IMPULSE

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Cover story: Line boring bar with cutting edges capable of compensation

- Interview: Trends and news in the area of clamping technology
- Competitive edge due to additive manufacturing
Dear Readers,
Dear Business Associates,

The new year has just begun and we would like to take this opportunity to extend our best wishes for your success and health. We look forward to continued collaboration in partnership with you and are hoping for many joint projects.

In spite of slight economic downturns at the end of the last year, we have concluded a successful fiscal year. For the first time, the MAPAL Group succeeded in exceeding the sales target of 500 million euro. As we continue to be geared for growth, this pleasing development offers us the basis for extensive investments in our locations. With a total investment volume of approximately 70 million euro, we will, for example, significantly increase our capacities for PCD manufacturing at the Pforzheim location. With a completely new plant in Eppingen, we will realign our product portfolio of actuating tools and special ISO tools. We will also considerably expand our capacities at the Meiningen location in the area of solid carbide tools. Equipped with the latest machine generations, as well as additional competent specialized personnel that we uniformly deploy at our international locations, we provide the basis for the ability to meet the increasing worldwide demand for our products and complete solutions.

Naturally, these extensive capacity expansions only make sense if our development area also has a leading edge with new and further technological developments. Our promise as a technology partner is to always set new trends in the area of metal cutting with the objective to make your production more resource-conserving, energy-saving and economical. Recently we have pursued completely new paths and have taken advantage of the opportunities offered by additive manufacturing. Thus, we are the absolute pioneer in the industry, and currently are the only manufacturer of precision tools that successfully implements this technology in series manufacturing. Also we have succeeded in revolutionizing a simple product such as a countersink, more than 40 years after its introduction to the market. Through an unequal spacing, results are achieved that have hitherto been impossible for countersinking.

Whether cutting-edge technologies or further developments of products that may seem somewhat non-descript – with MAPAL technology you are always one step ahead.

We hope you enjoy your reading.

Dr. Dieter Kress

Dr. Jochen Kress
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FROM THE ORGANISATION

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News

Personnel issue and construction project in Meiningen

Dr. Norbert Reich is the new addition to the management at MAPAL’s actuating tools competence centre

On 1 October 2014 Dr. Norbert Reich became a member of the management team at MAPAL ISOTOOL GmbH. Dr. Reich has a PhD in Engineering and has many years of experience in developing and managing technology companies. He will support MAPAL in further developing the actuating tools competence centre. Dr. Reich will be responsible for the production and administration divisions, while Patrick Fabry, also a member of the management, is responsible for sales. With this new strategic adjustment, MAPAL reacts to the growing demand of actuating tools. Next year, MAPAL’s fast-growing subsidiary will move from Sinsheim to Eppingen where a new production and administration building is currently being built.

MAPAL is also growing in Meiningen

MAPAL continues to expand its production capacities in Germany. In addition to the construction projects in Eppingen and Pforzheim, the production areas of the newest addition to the MAPAL family, WEISSKOPF in Meiningen, are also being increased in size. Two years ago this medium-size company, which now boasts a workforce of 50 employees, was included and successfully integrated in the MAPAL Group. WEISSKOPF produces special and standard tools from solid carbide. Given the growth of the international business, the plant in Thuringia is now working to capacity. The production and logistics processes are being further optimised with the addition of another hall on the company’s site in the business park in Dreßigacker. The construction of the hall and the commissioning of the machines are scheduled to be completed by autumn. As part of this increase in production capacity, MAPAL is set to create further jobs.

With the support of the state of Thuringia MAPAL builds a second production hall in Meiningen and invests 6.5 million euro in buildings and equipment. From right Robert Wörner (Managing Director WEISSKOPF), Jochen Staschweski (Secretary of State Thuringia), Dr. Ralf Herkenhoff (Member of the Executive Board MAPAL), Rolf Baumann (retired Member of the Thuringia Parliament), Uwe Rein (Authorised Officer WEISSKOPF), Fabian Giesder (Mayor Meiningen) and District Administrator Peter Heimrich visited the premises.
At the turn of the year 2014/2015 MAPAL has dispensed with gifts for its customers and business partners and has donated the entire gift budget, totalling 30,000 euro, to social institutions and organisations. „As a family-owned company we see it as part of our entrepreneurial responsibility, but also as a social responsibility, to exercise solidarity with those who need our help. For us it is a top priority to provide perspective to suffering, orphaned or critically ill children and youths, as well as to their parents, and to support them in a difficult life situation“, emphasises Dr. Dieter Kress. With the decision for the recipients of the donations MAPAL desires to send a clear signal and commits itself internationally as well as regionally.

The majority of the donations, 20,000 euro, again went to SOS-Kinderdorf e.V., which is active around the world.

Thus, this year MAPAL supports the SOS Kinderdorf (children’s village) Conakry in the West-African country of Guinea. The country is among the regions that have been hit hardest by the Ebola epidemic. Countless children have become orphans due to the virus. Out of fear of catching the disease usually they are not taken in and cared for by their relatives. In the SOS-Kinderdorf Conakry, these children who have become parentless and homeless should find a new and caring home. „We trust SOS-Kinderdorf e.V. For decades the association has performed outstanding work, so that orphaned children can, for the most part, grow up with peace of mind and health“, states Dr. Kress.

In addition, the „Bunte Kreis“ at the Aalen Ostalb Clinic has been supported with 5,000 euro, this organisation’s full-time and volunteer employees are committed to meeting the needs of critically ill children, their siblings and parents. MAPAL provided an additional contribution of 5,000 euro to the Children’s Hospice Service Ostalb and Heidenheim, which takes on an important task in accompanying children with terminal illnesses, and is committed to caring for the families concerned.
Two internationally successful automotive suppliers have named MAPAL as a premium supplier and certified the above-average expertise and cooperativeness of the company.

For the second time in a row, MAPAL has been awarded the status of „Preferred Supplier“ by the Bosch Group in the field of tools, this is the highest ranking in the Bosch supplier pyramid. Giari Fiorucci, Purchasing Director Tools at Bosch GmbH, visited the headquarters in Aalen on 9 October to hand over the certificate to Dr. Jochen Kress (Member of the Executive Board). Fiorucci praised the services provided, the cooperativeness and the excellent understanding of processes.

TRW Automotive, manufacturer of vehicles safety systems, awarded the „TOP Supplier Award“ for the first time in 2014 and acknowledged the achievements of its best suppliers at an official awards ceremony. This celebration coincided with the annual „Global Supplier Meeting“ on 22 October in Munich. For MAPAL it was a true honour to be among the first winners who were presented with a glass trophy by Jeromee Dorlack, Vice President of Purchasing at TRW Automotive. „We are very proud of this award“ explained Dr. Jochen Kress. „For us it is confirmation of our good sense of cooperation and partnership and motivates us to carry on providing the best possible technical support and service.“
There are roughly a billion vehicles on the roads around the world and it is predicted that this number will almost double in the next 20 years. New materials and production strategies aim to make vehicles lighter and more environmentally friendly. For example, the weight of the engine block can be reduced by up to 4 kg if the cylinder liners of the crank case are replaced by thermal spray coatings.

Prof. Dr.-Ing. Eberhard Abele, Managing Director of the Institute of Production Management, Technology and Machine Tools (PTW) at Darmstadt University of Applied Sciences, and Siegfried Wendel, Deputy Director Global Sales of the MAPAL Group, introduce the various cylinder crank case designs and different coating technologies in the 5th edition of the Technology Report. They explain the principle behind the thermal spray process and describe the individual steps involved in the pre- and post-processing of the cylinder head surface in order to ensure good adhesion of the spray layer and an optimal finish structure. MAPAL has developed a tool concept which allows processing in particularly short cycle times and minimal cutting edge wear.

The Technology Report is included in this issue of IMPULSE and can also be downloaded from our homepage. Please contact us to request additional printed copies free of charge.

The following articles have already been published in this series:
01 Interpolation turning
02 Energy efficiency
03 Minimum quantity lubrication
04 Trochoidal milling
Maximum quality and productivity from the line

Line boring bar with cutting edges capable of compensation

By using a line boring bar with compensatory cutting edges, the machine manufacturer MAG IAS has successfully optimised the machining of crankshaft bearing caps on a machining centre from a number of perspectives. Compared to the tools used to date for this task, with the new tool the overall quality has been improved, machining accelerated and the tool life increased. On the basis of these positive results, further possible applications are now being considered for the line boring bar with compensatory cutting edges which was developed in close cooperation with the MAPAL competence centre for complex actuating tools and facing heads.

The machining centre in which the innovative line boring bar is to be used is part of a series of 52 machining centres which form a flexible production line. This line was designed by MAG IAS for machining various engine cylinder heads made of grey cast iron and covers the entire process from cubing the grey iron block (GJL and GJS) through to final machining of the cylinder block.

Fifth flexible production line for China

“This is the fifth line which we have now delivered to China”, explains Martin Schmid, Head of Cutting and Process Technology at MAG IAS GmbH, with understandable pride. Martin Schmid believes that the key factors behind this success story are the high-performance machining centres at his company and, more importantly, the know-how which MAG IAS provides its customers in the form of process design. „We are never satisfied with the status-quo and are constantly working on improvements in order to maintain our leading position in years to come“ adds the specialist for cutting and process technology. This was also the motivation for further developing the tried-and-tested technology of line boring bars used in transfer lines and upgrading it for use in machining centres.

Prior to this, MAG IAS used MAPAL tools with guide pads with blades and guide pads attached to the circumference for the fine machining of crankshaft bearing caps. The connecting bars of the bearing caps were machined one after the other whereby the tool is always supported by the previous bar with the aid of guide pads in a pilot bore.

Machining by drawing for enhanced precision

„Excellent concentricities and diameter tolerances can be ensured for multiple connecting bars with this machining method. The machining quality is so good that we passed the customer’s quality inspection with flying colours“ stresses Martin Schmid. „Yet for us it was clear that we would achieve even better results if, instead, we were to use a line boring bar which allows a drawing motion."

Since with this solution all connecting bars are machined simultaneously (one cutting edge per bar), the entire process is accelerated. However, for this, the workpiece must firstly be lifted into the clamping system by a hydraulic device in order to position the workpiece in the pre-machined bearing bar. If it were not lifted the projecting cutting edges would collide with the workpiece when positioning centrically in the unmachined bearing (with its thus smaller diameter). Once successfully positioned, the workpiece is lowered for machining. This step requires a complex device and has a negative impact on productive times and the level of precision which can be achieved.

In order to compensate for unavoidable wear, the machine has to be stopped from time to time and the inserts must be readjusted manually. „This demands that the machines are stopped for at least 15 minutes at regular intervals“, states Martin Schmid.

From a line boring bar to an actuating tool

Once a MAPAL actuating tool had been successfully used to machine a cylinder bore, MAG IAS expressed its desire to further develop the conventional line boring bar into an actuating tool. „When it comes to complex tasks, I turn to the specialists at MAPAL“, explains Martin Schmid. „The experience gained from

The line boring bar with inserts that can be actuated enables several bearing points to be machined simultaneously with a drawing motion.
QUALITY IMPROVED
MACHINING ACCELERATE
TOOL LIFE INCREASED
Manual readjustment of the inserts to compensate for wear is not necessary with this innovative tool.

numerous projects shows that MAPAL is able and willing to implement innovations quickly. What’s more problems are solved without the need for long discussions.”

The solution developed together with MAPAL is confirmation of Schmid’s assessment and also impressed the customer: Since the cutting edges can now be controlled by a pull rod, it is no longer necessary to lift the cylinder block for positioning the tool in the bearing bar and machining with a drawing motion is possible. This makes the whole process faster and more precise. And as an additional positive side-effect, the device is simpler, more reliable and thus tangibly more cost-effective.

Automatic compensation

Manual readjustment of the inserts to compensate for wear is also not necessary with this innovative tool. After each use, the tool is measured by a plug gauge inside of the machining centre or outside the station and the value is reported to the machining centre control. Based on the values measured, the inserts are readjusted in order to automatically compensate for the wear determined.

Either a mechatronical system such as TOOLTRONIC® or a coolant pressure controlled system can be used to operate the tool’s internal pull rod. Another variant was selected by MAG IAS. Here the system is actuated by a pull rod of this company’s MAG coupling point which facilitates automatic tool changing and can accommodate both tools which can be controlled and those which cannot.

The 53 mm bore in the crankshaft bearing is machined with a maximum cutting speed of vc 120 m/min and a feed of 0.1 to 0.15 mm. The normally demanded concentricities of
20 µm and roundness of 8 µm are not a problem as demonstrated by test runs by the customer. The surface quality is between Rz 7 and Rz 12.

**Drill, deburr and chamfer with a single tool**

Given these good results, further possible applications are now being considered for the tool as Martin Schmid explains: „Another car manufacturer is planning, in an initial stage, to use a line boring bar with cutting edges which can be compensated for the rough machining of cylinders in order to increase tool lives."

Yet the tool is capable of much more since the cartridges can be divided around the circumference. In addition to pre- and fine machining, chamfering is also possible, e.g. on the bearing bars, with just one tool compared to the two or three tools required in the past.

Martin Schmid, Head of Cutting and Process Technology at MAG IAS GmbH, and the responsible Technical Consultant at MAPAL, Michael Hofmann, initiated the development of this line boring bar with cutting edges capable of compensation and have already discussed further areas of application for this innovative tool.
Latest developments precisely reflect current trends

Interview with Jochen Schmidt, Product Manager and Production Manager for Clamping Technology

Mr. Schmidt, the AMB and other major trade fairs in 2014 were not that long ago. What were you able to learn in terms of clamping technology?

At the AMB we presented an alignable hydraulic chuck for multi-bladed reamers as well as a hydraulic expanding arbour for face milling heads. Our new developments result from precise customer requirements and the feedback shows that we perfectly met the market needs. Both new products have been designed for users of multi-bladed tools for fine machining. This group wants clamping devices which enable the radial run-out of tools to be set perfectly. In an overall system which allows spindle, chuck and tool radial run-out errors of 3 µm for each component, overall run-out errors of up to 9 µm are possible on the cutting edge without any of the components exceeding the permissible tolerance range. This is not a problem for many processes, however in the case of fine machining with multi-bladed tools the radial run-out error is an all-important criterion.

Could you describe the two new products and their applications in greater detail?

The alignable hydraulic chuck is essentially based on the tried-and-tested MAPAL hydraulic clamping technology. In order to set the run-out precisely we have integrated three adjustment elements which are actuated depending on the direction of the radial run-out error. The setting is self-locking which means it offers an absolutely reliable hold during machining.

In the new milling cutter arbours the hydraulic clamping technology is used to centre the face milling head. A perfect radial run-out guarantees “genuine” multi-cutting edge capability and, with this, increased tool lives and reduced non-productive times. The dampening properties of the hydraulic clamping technology also have a positive impact on the surface quality.

When will the products be available on the market?

There is a defined standard range for both new products. Stocks will have been built up by mid March and we aim to start sales in April 2015.

In the 54th issue of IMPULSE we reported on the major expansion of the clamping technology site in Ehrenfriedersdorf. What has caused this significant increase in demand for chucks from MAPAL?

The reasons for this are many and varied. One of the key factors is that our customers are looking to increasingly reduce their number of suppliers. As a partner „from the spindle to the cutting edge“ MAPAL makes the ideal choice here and word of our expertise in the clamping sector has spread. What’s more, we offer our sales and service expertise around the world. This is one of the key demands, particularly of our larger customers.

As a full-service provider we are able to not only optimally align tools but also clamping technology to the conditions at our customers’ premises. After all, we are not focused on a specific clamping technology, but offer a complete range of products, in all areas.

The quality of the clamping technology from MAPAL and the great availability of products in stock are further criteria which serve to drive demand for our clamping technology.

The project business also needs to be mentioned. A considerable percentage of our clamping technology products are sold within the framework of projects and our engineering services remain popular.

Clamping technology is not the first thing which comes to customers’ minds when they think about MAPAL. Why should customers procure their clamping devices from MAPAL?

I would like to briefly mention three key advantages: MAPAL’s process understanding which means that clamping
technology is not regarded in isolation but as a building block in a larger structure; our know-how of all clamping technologies; and the fact that MAPAL boasts the most comprehensive range in this.

Are there clear advantages compared to other clamping technology specialists?

In practice we are frequently contacted by customers due to suspected tool problems which are actually caused by insufficient clamping. With MAPAL as a partner the two decisive components – the tools and clamping technology – come from a single source. This presents a major advantage in terms of the design and development of processes.

Do the products offer unique features?

Our HighTorque Chuck is undoubtedly unique on the market. The universal chuck is the only one to offer thermostability up to 170°C and, as such, is ideal for MQL and dry applications. Our MQL clamping technology can also boast a unique position. Our modular system comprising chucks and MQL interfaces guarantees absolutely loss-free and flow-optimised transport of the MQL medium to the cutting edge.

In an earlier publication you stated that MAPAL “learns at the cutting edge what the clamping technology of the future must be able to do”. So what should clamping technology offer in the future?
Alongside the classic requirements for clamping technology (high radial run-out accuracy, good retention forces and bending resistance) thermostability, as mentioned above, is becoming ever more important. The increase in MQL and dry machining processes and new machining strategies such as trochoidal milling are responsible for this. Simple, safe and reliable application is also a fundamental demand placed on clamping devices.

This issue of IMPULSE also includes a report from practice which describes cooperation with the machine manufacturer Hardinge in the HSK-T sector. Under what conditions are conversions to HSK-T particularly advantageous?

Conversions to HSK-T are particularly suited for customers who face falling product lifecycles or who produce small-scale series and prototypes. These situations are frequently linked with a desire for flexibility to react to order fluctuations by accommodating smaller jobs. In such cases the machines often have to be converted from one component to another and the re-tooling time is all-important. Given the pressures in terms of costs and quality, these customers therefore have to take suitable measures to reduce their non-productive times to a minimum and keep their running times as high as possible. Since HSK-T clamping units have short set-up times, they make the ideal choice here and the investment quickly pays off. We also use HSK-T clamping units in our in-house production facilities for hard turning. In addition to the advantage of reduced non-productive times, we have noted that the lifetimes of PcBN inserts is also positively influenced. Moreover, HSK-T conversions enhance the quality of older production machines.

Hardinge, one of the leading manufacturers of lathes for hard machining with a demanding customer profile, was impressed by the possibilities offered by HSK-T from the off. An excellent partnership has developed between our two companies which, today, goes far beyond HSK-T.

What is the focus for current developments and what trends have you detected for the coming years?

Alongside our commitment to the ongoing development of our products, we are currently working on accessing industries which do not use our clamping technology at present. For example, at the moment we are developing an automatic chuck based on hydraulic chuck technology for grinding machines, for workpiece clamping. With our innovation hydraulic energy is no longer required for the complete machining process but only for unclamping the workpiece. In addition to the significant reduction in energy consumption, this new product offers enhanced process reliability as with our new chuck the clamping pressure cannot drop.

What targets has MAPAL set for the clamping sector for 2015?

The overriding goal is to continue developing the clamping technology sector in a long-term and sustainable manner. We want to be able to give customers products which offer added value and which reflect our core competencies in terms of process understanding and consultation. We are also committed to recognising trends early on and implementing these. At present, for example, we have several new and enhanced products with which we want to set an example on the market as we did so successfully in the MQL field. We want to keep our standard range at a technically high level and, at the same time, expand the production of special solutions available at short notice based on hydraulic chuck technology. Our two production sites in Germany, Ehrenfriedersdorf for the comprehensive standard range and Aalen for special solutions, offer the ideal conditions for achieving just this.

Thank you for taking the time to talk to us Mr. Schmidt.
NEW: ALIGNABLE HYDRAULIC CHUCK

AT A GLANCE
- Compensation of spindle errors
- Easy handling
- Hydraulic expansion technology
- Higher quality and longer tool life
- No tool jamming
- Dirt resistant and low maintenance
Focus on services

Announcement: MAPAL Dialogue 2015

In addition to sophisticated tool technology, MAPAL also offers its customers reliable project support in the engineering sector, for optimising production procedures and with process management. Customers rate the resulting time savings and high-quality results and are pleased to make use of these services. It is becoming increasingly important that procurers, designers and machine operators keep up with the rapid technological developments in the machining sector. The integration and crosslinking of all components and peripheral devices necessary for a smooth production as well as interfacing them to customers’ ERP systems is therefore another important service module of MAPAL. This is why MAPAL made its service and training programme and first solutions to “Industry 4.0” the main focus of this year’s “MAPAL Dialogue”. MAPAL specialists and well-known speakers from industry and research will provide compact and valuable information on the entire range of product support services using practical examples. Users will also have their say and report on their experiences with the MAPAL services. This day will also provide an opportunity for the research and development centre at MAPAL to introduce its latest developments.

WHEN: 16. AND 17. JUNE
WHERE: AALEN
DURATION: 1 DAY
LANGUAGES: GERMAN / ENGLISH
MAPAL is continuously extending its product range and enhancing the services it offers. Find out about our innovations and experience the MAPAL Effect for yourself – ideally during a one-on-one at a trade fair or at your premises: Send an email to info@de.mapal.com to arrange an appointment.

Presence at trade fairs around the globe in 2015

Up-to-date information on trade fairs:

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In the machining of components of aluminium and other nonferrous metals, usually straight-fluted PCD drilling tools are used for drilling operations. However, modern machining processes increasingly require PCD-tipped drilling tools with a large helix angle. In the MAPAL Competence Centre for PCD Tools the technology for designing and manufacturing complex, highly spiralised PCD drilling tools has been developed and brought to market maturity.

The high-performance variants in the drilling area

The new spiralised PCD drilling tools offer crucial advantages over their straight-fluted counterparts. In summary, they enable extremely shortened machining times and a very high level of machining quality. With the new tools, previously complex drilling and boring processes can now be executed in one shot.

Through the spiral carbide guide chamfers the tools reach a higher percentage contact area and thus show a significantly better guidance behaviour in the bore. They have a lower vibration tendency, through which better bore qualities and surface qualities can be realised. The spiralised design of the chip flutes enables a „mechanically promoted“ chip removal. Moreover, the chip flutes have a high-gloss polished finish so that friction that occurs through chips is reduced and consequently heat input into the component is also reduced. Highly-positive rake angles reduce the necessary cutting forces. This is quite significant for the machining of filigree or unstable components and clamping setups.
In addition, the spiralised PCD drilling tools are the optimal tool design for machining interrupted cuts.

The advantages of machining with minimum quantity lubrication (MQL) relative to process and equipment costs, preservation of resources, environmental protection, etc. are becoming more established in practice. New processes are increasingly designed with MQL. In this area the spiralised PCD tools enable a safe and productive drilling process through the avoidance of chip congestion or tool break.

**In the technical lead thanks to know-how transfer**

Optimal embedding of PCD segments in a spiralised groove, rounded on all sides, imposes high requirements on production technology. Essentially, the current technology lead became possible through the state-of-the-art production equipment of the Competence centre for PCD Tools, and through a comprehensive technology transfer between the technologists of the competence centres for PCD tools and solid carbide tools. The lead geometries and the chip space design, as well as the grinding technology originate from the production of solid carbide tools. Likewise, engineering, design and geometry definition of the new PC Tools were adapted on the basis of the experience gained in the solid carbide area.

In addition, the latest generations of machines with innovative control systems are key factors that enable spiralised PCD tools to be designed and manufactured in a manner that is process-reliable and reproducible.
To ensure faultless performance of the tools, extensive application details also flow into the engineering and design via the MAPAL technical consultants and product specialists.

**Spark plug bore produced 75% faster**

A highly spiralised PCD drilling tool is used to machine the spark plug bore in a cylinder head of AlSi6Cu4. Machining occurs on a machining centre with MQL and into the solid metal; here the controlled chip removal out of the bore is of particular significance. For the first time, in this application example, a more process-reliable, one-shot solution is in use under MQL conditions, and it replaces three tools. At a rotational speed of $n = 5,600$ rpm and a feed speed of $v_f = 2,500$ mm/min the cycle time is reduced by 75% through the MAPAL solution. This represents a time savings of 42 seconds for a cylinder head of a 4-cylinder engine. The service life of the tools speaks for itself: In the MQL process described above, after almost one year the end of the tool life is still not reached; in a comparable wet machining process, a tool life of approximately 10 km has been achieved.

**Machining of the fastening screw bore of aluminium wheels at a new level**

Also using MQL, the fastening screw bores of aluminium wheels are machined with a highly spiralised PCD drilling tool. „Accuracy of measurements and surface quality play an essential role in the machining of the wheel fastening to exclude the possibility of bolts becoming loose“, states Oliver Kalmbach from the area of Technology and Optimisation of the wheel manufacturer BBS GmbH, describing the main challenge for the tool used. To achieve optimal chip removal for the MQL single-channel system, the complete tool bodies are polished and the cooling channels are optimised. Through a lasered negative chamfer introduced over the entire cutting edge contour, a fine, uniform, visually faultless surface is achieved. The tool also optimally satisfies the second quality criterion, the percentage contact area in the bore. At a speed of $n = 5,000$ rpm and a feed of $f_u = 0.3$ mm, the machining time is shortened by more than 70% as compared with the previously used solid carbide tool. The final service life of the tool cannot yet be conclusively evaluated because after 120,000 machined bores the tool does not yet need to be replaced. „At this number the tool life is already approximately 3 times higher than it was with the previously used tool“, Oliver Kalmbach is pleased to point out. „And currently we are testing whether the technology of the spiralised PCD tools can also be used for other machining processes, such as reference bores, or also milling processes of the valve pockets.“
PRODUCT FEATURES OF THE NEW PCD DRILLING TOOLS:

- Precisely embedded PCD segments that are perfectly matched to the respective step geometry.
- Transitions to solid drilling steps and step transitions without interference edge, polished and rounded.
- Highly polished chip flutes.
- Maximum helix angle.
- Bore depths to 7xD.
- Depending on the application, lasered cutting edge contours, lasered rake angles, chip breakers, and chip formers.

“The tool live is already three times higher.”
Successful tool management around the world

Supplier diversity, stock inaccuracies and tracking of consumption data, machine downtimes due to a lack of tools or the high expense for data maintenance, re-procurement and dispensing of tools – all these are essential reasons for providing reliability in metal-cutting manufacturing with a tool management service.

Custom tool management through modular system

High-performance tool management solutions precisely meet the individual requirements of a customer. In this regard effective tool management is brought to bear at several points in order to achieve improvements in the production structure. The most immediate effect involves the costs for tool procurement and tool use. Effective tool management can sustainably reduce both procurement costs for tools and the ongoing costs for tools through implementation of optimised and modern metal-cutting technologies. Machine availability in the customer’s production facilities is increased through improved tool requirements planning and an effective provisioning process. And ultimately intelligent tool dispensing systems with appropriate software solutions reduce personnel and time expenditures for tool provisioning.

The basic structure of the MAPAL Tool Management Services is a modular system with twelve individual services (see graphic). „With the modular tool management system we adapt our services very specifically to the respective situation. After a thorough analysis, we recommend to the customer the services that seem effective for him and that constitute a genuine added value.” This is how Frank Stäbler, Manager of Services at MAPAL, describes the initial situation of tool management projects.

Two current practical examples show how different the forms of successful tool management services can be.

In motorsport, powertrains from Albins are used particularly in the areas of racing, rally and off-road.
Albins Off Road Gear Pty Ltd. specialises in the design and production of drivetrain components for motorsport, particularly for the areas of racing, rally and off-road. The scope of services extends from individual gears, axles, drive flanges and ring and pinion drives to complete powertrain units and sequential shift transmissions. Albins has been delivering driveline solutions that meet the most rigorous requirements worldwide, for more than 30 years. The high innovation power of the company located in Ballarat (Victoria) has been put to the test in the most renowned motorsport races, such as the Dakar Rally. Since the company’s

The compact ST6 gear unit from Albins is a fast, effective transmission ratio.

Stephen MacDonald (centre, CEO Albins Off Road Gear), together with Peter Pink (left, Technical Manager MAPAL Australia) and Jörg Wilhelm (right, Vice President MAPAL Asia-Pacific) are pleased with the contract signing.

## Always the most suitable solution

The modular system enables precise adaptation of the tool management services to the needs of the customer.

### Tool logistics and tool management in Australia

Albins Off Road Gear Pty Ltd. specialises in the design and production of drivetrain components for motorsport, particularly for the areas of racing, rally and off-road. The scope of services extends from individual gears, axles, drive flanges and ring and pinion drives to complete powertrain units and sequential shift transmissions. Albins has been delivering driveline solutions that meet the most rigorous requirements worldwide, for more than 30 years. The high innovation power of the company located in Ballarat (Victoria) has been put to the test in the most renowned motorsport races, such as the Dakar Rally. Since the company’s

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founding in 1978 the enterprise has become an ultramodern manufacturing operation with more than 50 employees.

Albins’ core values of integrity, flexibility, and closeness to the customer are essential decision-making criteria in the selection of technology partners. After years of close collaboration, MAPAL Australia was selected as the partner for tool management. Now MAPAL Australia is responsible for procurement and provision of all tools used at Albins. In an initial step, prices and delivery conditions were renegotiated with existing tool suppliers. Over the next few months all machining processes will be subjected to an intensive review and the processes will be successively converted to the most current solutions. Technical Manager, Peter Pink, is responsible from the MAPAL side for the Albins project; he has conducted all negotiations and is available as contract partner in the day-to-day business: „We are in the fortunate position of enjoying the full trust of the responsibilities of Albins. They are very open to our new tool concepts and more economic machining solutions. Consequently, the collaboration is outstanding.”

**HICOM Diecastings commissioned the complete tool responsibility for several aluminium components to MAPAL Malaysia.**

**Successful cooperation with HICOM Diecastings, Malaysia**

MAPAL’s first extensive tool management project in the Asia-Pacific area has been implemented in Shah Alam, Malaysia with the company HICOM Diecastings Sdn Bhd, a leading manufacturer of cast components. Founded in 1985, HICOM has become the most well-known industrial enterprise of the country, and delivers high-quality aluminium die cast products worldwide to customers in the automotive, two-wheeler production and non-automotive areas. HICOM production is equipped with state-of-the-art machines and CNC control and monitoring systems to ensure an end-to-end high production quality, a fault-free production workflow, and short machine downtimes.

In 2014 HICOM decided to take advantage of the comprehensive tool management services offered by MAPAL, and thus achieve
an additional productivity increase through reliable production times and high machining quality. At the commencement of the project, MAPAL Malaysia was commissioned with the complete tool responsibility for several aluminium components. Thus, MAPAL is obligated to ensure the high quality standard for end products through technologically leading tool solutions, and at the same time, to increase productivity of production and machine runtimes.

The machining processes are designed with the leading MAPAL tool technology. To ensure provision of tools, as well as their faultless function, MAPAL Malaysia personnel are on-site daily in Shah Alam and are responsible for the pre-setting of the tools. Tool dispensing, pre-setting and provisioning of the sets of tools take place in a specially furnished tool management room. Different setting devices and a PC workstation for controlling and reporting are also found there, as well as the new automatic tool dispensing system, UNIBASE-M. “UNIBASE-M with its integrated automated procedures significantly facilitates the ordering and administration process”, states Kang Hum Lim, General Manager of MAPAL Malaysia. “We hope with the basis of the existing projects to be able to further extend the cooperation with HICOM in the near future.”
In the summer of 2013 the first 3D printer had recently been installed in the R&D lab at MAPAL and what was shown to us [journalists] there as the first result was really nothing more than an (admittedly impressive) gimmick, a laser-sintered world globe as grid sleeve with likewise laser-sintered (MAPAL) metal-cutting tools inside, which certainly illustrated what additive manufacturing technology is capable of: Namely producing spatial geometries in the laser printer without metal-cutting tools – out of powders of different materials and with their individual properties with design freedoms that metal-cutting machining can only dream of.

The time of experimentation went by quite quickly in Aalen: Just twelve months later, the innovative Swabians were able to refer to the first applications of this additive manufacturing technology that were ready for series production – their competitive edge worked out in this manner is evident.

How was this accomplished? Thanks to curiosity, imagination, courage, and industriousness. As described to us by Dr. Dieter Kress: „We are always very open to new developments, and the 3D printing technology must now really be fascinating to everyone (technician or not): „How something very concrete is produced with high precision from dust, as if by magic.” And he continues: „Naturally this stimulates the imagination and you immediately ask yourself whether you can use this. Initially there is indeed no specific idea, but rather a sure impression that this new technology could be helpful – however without knowing to what extent or how quickly. To learn this you must have the courage to invest in that which is actually uncertain – this is what we did and we have been rewarded for doing it“, states Kress with satisfaction, and then adds: „Incidentally, not for the first time: We have been able to have such experiences often – and in this area we are certainly not alone.“
Without having calculated quantitatively and qualitatively, or even being able to calculate quantitatively and qualitatively the period, the scope and the effect with which an investment will pay off, i.e. without amortization calculation, naturally also at MAPAL usually no decisions are made that impact the balance sheet. Also at MAPAL the controlling department checks whether an investment, no matter how intensively desired, will pay off at all. „This however“, states Kress, „is not always possible. For our decision, to invest with 3D print in what for us at the time was a completely new and also a completely unknown technology, our controlling organization could not support us, and would probably have rejected it with the legitimate comment that profitability is not assured”, and he compares: „However, this is precisely the advantage, particularly of the often and appreciatively cited German small and medium-sized business sector with its many family-owned enterprises, namely that management can decide very quickly without extensive debate in conferences, and having to be completely secured“, and is sure of itself and knows: „usually for the good of the enterprise – unfortunately, now and then also to its disadvantage.“

However: The decision, which is then farsighted, bold, and in principle correct, (made entirely without the controlling organization), is not enough. A fact that Kress is well aware of: „For the success, particularly of such an entrepreneurial decision, employees are then needed that respond to such guidelines and opportunities with committed enthusiasm and make the best of them.“ And apparently MAPAL has such employees in its R&D department, which is directly oriented to solving problems that customers actually face (not least through custom tooling), with its 15 engineers and 15 technicians, as well as its 10 technical employees (who alone have 10 high-tech machine tools, that are used similarly to how they are used by MAPAL customers). Kress confirms: „In conjunction with clearly formulated goals, our
people have all freedom for entrepreneurial implementing their capabilities, and they also use this freedom. Consequently, they are highly motivated – this is the necessary component of effort and persistence to quickly bring an investment, which is not secured through controlling, but which, naturally is future-oriented to the fastest possible success."

And the result is nothing to be ashamed of: At the AMB in Stuttgart MAPAL showed initial examples of successful 3D printing in conjunction with traditional manufacturing technology that are ready for series production – the Swabians from the Ostalb are thus harvesting their first hybrid fruits and are offering them to their customers with sound arguments:

For example, (thanks to laser sintering) weight-optimised external reamers for use on single-spindle and multi-spindle machines: they always function better the lighter they are - the possible maximum cutting speed with which they can be used is limited by their weight and the inertia resulting from the weight. The correct approach in principle: Reduce their weight. The traditional solution: Use titanium instead of steel ...

Titanium is indeed lighter (it does reduce the weight for the machining of part diameters of 8.5 mm by 38% from 390 g to 242 g), however the material is expensive, and it is also difficult and cost-intensive to machine. The really intelligent approach: 3D technology. Via a (patent pending) rib structure in the interior of the reamers, produced through laser sintering, MAPAL succeeded in reducing their weight to just 172 g – i.e. less than half. Dr. Jochen Kress points out: „With the laser-sintered external reamers, we can now work more quickly, and we can also achieve higher accuracy.”
As the second success example of the possibilities offered by laser sintering, at AMB MAPAL showed the QTD indexable insert drill, which has been available since 2013, from diameter 13 mm and upward, and which now for the first time (thanks to 3D technology) is also available for diameters between only 8 and 13 mm with internal cooling channels. Dr. Jochen Kress explains: „For us, also in the production of the tool body of the drill, laser sintering opens up geometric freedoms that up to this point have been impossible.” It is the 3D technology alone that makes it possible to design completely helical cooling channels without kinking deflection and deviating from the usual circular shape (!) in such a manner that they offer twice the coolant throughput that is possible with conventionally designed coolant channels with traditional manufacturing technology. In this case as well:

At least higher productivity and longer service life.
However: Isn’t laser sintering much too slow for series production and, what does it cost to use laser sintering? Dr. Kress responds: “Laser sintering with skilful automation runs unmanned – 24 hours a day, 7 days a week. Thus, it can certainly be operated rationally. In five years we will have at least five 3D printers installed”, he explains. “And the advantages for the users offered by laser-sintered tools should also certainly be worth their price – ultimately, the cost per part is the crucial factor.” He’s right.

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**QTD Indexable insert drill – standard product with high availability from stock**

The QTD indexable insert drill is impressive through extremely good chip formation and safe chip removal. The insert is held in a particularly stable and precise mounting and is clamped stable with a clamping screw. Thus high cutting rates and bore qualities can be achieved. While diameters starting at 13 mm can be produced with conventional manufacturing technology, the laser-sintering procedure is used for the diameter range from 8 to 13 mm. Indexable inserts and holders are available from stock to a great extent.

**FEATURES**
- Diameter range 8 - 32.75 mm
- Holder lengths 1.5 - 12 x D
- Inserts for steel, stainless steel, aluminium, and cast iron
- With internal cooling
- Secure insert clamping with Torx Plus® screw
- Excellent radial run-out accuracy
- Stable system for absorbing high axial forces

**ADVANTAGES**
- Same performance features as solid carbide drills
- Error-free insert mounting
- Easy handling; insert replacement in the machine is possible
- One holder for all inserts
- Long service life because the holder is not washed out
- Optimal chip formation and chip removal

Product information concerning the QTD indexable insert drill is available on our website. Alternatively, we would be pleased to send you the current product catalogue via regular mail. For this, please fill out the order form for catalogues and brochures at http://www.mapal.com/en/products/download/catalogues-and-brochures/catalogue-order-form/ or contact your technical consultant.
Economic machining in a single machining step

Process-reliable machining of stepped bores

Downsizing, improved performance, stricter exhaust gas limits and greater driving dynamics are the key demands on engine manufacturers. The manufacturers of connecting rods face the challenge of considerably reducing the weight of the connecting rods despite the high dynamic loads whilst, at the same time, cutting costs. This can only be achieved by using high-strength and innovative materials as well as optimised machining processes.

MAPAL has developed a step drill specially for the screw and tap bores on connecting rods which renders the mass production of these rods far more rational. The new step drill produces the screw bore in a single machining step.

Reliable step drilling in one shot

Traditionally two tools have been used to machine screw and tap bores in connecting rods due to the different diameters. This approach, however, demands additional stations and tool changes. MAPAL has developed a spiral step drill made of solid carbide which makes machining considerably more rational. Since the threaded through hole and threaded tap holes are produced by the same tool, misalignment of the two bored sections is ruled out. This ensures considerably improved bore quality.

A special geometry, coating and edge preparation together with the four guide chamfers guarantee optimal process reliability, outstanding performance and a long tool life. In addition, the step drill boasts a newly developed chip groove (patent pending). With this, a short helical chip is produced on the sinking diameter which can be freely transported away and which does not wrap around the drill or chuck.

Optimal chip removal thanks to the chip groove

When drilling into solid materials, chip formation can be well managed even with materials which produce long chips. The chips are broken into short sections and removed cleanly, even though when boring long-chipping materials chip transport is not normally this simple. Given the small cross-section of the material to be removed, long chips are produced which wrap themselves around the drill and make automated use impossible. To solve this problem in many cases the feed is briefly interrupted when machining. This results in longer machining times and, due to the changing loads on the cutting edges, also to increased wear.

With step drills too, i.e. the combination of a solid drilling step and a boring step, the chips removed by both these tools get in each other’s way and form a bundle. This can cause considerable damage to the cutting edges or even tool breaks.
The patented chip groove from MAPAL results in short chip curls and guarantees reliable machining with long tool lives. The chip groove is formed by the blade’s cutting surface and the shoulder surface adjacent to this. The cutting surface is designed to guide the chips towards the central axis of the step drill. Here they collide against the shoulder surface and are rolled into tight coils. A further advantage of the chip groove is the stabilisation of the cutting edge due to the optimised rake angle.

The combination of the geometry, coating, edge preparation, carbide and chip groove results in first-class process reliability and uniform results for series production and also ensures the extremely cost-efficient machining of screw bores in a single step.

AT A GLANCE

- Economic machining with a one-shot solution
- High process reliability
- Optimal chip removal thanks to the chip groove
- Specially for bores in connecting rods

The newly developed chip groove (patent pending) prevents long chips and chip coils.
MAPAL now cooperating with South Korea in the field of training

South Korea is seeking to improve the professional qualifications of its young people and follow the example of the cooperative education system in Germany. To this end, high-ranking representatives of the South Korean Ministry of Education visited MAPAL to find out about industrial technical training in the company. The results are to be included in a pilot project that the Korean government wants to introduce in 2015.

MAPAL invited eight vocational students from Korea aged between 17 and 18 and their supervisors to Germany for three months. The prospective mechanics learned theoretical and practical information about machining technology at the MAPAL training workshops in Aalen and Altenstadt. The young Koreans approached this right from the start with interest and a great deal of enthusiasm. MAPAL will offer all of them a job in the Korean branch once they have completed their training.

Up to now in South Korea, training has focused mainly on passing on theoretical knowledge. But with more practical experience, the South Korean government wants to give pupils the chance to gain better professional qualifications. During the visit of the Government Commission, MAPAL signed a memorandum which states that the company is willing to be a training partner for the Korean educational institutions in the future in order to provide sustainable support in the introduction of cooperative education in South Korea.

MAPAL has agreed to cooperate with representatives from the South Korean Education Commission in terms of industrial technical training. From left to right: Joo-Suk Park (Managing Director at MAPAL HTT Co. Ltd.), Dr. Joong Soon Lee (Head Teacher of Busan National Mechanical Technical High School), Dr. Hong Sun Kim (Responsible Head of the Korean Ministry of Education), Dr. Dieter Kress (President at MAPAL).
When low tolerances, high changeover accuracy as well as short set-up times are required when turning, the experts at Hardinge GmbH recommend the use of HSK-T interfaces to their customers. The company fitted the tool system to its precision and hard turning machines two years ago in close cooperation with MAPAL due to its outstanding properties. Batch sizes are dropping in many industrial sectors. This trend and the wide range of driven and stationary turning tools which are available today means that the number of machines delivered with HSK-T tools is constantly growing.

“In principle a high degree of machining precision can also be achieved with a BMT tool system as, for example, on our SUPER-PRECISION® machines from the T series for precision and hard turning”, states Markus Herdegen, Managing Director of Hardinge GmbH which is based in Krefeld, Germany and which specialises in best-in-class solutions for lathing, milling and grinding. And when this manager talks about precision, he is referring to form and position tolerances of 2 to 5 µm. „Yet if the tool has to be changed frequently due, for example, to smaller batch sizes, or if the machining process makes particular demands in terms of rigidity, then HSK-T makes users’ lives far simpler.”

And that is precisely why HSK-T was developed. Created specifically for stationary tools on lathes, the driver play was reduced compared to other HSK versions and the influence on the position of the cutting edge reduced. Furthermore, it is possible to place driven tools in the HSK-T position without having to convert the turret. As such, the HSK-T interface combines the advantages of the VDI interface, i.e., accommodation of stationary and rotating tools, with the handling and precision benefits of the HSK interface.

Increased rigidity for improved machining results

An application where the increased rigidity of the HSK-T interface comes into its own is thread cutting. The cutting material is subject to less wear, it has to be readjusted less often and a higher degree of precision compared to conventional tool systems is achieved. „For these and other similar cases, we recommend HSK-T to our customers”, stresses Andreas Leichsenring, Head of Applications at Hardinge GmbH. „When high demands are placed on precision and surface quality, the use of HSK-T means less stress as compliance with the tolerance specifications is also guaranteed in the longer term.”

Minimising set-up times with HSK-T

If, in addition, flexibility is also important, for example if multiple product changes have to be handled, then HSK-T is the obvious choice as changing the tools couldn’t be simpler. Thanks to the intelligent KS clamping cartridge only one screw has to be undone and the stationary HSK-T tool can be removed. As the precision tool is pre-set, after changing and securing with the screw, production can continue straight away without having to make a measuring cut. The investment costs in the HSK-T system pay for themselves quickly if the set-up times are also included in this calculation.

HSK-T tool range for almost all turning processes

Even so, many users did not take advantage of HSK-T in the past. This was due to the small range of products available compared to the VDI interface. However, the past few years have seen numerous changes. And MAPAL has been leading the way right from the start. This is evident from the latest 133-page HSK-T catalogue from the tool specialists in which 66 pages are dedicated to the complete turning tool holder range in the sizes HSK-T 40, HSK-T 63 and HSK-T 100. As such almost all turning processes are covered. There is also an excellent selection of inserts which have been developed specifically by MAPAL for hard machining. The flexible grooving system, VersaCut, features inserts with PcBN which can be clamped extremely securely. Here a solid clamping >>

Managing Director of Hardinge GmbH, Markus Herdegen (left), and the Head of Applications, Andreas Leichsenring (right), in conversation with Roland Kreuzer, Technical Consultant at MAPAL and Product Specialist for hard and fine machining as well as clamping systems.
HSK-T INTERFACE
OPTIMUM SOLUTION
FOR PROCESSES WITH
FREQUENT TOOL
jaw pushes the insert into a prismatic holder. The clamping jaw itself is embedded in the tool holder so as to ensure undisturbed chip flow and to protect the jaw from wear. Given their short projection length, the inserts are very stable and can be changed quickly. The special insert design means that damage to the holder following cutting edge breakage is all but ruled out. The system comprises inserts in a variety of widths and shapes for grooving and groove turning as well as thread cutting.

„The MAPAL programme enables us to achieve optimal results in terms of process.“
Markus Herdegen, Hardinge

Select the program and the job is done!

„The VersaCut and HSK-T 63 system is far superior to ones with a normal square holder“ stresses the Application Manager at Hardinge. „If an external thread is to be cut, if necessary the holder has to be assembled and all that then remains to do is start the program and – voilà – the job is complete. With square holders, on the other hand, problems, even if they are only minor, are always encountered. The opposite is true with the MAPAL holder.”
In addition to the extensive HSK-T and VersaCut product spectrum there is also, as is standard for MAPAL, a vast array of customer-specific solutions which are also used by Hardinge in combination with catalogue goods.

For the Hardinge Managing Director MAPAL’s large HSK-T and insert portfolio, which leaves no requirements unsatisfied, is ideal. „This enables us to achieve optimal results in terms of process design and, if necessary, to react very quickly.” This is important for Hardinge since more than 95% of all the machines which leave the site in Krefeld are ordered and delivered with the complete machining process.

**First-class support**

MAPAL provides Hardinge with optimal support, confirms Leichsenring: „MAPAL ensure timely deliveries and is able to act flexibly. The support provided is, quite simply, first class. The two companies work together closely as partners. This cooperation is shaped decisively by the excellent contact with the Technical Consultant Roland Kreuzer with whom we have successfully handled many joint projects.”

„Whether HSK-T is used or not is not determined by a specific tolerance which has to be observed”, summarises Markus Herdegen. „Increasing demands as regards precision and surface tolerances as well as falling batch sizes mean that we are fitting an ever growing number of machines with HSK-T – and this trend looks set to continue. And when we are presented with new requirements, such as MQL, thanks to our machines and the HSK-T system from MAPAL we are well prepared to cope with them.”

Andreas Leichsenring (left) and Roland Kreuzer in front of a precision lathe T51 from Hardinge, which was adapted for the HSK-T interface back in 2012 in close cooperation with MAPAL.
Reliable processing of materials that are difficult to machine

Energy efficiency and resource conservation require new materials. One thing is common to most of these lightweight materials: They are difficult to machine and make high demands on machine, tool and process. The development of cost-efficient and reliable tool concepts for their machining calls for great process know-how.

Thermal spray coating of cylinder bore surfaces as a pioneering technology for internal combustion engines

In aluminium cylinder crankcases, lining of the cylinder bore surfaces with cast or shrink-fit grey iron bushes is today state-of-the-art. In order to be able to build aluminium engine blocks with even thinner walls and lighter weight in future, the cast bushes are replaced with thermally sprayed ferrous metal coatings. These can be applied thinner, and the friction between piston ring and cylinder bore surface is reduced.

For this new technology in engine production, special tools are required for the conditioning of the cylinder surface before thermal spraying in order to ensure optimum coating adhesion. With the MAPAL tool solution, PCD form inserts are used to create a defined structure on the cylinder bore surface with which the sprayed coating can optimally interlock and attach itself. After spraying of the coating, the cylinder bore surfaces are dressed using fine machining tools with six bladed PcBN blades. The geometry of the bore surface is thus prepared for the final precision honing. The fine machining tools are equipped with coolant-controlled actuating mechanisms and cutting compensation to further increase the tool lives.
Complete machining of high-strength steel grades in the turbocharger

Downsizing and turbochargers are the driving forces behind modern engine development. In the past, machining centres and lathes were often necessary for the production of the turbine and compressor housings for turbochargers. The geometrically complex machining, particularly of the turbine housing, is further complicated by the fact that high-strength and heat-resistant cast steel grades are used here. These must not change their microstructure in a temperature corridor of -40° to +1050°C. The loads on the inserts are correspondingly high.

Modern production methods allow complete machining on one machine. Contours and recesses are machined using mechatronic tool systems and interpolation turning. Complete machining tools also combine a large number of machining steps. The tangential technology firmly embeds the cutting elements in the tool body. Apart from the stability, the tangential technology allows the use of highly positive blade geometries which offer benefits for the machining of the high-strength steel.

Reliable and cost-effective reaming of sintered materials on the cylinder head

Downsizing has also changed the valve train in the cylinder head in recent years. The dimensions of the valve seat and valve guides have gradually been reduced from one generation to the next. In line with the principle of downsizing and of getting more performance from smaller engines, the materials used for the valve seat rings have to withstand high loads and temperatures. But improved materials with higher hardness make machining more difficult. PcBN is generally used as cutting material in order to achieve reasonable tool lives. The choice of the optimum PcBN grade and the right edge preparation are of crucial importance. It is also essential that the blade is mounted absolutely vibration-free and firmly in the tool body. With the MAPAL solution for the machining of valve seat rings, the blade is installed in a prism mount to avoid even the slightest vibrations that would have a negative influence on quality and tool life. The prism mount as a fixed blade seat is integrated into the tool body so exactly that adjustment of the blade is no longer necessary.

Due to the extreme loads to which valve guides are exposed, the sliding and thermal conductivity properties of the materials used play a major role. In practice, sintered metals are increasingly being used, as they are less expensive and have a higher wear resistance compared with other materials. This latter aspect, however, makes high demands on the reaming tools used for the valve guide machining. Several tool solutions from MAPAL are essentially available, with guide pad tools up to diameters of around 6 mm being the first choice. For smaller diameters, the PCD solid head technology is used where a tool head of solid PCD is fastened to the end of a solid carbide tool body using a special brazing process. The innovative production process allows the tools to be equipped with a very large number of blades. In a recent application example, a valve guide reamer with a diameter of 5 mm had no less than six blades. The cylindricity values achieved with the tool are outstanding; furthermore, the tool life was increased by three times compared with a conventionally equipped tool.

MAPAL supplies cutting solutions for the cost-effective complete machining of turbochargers.

Tools with solid PCD head and a maximum number of blades are predestined for the machining of small valve guide diameters.
The challenge is to develop machining solutions that take the specific material requirements into consideration as well as the workpiece geometry and quality and the basic machining conditions.

Reliable milling processes for aluminium hybrid parts

Particular focus is placed on the engine block as the heaviest single component when it comes to weight optimisation measures. The changeover from grey cast iron to aluminium materials brought with it weight savings from 40 to 50%. Aluminium, however, has weaknesses when it comes to the coefficient of thermal expansion, which would lead to bearings expanding. The use of ferrous materials in the main bearing area allows this to be controlled. Today the advantages of the two materials are combined in series production by casting grey cast iron inlets into the aluminium housing. This combination represents a real challenge for the machining of both materials, as they require fundamentally different cutting materials and also different cutting speeds. This conflict generally leads to inadequate tool lives during machining, particularly when specific surface finishes have to be achieved.

One solution for the face machining of the cylinder crankcase is the monolithic PCD face milling cutter, HP-FaceMill, with fixed brazed PCD blades and a solid steel tool body. The breakthrough in the machining was achieved through the use of the milling cutter with the cutting speeds normally used for grey cast iron. Thanks to the large number of blades on the tools, respectable feed values can be attained even in a low speed range for PCD tools.
Alternative machining strategies for Inconel and titanium

Apart from the adaptation of the tool technology to the specific demands of new materials, the use of a new machining strategy can also provide the desired success. One example here is the trochoidal milling of titanium or Inconel. Due to the high strength of these materials, the load on the blades with normal milling strategies is very high. The high temperature, in particular, results in rapid wear. In order to counter this, low cutting rates and contact depths have to be used, resulting in long machining times, particularly for high-volume machining.

This is in contrast to trochoidal milling where the milling cutter is guided highly dynamically on a trochoidal path. The maximum pressure angle is thereby defined according to the material. For superalloys, for example, it is only approx. 40°. The cutting time of the milling cutter is therefore very short and the thermal load greatly reduced. Low cutting widths and hence smaller cutting forces allow higher axial cutting depths so that large cutting volumes can be attained. With dynamic trochoidal milling, the feed rate is modulated so that the average chip thickness is constant and a uniform load is exerted on the cutting edge.

A suitable machine with highly dynamic axes and high-speed controller and suitable CAM software are basic prerequisites for trochoidal milling. Specially optimised milling cutters bring further benefits here. As very high spindle speeds are used in the process, there is a risk of vibrations with conventional milling cutters. In order to avoid this, MAPAL uses optimised solid carbide milling cutters from the OptiMill® range with unequal cutting pitch and variable helix angles which tend to vibrate less even with high cutting data.
OptiMill®-SPM – new high-performance milling cutters for high-volume metal cutting of aluminium structural components

High stability during machining thanks to optimally embedded PCD blades. No notch effects or projections

Maximum infeed through optimal ratio of cutting edge length to diameter

Reduced cutting forces and high surface quality thanks to highly positive chip angles and enlarged axis angles

Unhindered chip removal. No corners or leading edges in the chip flute

Excellent rigidity thanks to conical design

High-volume machining of aluminium represents a major challenge in the aerospace industry. As a rule, wing parts or frames are machined from solid metal, often more than 90% of the raw part is removed. The tools and machines used, must of necessity provide a reliable and high performance to avoid scrap, and at the same time to keep machining times as short as possible. With the newly developed OptiMill®-SPM high-performance milling cutters, MAPAL introduces a highly efficient tool solution for the roughing of aluminium structural components.

KEY FACTS:
- High material removal rate: > 8 l/min at ø 32 mm with HSK
- Soft, low-vibration cutting
- Excellent surface quality at low power consumption
- Unhindered chip flow prevents tool break
- Polished chip spaces

STANDARD PROGRAMME:
OptiMill®-SPM tools are also available as standard as solid carbide versions. The programme is supplemented through variants with the CFS replaceable head system.