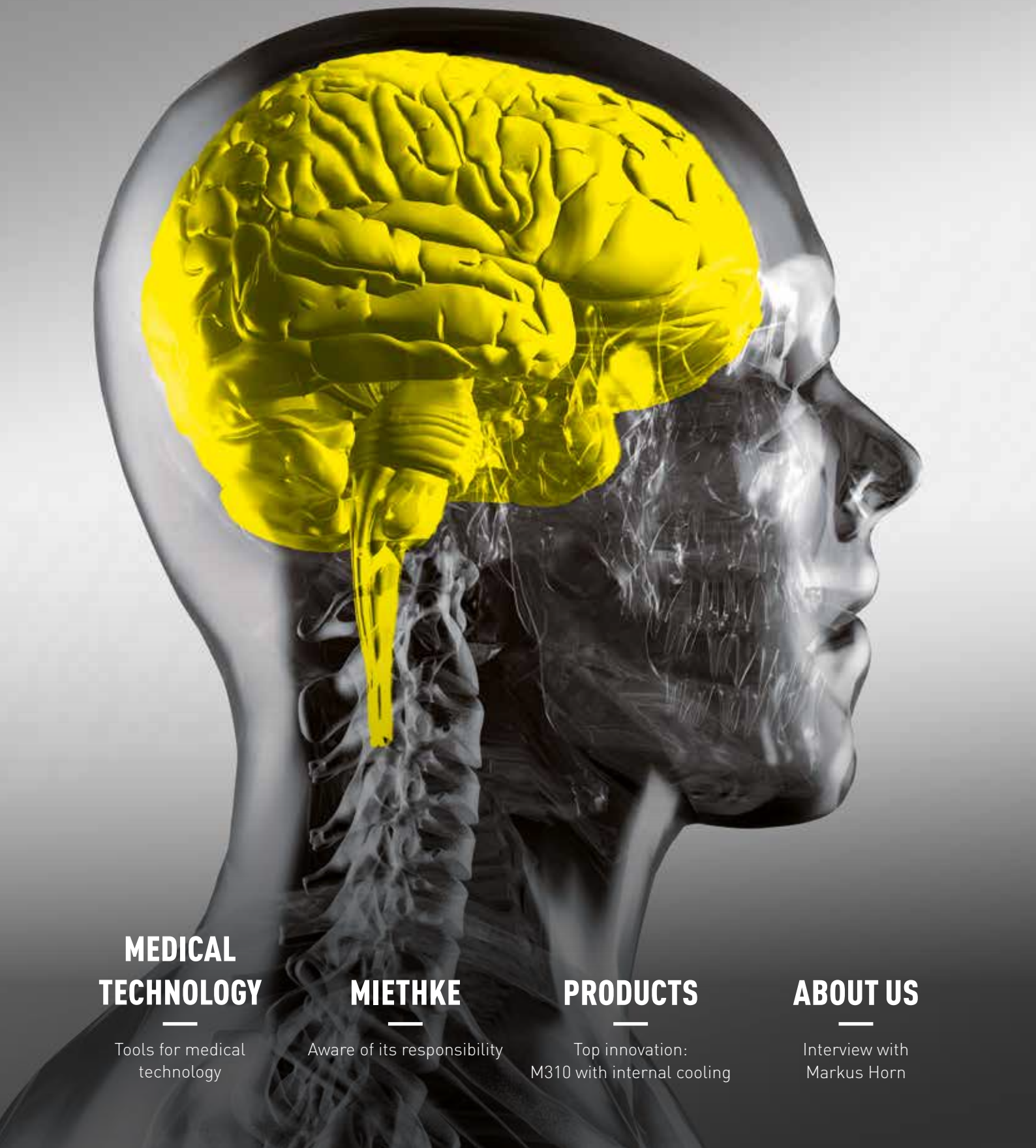
№ 01 2021

world of tools

HORN

SPECIAL FEATURE: MEDICAL TECHNOLOGY



DEAR READERS,

While we have been preparing this edition of "world of tools", COVID-19 has continued to be at the fore. Despite the presence of the pandemic in our everyday lives, in the media and at work, we think it is important to show that the medical sector, or – more precisely – the medical technology sector, is also addressing other matters, which are just as important. And that's exactly what we're going to do in this issue. In spite of the restrictions, most companies are still keeping going – and so are we. We are looking forwards and showing a little insight into what has slipped to the back of everyone's minds over the past few months.

We cannot change anything about the situation but we can make the best of it. For us, that means that we will keep focusing on innovative solutions using precision tools, additive production and wear parts, and on being a reliable partner for our customers. This issue will show you the results of the past few months, with a focus on tools. What's more, the subject of digitalisation has accelerated in a way that no one could have anticipated. We show how this is reflected in our products and how we interact with one another.

In 2021, we want to see lots of positive results and with a little consideration when dealing with one another, innovative spirit and the necessary perseverance, we are sure that we will be able to achieve this. We are optimistic.

Markus Horn, Lothar Horn and Matthias Rommel

world of tools
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SPECIAL FEATURE

TOOLS FOR MEDICAL TECHNOLOGY

Around 200 bones make up the human skeleton, which is held together and moved by over 600 muscles and numerous tendons. The organs, muscles, bones, vessels and nerves form a functioning, perfectly matched, complete system. With 100,000 beats per day, the heart pumps more than 6,000 litres of blood around the body. But what happens when the human body no longer works properly or the skeleton becomes damaged? This is where the challenges of medical technology begin. The dynamic development of the sector is unstoppable. The requirements of manufacturers and therefore their suppliers are increasing constantly: everything always has to be smaller, less invasive, more precise, safer and better for use in the body. These are just a few of the demands that manufacturers of medical devices have to confront on a daily basis.

As a tool manufacturer, HORN is able to meet these challenges and to constantly work on developing new tool solutions and production strategies for medical technology – from micro end mills for manufacturing sensitive titanium spinal column implants right through to grooving tools for the aluminium pump housing of a ventilator. HORN is always building on its expertise in tool technologies in the medical sector.

ORGANS, MUSCLES, BONES, VESSELS AND NERVES FORM A COMPLETE FUNCTIONING SYSTEM.

Our whirling technology is proof of this know-how. Key advantages of the whirling process include high cutting rates, long threads with high surface quality, deep thread profiles, short chips, multi-threads and minimal tool loads. However, despite having these benefits, the user has to face various technical challenges. One important aspect is the materials used for bone screws. The cutting edges of the whirling inserts are subjected to extremely high loads when machining titanium, stainless steels and other superalloys. To counteract edge wear while maintaining the required high machining volume and short processing time, tool manufacturers need to constantly optimise the tools and processes used and develop them further.

With JET Whirling, HORN presents a whirling system with internal coolant supply. By cooling the cutting edges directly, this system enables long tool life to be achieved. What's more, in conjunction with the stable whirling unit, the system achieves better surface quality on the workpiece and reduces the risk of chip build-up between the inserts. Surface quality plays a major role in the production of bone screws. Every groove or ridge can be a breeding ground for germs.

Broaching an internal hexagon socket

"Manufacturing a hexagon in titanium is relatively easy using profile broaching. Broaching in series production in cobalt-chromium, however, is virtually impossible due to its high strength and the significant tool wear," says a German user from the medical technology sector.

Due to this issue, HORN engineers proposed producing the hexagon socket using the shaping method. The method offers high precision and high process reliability as the cutting geometry and the carbide substrate can be easily adapted to the material being machined. The first tests quickly discovered the required solution. "The shaping tool makes it possible to produce precise fits and the surface quality is very good," says the user.

Implant 4.0

Digitalisation has also been playing an increasingly important role with implants in recent years. You can already find intelligent implants that can be controlled via an app in pacemakers or valves for regulating intracranial pressure. We can only speculate about what the future will bring but virtually every part of the body could be controlled using an intelligent implant in the event of a dysfunction: bladder, epilepsy and brain stimulators, retina implants, dispensing systems, and artificial pancreases – the list gets longer the more scientists, doctors and engineers you ask.

MEDICAL TECHNOLOGY

AWARE OF ITS RESPONSIBILITY

"We are passionate about researching and developing unique and innovative product solutions, and in doing so we constantly question the status quo." This is part of the company mission of Christoph Miethke GmbH & Co. KG from Potsdam, Germany. With its neurosurgical implants, the company is very much aware of its responsibility to provide functionality, safety and excellent product quality. After all, every one of their implants affects the quality of life of a person with hydrocephalus, who requires their trust. The Potsdam-based company relies on precision tools from Tübingen-based Paul Horn GmbH to manufacture the individual components from titanium. HORN is also constantly developing new and more productive solutions for users. "Thanks to these tools, we have already been able to optimise some of our components," explains MIETHKE machining technician Willi Engel.

The human ventricular system, made up of four interconnected cerebral ventricles, and the cerebrospinal fluid circulating around this system supply the brain with nutrients. All four ventricles are connected to one another and approximately 120 ml of cerebrospinal fluid circulates around them in adult humans. Another approximately 30 ml circulates in the external cerebrospinal fluid space and washes around the brain. The cerebrospinal fluid protects the brain from mechanical damage. It also regulates the intracranial pressure, keeps the brain tissue moist and transports metabolic products.

Every day, the body of an adult human produces approximately 500 ml of new cerebrospinal fluid, which is eventually reabsorbed by the venous blood system – so you could say that the fluid is replaced about three times a day. In healthy people, there is a balance between the production and resorption of cerebrospinal fluid. People with hydrocephalus generally produce more liquid than can be absorbed, resulting in the cere-

MIETHKE relies on the Supermini 105 system for axial grooving and finishing on the titanium valve cover.

Axial grooving of the valve cover with the Supermini 105.

bral ventricles becoming enlarged and causing an increase in intracranial pressure. This is where neurosurgical implants from Christoph Miethke GmbH & Co. KG come in.

Regulating the intracranial pressure

Compared to other neurosurgical procedures, the operation for implanting a cerebral shunt is neither dangerous nor difficult. The drainage systems are made up of a valve to regulate the intracranial pressure and catheters through which the cerebrospinal fluid is discharged. To implant a shunt of this kind, the neurosurgeon makes a few small incisions so that large parts of the system can be positioned in the subcutaneous tissue. Only the ventricular catheter has to be advanced into the ventricle and the end of the drainage catheter is placed into the corresponding body cavity (abdomen or the right atrium of the heart via one of the jugular veins). To position the ventricular catheter in one of the lateral ventricles, the neurosurgeon drills a hole through the cranium. The rest of the drainage catheter and the valve lie directly under the skin, whereby the valve is either positioned on the skull behind the ear, in the thorax or in the lumbar region.

"For implants, we always need to achieve the best possible component quality during production. As part of this, we are constantly optimising our production processes," explains Engel. The MIETHKE production team uses HORN tools for numerous machining processes. "We have been working closely

THE HUMAN VENTRICULAR SYSTEM SUPPLIES THE BRAIN WITH NUTRIENTS.

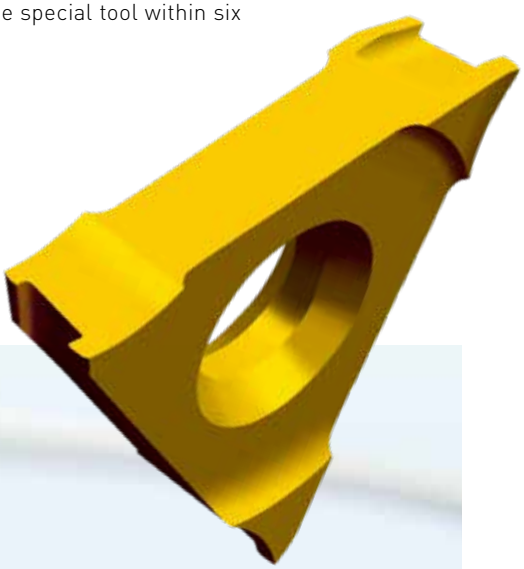
with HORN for over two years. The technical advisers are always available to give us support," Engel tells us.

High requirements

The Supermini 105 system is used to produce the thin-walled titanium cover for the proGAV 2.0 valve. This is both a tool for creating the face grooves and a special tool for finishing the cover. "For the tight fit on the cover with a length of 0.5 mm (0.02"), we had to design the Supermini tool with a corner radius of 0.05 mm (0.002")," says HORN engineer Christian Gries. Willi Engel continues: "The difficulty when machining titanium always lies in dissipating the heat and controlling the chips. For implants, we have strict criteria for the surface of the component and the extent to which it is free from burrs." By optimising axis travels in a CAM system, the experienced machinists were able to double the service life of the tools from the original 1,000 components to 2,000. "We have found the right ways to exploit the performance of the inserts to the maximum," explains Engel. MIETHKE makes tens of thousands of valve covers every year, so it is permanently set up on the machine.

The production of hose nozzles for reservoirs also required further process optimisation. Silicone hoses are fixed to the nozzles during use and the shape of the nozzle is copied. Action was needed in this area due to the dimensional accuracy and the large amount of time required for setting up and machining. Gries suggested replacing the copying process by using a profiled, three-edged S32T indexable insert. "In this way, the form can be machined and the nozzle parted off at the same time in one set-up," explains Gries. Those responsible were able to implement the production process within six weeks. The initial tests with the precision-ground indexable inserts were positive. However, a small burr formed during parting-off. By optimising the cutting edge profile and extending the trailing edge, it was possible to achieve the required results. "We supplied two variants of the special tool within six

BY CHANGING TO THE PROFILED S32T SPECIAL TOOL, MIETHKE WAS ABLE TO SAVE AROUND 20 SECONDS PER COMPONENT.



The implant for treating hydrocephalus.

Close cooperation over two years: MIETHKE technology expert Willi Engel (middle) in discussion with HORN application engineer Enrico Koitek (left) and technical sales representative Christian Gries (right).

weeks. The HORN Greenline system allowed us to respond quickly," Gries tells us. Engel is also pleased with how the implementation has gone: "We produce tens of thousands of nozzles per year. With this change, we are now saving around 20 seconds per component. We have also been able to increase the service life of each insert to 1,500 nozzles. What's more, we are also saving time setting up."

Additional Superminis in use

In addition to a shunt, a (paediatric) prechamber can be integrated and positioned on the skull. A prechamber of this kind makes it possible to drain the cerebrospinal fluid, administer medication and check the pressure. If the silicone membrane is punctured by a cannula, the fluid can be drained and medication admixed. The titanium base therefore eliminates the risk of puncture by a cannula. The MIETHKE production team also relies on the Supermini 105 system for machining this component, as well as for producing an 8H7 hole. With the HP geometry, the solid material is initially pre-drilled to a diameter of 7 mm (0.276"). An axial geometry is used to produce the final hole to 8H7 tolerance.

Willi Engel really values the successful collaboration between Christoph Miethke GmbH & Co. KG and HORN: "HORN always tries to make a lot of things possible. Even if it doesn't work, I think that's really great."

It all started with an idea and a desire to develop products to give hydrocephalus patients as normal a life as possible. Christoph Miethke GmbH & Co. KG is a medical company founded in 1992 that has developed into a medium-sized enterprise with a global presence, thanks in part to its close cooperation with sales partner B. Braun Aesculap. Currently, 220 employees work at the four sites in Potsdam, the capital city of the German state of Brandenburg. The product portfolio covers innovative neurosurgical implants to treat hydrocephalus. The constant exchange with all parties involved and users is absolutely indispensable for the company. At its state-of-the-art production facilities housed within historic 19th-century walls, the company focuses on manufacturing its products to the highest standards in terms of quality, precision and, consequently, safety.

MEDICAL TECHNOLOGY

FROM TOOL TO SOLUTION

Wearing mouth and nose protection reduces of the risk of airborne infection (via droplets) of the SARS-CoV2 coronavirus considerably. The enormous demand for masks in Germany is a major challenge and numerous companies are working on making products and solutions to meet this demand. One of the companies is Weber Ultrasonics AG from Karlsbad in the southern region of Baden in Germany. Weber is one of the leading manufacturers of ultrasonic welding equipment for mask production. To increase process reliability when manufacturing components from materials that are sometimes difficult to machine, production manager Sebastian Weiss's team made several adjustments. The focus was on the tool concept previously employed to produce an important face groove. In addition to new tools, the Baden-based company also even changed the coolant. They were able to find the ideal partners for this in HORN and lubricant manufacturer Zeller+Gmelin.

The "HORN drawer" with various types of cartridge.

By the end of June 2021, Germany should be able to produce up to seven billion protective masks a year, according to the Federal Ministry for Economic Affairs and Energy. As stated in the report, this includes certified FFP2, FFP3 and surgical face masks. The ministry is investing in this by providing over 60 million euros of subsidies. The aim of the state subsidy programme is to support production facilities making PPE and medical devices to protect patients alongside their primary products to ensure sufficient availability of personal and medical protective equipment to combat the coronavirus pandemic. As a first step, the personal protective equipment funding guideline is supporting investment in building and expanding systems to produce non-woven filter material using the melt blowing process. If the manufacturer is producing the masks as a medical product exclusively for medical use, they are subject to the European Medical Device Directive and must meet the corresponding requirements of the Medical Device Regulation.

Ultrasonic welding is used to produce surgical masks made of non-woven materials, as well as for medical components like membranes, adapters and connectors, functional components, blood filters and surgical instruments. What's more, medical packaging and products for wound dressing and hygiene place special requirements on the weld and seal quality.

During the welding process, mechanical vibrations at an ultrasonic frequency are introduced into the materials being welded via a specific tool – the sonotrode. The molecular and surface friction produces heat, which melts the plastic in the specific location

Weber relies on the S15A system for producing the face groove.

defined by the sonotrode. At the end of the welding process, a short cooling phase is required with the pressure still applied to cure the previously plasticised material homogeneously. After that, the connected parts can be processed further straight away.

Important face groove

Weber Ultrasonics produces all of the components and assemblies for its ultrasonic systems itself. For a titanium component in the converter, the machining technicians at Weber were worried about process reliability when producing a face groove. It is used for acoustic decoupling of the converter housing and has particular requirements in terms of precision and surface quality. "We produce the bottom part of the converter in different variants. The component is designed using FEM analysis according to its purpose. We need the precision and surface quality for uniform oscillation," explains Weiss. One of the most important characteristics relating to the oscillations is that they may only be transferred in the axial direction, not in the radial direction. When producing the key face groove, the company had problems achieving uniform precision and satisfactory tool life due to unwanted vibrations, which led to chatter marks on the surface of the deep grooves.

After looking in-depth at the current machining process, Robin Roos, team leader in mechanical production, contacted the HORN field sales force. Jürgen Schmid, product and project manager in the Sales Department, took a close look at the grooving process and suggested testing the HORN S15A face grooving

THE MINISTRY IS INVESTING IN PRODUCTION BY PROVIDING OVER 60 MILLION EUROS OF SUBSIDIES.

system. "As there are numerous variants of the lower part of the converter, we are also using a cartridge clamping system to reduce setup times and increase flexibility," explains Schmid. Even after the initial trials, there was a clear improvement in terms of service life, process reliability and surface quality. "The problem with the tools used previously was that the service life was between 2 and 100 grooves. The HORN insert was very stable straight away," says Roos.

New coolant

Schmid also suggested replacing the coolant that was in use with a new development from lubricant manufacturer Zeller+Gmelin. The Zubora TTS coolant is the result of a joint project between HORN, Zeller+Gmelin and a major machine tool manufacturer. "The idea behind the project was to develop a new, more effective product for machining superalloys. Zeller+Gmelin has achieved that with the new coolant. It is also worth emphasising that all of the experience of the lubricant manufacturer, the machine builder and the tool manufacturer was incorporated into the development," explains Schmid. "After successful tests on different superalloys, it was time for the first field test at Weber Ultrasonics," says Thorsten Wechmann, the product manager responsible for the development at Zeller+Gmelin. He continues: "By using Zubora TTS, it was possible to increase tool service life significantly. In addition, the completely new formulation improves the surface quality of the component. What's more, it was possible to increase the cutting parameters and therefore improve profitability long term."

As a result of this joint success, Weiss replaced all of the tools used previously for the critical face grooving operation with the system from HORN. "We wanted the tools to come from just one manufacturer – same system, shorter setup times, greater reliability," explains Weiss. He uses full radius facegrooving inserts from the S15A system in 2 mm (0.079") and 3 mm (0.118") widths. The IG35 coating is used for machining titanium and other superalloys. Thanks to HiPIMS coating technology, the coating exhibits very smooth properties and high heat resistance. Furthermore, it is free from coating defects such as droplets or other faults at the cutting edge. Each insert now has a service life of 100 components. The tool system used previously had a service life of 35 on average.

Special tools in no time

HORN supplied Weber with various cartridges for holding the numerous tool variants: "We changed everything over in just three months. We didn't just need the standard cartridges, but some special ones too. HORN is also able to supply special tools in no time at all," says Weiss. For the key face groove alone, Weiss created a labelled drawer with part numbers and associated cartridges. Chip management has also been improved considerably with the combination of the new tool and the new coolant. "The combination of the new strategy of tool and coolant now gives us the opportunity to produce 50 parts in an unattended ghost shift. We no longer have problems with chips that are out of control in terms of their length," Roos describes.

Exacting requirements are placed on the face groove of the lower part of the converter.

By using the newly developed coolant, the swarf when machining pure titanium could be converted from long strings into shorter, manageable chips.

The ultrasonic welding process from Weber Ultrasonics is used to produce surgical masks.

Close cooperation during the project: Sebastian Weiss, Robin Roos and HORN engineer Jürgen Schmid (from left to right).

The new Zubora TTS coolant is a fully synthetic solution with a concentration of 8 to 10 per cent. With the new concept, the focus was on lubrication, supporting chipbreaking and improving surface quality. "We developed the new coolant for the productive machining of titanium and other superalloys. However, the product is multifunctional and brings numerous advantages when processing other materials," explains Wechmann.

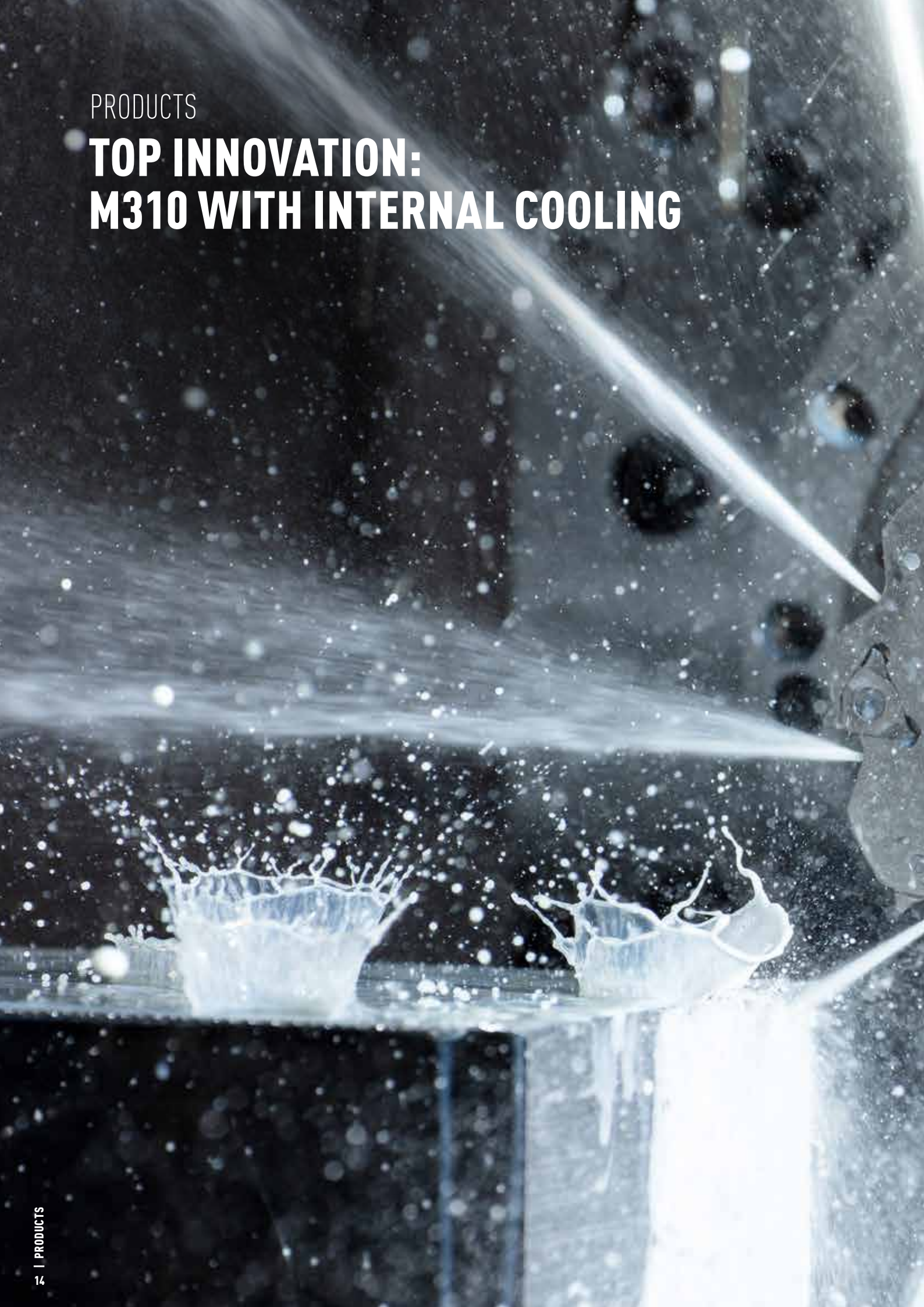
Weber and HORN have been working together for a few years. However, they only starting collaborating closely at the start of this project. Weiss is pleased with how things have gone: "HORN understood our requirements immediately and implemented them quickly and professionally. Jürgen Schmid's idea to test the new Zeller+Gmelin coolant met all of our expectations for the project."

Weber Ultrasonics:
Weber Ultrasonics AG develops, produces and sells solutions and components for the industrial use of ultrasonic technology. It focuses on cleaning, welding and cutting with ultrasound and includes other special types of application. In April 2020, Weber Ultrasonics was confirmed as an operator of critical infrastructure (KRITIS) and was also awarded the "Innovativ durch Forschung" seal of approval by the Stifterverband für die Deutsche Wissenschaft, an organisation that promotes German science. This seal is given to companies providing innovation through research. The company is certified to DIN EN ISO 9001 and has already been honoured several times for its exemplary company management. The family-run, medium-sized company based in Karlsbad employs over 160 people globally.

Zeller+Gmelin:
Zeller+Gmelin GmbH & Co. KG was founded in 1866 and employs over 900 people, almost half of whom are based at the headquarters in Eislingen. With its 15 subsidiaries, the medium-sized company operates around the world. Its product portfolio is split into three business areas: lubricants, industrial chemicals and printing inks. These high-quality products occupy a leading position on the international market. Zeller+Gmelin offers customised, comprehensive solutions from a single source, from research and development right through to production. R&D is extremely important at the company. In fact, around 20 per cent of the employees in Eislingen work in this department to constantly develop and optimise the innovative products to meet market and customer requirements.

PRODUCTS

TOP INNOVATION: M310 WITH INTERNAL COOLING

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PRODUCTS

EXPANSION FOR SLOT MILLING AND SLOT CUTTING

Expansion for slot milling and slot cutting

With its expansions to the tool range for slot milling and slot cutting, Paul Horn GmbH is responding to the requirements of users. HORN now offers the cutter body of the M310 milling system with an internal coolant supply. This increases the service life of the indexable inserts and therefore reduces tool costs. The internal coolant supply also allows a higher level of precision when slot milling as no heat is transferred from the cutting zone into the component. What's more, the flushing action of the coolant, combined with the geometry of the cutting edges, prevents chip jamming in deep grooves.

HORN IS EXPANDING ITS M310, M101 AND M383 MILLING SYSTEMS FOR SLOT MILLING AND SLOT CUTTING.

HORN offers two types of milling and slotting cutter. The screw-in milling cutter is available in diameters from 50 mm (1.969") to 63 mm (2.480") with widths from 3 mm (0.118") to 5 mm (0.197"). As an arbour milling cutter, the main bodies are available with diameters from 63 mm (2.480") to 160 mm (6.300"). The widths are also between 3 mm (0.118") and 5 mm (0.197"). The three-edged S310 carbide inserts are bolted on the left and right of the main body and therefore ensure a good distribution of the cutting forces. In addition to further geometries for processing different materials, HORN is introducing inserts with a geometry for milling aluminium alloys.

As well as expanding the M310 system, HORN is rounding off the range of the M101 and M383 milling systems. For the M101 tool, S101 inserts are available from stock with a width of 2.5 mm (0.098"). What's more, new inserts with an 8-degree lead angle are available especially for slot cutting. For the 383 system, HORN is expanding the range of bodies with diameters of 125 mm (4.921") and 160 mm (6.300").

PRODUCTS

DRILLING AND COUNTERSINKING IN CARBIDE

Drilling and countersinking in carbide

Paul Horn GmbH is proud to present DDHM, its CVD diamond-tipped tool system for cost-effective drilling and countersinking of carbides and sintered ceramics with a hardness of up to 3,000 HV. With the launch of this drilling system, HORN is further expanding its range of products for machining fully sintered carbides. With new geometries for producing precise core holes, the tool system allows machining to take place on conventional milling or turning centres and there are no costly and time-consuming grinding and eroding processes. There is also an opportunity for savings in that investment in expensive new machinery can potentially be avoided.

WITH THE LAUNCH OF THE DDHM DRILLING SYSTEM, HORN IS FURTHER EXPANDING ITS RANGE OF PRODUCTS FOR MACHINING FULLY SINTERED CARBIDES.

The DDHM system is aimed primarily at customers in the tool and die-making industries. The focus is on machining carbide punches and dies efficiently. However, the tool system also offers significant advantages in other contexts, including the medical and aerospace sectors; the automotive industry; and punching, forging and forming technology. The diamond tools enable shorter throughput times, high surface quality, lower overall costs, greater flexibility within the production process and longer tool life. The drills can be used for producing holes in solid material to a maximum depth of ten times the diameter. The CVD-D-tipped drills have a two-edged design and are available in diameters ranging from 2 mm (0.079") to 10 mm (0.394"). All versions boast internal channels for cooling with air.

PRODUCTS

PCD STEP DRILL FOR NON-FERROUS METALS

PCD step drill for non-ferrous metals
HORN is expanding its tool portfolio with cutting edges tipped with polycrystalline diamond (PCD). Following on from PCD parting-off tools, HORN now also offers users PCD-tipped step drills. The tool system allows greater drilling precision and better hole surface quality thanks to the sharp cutting edges. It is designed for creating holes and countersinks as well as pre-drilling in non-ferrous metals, such as in the production of aluminium wheels. The tools allow high cutting parameters during machining, which makes it possible to reduce the cost per component in series production, as well as the process time.

FOLLOWING ON FROM PCD PARTING-OFF TOOLS, HORN NOW ALSO OFFERS USERS PCD-TIPPED STEP DRILLS.

HORN only offers the PCD-tipped step drill as a special tool. The PCD tip is available on tools with a diameter of 4 mm (0.157") and above. The bodies are available in all common DIN shank dimensions from 6 mm (0.236") to 25 mm (0.984") diameter as a carbide monoblock version. The carbide shank provides good vibration damping during machining. All variants are fitted with an internal coolant supply. The monoblock tool body is available as a steel variant from a diameter of 32 mm (1.260").

PRODUCTS

PHILIPP DAHLHAUS ABOUT PCD

Philipp Dahlhaus is in charge of product management at HORN.

Mr Dahlhaus, what exactly is PCD (Polycrystalline diamond) in the context of precision tools?
PCD is a synthetically made substrate in which diamonds are sintered as grains in a metal matrix. It is produced by high-pressure, high-temperature synthesis or by high-pressure liquid phase sintering. With around 90 per cent diamond content and diamond grains between 0.5 (0.00002") and 30 µm (0.0012"), the tough, wear-resistant PCD cutting edges provide very high tool life when used for machining non-ferrous materials. Cutting speeds of up to 4,000 m/min (13,123.36 ft/min) can be achieved with ease under the right conditions. The metallic binder phase imbues a certain degree of toughness, which is advantageous in challenging applications. The various PCD substrates with custom-ground cutting edges are tailor-made to suit the required profiles.

Where are PCD tools used?
The areas of application are extremely varied, but most are related to the machining of aluminium with a high silicon content. The option to include chipbreaker geometries with laser technology makes the cutters ideal for machining lead-free or low-lead non-ferrous metals that can be very long-chipping. Carbide green compacts, GFR and CFR composite materials and plastics are also areas of application where PCD is used for turning, milling and drilling.

Do you have an example of a specific application?
Machining aluminium wheels is a good example. The PCD cutting edges achieve very high levels of surface quality and are an effective way to stop built-up edges from forming thanks to the diamond material's low coefficient of friction. In addition, PCD offers a 20-times greater service life than carbide thanks to its high level of wear resistance. The process reliability is therefore greater over a longer period and the frequency of tool replacement can be reduced. HORN has expanded its drilling product range with PCD step drills and is also providing impressive evidence of the performance that can be achieved with PCD tools.

"HORN IS PROVIDING IMPRESSIVE EVIDENCE OF THE PERFORMANCE THAT CAN BE ACHIEVED WITH PCD TOOLS."

NEW GROOVING GEOMETRY FOR HIGH FEED RATES

New grooving geometry for high feed rates

HORN is proud to present the EH geometry, a new development based on the S100 grooving system for parting off at high feed rates. The stable cutting edge allows feed rates of f = 0.25–0.4 mm/rev (0.01-0.016"/rev) when grooving and parting off and therefore a reduction in the time required for grooving operations. Process-specific chip formation ensures reliable chip removal and control. However, the high feed rates require a stable machine for grooving and parting off. The workpiece must also be clamped securely. From a feed rate of 0.3 mm/rev (0.118"/rev), HORN recommends reducing the feed rate for the first 3–4 mm (0.118-0.157") when grooving and parting off. Due to their high levels of stability, tool holders and cartridges for grooving along the Y axis are the top choice for use at high feed rates. HORN offers its single-edged inserts in 3 mm (0.118") and 4 mm (0.157") cutting widths.

Back in 2019, HORN expanded the S100 grooving system with new holder variants for parting off with the feed movement along the Y axis on turn-mill centres. This method enables a highly effective grooving process with high cutting values, resulting in shorter machining times. Furthermore, there is the option to part off large diameters with a compact grooving tool holder as well as to part off with narrower groove widths. HORN is now rounding off this system with the new geometry.

Large leverage forces occur, particularly when parting off workpieces with larger diameters. The space available in the machine often does not allow the use of tools with a larger cross section. With the new arrangement of the cutting edge in the tool holder, the cutting forces are diverted to the main cross section of the holder. This results in increased rigidity of the system as a whole for a given cross section of the grooving tool holder. This allows higher feed rates at the same groove width. The flow of forces in the longitudinal direction of the tool means narrower holders can be used to achieve the same system rigidity. In modern generations of turn-mill centres, parting off with the new grooving tools causes the cutting force to be diverted in the direction of the spindle, meaning a higher rigidity of the overall system.

LARGE LEVERAGE FORCES OCCUR WHEN PARTING OFF WORKPIECES WITH LARGER DIAMETERS.

PRODUCTS

NEW GEOMETRY FOR FINISHING GROOVES

New geometry for finishing grooves

HORN is proud to present the FB geometry, a solution for finishing grooves. By standardising the special cutting geometry, HORN is responding to users' requests for even better surface quality on the flanks and at the base of a groove or recess. This geometry has already been in use successfully for some time as a special solution for producing grooves for sealing rings and shaft seals. High surface quality is possible without any problems in the finishing process, even when the conditions are unstable. HORN offers the geometry for a variety of systems for external and internal grooving.

The geometry is available as a standard tool for the 224, 229, S34T, 315 and 64T systems for precision machining of external grooves. For internal machining, it is available for the 105, 108, 111, 114 and 216 systems. Further insert types are available as special tools and can be delivered quickly via the Greenline system.

HORN PRESENTS A SOLUTION FOR FINISHING GROOVES.

117 FORM DRILLING SYSTEM

117 form drilling system

With the latest development of the 117 form drilling system, HORN now offers the option to drill into solid material. The profiled tools provide economic advantages in series production and make it possible to reduce tool costs for large-diameter holes. HORN provides the profiled cutting inserts from a diameter of 16 mm (0.630") based on the 117 tool system to customer specification for use on turn-mill centres. The patented, precision insert seat of the 117 system guarantees high concentricity and axial run-out accuracy as well as highly precise changeover to within microns. The precision-ground inserts allow a high degree of manufacturing precision with tolerances up to 0.02 mm (0.0008") and high surface quality. This is also reflected in the production of precise grooves for O-rings.

Cost savings arise due to the ability to change the insert, the lower tool cost and the reduced machine downtime, as the inserts can be changed quickly. Furthermore, the coating cost is lower, as only the insert is coated. The internal coolant supply via the round shank at both cutting edges ensures cooling in the contact zone and efficient removal of chips.

HORN offers the tool system in widths of 16 mm (0.630"), 20 mm (0.787") and 26 mm (1.024"). Special profiles are precision-ground in accordance with the requirements of the application. The profile depth is t_{max} = 9 mm (0.354"), 12 mm (0.472") and 13.5 mm (0,531"). Maximum profile width is 26 mm (1.024"). The tool coating is specially selected for each application and is available for the material groups P, M, K and N. The round shanks are available with diameters 16 mm (0.630"), 20 mm (0.787") and 25 mm (0.984") in designs A and E as standard. HORN also offers special holders with greater support for the inserts. All variants have an internal coolant supply.

THE PRECISION-GROUND INSERTS ALLOW A HIGH DEGREE OF MANUFACTURING PRECISION.

PRODUCTS

REAL-TIME TOOL MONITORING

Real-time tool monitoring

In close cooperation with the Kistler Group, Paul Horn GmbH has further developed its globally unique solution for real-time monitoring of tools used in turning applications. Kistler is world market leader in dynamic measurement technology for measuring pressure, force, torque and acceleration. The Piezo Tool System (PTS) consists of a force sensor that is precisely built into the turning tool and provides information on the condition of the tool during machining. The system is able to measure forces from a few Newtons and has a standard sampling rate of 10,000 Hz, making it possible to measure even the smallest cutting forces. The machine operator is therefore able to identify defective workpiece materials or a tool breakage immediately, resulting in minimum waste and an outstanding level of quality. Furthermore, the user can extend the service life of the tools used. HORN offers the sensor-monitored tool holder as a square-shank turning tool holder, a gang tool unit for Citizen Swiss-type lathes, a holder for INDEX multi-spindle lathes and for the Supermini tool system. Additional interfaces for other machine manufacturers are in development.

The PTS is especially suitable for turning. In these applications, alternative measurement methods such as monitoring the drive power of the main spindle motor are not practical as they cannot detect minute deviations. Measuring structure-borne sound would also be unable to deliver consistently satisfactory results when machining small workpieces. Additionally, visual monitoring has to be ruled out due to the use of coolant and the high rotational speeds of the machining processes. The PTS solution is compatible with selected standard turning tool holders from HORN. It does not require any intervention in the CNC system, can be used on any machine and only takes up a small amount of space. Using the PTS results in reduced production costs, as well as increased production capacity.

ON SWISS-TYPE LATHES, THE SENSOR MAKES IT POSSIBLE TO MEASURE CUTTING FORCES FROM JUST A FEW NEWTONS.

Converting standard holders to PTS holders is easy and does not require any further modifications to the machine. The tool carriers exhibit outstanding stability despite the measurement technology that is built in. The PTS gang unit is used in exactly the same way as a standard version and allows all standard tools to be installed. Accordingly, the processes of changing tools and making adjustments are no different from the ones performed on a standard gang unit. The standard base holder 968 for INDEX multi-spindle lathes can be replaced directly with the PTS base holder 968. The holder system allows all HORN type 842 cartridges to be used. Tool change, cartridge exchange and adjustment of the centre height are identical to those of the standard tool.

TOOLS FOR PREMIUM JOINTS

EXPERTISE IN PIPE AND SLEEVE MACHINING

Paul Horn GmbH has succeeded in winning over the world's leading manufacturers of machine tools for pipe and sleeve production, as well as end users, through the continuous development of customer-focused tool solutions. The tool manufacturer is able create cost-effective machining solutions for use in API and GOST-compliant applications as well as for premium joints. With user-friendliness in mind, the tools are designed to give customers a productive edge over other solutions in the areas of handling, service life and cost per threaded connection. HORN's own in-house product management department, which is actively engaged in the development and continuous optimisation of productive machining concepts for OCTG, designs and delivers both standard and customer-specific tools.

Horn's product portfolio, which is designed to meet users' productivity requirements, can offer the right package of tools for all machines. The tool systems are available with standard machine interfaces including VDI, polygonal shank and round shank holders as well as solutions that are flange-mounted on turrets. The tools are adapted to the degree of automation in the system – from manual loading all the way through to fully automated production – and are designed provide a solution that can be relied upon to meet requirements. Both the screw clamp and the ground chipbreakers of the S117 and 315 systems, together with the carefully matched tool holders, make it possible to manage chip removal during sleeve and pipe end machining processes. There are no expensive parts such as chipbreakers or shims to install, allowing customers to make significant savings when procuring tools. The two systems demonstrate highly precise interchangeability and use substrates and coatings for the inserts that are tailored to the machining conditions, resulting in significant improvements in both cutting performance and tool life. The precise interchangeability provided by the precision insert seats reduces the number of tool adjustments that are needed after changing inserts.

In thread cutting in API and GOST-compliant applications, the S117's numerous teeth enable the number of cuts to be minimised. The 315 system has three usable cutting edges, leading to significant cost optimisation. It is an ideal choice for premium joints that permit no more than one to three teeth per cutting edge. The tool carrier is designed to work in perfect harmony with the insert, increasing the stability of the tool system. This means a lower tendency towards vibration, something that in turn improves surface quality, precision and tool life. In applications involving pipes with profiles that comply with ANSI/API-5L, HORN offers tool solutions for pipe end finish

HORN's M101 milling cutter system is a tool that has been developed specifically for pipe end machining after rolling, for separating sections for analysis and for assembling pipes and sleeves.

With a focus on user-friendliness, the tools are designed to give customers a productive edge over other solutions in the areas of handling, service life and cost per threaded connection.

machining in line with customers' requirements. The milling heads can be used to machine pipe ends with a wall thickness of up to 50 mm (1.97"). Integrated rollers compensate for any roundness errors. The workpieces that are produced comply with API tolerance requirements.

With its M101 slot milling system, HORN offers a purpose-developed tool for pipe end machining after rolling and for separating sections for analysis. The tool can also be used for pipe and sleeve assembly. The S101 self-clamping inserts, featuring widths of 2 mm (0.079") and above, deliver highly precise interchangeability, accurate cuts and short machining times.

HORN's extensive scope of manufacture covers everything from producing blanks in its own carbide machining department through its internal grinding shop and production support, to PVD coatings developed in-house. This keeps the company's lead times short. Furthermore, with the Greenline system, for limited quantities, HORN is able to offer delivery within one week of a drawing being approved by the customer. Not only that, but the tool manufacturer also allows users to benefit from process consultation services and acts as a solution provider, using its own in-house product management processes. HORN boasts expertise in processing a range of materials, from the easy-to-machine options of J55-K55, L80 and P110, to Q125 and all the way through to high-alloy materials like 13Cr or 28Cr.

Increasing drilling depths and more aggressive operational environments mean that CRAs (corrosion-resistant alloys) have become a focal point in pipe manufacture. Processing is a real challenge because these materials, which are used in HPHT (high pressure high temperature) fields, are so difficult to machine. The full weight of HORN's expertise is in demand due to the formation of built-up edges resulting from the machining of these tough materials. The company's many years of experience and in-house manufacturing capability are of real benefit here. Thanks to HiPIMS coating technology, the in-house produced coatings IG3 and HS3 exhibit smooth cutting properties and high heat resistance. The tool geometry, the substrate and the coating are adapted to meet the requirements of each application.

HORN IS ABLE CREATE COST-EFFECTIVE MACHINING SOLUTIONS FOR USE IN API AND GOST-COMPLIANT CONTEXTS AS WELL AS PREMIUM JOINT APPLICATIONS.

ABOUT US

INTERVIEW MARKUS HORN

Mr Horn, even during the COVID-19 pandemic, digitalisation seems to have come on leaps and bounds. What do you think about that?
In the current context of COVID-19, digitalisation refers primarily to remote working and the use of communication software, for example for video conferencing. There has been noticeable increase in its adoption due to the pandemic. Digitalisation in manufacturing companies is driven by Industry 4.0 and has been pressing ahead for years, including at our company. For us, the focus is primarily on sales, marketing (e.g., regarding ISO 13399) and our production. Digitalisation must always bring added value; as an end in itself it is no help at all.

DIGITALISATION MUST ALWAYS BRING ADDED VALUE.

How does digitalisation look in your production department, for example?
We have already had networked production for many years. We see this as the standard. Now, things like cameras, sensors, consistent networking of all cyber-physical systems, artificial intelligence (AI) and machine learning are all being added. In addition to this, automation options such as robotics help us with our day-to-day work. Man and machine are becoming integrated in a more and more synchronised manner. The major difference compared to a few years ago is the standards that have been introduced – which I believe are very important – to help us to implement digitalisation in the long term.

Which standard do you use?
We made architectural decisions, flattened the traditional automation pyramid and established integration between the business process level, the machine process level and the PLC level. For this, we use a service-oriented architecture with a corresponding process platform as the Manufacturing Service Bus. In addition to this structure, we rely on the OPC-UA standard from a technological point of view. The UMATI standard, which is becoming more and more popular, is ideal here. Standardised data formats, like GDX (Grinding Data eXchange) make it much easier to share information. In the retrofit and remote maintenance areas, we rely primarily on open-source solutions.

How exactly have you diluted or disrupted the automation pyramid?
Nowadays, the line between IT and automation is becoming more and more blurred. At the same time, new technologies are being developed, such as 3D printing. In the past, there were production-related limits, but now the only limit is our imagination. In other words, virtually anything that you could possibly imagine can also be produced. To channel this vast array of imaginative possibilities and develop a product within the scope of HORN specifications, we use a product configurator, among other things, in our design work. One example is thread whirling, where specially adapted inserts are used. These

can be designed in a matter of minutes using the configurator. The resulting design is available immediately on all levels of the traditional automation pyramid – from ERP right through to the sensors – via the Manufacturing Service Bus. This saves us time, which means we can reduce our delivery time.

How important do you think a digital twin is and what are the advantages?
In principle, a digital twin is a tool for reducing transaction costs. It helps not only with the tool selection itself, but also with tool management, for example via our HORN tool management system. A digital twin also makes integration in CAM solutions easier and provides support with process monitoring. A digital twin must be readable for the user – only then will it be able to bring advantages. This is why standardised, digital exchange formats are hugely important.

Paul Horn GmbH is a member of GTDE, the VDMA's (German Mechanical Engineering Industry Association) CAD data exchange working group. What is this intended to achieve?
GTDE stands for Graphical Tool Data Exchange. Being able to exchange tool drawings via the GTDE server saves time and money. It also reduces the error rate. ISO 13399 also plays a key role. The server provides an ideal platform for our customers to exchange standardised data. ISO 13399 is the basis for a good digital twin.

When you think about digitalisation with HORN products, the PTS system is what comes to mind. What is behind this abbreviation?
The abbreviation means Piezo Tool System (PTS). We developed the PTS together with Kistler, the world market leader in dynamic measurement technology for measuring pressure, force, torque and acceleration. The system consists of a force sensor which is inserted into the turning tool and provides information on the condition of the tool during machining. The extremely small piezo sensor can measure even the smallest cutting forces to a high resolution. The machine operator is therefore able to identify defective workpiece materials or a tool breakage immediately, resulting in minimum waste and maximum quality. The solution is compatible with selected standard turning toolholders from HORN. It does not require any intervention in the CNC system and can be used on any machine. The sensors can be replaced quickly and easily, and using the PTS results in decreased production costs as well as increased production capacity.

What do you expect to see in the near future in terms of digitalisation?
With the current situation, we are seeing exactly how important digitalisation is. The pressure or necessity to take action in many areas has led to numerous new ideas and thoughts regarding digitalisation. I think that it will continue to grow in future where there is a need. Standardisation plays a major role in ensuring that it can be applied comprehensively. With regard to production, this means that now that systems have been networked, the focus is on the resulting collaboration between the programmes and systems, as well as intelligent image processing, particularly AI.

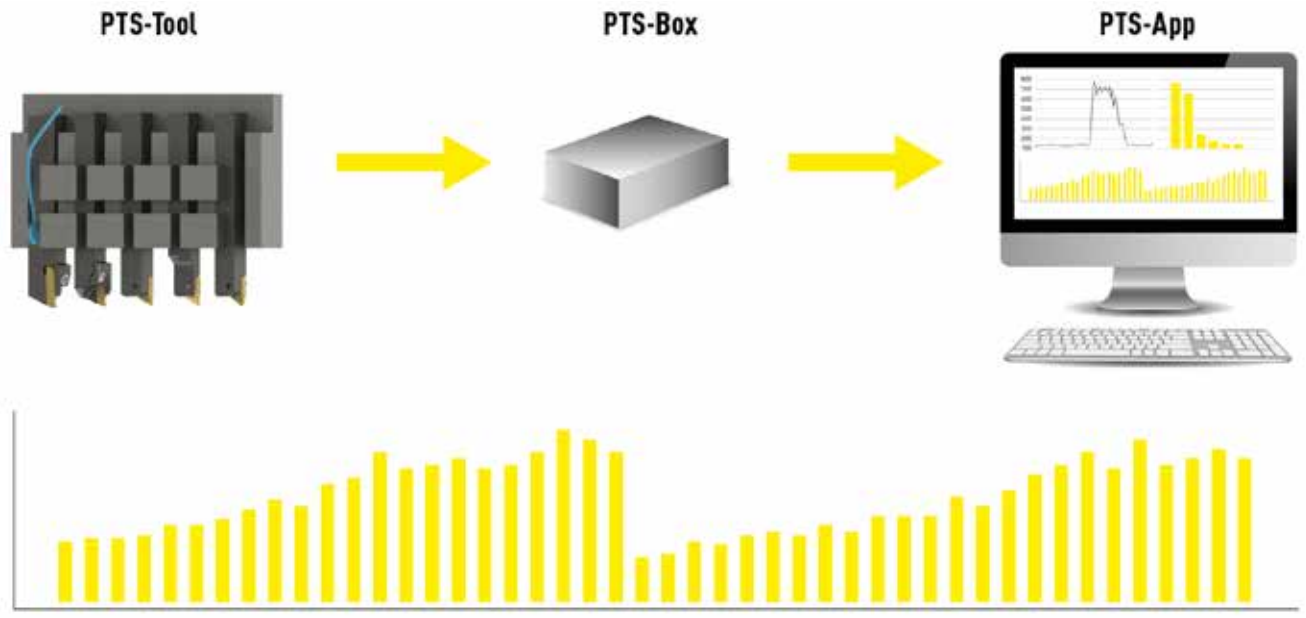
THE SERVER PROVIDES AN IDEAL PLATFORM FOR OUR CUSTOMERS TO EXCHANGE STANDARDISED DATA.

PIEZO TOOL SYSTEM

OPTIMISING THE MACHINING PROCESS – A SOLUTION WITH PTS

Holder type 968 for INDEX multi-spindle lathes with integrated PTS sensor (shown without sensor clamping wedge and cartridge).

Cost pressures impede complex machining operations in a global environment. Material fluctuations, tight tolerances and delicate tools are not making the situation better. Solutions and the search for optimum added value have been part of research for years. An additional problem is machine downtime arising from complex adjustments to tooling. It is therefore useful to monitor the process and tools, particularly when working at the limits. The tool as an interface between the workpiece and machine has an elementary function. It is possible to monitor the tool and process together so that you can intervene accordingly. The aims of successful product manufacturing can include using the tool until the actual end of its service life, monitoring the process with regard to vibrations or even just certifying the individual machining tasks for quality assurance purposes. With the corresponding data availability and data preparation, it increases the efficiency of the process as a whole through targeted interventions as a result of real-time recording. HORN and Kistler Instrumente AG therefore developed the Piezo Tool System (PTS) together, which records the smallest pieces of process data and variations.



Sequence of measurements during Swiss-type turning tool type 224 and data output with PTS.

Low cutting forces make it difficult to measure the load. Noise, coolant pressure, minimal changes in the spindle current and structure-borne sound measurements often do not work precisely enough or provide meaningful results. These are adverse circumstances encountered during sliding-head turning applications, for example.

With the Piezo Tool System, the machine operator gets a unique measuring system for recording process data in real time close to the point of cutting. The option to draw conclusions about the remaining service life of the tool opens up new perspectives regarding tool utilisation. The machine operator can make the relevant corrections based on the displayed material faults, cutting effects, chip jamming or tool breakages. This minimises waste and maximises the service life of the tool.

A piezo quartz sensor is integrated in the tool. The piezo quartz emits a measurable charge proportional to the load. The exact installation and corresponding alignment of the quartz play a key role. Installation must also be carried out with the sensor or sensors pretensioned so that they are within the linear working range. The sensor is adjusted and calibrated separately for each tool.

Thrust or pressure sensors are used depending on the tool and application. The sensor is integrated in the tool as closely as possible to the point of cutting. This is particularly advantageous when measuring minimal forces for microtuning. The measurement signal is converted into a voltage signal and amplified in the PTS box. The results are then presented visually on a separate screen using the PTS software. There are various display options to choose from: loads (average or maximum) or vibrations. The Piezo Tool System records the process force in high resolution. This means that every detail of the machining process is visible. A sudden increase in force can have various causes: insert edge fracture, chip jamming, end of service life. If they are familiar with the process, personnel will be able to correctly identify the end of the tool's service life.

The PTS works mainly with stationary holders, like those found in Swiss-type lathes or multi-spindle automatics, as the sensors still require a cable. At the moment, it cannot work with rotating holders. The closer to the cutting point, the more precise the result will be. With micromachining in particular, the sensors are placed directly in the insert holder. When the sensor is installed on the gang toolpost, it is possible to monitor the entire sliding-head turning process. With larger tools, such as holders for multi-spindle lathes, the sensor is installed in the holder in the direction of force flow. The PTS does not prevent the use of different cartridges in the same tool carrier.

WITH THE PTS, MACHINE OPERATORS GET A UNIQUE MEASURING SYSTEM.

At present, the PTS does not communicate with the control unless agreed with the machine manufacturer. Intervention by the machine control is feasible. Ultimately, however, the machine should not come

to a halt every time chip jamming occurs. The operator has other things to do! When it comes down to it, the PTS is a monitoring tool that supports the machine operator.

It is not a plug-and-play solution. The machine operator must have a certain amount of awareness to identify and interpret the corresponding data. A high degree of efficiency will only come with increasing experience.

The initial results with the PTS are promising. Kistler tested the system in its own production facility. Unexplained service life fluctuations of between 20 and 100 parts when finishing a critical boring process for micro sleeves had to be analysed and improved. As an initial step, the tools were used until the end of their lifetime with the help of the PTS. However, fluctuations in the service life still occurred. The solution was discovered by fitting other tools with sensors: the fault was in the earlier roughing process. Chatter was affecting the service life of the finishing tool. The roughing process has now been changed. The finishing operation is still monitored and Kistler now produces more efficiently with significantly improved tool life.

THE PTS IS A MONITORING TOOL THAT SUPPORTS THE MACHINE OPERATOR.

This led to the PTS being used for more applications, for example on multi-spindle automatics with modular tools (figure 2). Placing the sensor in the cartridge interface proved to be less advantageous, as the cartridges had to be changed approx. every 3 months.

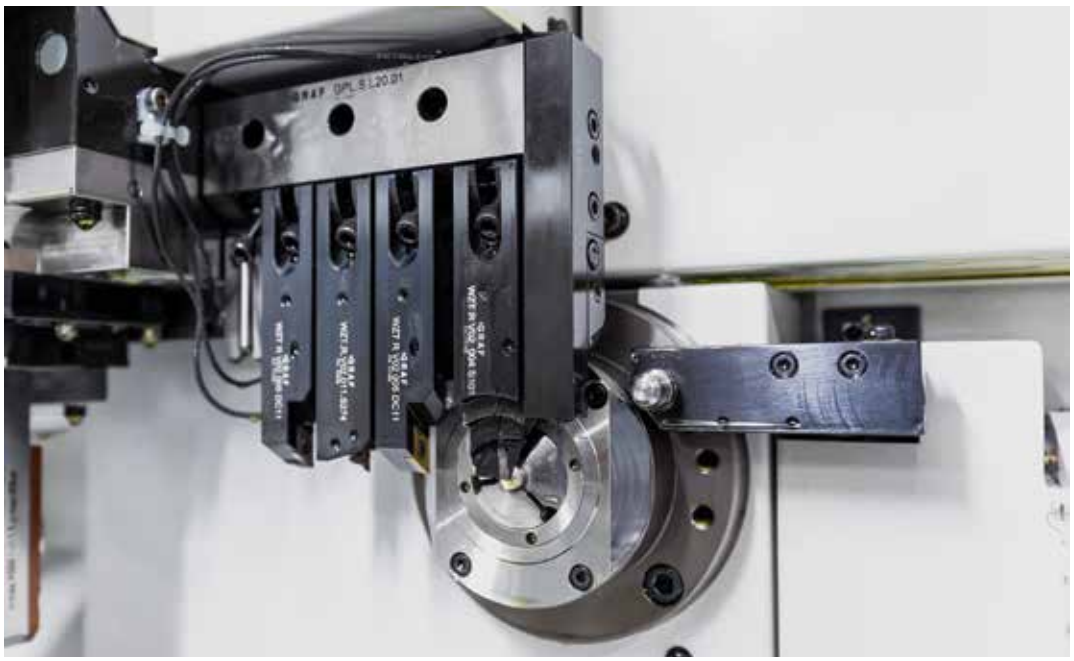
Analysing the rigidity of the holder led to the installation of the sensor in the direction of force flow. The rigidity of the holder only changed very slightly. However, the result of the measurement was very good.

In the test phase, other Supermini tools were also used for machining very small bores (figure 3). The PTS is absolutely ideal for miniature applications like this. The sensor is either integrated directly in the wedge clamp of the holder or in the holder itself. The experience gained from designing multi-spindle auto holders has been incorporated. As a result, there is a multitude of tools available for a huge range of tasks.

Process data can be recorded using the PTS regardless of the age of the machines. In many cases, only the critical tool in a manufacturing process needs to be monitored. The machine operator benefits from an overview of several machines at the same time. As only relevant data is recorded, there is no risk of generating excessive amounts of unused dark data. It is essential that the data obtained is also useful for analysis purposes after the tool has finished being used and can be integrated and processed as part of potential Industry 4.0 projects. This is the only way to optimise the added-value chain.

If there is no need to document each individual process step, the data must be limited to what is absolutely necessary using relevant filters. If the PTS is already part of an ERP system, information can be

The sensor system can also be integrated in gang toolposts.



The Piezo Tool System in use.

shared to ensure that new tools are available at the machine as soon as the service life of the old tool ends. Within production at least, this means that a uniform data standard is required.

Ultimately, importing data into AI systems helps employees not only to understand processes and respond accordingly but also to minimise setup times and prevent machine downtime as much as possible. When data is used properly by the PTS, it improves machine utilisation and therefore production considerably along the entire process chain. By using this data across departments or sites, less productive systems can be brought to a higher level and production can be streamlined at the same time.

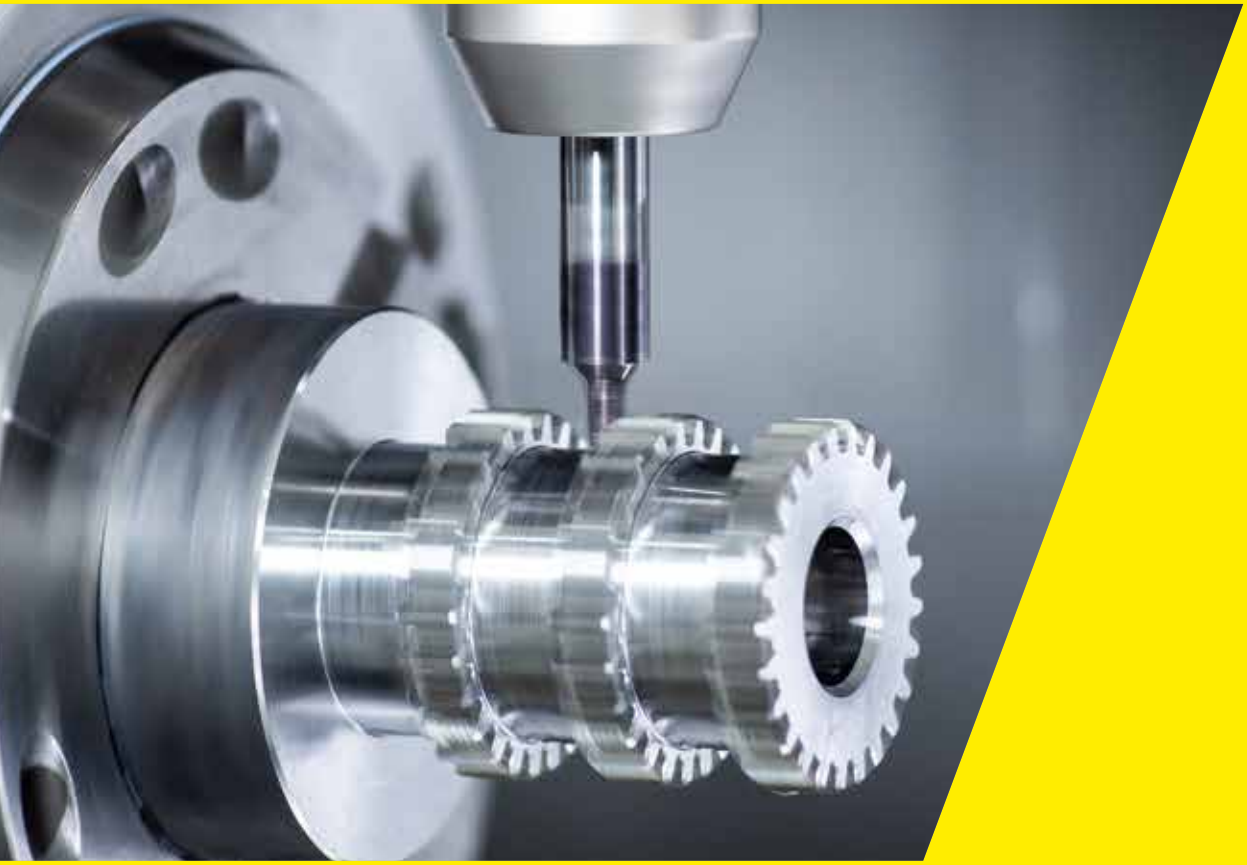
If you are able to derive relationships and patterns from the data, you will be able to make predictions based on fact. This will mean that you can take corrective action and eliminate contributing factors related to faults and failure. If deviations occur for no apparent reason, this can indicate the status of the machines and optimise maintenance intervals, for example. In this case, the PTS acts as a machine analysis tool.

The Piezo Tool System (PTS) is a powerful instrument that uses data to improve the capacity of production systems, the quality of products and operational efficiency. With digitalisation and data control on the up, the PTS has established itself in the market as a tool for increasing efficiency. The huge amount of interest in the PTS shows that users are looking for solutions of this kind. It has also made it possible to process data quickly along the entire process chain. At the moment, the PTS plays a supporting role; next, it will be able to intervene. As the data is obtained in real time, the machine operator is able to respond quickly based on the most up-to-date information. What's more, the purchaser and tool manufacturer can compare the tool status, as well as the operator.

WITH DIGITALISATION AND DATA CONTROL ON THE UP, THE PTS HAS ESTABLISHED ITSELF IN THE MARKET.

The PTS also supplies the various production managers with new facts about the tools and systems so that they can transfer findings from high-performing plants/systems to less productive ones.

We are currently working with machine tool manufacturers to implement the PTS in the control system. Another goal is to work on wireless data transmission so that the holistic approach adds value to the process.



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