

EDITION 67

MAPAL TECHNOLOGY MAGAZINE



# IMPULSE

FROM THE COMPANY

TECHNOLOGY HIGHLIGHTS

PRACTICE REPORTS

Cover story:  
External reamer ensures  
high-precision cylindricity





Dear readers,  
dear business associates,

as a global company, we are dependent both on free trade worldwide and a stable environment, which is why we are naturally observing the current political uncertainties with a certain degree of concern. In times like these, it becomes clear that it is not only one's own actions that determine a company's success. But that politics also has considerable influence if, for example, business with individual countries comes to a standstill as a result of sanctions.

Nevertheless, we are looking positively into the future and are pleased that we have continued to grow in 2017. The MAPAL Group has achieved a consolidated turnover of 610 million Euros – around six percent more than in 2016. Today, MAPAL employs around 5,250 people worldwide, 333 of whom are apprentices.

In addition to political uncertainties, another much-discussed topic has a direct influence on



our business: Electric mobility. The drive of the automobile is changing. The number of vehicles with an electric motor is constantly increasing and classic combustion engines are gradually being replaced.

We have solutions ready for the resulting requirements and changes. Because machining with the highest precision is also required for electrically driven vehicles. And not only for

drive parts. Electrification has led to the development of new and challenging parts, such as the scroll compressor. MAPAL already offers the appropriate tools and processes for reliable and economical machining of these components. We use all our know-how for this. Among other things, we focus on lightweight construction and additive manufacturing. We use the experience we have gained in these areas for optimum tool concepts.

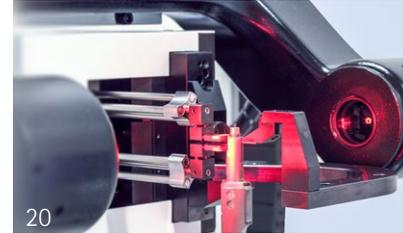
You will not only find these solutions at the MAPAL trade show stand at AMB. Numerous well-known machine manufacturers will also present their concepts for machining parts from electrically driven vehicles with MAPAL tools.

I look forward to discussing these challenges with you.

Yours

Dr Jochen Kress

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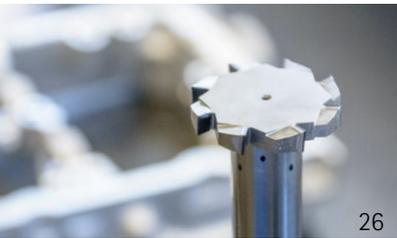
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### IMPRINT

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Interview with Dr Jochen Kress

# INDUSTRY 4.0

is not a switch you turn on

Electric mobility, digitalisation and demographic change are among the greatest challenges for tool manufacturers. Andrea Gillhuber spoke to Dr Jochen Kress about how a medium-sized company copes with these challenges.

*What are the biggest challenges for your company?*

**Dr Jochen Kress:** One of the biggest challenges is the technological transition from the combustion engine to electric mobility. It is clear that it will happen. The only question is to what extent and how quickly. The second major issue is digitalisation. It will have a lasting influence on how we will work in the future and how cooperation with our customers will develop. The third issue is demographic development. The current shortage of skilled workers is due to the good economic situation. Moreover, at the moment we have a political situation where we do not know in which direction it will develop. Within the company, we are currently occupied with our strong growth: We have found that a company with more than 5,000 employees is different from one with 3,000. This simply requires a different organisation and more structured processes.

*To what extent is the demographic change affecting the shortage of skilled workers?*

The so-called baby-boomers, the biggest generation in terms of numbers, will retire. At the same time, the number of job starters is lower. The supply is declining, but at the same time young people have more opportunities. This can be seen in concrete terms when it comes to filling specific jobs and positions. An example: The willingness to work the night shift has drastically decreased.

*Is there not a changeover principle for shift work?*

That exists, that's correct, but what would you rather do: take the night shift or work in the office with flexible hours and the same or higher earnings? Salary is one thing, but flexible working hours are decisive. With an office job you have the opportunity to watch your child play football or take care of your social life. The day shift used to be the normal situation at our company: with a start at 7 a.m. and an end at 3 p.m. – the rest of the day was still long! This is not the case for the night shift.



Guest article by Andrea Gillhuber | "Scope" magazine | published at WEKA BUSINESS MEDIEN GmbH | [www.scope-online.de](http://www.scope-online.de)

Another point is the high investment costs of the machines – which means the machine has to be running! Demographic change raises the question of how can I operate the machine without anyone standing next to it? Naturally we have the option of operating our machines economically over their service life, but we must generally find ways of making working hours more flexible for production staff as well.

#### *Which specialists are you looking for?*

We are always looking for specialists for manufacturing including metal cutting mechanics, technicians and engineers. And of course IT specialists. This is very exciting for us, as we are not a classic employer for IT specialists. In the meantime, however, we have earned ourselves a good reputation here as well.

We also observe that while a metal cutting mechanic, who completed his or her apprenticeship at the company, is to some extent tied to the industry with the knowledge he has acquired, this is different for IT specialists: they can program in any industry. An IT specialist is also productive within a few days as soon as he or she has understood his area of responsibility. External metal cutting mechanics must first understand our products and familiarise themselves with our machines – this can take a while.

#### *How many of your metal cutting mechanics continue their training to be technicians?*

A lot of them. There are also phases in which almost all apprentices of one year continue their training to be technicians. In general, we support qualification measures for our employees when they fit in with the personal and business development.

#### *You recently mentioned that the proportion of women among metal cutting mechanics is increasing. What is the reason for this?*

In the apprentice sector, the proportion of women is around 20 percent, but

I honestly do not know what prompted the young women to choose such a career. We're happy about it. However, the gender of our employees does not matter to us. Different views, different life experiences and different influences are the decisive factors in finding profitable solutions.

#### *Which processes can be automated in your production?*

As we are not a large-scale but a small-scale series manufacturer, the potential is still high. But many automation possibilities are only just emerging. It's easy to say: Put a robot on the machine. But that's not enough: For a robot to function, data must be available with the appropriate quality. A robot does exactly what it is told. It does not yet have the sensory, haptic and mental abilities to compensate for errors. It stubbornly runs its program and if, for example, the tool length is entered incorrectly, it will crash. A human, on the other hand, is something wonderful because he or she can recognise and compensate for mistakes in the process before and after. Another example: A person can hear a tool wearing out. But how do I get a machine to do that?

#### *Could Machine Learning help here?*

First of all, processes have to be clearly defined and then one can think about Machine Learning. But is it worth the effort? Of course there are sensors and algorithms that can support this. The development effort required to automate the small task when a tool should be changed currently bears no relation. The question of what it means to take people out of manufacturing will occupy us for a very long time to come. Industry 4.0 is not a switch that you turn on. There are many steps that we have to take here.

#### *A good database is one side of the coin but employees must also be able to handle new technologies. What approaches do you take here?*

Of course, employees must be appropriately qualified. But our primary concern is how we network different topics and areas within the company so that we keep media discontinuities to a minimum. →



#### *How do you bring OT (operational technologies) and IT together?*

It is always difficult, for example, when one person speaks German and another speaks French. It takes time for both persons to speak each other's language. IT has the methodological competence, OT has the know-how regarding production technology. Here too it takes time for both to communicate with each other. Ultimately, IT has always been the means to an end for us machining technicians. Nowadays we can no longer change processes without it. In the meantime, however, we speak the same language in many places. And if you achieve common goals, then that works very well!

#### *How do trends such as electric mobility influence your work?*

As a tool manufacturer, we always machine workpieces other people come up with. We must then ask ourselves how we can manage this with our means. Electric mobility per se means less business for us because an electric motor offers less scope for machining than a combustion engine. Nevertheless, we would like to take a strong position in this business area.

How e-mobility will ultimately affect us depends on various factors. First, how quickly and to what extent will the changeover take place? Second, how many cars will be produced in the future? And third, how does the design of the vehicles look in detail? At the moment, for example, a Golf has only one engine. An E-Golf will have one or two engines in the future, depending on its performance. Although an electric motor offers less scope for machining, if several engines are required per vehicle, we could compensate for this. In addition, electric motor housings are more complex.

#### *You respond practically to market trends, but have no influence.*

We have no direct access to the consumer, so we do not have to constantly respond to short-term trends. By the time a trend reaches us, in the case of electric mobility the car had already been developed and the machine had al-

ready been selected for production. Only then does the manufacturer come to us and ask for the appropriate tools. We are always dependent on those who produce something and how they produce something: If the product is cast or additively manufactured, we have no or hardly any part in the production.

We have grown in the automotive industry over the last 30 to 40 years. For us, electric mobility also means that we are stepping up our activities in other markets. These include aerospace as well as tool and mould making.

#### *Do you experiment with different metal powders for your additively manufactured tools?*

We use conventional material in powder form for our tool bodies and tool adapters. We are currently testing a ceramic material, but we do not expect initial results until next year. However, the customer does not buy the tool because it has been additively manufactured or it is in a blue box, but because it offers the best possible properties for him. If the benefit is not obvious to the customer, he buys another tool.

#### *Is the hype about additive manufacturing waning?*

Additive manufacturing will continue to advance. Materials will certainly be added and new applications will emerge. In addition, the processes need to be further industrialised. As the process becomes better known, it can be classified better and new fields of application can be identified.

#### *Will you continue to expand your additive manufacturing capacity?*

This will largely depend on our customers. If demand increases, we will continue to expand capacity. However, it will not replace conventional manufacturing because here the productivity advantage is enormous. ■

# DR. DIETER KRESS RECEIVES THE GOLD STAUFER MEDAL

As an entrepreneur, he has worked tirelessly and successfully, and he was active in an honorary capacity in many areas of public life for decades: For his impressive life's work, Dr Dieter Kress received the Gold Stauffer Medal - a personal and very rare award from the Prime Minister of Baden-Württemberg.

Dr Dieter Kress has already received several awards for his dedicated service. He received the Federal Cross of Merit and the Business Medal of the State of Baden-Württemberg. The city of Aalen honoured the entrepreneur's commitment to the city with its highest award, the Silver Plaque of Honour. Now another particularly honourable award has been added: Baden-Württemberg's Prime Minister Winfried Kretschmann awarded Dr Kress the state's Gold Stauffer Medal. An award that is only rarely given for outstanding services for the public good. Dr Nicole Hoffmeister-Kraut (Minister of Economic Affairs, Labour and Housing of the State of Baden-Württemberg) paid tribute and honoured "the life's work of an extraordinarily committed citizen and a great entrepreneur". She paid great respect to the civic commitment of Dr Kress and looked back on the variety of honorary positions he held. From 2003 to 2009, he was chairman of the Precision Tool Association. From 1997 to 2006, he was a member of the board of the German Mechanical and Plant Engineering Association, from 2001 to 2009 as a member of the main board. From 1993 to 2016, he was a member of the IHK Ostwürttemberg plenary assembly and took part in the IHK Innovation Forum. As a founding member of the P.E.G.A.S.U.S. Association, he supported young company founders and promoted the qualification of long-term unemployed in the "Chance 100" project. Hoffmeister-Kraut said that his commitment to the University of

Aalen was particularly outstanding. "You have been an important advisor and driving force on the Board of Trustees and the University Council. You have supported the university financially, carried out joint research projects and established the Chair for Machining Technology with other entrepreneurs." Dr Dieter Kress also supported the development of research in the field of additive manufacturing. In 2010 Dr Kress was awarded the title of Honorary Senator of the University of Aalen. As an entrepreneur he also has a record to be proud of, said the Minister. Under the leadership of Dr Dieter Kress, MAPAL has developed from a regional manufacturer into an international group of companies. Since he joined the company, sales have increased a hundredfold and the number of employees has risen from 100 to more than 5,250 today.

Dr Dieter Kress gave thanks for the words of honour. "The award is a great recognition for MAPAL and myself." He expressly included all employees of the family business. "The award is an incentive for all of us," promised Dr Jochen Kress, who took over the management of the company from his father at the beginning of 2018, as he welcomed guests from industry, politics and science. Two photos particularly characterise his father - one with him on the phone and another in front of a building sign: "He has always looked ahead." He wants to continue to keep this MAPAL philosophy alive. ■



OptiMill-Uni-Wave

# A MILLING CUTTER FOR ALL OCCASIONS

Larger cutting depths, better chip removal and a higher material removal rate – these were the goals that MAPAL experts set themselves in the development of the new OptiMill-Uni-Wave roughing milling cutter. The result: a universal milling cutter that is particularly cost-effective due to its innovative geometry and high cutting values.

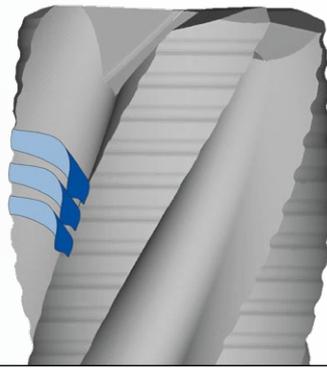
Solid carbide milling cutters for groove milling, trochoidal milling or quick roughing are particularly in demand in the mould and die making as well as general mechanical engineering industries. In addition to process reliability, the main focus is on cost-effectiveness.

In order to offer customers in this segment a milling cutter for universal use, which can be applied for the various milling operations and even for ramping up to 10°, MAPAL presented the OptiMill-Uni-Wave last year. It can be used for many materials. "Above all, parts made of steel and stainless steel are machined with our milling cutter", says Ulrich Krenzer, Managing Director of the MAPAL Centre of Competence for solid carbide tools.





MAPAL has developed a new knurl geometry for the OptiMill-Uni-Wave.



By comparison – the knurled geometry of the OptiMill-Uni-HPC-Rough roughing milling cutter.

The substrate used for the OptiMill-Uni-Wave is a carbide with particularly high ductility and high-temperature stability. A coating based on aluminium chromium nitride provides excellent wear resistance and gives the tool extreme thermal shock stability.

### NEW GEOMETRY FOR OPTIMUM CHIP FORMATION

"We have developed a new knurl roughing geometry that is optimally matched to the cutting material," explains Krenzer. This geometry ensures perfect chip formation. Short, tightly rolled chips are produced during machining, which are reliably removed. In addition, the new geometry distributes the cutting forces very favourably, which enables high feeds per tooth. The radial forces are reduced and higher axial forces are applied. The rounding of the cutting edges protects them against chipping and therefore are particularly resilient and stable. In addition, the groove profile has been further developed.

### IMBALANCE FOR VERY SMOOTH RUNNING

But that is not enough. "We took a close look at the entire geometry," Krenzer explains. Both the unequal spacing of the cutting edges and the

unequal pitch of the tool ensure significantly improved smooth running. "During machining with the redesigned OptiMill-Uni-Wave, we significantly reduced vibrations compared to other roughing milling cutters," says the Managing Director.

### THE RESULTS OF THE DEVELOPMENTS CAN BE QUANTIFIED:

- 30 percent better tool life in steel\*
- 37 percent higher feed rate at significantly higher cutting depths (up to 2xD)\*
- 15 percent lower spindle drive power due to lower cutting forces\*\*
- 40 percent lower pull-out forces\*\*

When machining steel (42CrMoS4), for example, a cutting depth of 24 mm (2xD) can be removed for a tool diameter of 12 mm with a cutting speed of 160 m/min and a feed rate per tooth of 0.045 mm. A material removal rate of 864 cm<sup>3</sup> per minute is achieved. The use of the complete cutting edge length – together with the high cutting data and machining rates – guarantees the high cost-effectiveness. The OptiMill-Uni-Wave can also be reground.

### REGRINDING FOR MAXIMUM COST-EFFECTIVENESS

"In order to make the best possible use of the cost-intensive carbide, we recommend that the milling cutter be reconditioned exclusively by the manufacturer," emphasises Krenzer. To exploit the full potential of the tools, re-grinding and re-coating to original manufacturer quality are essential. Only then is it possible to guarantee reliable, consistent machining results and machining performance of up to 100 percent compared to a new tool. The risk of a tool fracture and the related risks of damage to the part or machine are minimised. ■

\* compared to the OptiMill-Uni-HPC-Rough roughing milling cutter (in 42CrMoS4)

\*\* compared with a milling cutter with straight cutting edges

# EXTERNAL REAMER ENSURES HIGH-PRECISION CYLINDRICITY

The contract manufacturer Karl Völlm turns, mills and grinds all common workpieces with state-of-the-art CNC machines. To ensure the exact production of several spigots on planetary carriers, the machining specialists from Krefeld are also using external reamers from MAPAL for the first time.

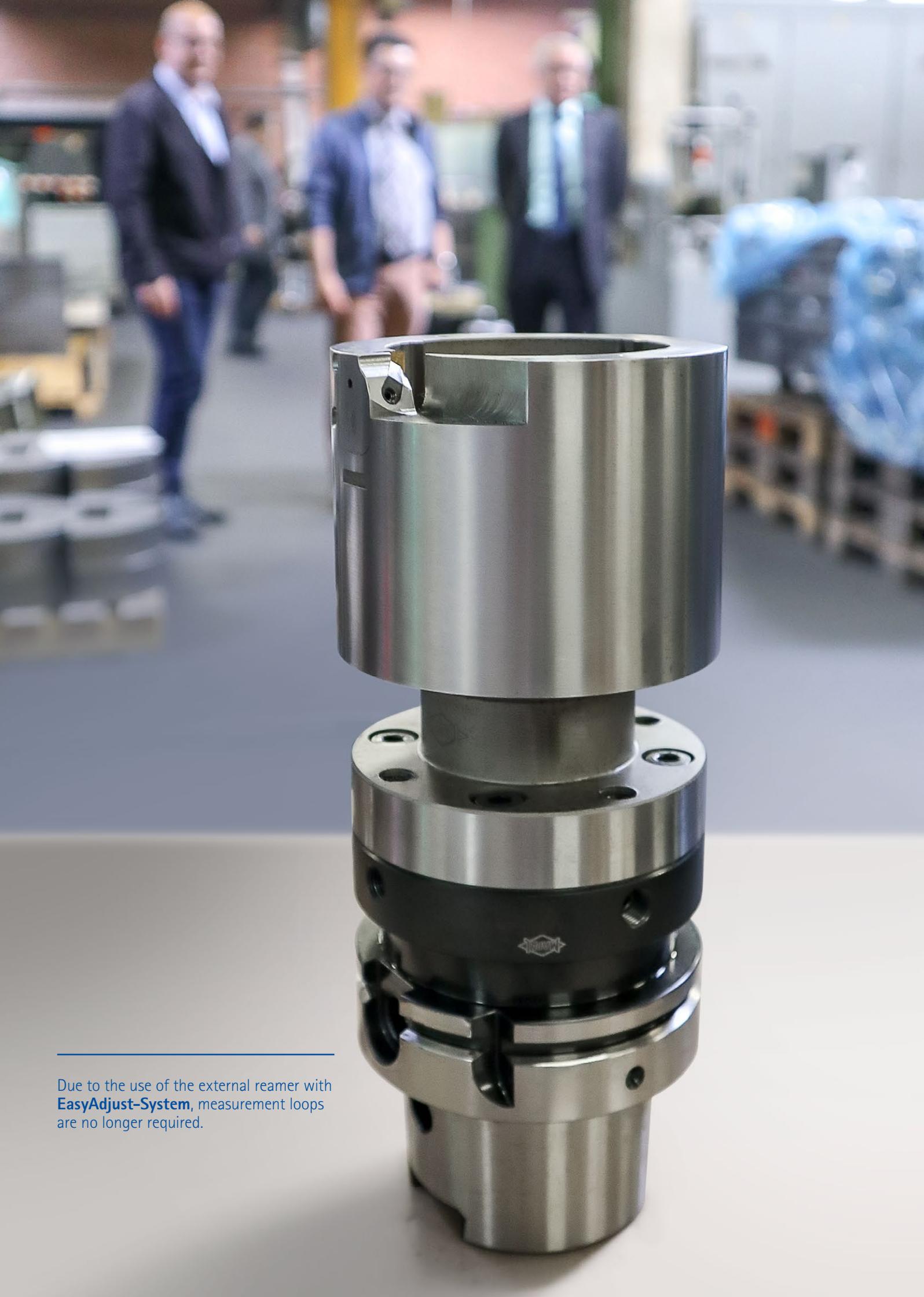
The company founded by Karl Völlm in October 1945 was familiar with the subject of machining from the very beginning. Starting with special piston manufacturing, the specialists based in Krefeld constantly developed their technology further. This strategy is also successfully continued in the third generation under the leadership of Ralf Baur. Nowadays Völlm covers all areas of modern machining technology.

As a contract manufacturer, Völlm produces a wide variety of parts. The range includes axle housings, pistons, hub carriers and crankshafts. The portfolio currently includes around 13,500 different items. "With all our products, we note that the requirements for accuracy, especially with regard to shape and position tolerances, are constantly increasing," says Managing Director Ralf Baur.

Völlm has been working with MAPAL for over 50 years. Völlm primarily uses reamers from the company for fine machining – one of the core competences of the precision tool manufacturer – for the manufacturer of valve guides, for example. Finely adjustable high-feed reamers from MAPAL are also used in other areas. In a current project involving the manufacturing of planetary carriers used for planetary gears, Völlm is using an external reamer from the precision tool manufacturer for the first time. The contract manufacturer has been producing these planetary carriers since 2017. →



*From left: Ralf Baur, Managing Director of Karl Völlm GmbH, Application Technician Frank Pfeiler and Hans-Adolf Thelen, Technical Advisor (both MAPAL).*



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Due to the use of the external reamer with **EasyAdjust-System**, measurement loops are no longer required.

### HIGH ACCURACY OF CYLINDRICITY REQUIRED

The biggest "sticking point" for the machining of planetary carriers made of heat-treated steel was the high accuracy required for the cylindricity of the spigots on the planetary carrier. With a diameter of 75 mm, they have a tolerance of 18 µm and with a diameter of 80 mm the tolerance is 25 µm – but the maximum deviation of the cylindricity is only 5 µm. In order to find the most suitable tool for this demanding machining step, Völlm evaluated various suppliers. "We decided in favour of MAPAL, among other criteria, because the tool concept convinced us and everything that the tool manufacturer had promised us before has always worked," explains Managing Director Ralf Baur.

This is also true for the manufacturing of planetary carriers. MAPAL designed an external reamer that is precisely matched to Völlm's requirements. External reaming tools can be used to machine outer diameters and shafts efficiently with µm precision. Hans-Adolf Thelen, Technical Advisor at MAPAL, explains: "The principle

of our external reamers is based on optimally absorbing and dispersing the cutting forces using guide pads so that no displacement forces and bending moments are exerted on the workpiece." The external reamer used by Völlm has an internal diameter of 75 mm and is equipped with MAPAL's own EasyAdjust-System. It requires a very low setting effort as it completely eliminates the need for time-consuming setting of the back taper.

An HSK alignment adapter and MAPAL's own module connection are used to ensure high-precision machining. In combination with the external reamer, the cylindricity of the spigots themselves and the accuracy of the spigots relative to each other are reliably achieved.

The tool is equipped with a PVD coated TEC indexable insert with four cutting edges for maximum cost-effectiveness. This ensures maximum tool lives – 470 spigots are machined with one cutting edge. The indexable insert only needs to be changed after 1,880 spigots. Production takes place on a machining centre with a cut-

ting speed of 120 m/min and a feed rate of 60 mm/min.

### MEETING TECHNOLOGICAL CHALLENGES TOGETHER

"What is particularly positive about working with MAPAL is that all technical requirements are always reliably met," appreciates Ralf Baur. "As a contract manufacturer, we are constantly getting new parts on the table, which present us with new challenges. As a result, our cooperation with MAPAL continues to develop." ■

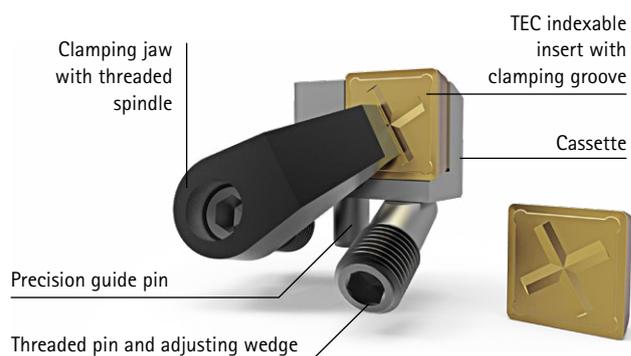
*All common workpieces are turned, milled and ground with state-of-the-art CNC machines.*





## EASYADJUST-SYSTEM

A drastic reduction in the setting effort for tools with guide pad technology was the goal of the development of the EasyAdjust -System. The heart of the system is an innovative cassette that stably holds the indexable inserts with six or four cutting edges without any play. The back taper of the minor cutting edge is already integrated in this cassette, thus eliminating the need for this setting effort. Due to the exact guidance of the cassette on a precision guide pin, the back taper remains unchanged even during diameter settings.



WELCOME TO THE


**AMB**

18. – 22.09.2018 | STUTTGART

**VISIT US  
IN HALL 1  
STAND 1D10**

## SOLUTIONS FOR YOUR PROCESSES

What developments are occupying the machining industry? What innovative tools and machining processes are available? What new products does MAPAL offer in the field of electric mobility and clamping technology? Interested visitors will receive answers to these and other questions at the MAPAL trade show stand at the AMB in Stuttgart. The MAPAL trade show team is available for visitors in Hall 1, Stand D10 and will provide the necessary special-

ist knowledge. In addition to a large number of new products, the entire range of tools for reaming, drilling, milling and devices for measuring and dispensing will be on display at the MAPAL stand. Moreover, innovative solutions, for example in the area of tool management, will be presented. C-Com provides efficient life cycle management for C parts. The start-up company is also represented at the MAPAL stand. ■





To order our free entry code, please visit:  
[www.mapal.com/AMB2018](http://www.mapal.com/AMB2018)



## INVITATION TO THE STAND PARTY

The AMB party at the MAPAL trade show stand will take place on **Thursday 20 September** from **6 p.m.** A great opportunity to end the day in a relaxed atmosphere with good music, finger food and relaxed conversation.



# INNOVATIONS AT AMB

## 1 INNOVATIVE MACHINING CONCEPTS FOR ALL COMPONENTS

Not only the drive and energy storage system are affected by the electrification of the vehicles, but also some auxiliary units. One example of this is the electric refrigerant compressor. At the heart of the electric refrigerant compressor are two nested spirals made of aluminium – the scroll stator and scroll rotor. The efficiency of the electric refrigerant compressor depends in particular on how precisely these parts are manufactured. The requirements for shape and position tolerances are in the range of a few micrometres. A special challenge is the machining of the "screw". MAPAL has developed an SPM milling cutter with a finishing geometry and a highly positive rake angle for this purpose. It ensures a low-vibration cut and is equipped with an additional chamfer on the diameter. This makes it possible to machine the base, wall and chamfer at the front face in one step. As a result, the tight tolerances with regard to perpendicularity and surface are reliably met.

## 2 PORTFOLIO FOR MILLING ROUNDED OFF WITH RADIAL ISO INDEXABLE INSERTS

MAPAL rounds off its portfolio of standard milling tools with a milling program with pressed, radial ISO indexable inserts. The new powerful face, shoulder, slot and shell end face milling cutters are designed for roughing and for medium machining of cast iron, steel and stainless steel. They have optimally designed tool bodies with the ideal number of teeth for the respective application. Positive and negative indexable inserts made of four different PVD cutting materials, based on newly developed carbide substrates and coatings, are available for the milling cutters.



Depending on the requirement, the most economically efficient variant is used. For example, between eight and 16 cutting edges per radial ISO indexable insert can be selected for face milling and between two, four and eight cutting edges for shoulder milling. The new tools are convincing in use due to their very smooth running and low noise. In addition, very long tool lives are achieved due to the possibilities for exact adjustment to the respective material and the respective application.

## 3 DRILLING WITH THREE CUTTING EDGES FOR ALL MATERIALS AND APPLICATIONS

Tritan-Drills from MAPAL have established themselves across the board due to their great economic advantages. Four new designs complete the range of products.

The Tritan-Drill-Uni-Plus for machining steels, stainless alloys and cast materials has been further developed with regard to its tool geometry. Finished groove profiles improve chip removal and a wear-resistant coating increases the tool life by up to three times.

The new Tritan-Drill-Alu and Tritan-Drill-Iron are newly available for use in aluminium and cast iron materials. The Tritan-Drill-Alu has a matched, polished groove profile. Large chip flutes and a special, sharp cutting edge preparation ensure optimum chip formation and reliable chip removal. The Tritan-Drill-Iron impresses with its corner radius design, giving more stability and wear resistance to the cutting edge, and has a special, wear-resistant coating.

The Tritan-Step-Drill-Steel was developed for stepped bores in tapping bores. The tool has innovative point thinning and finely ground chip flutes, so the chips are tightly rolled and broken. Their removal is reliable. The crowned cutting edge with a pulling cut from the centre to the stable cutting corner makes the drill robust. In combination with a wear-resistant coating, the machining results are excellent. Compared to step drills with two cutting edges, Tritan-Drills can achieve double the feed rates – while simultaneously increasing tool lives.



**A SELECTION**

# EVEN MORE PRECISION IN THE SETTING ROOM

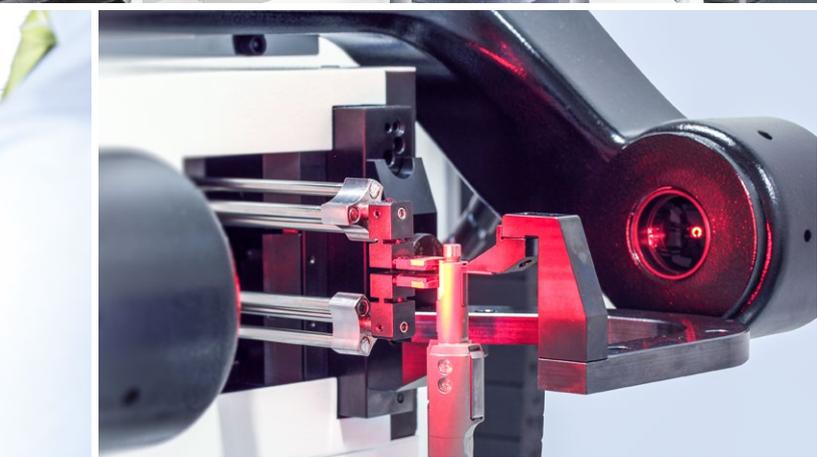
Many companies rely on MAPAL when it comes to evaluating processes and reducing running production costs. In addition to the complete range of precision tools, MAPAL focuses on the setting room in order to increase productivity with powerful and innovative setting and measuring devices, among other things. Because only precisely measured and set tools achieve reliable and precise results and reduce machine downtimes.

Markus Jakob, Team Leader Customer Service Mechatronic Systems, explains: "Maintenance and calibration procedures not only increase the service life of the device, but also consistently improve precision and process reliability to the level of a new device. Given the importance of the setting fixture in the production process, regular service is a logical consequence." MAPAL has therefore evaluated the complete service area for all aspects of the setting fixtures. The newly defined service packages are now presented to customers in a personal conversation and tailored to their specific needs. "We want to take a much more active approach to the service area for setting fixtures worldwide," emphasises Jakob. "We explain the advantages of a preventive service to our customers in detail. In order to not only offer the quality of customer service, but also to be able to supply it, we are currently conducting intensive training courses for our service technicians in addition to building up personnel capacities." The services are divided into two categories: "Creating precision" and "Ensuring precision".



## FAST OPERATIONAL READINESS: CREATING PRECISION

In order to be able to use a new setting fixture productively as quickly as possible, various preparatory work must be carried out, which MAPAL specialists can easily undertake. The commissioning of hardware and software components is top priority. The connection and alignment of the device are as much a part of the service as the definition and reporting of measurement and setting data and basic instructions for the users. The measuring instrument capability test provides a guarantee and certainty regarding the required precision and tolerances to be complied with. Existing tools and corresponding measurement programs can also be created by MAPAL employees to accelerate the availability and use of the setting fixture. Finally, MAPAL offers training and further education for various target groups and requirements in order to ensure efficient work.



### LASTING PROCESS RELIABILITY: ENSURING PRECISION

To ensure precision during operation, service modules have also been defined for this area. During annual maintenance or calibration of the setting fixture, all relevant features are carefully checked and calibrated; wear parts are replaced and software updates are carried out. Time can be saved by optimising the measuring programs. MAPAL employees provide support with know-how, update the factory data and install new tools. The modernisation of setting fixtures also contributes to lasting process reliability. Setting fixtures from MAPAL have a largely modular design and can be modernised by re-tooling. This ensures that the state of the art is always available. With the expanded capacities in technical support for setting fixtures, maintenance can be performed without complication as a response to user questions both on site and remotely by telephone.

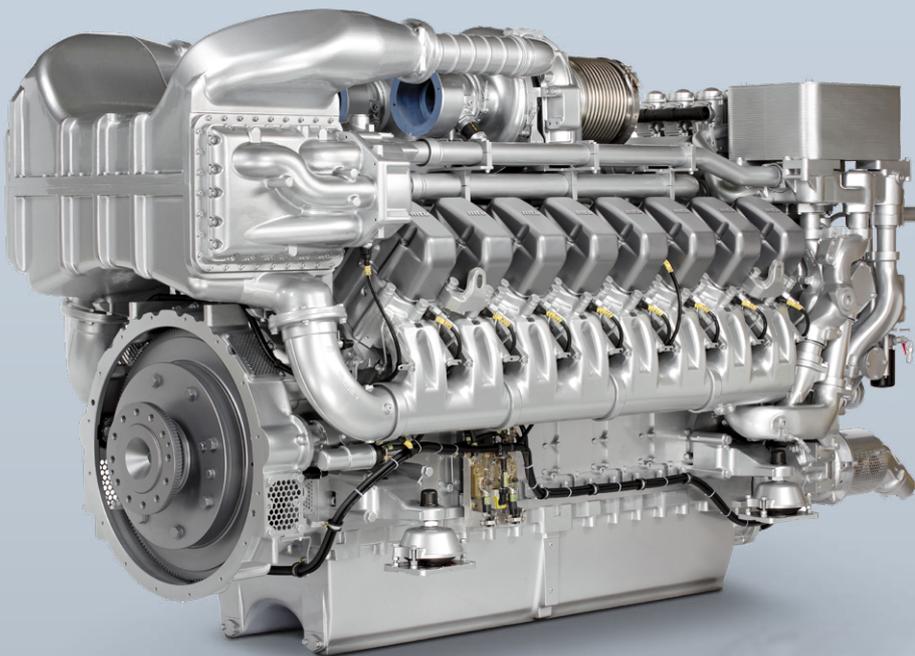
### PRECISION AND DURABILITY IN MANUFACTURING – MAPAL PROVIDES THE RIGHT SETTING

Setting fixtures must ensure reliability, high manufacturing quality and exact tolerances around the clock in order to guarantee reliable production. MAPAL's services, which will be presented at AMB 2018, stand for sustained precision, full functionality and safe handling of the fixture by the customers' employees. ■

# MINIMALLY INVASIVE FACE MILLING

Increased service life of large engines with custom milling cutter

Large engines of the MTU brand drive vehicles, construction machinery and generators for decentralised energy supply. They often have to prove their reliability for decades. The precision requirements for the components used are correspondingly high. When machining a mounting surface within an exhaust gas component, the accuracy requirements were hampered by accessibility. Rolls-Royce's division Power Systems, which includes MTU, relies on a customized milling cutter with ISO indexable inserts from MAPAL for this difficult task.



Starting with the cast part, MTU Friedrichshafen manufactures large engines for mobility and energy applications.



Working together for an optimum tool (from left):  
Thomas Jungbeck from MAPAL with MTU technicians  
Hans Schreiner, Waldemar Schmidt and Stefan  
Wohnhas.

Photo: MTU

In Friedrichshafen, the Rolls-Royce subsidiary MTU Friedrichshafen develops and produces diesel and gas engines for ships, heavy land and rail vehicles, industrial applications and decentralised power supplies. The product range includes series with 8 to 20 cylinders and an output of 800 to 10,000 kW. They are the core of the company's drive and energy systems. As soon as you arrive in Friedrichshafen by train or ferry from Lake Constance, it is very likely that an MTU product provides the necessary propulsion.

All application-related differences – engines for large ships have different requirements than those for construction machinery or even emergency power generators – have one thing in common: The drive units must be powerful, energy-efficient and environmentally friendly yet reliable and durable.

The reliable fulfilment of these requirements makes Power Systems a preferred partner for its customers. The MTU Friedrichshafen subsidiary determines not only the goals of the development engineers, but also the precision requirements in manufacturing. This starts in Friedrichshafen with the machining of cast parts and extends to the delivery of the finished engines and complete systems.

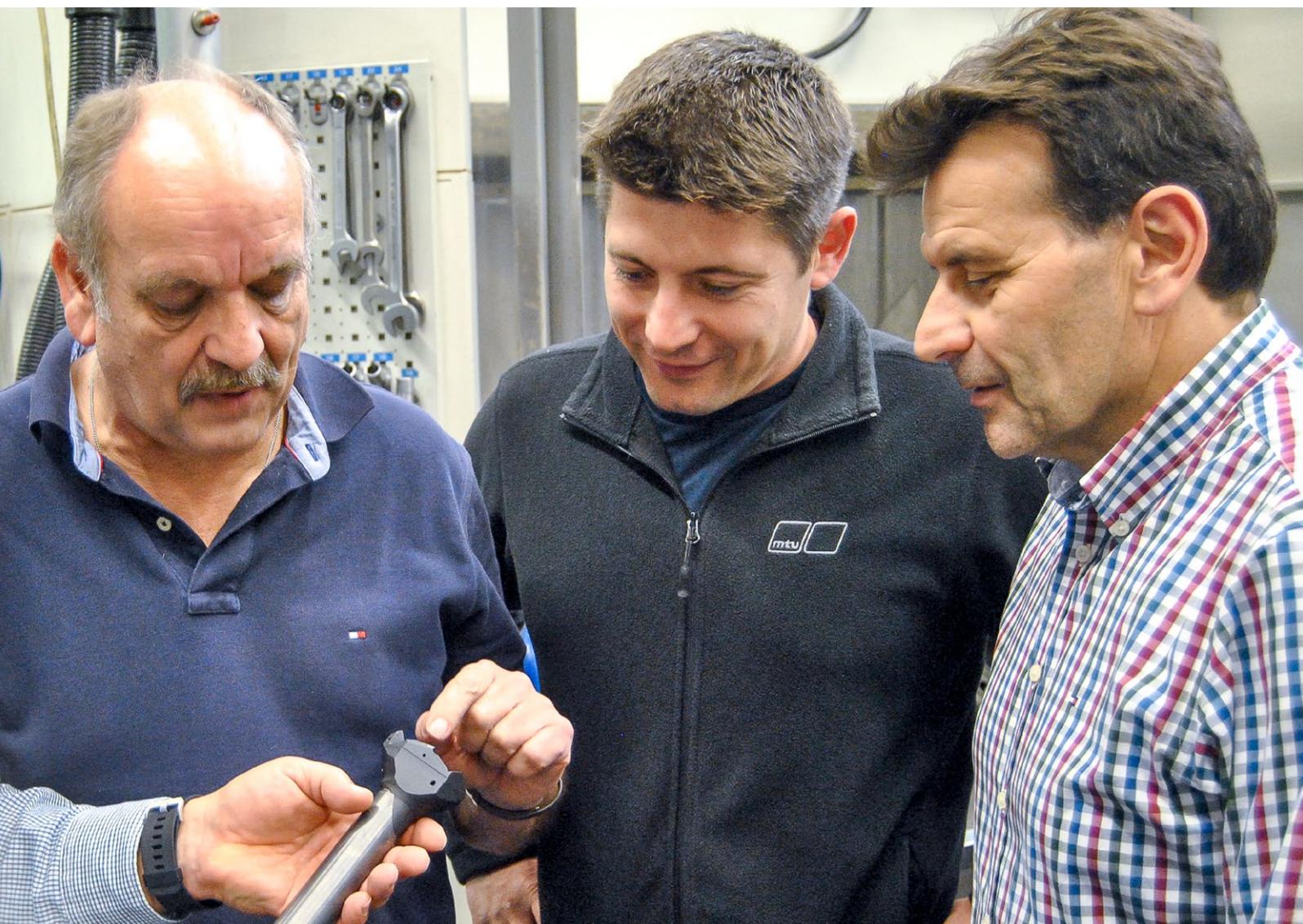
### Flatness as a quality factor

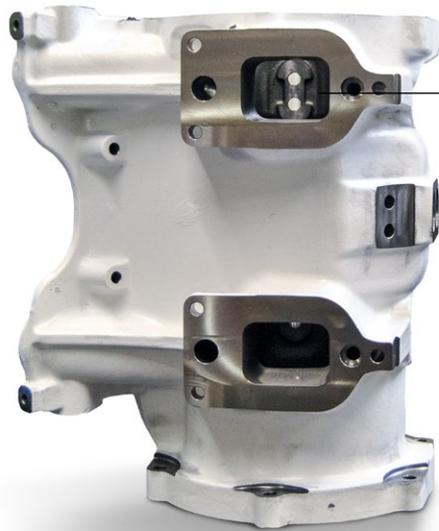
An example from an exhaust system shows the influence that high precision machining has on the durability and low maintenance of MTU's large engines. The exhaust gases from each pair of cylinders are removed by means of exhaust gas guide elements made of cast iron with GJL-250 lamellar graphite, which are arranged in modular rows depending on the size of the engine. Inside, moulded parts made of heat-resistant sheet metal absorb the exhaust gases from the engine and transport them to the turbochargers.

These sheet metal parts are fastened to the inside of the cast elements with two screws each. The mounting surface must feature outstanding surface flatness because unevenness provides scope for the sheet metal parts to move. Due to the constant vibrations in piston engines, this could lead to problems over time and in extreme cases even to shearing of a fastening screw.

### Area with restricted accessibility

"While we can place the two screw holes from the outside, the mounting surface with both bores can only be machined through the opposite rectangular inlet opening," says Stefan Wohnhas, the Production Engineer →





*Inside the grey cast iron exhaust gas housings – one each for two cylinders – the exhaust gas control systems made of heat-resistant sheet metal are fixed with two screws per cylinder.*



responsible for tool technology at MTU Friedrichshafen, describing the most important machining challenge. "The inlet opening is more than 10 mm narrower than the surface to be machined and is almost 300 mm away."

For some time now, the Friedrichshafen company has been using a counterboring tool with adjustable indexable inserts and a working diameter of 51 mm for pre-machining. Due to the small and distant entry opening, the shank of the special tool, which is over 400 mm long, is cranked. Over a length of 325 mm it has a diameter of only 24 mm.

If there was only a single countersink, the finish would also be of sufficient quality with this tool. The counterboring tool centres itself in the first bolt bore and machines the first half of the mounting surface. However, as the tool centres in the other of the two bolt bores for machining the second half of the mounting surface, the indexable inserts pass over a position that has already been machined. This leads to an uneven cutting pressure.

"So we were unable to comply with the required 70 µm flatness," reports Hans Schreiner, who can draw on 40 years of experience at MTU Friedrichshafen and is responsible for tool planning and procurement for large cubic parts.

### Changing methods with MAPAL

The responsible people at MTU decided to switch to a different machining method - face milling. "As we machine a 70 x 35 mm surface through a

rectangular opening only 54 mm wide, it was clear that we needed a special tool," says Hans Schreiner. "We approached MAPAL with our problem, because MAPAL has a reputation for mastering even difficult challenges. Other providers had already declined from the start."

### One tool, several diameters

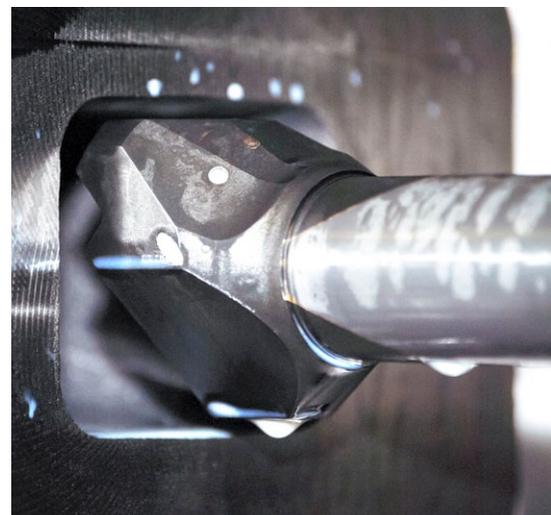
For MTU Friedrichshafen, MAPAL developed a 400 mm long milling cutter for finish machining. Its solid carbide shank has a diameter of 32 mm at the weakest point and is therefore significantly more stable than the shank of the counterboring tool. The face milling head is brazed onto it with four tangentially arranged, adjustable ISO indexable inserts. The largest external dimension of the milling head is 63.5 mm. It fits through the 54 mm wide opening only at a defined spindle position. The indexable inserts with two cutting edges are set at an angle of 45°. They are arranged asymmetrically and have four different flight diameters: 19.5; 27.5; 44.5 and 54.5 mm. Despite a traverse path of only 10 mm, the entire surface with a length of 70 mm can be machined.

"The arrangement of the inserts presented both the tool developers at MAPAL and our NC programmers with special challenges," says Stefan Wohnhas. The Aalen-based precision tool specialists also had to use all their experience to ensure optimum axial run-out despite the complex asymmetry of the machining head. This was successful. Using an axial adjustment option, the axial run-out can be adjusted to the µm.

MAPAL developed a task-specific special milling cutter for finishing, whose four length-adjustable, asymmetrically arranged indexable inserts enable face milling of the mounting surface by only partially passing over.

With the special tool, MTU exceeds the flatness specifications by a factor of 10. To allow retraction without rotation and thus without loss of time, the milling head is mounted at the appropriate angle to the tool adapter.

Machining the approx. 70 x 35 mm mounting surface can only take place through the rectangular inlet opening located at a distance of approx. 300 mm.



### Working together for a special tool

The cooperation during the development phase was intensive. After each development step, MAPAL provided the MTU experts with a 3D model of the tool. "This 'digital twin' made it possible for us to simulate the entire machining cycle in our NC simulation software," says Waldemar Schmidt, CAM Programming and Tool Planning at MTU Friedrichshafen. "This enabled us to detect collisions and fully test the behaviour of the milling cutter without having to produce expensive prototypes and without scrap."

Conversely, MTU technicians made a significant contribution to the success of the project by making adjustments to the workpiece. In order to prevent the feared instability caused by a shank that is too thin, they made a minimal design modification at the entry opening.

### Requirements clearly exceeded

"We were not always sure whether the design of a suitable milling tool would even succeed," says Waldemar Schmidt. "MAPAL convinced us that the opposite was true. With the tool we clearly exceed the precision requirements," reports Hans Schreiner. In this way, a flatness of seven instead of the required 70 µm is reliably achieved. 0.2 mm of material is removed during finishing. The average cutting speed is 120 m/min and the feed rate is 0.12 mm.

"Extensive measurements on a specially designed test engine confirmed the effect of fine machining with the special milling cutter developed by MAPAL," adds Stefan Wohnhas: "We received a tool with which we were able to sustainably improve the low maintenance and long-term quality of our large engines by minimally invasive face milling with a long projection length." ■

### CUSTOMER:

Rolls-Royce Power Systems, a division of the British technology group Rolls-Royce plc, is one of the world's leading suppliers of engines, drive systems and decentralised energy systems. The MTU and MTU Onsite Energy brands focus on high-speed engines and drive systems for ships, heavy land and rail vehicles, military vehicles and for the oil and gas industry with up to 10,000 kW output, as well as for power generators for emergency, continuous and peak power supply and complete cogeneration plants.

# FLEXIBLE RIGHT DOWN THE LINE

Highest precision and efficiency in large-scale series production

At the Plauen site, the Schweizer Group produces a closed bearing frame for a diesel engine that must meet the highest demands in terms of position and shape accuracy. With MAPAL as a technology partner, the company has succeeded in combining the required precision with the requirements of efficient large-scale series production - despite the delicate construction of the frame.

"At first glance, the machining task for manufacturing a cast aluminium bearing frame is clear and simple: a few milling surfaces and a series of bores. But that impression is deceptive. When studying the CAD drawing, the complexity of the task quickly becomes clear," says Andre Dumrese, Head of Technology & Development, who is responsible for product and process development across sites at the Schweizer Group. The complexity of the task is largely based on the requirements of the subsequent assembly steps. With a closed bearing frame, the camshaft is mounted directly in the bearing frame and the individual components are then thermally joined. This requires high precision of the bearing journal bore.

## STRICT DEMANDS ON THE SHAPE AND BEARING ACCURACY

This also applies to the closed bearing frame for a 4-cylinder diesel engine produced by the Schweizer Group for an automobile manufacturer. The bores of the two bearing journals may deviate from the ideal shape by only 30 µm for the part made of aluminium casting alloy. At the same time, a maximum deviation of 50 µm is specified for the positional dimension of the bores at the bore outlet of the two bearing journals - with a bearing journal length of 450 mm.

The specification for the surface finish of the bearing seat is also very narrow. Here the average roughness depth  $R_z$  must be between 6 and 16 µm. Another demanding directive is the squareness between the upper side of the bearing frame and the front face, onto which the vacuum pump of the brake booster is subsequently screwed. The deviation must not exceed 20 µm.

## DELICATE CONSTRUCTION MAKES MACHINING DIFFICULT

The delicate construction of the frame does not make it any easier to comply with these tolerances, explains Sören Schreiter, Head of Finished Parts Technology at Schweizer Group: "Fixed clamping at more than three points would distort the part, and the required accuracy of the camshaft bore could no longer be achieved."

The task is made even more difficult by the large quantities of up to one million units that will have to be handled each year after the start of series production in mid-2018. Those responsible at Schweizer Group have there-



fore entrusted the Plauen site with this major project, which already has extensive experience in the machining, cleaning and assembly of high-volume automotive components such as cylinder head covers or transmission cases.

The concept for the new machining line was planned and implemented in close cooperation with the partners involved. "All steps from product development, design of the casting process and fixture construction to machining must be optimally coordinated. This is the only way to meet the technical and economic requirements. It is therefore essential to bring everyone involved to the table," emphasises Andre Dumrese. In on it right from the start: MAPAL as a main supplier of machining tools for many years.



*Closed bearing frame for a 4-cylinder engine, which the Schweizer Group will produce in quantities of up to one million units per year from the end of 2018 at the Plauen plant. In on it right from the start: MAPAL as a specialist for the machining process.*

The bearing frame is manufactured on two identical 4-axis double spindle machines (horizontal) in combination with a custom-made fine boring module.

#### **BEARING JOURNAL FINISH: ONE AFTER THE OTHER INSTEAD OF SIMULTANEOUSLY**

The machining concept of the fine boring module is characterised by an innovative approach. The basis for the required precision is provided with the pilot machining of the first bore and the pre-machining of the bearing journal in the second clamping set-up with a step drill from MAPAL. Finish machining is then carried out in the fine boring module. Here, however, the two bearing

journals are not finish machined in parallel as usual, but they are reamed one after the other with a single-bladed fine boring tool from MAPAL with a 500 mm projection length. Reaming is carried out on one side and without additional bearings. Nevertheless, the radial run-out of all journal bores is reliably achieved with a deviation of less than 20 µm. The great advantage of this concept is that different bearing spacing's can be realised and the machine can be used flexibly as desired.

In addition to the bearing journal finish, there was another challenge when machining the bearing frame. On its underside, material elevations must be removed – but with very limited accessibility through the fixture. However, →



Stufenaufbohrwerkzeug  
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*Fine boring tools with one blade continue to provide the most precise bores. With an appropriate tool from MAPAL, a radial run-out of the bearing journal is achieved which deviates less than 20 µm from the ideal.*

*Dare to try something new: MAPAL has combined a boring tool with a pilot step to form a one-shot tool for semi-finish machining. It provides the basis for the precision achieved in finish machining.*



MAPAL has also found a solution for this. First the majority of material is removed with a solid carbide milling cutter. Then a milling cutter with eight brazed PCD cutting edges threads through the part and mills the surface backwards. Thanks to the slim tool shank, the milling cutter's radius of action is large enough to machine the entire surface.

#### PROVEN BENEFITS, NEW VENTURES

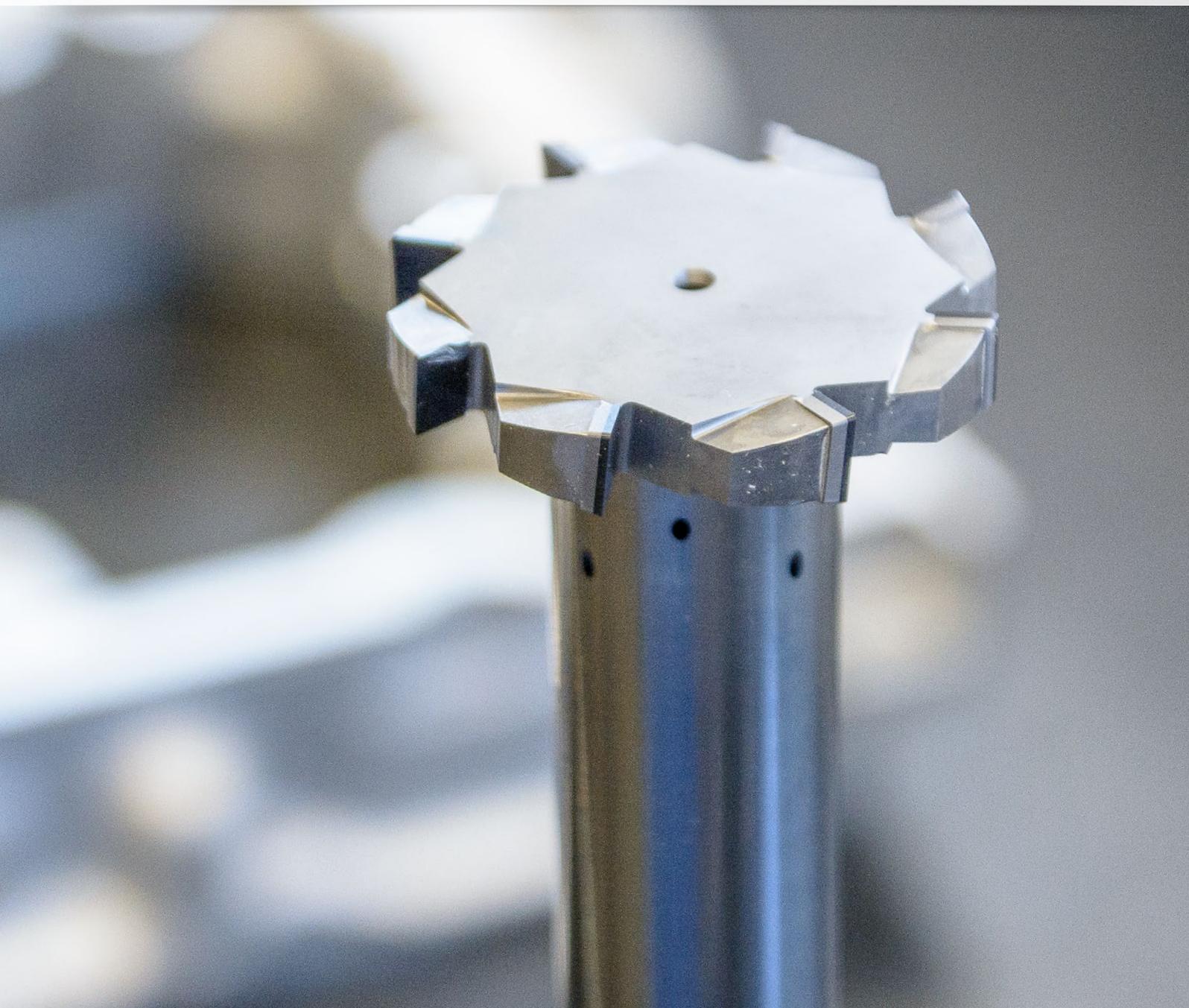
"Around 90 percent of all MAPAL tools used at the Schweizer Group are tipped with brazed PCD cutting edges, because they are easy to handle and economical. However, thanks to the HSK connection they still achieve sufficient machining precision up to tolerance class IT6", adds Andreas Wittenauer, who, as Head of Application Technology at the MAPAL Centre of Competence for PCD tools, has been supervising the plants of the production company in Germany and the Czech Republic for years. "We are always breaking new ground – the step boring tool is an example."

"We expect our tool partner to take on challenges and proactively make suggestions for improvement," emphasises Andre Dumrese. "The fact that we have been working successfully with MAPAL for decades is due precisely to this and not least because of our supervisor Andreas Wittenauer. He has known the company for over 20 years, is regularly on site and acts as the central contact person for all questions concerning tools. The close, trusting cooperation brings both companies forward and forms an optimal basis for mastering new technological and economic challenges in the future as well." ■



*Andre Dumrese (left), Head of Technology & Development at the Schweizer Group, Andreas Wittenauer (middle), Head of Application Technology at the MAPAL Centre of Competence for PCD tools, and Sören Schreiter (right), Head of Finished Parts Technology at the Schweizer Group, accomplished it together: The demanding production of the delicate bearing frame runs smoothly.*

*MAPAL also finds a solution for machining with restricted accessibility due to the fixture: The surface is milled backwards.*





## MINIATURISATION **IN CLAMPING TECHNOLOGY**

thanks to additive manufacturing

Miniaturisation plays an important role in many industries. And therefore also for machining manufacture. Therefore, clamping chucks also have to become smaller, more precise and more powerful. The requirements cannot be met with conventional manufacturing – MAPAL therefore relies on additive manufacturing by selective laser melting.

Whether in electrical engineering, medical technology, the aerospace industry, the watch industry or robotics and mechanical engineering – many products are becoming ever smaller, yet smarter, more user-friendly and more powerful. The topic of space is therefore crucial. Because space is not only limited on the wrist, in trouser pockets, on board an aircraft or in the human body, but also in the production halls of companies.

This requirement gives rise to the demand for productivity in the smallest possible space, which transfers the cycle of miniaturisation to the entire value-added level. Machine and tool technology in this small sector requires more and more functions having to be fulfilled in the smallest space, also in the area of clamping technology.

### PERFECT RADIAL RUN-OUT AND OPTIMUM BALANCING VALUE

The radial run-out accuracy of the clamping chucks for a chipping thickness in the range of a few thousandths of a millimetre must be almost zero. This is the only way to achieve good surfaces at maximum spindle speeds with a long tool life. In addition, it must be ensured that any contamination due to microparticles is excluded. Another important topic for machining in the miniature sector is the supply of coolant lubricant. Too much medium means complex downstream part cleaning, too little or no cooling leads to a loss in quality and productivity.

If handling should also be simple, conventional manufacturing reaches its limits. "The smaller the tool and clamping chuck, the easier handling must be. Because with each reduction, the handling of external peripheral devices becomes more complicated and more difficult", says Jochen Schmidt, Product Manager Clamping Technology at MAPAL. With shrink or collet



technology, it also takes considerably longer for the tools to be ready for use. In the case of multi-part attachments, the individual deviations of the components also add up to a considerable error chain.

#### ADDITIVE MANUFACTURING BY SELECTIVE LASER MELTING

"At MAPAL we use additive manufacturing by selective laser melting in all our product areas," says Jochen Schmidt. And this is the case in all situations where additively manufactured products can offer clear added value for the customer. Thanks to this innovative manufacturing process, MAPAL has succeeded in manufacturing clamping chucks in miniature format with HSK-E25 connection, for example for direct clamping of tools with a diameter of 3 mm. And these miniature clamping chucks meet all of the above requirements.

#### THE SMALLEST CLAMPING CHUCKS WITH THE BEST PROPERTIES

In order to guarantee radial run-out accuracy, the clamping technology specialists have integrated innovative clamping chamber systems into the new clamping chucks, which fit snugly against the tool shank. They are equipped with dirt grooves to displace microscopic dirt. The required balancing value is ensured thanks to internal balancing geometries including support structures, which also optimise weight and strength. "Overall, with our chucks in a small format, we achieve a more homogeneous and spindle-friendly acceleration and braking of the entire tool system consisting of clamping chuck and tool," emphasises Jochen Schmidt.

Thanks to additive manufacturing, MAPAL has succeeded in equipping the clamping chucks for the miniature sector with decentralised coolant outlets. Using parameters such as coolant pressure, setting dimension and spindle

speed, these outlets are designed in such a way that they convey the coolant lubricant directly to the cutting point. In the best case, a dosed loss lubrication, which makes subsequent cleaning of the parts superfluous, is achieved.

#### VERY EASY HANDLING WITHOUT PERIPHERAL DEVICES

The new clamping chucks from MAPAL in a small format enable simple and quick clamping of the tool. "Neither training courses nor high retooling costs or expensive peripheral devices are required for implementation," promises Schmidt. Because the hydraulic chucks are operated using a simple screw.

#### NEW POSSIBILITIES – NOT ONLY FOR TOOL CLAMPING

The new small hydraulic chucks also open up new possibilities for work-piece clamping. For example, for clamping hip joint balls. "Here we use the external hydraulic clamping technology. Specially shaped chip flutes inside the chuck and a special external geometry ensure that the balls are clamped very precisely and gently at the same time," explains Jochen Schmidt. In medical technology in particular, topics such as reproducible precision are of enormous importance. "And we can ensure this during machining thanks to our chucks," says Schmidt. ■

# MAPAL CHINA PRESENTS ITSELF AT THE CCMT IN SHANGHAI





MAPAL China was represented with a large exhibition stand at the international machine tool fair CCMT. With 264 square metres of exhibition space, the MAPAL stand was the largest of any tool manufacturer in the New International Expo Center in Shanghai. MAPAL China presented a series of new developments including tool solutions for machining electric motors or for machining components for wind energy converters.

This year, CCMT focused on digitalisation, networking and intelligent manufacturing. In line with this, MAPAL China presented new offers in the area of services and tool management and for the first time also presented the portfolio of the MAPAL subsidiary c-Com for C-part management. More than 2,000 customers and interested parties came to the MAPAL stand during the five days of the fair.

"Participation in the CCMT in Shanghai was one of our most important events this year," stresses Andy Liu, Managing Director of MAPAL China. After all, the trade fair is one of the largest and most important machine tool events in China. This is also reflected by the official figures of the trade fair organisers. More than 1,230 exhibitors from 23 countries and regions presented their products in Shanghai. With 125,723 tickets redeemed, almost 20 percent more visitors were registered than at CCMT two years ago. "For us, the trade fair is an ideal platform for making new contacts and talking to our regular customers," adds Liu. ■



Perfect organisation of tool supply optimises manufacturing

# EFFICIENCY FORMULA FOR GREAT SUCCESS

**Tool management** | TOYOTA GAZOO Racing finally won in Le Mans in 2018. Apart from a bit of luck, perfect preparation and flawless production were the basis for this. Tool manager MAPAL offers support.



Le Mans 2017. After a break in the second qualification, Kamui Kobayashi completes his first flying lap this Thursday evening. After this round, the TOYOTA GAZOO Racing team shines. The competition looks pensive from the TV screens. Kobayashi beat the lap record by a good two seconds. The fastest Porsche in second place is almost 2.5 seconds behind. When asked by his race engineer how he felt about the lap, the Japanese answered dryly: "Quite good." Then he pushes on to be able to drive even faster.

Kobayashi's Toyota TS050 HYBRID is one of the most technically demanding racing cars in motor sport history. One of the main features of this vehicle class is that the regulations only allow a certain amount of energy per lap driven. Officially, the drive system of the TS050 delivers around 1,000 hp. Half of this is supplied to the rear wheels by a V6 turbo engine.

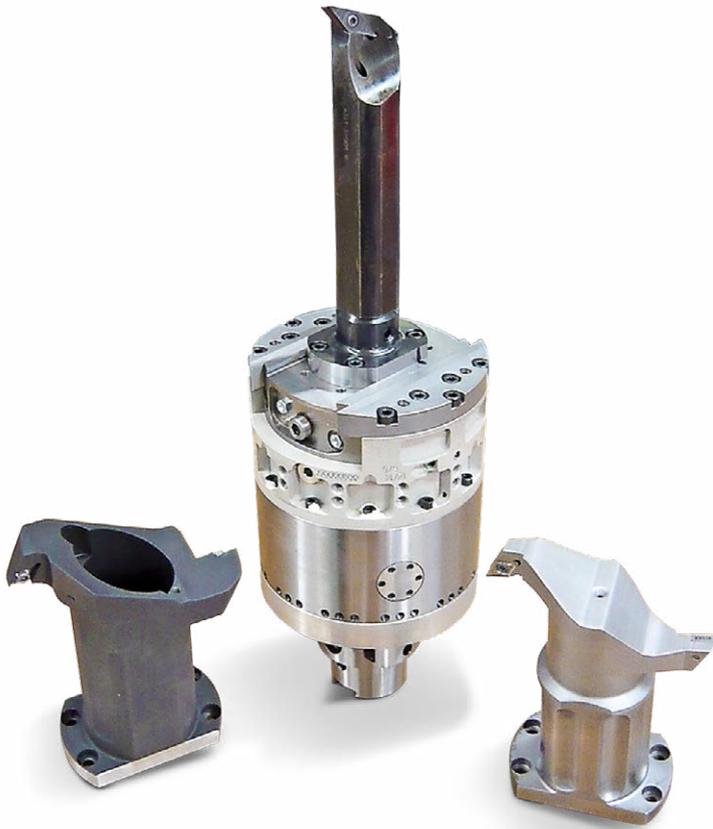
The power of the two electric motors can be distributed by the drivers to the front and rear axles as required. They vary this setting – depending on the weather and the track characteristics – partly from curve to curve.

While the drive unit of the TS050 comes from Japan, the chassis and aerodynamics are developed and built at Toyota Motorsport GmbH (TMG) in Cologne. One of the specialists there is Marcel Voigt who is head of CNC production.

Like the racing cars, the production processes at TMG are trimmed for maximum efficiency. "Today, we produce almost the same output of parts in single-shift operation as in three shifts a few years ago," says Voigt. "And this with just a moderate increase in tool costs." About 20 percent of this →



*Purely hightec: Technologically, Le Mans prototypes such as the Toyota TS050 Hybrid even put Formula One in the shade. The 1,000 hp hybrid cars of the 8-MJ class are trimmed for maximum efficiency.*



*The electrically driven actuating system TOOLTRONIC with the two mounting tools – the one produced from the solid on the left side, and the 3D-printed, lightweight version on the right.*

improvement is the result of further developed technology – with a higher degree of machine automation and more powerful tools – the rest is due to optimised processes.

Following Toyota's withdrawal from Formula 1 at the end of 2009, TMG had to make the transition from a cost centre to a profit centre "In CNC manufacturing, we were helped by the fact that we had already decided in 2007 to improve our processes with the help of an external tool manager," says Voigt "In terms of availability and cost reduction, we were satisfied with the tool dealer who had already supplied us for ten years. But the technological support was no longer adequate."

### **Tool manager needs process know-how**

When the contract with the former partner expired, those responsible at TMG decided to put this service out to tender again. In addition to another dealer, they asked two tool manufacturers. "The decisive factor for our decision was ultimately the overall package," recalls Voigt. "MAPAL convinced us not only with a wide range of products and great technological know-how, but also with its willingness to include products from other manufacturers in the range as a tool manager. We were advised, but the decision as to which tool we wanted to use was ultimately ours."

In addition, CNC technicians from TMG already knew the Aalen tool manufacturer as a reliable partner: "Klaus Schwamborn, today Regional Sales Manager at MAPAL, has been working for us as a Technical Advisor since 1999," says Voigt. "In our Formula 1 days, he designed custom tools – primarily complex fine boring and PCD tools. So we knew that we could rely on technological competence."

The new partners quickly intensified their cooperation. Technological advice was provided on tool procurement and inventory management. "Initially, a consignment warehouse was also planned, but we quickly realised that this concept did not harmonise with prototype manufacturing," says Voigt. By 2009, tool costs in CNC manufacturing had fallen by 61 percent. By contrast, utilisation rose by 35 percent and the number of parts produced by 63 percent.

Two MAPAL technicians, Jens Patotzka and Gustav Faff, are now permanently on site at TMG. "In addition, an application technician is in the house at least one day a week," adds Voigt. The latter supported the selection of tools, strategy and process parameters. After all, materials that are difficult to machine are the order of the day at TMG.

When it comes to finding the perfect solution for the fast, reliable and economical machining of composites or demanding titanium alloys, the MAPAL team organises comparative tests between tools from different manufacturers. Should the on-site team reach the limits of their knowledge, they involve the respective specialists in Aalen.

Quality assurance also has top priority for TMG in tool management. Some of the oldest words of wisdom in motor sport were not said for nothing: "If you want to finish first, you first have to finish." The tasks of Patotzka and Faff therefore include the incoming inspection of the delivered tools as well as the perfect pre-setting and exact measurement of the tools which they then provide to the respective machine according to the specifications of their TMG colleagues. Jens Patotzka is also responsible for inventory monitoring and tool purchasing. He can order the required goods from any supplier. If a new tool is to be procured, Marcel Voigt determines the

quantity together with him and releases the order. "The fact that all this runs through MAPAL not only relieves our warehouse logistics and our accounting, it also gives us more flexibility in terms of budget," says the senior CNC technician. "And the fact that we get the entire service from a single source without having to take care of it ourselves gives us more freedom for our core tasks."

### First optimise the individual processes

Although TMG is a typical small-series and prototype manufacturer, the specialists try to run unmanned production in late, night or weekend shifts from the second part. "And we succeed in 80 percent of cases," says Marcel Voigt not without pride. The basis for this are digitalised and networked processes. However, Industry 4.0 manufacturing requires extensive and complex preparatory work. Initially, the CNC technicians worked together with tool management to radically reduce the variety of tools in stock. In the first two years of cooperation, the number of different tools dropped from 7,650 to 4,320, and later even to around 2,150. To achieve this, the specialists sorted out superfluous variants and replaced custom tools – wherever possible – with standard tools. Tool management searched through the stock, prepared the figures and finally sorted them in consultation with TMG. For example, around 40 of 160 ball milling cutters remained after the clean-up operation.

MAPAL then issued a tool management manual together with the specialists from TMG. This manual documented defined processes and specified, among other things, how certain tools are to be assembled and measured. On this basis, TMG employees transferred the remaining tools into the CAM system. Each insert was saved with the corresponding cut-

ting parameters and technology data. After all data had been digitalised, the manufacturing specialists issued a programming manual with the help of which complete tools can now be derived. "If a tool is requested today, we can generate the data sheets required by tool management very quickly from the CAM system," Voigt explains. "Tool stock and movements can be easily tracked and monitored. This makes it easier for us to sort out tools that are no longer needed once a year."

In accordance with the Toyota philosophy, the specialists from TMG initially optimised all sub-processes. Only when each of them functioned as desired were they gradually chained together. In doing so, the team around Voigt recognised the potential of a Manufacturing Execution System (MES). It should route all processes – from the request for a part to delivery to the customer. "MAPAL also supported us in this decision without ever pushing us in any particular direction," says the Head of Production. Among other things, the Aalen-based company organised reference visits to customers who had similar processes and were already using such systems.

### New dispensing system is more ergonomic

A good ten years after the start of cooperation in the area of tool management, TMG uses a wide variety of products from Aalen. This also includes the UNIBASE series tool dispensing cabinets, for which another supplier supplied the hardware and software at the beginning. According to Marcel Voigt, however, it soon became apparent that the systems were not powerful enough for extensive networking. In addition, user-friendliness was lacking. "After other key account customers also expressed this criticism, MAPAL decided to offer its own cabinet system. We were regularly able to →



contribute our ideas to its further development." Later the Aalen-based company split its activities and developed the open platform c-Com in parallel with the UNIBASE dispensing and management system. TMG is currently concentrating on exploiting the potential of tool cabinets and the associated management software.

Here Marcel Voigt is pleased: "The UNIBASE-M cabinets of the latest development stage are significantly more ergonomic in operation and easier to program." It is particularly important to him that the cabinets can be networked more efficiently. "This has enabled us to build a much more accurate reporting system." TMG has had very good experience with the beta version of the new operating and management software. In the meantime, this design is available to all interested parties.

### Clever tools deliver the necessary quality

"Now that the organisation of TMG's production processes are close to the optimum, there is for the most part greater potential for improvement from the applications," says Klaus Schwamborn. One example of this is the use of electrically driven actuating tools for machining the valve seat rings of racing engines – such as the so-called Global Race Engine, which is used in Toyota's World Rallye Car. TMG used monoblock tools for this until 2013. "Due to the high development speed and frequent optimisation loops, we estimated around 68,000 Euros annually for monoblock tools alone before the changeover to TOOLTRONIC," recalls Marcel Voigt. "These costs are now completely eliminated." Even more decisive for the motor sport specialists, however, was the flexibility of the electric actuating tool. Whereas in the

past the technicians often had to wait weeks for a monoblock custom tool, today TOOLTRONIC creates a new contour within a few minutes after a simple program change. Further developed parts are available much more quickly – a crucial criterion in the case of a racing team. TMG now also uses TOOLTRONIC to machine complex suspension parts in one clamping set-up.

The partnership between Toyota Motorsport and MAPAL resulted in further tool solutions from which other MAPAL customers also benefit today. The experience MAPAL had gained with the 3D-printed, narrow hydraulic chuck was thus incorporated into the development of a mounting tool with an internal hollow structure for TOOLTRONIC. Compared to the version previously manufactured from the solid, the additively manufactured light-weight version has a considerably more favourable dynamic behaviour, which in turn contributes to better part quality.

And this can decide victory or defeat at long-distance races and at Le Mans in particular. Following Porsche's exit, TMG is the last remaining factory team to use the highbrow hybrid sports cars. This year, the Japanese were the big favourites to win in the 24-hour classic race in Sarthe. "On paper, our car was clearly superior to privately used prototypes," admits Marcel Voigt. But nobody knows better than Toyota: Paper counts for little at Le Mans. This race has its own rules. One of them is: Only those who cross the finish line on their own after 24 hours will be entered in the classification. And Toyota did a fabulous job of this in 2018. With Sébastien Buemi, Kazuki Nakajima and Fernando Alonso at the wheel, the big goal of winning the title was achieved. ■

*From the right: Marcel Voigt, Head of CNC Production and Programming at TMG, in discussion with Gustav Faff from MAPAL and Senior Milling Operator Michael Breuer from TMG.*



# TECHNOLOGY DAY LASER SYSTEMS AND MACHINING CENTRES

Informative, interesting and varied – this was the overall impression that the guests of LASERPLUSS in Idar-Oberstein were left with during the third Technology Day in June. The focus was on the latest machine developments and digital solutions in the tool industry across the entire process chain. The experts from LASERPLUSS also demonstrated the performance of the laser systems and machining centres. The CutMaster aroused particular interest with its combination of different machining processes in one clamping system. The visitors got an impression of how the efficient

production of chip guiding stages including cutting, marking and automatic measurement were carried out on a hexagonal PCD contour. On the RayCutter HS, the machining of round parts as well as pallet processing could be observed. On the RayDesk XL, the marking of a tool shank on a rotary axis could be seen. Wolfgang Prem, CEO of LASERPLUSS, was satisfied: "The atmosphere was good, we had exciting discussions with customers and some interesting projects were initiated." ■



# TECHNOLOGY DAY LIGHTWEIGHT MATERIALS

Lightweight materials are an important topic in the industry – they protect the environment and create competitive advantages. And their potential is far from exhausted. Over the past twelve years MAPAL has been enormously committed to the field of composite machining and has acquired extensive know-how from which new tool developments and machining solutions have emerged. Around 60 visitors came to Aalen in June to find out about the latest developments that were shown in practice at MAPAL's research and development centre as part of the Technology Day. The presentations by

MAPAL experts and guest contributions from renowned partners also highlighted various aspects such as ensuring part quality and reducing tool costs as well as the ideal machine concept for composite machining. The focus was also on the ideal tool geometry for the economical machining of lightweight materials and new findings on the diamond coating of precision tools. The interest of the participants was great and the event was already fully booked well before the registration deadline. ■

# PARTICULARS

**MAPAL MALAYSIA** today has 21 employees and, in addition to its headquarters in Balakong, near Kuala Lumpur, has an additional sales and service office in the north of the country. The Malaysian subsidiary also supports the plants in Thailand and Indonesia in the solid carbide business and supports customers in Singapore together with them.

## THE SECOND GENERATION TAKES OVER IN MALAYSIA



CHOOI TECK LIM

**The former Managing Director of MAPAL Malaysia, Chooi Teck Lim, has retired. His successors are his son Kam Hum and his daughter Janice.**

Chooi Teck Lim (72) retired from the management of MAPAL Malaysia on 28 February 2018. Lim has worked for almost twenty years for the sale of MAPAL tools in Malaysia. First as an employee of the sales agency ASA tools, since 2008 as co-owner of the joint venture MAPAL Malaysia. With great commitment, he supported the establishment of the Balakong subsidiary and developed it into a recognised technology and service centre. Lim will remain available to MAPAL for some time as an advisor.

KANG HUM LIM

The new managing director is Lim's son, Kang Hum. Kang Hum Lim (42) studied at Melbourne University in Australia. In 2001 he followed his father's path to the ASA Tools sales agency. Since the establishment of MAPAL Malaysia on March 1, 2008, he has been a member of the subsidiary's team and has now taken over the operational management of the joint venture.



JANICE LIM

Janice Lim (40) manages human resources and finance as the Financial Director. Chooi Teck Lim's daughter graduated from Melbourne University in Australia in 2010 and subsequently worked as an auditor and controller in various companies. In 2016 she joined the Executive Board of MAPAL Malaysia as her father's deputy.



# BEST SUPPLIER AWARD FOR MAPAL CHINA

MAPAL China is pleased about an important award. The Chinese car manufacturer Chery awarded MAPAL the status of "Best Supplier 2017". Chery honours the high delivery reliability and quality of the tools as well as the engineering and services of MAPAL China. It was the first time that Chery awarded this prize to a tool manufacturer. "This makes us particularly proud, and we are very pleased about the high appreciation of our work" thanked Andy Liu, Managing Director of MAPAL China, and Asia Director Armin Kasper at the award ceremony at the end of January in Wuhu.

Chery, based in Wuhu in the Anhui Province, is one of China's most successful car manufacturers. The state-owned company was founded in 1997 and sells its vehicles worldwide. The car manufacturer has several production facilities in China and abroad. Chery cooperates with Daimler and Fiat as well as the supplier ZF. International technology and design experts are involved in the development of Chery vehicles. ■





# RELIABLE MACHINING

of structural components  
susceptible to vibration

Thin-walled components can be found in a wide variety of industries. These components are often manufactured close to the final contour, but still require many machining tasks. The special challenge during machining is that these parts are very unstable and susceptible to vibrations due to their design. This entails special requirements for process and tool design.



"It is important for our customers to machine these parts in one clamping set-up if possible", emphasises Leander Bolz, Sales Manager of PCD tools at MAPAL. "In order to meet this requirement and to make all areas to be machined accessible for the tools as far as possible, reductions in the clamping set-up must be made. This means that the workpiece is not optimally supported and tends to vibrate". Thin ribs, voids and interruptions to be machined as well as strongly fluctuating stock removal of the cast blank are also special conditions. In addition, a large number of tools are required for large parts with many machining operations. Leander Bolz: "Wherever possible, we therefore try to combine individual machining steps with combination tools. In this way, we reduce non-productive times and the number of tool stations required."

MAPAL has a comprehensive understanding of the process with regard to the machining of unstable structural parts and is thus in a position to implement economical and reliable processes. Several starting points are of importance here. First of all, the cutting values can be finely adjusted so that rising vibrations can be avoided. Oscillations of the tool, which lead to vibrations and thus to poor tool lives and machining results, as well as oscillations of the workpiece must be avoided. The latter would cause the component to spring back against the cutting edge and could damage the tool. The second important aspect for fine tuning in the process design is the consideration of the basic tool body. Vibration is reduced by appropriate design and material selection. In addition, an intelligent arrangement of the cutting edges in

shape and position keeps the cutting forces low. And finally, the machining process itself also offers possibilities for the reliable machining of vibration-prone components. Rethinking and choosing alternative sub-processes results in a changed distribution of forces that can increase process reliability. For example, the replacement of a solid drilling operation by a circular milling operation can stabilise the process. →

## Adapted tool designs make vibrations controllable

For example, we used a circular milling cutter for face and circumferential milling to machine a suspension part because we had to contend with strong vibrations," says Leander Bolz, explaining an example of a successfully adapted tool for structural parts. For this purpose, a reduced helix angle and a reduced number of teeth were used for circumferential milling ( $Z=3$ ). With the resulting reduced machining forces, the vibrations are controllable. The subsequent face milling step of the tool, which is particularly susceptible to wear, is consequently carried out with economical ISO indexable inserts. With a contact width of 6 mm and a cutting depth of 60 mm, maximum cutting values can be achieved. In addition, the tool has been given a face geometry with  $Z=6$  in order to machine another face milling operation on the part economically and in the shortest cycle time.

### Cutting data:

$v_f = 2,700$  mm/min  
 $f_z = 0.1$  mm  
 $n = 9,900$  rpm

An adapted plunge milling cutter is also used in a suspension part. The tool semi-circularly plunges into a tab and cuts over the centre as the depth increases. An optimised face geometry and chip flute design, a load-reduced cutting edge arrangement as well as the integration of vibration dampers in the clamping tool used keep vibrations to a minimum and enable a reliable process.

### Cutting data:

$v_f = 1,200$  mm/min  
 $f_z = 0.1$  mm  
 $n = 4,500$  rpm

With a disc milling cutter set, several ribs and chambers are grooved simultaneously and the face surfaces are finish machined. In order to keep the milling process quiet and to prevent the chips from jamming, the cutting action has been specially adapted and a cut distribution realised. The tool reliably machines all areas in one operation, which is of great importance due to the demand for a high number of cycles.

### Cutting data:

$v_f = 600$  mm/min  
 $f_z = 0.07$  mm  
 $n = 1,500$  rpm

Bolz presents one particularly interesting tool used for the robot-assisted insertion of fixing bores as a final example. "This is a combination tool in several respects," he reports. "We have installed fixed brazed PCD cutting edges here for long tool lives and replaceable ISO indexable inserts for machining that is very susceptible to wear. In addition, the tool combines pre-machining and fine machining. And finally, it performs both a drilling and a milling operation."

### Milling cutting data:

$f_z = 0.1$  mm  
 $n = 3,800$  rpm

### Drilling cutting data:

$f_z = 0.08$  mm  
 $n = 480$  rpm

## MAPAL for a reliable process

In a wide variety of industries, vibration-prone, unstable parts must be machined reliably. Controlling the vibrations occurring due to the design plays an important role in the design of the process and tools. MAPAL is also an experienced technology partner in this area, which ensures reliable processes through a large number of adjustments during the process definition and design. ■



*Circular milling cutter for face and circumferential*



*Plunge milling cutter, cutting over centre*



*Disc milling cutter set for slot and face machining*



*Drilling/milling tool for pre-machining and fine machining fixing bores*

# MAPAL HiTECO in South Korea is "SUPPLIER OF THE YEAR 2018"

HYUNDAI  
POWERTECH

## 2018年 현대파워텍 협력회 정기총회 및 세미나

[일시] 2018. 4. 6(금) ~ 4. 7(토) | [장소] 제주 해비치호텔&리조트



Hyundai Powertech has named MAPAL HiTECO (South Korea) "Supplier of the Year 2018". The award was presented at the Hyundai Powertech supplier meeting on 6 April in Jeju Island, Korea. MAPAL HiTECO has been a partner of the automotive supplier since the establishment of Hyundai Powertech in 2001. "This award demonstrates the competitiveness of both companies and strengthens our trusting cooperation. We look forward to further developing our many years of partnership through further growth," said Joo-Suk Park (CEO & President of MAPAL HiTECO, 2<sup>nd</sup> from left), who accepted the award.

Hyundai Powertech is a specialised manufacturer of automatic transmissions in South Korea and belongs to the Hyundai Motor Group. The company supplies international automobile manufacturers. Together with its headquarters in Seosan-si, South Korea, Hyundai Powertech also has production plants in the USA, China and Mexico. ■



# MAPAL PARTNER is investing in the

# AK MAKİNA FUTURE



AK MAKİNA, MAPAL's Turkish trading partner, has moved its location to the industrial zone of Aydınlı – Tuzla on the outskirts of Istanbul and constructed a new building there. Ali Köymen, owner and managing director, relies on the long-term growth of AK MAKİNA. The expanded capacities will support customers even more efficiently.

Ali Köymen and MAPAL have had a cooperation based on partnership for many years. The foundation for this was laid over 30 years ago when Köymen, then co-owner of a commercial agency, took over the distribution of MAPAL tools in Turkey. It continued when Ali Köymen decided to found his own trading company at the beginning of the 1990s under the name AK MAKİNA. The company was set up in the Anatolian part of Istanbul and gradually increased the number of its employees. Köymen's son, Umut, has now also been working in the company for four years. He is head of the technical division. Organisationally, the sales agency is well-equipped to face the future. The new building in the industrial zone of Aydınlı has now also given AK MAKİNA the necessary infrastructure and takes account of the growing space requirements of the aspiring company. In addition to a generously dimensioned warehousing and production area for tool services, the building also offers sufficient space for the administration.

## EXTENSIVE RANGE OF PRODUCTS AND SERVICES

AK MAKİNA has steadily expanded its product portfolio in recent years and participated in the country's successful economic development. Turkey shows good growth rates particularly in machine and plant engineering and in the automotive industry. The country also has an important hub function for neighbouring countries.

## TECHNOLOGY PARTNER FOR CUSTOMERS

AK MAKİNA and MAPAL are regarded as specialists for high-precision and cost-efficient machining solutions, and have earned themselves an acknowledged market position as technology and service partners for the Turkish customers. With four German partner companies operating in different product sectors, AK MAKİNA covers all areas of bore machining. The complete MAPAL product range, including the associated services, are available to customers. The sales and service partner has all the standard MAPAL tools in stock to ensure quick delivery to the local customers. The services offered by AK MAKİNA include the regrinding and coating of HPR and PCD tools, the regrinding of PCD and PcBN indexable inserts and the re-tipping of PCD milling cartridges. ■



# INTERVIEW WITH: ALI KÖYMEN

Managing Director of the AK MAKİNA sales agency, Turkey

*Mr Köymen, the new building of AK MAKİNA is an impressive size and impressively demonstrates the successful development of your company. We warmly congratulate you on the successful new building. What do you expect from this investment?*

We are very optimistic about the future of AK MAKİNA. In our new building, we now have far greater capacities, in particular for regrinding and reconditioning of tools. Our customers benefit from this. We have adapted our organisational processes and structures to the greater space availability, and also strengthened our team in order to be able to operate even better and more flexibly on the market.

*In what industries is AK MAKİNA active as a technology and service partner, and in which branches of these industries are MAPAL precision tools used?*

We work predominantly with the automotive industry and its suppliers. We have already handled a very large number of projects with MAPAL tools for these customers, for example for the machining of cylinder head, engine block, transmission

casing, connecting rods, steering system components or pump housings. And for aluminium wheel rims - more than twelve million of those have been machined in the meantime using drilling tools from MAPAL. We also introduced the first MAPAL tool management project in Turkey for a producer of brake components in 2008, and still provide support today.

*What is important for your customers, and how do you meet their expectations?*

For our customers, cost-effective and reliable production processes are crucial. Their goal is to produce as little scrap as possible, true to the motto "First part, good part". The costs per part (CPP) also play an important role for the user. We therefore rely on the high-tech products from MAPAL and the know-how of our employees to offer the best machining solution for every application. Together with a modern machine park, intensive after-sales support, good service and high delivery reliability, we achieve high customer satisfaction. That's how AK MAKİNA distinguishes itself from the competition.

*How do you estimate the future potential for precision tools on the Turkish market?*

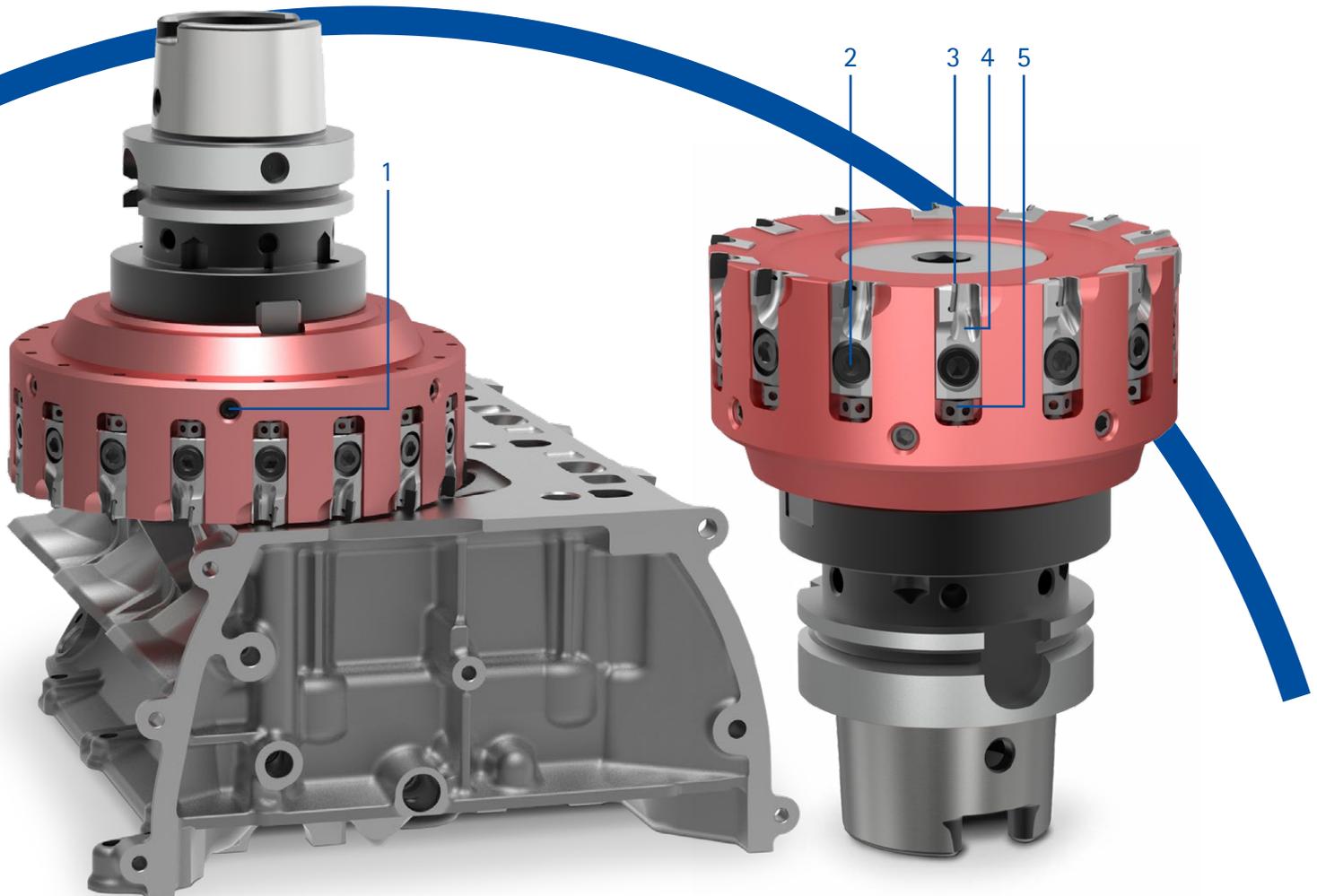
The Turkish automotive industry grew significantly, particularly in the export sector. I expect this development to continue and the demand for precision tools will increase further. The Turkish aerospace industry is also growing quite strongly as a supplier market and is of interest to our company.

*How would you describe the cooperation with MAPAL?*

Our cooperation is marked by partnership and great mutual trust. We have been working together well with the sales and technical field service people from MAPAL for many years. They support us in many respects, such as at the introduction of new products or when it comes to technology training for your staff and customers. The responsible MAPAL Regional Manager, Martin Häfele, visits us several times a year. And from time to time we are also in Aalen with customers to present the plant and provide an insight into the high technological competence of MAPAL. ■



# MAPAL SPOTLIGHT



1 | Balancing screw for optimum radial run-out due to balanced milling body

2 | Perfect seating of milling cartridge in tool body

3 | Special cutting edge geometry made of PCD enables very long tool lives and defined roughness depths

4 | Special chip guiding geometry for targeted chip removal

5 | Adjusting screw for exact and safe adjustment of the axial run-out even under extreme operating conditions

## New generation of PCD face milling cutters for the highest surface finish

The face milling cutters from MAPAL with replaceable PCD milling cartridges are the cutters of choice to achieve the best surfaces when machining aluminium in the automotive industry. The optimised "PowerMill-Blue" series impresses with its new chip guiding geometry. The chip former is no longer integrated in the tool body but directly in the milling cassettes. The chips are reliably removed to the outside and scratches on the surface as well as transport scoring is virtually eliminated. The result is even better surface finishes.

Instead of a central coolant supply, the cutting edges are directly supplied with coolant lubricant at the cutting edge. The coolant outlet is integrated in the milling cassette. As a result, the new milling cutter is also suited for MQL machining (up to  $\varnothing$  125 mm recommended). As with the previous generation, the milling cartridges in the tool body are accurately manufactured and guarantee a perfect circle of rotation of the cutting edges

### KEY FACTS:

- Means of choice for aluminium machining
- Cutting depths up to  $a_p = 5$  mm
- Optimised chip guiding geometry and coolant supply
- Milling cassettes can be interchanged with all PowerMill milling cutters
- Minimised noise
- Highest cost-effectiveness - PCD milling cartridges can be reground several times
- Lightweight design allows use at very high spindle speeds (from  $\varnothing$  160 mm)