EDITION 66

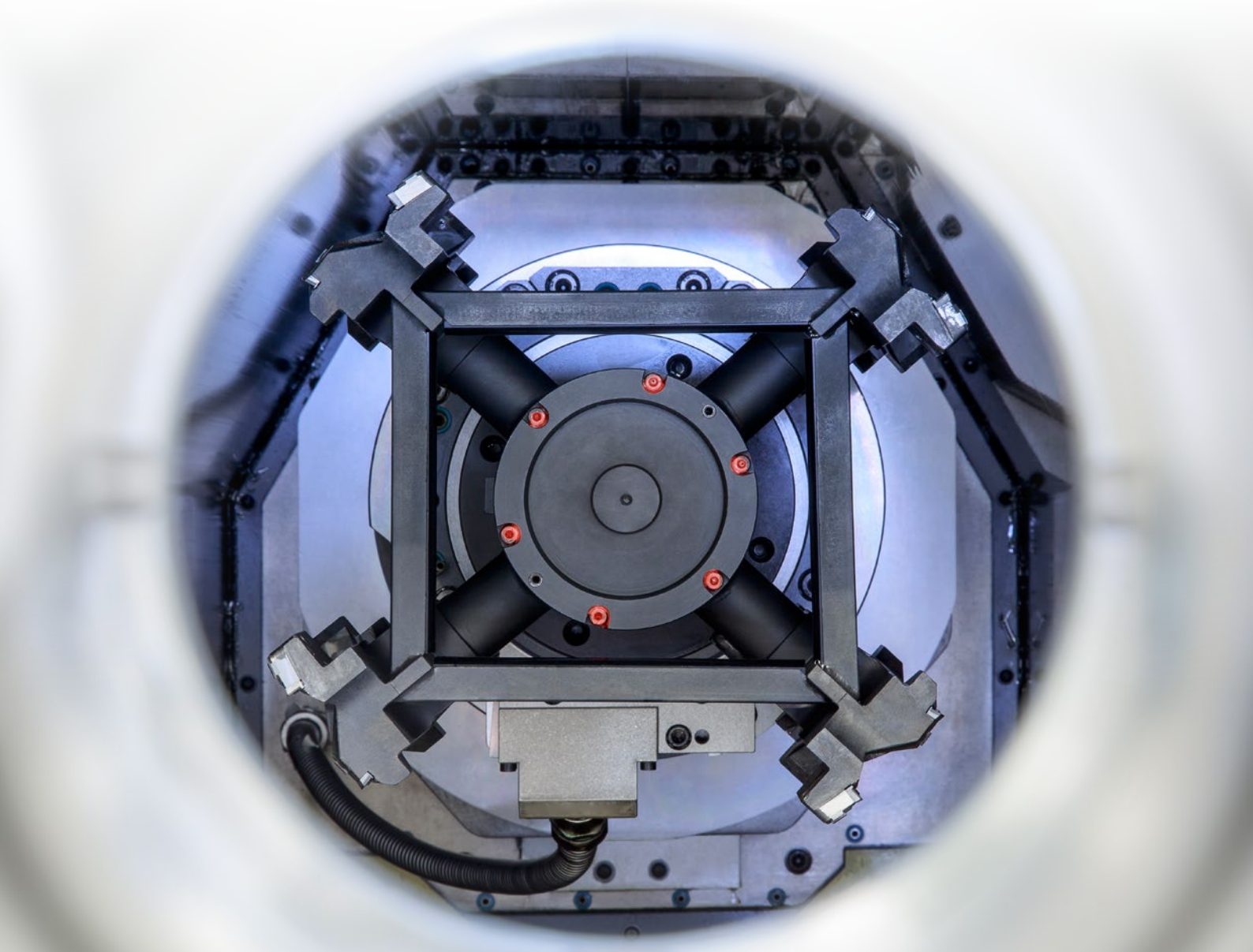
MAPAL TECHNOLOGY MAGAZINE

IMPULSE

FROM THE COMPANY

TECHNOLOGY HIGHLIGHTS

PRACTICE REPORTS



Cover story:
Machining on the way to electro mobility

Dear reader,
dear business associate,

our aim is to be close to the market and to maintain intensive contact with our customers. In this way, we want to recognise trends early on and – thanks to the freedom of a family company – respond quickly.

The additive manufacturing sector at MAPAL reflects this impressively. We have dared to focus on this new technology and to experiment with and research it. Within a few months, we were thus able to present our first additively manufactured product. Not a prototype, but a tool that we additively manufacture for large volumes. Today additive manufacturing at MAPAL is indispensable and provides products with considerable added value for our customers.

Our solutions for electro mobility are another example of how as your technology partner we deal with developments in the industry early on. We already offer comprehensive process solutions for machining processes that are needed for many – partly new – components in electronically driven vehicles.

With regard to digitalisation, which concerns the entire sector, it has become clear to us that the efficient handling of data is one the biggest challenges. With the Open-Cloud-Platform c-Com we responded to this need and founded c-Com GmbH in 2017. In the conceptual phase, we focused on customer problems as well as the challenges in our company to intensively deal with the topic of "networking the entire delivery chain" and brought in competent partners in the sector of software development, including SAP. This gave rise to an Open-Cloud-Platform that not only links the entire delivery chain but also deals with the challenges of operations in the machining sector. And so we have created a solution across sectors - not just an isolated solution.

We look forward to apply these solutions in your environment and meet other challenges of our time and the future together with you.

Yours

Dr Jochen Kress

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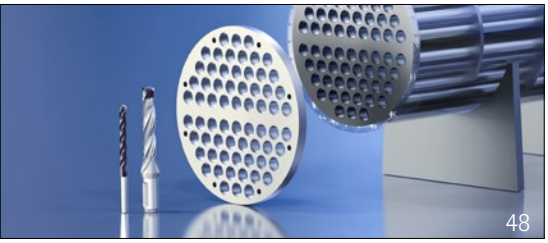
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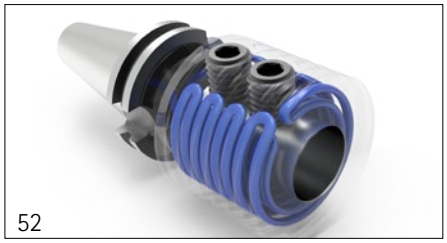
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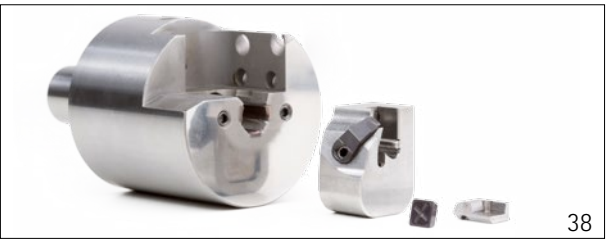
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IMPRINT

Editorial team: Andreas Enzenbach (V. i. S. d. P.), Patricia Hubert, Oliver Munz, Sabine Raab, Kathrin Rehor, Tobias Zimmermann, Sebastian Kuhn
Guest article: Helmut Angeli (NC-Fertigung)
Layout and Design: Alexander Rückle
Photo sources: MAPAL, c-Com, istockphoto, FESTO, F. Zimmermann

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P.O. Box 1520 | D-73405 Aalen | Phone +49 7361 585-0 | Fax +49 7361 585-1029 | info@de.mapal.com | www.mapal.com

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AN ERA COMES TO AN END

With the departure of Dr Dieter Kress from the MAPAL management, one of the most influential characters of the tool sector has withdrawn from the operative level. As president for almost 50 years, he not only shaped an internationally operating group from a regional niche provider, but also demonstrated an extraordinary instinct for trends and innovations. Reason enough to ask about his point of view.

Almost 50 years ago, you took over responsibility for MAPAL as president and passed this on to your son Dr Jochen Kress at the beginning of this year. How much does the current situation remind you of that time?
Not much at all. The conditions are simply too diverse. When I took over responsibility here, MAPAL was a regional provider of tools for thread cutting. Today we are an internationally operating complete provider for the machining of cubic parts and cover diverse areas from clamping, drilling and countersinking to reaming, fine boring, milling and hard turning. Today we offer actuating tools as well as devices for setting, measuring and dispensing tools not to mention all the services covering the tools. When I started we employed around 100 employees; now considerably more than 5,000 people work for MAPAL worldwide, 1,800 of them in Aalen.

I think that this alone makes it clear how much more difficult the task is that my son must manage now and in the future. In addition an abundance of new fields is emerging with progressive digitalisation (key word: Industry 4.0) in which we must successfully assert ourselves. My son has worked for 10 years in the company now and I can say today that with him our company is in the best hands. If I was not strongly convinced that my son will make an excellent president, I would not have handed over my life's work to so light heartedly. And if he needs paternal advice: I am still in the office every day and am available for him as a business partner and advisor at all times.

May I ask, what does your other son, Dr Steffen Kress?
Yes, you may. My son Steffen is Sales Director for Cotesa GmbH, an internationally operating manufacturer of high quality fibre composite parts for aviation and automobile construction based in Chemnitz. And anticipating the issue of possible connections: Yes, there is certainly motivation from both sides concerning the economical machining of these materials. ➔

It is a known fact that the tool manufacturers in Germany that are still family-owned are virtually the most successful ones in the sector. Examples include MAPAL, Horn, Haimer and Gühring. Despite this, they are becoming fewer. Why is that?

It has become increasingly more difficult for small manufacturers to assert themselves successfully on the market. Key word: globalisation. Today when a tool manufacturer supplies a large purchaser such as Bosch or Daimler, then the customer expects that the manufacturer has a worldwide presence and provides the same service and the same delivery capability all over the world. Small companies cannot accomplish this.

At the same time, the large tool manufacturers in the standard sector are often operating as full-range providers. There are hardly any technological niches. And: All large tool manufacturers make enormous efforts in the field of new coatings or innovative carbide. Smaller companies cannot keep pace with this research and development expenditure. I believe that today it is much more difficult than in the past for a company founder to achieve lasting success in the precision tool sector. At the same time the concentration process in our sector, for example Cerazit taking over Komet, is still in progress. This also shows the further decline of family companies.

You are also not entirely blameless of this development if you consider the company takeover of WWS and MILLER...

We should not judge too hastily here. Generally speaking MAPAL has taken over companies whose technological expertise was not reflected in economic performance. We have opened up an opportunity for these companies to further develop under the MAPAL wings. An example of this is WWS. Thanks to our access to international markets, WWS has developed remarkably. Today our PCD tools are manufactured around the world at 13 production sites. And in exactly the same quality as at the headquarters in Pforzheim. We manufacture around the world on the same machines and rely on identical processes and procedures everywhere. However in this context it should be noted that without the narrow tolerances for clamping, in other words the development of the HSK, the triumph of PCD tools would not have been possible.

And you were strongly involved in the development of the HSK connection...

As chairman of the standards commission, it is difficult not to be involved. But seriously, it was the large OEMs that insisted on a connection that was as uniform as possible but primarily one that was independent of manufacturers. This could not be realised with the connections used at the time such as ABS from Komet, Capto from Sandvik and KM from Kennametal, whereby the leading ABS system could only be acquired with a license. The HSK has proven to be a highly precise connection over time and as mentioned before really boosted technologies such as the use of PCD tools.

Which traditional machining processes will be replaced or at least pushed back by additive manufacturing in the short to medium term?

A good question which is difficult to answer based on fact. We ourselves now have five 3D printers in use and have achieved very positive results. In principle we can assume that on the whole cutting volumes will decline but this will only marginally affect the sectors in which MAPAL primarily operates. The ranges of accuracy that our tools cover cannot be achieved with the additive procedure. There is no additive procedure that can manufacture a H7 bore, for example. In this respect, we need not worry about the future.

But I could image that this could be the case with the emergence of electro mobility...

But here as well: "There is no need for scaremongering". The changeover to electric motors will not occur overnight. I am convinced that the sale of cars with conventional drives will still increase over the next ten years. But it would be careless if a company like MAPAL had not prepared itself in good time for possible influences from the e-mobility field with regard to the product range. The housings of electric motors of virtually all manufacturers are already machined with our tools today. In addition all fields of application concerning the chassis, steering and brake systems remain unchanged.

Completely independent of this, there are still a series of application fields where MAPAL tools are not yet or hardly ever used...

What are you referring to?

The die and mould making industry, for example. In future we will offer economical solutions for this field.

How large is the total volume of the automobile industry?

It is still around 50 percent and I am quite certain that we will also achieve this volume in the future. The growing fields of application of flexible slide tools alone justify my belief in such a positive forecast. But above all the unbroken high demand for custom tools in the field of automobile manufacturing makes me optimistic.

Custom tools are traditionally the sales focus at MAPAL or has this changed recently?

Not at all. We have a share of 95 percent with regard to custom tools and this does not refer to characteristic values such as different diameters or lengths but really specific differences such as steps according to drawings, face surfaces, specific coolant outlets, guide pad positions etc. We are quite likely the largest manufacturer of custom tools in the world and are therefore to a large extent not affected by imitations to the same degree as other tool manufacturers.

Particularly in the field of the automobile industry, a trend has developed for the parts to be increasingly smaller and made of materials that are difficult to machine. For this reason, some people speak of a possible renaissance of grinding technology in series production. Is this a development that MAPAL should be concerned about?

I don't see this trend at all for our product portfolio. Grinding does not replace reaming but the other way round. Hard materials can be machined significantly faster with PcBN tools and everything can be processed on 'normal' machining centres. There are a number of machining cases where grinding can be substituted with PcBN tools. I do not see this the other way round.

In the past, tool management was one of the prevailing industry issues. Today nobody talks about it anymore. Is tool management still relevant?

Absolutely. More than ever actually, because digitalisation gives rise to completely new possibilities. Data and information can be provided in a much more transparent and consistent manner for all parties involved. For this reason, we now offer our tool management services based on the c-Com platform under the key word 'Tool management 4.0'. This software solution ➔

that is open to all tool manufacturers as an Open-Cloud-Platform makes all relevant data digitally available. As a result inaccuracies for inventories and tracking of consumption data, machine standstills due to missing tools or the large effort for data maintenance, replenishment and the dispension of tools are a thing of the past. At the same time the system has a modular design and can be adapted to the individual situation of the customer.

Over the last few months, we have heard and read a lot about the controversial discussion with regard to the establishment of a Korean tool manufacturer in Oberkochen in the national media including television. To what extent is MAPAL also affected?

In general all companies in the region are affected because there is a lack of manpower in all industrial enterprises. But nothing is as bad as it looks. I find the figure of up to 1,000 potential employees that has been circulated to be overexaggerated. I assume that YG-1 wants to build a distribution centre in Oberkochen because I can't imagine that it really makes sense for a manufacturer of ISO inserts and carbide milling cutters to start up manufacturing in a high-wage country. But it is quite understandable that a company like Zeiss that has made a valuable contribution around the region and is committed on many levels is not exactly happy about this policy. With regard to MAPAL, I see hardly any impact because we rely on well-trained and fairly paid employees and these are generally not prepared to leave our company group for a potentially short-term benefit.

Speaking of well-trained... MAPAL is considered to place extraordinary importance on training. How many trainees are employed here?

Over the years we have around 130 trainees working for us. In this context I can only recommend everyone to see our training centre. There are not many companies that can access a similar modern machinery like our trainees can. ■

It is highly likely that we are the world's biggest manufacturer of custom tools.

Proof of the high training standard at MAPAL: Dr Jochen Kress (right) and Dr Dieter Kress (left) are pleased with Marcel Heiter about his award as "Tool grinder of the year 2018".

"TOOL GRINDER OF THE YEAR 2018"

The "Tool grinder of the year 2018" comes from MAPAL in Aalen. **Marcel Heiter** successfully got through the qualifying round of the competition and won in the final at the "GrindTec", the leading trade show for the grinding sector in Augsburg against the remaining competitors.

Heiter has been at MAPAL since 2008. The 25 year old finished his training to become a metal cutting mechanic with grinding technology as his specialist field. Due to his very good performance, his training period was shortened. Heiter is now working as a machine programmer at MAPAL and is responsible for the finish of precision tools. He has worked in the finishing of custom tools field for four years.

With Marcel Heiter, an employee of the MAPAL Group won the title of "Tool grinder of the year" for the second time in a row. In 2016 Roberto Krech, an employee at the Centre of Competence for solid carbide tools in Meiningen, won the competition.

With the "Tool grinder of the year", the profession of the cutting tool mechanic is brought into view for the general public, particularly school leavers. The competition is organised every two years by the specialist magazine "fertigung" with alternating machine manufacturers. ■

MACHINING ON THE WAY TO ELECTRO MOBILITY

The goal to significantly decrease global CO_2 emissions goes hand in hand with the change in numerous technologies. For the automotive industry, this means developing alternative drive concepts. Away from the combustion engine and towards the electric drive is one of the approaches. However there are many intermediate steps between both of these concepts because development does not occur overnight. In this way, the components of the conventional drive are further developed and the use of vehicles with hybrid systems increases. Nevertheless – sooner or later fully electrified vehicles will make up the majority of vehicles on the road. As a supplier of machining tools for the automotive industry, MAPAL already incorporated this topic early on in the strategic orientation of the company. And transferred its expertise when machining a conventional powertrain to the parts to be machined in electrically driven vehicles. ➔

"A far-reaching technology change is approaching", says Dr Jochen Kress, President of MAPAL Dr. Kress KG, summing up. And therefore a far-reaching change for the world of machining. However the development will not be surprising or achieved overnight. "Currently vehicles with hybrid systems and therefore machining operations are significantly increasing and a peak has not yet been reached. However we have to expect that the machining tasks in the automotive sector will decrease in the long-term."

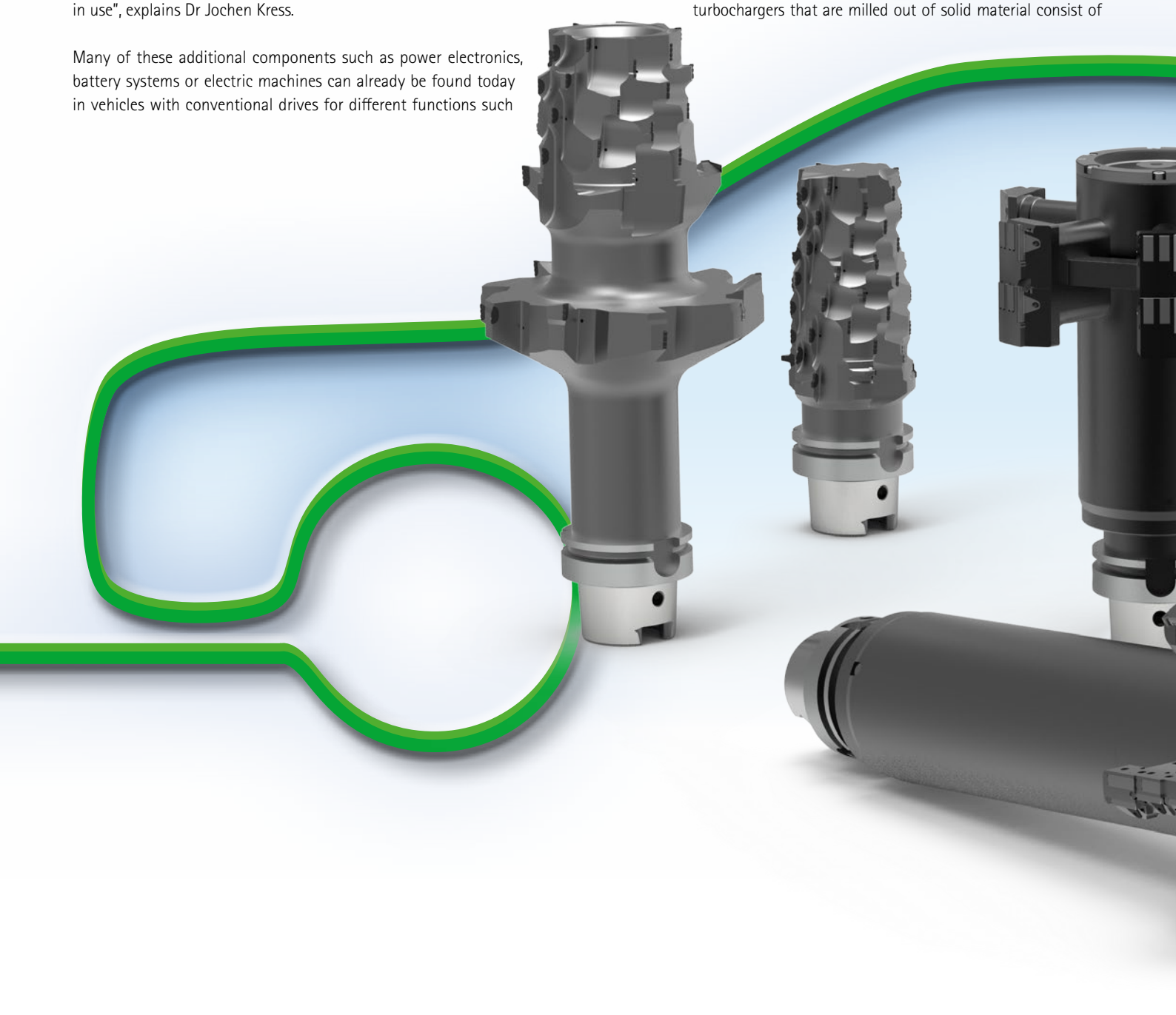
SEEING CHANGE AS AN OPPORTUNITY

Large automobile manufacturers and suppliers are increasingly getting ready for the fact that 25 to 30 percent of all vehicles will be completely electrically powered between 2025 and 2030. "We have prepared for this scenario intensively", says Dr Jochen Kress, "because we see the change as an opportunity." Value-added shares will be newly distributed along the entire production process. Completely new components will be required. "We have transferred our know-how that we gathered for many decades with regard to machining and services to the new requirements and components and developed appropriate concepts that are already successfully in use", explains Dr Jochen Kress.

Many of these additional components such as power electronics, battery systems or electric machines can already be found today in vehicles with conventional drives for different functions such as start-stop systems with braking energy recovery as well as in hybrid vehicles. In addition the classic combustion engine is being constantly further developed and optimised with regard to CO_2 emissions and efficiency. "We are currently focussing on three different concepts: the optimised or new components of the classic drive with combustion engine, the special components for hybrid systems as well as the new parts of fully electric vehicles", summarises Dr Jochen Kress.

DOWNSIZING COMBUSTION ENGINES

In the course of the further development of conventional drives, downsizing still plays a big role. Engines are becoming smaller even while having the same or even an increasing performance capability. A well-known option to increase performance is to use turbochargers. While early on, turbochargers were almost exclusively used with diesel engines, today exhaust turbocharging is also relevant for petrol engines. The higher exhaust gas temperatures of up to 1,050 °C require innovative manufacturing procedures as well as the use of new difficult to machine materials. For example, the housings of turbochargers are produced from heat-resistant cast steel. The impellers in the turbochargers that are milled out of solid material consist of



titanium or high-strength, forged aluminium. Both components, the housing and the impeller, represent special challenges for the tool and processes with regard to machining operations.

HYBRID TRANSMISSIONS REQUIRE HIGH PRECISION MACHINING

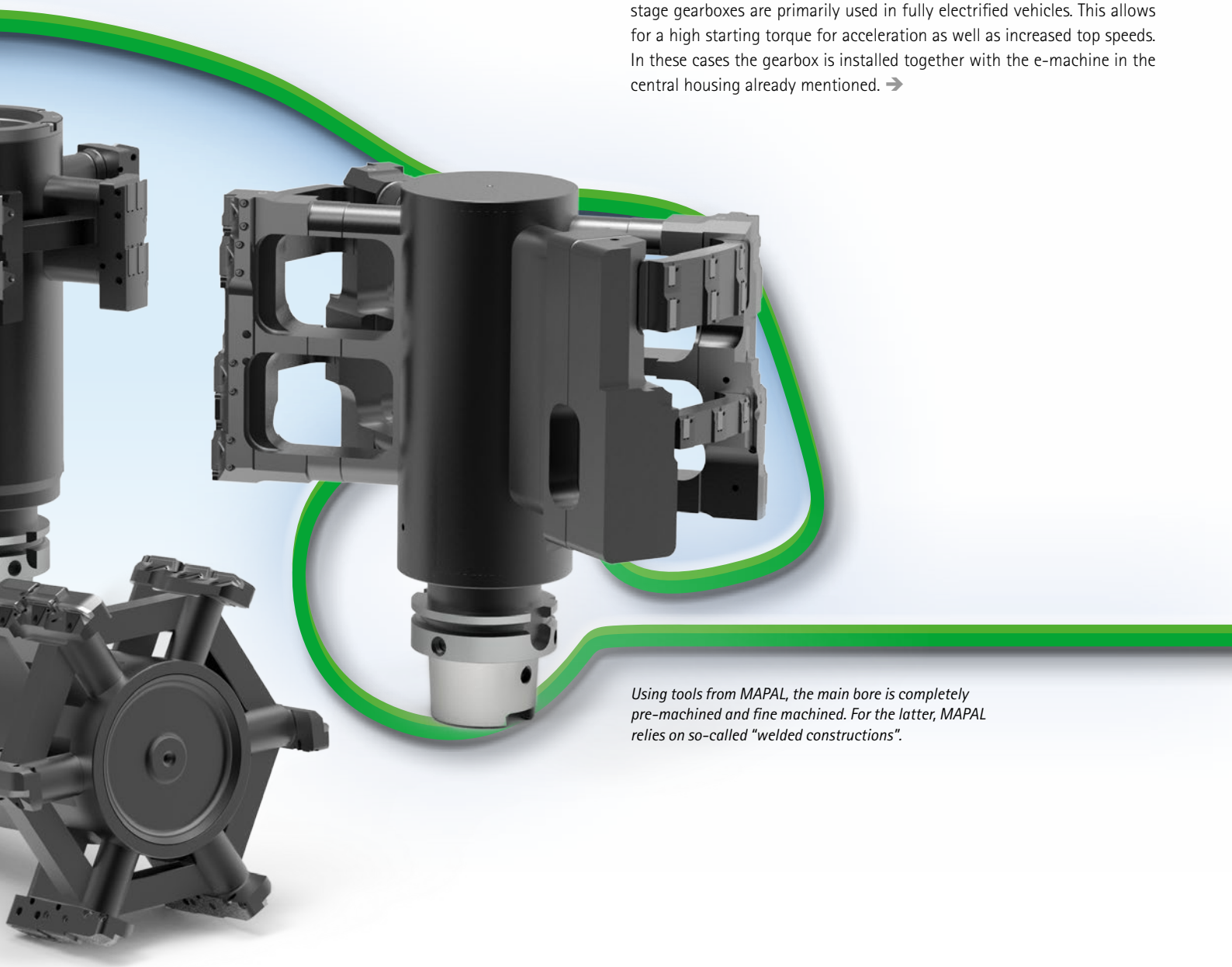
Together with the changes that arise from the further development of conventional combustion engines, other components are becoming more important in the course of the electrification of the drive train. Automatic transmission is an example of this. The development of hybrid transmissions with integrated electric drive and with optimised installation space and package is relevant here. For these gearboxes, MAPAL implements its entire expertise – for pre-machining and fine machining the main bore among other things.

DIFFERENT EXTENSION LEVELS FOR HYBRID VEHICLES

As an alternative to hybrid transmissions, smaller electric machines are often used in hybrid vehicles that are integrated in a separate housing in the existing transmission architecture. For example, they can be mounted as a unit between the combustion engine and gearbox. These so-called hybrid modules usually consist of a combination of e-machine and clutch. The third option for hybrid vehicles is fitting a complete e-axle drive. Most electric drives can be operated as a motor and a generator for energy recovery. Depending on the extension level, the installed e-machine applies the start/stop procedure, helps to recover braking energy, supports the combustion engine when starting up or accelerating and completely takes over vehicle propulsion. In this way, the combustion engine primarily operates in the region of optimum efficiency.

In all these cases, the e-machine is accommodated in a housing. Generally the housing has a cavity in which the coolant for the electric drive can flow. The geometry and size of the housing depend on the size of the e-machine and the function that it undertakes. A central housing is used for fully electrified vehicles. This housing must be machined with high precision. The main bore and bearing bore are the main challenges here. Because of the high speeds of the e-drive, the highest requirements are placed on the precision of the component and therefore machining.

In theory, purely electrically operated vehicles can work completely without gears. However to be able to realise different speed concepts, two-stage gearboxes are primarily used in fully electrified vehicles. This allows for a high starting torque for acceleration as well as increased top speeds. In these cases the gearbox is installed together with the e-machine in the central housing already mentioned. ➔



Using tools from MAPAL, the main bore is completely pre-machined and fine machined. For the latter, MAPAL relies on so-called "welded constructions".

UNIQUE SELLING POINT: FINE MACHINING OF DEEP BORES WITH LARGE DIAMETERS

For the complete machining of the central housing that is produced from aluminium, MAPAL offers the complete process including tools. The unique selling point of the tool manufacturer is the fine machining of deep bores with large diameters in particular. As for the main bore of the hybrid transmission, MAPAL relies on the lightweight but extremely stable tools in welded design that are ideally suited to machine the mostly thin-walled and unstable central housing. And the tool functions with high precision even with long projection lengths.

A pipe construction is used as a tool body for the "welded construction". The tools have only half the weight of a conventional boring bar. The carriers for the inserts and guide pads are welded on and support one another by means of connecting ribs. This minimises the risk of chatter. In addition the support for interrupted cuts is ensured. The resistance to bending is very good thanks to the tubular construction and the stabilising ribs. To keep the cutting forces acting on the component as small as possible, MAPAL individually designs the machining process as well as the tools depending on the stock removal situation, machine and clamping system.

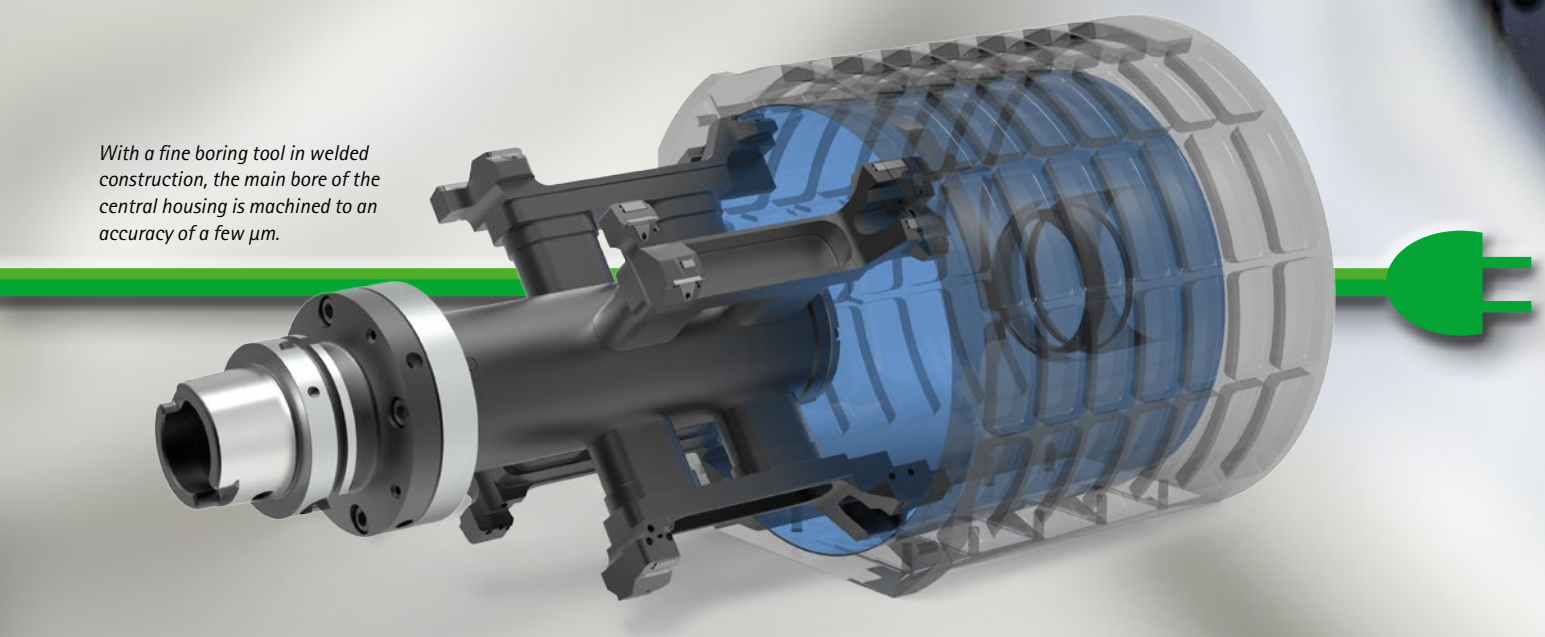
Generally machining the main bore is divided into the pre-machining, semi-machining and fine finishing steps. Pre-machining is often implemented with an ISO boring tool with cartridges and PCD-tipped ISO indexable inserts. Precision boring tools with a welded construction also with PCD-tipped ISO indexable inserts are suitable for the semi-finish. The main bore is machined with a fine boring tool with a welded construction to an accuracy of a few µm. Here the PCD-tipped inserts can be finely adjusted. Guide pads support the tool in the bore.

NEW REQUIREMENTS DUE TO NEW MATERIALS

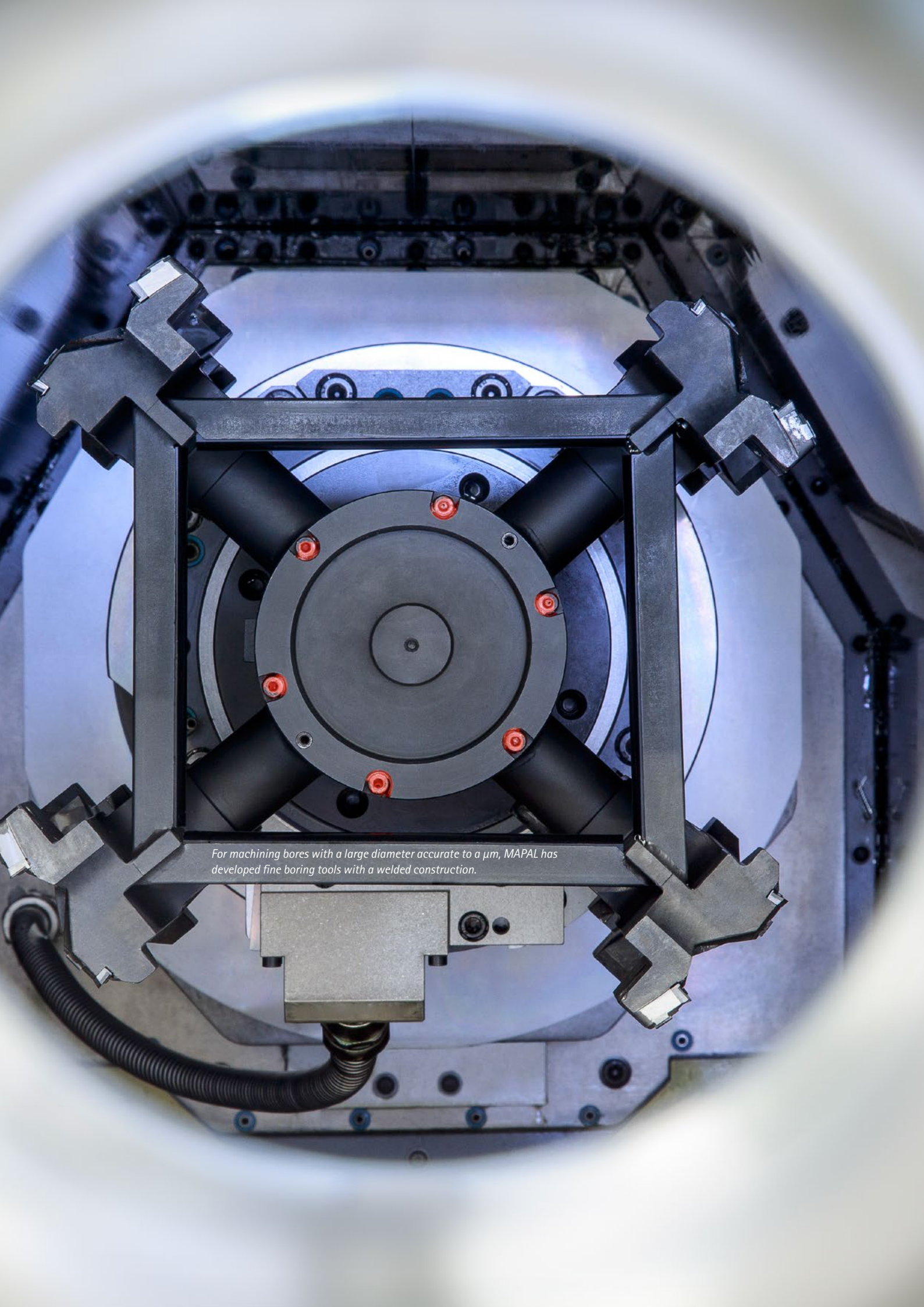
Together with the new components, new materials and lightweight design generally play a big role for the vehicle industry and especially for fully electric vehicles. Because to reduce the weight and therefore increase the range of the electric vehicles as well as to increase rigidity, entire body parts are produced from materials such as CFRP or magnesium, for example. As for the new components, these modern materials also present special challenges for machining.

ECONOMICAL MACHINING SOLUTIONS WITH THE HIGHEST PRECISION

It is not only the drive train and the car body of electric vehicles that offer potential for the tool manufacturers. Numerous other components are machined. On the one hand there are common components such as the wheel suspension, brake and steering system and on the other hand there are new components such as the battery tray or housing for the power electronics that place high accuracy requirements on machining. All in all MAPAL offers the best solution for all components of drive systems that have to be machined. ■



With a fine boring tool in welded construction, the main bore of the central housing is machined to an accuracy of a few µm.



For machining bores with a large diameter accurate to a µm, MAPAL has developed fine boring tools with a welded construction.

PERFECT COMBINATION FOR STRUCTURAL PARTS – FASTER, BETTER, LOWER CUTTING FORCES

The optimum machine tool + the optimum tool = the perfect combination. And that makes cost-effective processes and impressive machining results possible. One good example of this is the cooperation between the machine manufacturer, F. Zimmermann GmbH, and MAPAL. For demonstrations and machine acceptance tests, Zimmermann equips its new horizontal machining centre with milling cutters from MAPAL. ➔

In combination, the horizontal machining centre, the 3-axis milling head and the SPM-Rough ISO shoulder milling cutter achieved the best results.

ABOUT F. ZIMMERMANN GMBH

F. Zimmermann GmbH from Neuhausen auf den Fildern is a world leading high-tech supplier of milling machines and solutions used in the automotive and aerospace industries and for special applications. The company founded by Friedrich Zimmermann in 1933 has 200 employees and branches in Germany, China and the USA.

F. Zimmermann GmbH developed its first horizontal machining centre specially for the machining of structural parts for the aerospace industry. The aluminium structural parts, such as wing parts and frame ribs, are generally milled from solid material – with up to 95 percent material removal. Fault-free machining with respect to dimensional accuracy and surface finish is crucial here. And the component structure that becomes more and more delicate with increasing material removal represents an additional challenge. In order to make the milling process as efficient as possible even in these areas, the new FZH machining centre offers maximum rigidity. For the core technology of the new 5 or 6-axis horizontal machining centre is a robust, water-cooled travelling column. Whereas conventional machine concepts suffer from lever-related deviations with increasing slide, the guide carriage distance of the new Zimmermann machine increases with increasing plunging depth into the material. That actually increases the rigidity. In order to achieve maximum efficiency, Zimmermann employs its own patented M3ABC 3-axis milling head in the machining centre. Particularly in the pocket corners of a workpiece, this milling head has to perform only very small swivel movements – allowing the feed rate to be kept more or less constant and hence the machining time to be significantly shortened.

THE BEGINNING

At an open house in June 2017, Zimmermann demonstrated its new machining centre with tools from competitors. These tools failed to meet the expectations, however, and were unable to exploit the performance of the machine.

"Why not test the performance of the MAPAL tools?"

thought the project managers at Zimmermann, as MAPAL was presenting its milling cutters for high-volume machining at the event. No sooner said than done. A short time later, representatives of the two companies carried out extensive milling trials with different tools together.

THE MILLING CUTTERS

"Our goal was to choose the optimum tools from our portfolio for the machining operations on the Zimmermann machine,"

explains Dietmar Maichel, Project Manager 3D-Milling at MAPAL. The tool manufacturer's portfolio contains different milling cutters for the different tasks during the high-volume machining of aluminium structural parts. The tools are perfectly designed for use on such high-performance machines as the Zimmermann machine. The SPM milling cutters are available in a solid carbide design and with PCD and ISO inserts. A total of four tools are used today at Zimmermann for the different demands of the roughing and finishing operations.

THE INTERACTION

"The perfect combination – the machine, the 3-axis milling head and the tools from MAPAL – give the user a real performance boost,"

said a delighted Steffen Nüssle, Sales Director Export and Head of Applications Engineering at Zimmermann, immediately after the first tests. "With the SPM-Rough ISO shoulder milling cutter, we achieved the best results that we have ever achieved with a tool with indexable inserts." The ISO tools with polished indexable inserts are the latest addition to the MAPAL SPM product range. The SPM-Rough with wave profile also surpassed the expectations for material removal with excellent smooth running. "The complete machining of a 190x190x40 mm pocket is now effectively possible in less than a minute," explains Nüssle.

Working together for success (from left to right): Steffen Nüssle, Bernd Scheurenbrand, Application Engineer at Zimmermann, Norbert Meier, MAPAL Field Service, and Dietmar Maichel.

Analysis of the machining results directly at the horizontal machining centre.

THE PRESENT

The experts at F. Zimmermann GmbH are convinced by the MAPAL tools.

> "The use of the SPM milling cutters has given us a quantum leap forward in the aluminium machining. And it shows us what the perfect combination of tool and machine means in terms of performance,"

says Nüssle. In the meantime, the tools are therefore first choice when it comes to machine acceptance tests or demonstrations for customers from the aerospace industry at Zimmermann.

THE FUTURE

The Zimmermann machines are suitable not only for the machining of metals. "Many of our customers manufacture parts of composite materials," says Steffen Nüssle. Zimmermann therefore also wants to mill trial parts of these materials using MAPAL tools. "We are optimistic that with the MAPAL milling cutters for composite machining, we will also find a new secret weapon to exploit the performance of our machines even better." The corresponding plans are already in hand. ➔

Zimmermann relies on the solid carbide milling cutter SPM-Finsih to finish deep pockets and delicate structures in a single pass.

KEY DATA OF THE TOOLS USED AT ZIMMERMANN:

Roughing – solution for diameter ranges above 25 mm
SPM-Rough ISO shoulder milling cutter with indexable inserts

Diameter 40 mm – Feed rate 21 m/min – Material removal rate 6.9 l/min

➔ 10 percent lower cutting forces with the best surface finish compared with the milling cutters from competitors previously used.

Roughing – solution for diameter ranges up to 25 mm
SPM-Rough solid carbide milling cutter with wave profile

Diameter 25 mm – Feed rate 13 m/min – Material removal rate 7.3 l/min – Cutting depth a_p 37.5 mm, cutting width a_e 15 mm

➔ High material removal rates with the highest machining values.

Multi-stepped semi-finishing of thin-walled structures
OptiMill-SPM solid carbide milling cutter

Diameter 16 mm – Feed rate 12 m/min – Projection length 66 mm – Extremely sturdy thanks to conical form

➔ Time savings of over 40 percent are possible in combination with the 3-axis milling head.

Finishing of deep pockets and delicate structures in a single pass
SPM-Finish solid carbide milling cutter

Diameter 12 mm – Feed rate 3 m/min – Best surface finish – Cutting depth a_p 40 mm – Special finishing geometry – No vibrations

➔ Perfect results even with large machining depths and practically complete wrapping of the milling cutter.

FOR THE FIFTH TIME IN A ROW:

MAPAL REMAINS THE PREFERRED SUPPLIER TO THE BOSCH GROUP

At the end of 2017, the Bosch Group once again awarded MAPAL with the status "Preferred Supplier" in the tools sector. "Bosch is a very important customer for us. We are proud that our tools are used for different projects and Bosch is impressed with them. The Preferred Supplier award confirms our good work", thanks Dr Jochen Kress, President of MAPAL.

The Bosch Group and MAPAL have worked closely together for decades. MAPAL supplies tools and chucks for machining numerous components at different sites of Bosch in North America, Asia and Europe. To respond to the great importance that MAPAL attaches to Bosch, a Key Account Manager has looked after all the concerns of the customer for several years.

With the award, Bosch has certified MAPAL for the fifth time in a row for above-average, competent and efficient collaboration. ■

Christian Hasslinger (3rd from left), Bosch, together with Liliia Bagatova (2nd from left), Bosch, present the award of "Preferred Supplier" to MAPAL representatives Dr Dieter Kress (3rd from right), Dr Jochen Kress (2nd from right), Siegfried Wendel (right), Global Sales Director, and Key Account Manager Michael Kokoschka (left).

SMALLER, MORE HEAT RESISTANT AND MORE AND MORE INDIVIDUAL

Clamping technology from MAPAL

The role of clamping technology has changed. From mere holders of the tools and mass produced parts, the chucks have increasingly developed into application-oriented top performers. Because in order to make the best possible use of the tool and the machine, the chuck plays a decisive role. Completely new possibilities in this sector have been opened up by additive manufacturing – for which MAPAL has a clear advantage as a technology leader. Jochen Schmidt, Product Manager Clamping Technology, reports on how this came about and how clamping technology is further developing.

Clamping technology and MAPAL – what made a manufacturer of precision tools to be also active in this sector?

Jochen Schmidt: Machining and its results are always a sum of different factors. This means that for a tool to achieve its maximum performance capability, its clamping system must also be optimally designed for the corresponding conditions. As a solution provider in the machining sector, it was therefore logical for MAPAL to add chucks to the portfolio.

From today's viewpoint – has this decision paid off?

I can answer this clearly: Yes! Today we supply everything for the machining process from a single source. We see ourselves as a technology leader in the clamping technology sector with the advantages acquired with additive manufacturing.

What role does additive manufacturing play in clamping technology at MAPAL?

Generally over the last few years we have set a trend in clamping technology towards individual customer solutions. Thanks to additive manufacturing, we have been able to implement concepts for our customers that previously could not be realised.

For the optimum process, the clamping point must often be brought closer to the cutting point than was previously possible. To achieve this, chucks are needed that are extremely narrow without power loss. MAPAL complied with this requirement with hydraulic chucks with narrower contours, among others. They allow hydraulic clamping technology to be used where previously only shrink chucks were used. Together with more precise run-out and highly ac- ➔

MAPAL

curate clamping, this offers additional advantages for the customer: On the one hand, handling hydraulic chucks is significantly easier and tools can be clamped more quickly. On the other hand, the cost-intensive periphery concerning the shrink chucks can be dispensed with.

How exactly are the chucks produced?
The functional range is applied to the conventionally produced tool body by selective laser melting. In this way, we also manufacture hydraulic chucks with a narrow contour for direct clamping of tools with a diameter from 3 mm.

Apart from the geometries that previously could not be realised, are there other advantages that arise from additive manufacturing?
As a result of additive manufacturing, our hydraulic chucks can be reliably used at operating temperatures of up to 170 °C because thanks to this production method, the temperature-critical soldering point between the clamping sleeve and tool body can be dispensed with. This is all the more important because dry machining makes up an increasingly large share of production processes due to environmental aspects amongst others. For thermal loads that exceed this temperature limit, for example for friction stir welding, with additive manufacturing we have succeeded in integrating a separate cooling system in the chuck (also read page 52). This means that the user can work reliably with our chucks even at significantly higher machining temperatures.

Is additive manufacturing at all suitable for series production or just for customer-specific special clamping systems?
At MAPAL we have already been mass manufacturing with our machines since 2014. Today we operate several 3D printers at two sites. But naturally additive manufacturing is also perfectly suited for customer-specific projects.

What are the costs?
Basically it's like this: The completely new concepts for clamping technology that we implement with additive manufacturing provide our customers with clear added value. What may appear to be expensive at first glance, can turn out to be very profitable on closer inspection and with the aid of amortisation calculations.

A very impressive example of this is an application that requires a long projection length of the tool due to the dimensions. Here there are now two options. Either the customer applies a long chuck optimised for the application in combination with a standard tool. Or the customer uses a standard chuck and requires a long special tool. If one considers the service life of the tool and the chuck, in this case the higher procurement costs of the special chuck will already amortise after eight tool changes.

What other developments do you anticipate in the future in the clamping technology sector? What are the trends?
In my opinion the sensors in tool holders will primarily play a significant role in the future. Because in mass production, more and more chucks are required that can be integrated in in-

telligent production structures with a high level of automation. And smart clamping devices with corresponding sensors can provide important data for machining as a link between machine and tool.

What benefits are to be gained from this data?

For example, if the user knows the forces at the tool using this data, he can draw conclusions concerning the remaining tool life. He can therefore use his tools over a longer service life or conversely replace them before a tool break and therefore possible damage to the component. In addition scheduling sizes can be determined more accurately and a digital service for customers can be expanded thanks to the relevant data.

How will the role of clamping technology change by collecting this data?

The essential role of clamping technology will not change. A chuck always clamps a tool. A lot of other things will change – this means the options for evaluation and precise coordination of the individual factors will increase. As with the tools, we also offer our customers numerous services beyond "merely" clamping the tools. This includes the chucks already mentioned that are precisely matched to the relevant application. Incidentally they are also used in quite exceptional sectors for MAPAL.

For example?

Our chucks are now used for the manufacturing of sewing machines and hydroelectric turbines. We have developed many new fields of application whose specific requirements are met using our chucks. I am particularly thinking of customers from the mould and die making field that use our HighTorque Chuck (HTC) with narrow contour in many cases.

You also presented the hydraulic chuck with narrow contour last year for the direct clamping of small diameters. What was the response to this presentation?

Very good. These chucks open doors for us in many applications – including in the electronics and medical industry as well as the jewellery and watch industry. We have continued to work intensively and research in this field of miniaturisation. We will present the results in September at the AMB in Stuttgart. ■

Milestones in the development of clamping technology at MAPAL

USING NEW SOLUTIONS . . .

. . . FOR A RELIABLE PROCESS

In cases where completely new machining processes are necessary for common components, innovative technology partners are needed to bring a new process safely into series production. In the course of downsizing, for example, a relief bore is introduced in crankshafts to reduce the weight. To reliably realise this bore through the different bearings in industrial-scale production, MAPAL has developed an appropriate tool concept that is already successfully in use. ➔

To meet the requirements for smaller engines with increasing performance and reduced CO_2 emissions, different adjusting screws are turned. In this way, new materials are developed that are lighter but more stable. Or the components of the engine are modified to reduce the rotating mass and in turn the fuel consumption. For example, crankshafts for different engines are designed with a relief bore. This results in a significant weight reduction for the component.

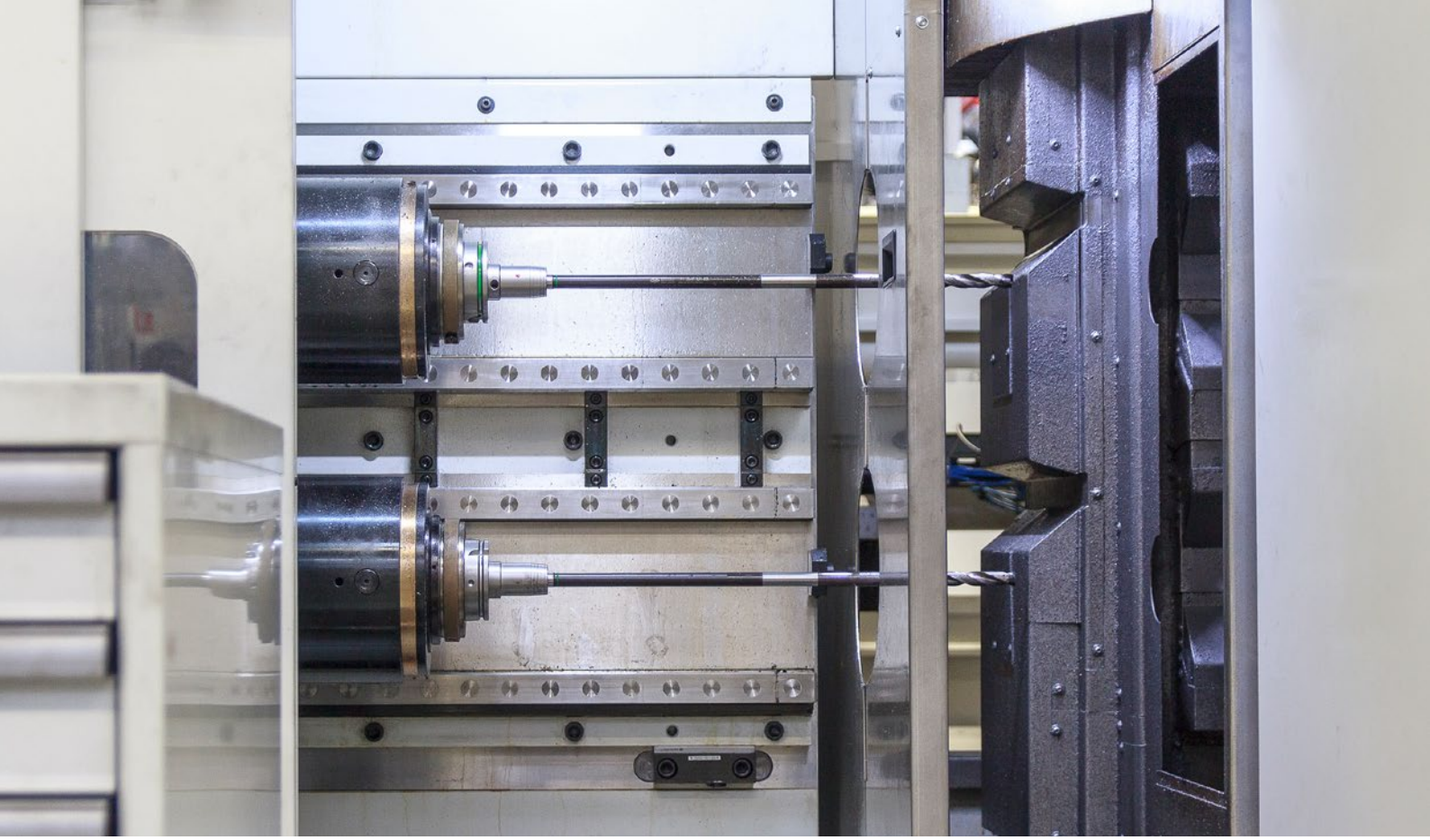
A NEW MACHINING PROCESS

For the manufacturing of crankshafts, the relief bore entails an additional machining process. At Daimler AG, the process development, planning and tool management departments work closely together with the manufacturing department for this. However together with the internal parties, suppliers that provide the optimum tools are also needed for reliable machining.

When the process was first designed, tools from different suppliers were considered. To introduce the bore through the bearing of the crankshaft, several manufacturers developed concepts. The solution from MAPAL was convincing. Many employees of the precision tool manufacturer are permanently on site in production in Untertürkheim to fix problems and to offer support during production. MAPAL has also done a lot of development work and performed trials during the entire time up to latest series. There is often a lack of time for this in mass production and so it is all the more worthwhile for manufacturing companies when a technology partner takes on this work.

A coated deburring cutting edge reliably ensures the desired chamfer at the bore entrances and outlets of the different bearings.

The relief bore of the crankshaft is machined with four drills at Daimler AG. Hydraulic chucks from MAPAL ensure reliable clamping of the tools.



The holder of the long drill alone is 480 mm long for machining the crankshaft for a 6-cylinder engine.

FOUR STEPS TO A RELIEF BORE

The process for machining the relief bore of the crankshaft made of micro-alloyed steel is realised with a total of four specially designed tools with two cutting edges. Minimum quantity lubrication is used for cooling. The cover bore is pre-machined with the first solid carbide drill (diameter 19.2 mm). The second solid carbide drill (diameter 18 mm) manufactures the pilot bore through the first bearing. A replaceable head drill (diameter 18 mm) is used as the third machining step. It finishes the first bearing and drills through the second bearing. The remaining bearings are machined with an additional, long replaceable head drill TTD (diameter 18 mm) from MAPAL. This tool threads through the first two bearings at slow speed and low feed, supports itself in it and achieves the best results for machining the remaining bearings despite the long projection length. This specially designed replaceable head drill consists of a holder made of steel with CFS connection, a CFS replaceable head holder with a length of 119.2 mm and finally the TTD replaceable head made of solid carbide. When machining the crankshaft of a 6-cylinder engine, the holder with CFS connection alone is 480 mm long.

BURR FORMATION WHEN STARTING UP THE SERIES

The four-stage machining process provided the desired results in the trials and series production with a low quantity. However, a problem occurred when starting up series production. A burr formed at the inlet and outlet of the individual bearing bores after around 100 bores that got bigger with each machined bore. The drill heads of the third and fourth drill already had to be changed after 100 bores. This is because the mechanical cleanliness of the component could not be ensured due to the burr. No metal particles may be found on the component. These could be released when operating the unit. Because of this, any residual dirt and every metal particle on the components must be categorically excluded.

A DEBURRING CUTTING EDGE IS THE SOLUTION

Those responsible approached MAPAL with this problem. The burr formation should be rectified as quickly as possible. However without using an additional tool for deburring. Otherwise the cycle time would increase and the process would have to be redesigned. MAPAL met this challenge. "We intensively developed solutions in our development department and fitted the replaceable head drill that machines all bearings with a deburring cutting edge", explains Tobias Moser who supervises the project as the responsible MAPAL field service specialist. The deburring cutting edge is spring-loaded and attached directly after the connection for the replaceable head at the CFS replaceable head holder. In the forward movement, the bore entrances are deburred and the bore outlets when the drill moves back.

The long drill enters the bore for drilling with a feed speed of 200 mm/min. At a defined point, the feed speed is reduced to 125 mm/min over a path of 4 mm. On this path, the deburring cutting edge generates the chamfer at the bore entrance and is simultaneously pressed into the interior of the holder by the spring system. The bore can then be machined with a feed speed of 375 mm/min. The retraction takes place in the same way. ➔

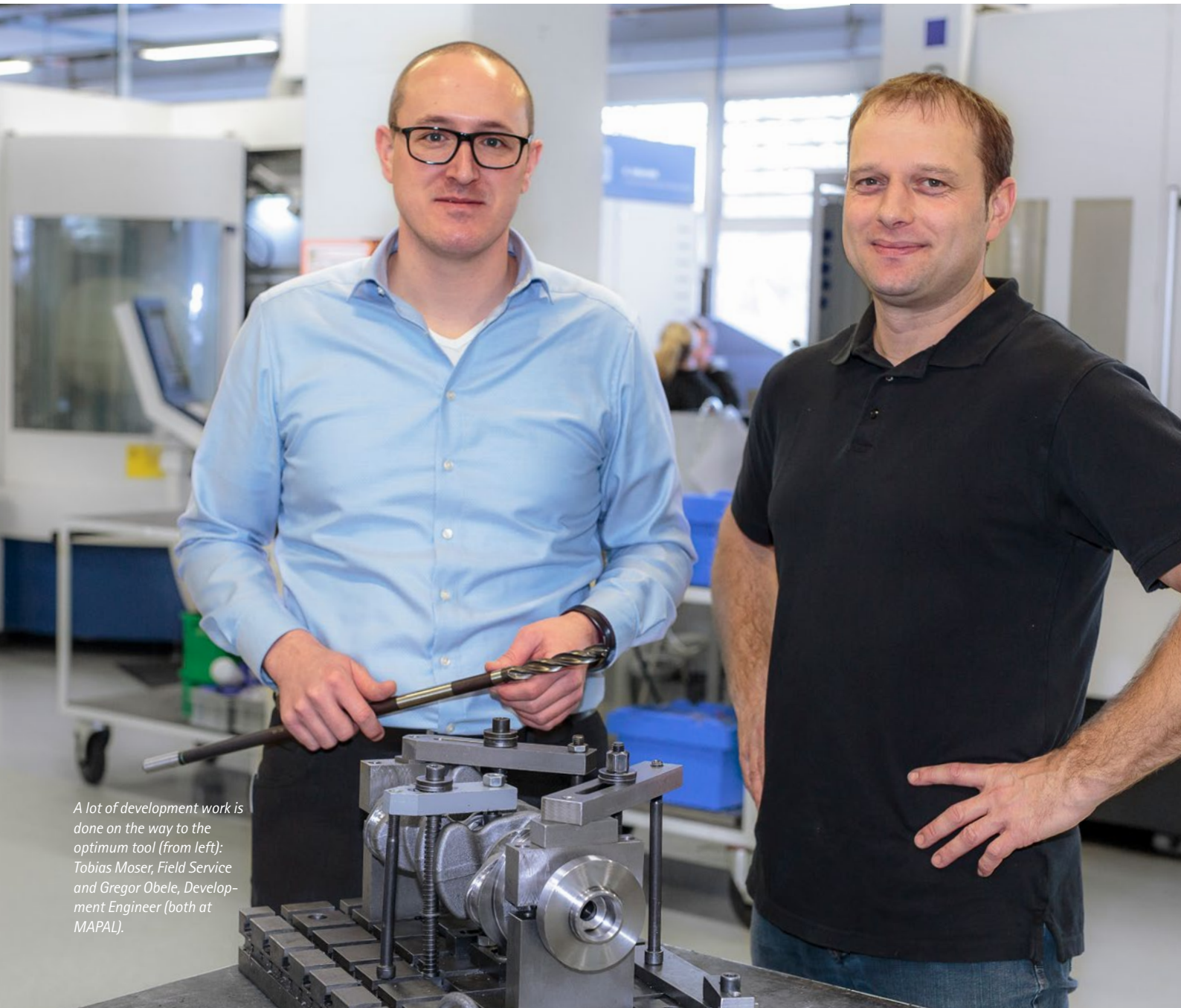
MASS PRODUCTION SINCE SEPTEMBER 2017

At the start of 2017, MAPAL tested the new concept in the research and development department with an original crankshaft. "With these results, we could work well and further optimise the tool"; says Moser. The result and speed of the optimisation was impressive.

Things got serious in summer. The modified tool with deburring cutting edge was tested on the machine for series production. The result was also desirable here, and the process including forward and backward deburring of the bores has been used since September 2017 in large-scale production. "Thanks to the deburring cutting edge, the service life of the tools is also much longer than before", says Tobias Moser. The first two drills are replaced after 2,000 bores and the drill heads of both replaceable head drills after 800 bores. And the deburring cutting edge? It only has to be replaced after 25,000 bores. This means that this process is the new standard for the relief bore of the crankshaft. And it has now been transferred to two other lines.

REDUCE CYCLE TIME WITH THE TRITAN-DRILL

Despite the reliable and satisfactory process, work on improvements and optimisation of the tools is naturally being continued. The first step was to reliably manufacture in large-scale production. Now the task is to make machining even more economical. A first step in this direction has already been taken. "We first used the deburring cutting edge uncoated. Now it is provided with a special PVD coating for an even longer service life", explains Tobias Moser. To be able to obtain higher machining values and therefore further reduce the cycle time, the same process is also currently tested on a test machine with counterparts with three cutting edges, different designs of the Tritan-Drill. And the results were very promising, reveals Moser: "If everything goes as expected, we will be able to implement the tools this year." ■



A lot of development work is done on the way to the optimum tool (from left): Tobias Moser, Field Service and Gregor Obele, Development Engineer (both at MAPAL).

NEW

SUPPLEMENTARY VOLUME

for the MAPAL catalogue

The latest MAPAL catalogues were published in 2017. They are available as a complete edition in eight parts. Thanks to their user-friendly design, the user has a perfect overview of the complete MAPAL product range. A supplementary volume has now been added. It contains a series of new products and service offers that expand the product portfolio.

Among other things, the topic of tool management 4.0 is included that MAPAL offers based on the c-Com Open-Cloud-Platform. New systems for efficient tool logistics supplement the offer in the setting room. In addition, the 250 page supplementary volume presents a variety of new and further developments of tools. This includes reaming tools for machining large diameters, additions to the range for drilling from the solid as well as a new generation of milling cutters for economical face and shoulder milling using indexable inserts with three and six cutting edges. Furthermore, the supplementary volume 2018 includes application-oriented hydraulic chucks as well as new cutting materials for boring and for mixed machining.

The printed edition of the supplementary volume can be ordered on the MAPAL website under the following link **www.mapal.com/en/catalogue-order**. Alternatively the supplementary volume is available online on the MAPAL web site for a quick overview and for download. ■

HSK IS BECOMING INTELLIGENT

Before Industry 4.0 and digitalisation became ubiquitous topics in the sector, an idea emerged. Why not make it possible for the HSK connection to transfer energy, data and media? The BaZMod project team embraced the implementation of this idea. Affiliated partners from the industry as well as research institutes developed an intelligent connection: HSK-i.

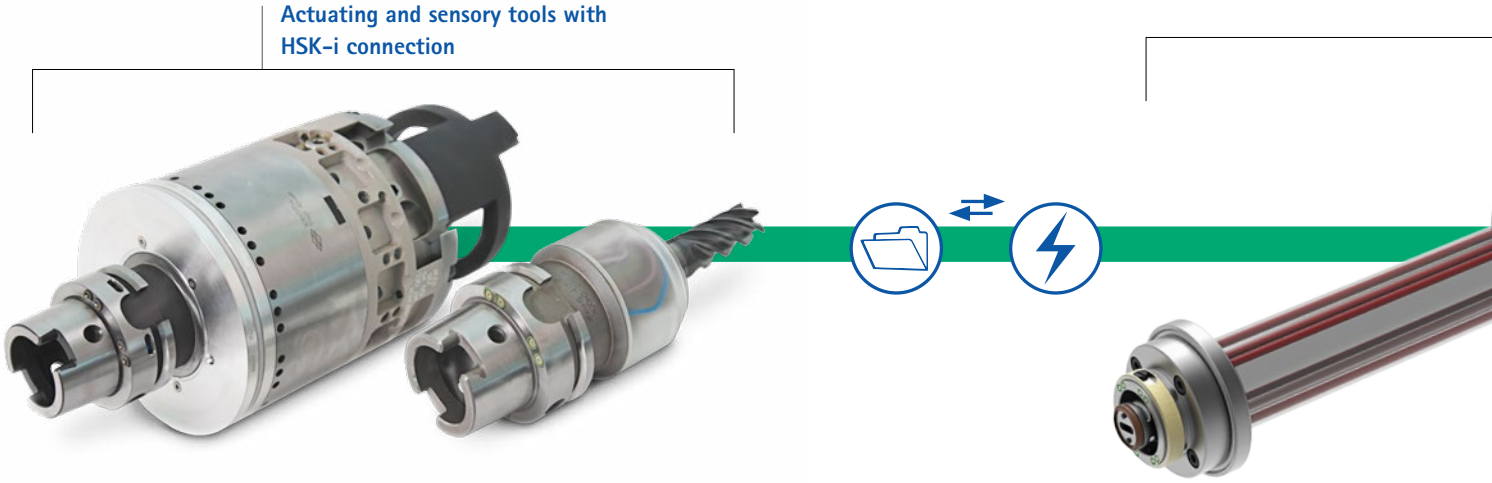
The hollow shank taper (HSK) is the connection of choice to achieve the highest radial run-out accuracy for machining operations. In 1993 it was first defined as a DIN standard and then in 2001 as an ISO standard. The HSK is a standardised connection independent of manufacturer that tool and machine manufacturers work with globally.

DIGITALISATION IN THE MACHINE TOOL

Specific machining information directly from the tool – this is one of the requirements of manufacturing companies for the future. Because processes should be further automated and today standard machines with very powerful and complex controllers are used instead of cost-intensive special machines. This transfers the complexity to the tool system. Topics such as predictive maintenance, adaptive control of the machine or order-optimised mounting are increasingly becoming the focus.

To be able to implement these topics, appropriate data is necessary. This must be collected in the rotating system. Because the machining forces, critical temperatures or vibrations arise here during machining. And the relevant measurement values can only be directly collected here. When the data is collected, it must be transferred. It is therefore necessary not only to collect data but also to ensure its transfer. Not only from the tool to the machine controller or to cloud solutions such as the c-Com Open-Cloud-Platform but also in the reverse direction to control actuating tools, for example.

To meet these requirements, experts from industry and science developed HSK-i, an intelligent connection that enables both the energy and data transfer bidirectionally. With HSK-i, intelligent tools can be provided with data and energy. The affiliated partners have now submitted a corresponding standardisation application. The areas of focus of MAPAL for the BaZMod project were on the "development of a universal and standardised connection for cyber-physical additional modules (CPM)" as well as the "prototypical development of more flexible systems (CPM) with standardised connection". ➔



To be able to use the HSK to bidirectionally transfer data and energy, eight electrical contacts were added to the HSK face surface. "These pins are very robust. We designed them so that chips, oil or coolant cannot damage the contacts", explains Bernd Essig, Team Leader in the field of mechatronic systems and part of the BaZMod team.

DIFFERENCES TO DATA TRANSFER VIA RADIO

Previously the possibility to transfer data from the work area was limited to radio transmission. "Radio solutions cannot be used efficiently for many machine tool operators. Batteries are required for data transfer via radio. And batteries directly in the work area mean a high maintenance intensity", explains Essig. It is only due to the fact that data can be directly transferred from the work area to the machine controller that the data transfer is simple, fast and without intensive maintenance. "Another aspect that contributes to sensor solutions now getting more interesting are the options for networking", continues Essig. "Because previously data could be collected, but the relevant assistance systems to appropriately evaluate and use it were lacking." With the advent of Industry 4.0 in manufacturing, the machines are becoming more adaptive and can respond to data accordingly.

TOOLS IN CONJUNCTION WITH HSK-I

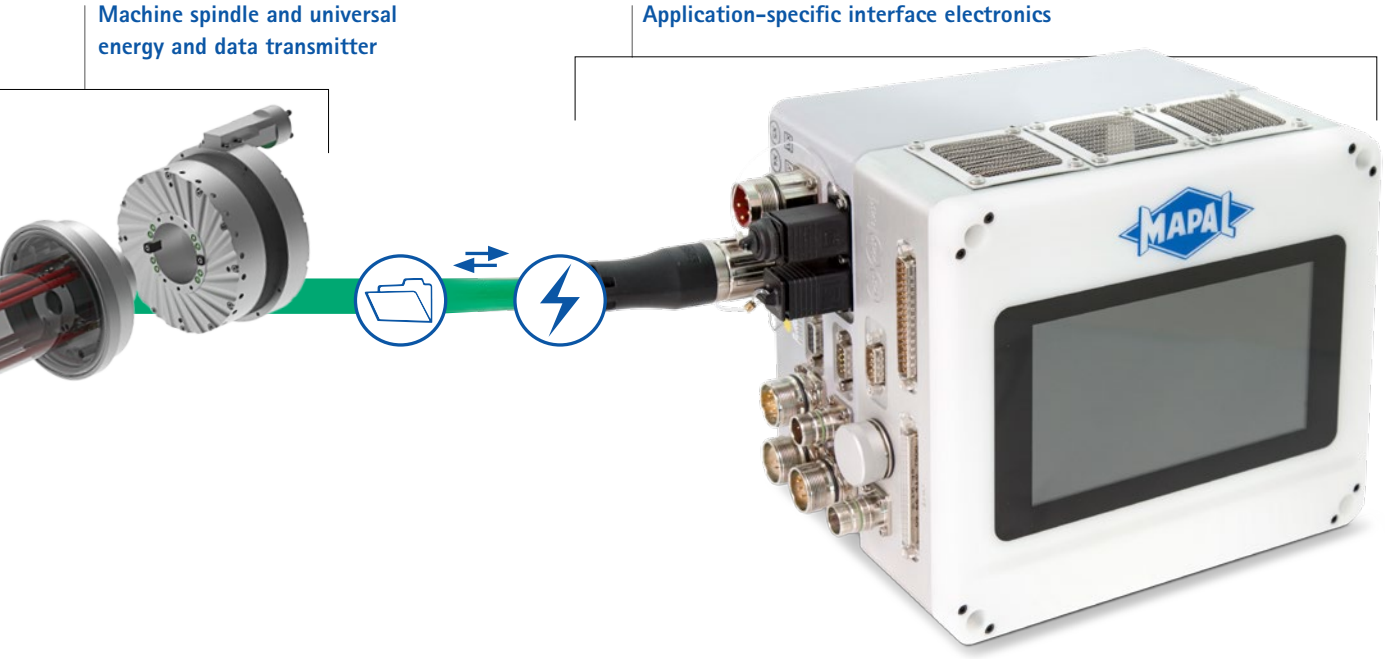
Actuating tools such as the MAPAL TOOLTRONIC are used in conjunction with HSK-i. Energy and data is exchanged via the contacts at the HSK connection. The difference compared with the previous procedure is the stator that until now had to be positioned in the machining area when using an actuating tool to be able to transfer energy and data in both directions. A tool restriction was associated with this in the work area. Thanks to the HSK-i system, the TOOLTRONIC can also be integrated without stator as a position-controlled axis in the CNC controller and perform full-featured turning operations as a rotating tool.

Beyond the actuating tools, tools fitted with sensors can be efficiently used thanks to HSK-i. This is another big advantage that the new system offers. Processes can be directly monitored by the tool. Here only a little additional installation space is needed at the tool. For example, a hydraulic chuck from MAPAL in a standard size can record and forward information on machining forces, temperatures or vibrations with sensors. In addition sensors can be directly integrated in the tools. Here the electronics are built so that they do not get damaged and operate perfectly at high temperatures up to around 125 °C.

Using this data that is obtained from the tool or chuck, the machine controller can intervene and control using assistance systems. For example, the feed or speed can be adapted if the machining forces are too large. This option is very useful for varying stock removal as is common for cast components. Why? The exact stock removal is not known at every individual position but the force that should act on the tool. Tool wear can also be detected early on using the data obtained and a tool can be changed.

PROTECT WORKPIECE FROM DAMAGE

For example, turbine wheels are often milled over hours. Thanks to the intelligent HSK-i connection, the vibrations during this machining process can be recorded and monitored, among other things. If values are too high, the responsible person can act accordingly and replace the tool or adapt the cutting data, for example. In this way, the workpiece is protected from damage.

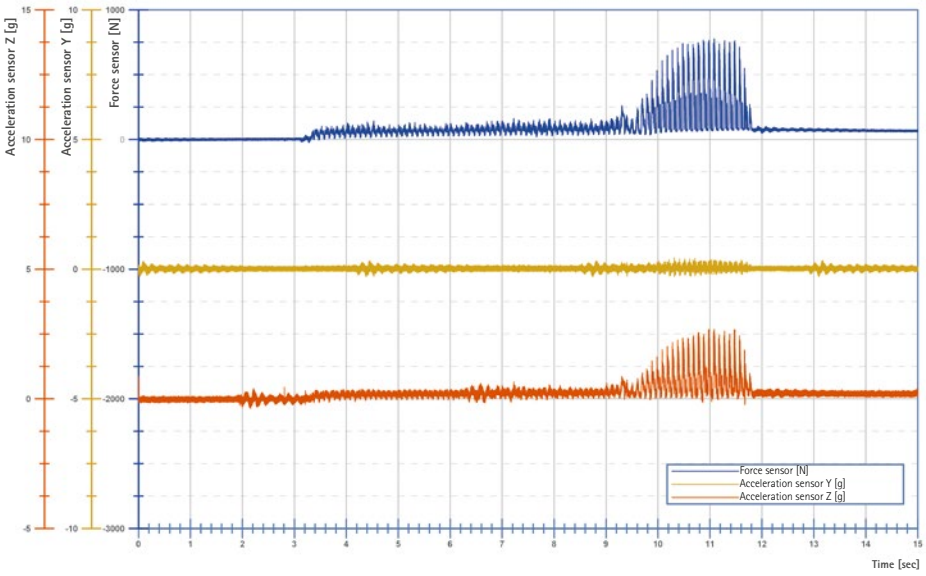


FASCINATING APPLICATIONS FOR THE FUTURE

"The possibilities that we obtain from direct bi-directional data and energy transfer are diverse", emphasises Bernd Essig. Today the options that can be implemented are fascinating. A lot more is conceivable for the future. "We have a lot of ideas – laser marking directly in the machining centre, visual inspections on the machine or ultrasound-assisted machining. The boundaries of what is feasible are being pushed further." ■

TOOLTRONIC sensor tool

Trial

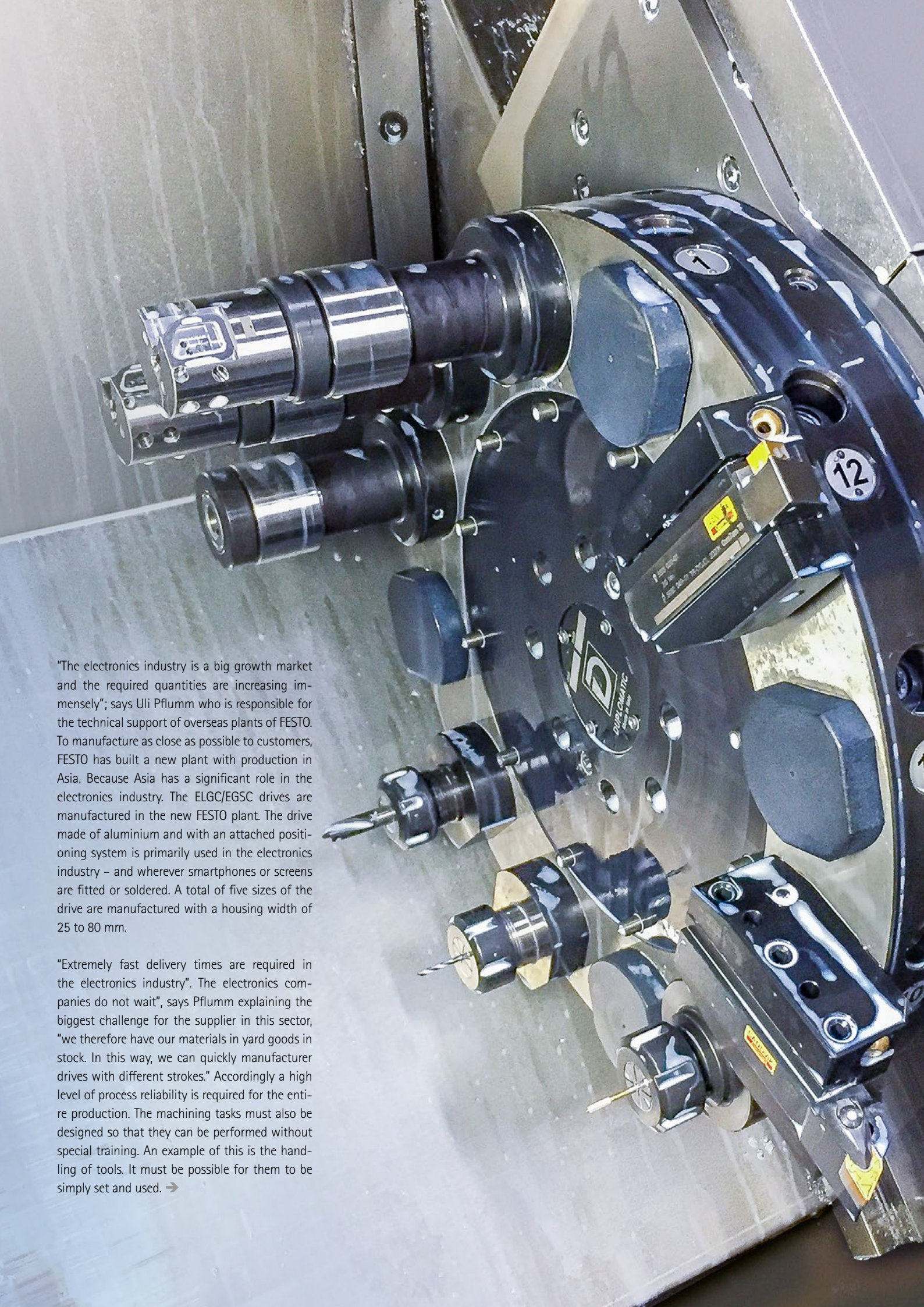


Trial graphic: In the trial the sensor data of force and acceleration are transferred in real time via HSK-i during turning with the TOOLTRONIC. In the diagram, unwanted stimuli of the tool are detected by means of the very high deflections.

SIMPLE HANDLING FOR EXTERNAL REAMING

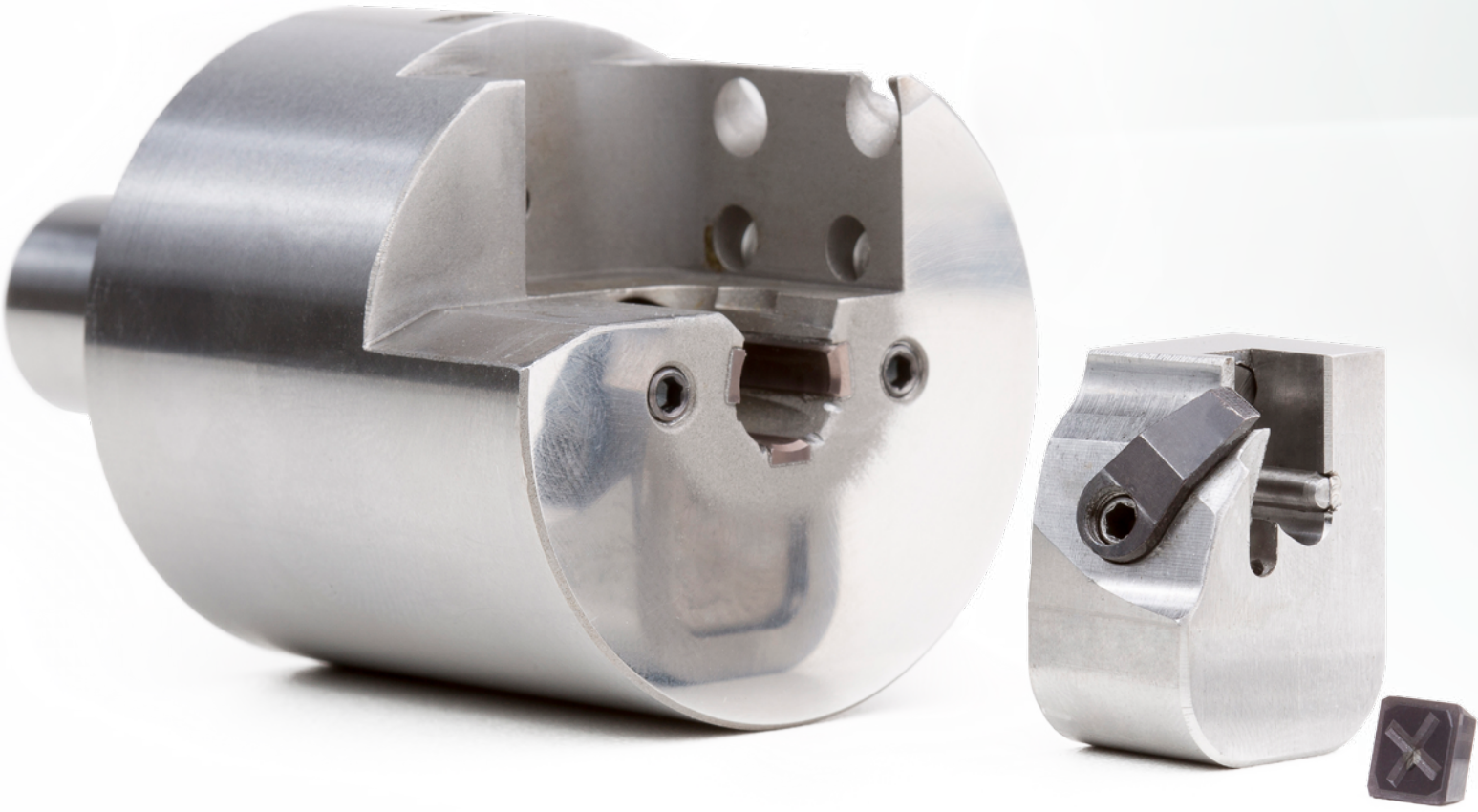
Innovative cassette concept simplifies the setting of external reamers accurate to a µm

Manufacturing an IT6 fit on small external diameters? "Here you have to grind", thought Uli Pflumm who works at FESTO AG & Co. KG in the area of Corporate Engineering Drives. There are other ways, as the machining of ball bearing spindles for ELGC/EGSC electric drives, that are used for the manufacturing of smartphones, shows. The required IT6 quality is reliably achieved here with an innovative external reamer – and with very simple handling.



"The electronics industry is a big growth market and the required quantities are increasing immensely"; says Uli Pflumm who is responsible for the technical support of overseas plants of FESTO. To manufacture as close as possible to customers, FESTO has built a new plant with production in Asia. Because Asia has a significant role in the electronics industry. The ELGC/EGSC drives are manufactured in the new FESTO plant. The drive made of aluminium and with an attached positioning system is primarily used in the electronics industry – and wherever smartphones or screens are fitted or soldered. A total of five sizes of the drive are manufactured with a housing width of 25 to 80 mm.

"Extremely fast delivery times are required in the electronics industry". The electronics companies do not wait", says Pflumm explaining the biggest challenge for the supplier in this sector, "we therefore have our materials in yard goods in stock. In this way, we can quickly manufacturer drives with different strokes." Accordingly a high level of process reliability is required for the entire production. The machining tasks must also be designed so that they can be performed without special training. An example of this is the handling of tools. It must be possible for them to be simply set and used. ➔



CHALLENGE: IT6 FIT FOR THE SPINDLE BEARING

There is a spindle made of 100Cr6 tool steel with ball screw drive inside the drive. A particular challenge for manufacturing the drive is the area at the spindle for its bearing. The smallest diameter of the spindle is 4 mm. For a quality of IT6, only a 8 µm diameter tolerance is allowed. "Previously I was of the opinion that grinding must be performed in such a case", confesses Uli Pflumm who is responsible for the machining process. However he wanted to dispense with grinding for the machining of the ball bearing spindle due to technical manufacturing reasons.

The technician was therefore looking for a solution and inquired at a manufacturer of lathes about a precision machining lathe that can manufacture this IT6 fit. The machine manufacturer could help him – but not with the appropriate machine. "He gave me the idea to manufacture the fit using the external reaming procedure" remembers Pflumm. Because with an external reamer, a very high quality can be achieved even on simple standard machines available on the market. "Until then external reaming was not a concept for me – but I liked the idea so much that I didn't pursue the search for a suitable machine", says Pflumm.

MAPAL COMPETENCE: EXTERNAL REAMING

External reaming in these tolerance ranges is a unique selling point of MAPAL. And: FESTO has already successfully worked with MAPAL for decades, and Pflumm confirms: "We use many tools for fine machining from MAPAL." MAPAL is the partner that FESTO relies on for its tools when high surface finishes are required for the piston areas of valves. And so Uli Pflumm approached the responsible field service specialist at MAPAL, Alfred Baur, with his requirements for the IT6 fit.

Two diameters with a difference of 0.5 mm for the bearing must be machined at each spindle, i.e. 4 and 4.5 mm for the smallest spindle, for example. "As we have two diameters to machine, we designed an external reamer with a stepped insert that reams both fits in one operation" says Alfred Baur describing the starting phase of the project. It was clear from the start that a floating holder will be used. On the one hand to compensate for the thermal growth of the machine and on the other hand to compensate for axial and angular offsets between the tool axis and the fit to be machined.

This concept made up of an external reamer with stepped insert and floating holder worked well and provided the required machining results. However generally the optimum adjustment of the inserts is a challenge for external reaming as the insert is inside the tool and is very difficult to access. Setting a stepped insert is even more complex. "Setting a stepped insert in an external reamer requires experience, talent and the appropriate equipment", describes Alfred Baur. "Because of the required simple handling, we abandoned the idea of a stepped insert and designed two individual external reamers for both diameters"; outlines Baur. To simplify the adjustment procedure of the indexable inserts, the external reamers are fitted with MAPAL's own EA-System (EasyAdjust). For the EA-System, the taper of the insert is already integrated in the cassette that is used as mounting for the insert. Here the adjustment procedure for the taper of the minor cutting edge is cancelled completely. Only the protrusion of the insert must be adjusted for the guide pads. This is actually a simple procedure that can be quickly implemented. "For an external reamer that machines a 4 mm diameter, this is very challenging",

says Baur. A measuring sensor must be moved in the external reamer, zeroed at the guide pads, moved on the insert and the relevant protrusion adjusted. And all this with a restricted view of the inside of the tool.

This means: This solution also provides the required results but did not comply with the handling requirements that Pflumm set. "FESTO imagined a solution that every employee can easily and quickly apply", says Baur. And so MAPAL continued to further develop the concept. And with great success.

TWO CASSETTES FOR SIMPLE SETTING

"We integrated the cassette of the EA-System in an additional removable cassette", says Baur describing the solution. As a result, the employees at FESTO now have several options to adjust the insert of the external reamer. Either in the classic way with the measuring sensor directly in the tool. Or alternatively the large cassette can be removed and the insert can be adjusted with a micrometer or measuring plate. The cassette is then reinstalled. The relevant setting dimension for the insert is laser-etched on the rear of the tool. This dimension corresponds to the middle of the tolerance. "If we set this dimension, we are definitely within the tolerance during machining" confirms Uli Pflumm. Both cassettes are precisely manufactured so that a changeover accuracy of 2-3 µm is achieved.

The FESTO employees rely on the micrometer for setting. "Setting the insert is now very easy for us", says Pflumm. When an employee sees how it works one time, adjusting it independently is not a problem anymore. Here the concept for external reaming meets the requirement for simple handling. The surface finish that the tools achieve is also impressive. The required average roughness depth is R_z = 6.3 µm though better values were consistently measured. The work was performed with a feed of 0.08 mm and a cutting speed of 50 m/min. The protrusion of the insert at the guide pads is 9 µm. A total of ten external reamers are needed for machining the spindles of the five sizes of the drive. The indexable inserts have four cutting edges – they can be turned three times until the indexable inserts must be replaced. With this and thanks to the fast machining performance, high efficiency is guaranteed.

"Here MAPAL has supported us in getting the machining process that is very challenging to work and to successfully realise our concept", says Pflumm describing the collaboration. He felt that he was always in the best hands. During the collaboration with MAPAL, the ambition of the tool manufacturer to solve the most challenging machining task is noticeable. After a pre-series was successfully implemented with the production of 4,500 drives, series production of the drive started in Asia at the end of 2017. ■

PARTICULARS

SIDNEY PIMENTA PAIVA

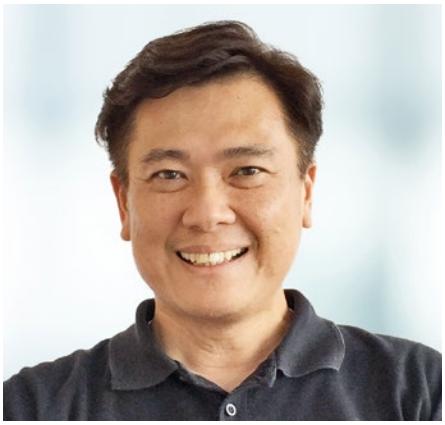
Managing Director |
MAPAL USA and MAPAL Brazil

Sidney Pimenta Paiva (60) is the new Managing Director of the American subsidiary MAPAL Inc. Paiva, who also steers the destiny of MAPAL do Brasil, came to the company in 1997. He successfully built up the Brazilian MAPAL do Brasil subsidiary and continued to further develop it. Paiva will make use of his many years of experience and his sound knowledge of the entire American market to set up MAPAL Inc. more widely in the USA and to increase its presence in individual market segments.

KOICHI MATSUDA

Managing Director | MAPAL Japan

The new Managing Director of the Japanese subsidiary MAPAL KK in Saitama is Koichi Matsuda (56). He succeeds Toshiyuki Funabashi who has retired. Matsuda brings extensive specialist knowledge as well as excellent language skills and cultural knowledge to his new position. He began his career in 1982 in Germany and was most recently working there in the management of international tool machine manufacturers. In 2000 he returned to Japan and took over the responsibility for the management tasks for companies in the machining industry.



JAMES TAN

Managing Director | MAPAL Thailand

James Tan (53) has taken over the management of MAPAL Tooling Thailand. Tan has extensive technical expertise and a good knowledge of the sector. He joined the company in 1995 and coordinated the sales and marketing activities for MAPAL in Singapore. In summer 2017 he was already responsible on an interim basis for the management of MAPAL Thailand. The subsidiary is based in Bangkok and employs 20 staff. It has a Service Centre for regrinding and reconditioning of tools.

RALF WACKENHUT

Managing Director |
Centre of Competence clamping chucks

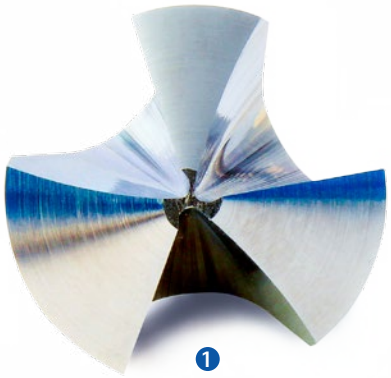
Ralf Wackenhut (37) is the new Managing Director for production of the Centre of Competence clamping chucks in Ehrenfriedersdorf. In addition Wackenhut is responsible for the manufacturing of clamping technology in Aalen. The qualified engineer and MBA holder started in 2004 as a designer at MAPAL in Aalen. Three years later he took over the management of design for fixed tools. In 2015 Wackenhut changed position to become the Technical Head in the Centre of Competence in Ehrenfriedersdorf. He manages the plant now together with Peter Tausend, Commercial Director.

TOBIAS SCHIELE

Managing Director | Centre of Competence solid carbide tools

Tobias Schiele (39) has taken over the commercial management of the Centre of Competence solid carbide tools in Altenstadt. Together with Ulrich Krenzer, the long-standing technical Managing Director, Schiele will steer the talent of the competence centre in the future. The trained wholesale and foreign trade clerk and business economist (VWA) came to the Centre of Competence as a commercial head at the start of last year. Before Schiele worked at a large manufacturer of drives as a commercial head and human resources manager.

WITH MAPAL FOR A **CHATTERFREE** PROCESS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During machining, vibrations often occur that are either stimulated externally or caused by the machining process itself. The self-excited chattering vibrations have a negative impact on the machining result and significantly reduce the service life of the tools. In addition the tool machine is subjected to high loads by the chattering. MAPAL has therefore developed different tool concepts that counteract the chattering vibrations.

3

Poor circularities and cylindrical forms, inadequate surface finishes and, in extreme cases, broken tools and inserts – the consequences of bending or torsion vibrations on the tool can vary during machining. Because vibrations lead to so-called chattering.

The chattering vibrations come from a dynamic instability of the machining process. This can have different causes. For example, an incorrectly clamped tool or inadequately fixed clamping can cause chattering. The same applies for long, narrow tools with correspondingly low bending resistance. If too much force acts on them due to excessive cutting speeds for example, chattering vibrations are the result. When machining very hard materials, increased vibrations occur compared with softer materials. Tool clamping also significantly affects the stability of the system. In addition high cutting depths and interrupted cuts also act as excitation of vibration. The ratio of the excitation and movement describes the stability of the process.

The precision tool manufacturer MAPAL has intensively looked into the causes for chattering vibrations. They can be prevented or compensated by different approaches. For example, one way is to reduce the load and dynamics of the system – as a result of adapted cutting speeds or the optimum relationship between the speed and feed. A second approach that is decisive for the tool manufacturer is, to design the tools themselves more stably, thereby reducing the acting forces and stabilising the machining process using special tool geometries.

UNEQUAL SPACING FOR REDUCED AXIAL FORCES 1

Chatter marks often occur at countersinks. Countersinks are usually manufactured using hand drills or cordless drills. These machine conditions inevitably give rise to instability of the entire system. It was therefore important when developing a new countersink for it to stabilise itself. MAPAL has developed a new generation of countersinks with significantly reduced axial forces for this use. The force reduced by 50 percent results from the significantly unequal spacing of the three cutting edges. The Y-cutting edge arrangement also leads to an even, defined applied force and prevents the cutting edges jamming. The result is significantly fewer vibrations on the tool which can be noticed by higher accuracies, better surface finishes and longer tool lives.

2

ARC SHAPED LAND FOR BEST SUPPORT 2

During boring processes, particularly with higher stock removal, radial vibrations often arise that cause chattering. The unequal spacing alone is not enough for high stock removal. For this reason MAPAL has fitted its tangential roughing tools (TSW) for this type of machining with innovative, six cutting edge indexable inserts with a special arc shaped land. This special geometry is a support surface on the insert that supports the tool in the bore and is comparable to an arc land chamfer on fixed reamers. The unequal spacing as well as the arc shaped land reliably prevents chattering and vibration for these tools.

WELDED CONSTRUCTION FOR "DYNAMIC LIGHTNESS"

Particularly for large, heavy tools with long projection, pendulum oscillations occur that must be absorbed or compensated. Otherwise work must be performed with such low cutting speeds that the process is not economical. For this case, MAPAL has developed the so-called "welded construction". A thin-walled tube serves as a tool body, making the tool extremely light but also very stable and rigid – "dynamically light". The carriers for the inserts and guide pads are welded on and supported one another by means of connecting ribs. To optimise the relationship of rigidity and weight and to counteract the pendulum oscillations, for this type of tool MAPAL simulates the machining forces as well as the stresses that arise, bending vibrations and torsion vibrations by means of FEM (Finite Element Method). All in all the risk of chattering is minimised and the support and therefore the stability of the entire system is also ensured for an interrupted cut.

ABSORBER SYSTEM FOR VIBRATION DAMPING IN THE SHAFT 3

Tools for boring and milling with very long projection often cause insufficient dynamic rigidity of the system and are more inclined to vibrate. To compensate this vibration, MAPAL has developed an innovative system for vibration damping directly in the tool shaft. An absorber system consisting of several spring packs compensates the frequency of the vibration in the opposite direction. In this way only minimum vibrations are transferred to the tool body – they are smaller by a factor of 1,000 when compared to a setup without an absorber system. Despite the longer projection, operation is smoother and more stable even at higher cutting values. ■

ROADSHOW IN KARAWANG

Minimum quantity lubrication (MQL) is an environmentally-friendly and cost-effective alternative to the conventional cooling lubricant process. At a roadshow in Karawang, not far from the Indonesian capital of Jakarta, 90 persons responsible for production from the automobile, bicycle and aerospace sectors were able to find about the advantages of MQL tool technology.

With 17,000 small islands, Indonesia is the largest island state in the world. Away from the tourist regions, a thriving automotive industry - together with the agricultural and raw material industry - has been established on the archipelago that produces passenger vehicles and commercial vehicles. This development has primarily been promoted by Japanese companies that are represented in the island state with numerous production plants. And they do not only produce for the local market. Indonesia is a member of the ASEAN group and cooperates with neighbouring regions. A supplier from the aerospace industry is also located in the island state and is supported by MAPAL Indonesia. The MAPAL subsidiary has been on site since 2014. Twelve employees take care of the needs of the customers in close coordination with the MAPAL Centres of Competence in Germany.

A LOT OF INTEREST FROM THE CUSTOMERS

After the success of the first roadshow 2016, MAPAL invited customers to a new show last November to Karawang. The city is located on the island of Java and is to the south-east of the capital Jakarta, the headquarters of MAPAL Indonesia. 90 participants, 20 percent more than at the first roadshow, demonstrated the high level of interest of the customers. One of the central topics of the second roadshow from MAPAL was minimum quantity lubrication. MQL not only makes an important contribution to environmentally-friendly machining processes - cost savings of up to 15 percent can also be realised. In his presentation, Asia Director Armin Kasper gave an insight into the development of tools suitable for MQL and referred to the many years of experience that MAPAL has in this sector. Mesut Coskun, Key Account Manager Asia at Bielomatik, specialist for lubricant technology, added to the topic with the presentation of lubrication systems in single and dual channel technology. Cost-efficient machining concepts were also the focus in other presentations. Oliver Manske, Business Development Manager Japan & Indonesia, showed new products of clamping technology including the additively manufactured hydraulic chucks. Tobias Oehler, product specialist from the Centre of Competence solid carbide tools in Altenstadt, presented high-performance milling cutters and drills. Video clips with machining examples and a tool presentation expanded on the content of the presentations. The speakers also included individual application cases of the participants and presented solutions for optimum processes. In addition they gave suggestions for additional options when using tools from the MAPAL product range. The comprehensive introduction to technology know-how was well received by the participants. A pleasant side effect of the roadshow was the possibility for them to strengthen personal contacts and build common relationships - as part of the event as well as for the following visits from the MAPAL specialists on site. ■

MAPAL

TTD-TRITAN:

Enormous potential for drilling from the solid on heat exchangers

The use of a heat exchanger is worthwhile in many fields of applications – not only in domestic heating systems. Wherever heat is produced, it can be actively used by a heat exchanger. And this helps to save costs and conserve resources in the energy balance. In turn, with the TTD-Tritan, MAPAL has achieved a quantum leap in efficiency for machining heat exchangers.

Many versions of heat exchangers are used in different industries. They help to make use of previously unused heat that is produced in the production process. This report deals with recuperators, i.e. heat exchangers where two liquid or gaseous media at different temperatures are pumped in circuits separated from each other. A heat exchange takes place without mixing the media. This technology conserves resources, saves energy and consequently increases the overall efficiency of production. Plate heat exchangers and bundle heat exchangers play a primary role within the recuperators.

Structurally bundle heat exchangers are usually made of metal and consist of a tube bundle that conducts a medium and a so-called orifice baffle with a front tube plate that a second medium flows through. The exact design concerning the exchange mechanisms, tolerances or operating parameters depends on the respective use of the heat exchanger.

LARGE MARKET FOR SOLID CARBIDE TOOLS

The tube bundle of a heat exchanger closes with a tube plate that features a number of bores depending on the size of the heat exchanger. To ensure that the medium does not escape at this component transition, high requirements are set at the bores with regard to position accuracy and size accuracy. Stefan Kühnle, Business Development Manager USA, reports on his experiences from the petrochemical industry: "In this sector in particular, heat exchangers have enormous dimensions. The tube plates often have several hundred bores that must be reliably and accurately machined while having long tool lives. A huge market for solid carbide tools."

DRILL WITH THREE CUTTING EDGES IS THE METHOD OF CHOICE

The TTD-Tritan was tested by a customer in the USA and was impressive all along the line. The TTD-Tritan that came on the market as a replaceable head version in 2016, was the only drill with three cutting edges that was available as a replaceable head system at the time.

Replaceable head systems in machining manufacture are first choice when it comes to meeting the demands of rising raw material prices, resource efficiency and streamlining of stocks. On the TTD-Tritan, tool head and tool holder are joined by Hirth serrations. This connection is easy to operate and particularly stable so that all the benefits and the performance level of the solid carbide equivalent are fully retained with the replaceable head variant. In addition it guarantees optimum torque transmission with at the same time high changing and radial run-out accuracy. The TTD-Tritan is perfectly centred via its pronounced drill tip and ensures very good circularity – and that at lower costs, because with the replaceable head system, the cost-intensive carbide is limited to the tool head. Lower costs are thus guaranteed even with large diameters.

"There were several reasons why we immediately decided to use the TTD-Tritan", reports Stefan Kühnle. "For machining different versions of tube plates, the customer first needs every diameter version in several lengths. Here we are able to provide a very wide diameter range in all the necessary lengths with our consistent program. We can also use smaller diameters in the monolithic solid carbide design. In addition less storage space is necessary when the wear parts are mainly limited to the drill heads. As a result the capital tied up in stock is naturally reduced. And finally we achieve significantly better cost-per-part values within the diameter range from 19 mm."

The first practical tests with the TTD-Tritan are impressive. On a Quick-Mill Intimidator 120 machining centre, tube plates made of carbon steel SA-516-70N were machined. The bore diameter was 1.008 inch (25.6 mm) and the bore length 2.5 inch (63.5 mm). Here the TTD-Tritan operated with a feed speed 59 percent higher than the replaceable head drill with two cutting edges from a competitor used to date. ➔

COMPARISON OF THE MACHINING PARAMETERS:

	TTD-Tritan	Replaceable head drill with two cutting edges
v_c [m/min]	120	118
f_n [mm/rev.]	0.7112	0.4572
v_f [mm/min]	1,374	864

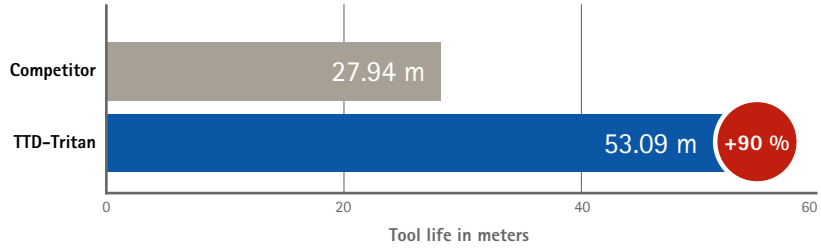
SHORT PROCESS – LONG TOOL LIFE

For the solid drilling operation described, the TTD-Tritan achieved a tool life of a good 53 metres while the drill previously used only achieved almost 28 metres. In addition to the significant increase of 90 percent, the MAPAL tool performed solid drilling in one operation and with a machining time of 29 minutes for the complete tube plate with 550 bores. "The TTD-Tritan achieves this due to its impressive feed speeds as well as due to the self-centring drill tip", explains Mogens Nielsen, Product Manager Solid Carbide Tools MAPAL USA. "In this way, upstream piloting is no longer necessary." In contrast the previous machining process had to be piloted. In addition, the tool of the competitor did not achieve a controlled chip formation. The tube plate therefore still had to be manually cleaned to remove the partly very long chips after piloting. "Overall with the TTD-Tritan, we reduced the machining time by 57 percent from originally 68 minutes to 29 minutes for all 550 bores of the tube plate", explains Mogens Nielsen.

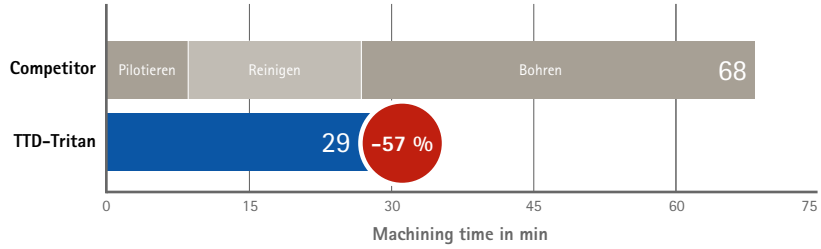
THE ADVANTAGE OF MAPAL: GUARANTEED AVAILABILITY

"Customers in the field of machining heat exchangers attach great value to guaranteed tool availability", reports Stefan Kühnle, Business Development Manager USA, and adds: "Here there can be no compromises." However our UNIBASE-M tool dispensing systems and the associated digital services are impressive." ■

Tool life



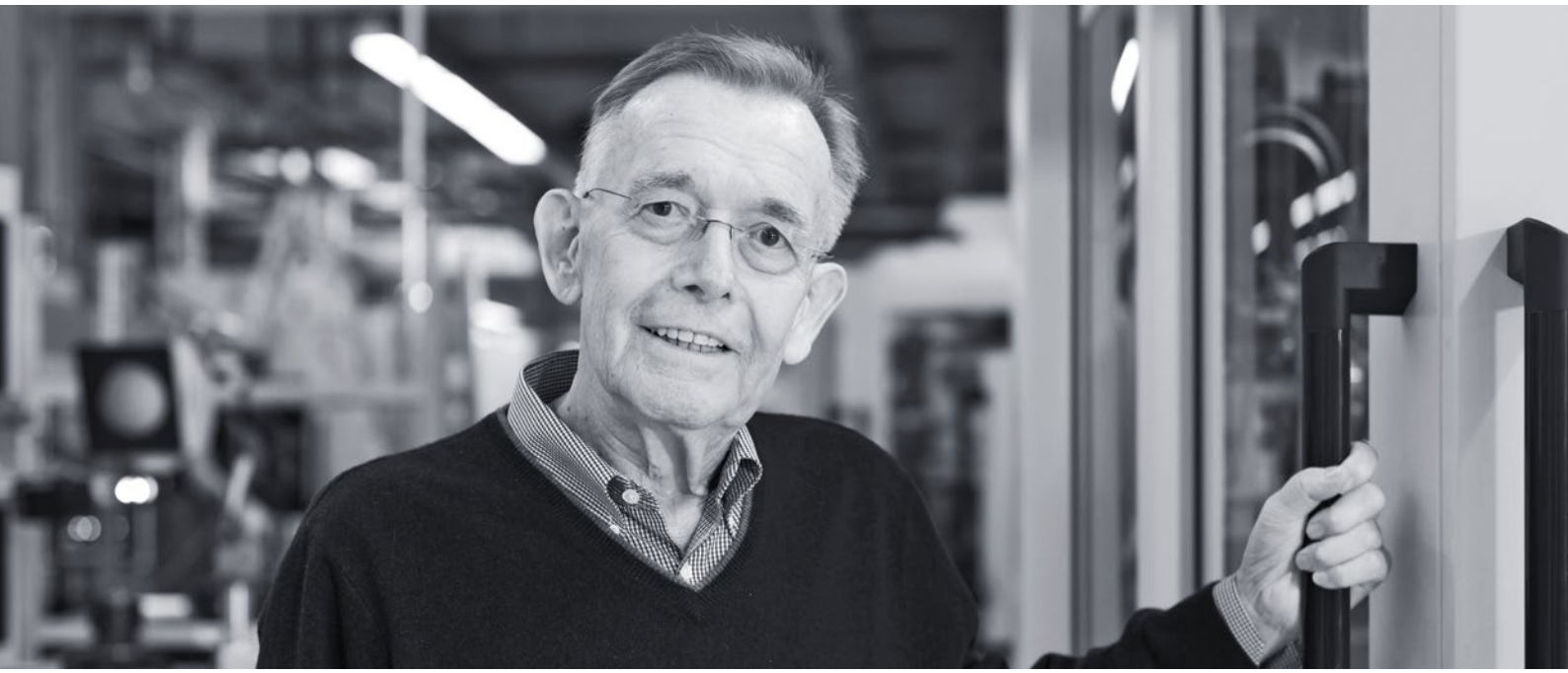
Machining time



WERNER STIEF

the pioneer of PCD tools has died

The MAPAL Group mourns the loss of Werner Stief. The founder of WWS Werner Stief GmbH, now the MAPAL Centre of Competence for PCD tools in Pforzheim, died at the age of 75.

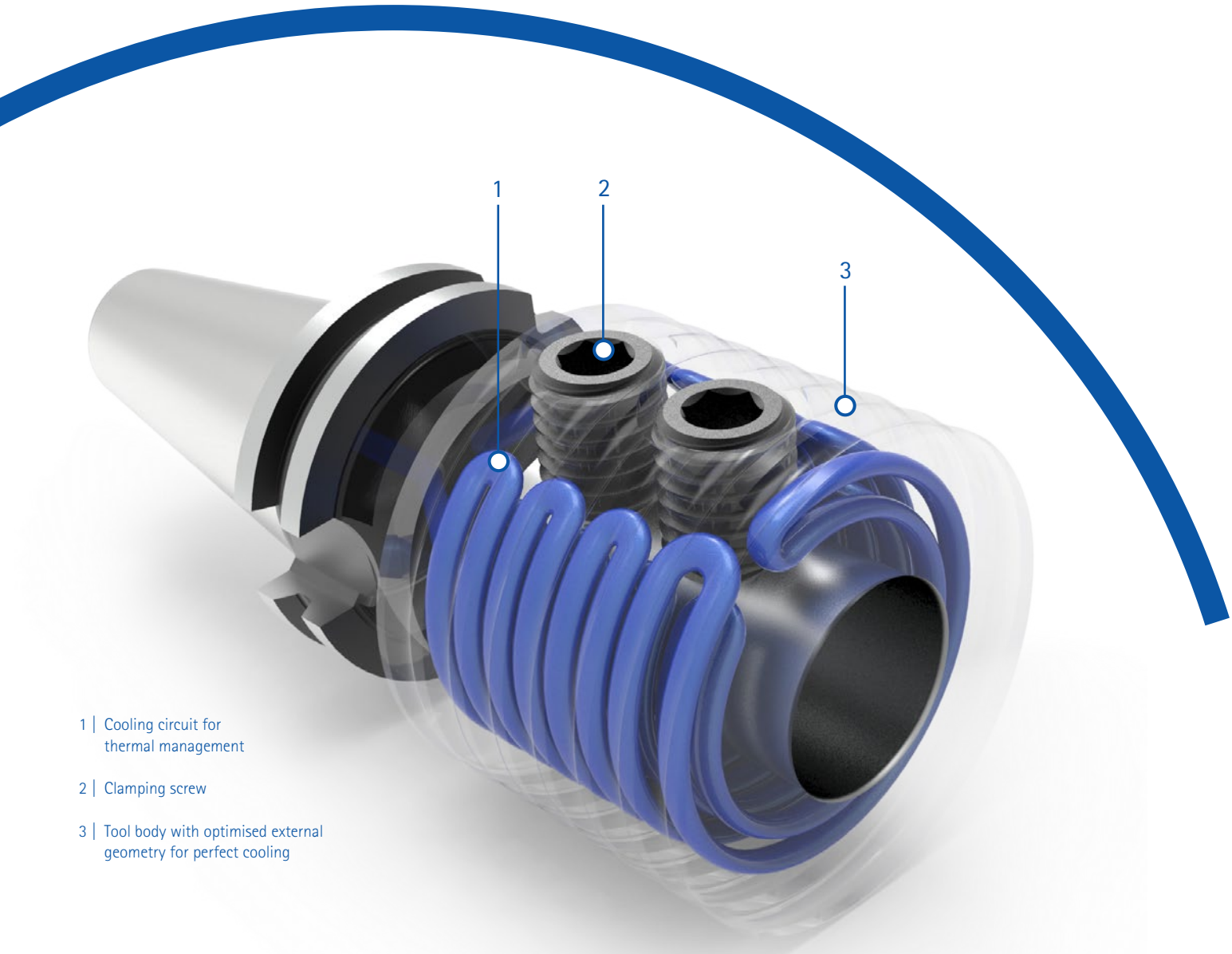


For more than 30 years Werner Stief defined the fortunes of MAPAL WWS. Werner Stief built up the company from scratch. He was a pioneer in this sector. He recognised the potential of PCD (polycrystalline diamond) for industrial metalworking early on. He worked with a great deal of commitment on the further development of the new diamond cutting material and the correspondingly tipped tools. The success of PCD tools and the company founded by him are to his credit. The MAPAL Centre of Competence for PCD tools is currently the world's largest manufacturer of PCD tools and the market leader in its sector. Stief retired in 2010 and stepped down from the management of MAPAL WWS.

Werner Stief was a person who attached great importance to a friendly atmosphere in the company. He enhanced team spirit and supported his employees. Dr Dieter Kress remembers Werner Stief as a visionary in the sector of PCD tools: "Working with Werner Stief after the majority acquisition of MAPAL WWS in 1994 was rewarding and always based on trust. " Dr Jochen Kress looks back on the life's work of Werner Stief with a great deal of respect and is shocked by his death: "We extend our heartfelt condolences to his family."

For his service and business achievement, Werner Stief was awarded the Baden-Württemberg Business Medal in 1998 which highlights his success. Werner Stief spent the last years of his life in Pforzheim. He died on 9 April 2018.

MAPAL SPOTLIGHT



1 | Cooling circuit for thermal management

2 | Clamping screw

3 | Tool body with optimised external geometry for perfect cooling

Correct clamping for every application

Perfect cooling for friction welding

Friction welding is already in use in many sectors: in the aerospace sector, ship and railway vehicle construction, medical technology and also in the food industry. With this procedure, a rotating pin is pressed in the butt joint of two workpieces and moved along the weld line. The material is heated by friction and stirred by the rotation of the pin so that the materials connect in a hot stamping process – without a filler material. A lot of heat is produced during the process that reaches into the spindle via the tool and clamping tool.

To prevent this, MAPAL has developed a clamping and cooling system for friction welding that is realised with the aid of additive manufacturing. A mounting tool is modelled on the tool body of the chuck with internal cooling duct system and surface clamping. The coolant is supplied internally via the spindle.

KEY FACTS:

- Usable at high temperatures
- Stable and controllable fusion process thanks to innovative clamping and cooling system
- Reproducible joint quality for vacuum-tight applications

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