



IMPULSE

MAPAL TECHNOLOGY MAGAZINE | EDITION 71



Cover story:
Highly precise machining
of truck engine cylinder bores

**Dear readers,
dear business associates,**

The manufacturing industry has found itself in difficult circumstances since last May. Although the EMO in Hanover provided us with some promising silver linings, our situation has not changed overnight. Despite an excellent start, 2019 for us was a year marked by economic weakness.

However, Albert Einstein once said that "in the middle of difficulty lies opportunity". We now have the opportunity to strengthen our approach to long-term trends such as digitalisation, the technological transition to E-mobility and new business areas. I believe that these are also the issues that concern you, and

on which you like to work with us. The many positive discussions we have had with you at leading international trade fairs, at our customer open days, and in conversations on site are evidence of this.

With that in mind, let us tackle 2020 side by side and discover its opportunities together. I look forward to further discussing the coming challenges and opportunities with you; it is now time to plant seeds for the future.

Yours,

Dr Jochen Kress



CONTENTS

FROM THE COMPANY



Test centre in France
expanded
pages 10–11

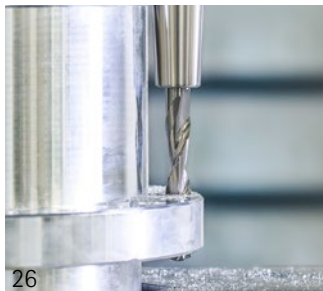
Successful trade show:
METALEX 2019 in Bangkok
page 25

Particulars
page 29

Workshops on E-mobility:
launched in Berlin and Erfurt
pages 34–35

MAPAL satisfied with
EMO experience
pages 39–41

TECHNOLOGY HIGHLIGHTS



PRACTICE REPORTS



Milling cast and steel parts
more cost-effectively
pages 18–21

Getting started
in die & mould sector
pages 26–28

The new
FaceMill-Diamond
pages 30–33

Cooperation, customer portals
and artificial intelligence
pages 36–38

Tools for the
die & mould industry
pages 42–43



New chucks for
standardised processes
pages 6–9

Cover story
Highly precise machining of truck
engine cylinder bores
pages 12–17

MAPAL relies on Vollmer
Technology in South Carolina
pages 22–24

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NEW CHUCKS FOR STANDARDISED PROCESSES

Mitsubishi Motors Corporation relies on shrink chucks and services from MAPAL

Every year, the production plant of Mitsubishi Motors Corporation (MMC) in Kyoto builds engines for around 1.2 million vehicles. Numerous tools from MAPAL are used for machining the engines for the Mitsubishi vehicles. In 2018, the persons responsible at MMC decided to change over multiple production lines completely to shrink chucks from MAPAL. →





MITSUBISHI
MOTORS



Cutting costs – automation – precision: These were the three keywords when the production of a new engine was being planned at MMC. "We wanted to bundle the work," explains Makoto Nishida, head of production for drive technology at MMC. He adds: "Over the past months, we have focused increasingly on automating tool logistics, adjustment and maintenance." The aim was to increase the cost-effectiveness of the new production line while maintaining at least the same level of precision.

In this case, MMC is relying on tools from MAPAL for machining the most important engine components. From PCD milling cutters and solid carbide drills to fine boring tools – tools for a wide variety of operations are used for machining cylinder heads, cylinder blocks and crankshafts. "We use numerous combination tools from MAPAL in order to perform multiple machining steps with one tool," emphasises Nishida.

"A further challenge we faced was preparing the tools for their application, in other words, simplifying the clamping and adjustment processes," Makoto Nishida remembers. After all:

standardise processes. "We designed application-oriented shrink chucks for various lengths and diameters that are equipped with an RFID chip for automating the processes," says Fukui. Shrink chucks achieve considerably better radial run-out values than collets and ensure reliable processes in the long term.

"The concept that MAPAL presented convinced us. However, the question was whether we would manage to implement everything by the start of production, including the procurement of the suitable shrink unit and the structure for identifying tools with the RFID chips," says Makoto Nishida. It was in this situation that MAPAL offered to do all the necessary work, including setting up the tools. "That was a huge plus for us," Nishida praises MAPAL's commitment, "because it allowed us to focus on other unresolved issues relating to engine production."

„The MAPAL employees provided us with full service.“

sises Fukui. This increases the number of possible regrinding operations for tools considerably and reduces tool costs.

Setting up the new production line started in November 2018. "The MAPAL employees provided us with full service. They even documented all the adjustment parameters and all the chucks and tools used. I don't think we would have enjoyed this level of service with a different manufacturer," Nishida describes the cooperation. The production manager was slightly concerned about the short amount of time between the provision of the shrink chuck and the planned start of production. "There was no reason to worry. All chucks were delivered on time," says Makoto Nishida. And so production started as planned. Roughly 2,500 chucks from MAPAL are now in use.

Nishida also highlights the communication with the individual MAPAL locations: "With tool manufacturers who have their headquarters abroad, our experience has often been that communication between the branch in Japan and the company headquarters does not work properly. There



1



2

"We experienced long non-productive times in preceding projects. Our aim was to reduce these significantly on the new line."

"MMC used various technologies for clamping the tools, mainly collets," Koichi Fukui, application engineer responsible at MAPAL in Japan, describes the initial situation. This was one of the issues MAPAL addressed in order to fulfil the requirements of MMC to reduce variety and

The persons responsible at MMC decided on a pre-adjustment and shrink unit suggested by MAPAL, which carries out the length adjustment of the tools. This unit allows the tools to be adjusted automatically. Furthermore, it was possible to design the shrink chuck without the length adjustment screw, which is usually required. This offers advantages not only with regard to automation. "We also extended the adjustment range from 10 to 30 mm," empha-

are often delays when it comes to clearing up difficulties. But we can rely on MAPAL completely in this respect as well. The company operates as a group, and, as a result, communication works very well." MAPAL works according to the same standards worldwide and offers customers the appropriate service.



The persons responsible at MMC are completely satisfied with the support they receive from MAPAL: "The employees of the tool manufacturer visit us in production, help us to fix flaws in the process and assist with the pre-adjustment of tools. MAPAL sells not only tools, but also comprehensive service." True to the motto of being the customer's technology partner, further joint projects are already being planned: "For example, we want to replace the collets with shrink chucks on other production lines," concludes Makoto Nishida. ■

- 1 The MAPAL employees are always available to MMC with their know-how.
- 2 The concept that MAPAL presented convinced MMC.
- 3 Every year, the production plant of Mitsubishi Motors Corporation (MMC) in Kyoto builds engines for around 1.2 million vehicles. From left: Masato Inove and Koichi Fukui (MAPAL) with Makoto Nishida, Haruko Takeuchi and Hajime Sekino (MMC).
- 4 Working together to find the optimal solution: The employees of MMC and MAPAL.
- 5 Roughly 2,500 chucks from MAPAL are in use, like those in the hands of Naoto Katayama, MMC (right), and Koichi Fukui, MAPAL.



TEST CENTRE IN FRANCE EXPANDED

MAPAL France celebrated the opening of a second building at the Vigneux-de-Bretagne site and invited customers and business partners to participate in a Technology Day.



Tour of the rooms





From left: Christophe Potier (CEO of MAPAL France), Dr Dieter Kress, Dr Jochen Kress, Siegfried Wendel (Senior Vice President of Global Sales), Laurent Benezech (Vigneux-de-Bretagne Site Manager)



The aerospace industry is one of the most important sectors for MAPAL. In Europe, local customers in this market are primarily served by the subsidiaries in France and the United Kingdom, as well as by the company headquarters in Germany. It is for this reason that the site in Vigneux-de-Bretagne, France, is being expanded. The test and application centre for research, development and testing has received significant investments. In addition to this, the spatial capacity of the site has been expanded from 225 to 635 square meters.

Vigneux-de-Bretagne lies on the main connecting route between Nantes and St. Nazaire. There are Airbus factories located in both of these cities. Within this context, MAPAL supports the aircraft manufacturer's suppliers as well as customers from the shipbuilding and wind energy sectors.

The site in Vigneux-de-Bretagne has developed positively since its opening in 2013. This led to the decision to purchase a second building directly adjacent to the existing factory being made in Spring 2019. An external corridor has since been created to connect the two buildings. The machinery has been expanded in order to provide additional capacity for commissioning tools and for testing purposes. MAPAL also provides services such as regrinding and reconditioning tools for customers on site.

GRAND OPENING AND TECHNOLOGY DAY

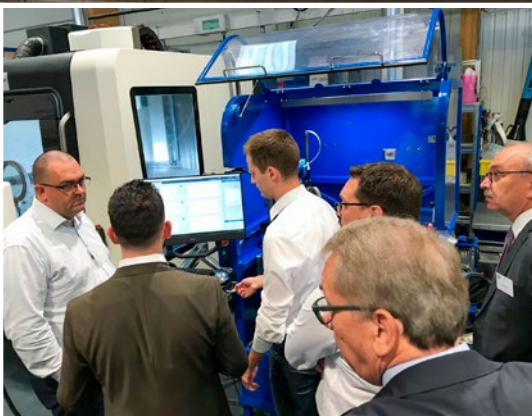
The new building was officially inaugurated in October. Customers and business partners, the Mayor of Vigneux-de-Bretagne Joseph Bézier and representatives from the press and MAPAL sites in Germany and France all took part.

Christophe Potier, CEO of MAPAL France, and site manager Laurent Benezech praised the commitment and dedication of the employees in implementing the expansion project. "The expansion of the site was a joint effort and we are all very proud of the new test centre." By "all" he meant the teams in Vigneux-de-Bretagne as well as those at the head office in Le Chambon-Feugerolles, the sales office in Paris, the production factory in Toulouse and the company headquarters in Aalen.

Dr Jochen Kress, President of the MAPAL Group, also thanked the employees for their efforts. In a speech delivered in French, he emphasised success achieved through working together. Kress said that he sees good prospects continuing for MAPAL within the aerospace industry in the future.

After the opening, the guests got a chance to visit the premises. They were then invited to take part in a Technology Day. The machining of lightweight and composite materials, as well as related services, took centre stage.

An exhibition gave guests an overview of the MAPAL portfolio, and product specialists provided information on the performance and uses of the tools. There were also live presentations of the machines and demonstrations at the test bench. ■





SUCCESSFUL TEAMWORK BETWEEN USERS, MACHINE MANUFACTURERS AND MAPAL

Highly precise machining of truck engine cylinder bores



Modern truck engines are produced at the Mercedes-Benz plant in Mannheim. The requirements for ideal engine properties include extremely tight tolerances for the decisive dimensions of the engine blocks. Thanks to the close cooperation between the specialists from Mercedes-Benz, the machine manufacturer and MAPAL, significant progress was made when a new production line for machining engine blocks was designed.

Manufacturing engines requires the highest level of precision. In order to ensure the best-possible engine properties, the corresponding surfaces in the engine block must be machined with the utmost accuracy. They have a complex geometry and numerous key characteristics (KC) for which the highest tolerance classes must be reliably observed. Depending on the engine type, these include multiple H7 fits, various areas with accuracy specifications less than 15 µm as well as chamfers with tight tolerances, including a 20° chamfer with an outlet, for which an angle tolerance of just $\pm 0.025^\circ$ (1' 30") must be observed while meeting the high requirements in terms of surface quality at the same time. Aside from all the accuracy, the focus is also on cost-effective manufacturing.

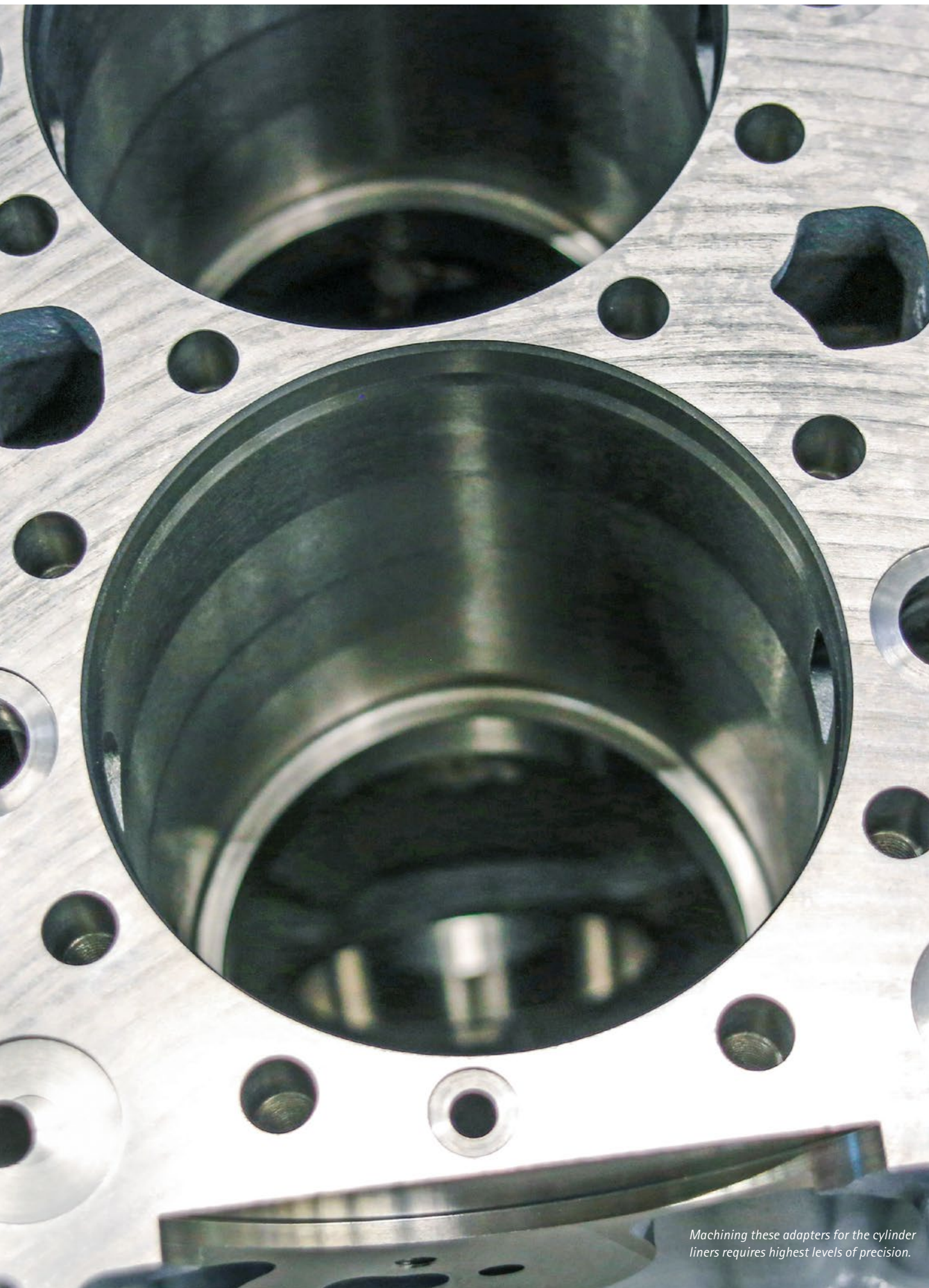
ONLY MANAGEABLE WITH ACTUATING TOOLS

A first line for machining these engine blocks was commissioned in 2011. When planning a second line, the persons responsible drew on their experience with the first line. They identified the machining of the bores for the cylinder liner adapters as particularly challenging. The machining was divided into two stations: one for pre-machining and one for fine machining.

To this end, MAPAL has developed complex actuating tools that are equipped with up to 20 indexable inserts, including ISO inserts and custom inserts. The actuating tools feature a tool body in monoblock design. The HSK-160 connection shows an enlarged face surface with a diameter of 200 mm. One tool weighs a total of up to 60 kg. Despite the connection and a tool length of 380 mm, it must be ensured that the tool has a radial run-out accuracy of 3 µm. The slides are actuated by a drawbar via an additional NC axis in the machine controller. It had to be integrated in the HSK connection and suitable for the automatic tool change. This challenge was solved with a high-precision bayonet coupling. It is used to couple the drawbar automatically during a tool change.



Form-ground inserts with a special contour are used in certain areas of the actuating tool.



Machining these adapters for the cylinder liners requires highest levels of precision.

Inside the tool, the movements of the drawbar are transferred to the slides by means of carbide ramps. In order to achieve the required quantities, three bores are machined simultaneously with three spindles. The three tools per machine are each assigned to a particular spindle, thus ensuring process reliability. For each tool, there is a sister tool and a further reserve tool for regular maintenance work and repairs at MAPAL.

Given that the tools have to be manufactured with great precision, the amount of manual manufacturing work at MAPAL was very high. For example, the slide shafts in the tool body were lapped by hand, and the accuracy of the drawbar mechanics had to satisfy the highest requirements in terms of precision. The manual working time for each of these tools alone amounted to multiple man weeks.

REPLACING THE CUTTING EDGES AND ADJUSTING THE TOOLS OUTSIDE OF THE MACHINE

With machining operations like these, the cutting edges of such tools are usually replaced and adjusted in the working area of the machine. Due to the cooling lubricant, this is not only uncomfortable for the machine operator, the machine also cannot produce during this time. In three-shift operation and with three tools per machine, this downtime would amount to three to four hours per day.

Together with the employees from Mercedes-Benz and the machine manufacturer, MAPAL consequently developed a concept for an automatic

tool change and for adjusting the tools outside of the machine. This may sound mundane at first, as this is quite a normal procedure with machining systems. However, the dimensions of the tools alone indicate the extent of the challenge in this case. Given that a machine with an automatic tool change for this type of machining and these dimensions is a world first, the project required a great deal of innovative spirit and the courage to try out new things from all project partners.

UNIQUE SETTING FIXTURES FOR HANGING TOOLS

In an effort to ensure that the external adjustment is as simple as possible, MAPAL developed the corresponding devices for transporting, adjusting and maintaining the tools. This included a handling solution for inserting and replacing tools in the magazine, as the tools are inserted into the machining system while hanging, which is quite unusual. Due to the high tool weight of around 60 kg, the effort of just "turning over" the tool twice manually would have put the personnel under a lot of strain. When working with such a weight, the safety aspect also plays a major role. Furthermore, there would have been a risk that the tool could be damaged in the process. This is why MAPAL realised two unique setting fixtures into which the tools are inserted in a hanging position. A cart for hanging transport between the machining system and the setting fixture was also developed. The tools are thus transported and adjusted in the same position in which they are used in the machining system.

The measurement results determined on the setting fixtures are transmitted directly to an RFID data medium on the tool. The controller of the machining system reads it out when the tools are inserted. This way, the machine can readjust some of the important measurements using the actuating slides during machining. As from the second workpiece, the results of the routine QA measurement are taken into account. This closed quality control loop for the tools was a high priority for Mercedes-Benz.

Overall, the line was commissioned as planned. The tools fulfil their tasks in accordance with all specifications, and the engine blocks are now manufactured with great precision on the production line. ■



MAPAL application engineer Christoph Wilhelm works on the measuring and setting fixture with a hanging tool arrangement developed specially for this application.



1 The slides of the actuating tool are actuated via a drawbar with high-precision bayonet coupling.

2 MAPAL developed a cart for hanging transport of the tools between the machining system and the setting fixture.



3 Three bores are machined simultaneously with three spindles. A sister tool is stored in the machine for each tool.

4 At a length of 380 mm, the run-out variation of the tool must not exceed 3 μm .

5 Semi-machined engine blocks in front of one of the special machines.



MILLING CAST AND STEEL PARTS MORE COST-EFFECTIVELY

Whether they're producing turbochargers, steering knuckles or cylinder blocks, customers can mill their cast and steel parts considerably more cost-effectively with the radial insert milling range from MAPAL than with the previously available solutions. Since the product launch in 2018, there have been a large number of measurable successes resulting from the use of the tools in the series.

Let's take a quick look back: MAPAL first showcased a product range for milling with compressed radial indexable inserts at the AMB exhibition in Stuttgart in 2018. "This move was the natural next step towards our aim of being a comprehensive service provider for our customers," explains Dr Wolfgang Baumann, who is responsible for the product range of tools with ISO elements at MAPAL. "But our aim isn't just to provide the customer with all their machining needs in terms of tools and chucks – we also want to offer them added value through our solutions," adds Baumann. Accordingly, the development process of the new tools was comprehensive and detailed.

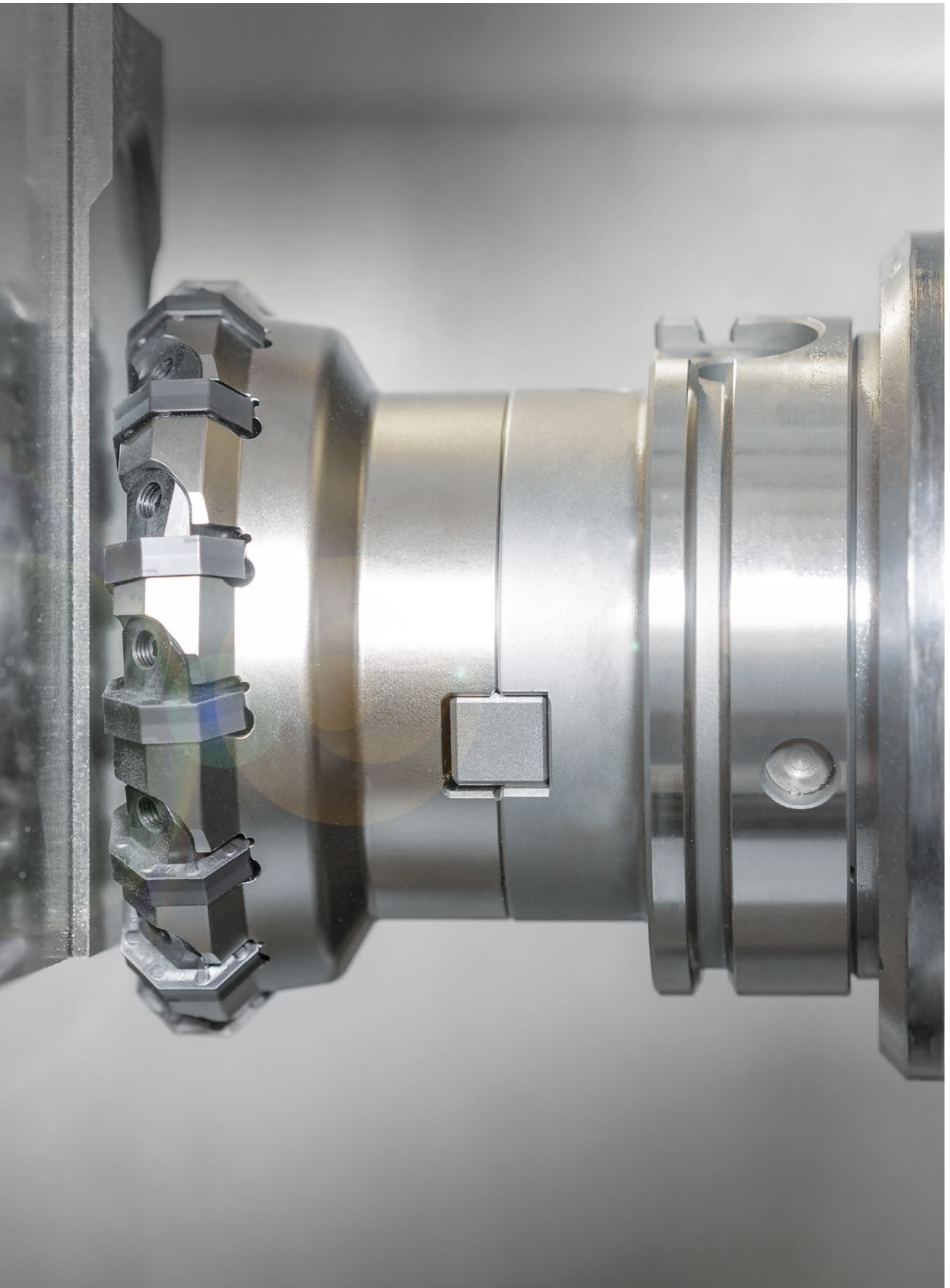
"Before this milling range, our focus was mainly on supporting customers with specific application needs, such as providing support for high levels of stock removal or unstable conditions," explains Dr Baumann. This machining

was mostly carried out using ground tangential indexable inserts. "We're obviously not the first company to offer a radial milling range. We've simply plugged a gap in our portfolio," admits Baumann. However, he further adds: "Through our work with special applications, we've accumulated extensive in-depth knowledge that has been incorporated into the development of our compressed radial blades. They therefore offer considerable added value and, in particular, economic benefits for users."

"The success stories that we've gathered over the past year prove that our meticulous work is paying off for our customers today," explains Dr Wolfgang Baumann enthusiastically. In many applications, the cost per part (CPP) was considerably reduced. There are several reasons for this: "In many cases, other tools were superseded once we had analysed the application and selected the optimal tool," Baumann explains.

→





"For some applications, our tools now machine significantly more parts until the blades have to be replaced. And in some other machining operations, the same machining times per part can be achieved with fewer blades. However, there are other cases where we can achieve considerably higher cutting data with more blades. We sometimes rely on indexable inserts with more cutting edges, thanks to which each individual indexable insert can be used for considerably longer."

By way of example, three machining operations on customer parts demonstrate the added value that the radial milling range offers:

1. TURBOCHARGER MACHINING

Face milling of the hot side made of stainless steel

The face milling cutter with nine blades from MAPAL replaces the previously available face milling cutter with seven blades.

	Previous solution	MAPAL face milling cutter
Tool diameter	100 mm	
Number of blades	7	9
Cutting edges per indexable insert	12	16
Clearance angle of indexable insert	Positive	Negative
Cooling	Dry machining	
Cutting speed	126 m/min	100 m/min
Feed	0.14 / 0.14 mm	0.22 / 0.34 mm
Feed rate	400 mm/min	650 / 1,000 mm/min
Stock removal	1,5+2,4 mm	3,5+0,4 mm
Machined parts per milling cutter tipping*	20	30

Thanks to the MAPAL solution, **50 %** more parts are milled in total, the cycle time is considerably reduced and the costs per part are **44 %** lower than previously.

2. STEERING KNUCKLE MACHINING

Shoulder milling/roughing of various connection points on a steering knuckle made of cast iron with spheroidal graphite – stock removal of between 2.5 and 4.5 mm.

The shoulder milling cutter with six blades from MAPAL replaces the previously available shoulder milling cutter with seven blades. Despite its negative clearance angle, it achieves the same tool life as the previously used solution with positively aligned indexable inserts.

	Previous solution	MAPAL shoulder milling cutter
Tool diameter	50 mm	
Number of blades	7	6
Cutting edges per indexable insert	4	8
Clearance angle of indexable insert	Positive	Negative
Cooling	Dry machining	
Cutting speed	300 m/min	300 m/min
Feed	0.128 mm	0.149 mm
Feed rate	1,711 mm/min	1,711 mm/min
Machined parts per milling cutter tipping*	2,000	2,000

Although the new milling cutter machines exactly the same number of parts as the previous one, the costs per part are reduced by more than half – **by 58 %**.

*Total without replacement of the indexable inserts or use of additional cutting edges

3. CYLINDER BLOCK

Shoulder milling/roughing of various surfaces on cylinder blocks made of cast iron with lamellar graphite – stock removal of between 2 and 4 mm.

The eight-edged shoulder milling cutter from MAPAL replaces a shoulder milling cutter which also has eight edges.

	Previous solution	MAPAL shoulder milling cutter
Tool diameter		80 mm
Number of blades	8	8
Cutting edges per indexable insert	4	8
Clearance angle of indexable insert	Positive	Negative
Cooling		Dry machining
Cutting speed	200 m/min	200 m/min
Feed	0.1 mm	0.1 mm
Feed rate	637 mm/min	637 mm/min
Machined parts per milling cutter tipping*	32	60

- › The tool life of the milling cutter from MAPAL is considerably longer than that of its predecessors under identical operating conditions – even with its negatively aligned indexable insert. And on top of that, the cost per part is also reduced **by 58 %**.



Dr Wolfgang Baumann

MAPAL RELIES ON **VOLLMER** TECHNOLOGY IN SOUTH CAROLINA



The tool manufacturer MAPAL has established itself in the south of the US in the state of South Carolina. MAPAL relies on the sharpening expertise of the Biberach machine manufacturer Vollmer for manufacturing its tools there. These tools are made of solid carbide or are tipped with PCD (polycrystalline diamond). Just under a dozen grinding and erosion machines run automatically and around the clock to machine cutting tools such as drills, milling cutters or reamers. Globally active manufacturers and suppliers to the local automotive and aerospace industries in particular are the kind of companies that make it to the top of MAPAL's customer list. With the help of Vollmer machines, MAPAL manufactures tools which meet the highest requirements in terms of precision and performance. →



"It is our aim to be a technology partner for our customers", says René Kristensen, Chief Operating Officer (COO) of MAPAL Inc. in the US. "Our second location in the US is in Fountain Inn and allows us to expand our business in the south of the United States. Not only can we provide more intensive support for our customers there, but we can also expand our customer base at the same time."

MAPAL ACTIVE IN TWO US LOCATIONS

MAPAL founded its US headquarters in 1977 in Port Huron in the northern state of Michigan, not far from Detroit and Ohio. The second location in Fountain Inn was opened in 2013 and is located in South Carolina about halfway between Atlanta (Georgia) and Charlotte (North Carolina). With both locations MAPAL is represented in the epicentres of the US automotive and aerospace industries. Fountain Inn is not only an important manufacturing site but is also home to the Aerospace Test Center from MAPAL. On top of this, the company offers services there, including regrinding customers' tools. Many of the manufacturers and suppliers who are based in this region are already MAPAL customers. They use solid carbide or PCD-tipped tools to machine metal, aluminium or composite materials.

WIRE ERODING FOR PCD TOOLS

MAPAL currently makes use of around a dozen Vollmer grinding machines for tool manufacturing in Fountain Inn. When it comes to machining PCD, the company relies on wire erosion machines. This technology is unique as the electrode consists of an erosion wire that is guided so close to the tool that a spark jumps between the electrode and the tool. In this way, the material of a PCD-tipped cutting edge can be specifically removed. Thanks to the fine erosion wire, MAPAL can precisely machine even complex geometries and the smallest inner radii – i.e. structures typical for step or bell tools. The first two Vollmer QWD 750 H wire erosion machines arrived at Fountain Inn in 2013 in time for the grand opening – two more machines of the same type followed in 2015. With appropriate automation, MAPAL can machine its PCD cutting tools automatically and around the clock. Almost two years ago, MAPAL decided to get in the new generation of Vollmer wire erosion machines in the VPulse 500 model.

"We are very pleased with how the QWD 750 H is performing, but the new VPulse 500 takes us to a whole new level!", says John Schuck, Production Manager at MAPAL in Fountain Inn. "The VPulse 500 has a new erosion generator that is much more efficient than with the QWD machines. With it and the new controller, we have optimised productivity, meaning that we have been able to reduce the cycle time compared to the previous machines. At the same time, the quality of tool surfaces and cutting edges improved."



TOOL GRINDING WITH THE VGRIND 360

The demand for solid carbide tools such as drills, milling cutters, reamers and tailor-made special tools also increased in Fountain Inn along with the rapid development in the manufacturing of PCD tools. For this reason, in autumn 2018 MAPAL decided to establish a Centre of Competence for solid carbide tools for North and South America at the South Carolina site. Thanks to the global partnership with Vollmer, which the tool manufacturer from Aalen has maintained with the Biberach regrinding specialist for years, MAPAL again decided to use regrinding machines that originated from their Swabian home.

In 2018, a total of five Vollmer VGrind 360 grinding machines set off on their journey across the Atlantic to South Carolina. The VGrind 360 is equipped with two vertically arranged spindles and enables efficient multi-plane machining. MAPAL has also decided on the HC 4 automation solution in order to manufacture tools using the machines around the clock and automatically. Two machines have a chain magazine for hollow shank taper tools, the other three magazines can hold up to 158 shank tools. This enables MAPAL to manufacture tools both in series and in low volumes.

WORLDWIDE CONSISTENT MAPAL QUALITY

All over the world, MAPAL tools stand for the highest quality and cost-effectiveness. Standardised manufacturing equipment and production processes ensure that the manufacture and reconditioning of tools meet the highest standards worldwide. For this purpose, MAPAL has introduced a global production system which enables each manufacturing location worldwide to share its designs, drawings, production plans or schedules for each tool type.

"The fact that MAPAL has also decided in favour of our regrinding machines in the US is both a confirmation and an incentive for us to continuously improve the quality of the eroding and grinding processes with our innovative strength", says Dr Stefan Brand, Managing Director of the Vollmer Group. "And of course, it makes us proud that with MAPAL, and our combined Swabian engineering skills, we can shape and expand the global market of the tool industry." ■

Successful trade show:

METALEX 2019 IN BANGKOK



Thomas Bareiß (right), Parliamentary State Secretary at the Federal Ministry for Economic Affairs and Energy, keeps up with developments in conversation with Armin Kasper, Vice President for the Asia-Pacific Area (MAPAL).

Back in November, MAPAL exhibited at the METALEX trade fair in Bangkok. It is the largest metalworking trade fair in the ASEAN region and attracted more than 100,000 visitors from the industry. Around 3,000 international companies were there to present their portfolios. Germany, which was METALEX's partner country this year, occupied one of 15 shared booths. There, MAPAL showcased its entire range – including precision tools for drilling, milling, reaming and fine boring, devices for adjusting and measuring, and the services offered by the company.

The visitors were particularly interested in the new developments on display, especially those in the field of e-mobility. The MAPAL exhibition team was delighted to welcome numerous visitors from Thailand, Singapore, Malaysia and Indonesia. "We had some interesting discussions and are expecting good post-fair business", concluded Armin Kasper, Vice President Asia-Pacific (MAPAL).

The next METALEX in Bangkok will take place from 18 to 21 November 2020.

SERVICE ON SITE

The MAPAL Tooling branch in Bangkok promises to provide customers with competent advice and quick response times. The team there has been looking after customers in Thailand for over ten years. ■

The MAPAL trade fair team ...



... welcomed numerous visitors to the exhibition booth



GETTING STARTED IN DIE & MOULD SECTOR

Companies that make dies and moulds expect high process and product expertise from their cutting tools manufacturer. They require their tools to offer the highest levels of precision, a long tool life, and – above all – process reliability. It is precisely these aspects that make MAPAL successful in sectors such as the automotive industry, machine engineering and the aerospace industry. So it shouldn't come as a surprise that the precision tool manufacturer is now also taking off in the field of die and mould making.



Structural changes to the market in fields such as the automotive industry are prompting many suppliers to strategically reposition themselves. "That's why we began to develop in sectors other than our largest source of trade – the automotive industry – years ago. We have established ourselves in the aerospace sector within just a few years", explains Dr Jochen Kress, President of the MAPAL Group. MAPAL is now planning to do something similar in the die and mould sector.

MAPAL has always offered tools that are also used in die and mould making. "However, we hadn't yet developed the market penetration or comprehensive portfolio we needed", says Dr Jochen Kress. MAPAL has therefore gradually built up both its portfolio and relevant expertise, most recently by integrating the company voha-tosec into the MAPAL Group. In taking over the company from Lindlar, MAPAL not only gained sound, deep knowledge of the market, but also products that complement the existing portfolio. New tools were developed in close cooperation, which were presented to the market at the EMO trade fair in Hanover:

NEW MILLING CUTTERS MADE FROM SOLID CARBIDE

MAPAL has introduced a new, powerful range of solid carbide milling cutters specifically developed for die and mould making under the product name OptiMill-3D. "In addition to extremely heat-resistant coatings and special carbide substrates, these tools are characterised by their dimensions and geometries, which are specially adapted to mould making", explains Carsten Klein, who is responsible for the die and mould making market segment.

The range includes tools with special face geometry for milling hardened components, a shoulder radius milling cutter for finishing 3D shapes up to a hardness of 66 HRC and new circular radius milling cutters for use in deep cavities or for complex free-form surfaces.

GREATER COST-EFFECTIVENESS WITH ISO TOOLS

A new range of milling cutters with ISO indexable inserts was also presented at EMO. The programme includes round insert milling cutters, high-feed and 90° shoulder milling cutters, ball and toric end milling cutters and finishing milling cutters. As such, the range of ISO indexable inserts covers the workpiece materials cast iron, steel, stainless steel, non-ferrous metal and hardened workpiece materials up to 65 HRC. Different cutting materials and coatings are used depending on requirements and the material to be machined.

NEARLY 100 % COVERAGE – AND NOT JUST FOR TOOLS

"Today, we are able to cover almost 100 percent of the needs of companies that make die and moulds," says Carsten Klein. This includes not only the milling cutters mentioned above, but also the complete range for drilling and reaming. However, when it comes to many milling tasks in die and mould making, the focus is not just on tool technology. Another decisive factor is the programming of the machine, which is a complex matter. MAPAL supports customers in this task and works closely with the relevant software manufacturers to do so.

As a full-service supplier, MAPAL's offerings extend beyond the tool and its programming: MAPAL wants to be a technology partner for its customers. For this reason, the company also supplies the appropriate clamping technology – among other things. The portfolio for this area includes everything needed for clamping. "Our 3-degree chuck in particular has proven itself in die and mould making", says Kress. This innovative high-performance chuck boasts a special feature: the HighTorque Chuck (HTC) with a slender contour combines the advantages of hydraulic expansion technology (such as the highest possible accuracy) with the three-degree back taper known from shrink chucks.

INDIVIDUALLY ADAPTED CHUCKS

Individually adapted chucks are made possible by additive manufacturing. This process enables the soldered connection between the sleeve and tool body previously necessary to be dispensed with. This was a limiting factor not only in terms of chuck geometry, but also in terms of thermal stability and torque transmission. Thanks to its geometrical freedom, the hydraulic expansion clamping technology can also be used in the case of parts with large tool restrictions or for deep cavities in places that are difficult to access, which previously required the use of shrink chucks. "We individually adapt our chucks to each customer's machining", explains Carsten Klein. This means that it is often possible to use standard tools instead of costly specialised tools. →





Carsten Klein

In addition to tools, programming and clamping devices, the MAPAL portfolio includes the complete range of peripherals for adjusting and measuring tools, as well as dispensing systems for storing and managing components. "And on top of that, we support our customers with comprehensive services", says Klein. One example of these services is Tool Management 4.0, which is offered using the open-cloud platform c-Com as a basis. "This means the customer no longer has to worry about the tools – we take care of storing, provisioning, purchasing and reconditioning the tools", Klein explains. And it all takes place with 100 percent transparency for the customer.

"In the end, the market will decide how strong a foothold we will gain in die and mould making", says Dr Kress. That being said, MAPAL has high hopes: "We are able to win over potential customers not just by being a full-service provider, but by supporting them with our decades of cumulative experience." Being on site, solving problems and meeting high expectations have always been of great importance to MAPAL.

For the time being, the company is focusing on die and mould manufacturers within Germany. "Our aim is to gain even more experience in the industry, and then incorporate that experience as we strengthen our engagement globally", says Dr Jochen Kress. ■



A new structure for MAPAL China: Moving forward into a new decade

Last year, the management of MAPAL China initiated an extensive reorganisation of the branch in Shanghai. This was prompted by changes in the market environment and technological developments in the automotive industry. "We are more and more coming up against strong competition. At the same time, customers expect increasingly flexible services – within ever-shorter timeframes. "We are therefore optimising our processes to enable us to react faster," says Andy Liu, CEO of MAPAL China. In order to avoid MAPAL China Trading and MAPAL China Production duplicating work, both companies were merged into one organisation. Going forward, they will operate jointly under the name MAPAL China. In the course of this organisational restructuring, MAPAL used existing synergies to optimise internal resources and reorganise individual work areas. To this end, Iris Shen (CFO) and Clement Tsui (COO) joined the MAPAL China management team, which oversees 400 employees, in 2019.



ANDY LIU
CEO | MAPAL China

Chief Executive Officer Andy Liu is responsible for sales and production at MAPAL China. He has been in a management role at MAPAL since 2007 and has a dual master's degree in mechanical engineering and business administration. Liu has 25 years of sector experience, ten of which he spent in the US.

IRIS SHEN
CFO | MAPAL China

Iris Shen has been strengthening the leadership of MAPAL China as Chief Financial Officer since March 2019. The finance and accounting expert studied at Tongji University in Shanghai. After completing her master's degree in 2006, she gained extensive experience in the areas of financial accounting and controlling at a number of renowned technology companies.



CLEMENT TSUI
COO | MAPAL China

Clement Tsui took on the role of Chief Operating Officer at MAPAL China in April 2019. Tsui has been active in various manufacturing management positions over the past 19 years and has worked in an international environment. Most recently, he managed the plant of a US automotive supplier in Shanghai.



PARTICULARS

THE NEW FACEMILL-DIAMOND: PROCESS-RELIABLE FACE MILLING WITH A LONG TOOL LIFE

MAPAL customers rely on the FaceMill-Diamond PCD face milling cutter for face milling work at high volumes, on unstable parts and in the HPC (high performance cutting) sector. With its solid steel tool body and the permanently brazed PCD cutting edges, it achieves top feed rates and material removal rates that are second to none. Following comprehensive further development in 2019, the productivity of the PCD face milling system has been increased once again.

"Particularly in the area of high performance cutting, the number one customer requirement is the achievable material removal rate alongside the best possible component surface," reports Andreas Wittenauer, Head of Application Technology in the PCD Tool division. He goes into more specific detail by adding: "For this reason, the FaceMill-Diamond features an exceptionally high number of permanently brazed cutting edges for its diameter. The cutting edges are designed for a cutting depth of up to 10 mm. Furthermore, the robust tool body absorbs the vibrations generated during machining and prevents damage to the component surface." Additionally, the FaceMill-Diamond can be inserted directly into the machine when newly equipped – without time-consuming adjustment work requiring operator expertise.

Based on this, MAPAL further developed the PCD face milling cutter in two ways in 2019, increasing its potential for further productivity.





EasyFix

A LONGER TOOL LIFE AND IMPROVED CHIP REMOVAL THANKS TO COOLANT OUTLETS DIRECTLY AT THE CUTTING EDGES

"High cutting values and the resulting chip volume may, under certain circumstances, lead to washout of the tool body. To counteract this effect and maintain an economical product life cycle, we have optimised the cooling concept and positioned the coolant outlets directly at the cutting edges," explains Andreas Wittenauer. "This ensures improved chip removal and protects the tool body, especially for applications with minimum quantity lubrication or air cooling."

A direct compare with the new generation of the FaceMill-Diamond and the previous model provides the specific improvements. A customer machines a part made of AISi1 with cooling lubricant on a machining centre. The application parameters of the 63 mm diameter milling cutter have deliberately been left the same for the comparison: a cutting speed of almost 3,000 m/min and a spindle speed of 15,000 rpm. Due to the high-gloss surface requirement, the feed per tooth is 0.04 mm and the cutting depth is 0.8-1.2 mm. "The customer was delighted with the new tool right away," says Andreas Wittenauer. "The surface it achieves is noticeably higher in quality and it removes the chips more effectively. We are pleased that we were able to increase the tool life by 15 percent with the new FaceMill-Diamond, and that the customer is now successively converting their entire inventory."

MODULAR VARIANT PROVIDES GREATER FLEXIBILITY

Customers with a diverse range of machinery want a certain degree of flexibility as far as tool use is concerned. In order to meet this demand, the FaceMill-Diamond is now also available in a modular version with a milling head. Andreas Wittenauer provides us with more details: "The modular version of the FaceMill-Diamond can be used flexibly – particularly for small series production and machinery that uses different interfaces, or even for large series where production is initiated on one machine and then continued on another."

In the context of a customer project, the modular version offered improvements for both the surface and the cycle time compared to the competing tool used previously. With a spindle speed of 12,000 rpm and a feed per tooth of 0.1 mm, the machining tool variant of the FaceMill-Diamond mills about three seconds faster than the previously used tool. As such, the quadruple mounting on the machine results in a saving of twelve seconds in the cycle time.

OPTIMISED WHEEL CARRIER MACHINING: TOOL LIFE EXPONENTIALLY INCREASED FROM 3,000 TO 40,000 PARTS

The FaceMill-Diamond is used not only in the standard variants available, but also as an individual specialised solution, as demonstrated in the machining of a wheel carrier made of Al-Si12(T4) on a machining centre. The employees responsible for the process complained about the use of a face milling cutter in the original process. With the competing tool that was used originally, the high cutting values required for cycle time reasons combined with the stock removal led to



Andreas Wittenauer



process-critical burr formation. Specifically, the chip was bent at 90° on perimeter of the part and was not cut, being instead retained as a so-called burr flag on the edge of the part. Several challenges became apparent in our first conversation with the customer. Andreas Wittenauer: "The heat-treated part has a strong tendency to vibrate and the hard chips wash-out the tool body. On top of that, several milling operations are required at different positions on the part – the stock removal is up to 7 mm axially and up to 3 mm radially."

The specialists at the Centre of Competence for PCD tools settled on a combined special cutting edge geometry in order to meet all the requirements provided. At the unchanged cutting values of a feed rate of 15,400 mm/min and a spindle speed of 7,000 rpm, the tool life was increased exponentially: the FaceMill-Diamond now reliably mills 40,000 wheel carriers, contrasting with the previous output of 3,000. Today, our customer has 16 FaceMill-Diamonds in circulation in order to machine their annual production quantity of 600,000 parts.

NEW FACEMILL-DIAMOND AVAILABLE

The FaceMill-Diamond is a high-performance product for face milling that can be used even more economically and flexibly thanks to the further development carried out in 2019. These additionally developed variants can be ordered with short delivery times. ■



Image source: pixabay (Disc010)

New platform for sharing knowledge

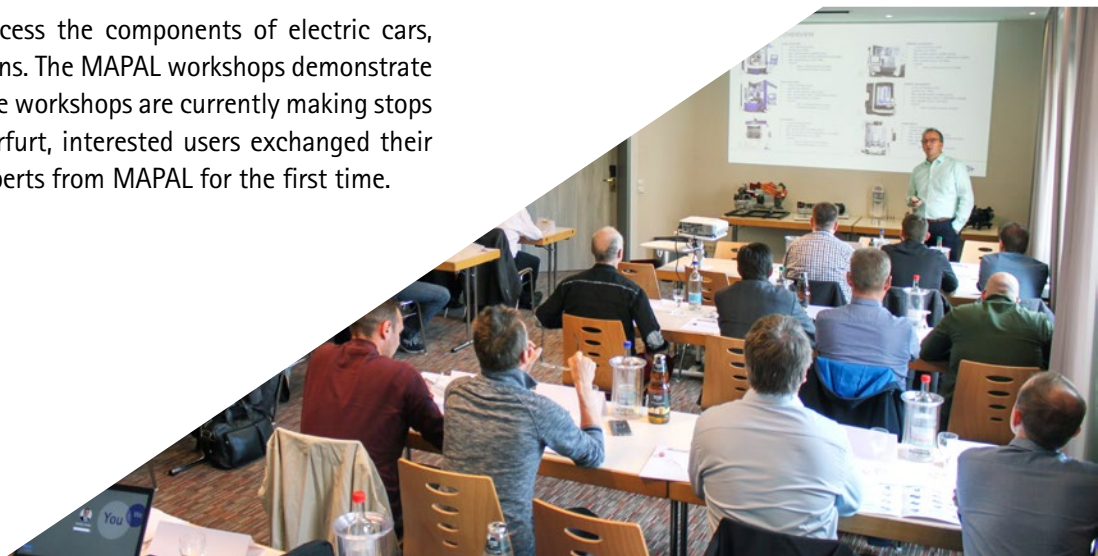
WORKSHOPS ON E-MOBILITY: LAUNCHED IN BERLIN AND ERFURT

Those who want to reliably process the components of electric cars, need new, innovative tool solutions. The MAPAL workshops demonstrate what these solutions look like. The workshops are currently making stops in various cities. In Berlin and Erfurt, interested users exchanged their thoughts with the E-mobility experts from MAPAL for the first time.

Electric mobility is changing production. New parts, new workpiece materials and new production processes are entering factory halls. OEMs, suppliers and machine manufacturers are all affected by the change in equal measure. Their employees at the planning and manufacturing level, as well as those in sales, need to keep up with the changes and acquire new expertise. This includes modern machining knowledge. And because machining specialists also learn a lot when they discuss things with the user, it is best to tackle the subject together.

For this reason, MAPAL is offering workshops on the subject of E-mobility. They have a regional focus and pack a lot into a small space of time. The tour started in October with two afternoons in Berlin and Erfurt. The programme included three speeches on key ideas, after which the participants discussed new machining strategies. There was also the possibility for visitors to meet

Workshop in Erfurt





Workshop in Berlin

Matthias Winter, MAPAL's e-mobility expert, presented machining concepts for parts in electric vehicles.

with an expert and have them take a look at and provide input on specific projects. MAPAL was in attendance with its knowledgeable representatives André Ranke, the Deputy Sales Manager for Central & North-East Germany, Frank Winkler and André Arnold (Area Sales Managers) and Matthias Winter. Matthias Winter is the head of the E-mobility market segment for MAPAL and intensively dedicates himself to the technological challenges of modern vehicle propulsion systems. In his presentations, he highlighted a number of key aspects of the technological changes occurring in the automotive industry. He focused on questions such as:

- What is happening in E-mobility and how is the market developing?
- What new parts and requirements will E-mobility bring?
- What machining strategies are available, and what solutions does MAPAL offer?

In providing answers to these questions, the E-mobility expert referred to parts such as the stator housing, the scroll compressor and the battery tray. These parts have components with demanding machining requirements. He explained that both a high degree of precision during machining and the control or reduction of vibrations are crucial to achieving optimum results at high cutting values. Winter pointed out that MAPAL already offers solutions that are suitable for series production. Examples of the parts and the tools used to machine them were also on display.

GOOD FEEDBACK

The response to the workshops from the participants was unanimously positive. The events were also a success for MAPAL. André Ranke said: "We have succeeded in demonstrating our expertise and what we can achieve in the area of E-mobility. This was particularly important for our cus-

tomers who rarely have the opportunity to come and visit our headquarters in Aalen due to the geographical distance. We were able to present the work carried out by our research and development department and demonstrate what our test centre in Aalen can do. A workshop provides us with a much better opportunity to do this than, for example, a short discussion at a trade fair."

MAPAL is planning to continue the workshop tour on E-mobility and on other topics relating to the machining of parts this year. Under the proven premise "regional and compact", the precision tool manufacturer will visit many cities in Germany. Additionally, if there are enough interested participants at a customer's site, MAPAL can arrange a visit to have conversations with and inform the people who will be using these tools in their everyday work. ■

Interested in a workshop on the topic of electric mobility? Then please send an email to e-mobility@mapal.com.



COOPERATION, CUSTOMER PORTALS AND ARTIFICIAL INTELLIGENCE

c-Com announces projects with MARPOSS and Oerlikon Balzers and introduces intelligent app

Step-by-step networking for in-house manufacturing, involving suppliers and customers and efficiently using data together – the digital services provided by c-Com, a member of MAPAL Group, make it all possible. However, the start-up isn't just developing its own applications. It's also generating added value for customers by working closely with cooperation partners.

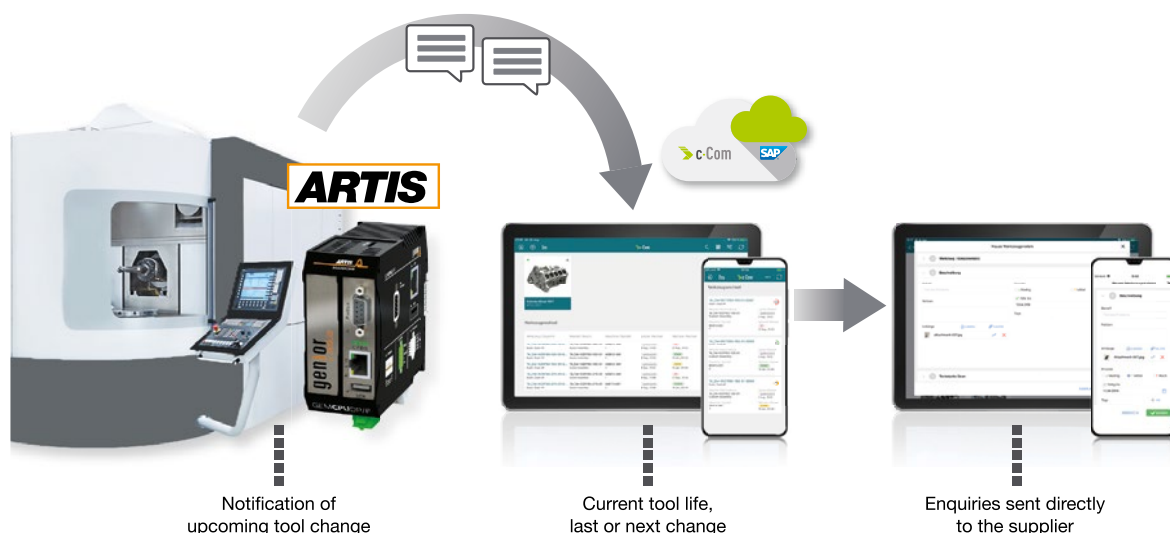
Cooperation with MARPOSS: reduced setup times and maximum tool service life

The optimal and longest-possible use of tools represents a vital cost factor for machining companies. But compromises are often necessary – particularly in series production and as part of automated processes. Tools with a defined tool life are replaced as soon as the specified tool life has come to an end. In many cases, though, the tool has not truly reached the end of its tool life and replacement is not yet necessary. However, companies play it safe to avoid quality issues and the risk of producing items that later need to be rejected.

This is one of the elements addressed by the ARTIS GENIOR MODULAR module by MARPOSS. The fully automatic tool- and process-monitoring system has been an established feature of the market for many years. It works by recording various measurements and assessing them on the basis of several criteria. For example, the module can measure the force that needs to be generated during the machining process. This enables the system to identify tool wear and potential tool fractures. The current status is shown on the machine control operating display or via a connected computer. By taking the measurements into account, tools can be used up to the true end of their tool life. The entire system is protected by the measurements taken by the module.

MARPOSS recently launched a collaboration with c-Com GmbH and its c-Com open cloud platform to provide module users with additional value: the ARTIS GENIOR MODULAR module and c-Com are set to exchange data. Once the defined tool limits have been reached, the staff member responsible receives a notification on their mobile terminal – which is made possible by the cooperation with c-Com. As a result, operators can react more quickly and boost the efficiency of their manufacturing processes.

The exchange of data also helps to forecast for upcoming tool changes. Depending on the user's preference, c-Com creates an overview showing a time limit or the number of workpieces remain-



Picture source: iStock (DKosig)

ing. With this information, it becomes possible to stock up on new tools at production facilities in good time. This reduces setup time and machine downtime caused by unavailable or unprepared tools. The number of spare sister tools can be minimised and fewer tool mounts are required.

At EMO 2019, MARPOSS and c-Com showcased the results of this promising collaboration – which is set to be intensified – for the very first time.

Cooperation with Oerlikon Balzers: transparency and sustainability thanks to digital processing for coating

Many tools are re-sharpened and re-coated to make production as cost-efficient as possible and to use raw materials sustainably. During this reconditioning process, the tool passes through several stages, which are usually carried out by different companies. Tools are recorded several times

to allow the processing of orders and to enable them to be assigned accordingly. This procedure is very complex for everyone involved – from the machine operators to the staff members carrying out the re-sharpening and coating. Physical product cards accompany the orders throughout the entire process chain. If a staff member responsible for re-sharpening sends a tool for coating, this staff member is often not aware of corresponding order status. This results in frequent queries. Neither tool users nor the coating and re-sharpening staff have an oversight of how many times the tool has been re-sharpened or coated in the past. In some cases, the number of re-sharpening processes is simply marked on the tool shank. Overall, the total benefit is reduced by the very high investment of time and effort required.

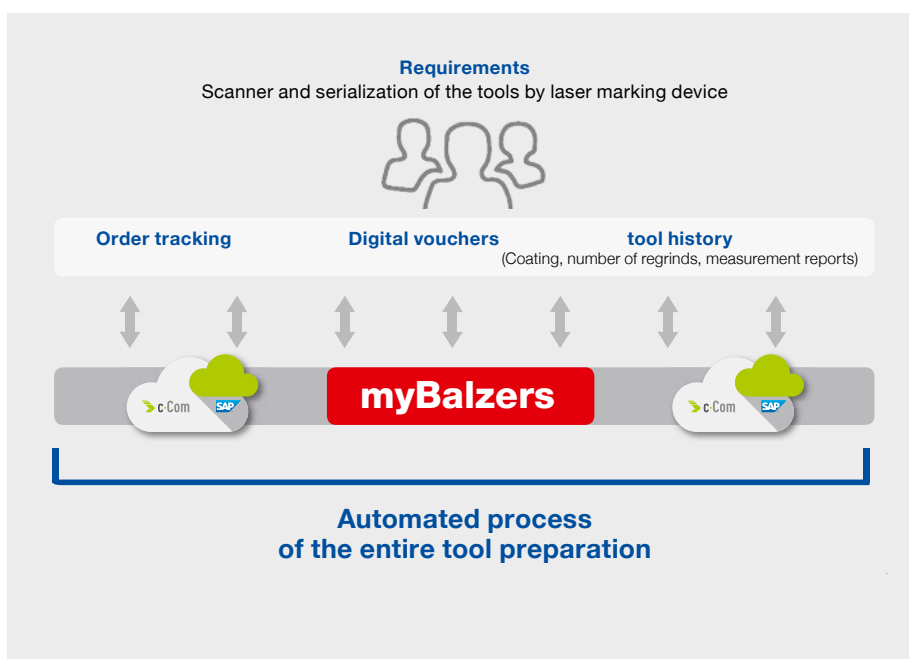
In cooperation with Oerlikon Balzers, c-Com has developed an application that enables significantly more effective and transparent order pro-

cessing. The prototype was showcased at EMO Hannover. The only prerequisite to benefitting from the advantages of digital processing for coating is identifying all tools with a unique ID.

The c-Com application exchanges data with the myBalzers customer portal run by Oerlikon Balzers. This way, the entire order process is digitalised, and all receipts are available online. It is easy to share documents such as delivery slips, invoices or order confirmations, and the status of each coating order can be viewed in real time. There is no longer a need to ask for order updates – a quick glance at the application provides the user with all the information they need.

The speed of the overall order process is also increased as the recorded data is made available for all successive steps. Tools are returned from reconditioning after a shorter period of time. As a result of significantly reducing the manual data input, the process is no longer as susceptible to errors.

On top of that, machine operators have access to all the important information about their tool at all times. Thanks to the collaborative approach by c-Com, they can access all data via the cloud. They know how many times their tool has been re-sharpened and are provided with comprehensive information on the coating. This data is extremely useful for the optimisation of processes. If the tool's performance drops, the cause of any issues can be established and resolved much more quickly. →





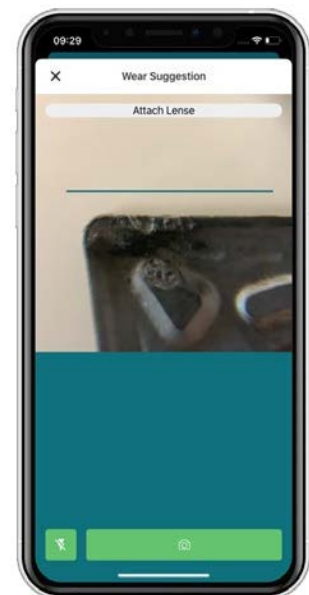
Involving coating staff significantly enhances the networking of the entire supply chain and serves transparency. This is one of c-Com's key objectives for the open cloud platform.

The c-Com wear detection app: a technical advisor in your pocket

Many factors need to work in concert to create a smooth, reliable machining process with optimal results. If the process results in poor output or even rejects, there may be multiple reasons for it. If worn blades are the cause, the following questions present themselves: What kind of wear are you dealing with? Why is this wear occurring and how can it be prevented in the future?

c-Com has developed a wear detection application to provide answers to these questions. The prototype for the application was presented at EMO Hannover. The application is very simple to use: first, the worn blade is documented using a smartphone and a conventional auxiliary lens for zooming in. The app then identifies the type of wear and suggests corresponding recommended actions. This allows users to prevent this type of wear in future.

The application is based on machine learning, a sub-category of artificial intelligence. This means that the application uses datasets to learn. Together with tool specialists at MAPAL, c-Com has compiled and categorized hundreds of images. Effectively, the algorithm was trained by being shown what different types of wear look like, allowing it to assess whether or not a blade is in good order. As a result, the application can identify different types of wear, including clearance surface wear, crater wear or a built-up edge. Based on this, the app then provides appropriate suggestions – such as reducing the feed, increasing the spindle speed or using a different kind of coating. At present, the advice and suggestions for how to proceed are still static. However, the c-Com team is working hard on the beta version of the app to enable it to use the application data for each tool to provide specific individual suggestions on what action to take. Put simply, it's a technical advisor you can keep in your pocket – with numerous potential extensions aimed at making users' lives easier. ■



The worn blade is documented using a smartphone. The app then identifies the type of wear.



MAPAL SATISFIED WITH EMO EXPERIENCE

MAPAL is thoroughly satisfied with its experiences at the EMO trade fair in Hannover 2019. "We went to Hanover with mixed feelings", said Dr Jochen Kress, President of the MAPAL Group. However, the trade fair exceeded the MAPAL exhibitors' expectations. Although the exhibition's organiser reported fewer visitors than two years ago, Kress summed up the experience by saying: "The quality of the contacts gained there was surprisingly high. The trade fair was very good for us. We had a number of positive conversations which we hope will provide us with momentum for the coming months." →



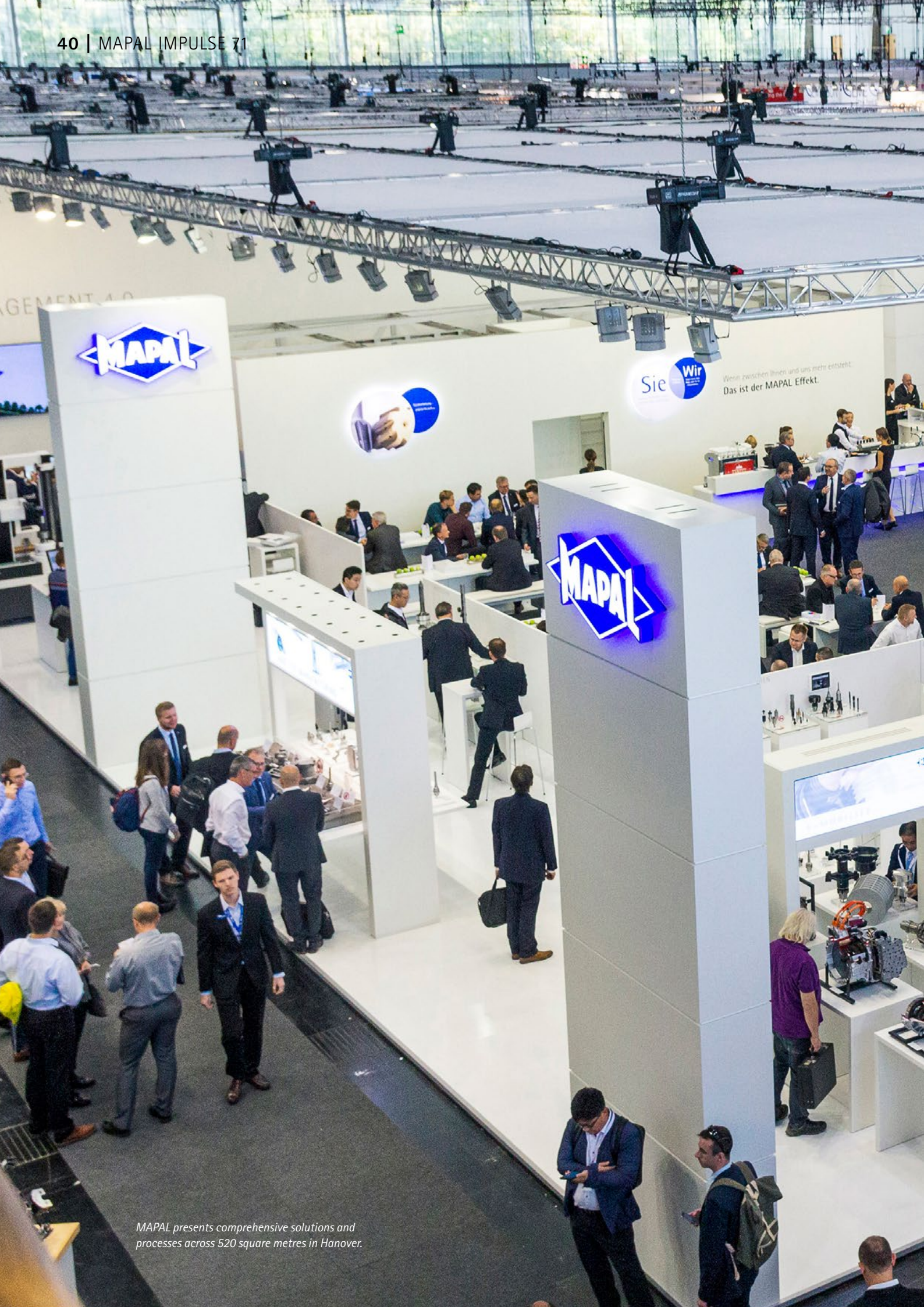
Bottom image: Dennis Minder from MAPAL gives a presentation on "The role of clamping technology in the processes of the future" at the VDMA Technology Forum.



Top image: MEP and Chairman of the European Green Party Reinhard Bütikofer (left) in conversation with Dr Jochen Kress (centre) and Andreas Enzenbach about current developments within the company.



Dr Berend Lindner of the CDU, State Secretary in the Lower Saxony Ministry of Economics, Labour, Transport and Digitalisation (right) finds out more about current developments at the MAPAL stand.



MAPAL



Sie Wir

Wenn zwischen Ihnen und uns mehr entsteht.
Das ist der MAPAL Effekt.

MAPAL

MAPAL presents comprehensive solutions and processes across 520 square metres in Hanover.



EMO Hannover



COST-EFFECTIVENESS AND ELECTRIC MOBILITY

According to Kress, the question many companies are concerned with is "What will manufacturing in the future look like in terms of parts and digitalisation?" Cost-effectiveness is a key consideration here. Companies that are mainly based in the automotive industry are primarily concerned with the issue of electric mobility and the manufacturing of the parts necessary for this field. Comprehensive solutions to this issue were on display at the MAPAL stand. "There was great interest in our extensive range, and our new products were very well received", says Andreas Enzenbach, Vice President Marketing and Corporate Communications. Above all else, MAPAL stands out because its complete machining concepts are already available, and the company is able to offer customers the entire process.

EYE-CATCHER – MAPAL CHUCKS GET A MAKEOVER

Illuminated in blue and displayed at the centre of the 520 square metre stand, MAPAL's newly redesigned chucks were the eye-catching star of the trade show. "We have examined our chucks, which play an important role as the connection between the machine and the tool, and optimised them in terms of shape, surface, weight and material usage", says Dr Jochen Kress. Among other things, the surface of the chucks is more resistant to corrosion thanks to the considered industrial design. The chucks are also lighter in weight and more rigid. On top of that, clear labelling of the controls ensures "foolproof handling". "The reaction to our new design was great. We are now working flat out on the series launch", says Kress.

POLITICAL CELEBRITIES AT THE EMO EXHIBITION STAND

On the first day of the trade fair, MEP and Chairman of the European Green Party Reinhard Bütikofer spoke with Dr Jochen Kress and Andreas Enzenbach about current developments within the company. Dr Berend Lindner (CDU), State Secretary in the Lower Saxony Ministry of Economics, Labour, Transport and Digitalisation followed suit on the third day of the fair. The key topics of conversation were the global economy, continuing digitalisation and structural change within the automotive industry, as well as how MAPAL is adapting to these pressures.

APPLICATION-ORIENTED – DENNIS MINDER AT THE VDMA TECHNOLOGY FORUM

MAPAL also participated in the VDMA Technology Forum on the third day of the trade fair. Dennis Minder, a member of the clamping technology product management team, gave a talk entitled "Application-oriented tool clamping technology – The role of clamping technology in the processes of the future". He demonstrated how it has become possible to shift boundaries as a result of additive manufacturing and how manufacturing can be made significantly more cost-effective by using application-oriented chucks. ■

MAPAL SPOTLIGHT

Tools for the die & mould industry

The range of highly capable tools by MAPAL ensures excellent and reliable results for all machining tasks in the die and mould industry. Cost-effectiveness and product quality are particularly important when meeting customer requirements. The tool range includes solid carbide end milling cutters, milling cutters with indexable inserts, and tools for drilling, reaming and countersinking. The portfolio is completed by high-precision chucks with excellent stability, even with long projections.

The tools are characterised by excellent dimensional accuracy and the highest level of precision. This enables the process-reliable realisation of complex 3D contours with low tolerance specifications. Special high-performance coatings ensure a high level of cost-effectiveness in the machining, even for particularly hard workpiece materials.



Milling

End milling cutters made from solid carbide

- Ball nose milling cutters
- Corner radius milling cutters
- Circular radius milling cutters
- High-feed milling cutters
- Shoulder milling cutters
- Trochoidal milling cutters
- Engraving and deburring milling cutters

Milling cutters with indexable inserts

- Round insert milling cutters
- Ball and torus milling cutters
- High-feed and 90° shoulder milling cutters
- Finishing cutters



Drilling from solid | Countersinking

- Solid drill with 100 % carbide
- Solid drill with replaceable head system
- Countersink
- Deep bore drill
- Step drill

Reaming

- High-performance reamers
- Replaceable head reamers
- Quick-adjustable reamers
- Reamers with guide pads

Clamping

- Hydraulic chuck
- Mechanical chuck
- Milling cutter arbor
- HSK adapter

