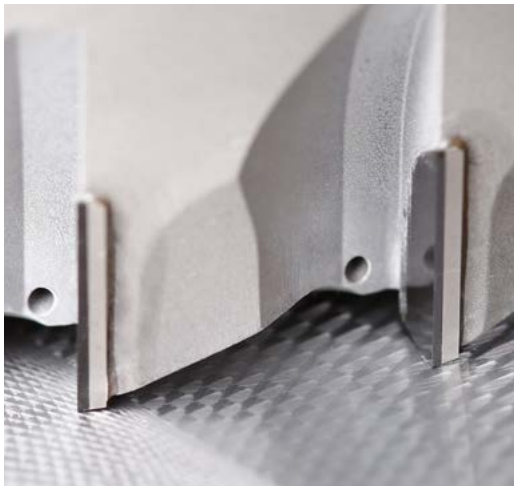
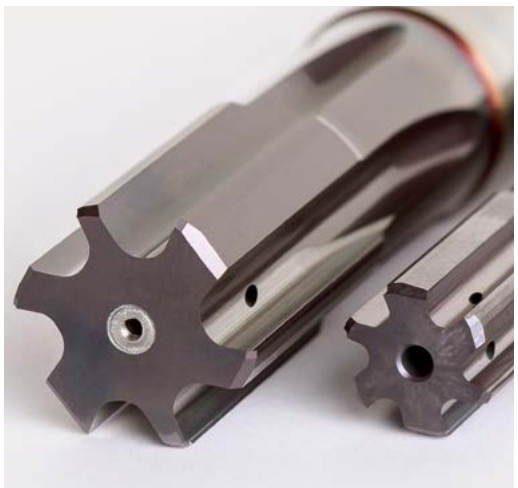
Your technology partner for machining

# INNOVATIONS 2019








When something exceptional develops between us:
**That's the MAPAL effect.**

# You

don't want to do everything differently. But many things better.

# We

**Opening up opportunities**

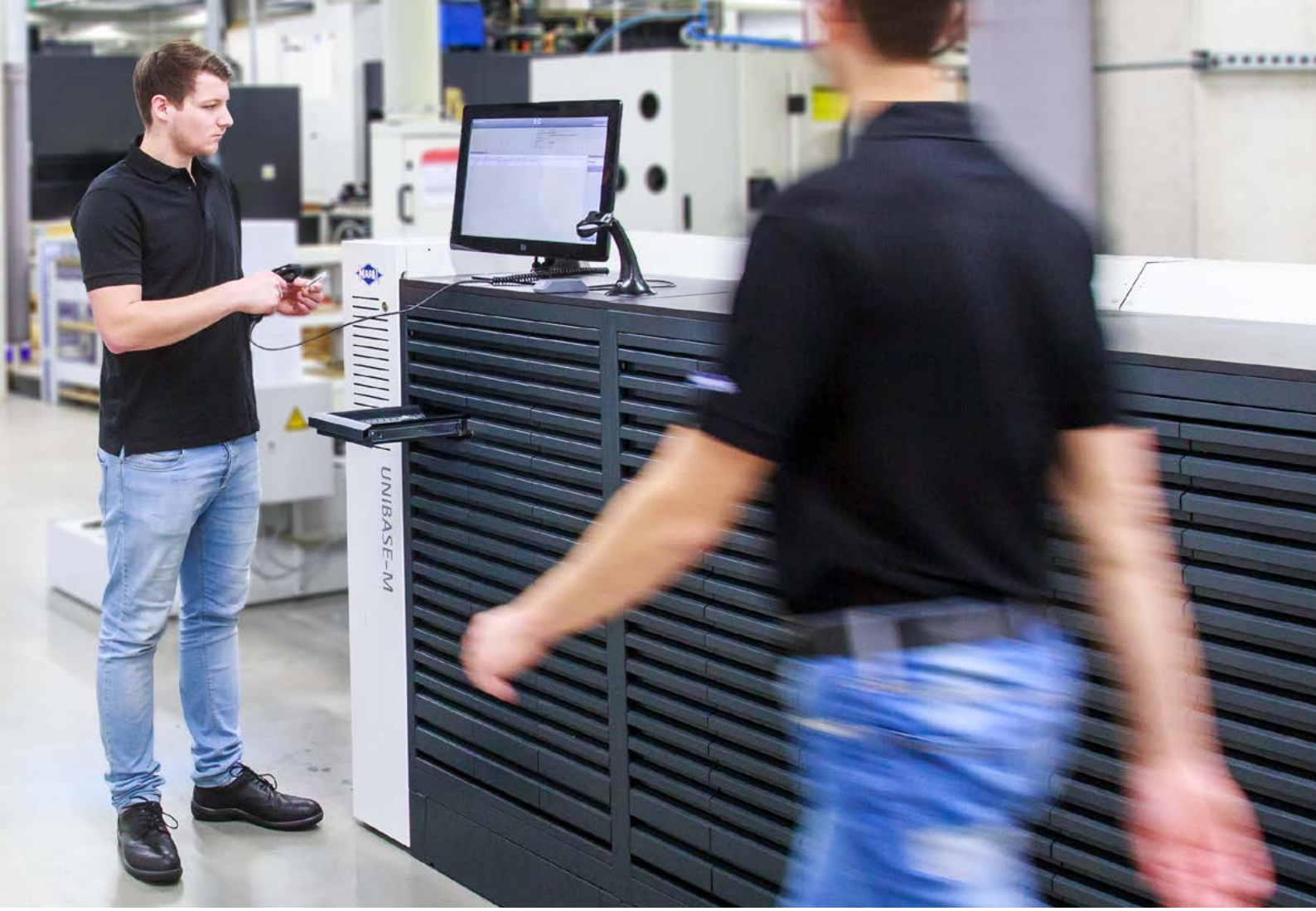
always find new ways to get more for you out of your processes.

# Innovations

## and product range additions 2019

The MAPAL catalogues contain the complete MAPAL portfolio – for the sectors reaming | fine boring, drilling from solid | boring | countersinking, milling, turning, clamping, actuating, setting | measuring | dispensing and services.

**The catalogues can be downloaded from and ordered at mapal.com**

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# Electromobility – Innovative machining concepts for all components

Even today, MAPAL already offers a wide range of innovative machining solutions for the manufacturing of the individual parts and components of electrified motor vehicles.

**1. High precision for large diameters using ultralight tools**

The high-precision machining of the main bore in stator housing presents a challenge for tool and machine. All other steps in the production of the stator housing could be carried out on machines with HSK A63 spindle. For the main bore, however, a machine with HSK A100 spindle had to be used. That is due on the one hand to the high cutting torques of up to 500 Nm, and on the other hand to the maximum permissible tool weight and tilting moment. Cost-effective manufacturing with short cycle times calls for a solution in which the complete machining can be carried out on one machine with small connections, as these machines are characterised by their high spindle speeds, lower investment and operating costs and lower energy consumption. In order to meet these demands, MAPAL has developed a fine boring tool of ultralight design. The low weight of around 10 kg meets the precondition for use on machines with smaller spindles. In addition to the weight, MAPAL has also optimised the cooling channels, a special back-flushing system ensures a far more effective removal of the chips, thus preventing chips from scratching the machined surface.

**2. Chatter-free machining of highly complex thin-walled battery housings**

MAPAL offers the necessary tools with the optimum strategy for the different variants of the battery housing. PCD as cutting material and the MQL technology are used for maximum cost-effectiveness. Different milling technologies are employed to reduce the cutting forces, depending on the required stock removal, machining application and component. For certain contours, for example, the use of milling cutter for high-volume machining can be expedient. The SPM milling cutter from MAPAL is ideally suited to this application. Thanks to its high positive cutting edge geometry and the optimised chip flutes, the cutting force is reduced by up to 15% com-

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pared with conventional milling cutters. If, for example, deep pockets are to be machined, MAPAL employs special PCD milling cutters whose cutting edges are arranged with both positive and negative axis angle. In combination with the trochoidal milling strategy, the cutting force is kept very low even in this machining operation – despite the material removal rate over the entire depth of the pocket.

**3. Spiral forms with tolerances in the µm range**

Not only the drive and the energy storage system are affected by the electrification of the vehicles, but also a number of auxiliary units. One example of this is the electric refrigerant compressor. The heart of an electric refrigerant compressor is two nested aluminium spirals – scroll stator and scroll rotor. The efficiency of the electric refrigerant compressor depends essentially on how precisely these parts are manufactured. The demands on form and position tolerances here lie in the range of a few µm. A particular challenge here, for example, is the machining of the "screw". A defined rectangularity of less than 0.04 mm and a surface roughness ($R_z$) in the single-digit µm range have to be assured. Despite these demands, the thin walls and the depth of the part, finishing has to be carried out in a single pass. MAPAL has developed an SPM milling cutter with finishing geometry and highly positive rake angle for this application. It ensures low-vibration cutting and has an additional chamfer on the diameter. It can perform the machining of base, wall and chamfer on the front face in a single step. As a result, the close tolerances for rectangularity and surface finish can be reliably achieved.

## AT A GLANCE

- Concepts and processes for all the components to be machined
- For example, stator housing, battery housing and auxiliary units

## ADVANTAGES

- Complete machining from a single source
- Maximum precision – assured through decades of experience
- New tool concepts thanks to innovative production methods

# Reliable machining of unstable structural parts susceptible to vibration

Thin-walled parts are used in a wide variety of applications. These components are often manufactured close to the net shape, but nevertheless require a great many machining operations. The particular challenge for these machining processes is that due to their design, these parts are very unstable and susceptible to vibration. That creates special demands upon the design of the process and the tools.

For the customer it is important that these parts are preferably machined in a single clamping system. In order to meet this demand and to make as many of the surfaces to be machined as accessible to the tools as possible, certain allowances have to be made in the clamping system. As a consequence, the workpiece is not optimally supported and tends to vibrate. Thin webs, voids and interruptions to be machined and widely fluctuating stock removals from the cast blank also call for special tool solutions. For large parts with a great many machining steps, this would require a huge number of tools. The expedient merging of these steps using combination tools in order to reduce the non-productive times and the number of tool slots is therefore the ideal solution – also from the point of view of the customer.

Thanks to its vast understanding of the processes for the machining of unstable structural parts, MAPAL is able to offer cost-effective and reliable processes. Three aspects are of particular importance here. Firstly the adjustment of the cutting rate is a factor for reducing or avoiding rising vibration. Both vibration of the tool – which would result in short tool lives and poor machining results – and vibration of the workpiece have to be prevented. The latter would result in a recoiling of the part against the cutting edge and could cause damage to the tool. The second important adjustment in the tool design is the evaluation of the tool body. Vibrations can be reduced here by an appropriate design and choice of material. Furthermore, an intelligent arrangement of the cutting edges in form and position helps to keep the cutting forces low. And finally the machining process itself offers possibilities for reliable machining of parts susceptible to vibration. Reorganisation and the choice of alternative sub-processes create a change in the distribution of forces that can increase the process reliability. For example, the use of a circular milling operation instead of a solid drilling operation can help to stabilise the process.

# Adapted tool solutions make vibration controllable

## AT A GLANCE

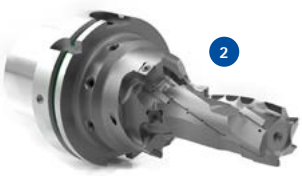
- Process and tool design for the machining of unstable parts susceptible to vibration
- Combination tools
- Modified designs of tools and clamping systems

## ADVANTAGES

- Cost-effective and stable processes
- Reduced non-productive times
- Increased process reliability thanks to optimum force distribution


**1. Solid drill with diamond-coated indexable inserts**

- ISO indexable inserts with three cutting edges for maximum cost-effectiveness
- Combined machining of chamfers using PCD cutting edges reduces the machining time




**2. Circular milling cutter for face and circumferential milling**

- Process-adapted tool design: special helix angle with Z=3 reduces the circular miller cutting forces while Z=6 maximises the cutting data of the face milling operation
- Particularly wear-susceptible machining performed using ISO indexable inserts


**3. Plunge miller cutting above centre**

- Optimised front geometry and chip flute design
- Modified clamping tool with vibration dampers
- Load-reduced cutting edge arrangement


**4. (Set of) disc milling cutters for Slot face milling**

- Simultaneous finishing of ribs and chambers
- Balanced cutting with cut distribution to prevent jamming of the chips and to ensure a smooth milling process

# Process solution for machining all types of connecting rods

Connecting rods are highly stressed engine parts. To take account of downsizing and the reduction of $CO_2$ emissions, connecting rods are also becoming increasingly lighter. This is achieved on the one hand through the use of high-strength and innovative materials, and on the other hand through modern production processes. This also changes the shape of the connecting rods and the variety of shapes increases. MAPAL offers the complete process for machining different types of connecting rods – whether on the transfer line or the machining centre as well as for wet or MQL machining.

When machining the connecting rod, the small connecting pin bore in particular is a challenge. Depending on the geometry, there are completely different drilling situations. For example, for stepped connecting rods or trapezoidal connecting rods, flat, deep and conical spherical surfaces or for existing forging noses. MAPAL has developed a modular tool concept for drilling from solid with indexable inserts especially for this type of machining. Radially integrated, sintered indexable inserts each with four cutting edges are used here.

The placement of the indexable inserts and the chip flutes are adapted to the special requirements of the different drilling situations. The cutting materials are also adapted. Amongst others, the new CVD coating from MAPAL is used, which combines the previously opposing high ductility and high wear resistance parameters and thus allows machining with significantly higher cutting speeds than before.

The tool body of the new tools is made of an optimised material with significantly less vibration. A central coolant supply in the holder ensures an optimum supply of coolant directly at the cutting edges. This means a significant increase in process reliability and stability during the machining of bores.

As a complete provider, MAPAL not only offers the optimum tools, but also chucks perfectly tailored to the respective type of machi-

ning, including hydraulic power chucks or the HTC with slim contour for locations that are difficult to access, such as the oil bore. With the mechatronic actuating tool TOOLTRONIC, MAPAL also offers the appropriate solution for complex geometries, for example bores that are not circular or shaped bores with an oil groove. MAPAL thus offers customers the complete process with minimum tool changes, which is specially geared to the prevailing conditions in each case.

## AT A GLANCE

- Complete process from a single source
- Machining of all connecting rod types
- Process for wet and MQL machining

## ADVANTAGES

- Perfectly matched tool and tool clamping concept
- Solutions for even complex geometries
- Cost-effective and reliable machining process

# TTD-Tritan –
# Machining of heat exchangers taken to the next level

Many versions of heat exchanger are used in different industries where they allow, for example, waste heat to be used for other processes. In the case of shell & tube heat exchangers that are generally made of metal and are classified as recuperators, one medium passes through the tube bundle and a second medium flows through the shell. A heat exchange takes place without mixing the media. Depending on the size, the tube plate at the end has a large number of bores. In order to ensure that the medium does not escape at this component transition, high demands on positioning accuracy and dimensional accuracy are made on the bores.

**Triple edge drill is the method of choice**

The triple-edge TTD-Tritan replaceable head drill improves the machining of the tube plates with respect to cost-effectiveness, precision and performance. On the TTD-Tritan, tool head and tool holder are joined by Hirth serrations. This connection is easy to operate and particularly stable, so that all the drill reaches the performance level of the solid carbide equivalent. In addition it guarantees the best torque transmission with simultaneous high changing and radial run-out accuracy. The TTD-Tritan is perfectly centered via its pronounced drill tip, ensures very good circularity and in many cases makes a piloting superfluous. In addition, the cost-intensive carbide is limited to the tool head for the replaceable head system, which leads to low tool costs even with large diameters.
The replaceable head system also has a positive influence on stock-keeping, as the wear parts are essentially limited to the drill heads. That in turn reduces the capital tied up in the warehouse.

MAPAL offers a wide range of diameters in all common lengths to allow various types of tube plate to be machined. Smaller diameters are produced with the solid carbide design of the Tritan-Drill.

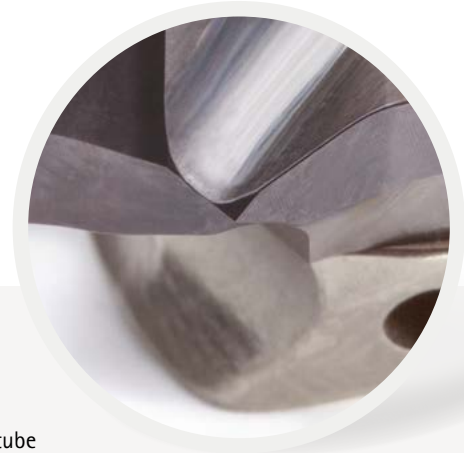
## AT A GLANCE

- The right drill concept for front and intermediate plates
- Triple-edge replaceable head drill for the machining of heat exchangers
- Easily operated, sturdy connection
- Pronounced drill tip for very good circularity

## ADVANTAGES

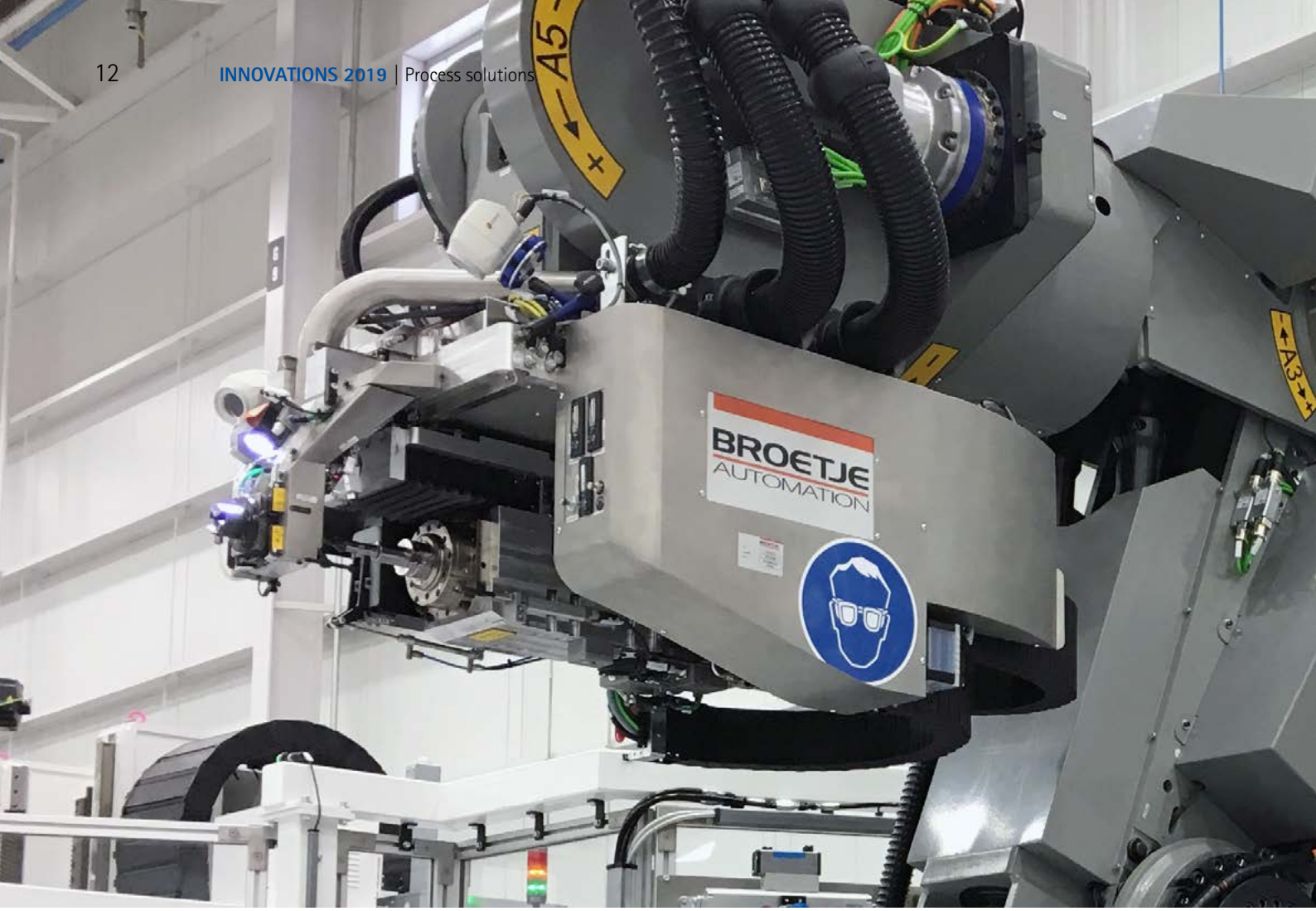
- Significant increase in feed rate and tool life
- Tritan geometry for good bore results
- Replaceable head system for high cost-effectiveness and easy handling
- Complete machining in one machining step

## The *BONUS*



**QTD indexable insert drill with new pyramid tip for stack machining**

In addition to the two front tube plates, slightly thinner intermediate plates with the same bore pattern are also installed in shell & tube heat exchangers. These intermediate plates are stacked above one another for machining, spot welded together, drilled and then separated again. With the QTD indexable insert drill with innovative, patented pyramid tip, MAPAL has the optimum solution for even this application in its portfolio. The newly developed indexable insert with pyramid tip has a very small chisel edge and a tip angle of 120°. Furthermore, the indexable insert is self-centering and ensures a controlled bore entrance. The intermediate plates can thus be reliably drilled in a single machining step.




# Aerospace – Drills ensure greater process reliability

The number of aircraft built per year is rising continuously. Final assembly of the aircraft, however, is still far from being a fully automated production line process. As a rule, an aircraft is fully assembled in one place. But here again, the degree of automation is increasing with more and more robots being used. Here robots with end-effectors for drilling and riveting mounted on shuttles are moved from assembly position to assembly position along the aircraft fuselage and position themselves automatically.

Conventional robots frequently do not have the optimum rigidity. This results on the one hand from the constantly changing positions of the main axes and the use of multi-stage planetary gear units, and on the other hand from the high weight of the end-effectors used that necessitate laborious control compensation before commissioning. The tool therefore has the task of carrying out the drilling process reliably and over a long tool life under these difficult boundary conditions.

In addition to this lack of rigidity, the very heterogeneous material combinations used in modern aircraft construction also represent a major challenge for the tool development. Multi-layer machining is state-of-the-art with combinations of aluminium, titanium and CFRP materials often being used. MAPAL has defined various tool features especially for the aerospace industry that can be adapted optimally to the material and the boundary conditions, depending on the machining situation.

The "MicroReamer" micro-cutting stage patented by MAPAL has the ability to cut at the side and to bring the diameters of all the layers to tolerances in the IT8 range. The burr at the bore outlet that has to be less than 0.1 mm can also be reliably achieved with this micro-cutting stage.

Also of great influence is the differential tip angle, i.e. the combination of a small tip angle in the middle of the tool and a large tip angle at the outside diameter. The small tip angle in the middle ensures immediate self-centering, a good radial run-out of the tool on entering the material and hence a high diameter precision. The large tip angle at the outer diameter guarantees a small outlet burr when

The industry is also reacting with the development of more rigid robot systems that in combination with the optimised tool solutions further enhance the process reliability and flexibility of aircraft assembly.

*Picture: Broetje-Automation GmbH*

aluminium or titanium are on the bore exit of the component. In cases where CFRP forms the external material layer, the differential tip angle prevents delamination at the bore exit. The prevention of any burr formation and delamination is of great importance for the compact fitting of the aircraft parts and hence for optimum strength that prevents localised overloading of the structure.

In combination with innovative diamond coatings that prevent the formation of built-up edges, high-performance drills from MAPAL ensure reliable processes and cost-effective results when machining using robots.

## AT A GLANCE

- Tool solutions for drilling processes with robots
- Wide range of material combinations can be controlled

## ADVANTAGES

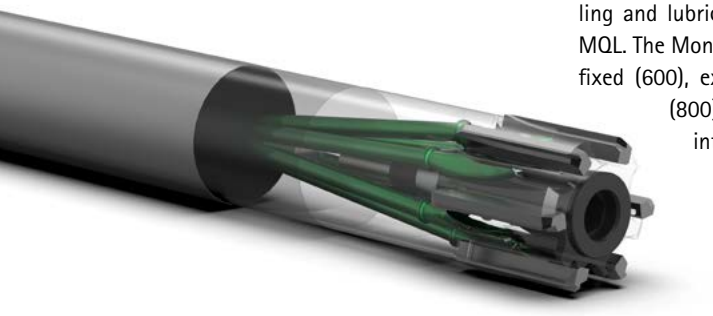
- High process reliability
- Optimum tool design for every application
- Many years of experience guarantee the best machining results

# MonoReam – Optimised cooling for reaming

Multi-bladed reamers are the tool of choice when high cutting rates and short machining times are called for. In view of the limitations of conventional production methods, it has not been possible to date with steel tool bodies to direct the coolant exactly to all the functional areas of the tool. Compromises always had to be accepted in the design of the coolant channel bores. Thanks to additive manufacturing, MAPAL has now succeeded in redesigning the coolant supply and the form of the coolant outlet and to gear the system perfectly for reaming operations.

Thanks to special cooling lubricant outlets on the multi-bladed reamers, the coolant can now be delivered to exactly where it is needed. In this way optimal chip removal and ideal cooling, as well as efficient lubrication of the cutting edges and the arc land chamfer are ensured. In turn, this aspect results in less abrasive wear on the arc land chamfer, better chip removal as well as optimised machining results.

All reamers in the three MonoReam series are available with the new additively manufactured tool heads and therefore optimised cooling and lubrication – even on the usage of MQL. The MonoReam reamers are available as fixed (600), expanding (700) and adjustable (800) variants. The three series are interchangeable.



## AT A GLANCE

- MonoReam multi-bladed reamers with optimised cooling
- Special cooling lubricant outlets thanks to additive manufacturing
- Suitable for MQL
- Straight and left-hand fluted, short and long design
- Suitable for through bores and blind bores

## ADVANTAGES

- Efficient cooling and lubrication of blade and arc land chamfer
- Improved chip removal
- Better machining results

# FixReam – Improved series and new model

The FixReam high-performance solid carbide reamers (FXR) cover a wide range of applications. Depending on the diameter, the high-performance reamers have between four and eight cutting edges with internal cooling and achieve correspondingly high feed rates.

MAPAL has optimised the whole range. New carbide substrates geared specifically to the machining operation in combination with new coatings result in longer tool lives. A new arc land chamfer allows the reamers to enter the bore more precisely – as a result, circularities and cylindrical forms are further improved.

In addition to the optimised series, MAPAL is also presenting a further model of the high-performance reamer. The new "FixReam short" for the machining of steel and cast iron allows both through bores and blind holes to be machined with one and the same reamer. That is made possible by the innovative design. It is therefore suitable also for use with short and medium production runs. Stocking costs are reduced thanks to the universal range of applications. In addition, the short form of the reamer preserves carbide metal resources and improves the stability of the tool.

## AT A GLANCE

- Optimised series – new substrates, new coatings, new arc land chamfer
- New and universal model for through bores and blind holes in steel and cast iron machining

## ADVANTAGES

- Tool life, circularity and cylindrical form improved
- Reduced stock costs thanks to universal FixReam short
- Carbide metal resources are conserved



# New chip breaker for the machining of aluminium with low silicone content

The machining of parts made from aluminium with low silicone content (silicone content less than three percent) results in long chips. These have a negative effect on the process in a number of ways. On the one hand there is a risk of the chips wrapping around the tool and hence negatively influencing the surface finish and the dimensional accuracy of the bore. On the other hand, long chips cannot be reliably removed from the part, the clamping fixture and the machine automatically during series production. This can lead to machine standstill and laborious reworking.

MAPAL has now developed a new chip breaker to ensure defined chip breaking during boring and reaming with PCD in aluminium components with low silicone content. Its special topology developed in time-consuming 3D simulations ensures defined chip breaking and hence short chips. Even with low feed rates and low stock removal, defined chip breaking and a defined chip shape are ensured. This guarantees highest performance and process reliability.

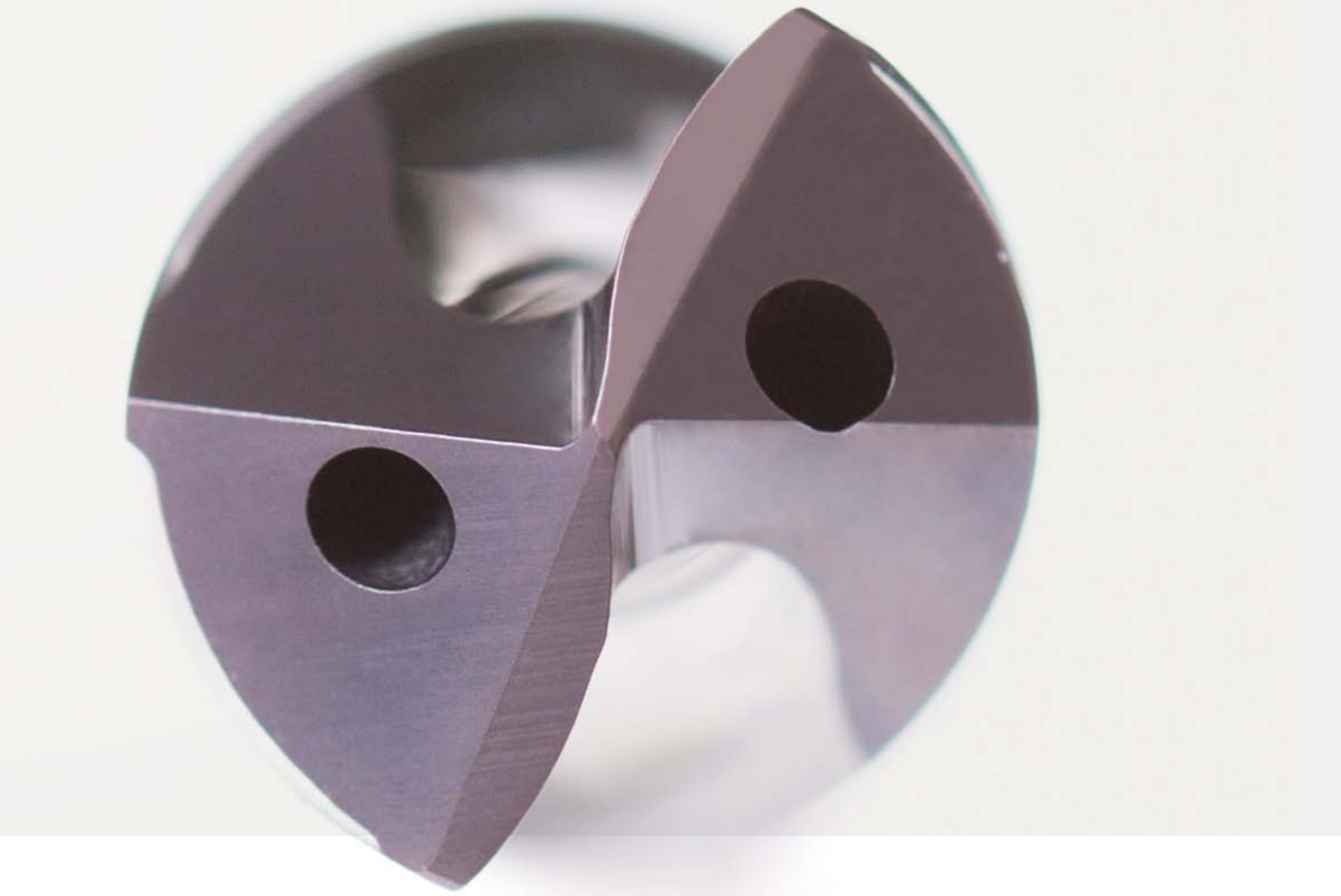
The newly developed chip breaker can be integrated into the PCD cutting edge or PCD indexable insert, irrespective of the particular application, and can therefore be universally used.

## AT A GLANCE

- Special topology of the chip breaker
- Developed using 3D simulation
- Defined chip breaking and chip shape

## ADVANTAGES

- Highest performance
- Process reliability
- for universal application
- No damage to the surface due to scratching
- No damage to the cutting edge due to long chips
- Universally applicable for every PCD cutting edge



# MEGA-Speed-Drill-Steel – Highest productivity and longest tool

With the MEGA-Speed-Drill-Steel, MAPAL is presenting a new drill for high-speed machining that is specially geared to the drilling of steel.

Compared with conventional two cutting edge drills, the new MEGA-Speed-Drill-Steel allows up to 20 percent higher feeds and up to double the cutting speeds. Three guide chamfers ensure maximum smooth running and process reliability. Thanks to the precision ground flute profile, friction between chips and tool is reduced and the chips are removed quickly and reliably. Thanks to its special crowned form, the main cutting edge is extremely sturdy and strong. The combination of these features ensures long tool lives and maximum productivity.

## AT A GLANCE

- High-speed drill for drilling in steel
- Available in the diameter range 3-20 mm
- Drilling depth 5xD

## ADVANTAGES

- Cutting edge extremely sturdy and strong
- Long tool lives
- Highest productivity

Tritan-Drill-Alu | Tritan-Drill-Iron | Tritan-Drill-Uni-Plus | Tritan-Step-Drill-Steel

# Tritan-Drill – Drilling with three cutting edges for all materials and applications

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

The tool geometry of the Tritan-Drill-Uni-Plus for the machining of steels, stainless steel alloys and cast iron materials has been further developed. Smooth flute profiles improve chip removal and a wear-resistant coating increases the tool life by up to three times.

The Tritan-Drill-Alu and the Tritan-Drill-Iron are now available for drilling in aluminium and cast iron materials. The Tritan-Drill-Alu has a tailored, polished flute profile. Large chip flutes and a special, sharp cutting edge preparation ensure optimum chip formation and reliable chip removal. The Tritan-Drill-Iron impresses with its corner radius design that offers greater stability and wear resistance of the corner of the cutting edge and a special wear-resistant coating.

The Tritan-Step-Drill-Steel was developed for stepped bores in tapping bores. The two cutting edge drills used to date tend to oscillate up and down along the chisel edge due to the flatness of the chisel edge in the middle, resulting in poor boring results. The new Tritan-Step-Drill-Steel with three cutting edges has an innovative point thinning and precision ground chip flutes for closely rolled and broken chips. The chips are reliably removed through the relatively small chip flute. The crowned cutting edge with pulling cut from the centre to the sturdy corner of the cutting edge makes the drill extremely sturdy. In combination with a wear-resistant coating, the machining results are outstanding: Compared with double edge stepped drills, the Tritan drills allow double the feed rates to be achieved – with a simultaneous increase in the tool life.

## AT A GLANCE

- Tritan-Drill-Uni-Plus for universal application: Available as standard with shank form HA in the diameter range 4-20 mm and in the lengths 5xD and 8xD
- Tritan-Drill-Alu and Tritan-Drill-Iron as application-specific special solutions for the respective material groups
- Tritan-Drill-Step-Drill for stepped bores in tapping bores

## ADVANTAGES

- Very high cost-effectiveness and performance thanks to high feed rates and long tool lives
- Broad range of standard versions guarantees high availability

Picture: F. Zimmermann GmbH

# OptiMill-SPM – Reliable processes when milling from solid

Aluminium structural parts, such as wing parts and frame ribs, are generally milled from solid material – with up to 95 percent material removal. Fault-free machining with respect to dimensional accuracy and surface finish is crucial here. And the part structure that becomes more and more delicate with increasing material removal and decreasing wall thickness represents an additional challenge. The reduction of the cutting forces produced therefore has a major effect on the quality of the part. Above all thin walls and free-standing sections can be displaced by excessively high cutting forces.

MAPAL has now developed new tools with polished indexable inserts for the roughing and finishing of these parts. The new tools complement the MAPAL SPM range for the machining of structural parts. For roughing, a special cutting edge profile has been developed that significantly reduces the cutting forces and the heat introduction into the component.

The new finishing geometry prevents the pulling inwards of the tool during the finishing of deep pockets even with high wrapping.

The tools in the OptiMill-SPM series are characterised by their conical neck. In this way high rigidity is guaranteed over the entire machining process. The highly positive cutting geometry and the optimised chip flutes ensure a significantly reduced cutting force.

## AT A GLANCE

- Maximum contact depth
- Polished chip flutes
- Highly positive rake angle and conical form
- PCD and ISO indexable inserts available

## ADVANTAGES

- Optimum chip removal
- Reduced cutting forces and high surface finish quality
- Reliable machining of delicate components

# Radial ISO indexable inserts – Portfolio for milling rounded off

MAPAL is rounding off its portfolio of standard milling tools with a milling cutter range of compacted radial ISO indexable inserts. Until now the focus was mainly on a milling cutter range with ground tangential ISO indexable inserts. These are used in particular for special applications, very large stock removal, unstable conditions or disc milling cutters.

MAPAL has incorporated the comprehensive know-how gathered in these special applications into the new series of milling cutters with radial ISO indexable inserts. The new powerful face, shoulder, slot and shell end face milling cutters are designed for roughing and for medium machining of cast iron, steel and stainless steel. They have optimally designed tool bodies with the ideal number of teeth for the respective application. Positive and negative indexable inserts made of four different PVD cutting materials, based on newly developed carbide substrates and coatings, are available for the milling cutters.

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

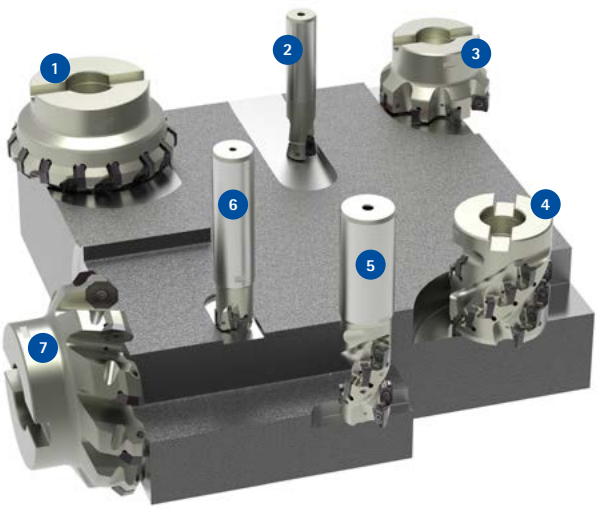

## AT A GLANCE

- Milling cutter range with compacted radial ISO indexable inserts
- Plane, shoulder, slot and shell end face milling cutters
- For roughing and medium machining of cast iron, steel and stainless steel
- Positive and negative indexable inserts made from four different PVD cutting materials

## ADVANTAGES

- Comprehensive complete range for cost-effective and efficient machining
- Very smooth running
- Low noise
- Maximum tool lives

1. Face milling cutter with close spacing and 16 cutting edges for maximum cost-effectiveness
2. Shoulder milling cutter with cylindrical shank and positive basic form – ideally suited for steep angle plunging
3. Shoulder milling cutter with eight cutting edges
4. Shell end face milling cutter for steady machining operations – ideal for shoulder milling with large cutting depths
5. Shell end face milling cutter with cylindrical shank and up to four cutting edges
6. Shoulder milling cutter with cylindrical shank and up to four cutting edges
7. Face milling cutter with positive basic form – ideal for machining operations susceptible to vibration



OptiMill-Trochoid-Uni OptiMill-Trochoid-PM OptiMill-Alu-HPC-Pocket OptiMill-Uni-Wave

# OptiMill milling cutters and power chucks – Optimum combination for high-performance milling

MAPAL is extending its range of solid carbide milling cutters and presenting new models from the OptiMill ranges 'Wave', 'Trochoid' and 'Alu-HPC-Pocket'.

The trochoidal milling cutters from the MAPAL OptiMill-Trochoid range now have additional specially formed chip breakers. These ensure short chips and their reliable discharge from the process. The solid carbide tools impress with very high cost-effectiveness thanks to high cutting rates with cutting depths up to $a_p$ = 5xD.

Time-consuming ramping processes or pilot bores are frequently the order of the day when milling pockets. In order to eliminate these steps during the machining of aluminium, MAPAL is now offering the OptiMill-Alu-HPC-Pocket solid carbide milling cutter.

For this, the OptiMill-Uni-HPC-Pocket that is successfully used for numerous machining operations was specially adapted to the machining of aluminium – including adding a new coating.

With the OptiMill-Uni-Wave, full slot milling with a groove depth of up to 3xD is possible. The solid carbide milling cutter that can be used for a wide range of materials can be operated with high feeds. Thanks to the innovative knurled roughing geometry, short and closely rolled chips are produced during machining that can be reliably discharged from the process. The milling cutter is now available as standard in new sizes and lengths.

MAPAL has not only expanded its range of high-performance solid carbide milling cutters, but with the new power chuck is now offering at the same time the optimum holder for the new milling cutters.

The new power chuck impresses with strong clamping, simple handling and very good radial run-out. The location bore is manufactured in the single-digit µm range. A patented spring element in the location bore ensures a defined form closure between tool and chuck. The tool can be reliably clamped in the chuck by hand without the use of a torque wrench. The chuck exhibits its full strengths during high-speed milling operations.

## AT A GLANCE

- Combination of power chuck and high-performance milling cutter
- The right tool for every milling application with new features, for further materials and in new sizes
- Groove milling, trochoidal milling and pocket milling

## ADVANTAGES

- Easy handling
- Maximum cost-effectiveness and precision
- Coordinated complete system from a single source

# FaceMill-Diamond – Greater flexibility for face milling

The FaceMill-Diamond PCD face milling cutter has been successfully in use worldwide for many years. It demonstrates its particular strength, however, during HPC applications or when machining unstable parts – and that with cutting depths up to 10 mm. The monolithic design with brazed PCD cutting edges allows large numbers of teeth, thus enabling high feeds and higher material removal rates. Machining with the FaceMill-Diamond results in very good surface finishes and a long tool life.

The FaceMill-Diamond has now been overhauled with the goal of making the proven solution even better. For optimum cooling and lubrication of the PCD cutting edges, the coolant outlets are positioned directly at the cutting edges in the new model. This ensures an improved chip removal and offers significant benefits, particularly in applications with MQL or blowing air.

The most apparent change in the new FaceMill-Diamond results from the demand for greater flexibility and independence of the machine interface. The face milling cutter is now designed as a modular cutter head variant. The milling cutter can now be flexibly used particularly for small series with different machine parks or even for large series that are produced on another machine and then relocated.

## AT A GLANCE

- Large number of fixed brazed PCD cutting edges
- Proven geometry variants available for different surface finish demands (< 10 µm / > 10 µm)
- Cutting depths of up to $a_p$ = 10 mm possible

## ADVANTAGES

- Improved chip removal and longer tool lives thanks to cooling directly at the cutting edge
- Cutter head variant for flexible use with different machine interfaces


# Vibration damping – Significantly improved surface finishes

Vibration often occurs during machining. This leads to dynamic instability of the system. Inadequate surface finishes, insufficient accuracy, high machining noises, shortened tool lives and, in extreme cases, broken tools and cutting edges can be the result.

In order to minimise these vibrations and their consequences, MAPAL has now developed an innovative system for vibration damping in the tool shank, as particularly tools for boring and milling with very long projection length tend to vibrate due to an inadequate dynamic rigidity of the overall system. When designing the new system, the developers took into account all factors arising from the interaction of the machine tool, the tool and type of clamping as well as the component.

The result: A system for vibration damping tailored to the rigidity of all common machine types. It can be used for machining different materials with different tools.

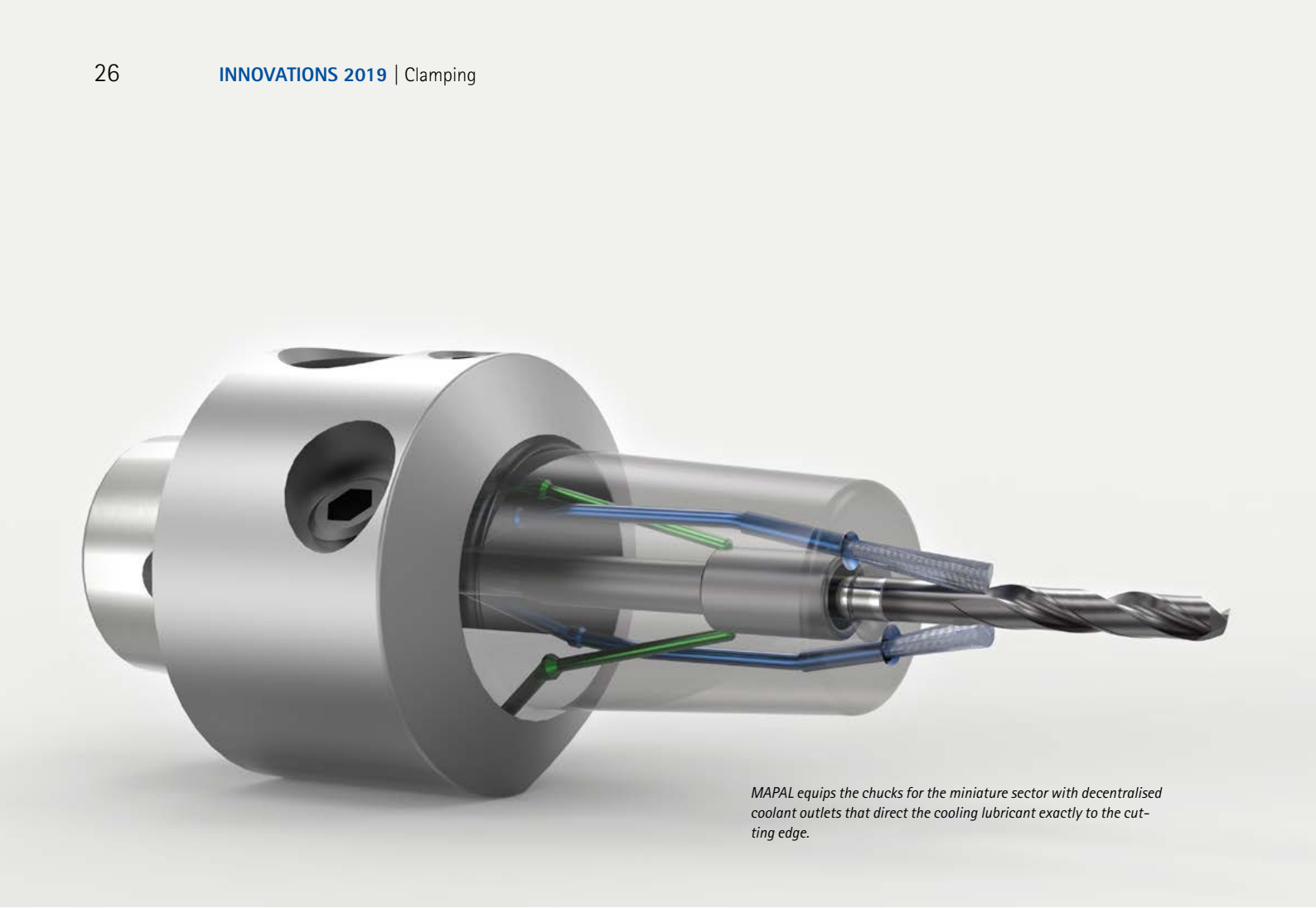
The self-contained system of auxiliary mass and several steel spring packages counteracts the deflection of the tool body and minimises it. Compared with tools without absorber system, the vibration amplitudes can be up to 1,000 times lower. Despite the long projection length, quiet, stable running is achieved. This makes it possible to work at higher cutting speeds and significantly increases the material removal rate. In addition, significantly better surface finishes are achieved thanks to vibration damping.

## AT A GLANCE

- System for vibration suppression directly in the tool shank for tools with long projection length
- Tailored to the rigidity of all common machine types
- Available with internal coolant supply for clamping diameters 16, 22 and 27 mm with a length of 200 and 300 mm for SK40, SK50, HSK-A63 and HSK-A100 connections

## ADVANTAGES

- Smooth, steady running despite long projection length
- Higher cutting speeds, higher material removal rates
- Better surface finishes



*MAPAL equips the chucks for the miniature sector with decentralised coolant outlets that direct the cooling lubricant exactly to the cutting edge.*

# Miniaturised clamping chucks – Maximum productivity in a confined space

Thanks to additive manufacturing, MAPAL has succeeded in producing hydraulic chucks in miniature format with HSK E25 connection, for example for the direct clamping of tools with a diameter of 3 mm. These meet all the demands on chucks for the miniature sector with respect to radial run-out accuracy, balancing value, cooling lubricant supply and handling.

In order to guarantee perfect radial run-out accuracy, innovative clamping chamber systems are integrated into the new chucks that fit tightly against the shank of the tool. They are fitted with dirt grooves as protection against micro-soiling. The demanded balancing value is ensured thanks to the internal balancing geometries and supporting structures that also aid the optimisation of weight and strength. The miniature chucks allow homogeneous acceleration and deceleration of the whole tool system of chuck and tool for less loading of the spindle.

The innovative manufacturing method has also enabled the chucks for the miniature sector to be equipped with decentralised coolant outlets. These outlets are designed using parameters such as coolant pressure, setting dimension and spindle speed so that they deliver the cooling lubricant precisely to the cutting edge. In the best case, a metered total-loss lubrication system is achieved that eliminates the need for subsequent cleaning of the parts.

The new miniature chucks from MAPAL allow quick and simple clamping of the tool. Neither training courses nor high setup costs or expensive peripherals are required for implementation of the chucks.

**New possibilities – not only for tool clamping**

The new small hydraulic chucks also offer new possibilities for the clamping of workpieces. For example, for the clamping of artificial hip joint balls. Specially formed clamping chambers inside the chuck and a special outside geometry ensure that the balls are very precisely and at the same time gently clamped. Particularly in medical technology, topics such as reproducible precision are taking on enormous importance – and this is ensured during machining thanks to the new chucks.

*Thanks to additive manufacturing, the hydraulic clamping technology can also be used for chucks with HSK E25 connection and lean contour.*

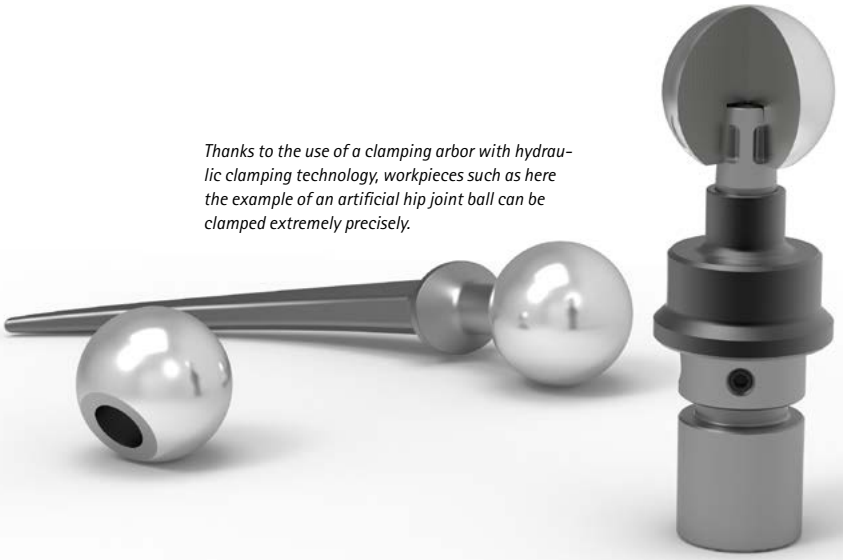

## AT A GLANCE

- Hydraulic chucks in the miniature sector
- From HSK E25 connection
- Tool and workpiece clamping

## ADVANTAGES

- Direct clamping of small-diameter tools
- Highest precision
- Decentralised coolant outlets
- Easy handling

*Thanks to the use of a clamping arbor with hydraulic clamping technology, workpieces such as here the example of an artificial hip joint ball can be clamped extremely precisely.*



# UNIBASE-S –
# Reduce time and logistics

MAPAL offers a variety of UNIBASE dispensing systems for optimum storage and management of tools, components and accessories. They can be individually linked thanks to the modular principle. These systems are often situated in a central location in the production hall. In order to store and manage frequently required consumables in a decentralised and space-saving manner, MAPAL has developed the new, cost-effective UNIBASE-S single automatic dispenser. It can be linked to an existing UNIBASE system or used as a stand-alone solution.

Thanks to its compact dimensions, the UNIBASE-S stock-controlled dispensing system can be installed directly on the workbench. The 80 tools slots provide ideal storage for e.g. indexable inserts, tools or chucks. This saves the employee a trip to the central warehouse and ensures manufacturing-related article procurement.

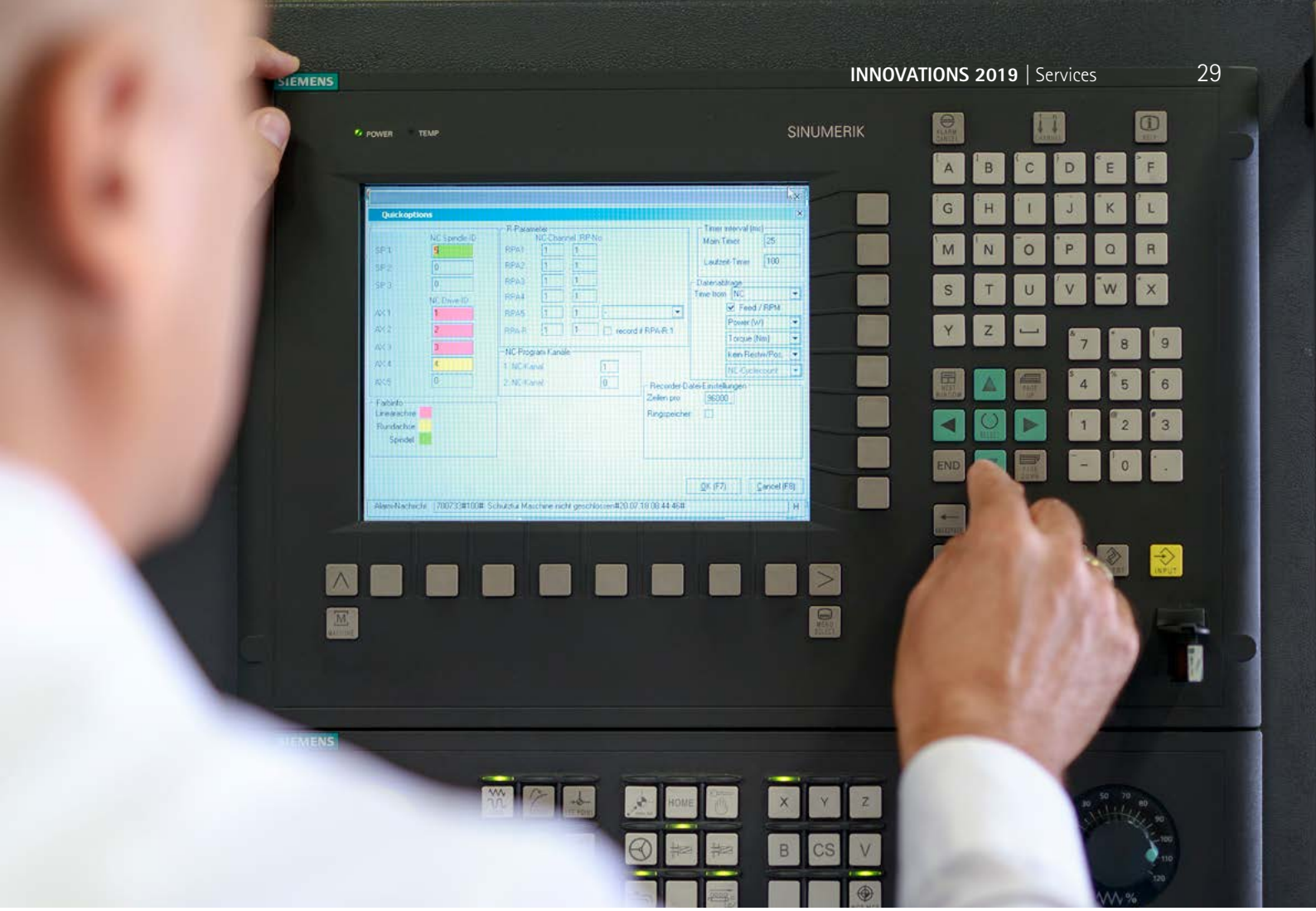
Article removal is quick and uncomplicated in just a few steps. To do this, the employee logs on directly to the device via the integrated touchscreen. After the desired article has been selected via the pre-installed software, the search function of the software supports this and an LED illumination identifies the compartment with the corresponding article. The dispensing drum is rotated manually so that it is at the removal position and the article can be removed. The system automatically registers the withdrawal – in this way, the current status is always used.

## AT A GLANCE

- Stock-controlled dispensing system
- 80 tool slots, individual dispensing
- Central locking

## ADVANTAGES

- Just-in-time article procurement
- Cost-effective
- Very compact – installation directly on the workbench




# Process analysis identifies potentials

Customers use the re.tooling service when they set up manufacturing for a new component, or when converting the existing machine park for the manufacturing of a new component. Or when optimisation is necessary during running production. In such cases, MAPAL offers the comprehensive analysis of all the process-relevant data and NC programs using software options that represent a new module in the re.tooling service, and so identify previously unused potentials. This is possible for the machining of one part, of several parts or also for identical machining operations on several machines. The result: Customers achieve a higher part production – without increasing tool or machine wear.

All the relevant information on process, component, materials, machine and parts produced is collected directly at the manufacturing line – with a focus on the individually defined goals. The software collects the data during the running process from the communication between control panel and numerical control unit. No intervention is made in the machine controller, so that the warranty for the machine and its controller is not affected.

After the data collection, the MAPAL experts analyse all the productive and non-productive times, paying attention for example to the spindle speeds, feed rates and current power consumption. The use of every single tool and the corresponding CNC programs is examined, the movements are visualised and corresponding optimisation potentials are identified. It becomes apparent, for example, when a tool runs for a period of time without power consumption. In this case the approach path offers savings potential. The analysis also reveals inconsistent machining operations that could endanger the process reliability.

Depending on the customer's demands, MAPAL then takes over the CNC optimisation, transfers the improved process to the machine and verifies the reduced program runtimes, improved component qualities and reduced tool costs in renewed process audits at regular intervals.

## AT A GLANCE

- New module for the re.tooling service
- Process optimisation during running manufacturing
- Identification of optimisation measures

## ADVANTAGES

- Higher process reliability
- Higher part productivity thanks to reduced program runtimes
- Higher component quality
- Lower tool costs


# Tool Management 4.0 – successful applications

For around one year now, MAPAL has been offering its "Tool Management 4.0". This uses the open-cloud platform from c-Com GmbH. The processes are digitised and displayed transparently using the c-Com SaaS solution (Software as a Service). In addition to the benefits of classic tool management, such as 100% tool availability, resource conservation and reduced inventory costs, Tool Management 4.0 opens up completely new potentials for the customer. Where individual lists with limited access were used in the past, the data are now available to every authorised person with Tool Management 4.0. It no longer has to be maintained in different systems. Data discontinuity is prevented. The individual projects are now being gradually changed over to Tool Management 4.0, depending on the agreement with the customer. The first projects are already in successful operation.

**Examples:**

**Cost per part reporting for engine production**

For example, MAPAL has changed over the whole tool management to the new platform for the works of a car manufacturer with the capacity for the manufacturing of 500,000 engines per year. The existing tool management is conducted exclusively via the platform. The most important indicators at tool level, such as consumption, stocks and overall the cost-per-part can be displayed transparently and read out automatically.

**Regrinding handling for roll milling cutters**

For another MAPAL customer, a TIER1 supplier to the automotive industry, the focus is on regrinding as the first step in the changeover to Tool Management 4.0. MAPAL has been responsible for the tool management there since 2012. Even then, the tool costs were reduced by around 15 percent.

The supplier has some 60 different roll milling cutters from various suppliers in use for more than 70 machining operations. The logistics surrounding the regrinding of the roll milling cutters that was not part of the tool management has been handled to date in the form of vast Excel files that are constantly sent back and forth by e-mail between the company's logistics department and the respective supplier. The consequences of this method were stocks that were too high or too low, regular


difficulties with the suppliers due to a shortage of tools and resulting stoppages in production – along with the high administrative costs for clarifying misunderstandings. The manufacturers of the roll milling cutters have indeed saved the number of regrinding processes of each individual tool in a database, but this data was not available to the customer.

With the changeover to Tool Management 4.0, MAPAL has now also taken responsibility for this aspect. First these tools were personalised with a data matrix code (DMC) and the data stored in the cloud. The current stock and status, how often the tools have already been reground and the remaining tool life can now be checked at any time. In this way, the tool costs for the roll milling cutters were reduced by 20 percent within a very short period of time – thanks purely to the transparent overview.

A similar project that MAPAL is carrying out for an automotive industry supplier also involves the regrinding handling. In this case, PcBN indexable inserts that are used for hard milling are being serialised. With a clear benefit for the customer: The status of every single special indexable insert is known at all times so that optimum use can be made of the regrinding potential of the PcBN cutting material.

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