

No  
02

**world<sup>of</sup> tools**



20  
22

**SPECIAL FEATURE:  
GEAR CUTTING**

**GEAR CUTTING**

**INTERVIEWS**

**MICROMACHINING**

**AMB 2022**

## DEAR READERS,



In the machining sector, more and more components with gear teeth are appearing. Reasons for this include the development of electromobility and electrification of society. In addition, the demand on the quality of the gear profiles is increasing. Thanks to modern machine tool concepts with coupled and synchronised spindles, processes such as gear skiving can be performed on universal turning machines and machining centres. In order for the processes to be used optimally in practice, the interaction between machine, cutting cycle and precision tool is essential. In this context, a joint campaign with DMG MORI on the topic of gear cutting has been running since the beginning of the year.

The two exhibitions AMB in Stuttgart and IMTS in Chicago: Both trade fair heavyweights in the machine tool industry will take place again in September 2022. We will show visitors to the events our latest innovations and processes as well as live machining and enjoy face-to-face discussions again.

With a view to micro and small parts machining, in this issue of our world of tools we present you with insights into Swiss-type machining that impressively show how shaft-type components may be precisely produced. We hope you enjoy reading the following pages and find them interesting.

Three handwritten signatures in black ink, arranged horizontally. The first signature is 'Markus Horn', the second is 'Lothar Horn', and the third is 'M. Rommel'.

Markus Horn, Lothar Horn and Matthias Rommel

# world<sup>of</sup> tools

## N<sup>o</sup> 02 2022

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# WONDERS OF TECHNOLOGY – GEAR CUTTING

**No cars, watches or machines could function without gears. The technical world and our everyday lives would be unthinkable without them. The production of precise gears can be a challenge for the manufacturer. The choice of tooling solution for the production of gears depends on various factors: Module sizes, batch sizes and the available machine technology are the main factors that determine the manufacturing technology to be selected. In particular, the newer machine tools with coupled and synchronised axes today offer possibilities for gear manufacturing that were previously reserved for special machines.**



A distinction is made between gears and shafts with internal or external teeth. Gears can be spur, straight, helical or herringbone, as well as straight-toothed or spiral bevel, helical gears in which the two axes do not necessarily have a common point of intersection, as well as similar hypoid gears. A gear can also be a worm in a worm gear. A special form is, for example, the toothed rack. Depending on the position of the axes in relation to each other, the gears are subdivided into roller gears and screw gears.

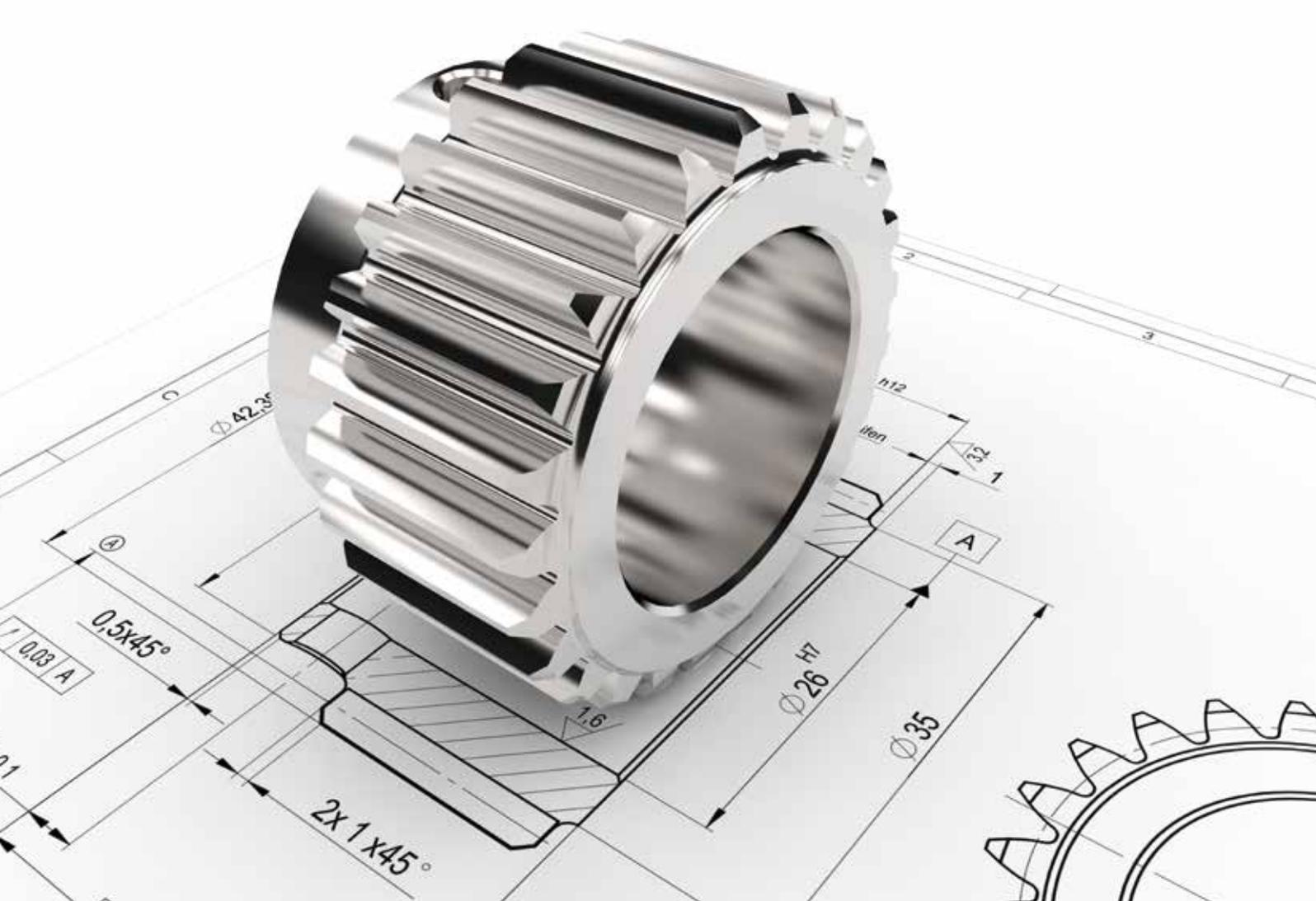
The most common tooth form is the involute. Involute gears are equally suitable for transmission ratios from fast to slow and vice versa, and for clockwise and counter-clockwise rotation. They have relatively low backlash and are simple and inexpensive to manufacture. The second important type of gear is cycloidal. Its advantages are low friction in the transmission from slow to fast and larger feasible transmission ratios. However, this type of tooth is more demanding in terms of design and production. So-called pinion gears no longer play a major role (except for the special form of chain drive as found in bicycle and motorbike drives).

The measure of the size of the teeth in a gear is the module. It is defined as the quotient of the gear pitch  $p$  (the distance between two adjacent teeth) and the constant  $\pi$ . Variables of the teeth such as tip and root height, root radius and tip chamfer are specified with the module. In order to be able to use standardised tools, DIN 780 standard is used. In the preferred series I they range from module 0.05 to module 60 and in the preferred series II

## NO CARS, WATCHES OR MACHINES ARE ABLE TO WORK WITHOUT GEARS.

from module 0.055 to module 70. In the Imperial-system of measurement, the "diametral pitch" is used instead of the module.

Machining processes with a geometrically defined cutting edge are hobbing, profile milling, planing, shaping, broaching, skiving, profile broaching, 5-axis free-form milling and shaving. Machining processes with indeterminate cutting edges are gear or profile grinding, honing, lapping, eroding and etching. For large series machining of gears in



mechanical and automotive engineering, one relies primarily on machine tools with special kinematics and elaborately designed tools, such as gear hobbing machines. These expensive investments usually only pay for themselves when producing large series. Demanding and precise tooth contours can be machined on common CNC turning centres and CNC machining centres with tools adapted to the application.

HORN's product portfolio includes a wide range of tools for the production of different gear tooth geometries from module 0.5 to module 30. Whether teeth on spur gears, shaft-hub connections, worms, bevel gears, pinions or on customised shapes, all these tooth profiles can be produced economically today with tools for milling, grooving and other processes. Further proof of competence in gear cutting is provided by the gear skiving product range. The process has been known for over 100 years. However, it has only found wider application since machining centres and universal turning machines with fully synchronised spindles and process-optimised software have made it possible to use this highly complex technology.



#### **HORN - DMG MORI**

Gear broaching, gear milling and gear skiving. Paul Horn GmbH and DMG MORI have launched a campaign on these three core gear cutting solutions to demonstrate the high performance achievable with the correct combination of machine, cutting cycle and precision tool.

STATEMENTS

# LOTHAR HORN



Lothar Horn, Managing Director of Paul Horn GmbH.

**For us, gear cutting is a central application in many respects. Most people think of gears as a gearbox containing gear wheels. Technically, this is also an image that we immediately see when it comes to gears, but the topic goes further. We are closely involved with our customers and partners and especially with machine manufacturers in this area. We complement each other, exchange ideas and work hand in hand to implement new machining solutions and drive developments forward – we make a difference.**

## **WITHOUT GEARS, OUR TECHNICAL WORLD WOULD BE UNIMAGINABLE.**

Without gears, our world today would be unimaginable. Gears meshing with other gears transfer torque from one shaft to another and change speed and direction of rotation. They convert linear movement into rotary movement and vice versa. They connect rotary axes at different angles to each other, transmitting torque positively and without slippage. In gearboxes, they increase or decrease the speed and torque many times over. Precise watch movements comprising many micron-precise gears move the hands of mechanical wristwatches with the highest degree of accuracy, while powerful gearboxes transmit several thousand kW of power. In short: gear teeth move the world.

In order to be able to realise their production, not only special machines are used nowadays but increasingly also universal turning machines and machining centres with corresponding cutting cycles and precision tools.

STATEMENTS

# DR.-ENG. MASAHIKO MORI



Dr.-Eng. Masahiko Mori, President, DMG MORI COMPANY LIMITED.

**Hardly any other machine element combines as many technical disciplines in its production as the gear wheel. The interplay of mechanical engineering, control and drive technology has just as much of an effect here as manufacturing technology and precision tools, including cutting material development.**

With the 5-axis capability of our universal machines and especially by integrating the technologies of turning, milling and even grinding, we have taken gear cutting out of the niche of the specialists. This gives all our customers another lucrative manufacturing option, ideally on automated machines. Both gear cutting and automation can often be retrofitted.

Compared to specialised gear cutting processes, universal machining offers the constructive degree of freedom to produce countless types of gears in one clamping and on one machine. This saves investment costs, reduces internal transports and ultimately shortens throughput times and delivery times.

The use of task-oriented universal tools creates unrestricted freedom for our customers with regard to gear types and module ranges. Tooth and tooth root shape as well as gear size can be freely selected by our common customers within the process limits.

## **GEAR CUTTING GIVES ALL OUR CUSTOMERS ANOTHER LUCRATIVE MANUFACTURING OPTION.**

SPECIAL FEATURE

# SKIVING OF PRECISE PLANETARY GEARS

**In 1928, Karl Neugart started producing gear parts in the Black Forest. Almost 100 years later, the company is considered a top supplier of precision gears. "We have been working on our know-how for a long time," says Christoph Wangler, process developer at Neugart GmbH. For the production of gear components, the company relies on the gear skiving process in addition to other manufacturing methods. Neugart has found the right tool partner for this in Paul Horn GmbH. In the meantime, the close cooperation between the two companies for the development of new skiving tools has developed from a pure supplier-customer relationship.**

"Our founder Karl Neugart began producing gear components for mechanical devices and office machines at the end of the 1920s," Wangler recounts. Today, the company develops and produces planetary gears and customised special gears, with 750 employees worldwide. The family-owned company manufactures the individual gear components exclusively at its headquarters in Kippenheim in southern Baden. With its expertise in manufacturing planetary and customised gears in over 14 million possible product configurations, Neugart supplies around 450,000 gears per year to the automation, packaging, machine tool and food industries, among others. In addition, Neugart developed the world's first planetary gearbox in hygienic design for use in the food and medical industries.

## Sun and planets

In an epicyclic gearbox, several spur gears distributed evenly around the circumference run between a gear wheel with internal and external teeth on a concentric circular path. The rotation of the spur gears is analogous to the orbit of planets in the solar system. For this reason, such gears are also referred to as planetary gears or planetary gearboxes. The housing with integrated internal gears is called a ring gear. In most cases, the housing is fixed. The driving sun pinion is located in the centre of the ring gear



More than 40 variants of the precision tools are in use at Neugart for producing gears from module 0.5 to 2.



For gear skiving, Neugart relies on tool systems from HORN.

and is coaxial with the output. It is usually connected to a tensioning system to allow mechanical connection to the motor shaft. During operation, the planet wheels, which are mounted on a planet carrier, roll between the sun pinion and the ring gear. The planet carrier also forms the output shaft of the gearbox. The planet wheels have the function of transmitting the required torque. Their number of teeth has no influence on the transmission ratio of the gearbox.

For the production of internal gears in the ring gears, especially for use in precision gearboxes, the company relies on the gear skiving process. "For gear skiving, we rely exclusively on tools from HORN. The performance and precision have impressed us," says Wangler. Neugart uses gear skiving in the module range from 0.5 to 2. "We have been working with Neugart for a long time. The intensive cooperation in gear skiving began about four years ago," says HORN sales representative Karl Schonhardt.

More than 40 different skiving tools are now in use at Neugart in series production. The design departments of both companies are in close contact for the development of new tools. Tool trials and determination of the appropriate cutting data for new skiving processes usually take place at HORN in the demonstration and test centre. "This means that the new tool can be used immediately by the customer," says Schonhardt. On the other hand, Neugart also offers HORN the possibility of field tests of newly developed tool systems. "We see close cooperation in the gear skiving process as very important. In order to get the optimum machining result, the cooperation should work in a precisely coordinated way, just like in one of our gearboxes – and it does," says Wangler.



### Time and precision

Neugart relies on a machine from DMG MORI for skiving the ring gears. "With the CTX beta 1250 TC, we have a flexible machine with user-friendly cycles on which the generating processes run reliably," explains Wangler. Before the introduction of the skiving process, Neugart relied on different gear broaching techniques. The changeover to gear skiving brought many advantages in terms of time savings and precision as well as the quality classes of the gears. The higher precision played a particularly important role in the production of components for precision gears.

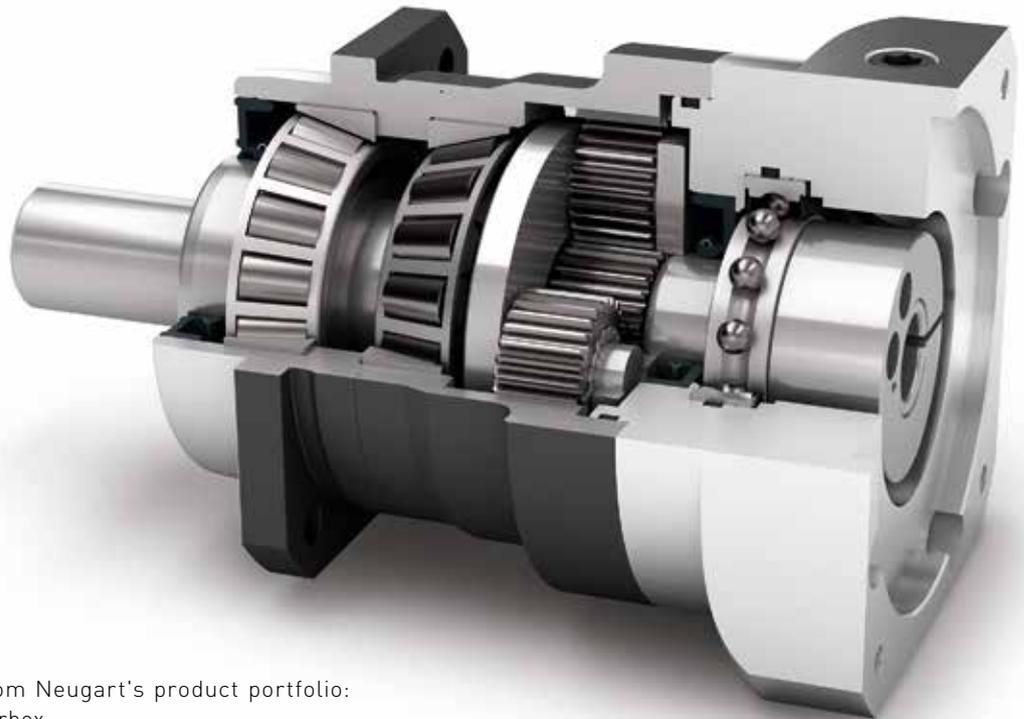
The tool system includes cutters for highly productive machining of internal gears, splines and other internal profiles as well as external gears with interference. The most important advantages of skiving in these applications are the significantly shorter process times compared to gear broaching, the ability to use skiving tools on optimised turning/milling centres, turning and gear cutting in one clamping and the elimination of undercuts at the end of the gear teeth. In addition, the usually more productive and cost-effective production

compared to shaping and broaching and the four to five times shorter cycle time compared to slotting are major benefits. So also is the possibility of hard machining of gear teeth into solid material. The skiving tools are designed for producing medium to large batches. Each tool is individually adapted to the application and the material to be machined, the different tool interfaces being based on the number of teeth and module size.

Especially with internal gears, HORN tools have the advantage of short processing times for larger modules, for example. For skiving larger modules, large and stiff milling/turning centres are required, which enable the corresponding synchronisation between workpiece and tool spindle. The larger the module, the more critical the machine is in terms of rigidity. With a division of cuts between the left and right flanks, this issue can be mitigated as far as the tool is concerned. After gaining

## THE MOST IMPORTANT ADVANTAGES OF GEAR SKIVING ARE THE SIGNIFICANTLY SHORTER PROCESS TIMES.

experience with small solid carbide skiving tools, HORN used the know-how gained to cover larger modules as well. Each application is checked for feasibility by the technicians before implementation and the tool design and recommendations for the process are discussed with the user.



An example from Neugart's product portfolio: a planetary gearbox.



Close cooperation: Karl Schonhardt (left) in conversation with Christoph Wangler.

#### **Solid carbide or with replaceable head**

The system includes tools in cylindrical or conical form for modules from 0.2 to 2. The solid carbide monobloc variant is available in diameters up to 20 mm (0.787") and in a slim design. They are used for producing small modules and components, preferably when a slim shaft is required due to the risk of collision. The grades and coatings matched to the application produce high surface quality on the workpiece. For tool diameters over 20 mm (0.787"), skiving tools with an interchangeable head system are used. The precise interface allows the cutting head to be easily changed in the machine without removing the holder. The carbide holder ensures high rigidity, wear resistance and precision. For larger modules, HORN relies on the use of a tool holder equipped with indexable inserts. Especially with the WSR tool type, HORN offers the option of placing the internal coolant supply in front of or behind the cutting edge. This means that, depending on the application, blind holes, through holes or stepped holes can be machined with the appropriate cooling.

**THE PRECISE INTERFACE ALLOWS THE CUTTING HEAD TO BE CHANGED EASILY.**

#### **Not only gear skiving**

Neugart has been relying on HORN's hobbing tools for about four years. However, the cooperation has existed for much longer. Other tool systems for parting off, form tools for grooving and other tools are also used. "We are very satisfied with the performance and reliability of the HORN tools. Furthermore, we are also impressed with the the fast delivery times. It means we can react quickly to urgent customer requests," says Wangler.

SPECIAL FEATURE

# EXACT TOOTH PROFILES FOR EXTRUSION

**High pressures, high torques and a high level of manufacturing precision: the production of screws at KraussMaffei in Hannover for extruders demands a high level of expertise from the approximately 600 employees. The screws are subjected to high stresses during the extrusion process. The modular design of the screws requires splines for precise positioning of the individual elements. For production of the gears, the user relies on gear broaching in addition to other processes. With Paul Horn GmbH, the company has found a suitable tool partner for these processes and at the same time increased production and saved non-productive time.**

In extrusion, plastics or other viscous, hardenable materials are pressed through a die in a continuous process. For this purpose, the plastic - the extrudate - is first melted and homogenised by the extruder using heat and internal friction. Additionally, the pressure necessary for the material to flow through the nozzle is built up in the extruder. After exiting the die, the plastic usually solidifies in a water-cooled calibration unit. KraussMaffei specialises in compounding, which improves mechanical properties such as tensile strength, impact strength or elongation at break.

One of the centrepieces of such plant is the extruder screw. It is generally divided into three zones. The feed zone is located

in the rear area. In this zone, the material is fed in as a solid (granulate) via a feed hopper and melted from the outside via heating elements. The rotation of the screw conveys the material into the compression zone, where it is compacted by the reduced flight depth of the screw and where the necessary pressure is built up. Finally, the discharge zone ensures homogeneous material flow all

**ONE OF THE CENTREPIECES OF SUCH A PLANT IS THE EXTRUDER SCREW.**



HORN relies on the 117 system for broaching the spline.

the way to the mould. Depending on the material to be processed, extruder systems can be equipped with one, two or more screws.

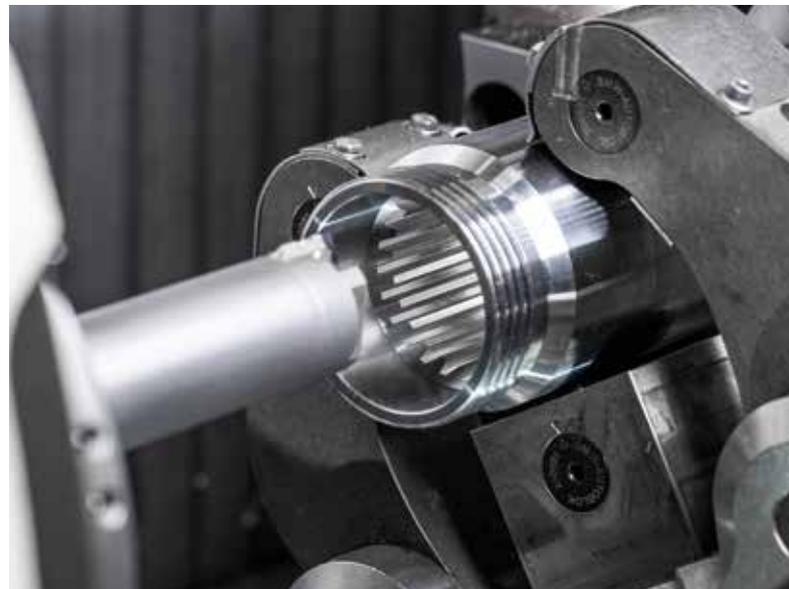
#### **Precise splines**

"The screws are mostly modular, so we put the individual elements on a mandrel. This creates screws of any length," says production planner Andreas Rudolf. He is constantly working with his colleagues from the work preparation department on optimising the production processes. They also take a close look at the production of the mating teeth of the connecting sleeves. "The sleeve is the link between the gearbox and the extruder screw," says Rudolf. The diameters of the sleeves range from 25 mm (0.984") to 180 mm (7.087"), depending on the diameter of the screws. The spline is a multiple drive connection used for radial transmission of torque between the shaft and the hub. To ensure that all flanks of the spline serrations are involved in the transmission of the force, a high degree of manufacturing precision is required. The shaft and hub can be moved in the axial direction as well.

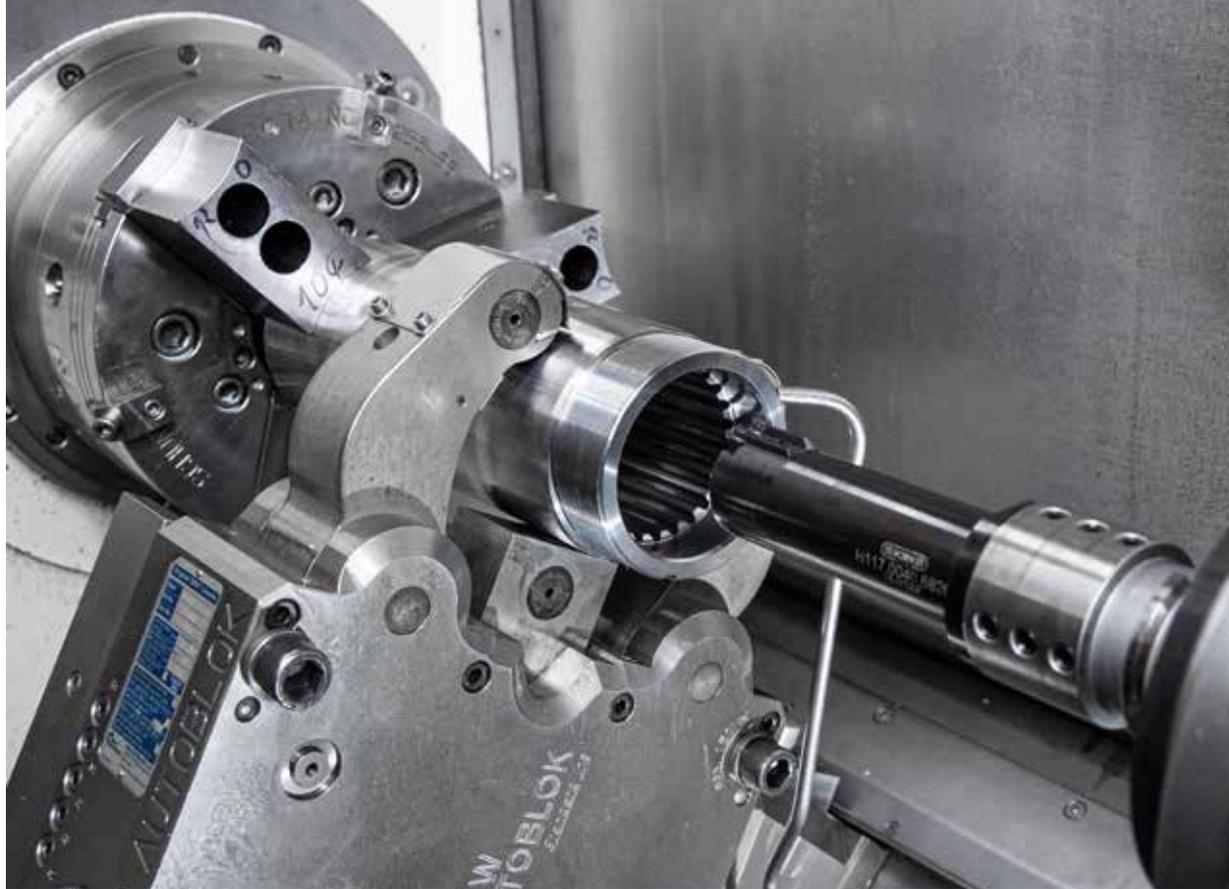
"Until now, we have eroded the splines due to the component geometry. The long eroding process as well as the non-productive times demanded a rethink of the production strategy. We wanted to produce the components completely finished on one machine," explains Rudolf. So the production planners contacted Andreas Nitschke, the HORN sales representative responsible for KraussMaffei. Nitschke suggested broaching the mating splines. "The component geometry and the length of the splines do not allow other methods to be used, such as gear skiving, which is a faster process," says Nitschke.

#### **Gear broaching with HORN**

Two mating splines are required on each sleeve, one for the gear hub and one for the connection to the extruder screw. The gear teeth must be aligned with each other, which is an important quality feature, especially for twin-screw extruders.



The changeover from EDM to gear broaching brought advantages in productivity.



The length of the serration requires a stable tool holder when broaching.

For the production of the sleeves, KraussMaffei relies on a CTX beta 1250 TC turning/milling centre from DMG MORI, which is equipped with a linear axis to minimise machine wear during the broaching process. Different HORN tool systems are used for producing the splines. For larger inside diameters, Nitschke chose the 117 system and for smaller diameters the 110 type Supermini system. However, the broaching process is the same for both tool systems. The cutting edge profiles of the inserts are precision ground. The profile of the insert is the same as the profile of the tooth.

In operation, the machine positions the tool in front of the component and the infeed is programmed, followed by machining of the workpiece. At the end of the spline there is a recess which allows for chip evacuation. There the tool lifts again and returns to the starting position. This process is repeated until the required tooth depth is reached. The infeed per stroke for this component is 0.1 mm (0.004"). Then the spindle indexes one tooth further and starts again from the beginning until all the teeth have been produced. For larger diameters and thus for deeper tooth profiles, the



### KraussMaffei

KraussMaffei is one of the world's leading manufacturers of machinery and systems for the production and processing of plastics and rubber. The range of products and services covers all technologies in injection moulding, extrusion and reaction processing. With a high level of innovative strength, the company ensures sustainable added value for its customers across the entire value chain with standardised and individual product, process, digital and service solutions. KraussMaffei's customers include companies in the automotive, packaging, medical and construction industries, as well as manufacturers of electrical and electronic components and household appliances. KraussMaffei employs around 4,700 people worldwide.



inserts can also be designed with multiple cutting edges. The tool has a finishing cutter and one or more roughers. This relieves the load on the finishing insert. Broaching on the machine offers the user various advantages. Different grooves, profiles, serrations or even guide grooves can be produced. One clamping is sufficient to finish the workpiece. This saves further machining as well as investment in other plant such as broaching machines or eroding systems.

#### Goal achieved

After the first side of the component has been produced, the counter spindle picks up the workpiece to allow the second side to be machined. To ensure that both tooth flanks are exactly aligned with each other after the second side is picked up and machined, the machine operators had to reach into their bag of tricks. "The changeover accuracy of the

HSK63-T tool holder was not sufficient for our quality requirements, so we were able to significantly increase the precision with in-process measurement of the tool in the machining area," Rudolf explains. The goal of the changeover to complete machining of the connecting sleeves

## BROACHING ON THE MACHINE BRINGS VARIOUS ADVANTAGES TO THE USER.

has been achieved. In addition to higher component precision, the changeover simultaneously increased productivity and reduced non-productive times. "We are very satisfied with the performance of the broaching tools from HORN. The precision and tool life have impressed us," says Rudolf.



Modular design: two extruder screws under construction. The sleeves are visible at the front.



Successful cooperation: Machine operator Lars Remmling in conversation with Andreas Rudolf and HORN sales representative Andreas Nitschke.

SPECIAL FEATURE

# FLEXIBLE SOLUTIONS FOR GEAR MILLING

**The cooperation between HORN and DMG MORI allows the economical machining of gears. The continuous further development of HORN tool systems in combination with DMG MORI gearMILL software enables the user to productively manufacture gear components on universal machining centres with standard tools. The cost-effectiveness is evident with individual parts and prototypes and extends to the production of high-quality gear geometries in small and medium series.**

With the gearMILL software, machine tool manufacturer DMG MORI has taken a decisive step in the economical production of gear components on universal machining centres. The software enables the calculation of different gear geometries and subsequent generation of the milling paths. This applies to spur, straight, helical and herringbone gears, worm gears, different bevel gears such as Klingelnberg cyclo-palloid and other gear geometries.

## Standard tools and software set standards

Tools from the HORN standard range are used for gear cutting. These include end mills, ball nose cutters, torus end mills, side milling cutters and conical end mills. "Theoretically there is no limit to the module but in practice HORN mainly limits itself to gears up to module 30. However, more important than the specific module size is that gearMILL enables universal 5-axis machining centres to produce highly complex gears. The economic effect is enormous. On universal machining centres, it is possible to machine a raw part geometry first and then finish the gear in the same clamping for one-off production, prototyping or small to medium series production. This is a great economic and time advantage compared to conventional machining on expensive gear cutting machines," explains Joachim Hornung, Key Account Manager at HORN. The use of standard tools for gear cutting offers the user fast turnaround, lower tool costs compared to special gear cutting tools and flexibility due to the rapid availability of the HORN tool systems.

In close partnership over many years, HORN and DMG MORI have been cultivating further developments in the field of general machining technology. Increasing customer benefits, saving costs, reducing process times, increasing process reliability, reducing lead-times and, above all, using standard tool solutions universally were the common goals from the very beginning. The successful implementations in the market speak for themselves. High



HORN developed the M279 milling system for economical roughing of cyclo-palloid gears.



For finishing gears, HORN offers numerous different solutions with its extensive standard tool range.

feed milling proved to be particularly advantageous. In recent years, HORN has placed special emphasis on this technology and developed an extensive standard tool programme. The wide range of high feed milling cutters, for example for near-net-shape roughing of gears, extends from cutter heads of the DAH system, solid carbide replaceable heads of the DG series to the solid carbide range of the DS series. The carbide grades specially developed by HORN are characterised by long tool life due to their high toughness and wear resistance. This also applies to the milling cutters for finishing tooth flanks, for example, special geometries and replaceable heads based on the DG system. The main advantage: high stability even with small modules. The rigid conical tool geometry requires only minor compensating movements of the machine. Even the root circle radius can be created with the same tool.

#### **Accelerated manufacturing processes**

The various milling cutters in HORN's standard programme comprehensively cover the demanding production of different gear geometries. In conjunction with gearMILL control software developed by DMG MORI, this results in flexible, fast and particularly economical machining of high-precision gear contours of any geometry on universal machining centres for production of prototypes and small to medium batches. Inflexible and expensive production using special gear cutting machines and tools can thus be replaced by accelerated manufacturing processes.



Joachim Hornung, Head of OEM at HORN.

**THE SUCCESSES IN THE MARKET SPEAK FOR THEMSELVES.**

INTERVIEW

# MARKUS HORN AND CHRISTIAN THÖNES

**HORN and DMG MORI are currently running a joint gear-cutting campaign. What topics does the campaign cover?**

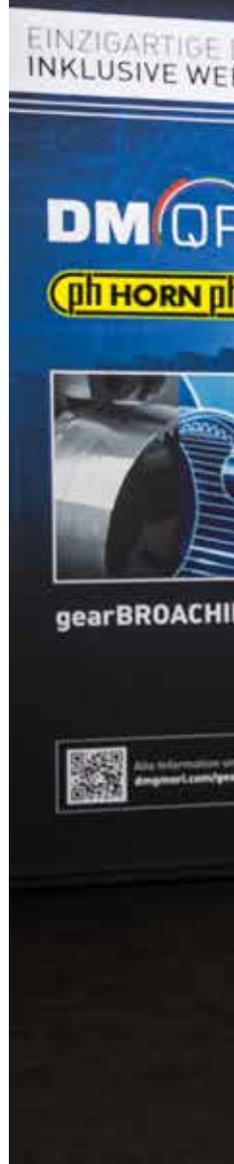
**Christian Thönes:** With this campaign, we want to make it clear that machining can only generate perfect added value for the customer from the holistic interaction of machine, precision tool and process. This is particularly evident in the top class of gear machining. As a worldwide leading manufacturer of high-precision machine tools, we are therefore pleased to have Paul Horn GmbH at our side as a partner who has mastered the profession of cutting material and tool development as well as tool making.

**Markus Horn:** The campaign is intended to illustrate the performance of the joint solutions: the combination of machine, cycle and tool and what added value this means for users. A big advantage is that many existing machines can be adapted to individual processes. Then the corresponding tooling solution can flow in. DMG MORI is a powerful and globally active partner with whom we can optimally solve customer requirements in this demanding area of machining.

**Who are you addressing with the campaign?**

**Markus Horn:** With the different gear solutions, we address users who are already active in the field of gear cutting or who want to be active in the future. The most diverse tooth profiles can be produced extremely economically with the right machine-cycle-tool combination. We see ourselves as partners in the development of new manufacturing strategies. The design of a tool also includes the definition of the machining parameters and the settings on the machine tool, which are supplied by us when the tool is handed over. The preparation of the gear cutting tools is crucial when considering cost-per-part.

**Christian Thönes:** Our range for gear cutting is so far-reaching and quality-oriented that basically all users are addressed. In metal-cutting workshops and job shops, gear cutting is gaining an increasingly strategic dimension because they are diversifying their range of services in this high-end area. But also specialised gear manufacturers know how to use the flexibility of gear cutting on universal machines for small and medium batch sizes down to individual





DMG MORI Chairman Christian Thönes and HORN Managing Director Markus Horn.

parts. This allows them to flexibly absorb production peaks, repair defective gears quickly or produce a gear "on the spur of the moment". Above all, they appreciate the gear quality of  $\geq 7$  when hobbing with our gearSKIVING technology cycle or even  $\geq 5$  with gearMILL. This is comparable to the quality obtained using special machines, but with faster process times, for example at our mutual customer Mönninghoff in Bochum, Germany, which takes advantage of gearSKIVING.

**What are the advantages for users?**

**Christian Thönes:** Synchronisation of axis movements on universal machines with universal tools reduces investment and operating costs and equally increases the number of degrees of freedom and flexibility in delivery. In each individual case, it is

also true that complete machining shortens the process chain, thus reducing throughput times and the in-house logistics effort.

**Markus Horn:** Our joint customers have the advantage of being able to fall back on these technologies

**THE CAMPAIGN AIMS TO ILLUSTRATE THE PERFORMANCE OF THE JOINT SOLUTIONS.**

as well as in-depth gear-cutting know-how – be it on the machine side or the tool side. Gear cutting on universal machines is becoming more and more common. This gives users increasing flexibility and allows them to carry out work in-house that was previously outsourced.

**What role do technology cycles play?**

**Christian Thönes:** There is probably no application that benefits as holistically from our many years of expertise in technology cycles as gear cutting. Since 2010, DMG MORI technology cycles have guided the user through conversational programming. As a result, entering just a few gear parameters leads almost automatically to the perfect NC program. This usually saves 60 percent of the time in digital preparation. Depending on the gear, different technology cycles are used. gearSKIVING offers the widest field of application for skiving internal and external gears up to module 11. We have realised large bearing rings up to 3,000 mm (118") in diameter at SKF in the USA. In contrast, gearMILL enables gear milling of large gears and modules larger than 3 with standard tools, virtually without limit. And gearBROACHING is ideal for workpieces with interference contours up to module 4.

**Markus Horn:** Technology cycles enable users to implement processes, such as the different types of gear production, in a relatively uncomplicated way. Of course, in most cases there is an application engineer on site who optimally adapts the tool to the application. In addition to the cycles, the machine, tool, workpiece and workholding also play a central role. It is important to keep an eye on the entire process.

## AN APPLICATION TECHNICIAN ON SITE OPTIMISES USE OF THE TOOL.



The cooperation is centred on gear broaching, gear milling and gear skiving.

**What do the associated tooling solutions look like?**

**Markus Horn:** The tools are, depending on the process and the task, standard solutions or often also bespoke special tools. For grooving, either single-edge inserts or multi-edge inserts are used, which engage with the workpiece directly in matching holders via the spindle or using driven tools - so-called grooving attachments. In gear milling, these are usually solid carbide cutters, or else cyclo-pal-loid cutters with interchangeable inserts. In gear skiving, tools are solid carbide for smaller modules, while for larger modules they are bodies fitted with interchangeable inserts.

**Christian Thönes:** The range includes, among other things, high-performance tools and interchangeable insert systems for gearSKIVING or high-precision broaching tools for gearBROACHING. The team of experts at HORN examines a customer enquiry within three working days and then implements even task-specific tools within a few weeks.

**Where and how can one see these solutions demonstrated?**

**Christian Thönes:** The DMG MORI Technology and Service Centers as well as all our production plants are available to customers at all times. Moreover, gear cutting on universal machines in particular was a hot topic during the DMG MORI in-house exhibition in Pfronten and will remain so until the national autumn trade fairs this year.

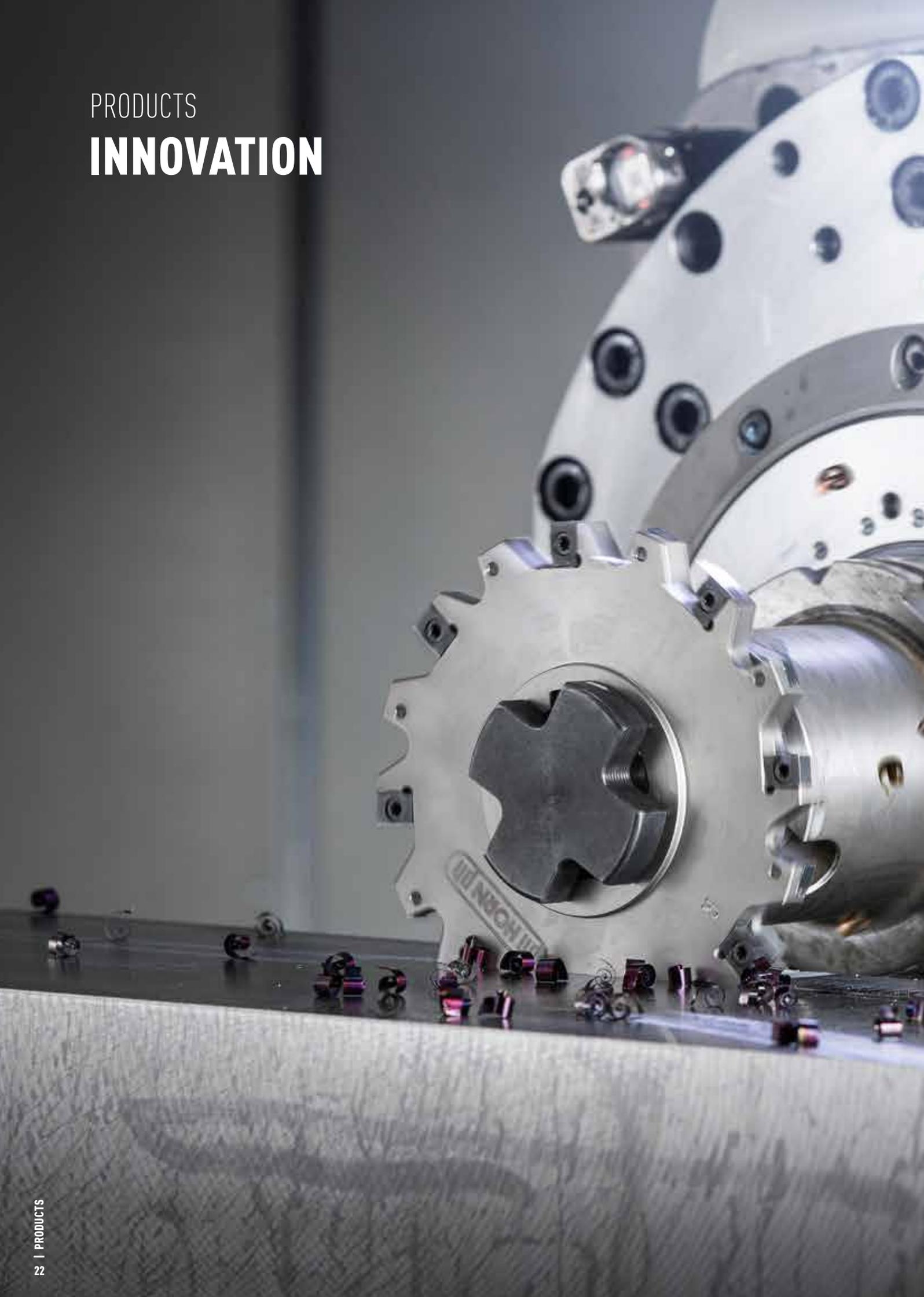
**Markus Horn:** The next opportunity to experience our joint solutions live is at AMB in Stuttgart. There we will show gear cutting on a DMC 65 FD H monoBLOCK as well as different milling operations on a DMU 75 monoBLOCK on our stand in Hall 1. In addition, the processes are also running in our demonstration centre.



For larger modules, HORN also offers gear skiving systems with indexable inserts.

**EITHER SINGLE-EDGE INSERTS OR MULTI-EDGE INSERTS ARE USED FOR GROOVING.**

PRODUCTS  
**INNOVATION**





## PRODUCTS

# GROOVE AND SLOT MILLING SYSTEM M475



### Groove and slot milling system M475

HORN is presenting a completely new generation of grooving and parting-off system at AMB 2022. The newly developed tool system enables highly economical and productive milling performance. Each precision-ground indexable insert offers four usable cutting edges, two left and two right. This means that the user no longer needs different inserts to equip the milling cutter body. HORN offers the positive inserts with round chip breaker groove in the new grade RC4G. This grade enables high cutting performance during the milling process. The M475 system complements the existing HORN milling systems M310, 382 and 383. The special surface treatment of the milling cutter bodies offers a high level of protection against abrasion from chips.

The cutter bodies are available from stock as side milling cutters, shell milling cutters and screw-in milling cutters. The shell and screw-in milling cut-

ter variants are equipped with an internal coolant supply. HORN offers the side milling cutters in diameters from 80 mm to 200 mm. The cutting and grooving width is optionally 5 mm (0.197"), 6 mm (0.236") or 8 mm (0.315"). As shell mills, the tools are

## THE USER NO LONGER NEEDS DIFFERENT INSERTS FOR EQUIPPING THE MILLING CUTTER BODY.

available in diameters from 63 mm (2.480") to 200 mm (7.874"). The groove widths are the same as for the side cutter variant. The screw-in cutters are available for groove widths from 5 mm (0.197") and diameters from 40 mm (1.575") to 63 mm (2.480") as standard. The effective number of teeth of all variants depends on the respective diameter. For example, it is  $z_{eff} = 2$  for the 40 mm (1.575") diameter shell mill and  $z_{eff} = 13$  for the 200 mm (7.874") side cutter. The large number of effective cutting edges also contributes to the economic efficiency of the new M475 milling system.

## PRODUCTS

# FINISHING AT HIGH SPEED



### Finishing at high speed

HORN has developed the new DTM 1710 milling system for finishing non-ferrous metals and plastics with abrasive fillers. Due to the high feed rates that can be achieved, the tool system enables high productivity and economic efficiency. The precision laser-cut PCD inserts produce very high surface quality during the finishing process due to the precision of the PCD cutting edge, the high quality PCD substrate and the  $\mu$ -precision axial run-out.

The PCD cutting edges brazed on cassettes can be fine-tuned axially via adjusting screws on the tool carrier. For use at high speeds, the cassettes are protected against the resulting centrifugal force. The axial run-out is set by HORN engineers before the tool is delivered.

Compared to other tools of this type on the market, the HORN milling system offers a higher number of cutting edges for any given diameter. The aluminium alloy milling body ensures low weight, minimising spindle wear. For long-term protection against abrasion from chips, the cutter body has a special surface treatment. To achieve high surface quality and for use at high speeds, the tool must be finely balanced with the tool holder. For high balancing accuracy, holes are provided around the cutter body. To achieve the best possible results, the entire ma-

chine environment must be taken into account and brought to the highest possible level of stability. The design of the machine, guideways, spindles and the workholding system as well as the milling tool have a decisive influence on the result. HORN offers the

## **DUE TO THE ELEVATED FEED RATES THAT CAN BE ACHIEVED, THE TOOLING SYSTEM ENABLES HIGH PRODUCTIVITY AND COST EFFICIENCY.**

milling system at market launch in the diameters 50 mm (1.969") (z = 10), 63 mm (2.480") (z = 14), 80 mm (3.150") (z = 18), 100 mm (3.937") (z = 24) and 125 mm (4.921") (z = 30). All variants have an internal coolant supply directly onto the cutting edge.

The HORN high-performance PCD cutting material is composed of a sophisticated mixture of different sizes of diamond grains. As the proportion of diamond by volume increases, so do the effective hardness, toughness and cutting edge quality. Strict quality standards and their control are a matter of course and ensure strong performance. For the DTM 1710 milling system, HORN offers the cassettes in two different PCD substrates according to the material to be machined.

## PRODUCTS

# NEW I GEOMETRY FOR THE MINI SYSTEM



### **New I geometry for the Mini system**

HORN has developed a new chip breaker geometry especially for the 108 Mini tool system. The I geometry is primarily intended for use when materials with poor chip formation properties are being machined. The geometry is suitable for copy turning, longitudinal turning and facing. Particularly if infeed rates are small when machining steel and stainless steel, the tool system demonstrates efficient chip control. This leads to higher process stability and also to longer tool life. HORN has also developed the new I geometry to improve machining of lead-free materials. Due to poor chip formation, these materials are likely to pose even greater challenges for the user in the future. For small infeed depths, HORN also offers the inserts with small corner radii from 0.05 mm (0.002"). Corner radii from 0.05 mm (0.002") to 0.2 mm (0.008") are available from stock as standard.

The screw-mounted inserts of the Mini system are among HORN's core products. The tool system is mainly suitable for turning applications. The precision tools have proven themselves especially suitable for boring and internal grooving. Due to the low-vibration carbide tool carriers, the inserts produce good surface finish even with long over-

## **THE I-GEOMETRY IS PRIMARILY INTENDED FOR USE WHEN MATERIALS WITH POOR CHIP FORMING PROPERTIES ARE MACHINED.**

hangs and ensure high process reliability. The extensive portfolio of the Mini system offers inserts in various sizes for different inside diameters, geometries and substrates as well as with CBN or diamond edge coating.

## PRODUCTS

# GEOMETRY FOR SWISS-TYPE TURNING



### Geometry for Swiss-type turning

HORN is expanding the S224 double-edged grooving system for Swiss-type machining. The indexable insert with PT geometry is particularly well suited to use in confined spaces and for back turning. The cutting geometry is designed for productive longitudinal, face and contour turning. The optimised chip breaker geometry ensures reliable swarf control. HORN offers the cutting insert with a choice of two different coatings to suit various materials. The 2.8 mm (0.110") cutting edge angled at 50 degrees ensures low material wastage when parting off the workpiece.

The maximum cutting depth of the new PT geometry is  $a_p = 2.5$  mm (0.098"). Inserts are available from stock in left- and right-hand versions with a corner radius of 0.2 mm (0.008"). Depending on the material to be machined, HORN offers the coatings EG5 as well as IG3.

The matching toolholders are available in sizes 12 x 12 mm (0.472 x 0.472") and 16 x 16 mm (0.630 x 0.630"), in left- and right-hand versions. The targeted internal coolant supply to the shear zone ensures efficient cooling for all holder variants.

**HORN IS EXPANDING ITS DOUBLE-EDGED GROOVING SYSTEM DESIGNED FOR SWISS-TYPE TURNING APPLICATIONS.**

## PRODUCTS

# GEAR SKIVING UP TO MODULE 8



### **Gear skiving up to module 8**

For producing gears with a deep profile, HORN has further developed the WSR gear skiving system. The company has adapted the WSR tool system, with its patented hollow shank taper interface, to produce larger gears up to module 8. The maximum diameter is 120 mm (4.724"). Compared to tools fitted with indexable inserts, the solid carbide cutter offers significantly higher manufacturing precision. The flexible design of the shank can be adapted to the machining conditions. Functionality and flexibility are guaranteed by in-house production of the solid carbide cutter and the shank.

With the expansion of the gear skiving system, HORN is responding to the wishes of users who would like to transfer the performance features of the WSR tool systems to larger modules. The performance and

precision of the tool makes it possible to finish-machine gears without reworking. In addition, long tool life further increases the cost efficiency of the gear skiving system. HORN offers the tools with a versatile internal coolant supply: cool-

## **HORN ADAPTS THE WSR TOOL SYSTEM TO PRODUCE LARGER GEARS UP TO MODULE 8.**

ing from the back onto the cutting edge, from the front onto the cutting edge or a combination of both. In addition, there is an in-house resharpener service for the gear skiving cutters to restore the original values.

## PRODUCTS

# NEW HIGH PERFORMANCE COATINGS



### **New high performance coatings**

With the new RC2 and RC4 coatings, HORN is exhibiting new developments in the field of high-performance tool coatings. The high toughness and hardness allow the machining of steels at high cutting speeds and lead to a significant increase in tool life. The high temperature resistance enables productive use in dry machining as well as with minimum quantity lubrication. Numerous tool sys-

## **HORN IS CONSTANTLY INVESTING IN NEW AND MODERN TECHNOLOGIES.**

tems are available from stock with the new HiPIMS coating. In-house coating enables fast delivery times even for special tools.

HORN is constantly investing in new and modern technologies. In 2015, the company CemeCon delivered the world's first of three HiPIMS systems to HORN. The High Power Impulse Magnetron Sputtering technology brings specific advantages and new possibilities in the coating of precision tools. It enables the build-up of dense, compact coatings that are very hard and tough. The coatings have a homogeneous structure and uniform coating thickness even if the tool geometry is complex. Research and development of new and existing coatings and technologies is a central component of success. HORN employs a team of engineers who work exclusively on this subject. Since in-house coating started, research and development projects have been carried out in cooperation with equipment manufacturers.

## PRODUCTS

# NEW CARBIDE GRADES FOR SYSTEM DAH8



### New carbide grades for system DAH8

HORN is expanding the range of carbide grades for the DAH milling system to enable its use for machining a wider range of materials. The new grades SC6A and IG6B complement the tool system for high feed milling. The expansion gives customers the opportunity to choose grades best adapted to their machining applications. The SC6A grade is suitable for machining the ISO M material group, as well as ISO S materials as a secondary application. HORN has developed the IG6B grade for machining the ISO P group, while it is also suitable as a multi-purpose grade for other material groups.

With the DAH82 and DAH84 systems, HORN is showing a new generation of tools for high feed milling. The eight usable cutting edges of the precision-sintered insert offer a competitive price per cutting edge and hence economical and efficient machining. The positive cutting edge geometry ensures a soft and quiet cut as well as good chip flow despite the negative mounting position. HORN offers the inserts in the substrates SA4B, SC6A and IG6B, which are suitable for universal use machining various materials. The large radius of the main cutting edge of the insert produces a soft cut, ensures an even distribution of cutting forces and thus promotes long tool life. The maximum cutting depth is  $a_p = 1.0 \text{ mm}$  (0.039") [DAH82] and  $a_p = 1.5 \text{ mm}$  (0.059") [DAH84].

The DAH82 variant is available as an end mill and as a screw-in milling cutter in the following diameters: 20 mm (0.787") (z = 2), 25 mm (0.984") (z = 3), 32 mm (1.260") (z = 4), 35 mm (1.378") (z = 4) and 40 mm (1.575") (z = 5), where z denotes the number of inserts. As an arbour milling cutter it is available in diameters of 40 mm (1.575") (z = 5), 42 mm (1.654") (z = 5) as well as 50 mm (1.969") (z = 6). For diameters in excess of 50 mm (1.969"), the larger DAH84 system is used. The variants are available only as arbour milling cutters in the following diameters: 50 mm (1.969") (z = 4), 52 mm (2.047") (z = 4), 63 mm (2.480") (z = 5), 66 mm (2.598") (z = 5), 80 mm (3.150") (z = 6), 85 mm (3.346") (z = 6), 100 mm (3.937") (z = 7) and 125 mm (4.921") (z = 8). All tool bodies receive a special surface treatment of high strength and hardness, imparting long-term protection against abrasive wear from chips.

**HORN IS EXPANDING THE RANGE OF CARBIDE GRADES FOR THE DAH MILLING SYSTEM TO ENABLE ITS USE FOR MACHINING A WIDER RANGE OF MATERIALS.**

## PRODUCTS

# SUPERMINI SET



### Supermini set

HORN now offers users its proven Supermini tool holder system with face clamping as a set, thereby responding to customer requests for different tooling system heights. With this holder variant, clamping is not carried out via the lateral surface of the cutting insert but via a clamping wedge on the face. This results in a greater holding force on the insert and thus high rigidity of the entire system. Furthermore, this style of clamping increases repeatability when changing the insert and provides better utilisation of the available space. This turns out to be a great advantage on Swiss-type lathes, as the user can change the cutting insert without removing the tool holder.

**A CLAMPING WEDGE ON THE FACE RESULTS  
IN A GREATER HOLDING FORCE ON THE INSERT.**

The set consists of a round shank holder and three different clamping elements. The latter are suitable for the three different insert heights of the Supermini system, 03, 04 and 05. A customer can select the desired diameter of the round shank holder when ordering. HORN offers it in the diameters 10 mm (0.394"), 12 mm (0.472"), 16 mm (0.630"), 20 mm (0.787"), 22 mm (0.866"), 25 mm (0.984) and 28 mm (1.102"). Inch dimensions are available in 1/2", 5/8", 3/4" and 1" diameters. All sets are available from stock.

ABOUT US

# AMB 2022 – STUTTGART



International Exhibition  
for Metal Working

13 – 17.09.2022  
Messe Stuttgart  
Germany



**Since 1982, AMB in Stuttgart has presented the highlights of the international metalworking industry every two years. The focus is on products, technologies, innovations, services and concepts for people who are passionate about metalworking. This makes the exhibition a marketplace, training opportunity and networking platform all in one. Whether for visitor or exhibitor, over the years AMB has become one of the most important dates in the industry calendar.**

AMB – International Exhibition for Metalworking – has established itself as the leading trade fair every even year. It occupies a top position among the industry's exhibitions and is one of the top five worldwide. Across a total exhibition area of more than 120,000 square metres (1,291,669 sq ft), all world market and technology leaders gather and present innovations for tomorrow's production. Visitors also benefit from the clear and thematic hall layout. AMB is supported by an attractive supporting programme and exciting special shows. Whether by plane, car, S-Bahn or train – the Stuttgart trade fair grounds are easy to reach.

As usual, the HORN exhibition stand is located in Hall 1. Visitors can experience innovations, processes, solutions and live machining on an area of about 500 square metres (5,382 sq ft). HORN precision tools are being used on three machines under power. The new trade fair concept is relevant to both production and product, which puts even more focus on and demonstrates the performance of the tools.

Other highlights include, for example, the special Youth Show where HORN trainees will be presenting themselves, the VDMA Innovation Forum, WorldSkills Germany, Art Meets Technology and the Self-guided Tours.

## AMB HAS ESTABLISHED ITSELF AS THE LEADING TRADE FAIR WORLDWIDE.



**Anne Neumann, Exhibition Management at HORN**

For us, AMB in Stuttgart and IMTS in Chicago are absolute highlights. Especially as both trade fairs could not take place two years ago due to the pandemic, or could not take place to the usual extent, we very much welcome the opportunity to have face-to-face discussions with our customers, interested parties and visitors again in Stuttgart and Chicago. We look forward to seeing you!

ABOUT US

# IMTS 2022 – CHICAGO



## IMTS2022

INTERNATIONAL MANUFACTURING TECHNOLOGY SHOW  
SEPTEMBER 12 – 17, 2022 • MCCORMICK PLACE • CHICAGO



**IMTS – the International Manufacturing Technology Show, one of the largest and oldest industrial trade fairs in the western hemisphere. It takes place every two years at McCormick Place in Chicago, Illinois. IMTS 2022, which will be held from 12th to 17th September 2022, is the place where inventors, manufacturers, vendors and drivers of manufacturing technology meet and get inspired. Industry professionals from around the world attend IMTS to discover the latest innovations in digital and traditional manufacturing, learn about more than 15,000 new machining technologies and find processes that help them solve their manufacturing challenges and improve efficiency.**

2022 will see the 33rd edition of North America's premier manufacturing technology show. IMTS 2018 saw the highest number of exhibiting companies ever (2,563) and was the largest in terms of registrations (129,415) and net square footage of exhibit space (132,315) at the McCormick Place complex. IMTS is held every even year in Chicago and attracts buyers and sellers from 117 countries.

## INDUSTRY EXPERTS FROM ALL OVER THE WORLD VISIT IMTS.

The HORN USA exhibition stand – Stand 431722 – is located in the West Building. Visitors can experience innovations, processes, solutions and live machining in a stand space of about 500 square metres (5,382 sq ft). HORN precision tools are being demonstrated on three machines under power. The new trade fair concept is close to both production and product, which puts even more focus on and demonstrates the performance of the tools.

### Why should you visit IMTS?

- **Technology: 90 percent of visitors found new products or ideas.**
- **Inspiration: 88 percent of visitors found new solutions.**
- **Community: 93 percent of visitors achieved their goals at IMTS.**

ABOUT US

# SOLUTIONS FOR MICROMACHINING AND SWISS-TYPE TURNING



**Outer diameters of 0.1 mm (0.004"), recesses of 0.5 mm (0.020") and feed rates of 5 µm (0.0002") – welcome to the world of micromachining! Screws for hearing aids, balance weights for automatic wristwatches or micro-turned parts for medical assemblies: Manufacturing such parts requires know-how, precise machines and special tools. With cutting depths of down to 0.01 mm (0.0004"), users place very high demands on the tools used. They include shiny surfaces and high dimensional accuracy of the components through the use of low cutting force. HORN has developed suitable solutions with the µ-Finish system for micromachining as well as with other tool systems and manufacturing processes for Swiss-type lathes.**

The demands on the tools for micromachining with Swiss-type lathes are high. Due to the sometimes very small cutting depths, the tool edges must be very sharp in order to keep the cutting force as low as possible. However, the ground cutting edges are susceptible to microchipping. Even limited chipping

workpiece when machining the smallest diameters. In the best case, the machine operator should be able to turn the insert without having to readjust the centre height. With the µ-Finish system, HORN offers a changeover accuracy of +/- 0.0025 mm (0.0001") when indexing a double-edged insert. This is made possible by the precise peripheral grinding of the insert in conjunction with the stable insert seat. In addition, the contact surfaces of the square shank toolholder are also ground, which has an effect on the holistic precision of the HORN system.

## PRODUCING A SHARP, FLAWLESS TOOL EDGE REQUIRES A LOT OF KNOW-HOW.

in the range of a few µm at the cutting edge has a negative effect on the surface of the machined workpiece. Furthermore, the surface quality of the rake face plays an important role. To counteract built-up edges, the rake face must have good sliding properties. For this reason, it is finely ground or polished.

### **Changeover accuracy of 2.5 µm**

Clamping of the inserts is another important point in tool design. When machining turned parts of small diameter, the centre height of the tool must be precisely measured. Even slight deviations in centre height have a negative effect on the quality of the

The grinding of a sharp, flawless tool cutting edge requires a lot of know-how. Grinding wheels with the finest grits, special new grinding techniques and a microscope with 400x magnification are necessary to ensure that the tool performs as required. In the process, every batch of the µ-Finish system produced is subject to 100 per cent inspection. Important quality assurance criteria are the tightly toleranced high surface quality of the rake and flank surfaces, the centre height and, in particular, the sharpness of the cutting edge. There must be no visually recognisable irregularities on the cutting edge with the µ-Finish system.



HORN offers complete tooling solutions for users.



The S274 system with precision-ground cutting edges enables precise machining of very small turned parts.

HORN presents itself as a holistic supplier of tools for all Swiss-type machining operations. The extensive insert portfolio can be easily adapted to the requirements of different processes in sliding-headstock turning. Close partnerships have been established with the companies Graf Werkzeugsysteme, Boehlerit and W&F Werkzeugtechnik to provide solutions for the interfaces between the cutting insert and the machine, including for ISO tools.

#### **Broad knowledge**

**HORN's know-how does not only apply to cutting tools. The tool manufacturer also supports its customers and partners with knowledge of the correct application data and the development of new tool systems and manufacturing processes for sliding-headstock operations. This includes, for example, competence in driven tools, tool holders for backworking and entire tool solutions.**

ABOUT US

# PRECISION FROM ALLGÄU

**Reinhard Buck's company motto "Gscheid gmacht" not only appears on his company logo. The entrepreneur lives the motto together with his employees in his company zmtec. In Leutkirch in the Allgäu, the company produces everything from microcomponents to complex assemblies. Reinhard Buck's specialities include micro-turned parts from a diameter of 0.5 mm (0.020"). For productive machining, he relies on tool systems from Paul Horn GmbH. "We see the large variety of tools and the good price in relation to tool life as a great advantage of HORN," he says. For machining a rotary slide with a diameter of 1.6 mm (0.063"), Buck relies, among other things, on the S274 tool system and the 606 circular milling tool with a cutting width of 0.3 mm (0.012").**

In 1993, Reinhard Buck started producing turned parts in his garage in addition to fulfilling permanent jobs in various companies. The fascination for automatic lathes never left him. His motivation at all times was: "The better I master the technology, the easier it is to earn money with it". In 2007, he decided to set up his own business, which he did the following year. The global economic crisis began shortly after he started.

Thanks to its good reputation and the high quality of the work, his company zmtec was able to grow despite the crisis. Currently, the managing director employs 25 people. His know-how for small and very small turned parts has made him a problem solver for tricky turned parts. His customers include companies in numerous sectors including medical, dental, mechanical engineering, aviation and even hunting weapons.

### **Absolutely no burrs essential**

Buck saw the potential to optimise the machining process for the rotary slide, which is used in a hydropneumatic valve. The company produces around 20,000 of the X8CrNiS18-9 (1.4305) components per year. The component has a length of 2.6 mm (0.102"), a thread size of M 1.6 and a fit with a diameter of 1 h8. To set the rotary slide in use, a slot with a width of 0.3 mm (0.012") and a depth of 0.5 mm (0.020") has to be milled on the threaded portion of the turned



Turning the M1.6 x 0.35 thread with the S274 system.



The required freedom from burrs was a challenge.

part. "The difficulty in machining is, among other things, the need for a total absence of burrs on the component. When you mill a slot in a thread, freedom from burrs is not easy to achieve. You cannot simply deburr such a small component with a file. The thread would immediately be unusable," Buck explains.

For the Swiss-type machining of the outer contour, Buck relies on the HORN S274 tool system. "For machining stainless steel, we chose the IG35 tool coating. This offers high performance when machining stainless steels, titanium and superalloys," explains HORN sales representative Gisbert Voß. In combination with the HORN chipbreaking geometries, the aluminium-titanium silicon nitride coating inhibits the formation of built-up edges due to the low friction. As a result of the HiPIMS coating technology, the layer has very smooth properties and high heat resistance. Furthermore, the tool coating is free from coating defects such as droplets on the cutting edge. The user can run higher cutting values, which enable a shorter cycle time and has a positive effect on unit production costs. In addition, the use of the coating allows higher quality surfaces to be achieved.

**"THE BETTER I MASTER THE TECHNIQUE, THE EASIER IT IS TO MAKE MONEY WITH IT."**

#### **Slot milling with the System 606**

After turning the outer contour, a cutting insert from the S274 system takes over the production of the thread. The M 1.6 thread has a length of 2.2 mm (0.087") and a pitch of  $P = 0.35$  mm (0.014"). After thread turning, the next machining step is milling the slot. "We used to cut the slot with a fine HSS saw blade. There was potential for improvement here," says Buck. Voß suggested milling the slot with the Type 606 six-flute circular milling

system. The first trials were immediately successful and Buck replaced the HSS tool with the HORN milling system. To ensure that the part is burr-free after slot milling, the thread turning and slot milling process is repeated three times. "After that, the component is burr-free," says Buck.

HORN expanded the circular milling system to include tools for milling narrow grooves. The rounding off of the tool portfolio offers the user the possibility to avoid cost-intensive machining processes in the production of narrow grooves. HORN offers the tools in cutting widths from 0.25 mm (0.010") to 1 mm (0.039") as standard, depending on the diameter. The maximum milling depth  $t_{max}$  is between 1.3 mm (0.051") and 14 mm (0.551"), according to tool diameter. Depending on the material to be machined, the cutting inserts are available with different coatings. Due to its mass, the solid carbide tool shank ensures vibration damping during milling. All variants of the tool shanks are equipped with an internal coolant supply.



They have been working closely together for years: Gisbert Voss talking to Reinhard Buck and machine operator Jürgen Schmid (from left to right).

#### Good cooperation

**Buck had already worked with HORN before founding zmtec. He appreciates the support and technical advice of the tool manufacturer from Tübingen. "We see the large variety of tools and the good price in relation to tool life as a great advantage of HORN over other tool manufacturers. Furthermore, we get competent advice and the right tool solution, even for very difficult tasks."**

The comparison with a match illustrates the size of the component.



## ABOUT US

# HORN APPRENTICE GERMAN CHAMPION IN CNC MILLING

**Tom Schmid, an apprentice at Paul Horn GmbH, is the German CNC milling champion. He prevailed over 13 participants in the final round at the beginning of June at the Chiron Group in Tuttlingen. The award ceremony took place on 23rd June.**

The task of the final round was to design, program and manufacture three complex components within a given time. Not only was good time management required of the participants, but also precision. At the end of the competition, all three manufactured components had to fit together as an assembly.

The next competition, the International WorldSkills Championship, will be held in October. Due to the pandemic, the event will not take place in Shanghai (China) in 2022, but in Leonberg for CNC milling. At this event, Tom Schmid will be able to measure his skills against international participants. "I am very happy about the result and the opportunity to compete in the upcoming world championship," says the budding industrial mechanic. In addition to Schmid, two other HORN trainees made it into the top 10 in this discipline: Christian Falch achieved third place and Lars Bauer finished the competition in tenth place.

The German championship was organised by WorldSkills Germany e.V., a German non-profit association with headquarters in Stuttgart. It was founded in 2006 as a promotional initiative for national and international vocational competitions. As a recognised network partner in the field of dual training, the association opens up new ways for young people to turn their passion into a profession and become the best in their field! WorldSkills Germany is thus marketing vocational education and training and increasing the recognition of dual training occupations. With the successful concept of "learning in competition", WorldSkills Germany strengthens vocational education and training, increases its attractiveness and supports lifelong learning.



Christian Falch, German Champion 2022 Tom Schmid and Lars Bauer (from left to right).

## THE NEXT COMPETITION, THE INTERNATIONAL WORLDSKILLS CHAMPIONSHIP, WILL BE HELD IN OCTOBER.



# GEAR SKIVING ENGINEERED FOR MAXIMUM THRUST

## EXPLORE HORN

Exceptional performance comes from pairing the optimal machining process with the perfect tool. HORN combines cutting-edge technology with outstanding performance and reliability.



[horn-group.com](https://www.horn-group.com)