IMPULSE

MAPAL TECHNOLOGY MAGAZINE | EDITION 77

Focus topic:

MODERN MATERIALS

Dear business partners and readers,

we had hoped for a return to normality in 2022. The war in Ukraine and its unforeseeable effects, as well as the ongoing pandemic, however, do not allow for this. It is all the more important for us to focus on our on our business activities.

We took a big step at MAPAL in February by finalising our new range of catalogues for standard tools. The new catalogues include a completely reworked product portfolio with powerful tools for bore machining, milling and tool clamping. The products are largely available from stock and can be delivered quickly.

The high performance, quality and precision of MAPAL cutting tools can make your machining work even more cost effective. Our added value and quality promise: We have the entire process in focus. You receive perfectly harmonised components including inserts, tools and tool clamping from a single source and thus gain a considerable advantage in performance.

The new range of catalogues is available in a navigable PDF format. We dispense with a proactive postal dispatch of the catalogues and are taking sustainability considerations into account. We are positive that we are on the right track with our new product range and will remain your innovative and reliable partner.

I am particularly proud of the high quality of our apprenticeship programme. In this way, we guarantee that our products are produced by highly qualified experts. Our training programme scored a big victory this year: Two of our mechatronic engineer apprentices won the German championships for "Robot Systems Integration". They prevailed against highly qualified teams and earned a ticket to this year's world championships is Shanghai. Quite an achievement for the young men: They asserted themselves in a competitive environment and now have the opportunity to take part in an international professional competition at a young age. This was made possible both by their extraordinary personal commitment and the great importance that is placed on apprenticeships at MAPAL in one of the most modern training centres in the region.

I hope that personal encounters and a direct exchange with you will soon be possible again without restrictions.

Have a good read!

Yours,

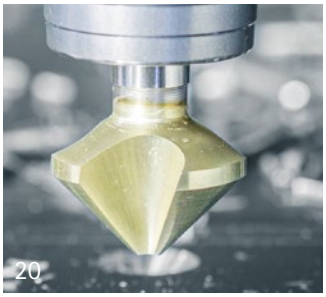
Dr. Jochen Kress


MAPAL

CONTENTS

FROM THE COMPANY

18



20

42

TECHNOLOGY HIGHLIGHTS

Titanium machining
takes off
Pages 06–09

Even more cost-effective
turbochargers
Pages 22–25

Milling stainless steel
with six cutting edges
Pages 38–41

PRACTICE REPORTS

3D milling of CFRP
prototypes from batch
sizes of one
Pages 14–17

Cover story
Automotive technology
for aeroplanes
Pages 28–33

FOCUS TOPIC:
Modern materials

IMPRINT

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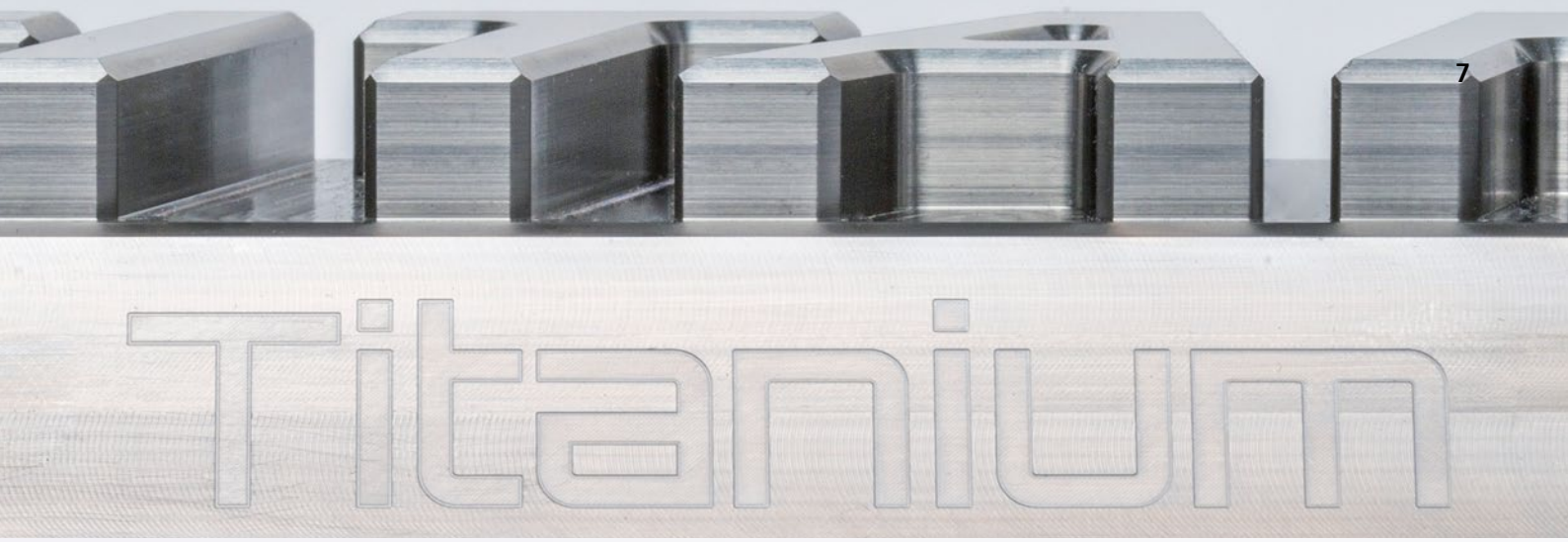
TITANIUM MACHINING TAKES OFF

There are numerous applications waiting for new titanium machining tools from MAPAL. In medical technology, this workpiece material is used for implants because of its strength and compatibility with human tissue. Automotive manufacturers use it to create powerful sports cars. The blades of large gas turbines, made of titanium, absorb enormous forces. The aircraft industry is producing more and more highly stressed parts made of titanium. MAPAL is making drilling and milling of the ductile, high-strength workpiece material more productive, thereby reducing costs.



HUGE OPTIMISATION POTENTIAL FOR AIRCRAFT PARTS

In the past, MAPAL has made a name for itself in machining titanium components on aircraft, particularly with customer-specific custom tools in assembly. These tools are used by all the major manufacturers, both in the pre-assembly and in the large final assembly lines.

Faced with massive cost pressure due to the coronavirus crisis, aircraft manufacturers and suppliers are now abandoning the requirement not to change processes in the very long term once they have been qualified. For safety reasons, the design and mechanical machining of the parts had been left untouched. From today's perspective, a number of processes are highly inefficient. In some cases, HSS tools from the 1980s are still used to manufacture parts.

For MAPAL, this is an opportunity to step up its entry into parts production for the aerospace industry with much more efficient solutions. „The potential in this market is huge for us," says Jens Ilg, who works in the Aerospace & Composites segment at MAPAL and is excited about the new opportunities. „All manufacturers want to save costs now, and we are the specialists for that. When it comes to more efficiency, process understanding or even combination tools, we're the ones for the job."

Challenging machining operations for parts, which MAPAL has set its sights on, fit in with this. Hinges, for example, are needed in very different places on the aircraft, e.g. for doors, cargo gates, landing gear doors, flaps or the tail unit. They're machined in much the same way as a camshaft bearing axis in a car engine. The tools used are up to one metre long and produce H7 accuracy. The number of titanium components in an aircraft will continue to increase. In their newer types, Boeing and Airbus are using more CFRP, which is why the adjacent structural parts as well as rivets can no longer be made of aluminium due to the electrochemical series.

A LOT OF HORSEPOWER PLACED SECURELY ON THE ROAD

What works well in aircraft construction also applies in the production of sports cars, and even more so of supercars: titanium where it matters, as Dr. Piotr Tyczyński, Global Head of Segment Management Aerospace & Composites emphasizes: "The industry uses high-strength titanium alloys for control arms, brake calipers or chassis parts that are exposed to high loads. This often involves precision fit bores that connect parts, such as the control arm to the body."

The starting materials are usually near-net-shape forgings that still require semi-roughing or finishing operations to produce the outer contour and to drill and ream the thrust bearings. As in aircraft construction, the brake calipers of automotive racing cars are also usually milled from a solid block. Parts and tools are smaller here, but the tolerances needed are in the same range.

A SECOND HIP THAT LASTS A LIFETIME

Dimensional accuracy is also required in the medical market, where high surface finish is also important. For instance, hip prostheses require a defined surface roughness on the one side to favour ingrowth into the bone, and an absolutely smooth surface on the socket side to achieve a long service life with as little friction as possible.

Titanium implants in dentistry also have similar requirements. Pins for fixing teeth are being used more and more. Titanium is also used for external prostheses, mainly for the moving parts of artificial limbs.

MAPAL'S THREE NEW TITANIUM TOOLS

New drills and milling cutters made of solid carbide and milling cutters with indexable inserts extend MAPAL's standard portfolio for machining titanium. All three new developments feature high cutting values and well thought-out heat dissipation.

In designing the tools, MAPAL followed the requirements for titanium machining set by the target markets. The range of available diameters is correspondingly broad, starting with small sizes from 3 mm, as often required in medical technology, through the medium sizes for sports car components to the large tools for aircraft construction and energy technology. In tests, MAPAL has recorded 25 to 35 percent longer tool life for its tools compared to competitors.

MEGA-SPEED-DRILL-TITAN: COST-EFFICIENT AND PRODUCTIVE

The focus in the development of the MEGA-Speed-Drill-Titan was on cost efficiency with maximum possible productivity. „Our goal was to develop a solid carbide drill that can run at a very high feed rate in titanium materials, resulting in very low cycle costs," explains Jens Ilg. In contrast to the assembly areas in aircraft construction, where no cooling lubricant or only a small amount of MQL can be used given the already finished assemblies, cooling lubricant can be used in parts production on machining centres to machine titanium efficiently.

MAPAL has equipped the drill with four guiding chamfers for optimum roundness. Convex cutting edges and an efficient coating allow for increases in tool life of up to 30 percent. To get the maximum coolant flow to the main cutter, the coolant channel is not open in the direction of the chip flute, but the coolant is guided along the outside surface to the rear. In this way, the guiding chamfers experience maximum cool-

ing, dissipating the heat generated effectively. MAPAL uses a new design for the chip flute to produce the smallest possible chips and to discharge them through the flute. Typical parts that can be created with the drill, which achieves a cutting speed of up to 40 m/min, are structural parts in the aerospace industry, for example brackets for the wing box or the landing gear with its numerous bores.

OPTIMILL-TITAN-HPC: VERSATILE ROUGHING AND FINISHING

The OptiMill-Titan-HPC roughing-finishing milling cutter is a versatile tool. It is also ideal for smaller manufacturers who prefer not to have a single milling cutter for every kind of machining. The solid carbide tool can perform roughing operations and can also be used for a finish cut. The special cutting edge preparation produces clean surfaces and allows finishing up to a working depth of 2xD. In conjunction with the MAPAL MillChuck, optimum coolant supply via the shank is possible. The core of this milling cutter with four cutting edges rises from the cutting edge to the shank, giving it greater stability. The spacing of the cutting edges and the pitch of the spirals are uneven to achieve smooth running. The coating, which contains silicon, and the polished chip flutes are highly heat-resistant, counteract the tendency to adhesion and therefore ensure optimum chip evacuation. The OptiMill-Titan-HPC milling cutters are available in the diameter range from 4 to 25 mm. Special dimensions are available.

The OptiMill-Titan-HPC is the number one tool for manufacturing titanium brake calipers for sports cars. MAPAL is also successfully using the tool to manufacture a wide range of parts for pilot customers. Rotor heads, door frames, flaps and structural parts for vertical tail planes (VTPs) are just a few examples.

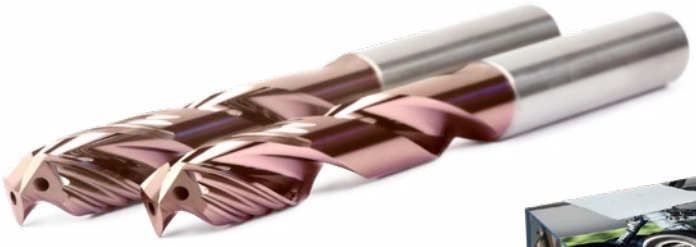
NEOMILL-TITAN: INDEXABLE INSERT MILLING CUTTERS WITH A BITE

The NeoMill-Titan family of tools with indexable inserts for titanium machining consists of shell end face milling cutters in slip-on and shank versions as well as shoulder milling cutters in the standard portfolio. MAPAL has developed the topography of the indexable insert from scratch for optimum chip formation and evacuation. An equally new cutting material concept minimises wear and prevents the titanium from sticking. The available corner radii of 0.8 mm to 4 mm are tailored to structural parts in the aerospace industry. To save weight, several


GettyImages | Mark Evans

The new OptiMill-Titan-HPC solid carbide milling cutter performs both roughing and final cuts in titanium very reliably.

The NeoMill-Titan milling cutter range for titanium machining is equipped with completely newly developed indexable inserts.



Cost efficiency with the highest possible productivity – the new MEGA-Speed-Drill-Titan from MAPAL.

pockets are milled here, and their final contour should already be achieved as well as possible by pre-roughing. In the manufacturing of tail fin structures, about 90 percent of the material is removed.

MAPAL offers the indexable inserts with two different substrates. One grade is designed for universal applications and is aimed at customers whose focus is more on product price and less on cost per part. The second grade is more temperature-resistant, enabling higher cutting speeds and the machining of more highly annealed titanium material. Cutting speeds of up to 70 m/min can be achieved. „With this approach, we specifically address the requirements of the market," says Dr Piotr Tyczyński. „We take into account the individual needs of our customers and offer an optimally fitting solution."

The tool body has also been newly developed for the high-tech inserts. With flowing shapes, the chip flutes transport the chips out of the shear zone. The coolant is fed axially directly through the milling arbour. The unequal spacing of the inserts provides additional stability and smooth running. The coolant is supplied axially directly via the milling arbor. The whole milling cutter is basically a hollow body with a large chamber in the centre, from where the coolant is conveyed to each insert. The coolant outlets are designed variably. By changing a threaded pin, the operator can regulate the flow rate for each individual cutting edge.

MAPAL supplies the shoulder milling cutters for titanium from stock in diameters from 40 mm to 125 mm. The shell end face milling cutters are stocked from a diameter of 32 mm to 80 mm. Special dimensions are also available upon request. ■

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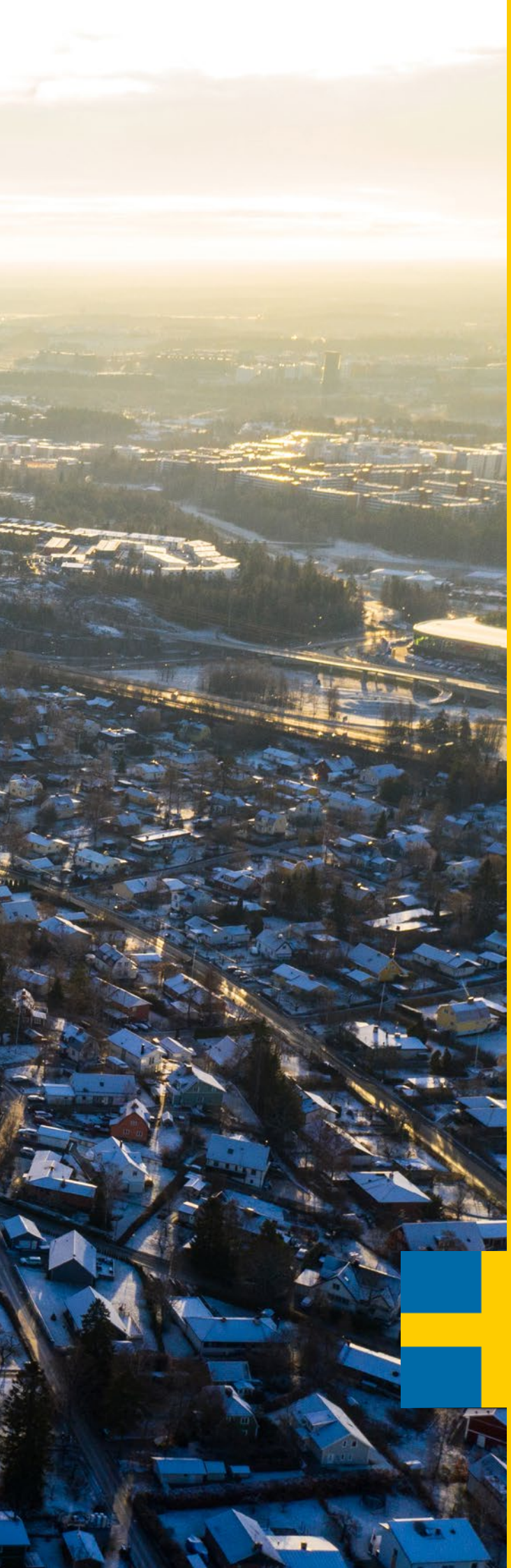


MAPAL precision tools for Sweden

COLLY: Our reliable partner for 60 years

For 60 years – and therefore longer than any other company – the Swedish sales agency Colly Verkstadsteknik AB has been working with MAPAL. Today, the company is represented in many industries with the MAPAL product range. In addition to the automotive industry, these include mining, forestry and mechanical and plant engineering. ➔

Managing Director Conny Erixon

Björn Torslund has worked at Colly for 35 years

HOW COLLY CAME TO BE

The sales agency Colly Verkstadsteknik AB is mostly just called Colly. Its headquarters are in Kist, a neighbourhood in Stockholm's north-west, just a few minutes from the capital's downtown. Colly comes from the names of its founders (Company Lindgren, Lindgren and Youngwall). They set up the sales agency in 1957. Only two years later, they decided to cooperate with MAPAL, which was also quite a young company at the time. "We are very proud to be MAPAL's oldest sales agency worldwide", says Conny Erixon, Managing Director of Colly. The company, which today belongs to the Swedish industry group Indutrade, has 23 employees and an annual turnover of EUR 12 million. Besides precision tools and clamping device, Colly also offers equipment for tool settings, setting fixtures and shrink units.

COLLY'S CUSTOMERS

Colly's core market is the automotive industry, which also forms the roots of its business activities and is still its most important consumer group. A long relationship exists with the automobile and lorry manufacturers Volvo and Scania and also include many suppliers to world renowned automotive and lorry makes. "Due to our cooperation with MAPAL, we have an exceptional reputation in the industry", Erixon explains. Concentrating on the customer and endeavouring to meet their requirements and needs optimally with innovative products and solution concepts, "that is the claim that unites Colly and MAPAL. Through this commitment, we have been able to establish ourselves as a premium supplier on the market and earn the recognition of our customers." Erixon has worked for the Swedish sales agency for 17 years and took over the helm in 2019. Björn Torslund is responsible for MAPAL tool sales. The product manager has amassed an immense amount of process knowledge over his 35 years at Colly. "Regardless of how complicated the machining task is, Björn Torslund will find a seemingly impossible tool solution", Erixon reports. No wonder that most customers simply refer to Torslund as „Mr. MAPAL".

Besides the automotive industry, Colly is also active in other sectors today. This development is due to the growth of MAPAL's tool portfolio and their concentration on other markets. MAPAL's expansion also allowed the Swedes to become active in new fields, such as forestry, mining or machine and plant engineering. And Mr. MAPAL also contributes his expert knowledge here, as an interesting application in mining shows: A manufacturer of rock drills needed carbide drills in various designs. In order to cover all tolerance classes for every bore diameter, seven tools were required. This was too much for the customer. Their request: The number of drills required was to be reduced to three. Torslund had numerous test series run on the customer's machines as well as at MAPAL's R&D centre in Aalen. "In the end, we found a solution which completely satisfied the customer's requirements", the product manager reports. With the support of the MAPAL experts, we were not only able to reduce the number of drills, we also doubled the tool life to 5,000 bores per drill from the requested 2,500 bores. "This additional performance was a bonus that really delighted the customer", Torslund proudly explains. This example shows what customers expect from tool suppliers and the potential of high-quality precision tools. "In today's mass production, there is no room for simple solutions. We have to develop machining concepts that achieve a high standard. With short cycle times and trouble-free production processes, one can achieve the highest degree of productivity", says the tool expert. With customised process solutions, we are on the right track, according to Torslund. "Custom tools now make up half of our orders", Conny Erixon confirms.

RECONDITIONING ON SITE

A big milestone in Colly's history was the certification of their regrinding service by MAPAL five years ago. The reconditioning of high-quality tools is worthwhile as the tools are usually available again more quickly than if they are reordered. In the past, MAPAL experts took care of this service. Colly has its own regrinding operation in the meanwhile. "In this way, we ensure that the quality of the reconditioned tools meet MAPAL's high standards", Erixon emphasises. Colly is currently devoting itself to electric mobility. "We are gaining initial experience here in the field of tool technology and are glad that MAPAL has already developed pioneering process solutions for this new segment. Innovations are the foundation for a successful future. That's why we are happy to continue our cooperation, preferably for another 60 years", Conny Erixon says. ■

Managing Director Conny Erixon in front of the company building of Colly Verkstadsteknik AB in Kista.

Developing turnkey milling processes for CFRP machining

3D MILLING OF CFRP PROTOTYPES FROM BATCH SIZES OF ONE

Compared to conventional metal designs, parts made of carbon fibre reinforced plastics (CFRP) are considerably lighter with the same load capacity. This offers great advantages – and not just in the aerospace industry. Low weight, high strength and low mass forces are also important in numerous other fields of application. CFRP is increasingly being used in racing cars, high-end bicycles or sports equipment, in machine engineering and for handling equipment or robots. As a development partner, MAPAL supports the development and implementation of turnkey processes with a high level of process expertise and an extensive range of tools.

„We are a specialised industrial service provider with a wide range of technical products as well as services and solutions. The area of composites covers a wide range of semi-finished products through to complex three-dimensional component geometries made of GRP and CFRP", explains Wulf Wagner, Product Manager of the Composite Technology business unit at ERIKS Deutschland GmbH. Particularly for products as these, customers expect support in the joint development of innovative solutions. Thanks to its exceptional engineering department, the company also designs, calculates and manufactures complete CFRP components for its customers as prototypes or in series.

CFRP moulded parts are created from „prepregs". This semi-finished fibre product is already impregnated with a suitable resin that has not yet cured. In series production, the compression moulding process presses prepregs, which have been laid on top of each other, into mould halves with appropriately designed geometries. The hot tool cures the resin and a component with the contour of the desired part is produced. However, five-figure sums have to be invested in the metallic mould halves. This cost barrier is proving to be a drawback for many potential users who may only need one or a few parts.

In order to offer customers a cost-effective alternative, especially in the start-up phase of a development, the standard insert material EPRATEX_ CFS 100 was developed, as Wulf Wagner explains.

Solid, 100 mm thick CFRP block made of EPRATEX_CFS 100 and the test component produced from it by milling.
(photo: Klaus Vollrath)

The same prepregs are used for this. The uniformly 100 mm thick panels are available in dimensions up to 350 x 500 mm. The random orientation of the fibres in the material means that the properties are largely isotropic. The validated manufacturing process ensures reliable compliance with the properties specified in the data sheet for the structural design. Variations in dimensions, thickness and matrix system are possible on request. By machining on suitable machining centres, any desired number of pieces can be produced, from individual parts to small series.

WANTED: A TURNKEY MACHINING PROCESS

"While there are numerous suppliers of CFRP laminate panels with low wall thickness on the market, 100 mm thick panels are special", says Sven Frank, Global Head of OEM Management at MAPAL. However, since machining CFRP is not that simple, ERIKS was looking for a turnkey validated and optimised machining process. Wulf Wagner came into contact with MAPAL. In addition to an extensive range of tools for machining CFRP workpiece materials, the precision tool manufacturer has a

Wulf Wagner, Product Manager of the Composite Technology business unit at ERIKS Deutschland GmbH.

high level of expertise in process design and implementation. "What's more, our research and development centre, which is eminently equipped both technically and in terms of personnel, can do test machining", explains Frank. He emphasises: "MAPAL is happy to contribute all these resources to development projects that we conduct jointly with customers." In doing so, the company is ready to take on any challenge. The test component chosen by ERIKS is a bracket in standard geometry from the Euro Gripper Tooling (EGT) system, which is used in large quantities in the German automotive industry in an aluminium design. The RCG Omega bracket is 30 per cent lighter and enables significant advantages in the design of Euro Gripper Tooling (EGT) systems.

SPECIAL DEMANDS FOR THE TOOLS

"The carbon in the carbon fibres of CFRP sometimes has diamond-like structures. Uncoated solid carbide tools cannot withstand this extremely abrasive material for long", explains Dr Oliver Pecat, Team Leader for Aerospace Development at MAPAL. "Within one metre of milling path in a full cut, the cutting edge radius of a freshly ground solid carbide milling cutter skyrockets from 2 µm to 15 or 20 µm, while the cutting forces triple." More cost-intensive tools with PCD (polycrystalline diamond) inserts hold up better but leave the tool designer with far fewer degrees of freedom in the geometry. For CFRP machining, MAPAL thus prefers diamond-coated solid carbide tools. MAPAL has been producing the extremely hard and abrasion-resistant CVD coating used in this case in-house since the beginning of 2021. "In total, we've designed the machining of the ERIKS bracket with ten tools", says Pecat. "In addition to the EcoFeed face milling cutter with PCD milling inserts, various versions of the OptiMill-Composite-Speed solid carbide milling cutter in a roughing-finishing design and the MEGA-Drill-Composite-UDX are used, all of which are proven and process-reliable tools in the machining of composite materials."

WITH MAPAL TO THE OPTIMUM MACHINING PROCESS

The project allowed the R&D department to make full use of its extensive capabilities to design and validate an optimal machining process: the CAD geometry data was transferred with the aid of two of the four CAD/CAM programmes available in-house – Siemens NX and Solidcam. The developers carried out all the machining processes in comprehensive application simulations. Machine properties and clamping situations were taken into account. The development of the process steps was iterative – idea, simulation, test and evaluation. "The successful completion of the development opens up a market with a lot of future potential for both ERIKS and MAPAL", concludes Sven Frank.

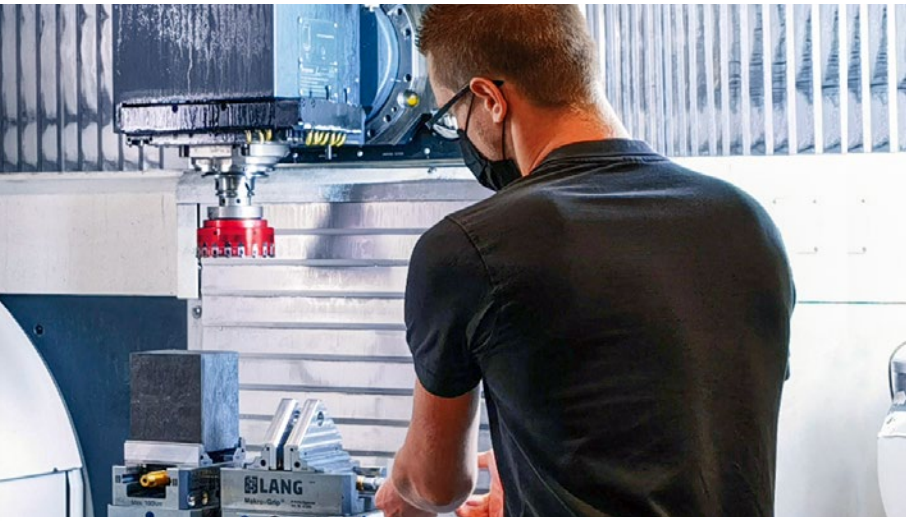
SPECIAL FEATURES OF CFRP MACHINING

"CFRP workpiece materials behave totally differently to metals during machining because the carbon fibres break brittly", says Tizian Gühna, CAD/CAM programmer at MAPAL. With metals, the heating of the workpiece is largely based on the energy absorption through plastic deformation of the chips before breaking off. The carbon fibres in the CFRP workpiece break completely brittly as soon as the stress in the material exceeds a critical point. Hardly any heat is generated in the process. Consequently, the cutting speed can easily be increased to high values as soon as the other parameters of the process are set. Of course, the rigidity of the machine and the clamping setup as well as the avoidance of vibrations have to be taken into account.

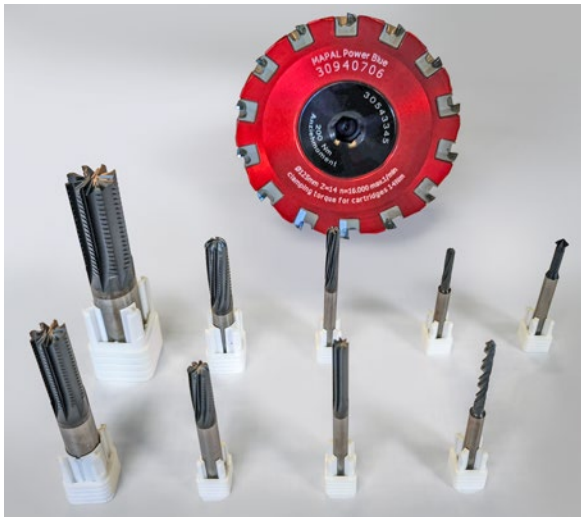
PARTS FOR NUMEROUS HIGH-TECH SECTORS

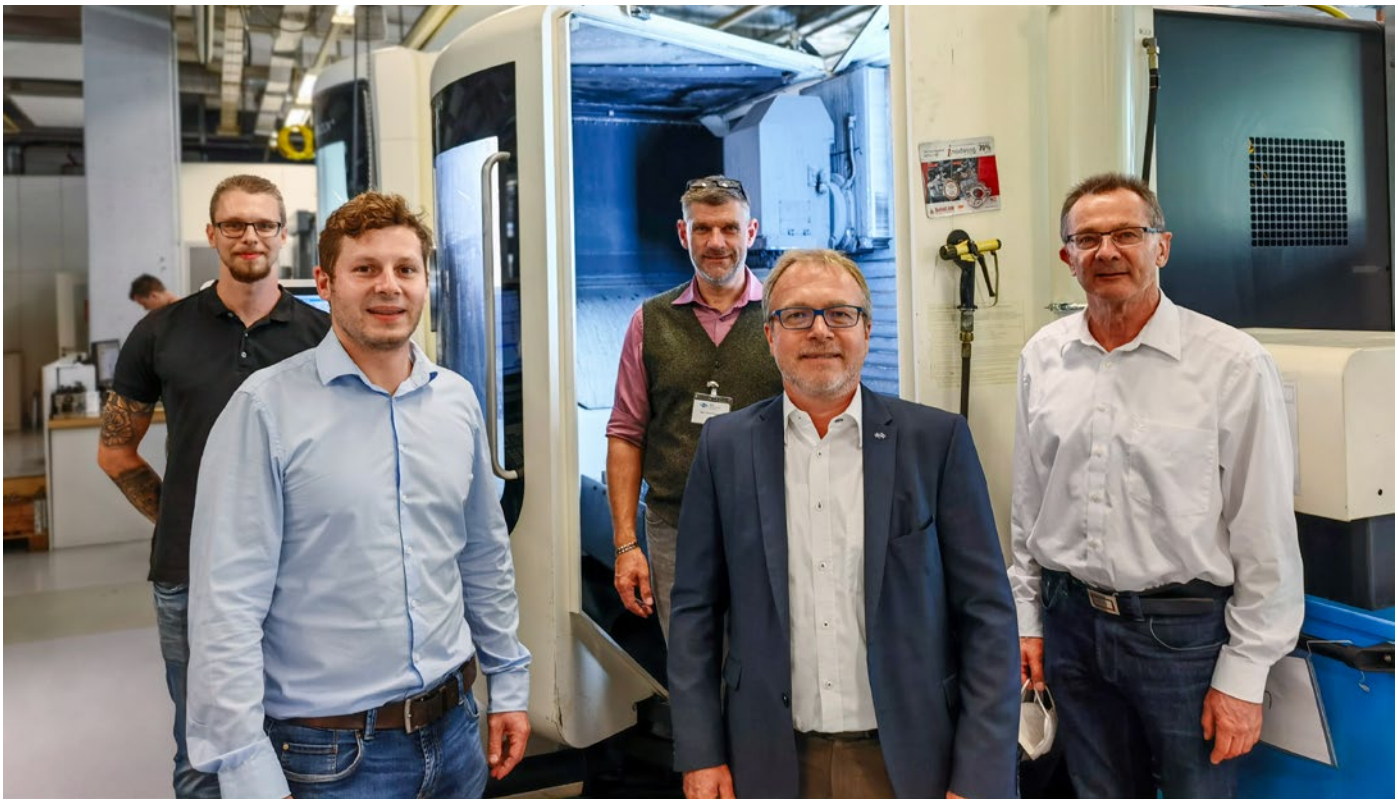
"In aircraft construction, there is a great demand for carbon-fibre parts that have been produced using validated processes", says Dr Peter Müller-Hummel, Component Manager for Aerospace and Composites at MAPAL. Particularly in the interior of passenger aircraft, there are countless parts with medium to low safety classifications such as seat fasteners, cable holders and pipes. These often have to be adapted during the development and testing of a new aircraft, which

The five-axis machining was carried out on a DMU 80 monoBlock in MAPAL's test centre. (photo: Klaus Vollrath)



The test component chosen by ERIKS is a bracket in standard geometry from the Euro Gripper Tooling (EGT) system was machined with ten different tools from MAPAL. (photo: Klaus Vollrath)





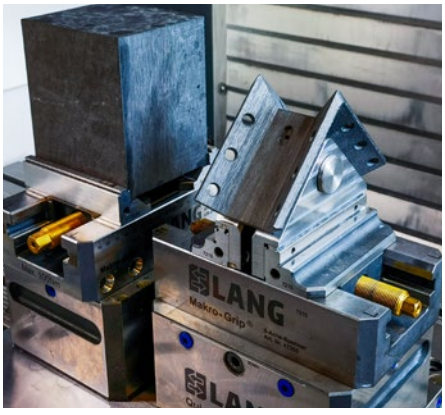
Successful cooperation, from left: Tizian Gühna (CAD/CAM programmer MAPAL), Dr Oliver Pecat (Team Leader for Aerospace Development MAPAL), Wulf Wagner (Product Manager of the Composite Technology business unit at ERIKS Deutschland GmbH), Sven Frank (Global Head of OEM Management at MAPAL) und Dr Peter Müller-Hummel (Component Manager for Aerospace and Composites at MAPAL).

results in a large demand for parts in smaller quantities. Müller-Hummel also sees a high demand for small series parts in a host of other sectors such as the automotive industry, machine engineering or medical technology, where the EPRATEX_CFS 100 panel material is ideal.

"HIGHLY SATISFIED" WITH MAPAL AS AN INNOVATION PARTNER

"We'd been in contact with MAPAL for years and had successfully worked together to solve a wide range of tasks", Wulf Wagner recalls. This means that there was a solid foundation of trust. This time, too, things went quickly after the initial contact: within just two weeks MAPAL had decided not just to tackle the project, but also to give it high priority. At the working level, communication with the various specialist departments and the employees there went very smoothly right from the start. The goal was achieved in the gratifyingly short time of only two and a half months. "That's why we'll certainly be knocking on their door again for future development projects", Wulf Wagner sums up. ■

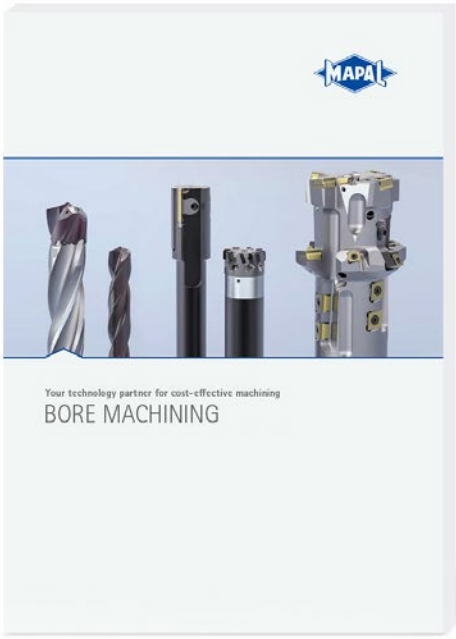
Both clamping set-ups of the part in the working area of the DMU milling machine. (photo: Klaus Vollrath)

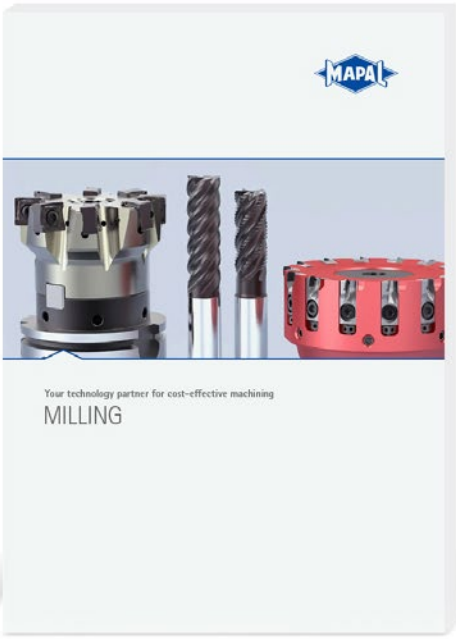


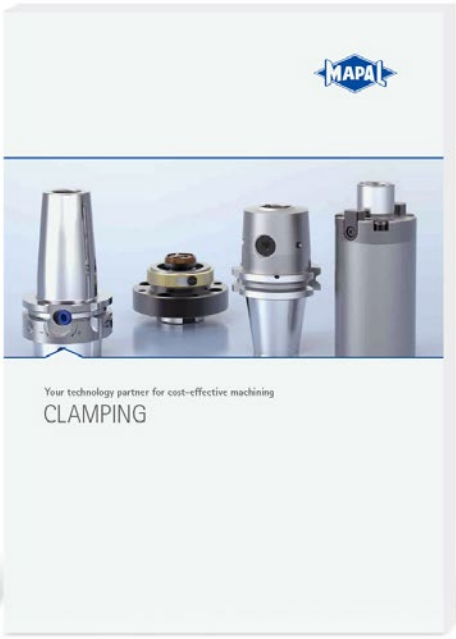
New catalogues:

BORE MACHINING, MILLING AND CLAMPING

MAPAL has published new catalogues for the bore machining, milling and clamping areas. The product ranges' assortments have been comprehensively revised and adapted to customer needs even more.







In addition to established products, the catalogues include a number of innovations. Over a total of 1,500 pages, users can find 13,500 products from which to select the perfect boring or milling tool and matching clamping device for practically all machining tasks. By streamlining the range, high availability from stock has been guaranteed for the tools. MAPAL therefore offers quick delivery times without sacrificing quality. Around 80 percent of listed items are available ex works in Germany. They can be shipped immediately after receiving the order.

The structure of catalogues' content has also been given a new look. The revised assortment with configuration options and clever selection logic offer orientation when choosing the optimal tool.

MAPAL has consolidated the previously separate catalogues for the product groups drilling from solid, boring, countersinking as well as reaming and fine boring into a single new bore machining catalogue.

Items no longer listed in the new catalogue can still be ordered upon request. ■

All catalogues can be viewed online or downloaded as PDFs.

PARTICULARS

FRANK STÄBLER | SALES DIRECTOR FOR GERMANY, AUSTRIA, SWITZERLAND AND HUNGARY | MAPAL AALEN

On 1 November 2021, MAPAL welcomed a new Sales Director in the Germany, Austria, Switzerland and Hungary region. Frank Stäbler is taking over from Siegfried Wendel, who managed the region for 13 years and is now responsible for Global Sales in his new role as CSO. Stäbler joined the company in 2003. The machine engineer has held positions with various responsibilities for many years in the MAPAL Group. He worked on site in China for three years. Most recently, he led an international team of specialists as the Global Head of Tool Management and Services. Stäbler is excited about the new challenge that awaits him as Sales Director for Germany, Austria, Switzerland and Hungary: "A focus of my work will be expanding our market presence in Germany, Austria, Switzerland and Hungary." He also plans to organise customer service and customer support in a more digital way in order to be more in line with the future as well as customer needs.

DR WOLFGANG BAUMANN | VICE PRESIDENT PRODUCT AND APPLICATION MANAGEMENT | MAPAL AALEN

Dr Wolfgang Baumann became Vice President Product and Application Management (PAM) on 1 January 2022. As a result, Baumann has strategic responsibility for the Aalen site's products. The material science engineer joined MAPAL in 2010 and was Global Head of Product and Application Management previously. In recent years, the 43-year-old has been successfully driving the development of multiple product groups forward. At the same time, he supervises the cutting material and coating areas as well as workpiece material analysis. Baumann graduated from university in Stuttgart and completed his PhD in metal research at the Max Planck Institute.

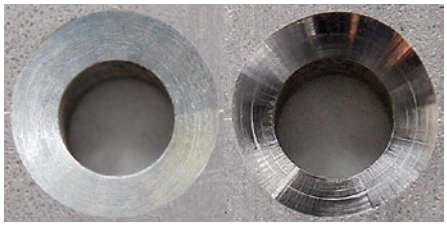
ERIC NIETZOLD | MANAGING DIRECTOR | CENTRE OF COMPETENCE FOR CLAMPING TOOLS EHRENFRIEDERSDORF

Eric Nietzold was named Managing Director of the Centre of Competence for Clamping Tools in Ehrenfriedersdorf on 1 January 2022. Nietzold assumes overall responsibility for the factory in Ehrenfriedersdorf, Saxony, where he was previously responsible for production. The machine engineer with a Master of Business Engineering comes from Saxony. He graduated from the Dresden University of Technology, after which he took on roles in the area of cutting material development and custom machine construction in the precision tool industry.
Nietzold takes over from Peter Tausend, who retired on 31 December 2021. Tausend founded the company WTE Präzisionstechnik GmbH in 1999, which was integrated into the MAPAL Group in 2008 as the Centre of Competence for Clamping Tools. It has grown to its present size under his leadership. Tausend also played a key role in growing the MAPAL Group's trade business.

MAPAL IS INVESTING IN COUNTERSINK MANUFACTURING

MAPAL's patented countersinks have proven themselves time and again in use.

Frank Dreher, Managing Director of the Centre of Competence for multi-bladed reamers.



High-quality countersinks for better rivet hole connections: MAPAL countersink (left) compared to a conventional countersink tool (right).

No bore without a countersink, that is a widely applicable rule. For this reason, MAPAL has a very successful product in its portfolio for the machining step. The production of the patented countersinks is being taken to a new level in 2022, both in terms of technology and processes, making a significant contribution to sustainable production.

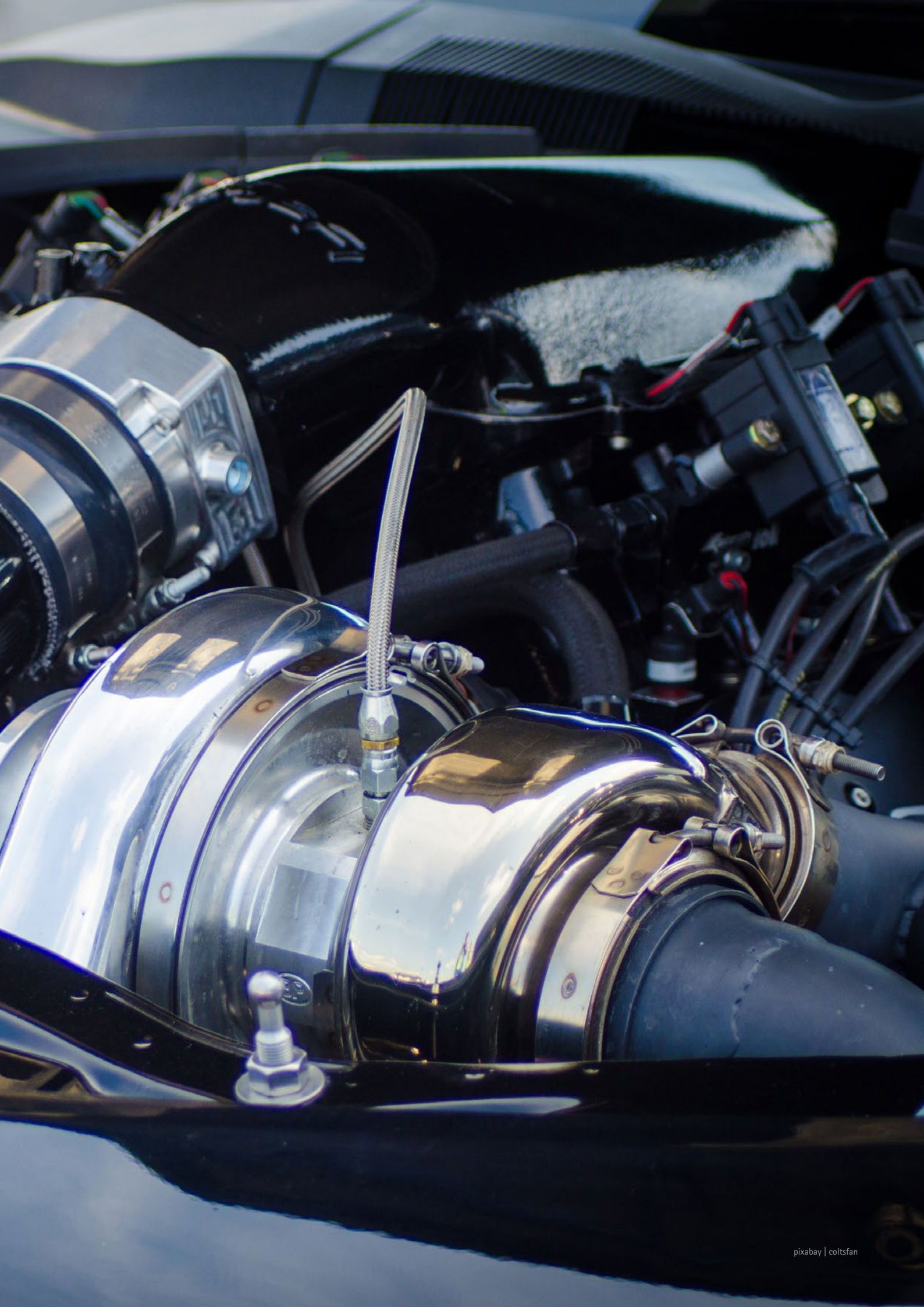
The patented countersinks are designed with three cutting edges and have extreme unequal spacing. The design reduces the axial forces by 50 per cent as well as the forces acting perpendicular to the tool axis. This results in significantly less vibration on the tool during machining and consequently increased accuracy and better surface values. The contact of bolt and rivet hole connections is directly improved, and there is no setting under load. The smooth running of the tools also reduces the load on the machine. Users therefore run the MAPAL countersinks at higher cutting speeds and achieve long tool lives.

Frank Dreher, Managing Director of the Centre of Competence for multi-bladed reamers at the MAPAL Group, explains: "Our countersinks prove themselves time and time again in use – both the HSS variant and the solid carbide countersinks for machining demanding workpiece materials such as titanium, high-alloy cast iron, Inconel or CFRP." This is why MAPAL is investing millions in the Winterlingen site in 2022 and particularly in countersink manufacturing. As a result, a completely new manufacturing technology is being introduced outside of machining: "This reduces our use of material and improves our energy balance." MAPAL is also investing in the connectivity and automation of processes. For instance, through advanced image processing technology for pre-positioning in the machines, resulting in a reduction in non-productive time. Dreher points out: "We deliberately focus our production to the Winterlingen site, on manufacturing in Germany. Of course, we are encouraged by the feedback from our customers, who very much appreciate the price-performance ratio of our countersinks. Thanks to the investments in 2022, we ensure short delivery times and a reliably high level of quality." ■

Radial standard milling range NeoMill from MAPAL

Even more cost-effective turbochargers

The transformation of mobility is in full swing. And so the focus has turned to developing new parts. However, it's clear that motors with turbocharger will continue to be built for some time. Therefore, the machining business continues to strive for tool solutions with higher cutting values, longer tool life and thus lower costs per part. MAPAL has expanded its portfolio for turbocharger housing in order to make the entire machining process even more productive. ➔



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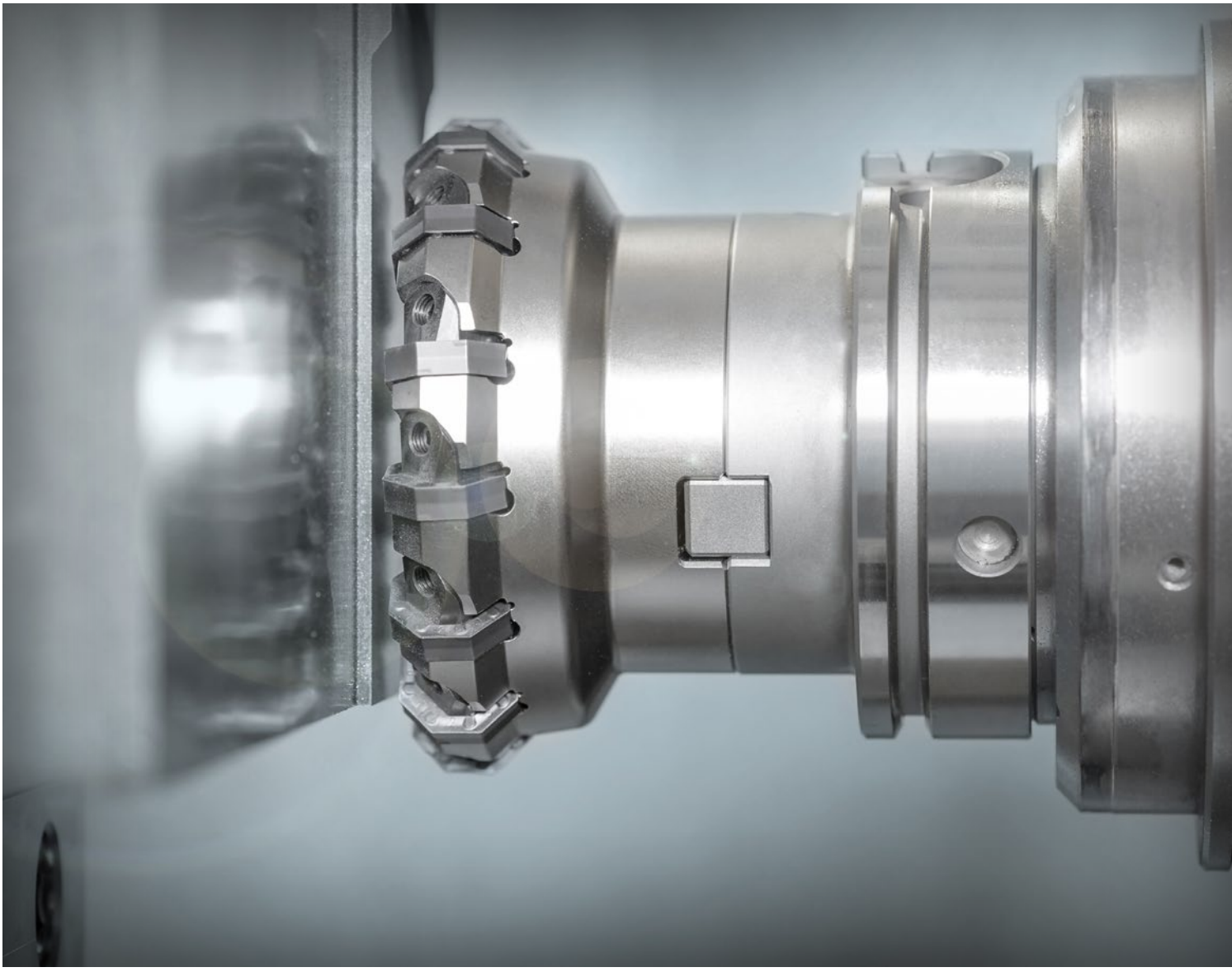


The turbocharger housing is a particularly worthwhile part to optimise in manufacturing as its machining involves a great deal of wear and tear. While the tool life for other car parts like cylinder crankcases, stub axles or brake calipers are in the thousands of parts, on average 30 to 140 turbocharger parts can be manufactured by a tool, depending on the machining length and workpiece material. Typically, turbochargers are made with the workpiece materials 1.4847, 1.4848, 1.4849 or 1.4837, which are heat-resistant stainless cast steels – a material that is extremely abrasive.

"If we manage to machine ten more parts per tool, it will have a very big effect on tool changing costs and thus the cost per part", explains Heiko Rup, Product Manager for tools with indexable inserts. MAPAL is a proven partner for drilling and countersinking operations as well as contour machining. The precision tool manufacturer makes the entire turbocharger manufacturing process more economical with NeoMill milling cutters, which were introduced last year.

NEW MILLING CUTTERS MAKE MAPAL A COMPLETE SUPPLIER

MAPAL has become a complete supplier for machining turbocharger housings with two milling cutters from the NeoMill portfolio: the face milling cutter NeoMill-16-Face and the shoulder milling cutter NeoMill-4-Corner. The face milling cutter machines the connecting surfaces of the manifold and exhaust flange on the turbocharger housing. A diameter range from 63 to 200 mm is offered with indexable inserts with 16 cutting edges. Only minimal cutting force occurs during machining.

Because of the clamping of the workpiece, tool restrictions can occur, in which case a shoulder milling cutter is required instead of a face milling cutter. The NeoMill-4-Corner shoulder milling cutter is equipped with four-edge indexable inserts, whose cutting edges also have a negative form. MAPAL developed a new chip guiding stage for this milling cutter especially for difficult to machine materials. For heat-resistant cast steel and stainless steels, it creates less cutting force and thus machines with minimal burr formation. The shoulder milling cutter is available for smaller diameter ranges from 25 to 100 mm.

The face milling cutter NeoMill-16-Face is equipped with indexable inserts with 16 cutting edges and machines the connecting surfaces for the manifold flange and exhaust flange.

The corner milling cutter NeoMill-4-Corner is used in case of tool restricting contours on the workpiece.

In practice, turbochargers are machined both wet and dry. Thus, a wide variety of cutting material is available in the NeoMill range, which are optimised for dry machining, wet machining or machining with minimum quantity lubrication.

Due to the high degree of wear and tear, test of new tools quickly delivers tangible results. These have led many manufacturers to replace their old milling cutter with NeoMill.

COST PER PART HALVED

One customer was using a 100 mm face milling cutter from another manufacturer to face mill the hot side of stainless steel. It had seven indexable inserts each with twelve positive cutting edges and was able to machine 20 parts per tipping. The NeoMill-16-Face with nine inserts and sixteen cutting edges with negative forms machines at a markedly higher feed rate. In total, the user can mill 50 per cent more parts and cut costs per part by 44 per cent with the NeoMill face milling cutter.

Another application example involves the shoulder machining of a turbine housing made of low-nickel cast steel (similar to 1.4837) with minimum quantity lubrication. The shoulder milling cutter used to date had six double-edge indexable inserts and required three passes to remove the material. The NeoMill-4-Corner is also equipped with six inserts at the same diameter. However, the inserts have four cutting edges. The NeoMill shoulder milling cutter only requires two passes to cover the entire cutting depth, thus reducing the cycle time by 19 per cent. The tool life per tipping also increases by 28 percent. On average, the NeoMill shoulder milling cutter cuts costs per part in half. ■

Virtual meeting

Annual conference of international representatives and sales teams

In December, international representatives and salespeople met for their two-day annual conference. Because of the pandemic, the meeting took place virtually for the first time. Armin Kasper, Vice President Asia Pacific and responsible for supporting the representatives, shared news about the latest developments at the MAPAL Group with the help of experts from various departments. The current product and service range as well as communication and online tools took centre stage. More than 110 participants from 20 countries participated in the online meeting and exchanged views digitally. It was a successful premiere, as the participants' feedback shows.

Frist of all I want to congratulate you for the online meeting these last two days. It was very interesting and attractive with a lot of information.
Jesus Garcia Lanciego – Managing Director AYMA Herramientas / Spain

Excellent meeting, very interesting topics discussed.
Javier Federico Molina – WSM Herramientas de Precisión / Argentina

The contents of the representative meeting are very good.
H.H.Hsu – CEO Hungh Chih Limited / Taiwan

Thank you for a great meeting.
Nataša Bernard – CEO MB Naklo / Slowenia

Thanks to all presenters and participants.
Martin Dietsche – CEO UMI Middle East FZE / United Arab Emirates

I attended meetings both days! It is essential to keep all members of our "MAPAL family" informed about new approaches, technologies and innovations, especially how excellent MAPAL is preparing for the changes in the market that will take place in the not-too-far future. ... and there was no better way to do it than your EXCELLENT representative days! Congratulation! I really enjoyed it!
Bijan Sabetizadeh – CEO Persian Rah Soo Kav Co. / Iran

The outer contour is preroughed on the six-axis FZ42 with a VH60 milling head with a NeoMill-Titan.
(© F. Zimmermann GmbH)

Titanium machining on a gantry machine of F. Zimmermann GmbH

AUTOMOTIVE TECHNOLOGY FOR AEROPLANESN

The machine manufacturing company Zimmermann brought MAPAL aboard as a tool and technology partner to design a turnkey machine for producing titanium parts for the aerospace industry. MAPAL's line boring technology combined with a new generation of tools to machine titanium made this particularly challenging project a resounding success.

The F. Zimmermann GmbH from the town Neuhausen auf den Fildern is known above all for its big portal milling machines. The export-oriented machine manufacturer has already delivered more than 550 systems in 37 countries worldwide. They can often be found in the R&D departments of large corporations where they support the entire product development process from drafting designs to the various stages of prototyping. "Everything which one day takes form was on one of our machines as a model", says Steffen Nüssle, Head of Sales and Application Technology at Zimmermann.

Typical material for model making are wood, polystyrene and Ureol. Zimmermann began metalworking more than 20 years ago with aluminium. This was their door opener for the aerospace industry. Gradually, they tried their hand at machining composite material, steel and highly heat-resistant workpiece material like titanium, Waspaloy, Inconel and invar. Models and prototypes are not the focus anymore with these materials. The aerospace industry uses the portal milling machines to produce parts.

BESPOKE TURNKEY MANUFACTURING – FOCUS ON SIMULTANEOUS ENGINEERING

"We have always been craftspeople and not mass producers", is how Nüssle describes the manufacturing philosophy at Zimmermann. The modular structure makes it relatively easy to adapt the machines to the requirements of the customers. Multiple machines are already being deployed by an Asian aeroplane parts supplier. However, the new order goes far beyond what Zimmermann has delivered to date. The customer wanted a highly customized gantry machine with many features and additional benefits. A fixture was also needed to machine a certain part. In additions, those responsible at Zimmermann were to select and commission the tool set for the special machining process. Programming the part was also part of the job. "In principle, this is a turnkey machine, where the customer only has to press a button and the part is machined on its own", says Nüssle.

The part in question is an approximately 1.5-metre-long mount. A particular machining challenge was posed by the row of twelve bores in the lugs, which are located over a space of 990 mm on the workpiece. The customer required high precision here. A tolerance of H7 was stipulated at a bore diameter of 17 mm. Over the entire length of the part, the concentricity of the bore had to be less than 0.05 mm. The same accuracy is necessary for the perpendicularity of the bore lugs towards the part surface.

Zimmermann picked MAPAL as its tool partner for good reason. "Our application engineers don't make any compromises for a turnkey project like this one. Only a very good system partner comes into question", says Nüssle, who goes on to report that he had only the best experience with the tool manufacturer.

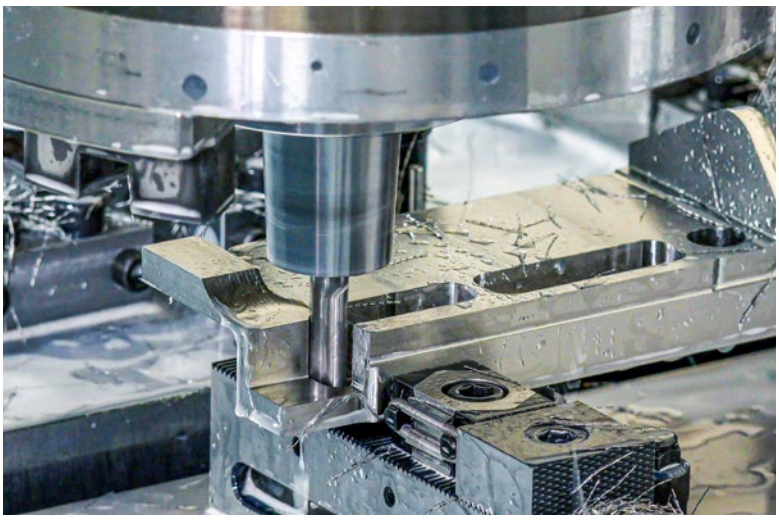
Past Zimmermann turnkey projects involved wing spars for the Airbus A350 or countersinks and deep bores on wind turbine blades made of fibreglass. While employed for another machine manufacturer, Nüssle also worked with MAPAL. This involved machining bearing seats for crankshafts and camshafts for large diesel motors using the line boring technology. MAPAL has acquired extensive knowledge about such line boring bars from the automotive industry. Now this knowledge is required for aerospace parts whose lugs are very similar to the journal bearings in the crankshaft bearing aisle of a combustion engine.

"This project challenged our technological knowledge in all realms", asserts Sven Frank, Global Head of OEM Management at MAPAL. "We didn't even have a sketch of the part to start with, on which we could have based our concurrent engineering with Zimmermann." That fact is all the more challenging as a CAD/CAM-based NC simulation is of upmost importance and forms the basis for a milling strategy, the individual process sequences and the definition of the fixture concept. Both partners highlight that detailed simulations and finetuning of individual steps were very important for the cooperation. The total cycle time was also calculated through simulations.

POWDER-METALLURGICAL TITANIUM

The project partners brooded over the material for the part. The customer announced forged blanks made of the titanium alloy TA15m. "All of us have experience with aerospace titanium, so we knew what we were getting into, but even our full-fledged aerospace experts had never heard of this special alloy", Steffen Nüssle admits. Jens Ilg, who works in the Aerospace & Composites segment at MAPAL, agrees: "The material was exotic for us, too." They discovered that TA15m is a workpiece material that is manufactured powder-metallurgically. The sin-

An OptiMill-HPC-Titan is used to machine the gaps between the lugs.



The OptiMill-Tro-Titan finishes the pocket wall. The complete depth is machined in one cut.

tered material is redensified in a special process, whereby the workpiece acquires the characteristics of a forged part.

The customer did not provide any blanks to design the machine with. Thus, the project partners had no other choice but to take a titanium bar and mill the form of the blank with its measurements from the solid block. In this way, a blank was imitated, which represented the starting point of manufacturing for the customer. This preparatory work alone took 30 hours of machining time.

At the same time as the machine was being constructed by Zimmermann in Neuhausen, MAPAL began with tool tests in Aalen. The tool manufacturer could rely on a new generation of titanium tools for this purpose. In order to achieve high removal rates, the NeoMill-Titan shell end face milling cutter was chosen. MAPAL developed the new topography of the indexable insert in such a way that the chips are optimally formed and removed. An equally new cutting material concept minimises wear and tear and the formation of built-up edges.

Even experienced application engineers were surprised how smoothly and almost silently the tool works. The tool life is also impressive. The 60 minutes that Bernd Scheurenbrand expected were exceeded considerably. "Some of the tools were at work for almost seven hours – that's a sensational tool life", the experienced application engineer from Zimmermann praises. This result was made possible, among other reasons, due to the modern protective coating with a good adhesion to the tool, an effective temperature barrier and a very smooth surface that reduced heat on the cutting area.

CONVINCING NEW TOOL GENERATION

To clear out pockets and cavities on the part, MAPAL selected the solid carbide milling cutter OptiMill-Titan-HPC in a special length. When machining the gaps between the lugs, the trochoidal milling cutter OptiMill-Tro-Titan was able to show off its strengths with short contact times and optimal heat removal. Over the entire milling area, it created absolutely straight walls with reflective surfaces. "In tests, we were able to mill the lug down to a wall thickness of 3 mm without it pushing away or vibrating", Ilg reports. This was a relief for Nüssle: "If the end milling cutter hadn't worked, we would have needed a special machine to work the journal bearings at the same time on both sides with disc milling cutters to balance the forces out."

Excellent cooling is essential when machining titanium to remove the heat that develops. MAPAL MillChucks with integrated coolant supply were used to bring the coolant pressure to the milling cutter. Zimmermann chose the company Blaser Swisslube as a further project partner to provide the cooling lubricant as their coolants are ideally suitable for high pressures.

For the bores on the sides of the lug, MAPAL developed a custom tool with angular drill head-based on the MEGA-Speed-Drill-Titan. The drill bores, then deburs back in the countersink step and finally produces a chamfer in reverse.

LINE BORING FROM TWO SIDES

Line boring is an ideal way to create the main bore of the mount. The twelve lugs are arranged in four groups with three journal bearings. The first lug pack is initially piloted. The drill for machining the second lug pack is guided through these pre-machined bores. Due to the length of the part, the lug packs 3 and 4 had to be machined mirror-inverted from the other side.

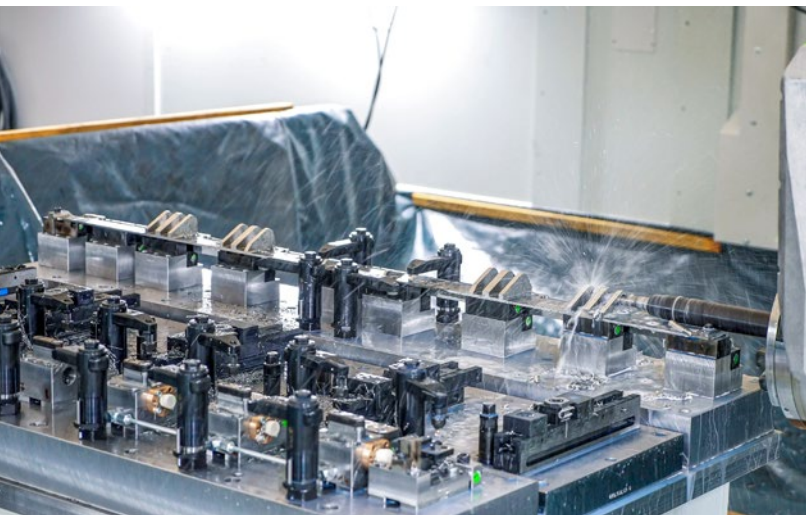
The 685 mm line boring bar with a diameter of 17 mm, which does the fine machining in the end, has two adjustable inserts and is led between the lugs in guide bushes. The first insert ➔

Drilling, countersinking and reverse deburring of a fixing bore with a right-angle drill head.

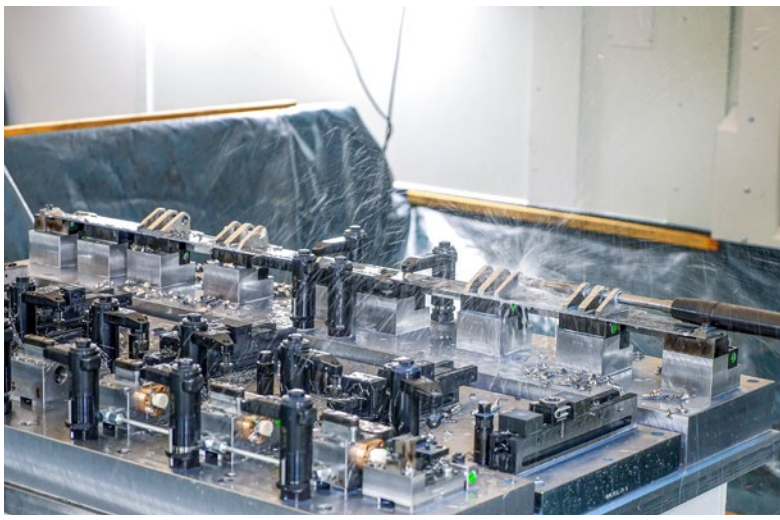
Reaming of an index bore with a fixed reamer from the FixReam range.

Close technology partnership in a turnkey project from left: Application Engineer Bernd Scheurenbrand and Steffen Nüssle, Export Sales Manager and Head of Application Technology, from F. Zimmermann GmbH with Jens Ilg (Component Manager Titanium & Stainless Steel), Andreas Rotenberger (Test Engineer / CAM Team) as well as Julian Kraus and Lukas Weiß, both programmers in the CAM Team at MAPAL. *(© F. Zimmermann GmbH)*

The main bore of the first lug pack is piloted by the MEGA-Speed-Drill-Titan.



A special design of the MEGA-Speed-Drill-Titan carries out the pre-machining of the main bore of the second lug pack. The tool is led through the first lug pack.



bores the main bore, thus eliminating any offset that might have occurred during pre-machining. The second insert then completes the final diameter in H7 quality. The long boring bar reminds Jens Ilg of a lightsabre: "The swinging motion that positions the tool on the part brings Star Wars to mind." The gantry machine, a six-axis FZ42 with a VH60 milling head, offers more than enough room for the machine's spectacular lunges. The working area is 8.50 x 3.90 x 1.50 m large and is separated in an area with a fixed machine table and an area with a round table for further processing.

Transferring the results from MAPAL's test centre to the machine in Neuhausen was a critical stage of the project, Steffen Nüssle remembers: "After the successful test runs in Aalen, we knew where we were headed. Our gantry machine is a lot bigger than the machining centre in Aalen, has bigger moving masses and lever lengths. Thus, it isn't quite as rigid."

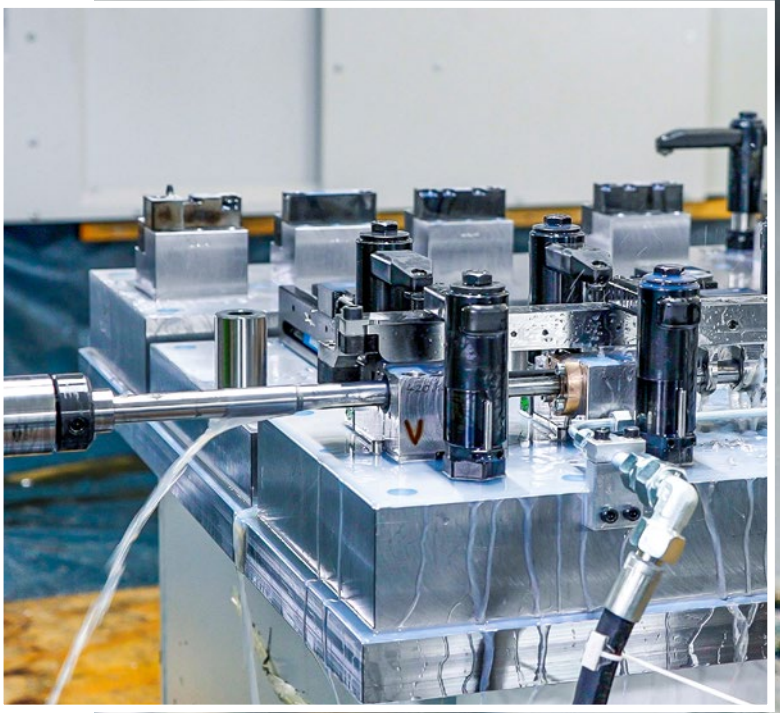
The misgivings were quickly allayed: The desired accuracy was achieved with high process reliability in Neuhausen, as well. This was particularly true for the middle of the workpiece, where the bores meet each other from both sides and a small offset could occur. The measured results prove that the machining was symmetrical. Just 8 µm difference was measure here. The line boring process ensures that the precision that is once reached can be reproduced for years to come, as the machine only provides the feed and spindle speed, while the actual geometrical guidance is provided by the fixture.

Zimmermann paid close attention to vibration dampening while designing their fixture. The many buckles and clamps however also resulted in many tool restrictions. Here, the machine manufacturer harnessed its expertise in model making to first create a blank out of plastic. "If the first attempt failed, we would have neither damaged the expensive titanium or the tool, let alone the machine," says Nüssle. But it worked from the get go. Only the cutting parameters had to be adjusted for the first titanium part.

Steffen Nüssle was very impressed by the good cooperation between Zimmermann and MAPAL: "I've already been involved in many turnkey developments, but have never experienced a project that went as smoothly as this. It was a lot of fun." The geographical proximity between Neuhausen and Aalen was also a big advantage: They only had to drive an hour to be able to discuss the next steps together right at the machine. ■

The 1.50 metre mount for an Asian aeroplane parts supplier. (© F. Zimmermann GmbH)

The line boring bar with a diameter of 17 mm and total length of 685 mm finishes the machining of the main bore.



The large-scale research project

X-FORGE

Manufacturers become service providers

You don't have to buy a machine to use it: Digitalisation makes new business models possible that are based on the automatic exchange of data. In the large-scale research project „X-Forge", experts from science and industry clarify which requirements have to be met to make such business models economically and technically viable.

Digitalisation has transformed the manner in which manufacturers product their goods. The business relationships that companies enter into with each other have also changed during the fourth industrial revolution. Rigid supply chains have become flexible supply networks, where routines are a thing of the past and the protagonists are constantly changing. This

iStock | DKosig

Guest article by the Frauenhofer IPA (abridged version), author: Hannes Weik

complex interaction reminds one of an ecosystem involving animals, plants and microorganisms. Experts thus refer to supply networks as digital ecosystems.

The digital ecosystem is kept running through the automatic exchange of data between all stakeholders. This continuous exchange makes new, data-based business models possible where the manufacturers not only become service providers, but all the processes on a shop floor are understood to be a single service: Everything as a Service (XaaS). In the large-scale research project X-Forge, experts from science and industry examine some of these new business models and clarify what data must be collected and exchanged for them and how this data transfer is technically implemented.

X-Forge is split into four consortium projects. The Fraunhofer Institute for Manufacturing Engineering and Automation IPA is involved in all of them.

WHEN THE PLANING MACHINE SENDS A BILL

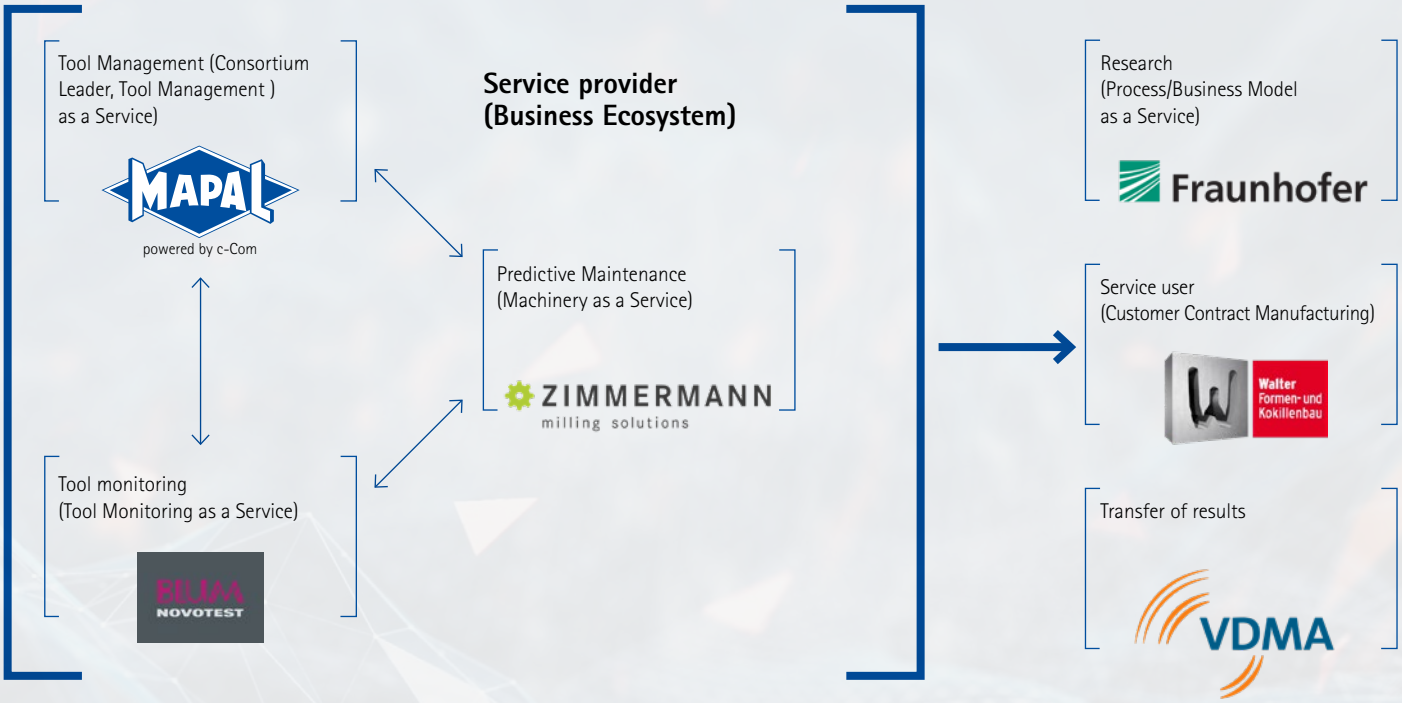
The woodworking industry in Baden-Württemberg is made up of family-run SMEs for the most part. They can only afford the high costs of newest high-tech machines with great effort. A possible solution: Pay per use. The woodworking machines remain the property of the manufacturer, carpenters and cabinetmakers pay monthly to use them. In the consortium project "Wood Working as a Service" (WOODaaS), researchers are currently investigating how such a use-based business model has to be arranged so that it is equally attractive to both the manufacturer and user.

THE SELF-CONFIGURING MACHINE TOOL

Productivity as a Service
PRODaaS
A X·FORGEBW project

Contract manufacturers and suppliers for metal machining are under enormous pricing pressure in international competition. The machine tools have to be used effectively, around the clock if possible, maintaining high processing and manufacturing quality at a low cost even for small series and single items. This is to be made possible by a use-based model, as well: Contract manufacturers shouldn't have to buy expensive machines anymore in the future. Instead, they are to pay for a package that includes machine tool, cutting tool and IT services. ➔

Productivity as a Service – Consortium



The service partners involved – machine manufacturer, tool manufacturer, platform provider, sensor supplier etc. – work together holistically as a provider ecosystem to develop a Productivity-as-a-Service offering. © Fraunhofer IPA

The latter should not only offer payment and maintenance processes that are triggered automatically but also intelligent algorithms that autonomously intervene in the machining process to optimise parameters during operation. Excessive wear and tear and damage to parts should be avoided in this way. "Cutting machine operators then no longer have to grapple with the machine settings nor hire third parties to optimise their production processes", says Oliver Schöllhammer from Fraunhofer IPA. Schöllhammer and his team want to achieve this by unifying process and production data – which has been stored separately until now – and feeding them into self-learning algorithms.

Beside Fraunhofer IPA, a number of companies and institutes are involved in the Productivity as a Service (PRODaaS) consortium project: Karl Walter Formen- und Kokillenbau GmbH & Co. KG from Göppingen, sensor manufacturer Blum-Novotest GmbH from Grünkraut, machine manufacturer F. Zimmermann GmbH from Neuhausen auf den Fildern and tool manufacturer MAPAL Dr. Kress KG (consortium leader). The Ministry of the Economy, Labour and Tourism of Baden-Württemberg funds PRODaaS with 3 million euro from its funding programme InvestBW.

A DRIVE SYSTEM THAT GIVES YOU TIPS TO IMPROVE PRODUCT QUALITY

For most companies, it is becoming increasingly difficult to recognise and implement optimisation potential for their own products or manufacturing processes. Thanks to digitalisation however, new approaches are arising to achieve further optimisation. The consortium project "Product Life Cycle Enrichment as a Service" (PLCEaaS) collects all data that are created during the product lifecycle of a drive system in one place and makes them accessible. These data can be processed and evaluated with an easy-to-use analytics toolbox.

A SHOP FLOOR FULL OF SERVICE

The project partners of the consortium project "Smart Factory as a Service" (FABaaS) are going another step further. It's not the operation of an individual machine or lifecycle of a specific product that is being developed into a use-based business model, but the entire end-to-end process of a manufacturer – from the order to production to delivery and payment. ■

The partners of the consortium project "Productivity as a Service" are exploring a use-based business model for machine tools where companies from the metalworking industry pay for a package of machine tool, cutting tool and IT services. The high purchasing costs for machine tools are avoided.

MAPAL OptiMill-Tro-Inox

MILLING STAINLESS STEEL WITH SIX CUTTING EDGES

Compared to well-known market solutions with four or five cutting edges, the new six-edge solid carbide trochoidal milling cutter OptiMill-Tro-Inox for machining stainless steel (inox) from MAPAL stands out with a 20 per cent increase in material removal rate and a 30 per cent longer tool life.

For stainless, austenitic steels like the workpiece materials 1.4571 or 1.4462, the material removal rate was markedly increased compared to past tool solutions. The tool life has even been doubled. The number of cutting edges contributes to performance gains, but that's not all. Many factors play a role in this success. The biggest step forward was related to cutting material – a combination of new carbide types and a corresponding coating.

Trochoidal milling is a very dynamic machining process, which manages an extremely high material removal rate when roughing to quickly mill a part that is close to its final contour. The milling cutter continuously plunges into the material and resurfaces again. This imposes special demands on the cutting edge with regard to high impact strength.

TOUGH CARBIDE IS LESS SENSITIVE

Especially when it comes to machining stainless steel and dynamic processes like trochoidal milling, a tough carbide is required. It is less susceptible to breakage and jolts, so it does not chip as easily. Wear and tear can be greatly reduced with tough tool material. MAPAL achieves this high impact strength through the high cobalt content of the carbide. Further material additives ensure that the new cutting material HP826 also has similar hardness characteristics to more brittle carbide. The cutting material was specifically developed for milling applications in the workpiece material groups ISO M and S. It does not react as sensitively to knocks or chip jamming as harder carbide with less cobalt content. Additives with higher thermal conductivity offer certain advantages during machining.

Every time the milling cutter enters the material and resurfaces, it heats up and cools down. If the cooling process is not optimal, the tool life can be affected. The cooling situation of the cutting edge is decisive. MAPAL tested various new types of coating. With the optimal coating, it was possible to increase the hot hardness and enhance thermal shock resistance. One can see that the modern multi-layer coating of the new OptiMill-Tro-Inox contains silicon due to its copper colour – a proven additive to limit heat exposure in tools. The new coating makes the solid carbide milling cutter more resistant and increases the stability of the cutting edges.

MAPAL's new six-bladed tool does not only compete with other solutions on the market but also with milling cutters in its own portfolio. In the OptiMill-Tro family, the tool manufacturer al- ➔

MAPAL's six-edge OptiMill-Tro-Inox trochoidal milling cutter achieves a 20 per cent higher material removal rate than other solutions on the market.

ready introduced solid carbide trochoidal milling cutters with five and seven cutting edges in recent years. The difference between these two tools is above all in the application. The seven-bladed tool is meant for smaller material removal rates because the chip spaces are a little tighter. Seven teeth however make very quick machining possible. The five-bladed tool is above all used for high roughing material removal rates.

SIX INSTEAD OF SEVEN OR FIVE CUTTING EDGES

With the new six-bladed tool, MAPAL has struck a balance. With it, the user can machine at a brisk pace, as it works well both during roughing and semi-finishing. The five-bladed tool is a well-established product for heavy machining that is very popular on the market. However, it has its limits with only five cutting edges. The seven-bladed tool offers high performance, but is more of a specialist. MAPAL wants to replace it with the new six-bladed tool, which is more versatile. The transition will be gradual as customers use the seven-bladed tool for established processes and are happy with the tool. MAPAL will give them the opportunity to convince themselves about the six-bladed tool's performance in field tests. To enable a 1:1 replacement, MAPAL has kept the dimensions for the new OptiMill-Tro-Inox. It is also available in the diameter range from 4 to 20 mm in designs from 2xD to 5xD.

The equation "more cutting edges = higher manufacturing efficiency" does not necessarily hold true. Additional tensile forces at the spindle in particular are a constraint which increases with each additional cutting edge, as is the decreasing chip spaces. High-temperature-resistant and tough workpiece material is hard on the chip flutes at high machining volumes and/or removal rates. This means that reliable chip removal and also process-reliable machining are more difficult with smaller chip spaces. Additionally, "smearing" the slot often results in premature tool breakage.

Through intense development and cutting-edge features, MAPAL enables process-reliable machining with a six-edge tool. As the seven-bladed tool was already a leader on the market because of its performance, MAPAL used this predecessor tool as the basis for improving design in the macro geometry of the six-edged successor. Machining inner contours was the weak point until now. When the tool does large wraps, for example when machining the corners of a pocket, the chips have nowhere to go and wind around the tool. A new chip breaker solves this problem. The chips are a lot shorter and can be removed a lot better. A new groove shape and optimised helix angle help here.

Due to the larger chip spaces, OptiMill-Tro-Inox has an increased side material removal rate (a_e) than its seven-edge predecessor. In addition, the feed per tooth can be increased by ten to twelve per cent. These two features together compensate for any potential disadvantages posed by the lower number of cutting edges. It also takes the burden off machines that often reach their limit due to the dynamics of trochoidal milling processes.

FOCUS ON MAXIMUM MATERIAL REMOVAL RATES

With its benchmarks for trochoidal milling, MAPAL focuses on maximum material removal rate. In tests, material removal rates are measured up to the end of tool life. Both the tool life and the cutting parameter are recorded. It was proven that six-bladed tools have higher material removal rates than the seven-bladed tools and thus make more efficient and economical machining possible. In addition, they can be more universally used with stainless steels than the seven-bladed tools, which in turn excel with special duplex steels. In tests with austenitic chrome-nickel-molybdenum steel 1.4571, the OptiMill-Tro-Inox with a diameter of 12 mm and a cutting depth of 5xD achieved a material removal rate of 0.108 l/min, which is 20 per cent more than a comparable product on the market that reached 0.09 l/min.

Another test showed how weak points come to the fore when powerful tools are pushed to their limits on very dynamic machines: Machining had to be halted almost immediately as the chip conveyor was unable to remove the chips quickly enough. MAPAL recommends its side lock chuck MillChuck, which keeps the tool from turning out of position and securely clamps it, so the tool adapter is not the weak link in the chain. As stainless steel usually has to be machined wet, another advantage is that the MillChuck brings the coolant directly to the machining surface through the chuck. The steady cooling counteracts thermo shock, increasing the tool life of the solid carbide tool.

Fields of application for the OptiMill-Tro-Inox can be found wherever stainless steel is machined in a highly productive manner. In addition to general machine engineering, this above all includes the food, pharmaceutical and medical technology industries. ■

Due to an optimal mix of number of cutting edges, chip breaker and innovative groove shape, the six-edge trochoidal milling cutter OptiMill-Tro-Inox reliably machines workpiece materials from the ISO material group M, which are resistant to high temperatures and tough.

The innovative coating makes the solid carbide milling cutter more resistant and increases the stability of the cutting edges. The OptiMill-Tro-Inox thus works reliably longer despite repeatedly heating up and cooling down due to entering the material and resurfacing.

German "Robot System Integration" Championship:

THE TITLE GOES TO MAPAL

Victory for the MAPAL team: Martin Ernsperger (Manufacturing Technology and Automation, MAPAL) with the newly crowned German champions "Robot Systems Integration" Philipp Raab and Marvin Schuster (from left). The competition took place at the company Fanuc in the town of Neuhausen auf den Fildern.

Philipp Raab and Marvin Schuster, both working as mechatronics technicians at MAPAL in Aalen, have accomplished a remarkable feat. The 19-year-olds were the youngest participants in the German "Robot Systems Integration" Championship. The organiser was the robot manufacturer Fanuc. The two MAPAL employees not only came out on top in the national vocational competition, they won it by a clear margin of 15 points over the runners-up in second and third place.

CHALLENGING TASK – STRONG COMPETITION

Six teams, including students from the universities of Reutlingen, Heilbronn, Bochum and Aachen, competed for the first time for the title of the German "Robot Systems Integration" Championship. The task set out for the competition was demanding and geared to the level of international vocational competitions. The task was to set up a robot system in such a way that it independently assembles a pneumatic cylinder from four individual parts – cylinder, piston, spring and cover. This not only required a lot of specialist knowledge and precise programming skills. The participants also had to demonstrate teamwork and mental prowess because there was a tight time limit and there were a few hurdles to overcome. In addition, the teams had to plan and visualise the complete system both analogue and virtually.

WELL PREPARED

MAPAL had actively supported and promoted the two mechatronics technicians in the run-up to the competition. Martin Ernsperger, who works in the company's manufacturing technology and automation department, supervised the young colleagues. "We practised the technical sequences over and over again until Philipp and Marvin had it mastered", he reveals and is delighted about the "phenomenal success" of his protégés. Uwe Heßler, Head of Training and Further Education at MAPAL, is also proud of the two competitors. It shows that "dual training offers enormous advantages when it comes to acquiring craft skills".

There were a few difficult points during the one and a half day competition, Philipp and Marvin report. "It really helped that we are a well-coordinated team and get along well." That was their greatest asset in the competition, say the two, who have known each other since their school days and have always been determined and ambitious. They were the first graduates that the company trained as mechatronics technicians, as part of a joint training programme with the Aalen-based company Alfing Kessler Sondermaschinen. The young mechatronics technicians completed their exams in the summer 2021 and were delighted to achieve distinctions. With this championship title under their belts, Philipp and Marvin have also secured their place in the Robotics Luxskills in Luxembourg and the 2022 World Championships in Shanghai. There, the team will compete as representatives for Germany.

Deutscher Maschinenbau Gipfel
Zukunft produzieren

2021 SUMMIT OF GERMAN MECHANICAL ENGINEERS IN BERLIN

The challenges facing machine engineers in IT and digital transformation were the focus of the Deutscher Maschinenbaugipfel (German Summit of Mechanical Engineers) in Berlin. Experts and decision-makers from industry and politics discussed means, possibilities and solutions for handling new technologies.

Matti Maier, Business Development Manager at the MAPAL subsidiary c-Com GmbH, presented the use of blockchain technology in machine and plant engineering in his talk. In combination with smart contracts, new business and accounting models can be integrated in machining applications, for example. This combination provides high data quality, saves costs and is also suitable for use cases where goods have to be tracked from logistics department through to the approval and acceptance processes for machines, components, tools, processes or drawing. ■

"In combination with smart contracts, new business and accounting models can be integrated in machining applications, for example."

Matti Maier, Business Development Manager of the MAPAL subsidiary c-Com GmbH

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