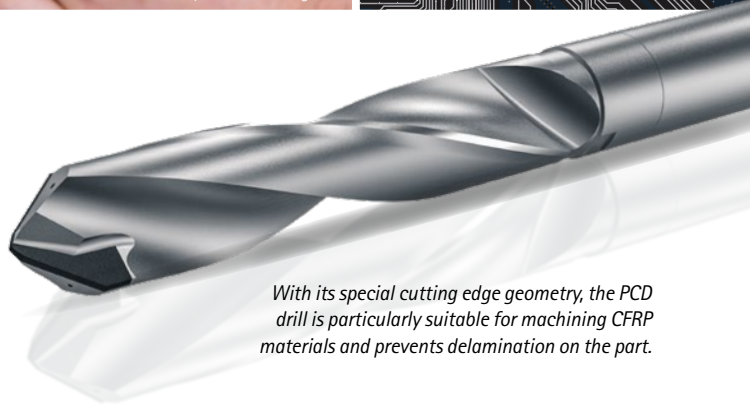
1 Ventilators

2 Aircraft doors

3 Lock cylinder

4 Spectacle lenses

5 Printed circuit boards



With its special cutting edge geometry, the PCD drill is particularly suitable for machining CFRP materials and prevents delamination on the part.

layers of different fibre-reinforced plastics and are usually already coated. The machining of the sensitive parts must be completely oil-free. For this purpose, MAPAL has designed its tools so that they can cope with the abrasive material mix without the need for lubricants. Both the cutting edge geometry and the handling of the tools have been adapted to the special requirements.

FASTER TO NEW GLASSES

PCD tools are used as standard for machining spectacle glasses. MAPAL has developed a custom tool for a major customer in the glasses industry that significantly increases productivity. The data measured by the optician is sent directly via a remote data transmission network to the machine, which automatically mills lenses with the required optical corrections. For the process, the machine, spindle, number of cutting edges, cutting edge geometry and edge preparation were coordinated in such a way that the customer was able to produce with great accuracy and reduce the costs for each part thanks to long tool life and fast machining.

"We're able to transfer the expertise gained in the automotive industry to other industries – even when it comes to completely different materials such as glass or plastics," explains Leander Bolz, Sales Manager of PCD Tools at MAPAL. An advantage is the sales department's focus on technical advice, which can also put together all-round carefree packages for the customer. As the manufacturers of high quality parts often have global production sites across various locations, it's a plus that MAPAL also has an international positioning. "We have twelve manufacturing facilities for PCD tools worldwide that deliver the same quality everywhere, provide on-site service and also carry out repairs," assures Carsten Lehmann. ■

MAPAL's PCD face milling cutters show their potential wherever the focus is on close-tolerance flat surfaces or special surface tolerances as it is the case, for example, in printed circuit board manufacturing.

COMMITMENT TO **SCIENCE**

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The MAPAL Group has joined the Advanced Forming Research Centre (AFRC) at the University of Strathclyde in Glasgow. The scientific research facility is part of the National Manufacturing Institute Scotland (NMIS) group and supports the development of innovative manufacturing technologies. MAPAL's membership activities are coordinated locally through its branch offices in Rugby and Lisburn, Northern Ireland. „Over the last ten years, MAPAL has made significant investments in new products and technologies. We've also successfully expanded our presence in our traditional and new market areas," explains Mark Radcliffe, Business Development Manager at MAPAL in Rugby. Following discussions with the AFRC about future developments, numerous synergies emerged between the expertise MAPAL offers and the technologies the AFRC team is keen to explore. „We believe that joining the AFRC will improve the transfer of knowledge and hope that it will raise MAPAL's profile in new sectors," Radcliffe added. Crawford Cullen, Senior Manufacturing Engineer, NMIS, described MAPAL's joining „as a great addition to the Machining & Additive Manufacturing team". As a close partner to the automotive industry and an expert in machining composite materials, MAPAL has a wealth of machining knowledge that it will contribute to the AFRC's research programmes as well as its network. ■

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MAPAL offers process reliability

WHEN YOU HAVE TO MAKE SURE NOTHING ELSE GOES WRONG

A lot has already happened in the production process before methods like drilling, reaming or threading are used. This makes it all the more important that tool failure doesn't lead to damage or even destruction of the almost finished part during these final machining steps. MAPAL's tools are more than just extremely reliable – they also enable high productivity. Three-edged drilling and reaming in one step are just as much a part of this as the thread milling cutter integrated into a combination tool.

Deep bores in stainless steel are a particular challenge to process reliability because the chips produced here literally resist being transported out. Initially, they become plastically deformed, only to elastically open up again after a few millimetres, and then they tend to jam. With its high-performance drill MEGA-Speed-Drill-Inox, MAPAL has already established a solution on the market for bores of up to 5xD in stainless steels, but customers are asking for more: it should be possible up to depths of 8xD and 12xD. ➔

THREE GUIDING CHAMFERS FOR MORE SPEED

The MEGA-Speed-Drill-Inox is characterised by a special technology with three guiding chamfers. They force the drill to move orbitally, which reduces the friction on the guiding chamfers, thus allowing 40 percent higher cutting speeds than with conventional double-edged drills. High-speed technology in drilling is the tool manufacturer's answer to high-speed spindles in the machines, which reach up to 18,000 rpm and only develop their maximum torque in the higher spindle speed range. „We have taken it upon ourselves to develop a solution that can fully exploit this," explains Michael Villwock, Product Manager for solid carbide tools at MAPAL.

MAPAL has changed the groove profile to ensure high process reliability with this concept, even at greater drilling depths. A slot core that tapers towards the rear ensures reliable chip removal. The fine grinding of the profile effectively reduces the friction of the chips in the drill. The improvements are measurable: while competing products reach a point at drilling depths of 8xD where the torque increases extremely, the MEGA-Speed-Drill-Inox shows a consistently low torque even at 12xD. The geometry of the point thinning, the chip shaping and the cutting edge preparation, which is perfectly matched to the workpiece material, have also been modified in the new models.

DRILLING AND REAMING IN ONE TOOL

The Tritan-Drill-Reamer combines drilling and reaming in one tool. The drill reamer is a good compromise when it comes to creating precision fit bores in IT7 tolerance. Eliminating the need to change tools for a second machining step shortens cycle times by a few seconds. This is particularly beneficial for users who only produce a few bores per part. The Tritan-Drill-Reamer is a further development of MAPAL's double-edged MEGA-Drill-Reamer and is based on the three-edged Tritan-Drill.

Tangled chips, which are drawn into the secondary flute, wrap around the tool and destroy the part, are an absolute nightmare for the user. With its three-flute solution, MAPAL has been able to eliminate this problem and ensures high process reliability even with long-chipping steel materials. For the combination tool, the drill with three cutting edges was supplemented by three further guiding chamfers. Together with these six guiding chamfers, the self-centring chisel edge ensures that the drill reamer is very insensitive to different application parameters and always offers the highest process capability. The tip looks like a small star and has a screw face grinding with a chisel edge. It guarantees the highest positioning accuracy of the tool.

With the help of its test series, MAPAL's Research and Development proves that changes in the cutting values cause hardly any deviations in the bore diameters. This saves time-consuming searches for the right cutting parameters during manufacturing, which reduces the setup effort and leads to faster results. The roundness also remained constant over hundreds of test bores.

MAPAL offers the Tritan-Drill-Reamer for diameters from 4 to 20 mm in lengths of 3xD and 5xD with internal cooling. Diameters in 1/100 intervals are also available for producing a wide range of fits with the drill reamer with high precision as well as achieving further IT7 tolerances.

PCD THREAD MILLING CUTTER PIGGYBACKING ALONG

Custom tools customised for a specific application guarantee compliance not only with tight shape and position tolerances on the part, but

1 *A strong team: to achieve an optimum drilling result, MAPAL recommends the Tritan-Drill-Reamer in combination with the new Hydro DReaM Chuck hydraulic chuck.*

2 *With 8xD and 12xD in stainless steel: forced orbital movements reduce the pressure on the three guiding chamfers of the MEGA-Speed-Drill-Inox. The flute core tapers towards the back and ensures reliable chip removal.*

3 *Drilling and reaming in one go: with a self-centring chisel edge and six guiding chamfers, the Tritan-Drill-Reamer with three cutting edges offers maximum process reliability with a variety of application parameters.*

also enable short cycle times. When these combination tools are used, it makes sense to throw in a useful tool at the same time: a PCD thread milling cutter.

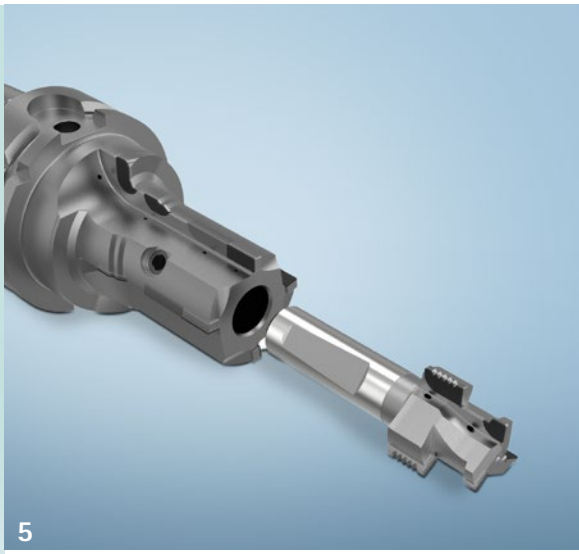
There's no need to use the additional tool component for the same work step. For example, a custom tool can be designed primarily for boring and applying a chamfer, and the thread is created at a completely different location on the part. With one tool change eliminated, the cycle time is shortened. „We always spring into action when a very large number of threads need to be produced cost-effectively or high precision is required," says Matthias Fuchs, Product Specialist for PCD tools at MAPAL.

The change from a solid carbide cutting edge to polycrystalline diamond as the cutting material can bring different advantages. The PCD thread milling cutter has a significantly longer tool life, enables longer dimensional accuracy of tolerances, such as the flank angle, with higher cutting values, and maintains the required surface qualities. MAPAL demonstrates how this works in practice with a large number of hands-on examples. Compared to a solid carbide tool, the cutting values for thread milling in a cylinder head could be increased by 30 percent. In the manufacturing of brass flow metres, the cycle time was reduced by 40 percent compared to solid carbide. A PCD thread milling cutter finishes M12x1 fine threads in highly hardened and tempered forged aluminium for a common rail flange with a tool life of around 85,000 threads.

In automated assembly lines, a burr-free and bevelled thread increases process reliability during assembly. There is also the option of integrating a deburring cutter, which saves the extra machining step of deburring.

Another advantage is that users have to reset the tool much less frequently. With solid carbide tools, the shape of the threads produced changes with increasing wear and tear, which requires corrections in the machine control. In the production of an M12 thread for a customer, the tool life advantage of the PCD thread milling cutter is clearly demonstrated: while it reaches a life of 120,000 parts, its solid carbide counterpart reaches only 14,000 in comparison. To achieve these quantities, the solid carbide thread milling cutter required four radius corrections of 50 µm each, while the PCD thread milling cutter only needed one adjustment of 5 µm.

As an alternative technology, the tap drill produces the thread in a single step, while the thread milling cutter first requires a core bore. Nonetheless, when threading in large-scale manufacturing, milling is preferred for reasons of process reliability, to prevent problems with tool breakage or chip removal. In the end, you have to make sure nothing else goes wrong. ■



4 *The range of solutions for PCD thread milling is wide: from deep threads with long cutting edges and different numbers of teeth to stable combination tools and thread milling cutters with individual cooling concept with minimum quantity lubrication to the simple, cost-effective tool solution.*

5 *Cost-effectiveness through combination: the thread milling tool is inserted into a PCD boring tool. The part that wears out quickly is easy to replace. There's no need to recondition the entire tool.*

How ZEISS and LASERplusSYSTEMS are setting benchmarks in modern

MEASUREMENT TECHNOLOGY

The customized RayMarker® Flex XXL for marking of aluminum profiles

Carl Zeiss Fixture Systems GmbH (CZFS) develops and manufactures measuring devices at its Tholey site - primarily for the international automotive industry. Since October 2007, the company with its approximately 130 employees has been a subsidiary of Carl Zeiss Industrielle Messtechnik GmbH.

About LASERplusSYSTEMS

Since the beginning of 2020, LASERplusSYSTEMS has been a division of the Global Retool Group and, within the framework of this group, continues the work of Laserpluss AG at the Idar-Oberstein site. Until that time Laserpluss was a company of the MAPAL Group. LASERplusSYSTEMS offers new laser systems for marking, engraving and cutting of various materials and thus continues a part of the product range of Laserpluss.

Both companies are linked in a technology and service partnership. MAPAL provides support at the sales level and, in addition, has numerous products from the areas of cutting and engraving in use in its own production.

In the year 2000, CZFS launched the ZEISS CARFIT system, a modular construction system based on aluminium extrusion profiles. „With this system, we create the fixtures for measuring body parts as well as plastic parts for the interior and exterior of vehicles during development. The customer uses the fixtures in the prototype and pre-series phase and later in series production," explains Stephan Kirsch, Head of Product Management / Design at CZFS.

ZEISS CARFIT systems are the result of decades of experience in measuring and fixture technology. The systems are permanently developed further based on the know-how from the company's own fixtures and the wide range of customer applications. In order to ensure constant adaptation to current customer requirements and innovative practice in the build of test equipment worldwide, CZFS products are consistently optimised and perfected, as the following example shows.

NEW CHALLENGES THROUGH OPTICAL MEASUREMENT TECHNOLOGY

For a fast and cost-effective production of prototypes, modern methods have been introduced in vehicle development, which make the entire quality assurance process more efficient. For some years now, this has included optical measurement technology, which allows lightning-fast quality inspections and is therefore increasingly replacing tactile measurement.

For fixture construction, this change in technology in the field of prototype development has created a particular challenge.

„Previously, we built the fixture, and our customers' metrology technicians placed the fixture on a tactile, conventional measuring machine, inserted the component and measured it. For some years now, however, optical metrology has been gaining ground, where robots equipped with sensors take over the measurement. This has enormous implications for the design of the fixture," says Kirsch.

In addition to high precision and technical functionality of the fixtures, now flexibility, simplicity and cost-effectiveness increasingly play a role. Due to various factors, optical measurement has lower structural requirements for the fixture, which means that it can be designed much more simply. A measuring fixture becomes a holding fixture, so to speak, which, among other things, has an effect on the price the customer is willing to pay.

CZFS has reacted to these changed conditions and launched a new product under the name CARFIT lite, specifically designed for the require-

Scanner unit with optics and extraction system

Image source: LASERplusSYSTEMS

Visual inspection of a lasered profile

ments of optical metrology. CARFIT lite represents in principle a simplified „good enough" version of the conventional CARFIT system.

OPTIMIZED CONNECTING ELEMENTS REDUCE ASSEMBLY EFFORT

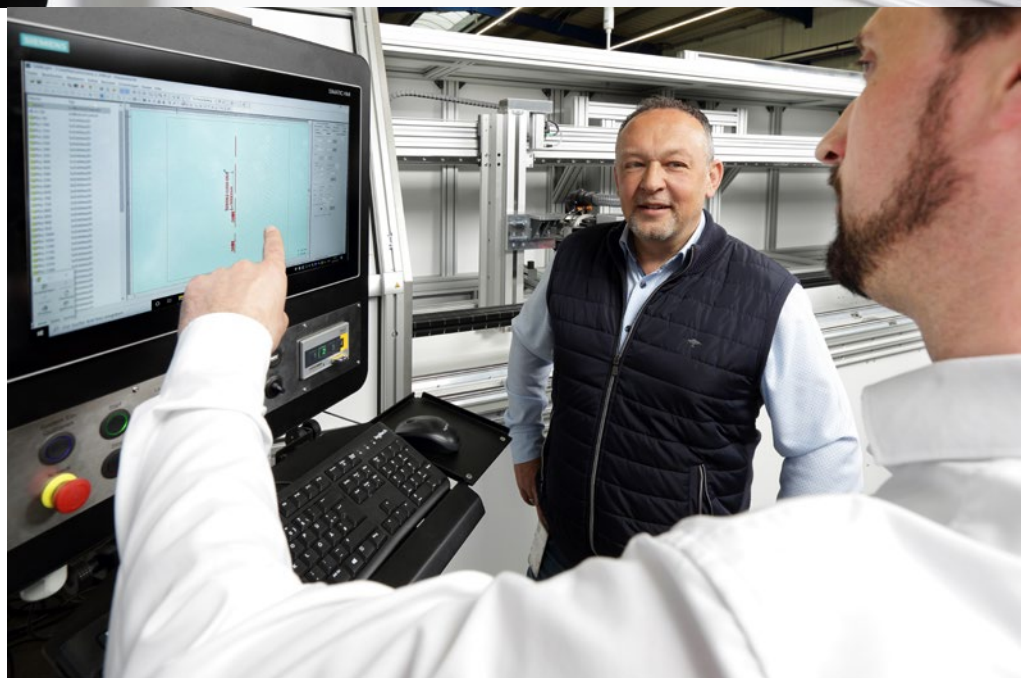
During the development of CARFIT lite, numerous simplifications were made, from the basic materials and the large number of elements to the connection technology of the fixtures.

A key element of the fixture is the profile system, which accounts for around 80 percent of the components of a fixture. „By using a less expensive profile with less expensive connection technology, I can significantly influence the manufacturing price of a fixture. That's why we started from there - new profile, new connection technology," explains Stephan Kirsch.

To facilitate positioning during profile assembly, the connection points of the profiles were previously machined at great expense. In the development of the new fixture, this time-consuming and cost-intensive process was replaced by attaching a lasered dimensional grid to the profiles, which serves as an assembly aid and has become the distinctive visual characteristic of the new profile.

CUSTOMIZED SOLUTION

After the contracting out of laser processing to an external provider was rejected for cost reasons, CZFS decided to invest in its own laser system.



A thorough introduction to the control and operation of the machine facilitates the implementation of the system

This is where LASERPLUSS AG, which was still part of the MAPAL Group at the time, came into play.

„We were looking for a supplier who could deliver a system that was tailor-made for us," says Kirsch.

Custom-fit solutions are the special strength of LASERplusSYSTEMS. Formed in 2020 from the former LASERPLUSS AG, LASERplusSYSTEMS is now part of the powerful Global Retool Group, which, with its subsidiaries SVQ and WEMA VOGTLAND, offers an innovative range of services worldwide in the fields of retooling, welding, laser processing and automation.

„The customer knows his problem pretty well - we make this our challenge," says Felix Bott, department manager laser markers at LASERplusSYSTEMS. „Together with the customer, we develop a solution that is individually tailored to

his requirements with adapted automation options that are optimally aligned to his production chain."

The system designed and supplied by LASERplusSYSTEMS ensures accurate, high quality and at the same time fast, efficient and cost-effective laser marking of the profiles.

The rectangular profiles made of black anodized aluminum are marked at specified intervals to give the product its typical fine lines. In addition to a clean, durable marking with a good contrast, an accuracy of the graduation marks of +/-1 tenth is required.

Since the marking is to be done circumferentially, the machine has a rotary axis with clamping device (4-jaw chuck) and a freely movable tailstock with counter tip. Components from 25 mm in length to 3 m in length are machined, and the diameters of the parts can vary from 10 mm to 200 mm. To cover the range of profile lengths, the machine is equipped with a belt-driven X-axis with direct path measuring system to achieve absolute accuracy.

A special challenge for the programming of the system resulted from the workflow at the customer's site, as the profiles are not labeled in batches, but project-related. This means that the profiles are picked for one project in different variants and lengths and just like this placed on a trolley for the operator at the machine. At the same time however, the machine had to be quick and easy to operate, with only low potential for operator error.

This task has been solved by using two different automatic detections in the machine. On the one hand, the type of profile is recognized via the fixture mounted on the machine in each case, and on the other hand, the length of the inserted profile is determined by means of an optical length measuring system that measures the path from the rotary axis to the tailstock. Both together result in a stored machining program with all the necessary information. The operator simply inserts a profile into a fixture, presses the start button, and the program for the respective profile runs fully automatically.

The set goal of an economic production of a simple and at the same time highly effective component fixture could be achieved with the help of the system from LASERplusSYSTEMS. The system was put into operation in August 2020 and has since been running to the complete satisfaction of Carl Zeiss Fixture Systems.

In addition, the professional competence and the comprehensive consulting by the LASERplusSYSTEMS team could convince the customer. „The team addressed all problems promptly and completely and presented us with suitable solutions," summarizes Stephan Kirsch.

Since the use of optical measuring systems is becoming more and more common in the automotive industry, CZFS might soon think about a capacity expansion and thus a follow-up project for another laser system. „In that case, we would like to bring LASERplusSYSTEMS back on board," adds Kirsch.

Individual concept development together with the team of Carl Zeiss Fixture Systems

Z-axis drive unit

Image source: LASERplusSYSTEMS

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Material No. 10168862 | V1.0.0
IMP76-EN-MA-01-095-0921-VVA Printed in Austria.