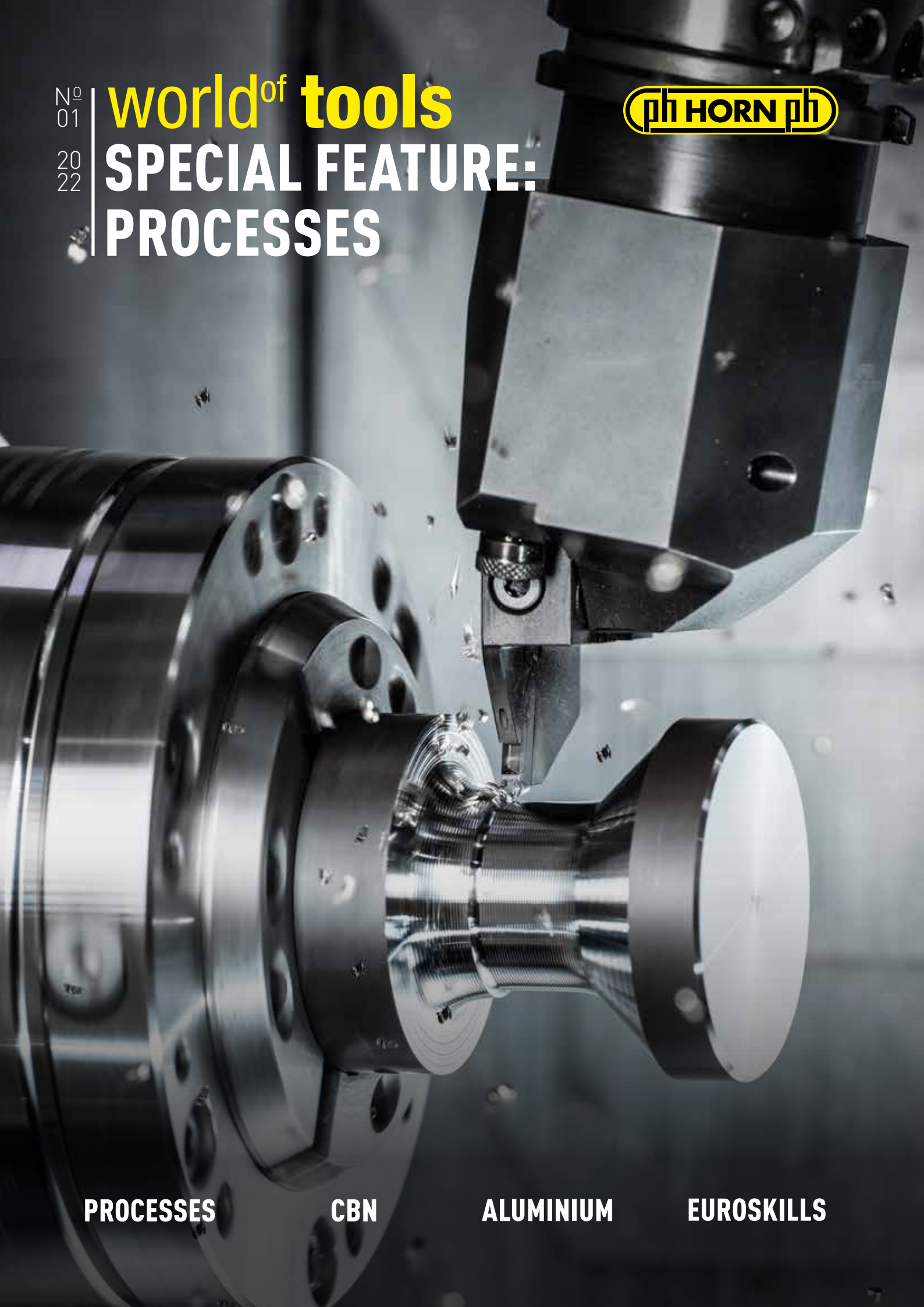

№ 01 2022

world of tools

HORN

SPECIAL FEATURE: PROCESSES

PROCESSES CBN ALUMINIUM EUROSKILLS

DEAR READERS,

Tools, workholding, machines and controls all make up processes. However, in most cases it's not quite as simple as it might appear at first glance. There is a lot that needs to happen first, especially when it comes to software and cycles, or even the properties and functions of machines – the keyword here is synchronised spindles – and much more. Processes require a comprehensive approach and understanding to make them workable for users and to provide added value. Gear skiving, polygon turning and high-speed whirling are all processes that have recently come to the fore. Our understanding of processes is the key to holding our own in premium class machining.

Fostering young talent is an essential part of what makes us HORN. Only by considering the skilled employees of tomorrow, and taking action now, can you lay the foundation for long-term success. This is precisely why we decided to become a sponsor of EuroSkills 2021. As well as having our own training department and the HORN Academy, we also share a facility with the Nachwuchsstiftung Maschinenbau foundation. This combination allows us to keep our finger on the pulse, with our sights set on the future.

We hope this edition of World of Tools provides you with plenty of valuable information.

Markus Horn, Lothar Horn and Matthias Rommel

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PROCESSES

MASTERING PROCESSES

“No cars can drive, no planes can fly, and no joints can be replaced by surgeons without precision tools first being put to use”, says HORN CEO, Lothar Horn. The same applies when it comes to machining. Only by mastering the machining process can we really tease the maximum performance out of the tool being used. However, not mastering the tool itself also results in an inability to achieve economical results, even with the best process knowledge. HORN’s engineers combine their expertise in the manufacture of precision tools with productive machining processes.

Customer component from the field of tool and mould making.

Every machining operation is a process: from grooving and parting off, to groove milling or face milling. These are processes that engineers perform every day and are stored as cycles in every machine control system. For this reason, HORN’s product portfolio boasts a huge selection of different tools. Furthermore, specialised machining processes such as gear skiving, bevel gear milling, thread whirling, brilliant-finish milling and turning, or speed forming require a high level of expertise in both tool technology and when it comes to process knowledge. For example, this expertise may involve the design of the tool cutting edges for whirling a multi-thread bone screw or the tooth profiles of gear hobs.

HORN has developed a set of speed-forming tools for machining grooves into cubic workpieces with maximum productivity. To create deep and narrow grooves (with a width of 2 mm (0.079") to 3 mm (0.118")), tool and mould makers generally use milling cutters with a large length-to-diameter ratio. Due to the high risk of breakage, relatively low feed rate and infeed settings have to be selected. But thanks to its tools, HORN allows you to create grooves with a depth of up to 20 mm (0.787") quickly and cost-effectively using the speed forming technique. The tools are based on the Supermini 105 system. As with broaching, the tool travels along a programmed path with a fixed tool spindle orientation. The maximum infeed for the individual strokes is 0.3 mm (0.012") with a fast feed rate setting (maximum 60 m/min (196.85 ft/min)).

Not only that, but the tool can also be combined with a cycle for producing curved or undulating grooves. This makes it a highly productive solution for creating cooling fins or reinforcing ribs on a casing, for example. When used with appropriate machines and components, the tools achieve shorter machining times because the droplet shape of the Supermini system is able to withstand higher bending loads, thereby allowing infeed in the longitudinal direction of cutting.

HORN has developed tools for the polygon turning process to manufacture non-circular contours. By adopting an axial feed, the tools enable you to produce non-circular contours on lathes consistently. This technique facilitates the production of polygon shapes, for example. During operation, the workpiece and tool axes are offset in relation to one another and a specific speed ratio is established between them. The tools are suitable for external and internal ma-

HORN DEVELOPED THE POLYGON TURNING PROCESS TO MANUFACTURE NON-CIRCULAR CONTOURS.

HORN has developed a set of speed-forming tools for machining grooves into cubic workpieces with maximum productivity.

HORN has developed tools for the polygon turning process to manufacture non-circular contours.

chining alike. Together, the axis offset, workpiece-to-tool speed ratio and circle of rotation of the cutting edge define the dimensions of the contour. Every tool system for polygon turning is individually tailored to the workpiece contour to be produced. The technique is highly suitable for series production processes because no jerky movements or reversals of motion occur during machining. HORN offers the polygon turning tool system in response to enquiries from customers who are looking to produce spline gears, polygons and other shapes in a cost-effective manner.

These are two examples of how HORN demonstrates that the company is there to support its users, not only as a pure precision tool manufacturer. With its expertise in tool manufacturing and extensive process knowledge, HORN sees itself as a problem solver, even when it comes to special machining solutions.

SPECIAL FEATURE

THE PROCESS OF BRILLIANT-FINISH MACHINING

Mirror-finish surfaces and roughness to within nanometres. These are properties that can only be achieved with the process of ultra-precision machining or brilliant-finish machining. Using the right precision tool with the appropriate grade ensures the perfect result. The surface produced is always a mirror image of the cutting edge of the tool. Thanks to its internal structure and hardness, only a cutting edge made of monocrystalline diamond (MCD) can be polished finely enough for an absolutely flawless surface to be produced during cutting. There are no computer-aided machines for perfect polishing of a flawless cutting edge. Only the expert touch and knowledge of specially trained employees can guarantee this brilliant-finish result. The finishing of top-class tools is a purely manual task.

Brilliant-finish machining with MCD is one of the ultimate disciplines in the field of machining with geometrically defined cutting edges. Two hundredths of a millimetre of finishing allowance separate a very good surface from a perfect surface with mirror finish. The range of applications is broad and the manufacturing process is used in numerous industries. In the jewellery industry, the tools provide dazzling shine; for example, in the production of visible parts for quality wristwatches and most wedding rings. In the production of mirrors for space telescopes, the virtually perfectly accurate shape of the milled mirror surface guarantees a distortion-free view into space. Diamond-tipped tools have been used in the manufacture of almost every vision aid, from glasses to contact lenses. Another possible application is tool, model and mould making. This is an area where time-consuming and expensive polishing can be saved. The list goes on, not least in the medical sector, where these tool systems are firmly established.

Applications in research

In scientific fields, researchers hope to gain new insights with the help of mirrors with brilliant-finish, precision surfaces. One example is a group of astrophysicists at the University of Kassel. In a vacuum chamber, the scientists are creating materials that otherwise only exist in outer space in order to learn more about how stars grow and decay. Sophisticated laser systems and high-precision mirror systems aid the researchers in investigating their ideas and theories. In the research, laser beams are directed via the mirrors through a gas cloud that has been created. The more often the beam is reflected back and forth, and therefore the more often the beam passes through the gas, the clearer the detected signals become. Before brilliant-finish machining, researchers relied on polished mirrors. These had a mirror-like surface, but there were too many geometric inaccuracies affecting the smoothness due to the number of times it had been polished. MCD-tipped milling cutters were able to overcome these issues.

Brilliant-finish surfaces can also be produced on non-specialised, universal machining centres. The bearings of the drives and the spindle play a decisive role in this. Brilliant-finish machining is limited to non-ferrous metals, precious metals and fibre-free plastics. Its economical application in steels is not possible due to chemical interaction. In use, the carbon in the diamond would diffuse into the iron in the steel and dissolve the diamond.

Craftsmanship

In order to produce brilliant-finish surfaces, the quality of the tool cutting edge plays a decisive role. The quality of the cutting edge is reflected in the surface to be machined. The final grinding or polishing of the MCD cutting edge takes real craftsmanship. Similarly

to when cutting a diamond for jewellery, finish grinding of a tool cutting edge for brilliant-finish machining is carried out by hand. What's more, air-bearing grinding tables with a table top made from solid granite provide optimum conditions for grinding the cutting edges. A microscope with 200x magnification is used for visual inspection. Under this magnification, the cutting edge must be absolutely free of any imperfections. The resulting cutting edge has a maximum radius of 0.0002 mm (7.8740157e-6"). HORN has developed a special grinding machine for grinding MCD ball nose end mills for brilliant-finish machining of freeform surfaces, with which even the smallest radii can be ground reliably.

It is mainly synthetic diamonds that are used for brilliant-finish machining. Two different methods can be used to produce synthetic stones. In the HPHT (high pressure, high temperature) method, the diamonds are created under elevated levels of pressure and heat, meaning they are created in an almost natural way, only not over millions of years, but within a few hours or days, depending on the desired size. Using this method, pure graphite powder is converted into a diamond at a pressure of 60,000 bar and a temperature of 1,500 degrees Celsius (2,732°F). Diamonds created using this method are characterised by a slightly yellowish colour, which is caused by the refraction of light from embedded nitrogen atoms. The maximum edge length of the synthetic stones is 10 mm (0.394"). Dimensions beyond this are theoretically possible, but would not be economical.

HORN uses even purer MCC diamonds for MCD tools. These monocrystalline stones are created using the CVD method. Various gases (mainly methane) are used to provide the carbon source and are separated during the process to allow the diamond to grow. These diamonds are characterised by their crystal-clear to slightly brownish colour, depending on the thickness. A major advantage of this method is the feasible edge length of the stones, as even longer tips with cutting edge lengths of 30 mm (1.181"), for example, can be achieved. Before these methods were implemented, natural diamonds had to be used for such tools, which was difficult due to their high price, lack of availability and natural inclusions.

Polishing the MCD cutting edges takes real craftsmanship.

USING THE RIGHT PRECISION TOOL WITH THE APPROPRIATE CUTTING MATERIAL ENSURES THE PERFECT RESULT.

SPECIAL FEATURE

HIGH QUALITY DIAMONDS FOR A BRILLIANT RESULT

"We branched out into the sectors that others had avoided", says company founder Walter Schumacher. Together with his son, Stefan, he runs the company Walter Schumacher Impuls Technik GmbH, (SIT). The company specialises in the development and production of special valves and stand-alone valve solutions, which are used in numerous industries. The product range includes valves for all types of media, ranging from high-vacuum valves to high-pressure valves rated up to 800 bar. One of these special solutions made from aluminium consists of several helium valves, various sensors, pressure relief valves and throttles, which control and regulate various pressures. The emphasis is on the surface quality of the mating surfaces, which ensures functionality in high-technology analysis. SIT achieves a surface quality of Ra 0.012 µm (4.724409e-7") using a diamond tool from Paul Horn GmbH and by having invested in a new turning/milling centre from the machine manufacturer Mazak.

"Our surface finish specification at the start of the project was Ra 0.02 µm (7.87402e-7")", says Stefan Schumacher. The surface quality of the valve block plays a crucial role, as it acts as a sealing surface in the valve assemblies. "Sealing hydraulic valves with oil pressures of around 450 bar is technically relatively simple to implement. With valves for controlling the flow of helium or other gases that have to tolerate pressures of up to 800 bar, this is technically a very difficult challenge, which not many people want to take on", explains Walter Schumacher. Even with technical perfection, it is not possible to produce a perfect sealing surface. The leakage value is 1 x 10-7. For this reason, the almost perfect, brilliant-finish surface of the valve block plays a key role.

Complete valve block machining

Before making the move, SIT relied on a specially developed polishing process to produce the valve block after machining. However, the time and personnel required for reworking meant that optimisation was required. SIT lacked the right machinery for this, however. After the move to the newly built company headquarters, investment in a new turning/milling centre had made it to the planning stage, but the

The HORN DTM milling system with MCD cutting edges made surface qualities down to Ra 0.012 µm (4.724409e-7") possible.

The solid workholding attachment developed by Mazak.

THE SURFACE QUALITY OF THE VALVE BLOCK PLAYS A CRUCIAL ROLE.

machine manufacturer was yet to be selected. "We approached a few potential suppliers with our requirements. Mazak immediately expressed a high level of interest and proposed a complete valve block machining solution", says Stefan Schumacher. The company opted for the INTEGREX i-200ST turning/milling centre. The INTEGREX is designed for rigidity and stability, added to which the spindle runs smoothly and with low vibration. In addition to the machinery, Mazak and another partner designed a workholding attachment for the 300 mm (11.811") long, 110 mm (4.331") wide and 30 mm (1.181") high valve block. The attachment is mounted directly on the spindle flange, where the chuck is normally. The number of clampings was consequently reduced from nine to just two.

HORN takes the top spot

Once the machine concept had been decided, the next step was the tool planning. "After initial contact was made and the machining task had been outlined, it quickly became clear to me that the finishing processing should be performed using our DTM milling system", says HORN product manager Jürgen

Schmid. The tool is tipped with a monocrystalline diamond (MCD) cutting edge. The second cutting edge is tipped with PCD and is used as a pre-cutter to achieve the defined allowance of 0.02 mm (0.001") for the MCD. "As well as HORN, an alternative tool manufacturer was also in the running. However, HORN solved the task on the first attempt, while the other manufacturer needed three attempts. This made our choice clear, not only because we were immediately satisfied with the result, but also because of how impressed we were by the company's expertise. We also use other tool systems from Tübingen and are very satisfied with them", says Walter Schumacher.

The surface milled by the HORN DTM tool system achieved a measured value of Ra 0.012 µm (4.724409e-7"). The tool body has a diameter of 125 mm (4.921") and has two cutting edges – an MCD insert and a PCD pre-cutting insert mounted opposite each other in the milling cutter body. The six free seats are fitted with carbide balancing inserts. The tool is finely balanced at HORN to ensure it runs without vibration. The insert seats in the DTM body can be adjusted in the axial direction via an adjusting screw. Every ten-degree rotation moves the insert seat by 0.01 mm (0.0004"). This means that the axial run-out of the individual cutting edges can be adjusted with micron precision. The internal coolant supply ensures targeted cooling of the contact zone and enables efficient chip removal. The low mass of the aluminium body protects the spindle and reduces energy consumption compared with steel bodies.

Delicate surfaces

"One difficulty was the large number of holes drilled into the surface to be machined. Necessarily, brilliant-finish milling must be the final machining operation, as otherwise very fine chips from drilling, reaming and thread milling would damage the reflective mirror surface", explains Schmid. "Even fingerprints can render the sealing surface unusable later on", adds Stefan Schumacher. The interrupted cut across the drilled holes posed no problem for the HORN tool. During

ONE DIFFICULTY WAS THE LARGE NUMBER OF DRILLED HOLES ON THE SURFACE TO BE MACHINED.

Dazzling teamwork between SIT, HORN and Mazak.

A successful collaboration for 20 years: Stefan Schumacher (SIT) talks to Paul Hauser and product manager Jürgen Schmid (both at HORN).

processing, the milling cutter moves once longitudinally over the workpiece at a speed n = 5,000 rpm and with a feed rate of v_f = 500 mm/min (19.685"/min). The cutting speed is v_c = 1,960 m/min (6430.446 ft/min). To reduce re-cutting of the chips, the tool is set at a minimum lead angle of 0.008 degree. A commercially available emulsion is used for the coolant. "We are very satisfied with the performance of the tool. In series production, we now achieve surface qualities between Ra 0.012 (4.724409e-7") and Ra 0.014 µm (5.511811e-7")", summarises Stefan Schumacher.

SIT: the company

Almost 40 years of experience in top-quality valve technology has enabled Walter Schumacher to build up a solid customer base in almost every industry sector. The main field of activity is the manufacture of special valves and customised, stand-alone solutions. Development, production and distribution are all under one roof. SIT offers its customers short lead times from initial contact to the finished product, resulting in lower costs and direct contact with decision-makers. The use of modern machinery and specially trained personnel enable the company to produce large series as well as one-offs with consistent quality and in accordance with individual customer requirements. Each and every valve undergoes quality control. The workmanship, performance and leak tightness – up to and including a helium leak test with a report if required – are carefully checked before the goods are dispatched. Tested assemblies, which include components such as flow regulators, filters, pressure relief valves and pressure transmitters, in addition to the valves, reach SIT customers as a complete package.

SPECIAL FEATURE

THE PROCESS OF WHIRLING

The whirling method was invented by the German Karl Burgsmüller in 1942 and 80 years later, manufacturing industry still relies on the process as it offers significant advantages over conventional threading methods. However, tools have been continuously evolving during this time. In 2018, HORN introduced jet whirling, an internally cooled process, which represents a new milestone in whirling technology. HORN has demonstrated its expertise in the whirling process with this development.

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

HORN demonstrates its expertise in the area of thread machining with the jet whirling process. As part of a collaboration with W&F Werkzeugtechnik in Großbettlingen, experts from both companies have jointly developed a whirling system with an 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 is of major importance in the production of bone screws. Every groove or ridge can provide a breeding ground for germs.

Tight spaces

Swiss-type lathes are usually used for the production of precision screws. This is a very productive and space-saving machine technology. However, one challenge is the restricted space inside the machine. For this reason whirling units must be very easy to set up and use. Thanks to its face-and-taper contact system, the HORN whirling head boasts a high changeover accuracy and is easy to change with just three screws. It takes less than a minute to exchange the head on the whirling unit interface, which offers radial and axial run-out of 0.003 mm (0.0001"). The maximum speed is 8,000 rpm.

High-speed whirling offers a big increase in productivity through turning and whirling in parallel.

With jet whirling, HORN and W&F Werkzeugtechnik demonstrate their know-how in whirling.

HORN is proud to present another technique in the form of high-speed (HS) whirling. This technology was established in collaboration with machine manufacturer Index-Traub. HS whirling boosts productivity significantly by performing the turning and whirling operations in parallel. With this technique, the speed is high enough for turning to be carried out prior to whirling. The turning tool, which is located upstream of the whirling tool, reduces the volume of material that would otherwise have to be removed by the whirling tool. This enables longer tool life to be achieved and improves surface quality. The whirling heads are very similar to conventional ones. The only difference lies in the geometry of the cutting inserts. Single-start and multi-start threads can be produced using just one cutter unit.

HORN offers further whirling technologies in addition to its jet and high-speed whirling solutions. Of these, the most universal technology is the standard whirling method. The whirling head can be connected to any whirling unit. For faster whirling head and cutting insert changeover away from the machine, HORN has developed a modular whirling system. Thanks to the precision interface, there is no need to readjust the whirling head once it has been removed from the machine. In addition, spacer rings make it possible to adapt the whirling tool to different interfaces. With HORN turbo whirling, high productivity is ensured.

HORN DEMONSTRATES ITS EXPERTISE IN THE AREA OF THREAD MACHINING WITH THE JET WHIRLING PROCESS.

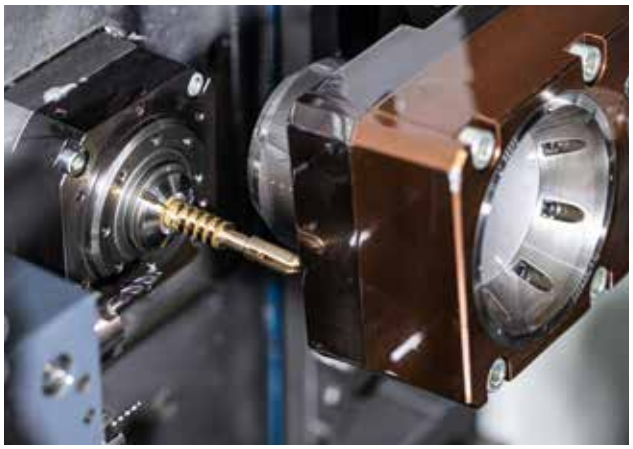
The cutting force distribution between the roughing, pre-finishing and finishing cutters reduces the load on the whirling tool's inserts. As a result, the system offers faster process times and lower tool costs.

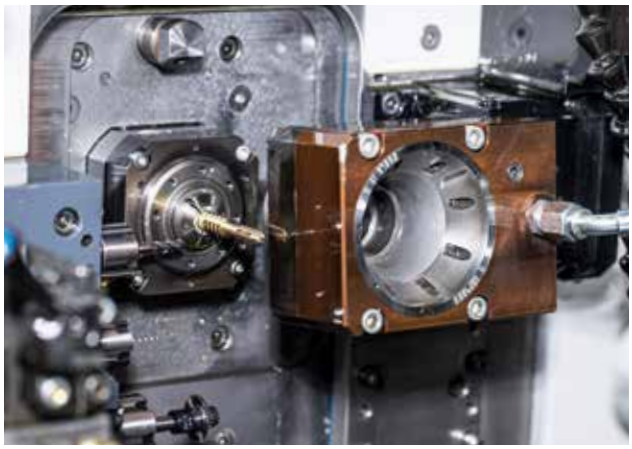
SPECIAL FEATURE

WHIRLING FOR EXCELLENT SOUND QUALITY

Music makes people happy one moment and can bring them to tears the next. It can help drive people to peak performance in sports, or make them anxious. But one thing that music never does is leave you cold. And the guitar evokes more emotion than virtually any other instrument. Whether around a camp fire or at a rock concert in a stadium, the way guitars work is always the same. Schaller GmbH, based near Nuremberg, has been dealing with the functioning of this plucked instrument for over 75 years. During this time, the company has become the world market leader in guitar parts. With modern machinery, the team led by plant manager Dominik Weininger turns and mills the precise components required to produce excellent sound quality. It also relies on the internally cooled whirling system from Tübingen-based Paul Horn GmbH.

Schaller GmbH specialises in machine heads, bridges, tremolos and strap locks. Helmut Schaller founded the company at the end of 1945 as a repair workshop for radios and other electronic devices. In the early 1950s, he began to develop amplifiers and speakers for musical instruments. Through a business partnership with an instrument maker, Schaller began developing and manufacturing guitar parts. By the 1960s, Schaller had become one of the most prominent guitar accessories suppliers in Europe. The reputation of Schaller's machine heads in particular precedes it. The M6 machine head was the world's first fully enclosed and self-locking precision machine head. Since then, leading international guitar manufacturers such as Gibson, Ovation and Fender have relied on components from the Bavarian music factory.





Jet whirling has reduced the machining time for worm threads by half, raised quality and ensured an increase in tool life.

With the jet whirling system, HORN introduced at AMB 2018 the world's first system with an internal coolant supply.

Precise worm gears

The machine heads on plucked instruments are used to tighten and tune the individual strings. They are at the top of a guitar and have a transmission to ensure a high degree of precision when tuning the strings. Other important properties are ease of movement and stability due to the self-locking mechanism. The higher the precision of the components, the higher the quality. The transmission of the machine head uses worm gears, as these are the only gears to enable precise adjustment and reliable self-locking.

A central part of the machine head is the adjusting screw with the worm thread. Department head of CNC turning and milling Nicole Gawatsch saw potential for improvement in this thread. "We previously milled the worm thread with a side milling cutter. The machining time required was too long for us and we often had to take the part and re-clamp it by hand", Gawatsch explains. "We became aware of HORN's internally cooled jet whirling at AMB 2018 and immediately contacted our HORN sales representative", continues plant manager Weininger. Initial discussions with HORN about the new whirling system and the start of the project quickly followed.

The first whirling system with internal cooling

With the jet whirling system, HORN launched the first whirling tool to feature an internal coolant supply. This whirling system offers optimised cooling directly at the cutting edge and was developed by HORN in conjunction with W&F Werkzeugtechnik. The major challenge was to bring the coolant directly to the cutting edge in a confined space and to do this at high whirling speeds. The cooling channels partially integrated in the insert seat direct coolant to each cutting edge. In addition, the coolant flows through the chip space. By cooling the cutting edges directly, this system enables long tool life to be achieved. What's more, when used in conjunction with the stable whirling unit, the system achieves better surface quality on the workpiece. Thanks to the patented W&F interface with its face-and-taper contact system, the whirling head boasts high changeover accuracy and is easy to exchange with just three screws. The internal coolant supply reduces the risk of chip build-up between the

THE GUITAR EVOKES MORE EMOTION THAN VIRTUALLY ANY OTHER INSTRUMENT.

Leading international guitar manufacturers rely on Schaller machine heads.

cutting inserts, which offer radial and axial run-out of 0.003 mm (0.0001"). The maximum speed is 8,000 rpm.

The first tests at Schaller were not an instant success. "The problem was that the coolant pressure of the machine was too low. The whirling unit requires a high coolant pressure for satisfactory operation, but the machine only delivered a low pressure", explains HORN sales representative Peter Rümpelein. After producing 20,000 parts, the bearings of the whirling unit had to be replaced due to insufficient cooling. Nicole Gawatsch then moved the whirling process to a Tornos Swiss GT sliding-head lathe. The large pump capacity ensures the high coolant pressure is delivered. "The high pressure provides cooling and lubrication for the unit", says Rümpelein.

Machining time halved

After a delayed start, the whirling process now runs reliably. "The whirling unit has been running 24/7 in the machine for over a year. We are very satisfied with the tool system", says plant manage Weininger. The successful change in the process is also reflected in the processing time. Previously, Gawatsch needed about a minute to mill the worm thread. Conventional whirling takes 40 seconds. "With internally cooled whirling, we have halved the machining time to just 20 seconds per component. Given the incredibly high number of components we process each year, this is an enormous saving", Gawatsch explains. In addition to the reduced machining time, the surface quality of the finished components is also improved significantly. Moreover, the service life of the indexable inserts has increased many times over.

Only one version of the whirling head with insert seats for the type S302 indexable insert is used at Schaller. "We only need to change the inserts for the different threads", says Gawatsch. For whirling, the S302 system, which has three cutting edges, is mainly used at HORN. There is a high degree of manufacturing precision

when it comes to grinding the cutting inserts. The three cutting edges are subject to a length tolerance of less than 0.005 mm (0.0002") when turned. This ensures the excellent concentricity of the entire system, the high changeover accuracy when indexing the inserts and the outstanding surface quality. "The cutting edge profile of the S302 system can be adapted to almost any special requests from the user, whether it's for single or multi-threads", explains Rümpelein.

The whirling method has been around since 1942 and hadn't seen any major developments for a long time. Conventional thread whirling is a method that is primarily used on Swiss-type lathes to produce bone screws, or on a large scale, to produce threaded spindles. To implement the process, a rapidly rotating whirling head is positioned in front of the guide bush of the Swiss-type lathe, eccentrically to the workpiece axis. The rotating workpiece is fed axially into the whirling head, which is pivoted to achieve the specified lead angle of the thread.

"WE ONLY NEED TO CHANGE THE INSERTS FOR THE DIFFERENT THREADS."

A successful partnership: Peter Rümpelein (HORN) talks to Nicole Gawatsch and Dominik Weininger (both at Schaller)

INTERVIEW STEVE SMITH

Mr Smith. How is your market structured in Great Britain?
Important industries are, for example, aerospace, medical and automotive. But the oil sector also plays an important role. New machining processes and strategies are required in order for us to keep ahead of the global competition. Thanks to our strong field service team, we are able to optimally advise on the various issues, requirements and challenges and enter discussions to solve problems.

When you think of processes, what comes to mind first?
I think of the coordination between the precision tool, the component and the machine tool, including the control system. These factors must be carefully considered to find the optimal solution. A holistic approach is always required. Furthermore, when I think of processes, I think of gear skiving, polygon turning, broaching, 5-axis milling, polygon milling, speed forming, single-point gear milling and much more.

HORN encourages dialogue with customers. To what extent is this important with regard to machining processes?
It is important that all necessary information is obtained from the customer. This can only be achieved through a good customer relationship and appropriate discussions. Often, aspects arise on site and in conversation that can have a decisive influence on the achievement of goals. In machining, especially when operating at the limits, dialogue is key. How does a new process come into being? First of all, there is either an idea or a requirement. This is followed by asking the user what advantage they expect. The next step is a feasibility study.

Can a process be performed just by the tool or do other requirements have to be met?
Here again we are in the ecosystem of machine – control – tool – component. The determination of profile contours in conjunction with machine movements often requires new mathematical approaches. A holistic view is essential in this phase. If all factors are assessed positively, the next step is the design, coordination and test phase before the process is finally approved.

Steve Smith is National Sales Manager for the UK market.

Steve Smith has been with HORN Cutting Tools Ltd since 1999.

How important are partners – for example machine manufacturers?
Partners are important in the development of a successful production process. Machine tool manufacturers play a central role. Certain processes require perfect coordination between the machine tool and the cutting tool. As a tool manufacturer, we often develop the associated cutting cycles together with the machine manufacturer.

What are the advantages of power skiving, for example?
With gear skiving, both internal and external teeth can be produced in the same machine set-up, for example when turning. If the appropriate conditions are met, cycle times can be drastically reduced compared to broaching and slotting. The fact that this is now possible on universal machines opens up new possibilities for many customers. We are able to offer the right tooling solution from module 0.2 to module 8.

Do you have a specific application example?
One of our customers relied on outsourcing its gear production for many years. The components were turned in-house and then sent to a gear machining subcontractor for internal gear cutting. Due to increased transport costs and a desire for more independence, the customer decided to use the power skiving process. As a result, it is now possible to machine the component completely in a single clamping. The customer now has direct control over the entire machining process and also benefits from shorter lead times, reduced administrative effort and lower costs.

What do you expect in the future?
Advances in machine tools continue to open up new possibilities that would have been unthinkable not so long ago. For example, direct drives to tool and workpiece spindles allow unrestricted movement. Furthermore, new methods such as additive manufacturing are increasing and we are rising to the challenge with appropriate solutions. Our further developments in micro-machining ensure that we continue to push the boundaries and strengthen our position for the future, for example in the medical and watchmaking industries.

PARTNERS ARE IMPORTANT IN THE DEVELOPMENT OF A SUCCESSFUL PRODUCTION PROCESS.

PRODUCTS

INNOVATION

PRODUCTS

PCD DRILLING TOOLS

PCD drilling tools for non-ferrous metals

HORN presents its expanded portfolio of tools with cutting edges tipped with polycrystalline diamond (PCD). Following on from PCD parting-off tools, HORN also offers users PCD-tipped step drills. The tool system allows greater drilling precision and better surface quality thanks to the sharp cutting edges. It is designed for drilling, boring and countersinking in non-ferrous metals, such as for 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.

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 monobloc version. The carbide shank provides good vibration damping during machining. All variants have an internal coolant supply. The monobloc tool body is available as a steel variant from a diameter of 32 mm (1.259").

The cutting material PCD is a synthetically produced, extremely hard, intergrown mass of diamond particles with random orientation in a metal matrix. It is produced by sintering together selected diamond particles at high pressure and temperature. The affinity of the iron for the carbon in the diamond only permits economical machining of steel in rare cases. As the temperature increases, the carbon from the diamond diffuses into the steel, which severely limits the tool life. For this reason, this cutting material is mainly used for machining non-ferrous metals.

THE TOOL SYSTEM PROVIDES GREATER DRILLING PRECISION.

PRODUCTS

CUBIC BORON NITRIDE FOR TOUGH JOBS

Cubic boron nitride for tough jobs

HORN is expanding its tool portfolio for machining hard materials and other steels. Tools tipped with cubic boron nitride (CBN) offer optimised machining of nickel-based and other superalloys as well as powder metallurgical and hardened steels. The ultra-hard cutting material CBN demonstrates its strengths in smooth cutting and interrupted cutting when hard turning and grooving. By including extensions in the standard range for the Supermini 105, Mini 11P, 229 and 315 systems, HORN offers the user fast delivery of the desired tool systems from stock.

The Supermini system is available in left and right hand versions with different corner radii. The CBN-tipped variants are suitable for internal machining from a diameter of 2 mm (0.079"). Different projection lengths of the solid carbide bodies are also available. Tools in the Mini family can be used from an internal diameter of 6.8 mm (0.268") and are also available in left and right hand versions. The single-edged tool type 315 is suitable for external grooving operations from a groove width of 0.5 mm (0.012"). In the cutting insert system 229 the previous CBN substrate CB 50 is replaced by the higher-performance substrate CB 35. The cutting inserts are available with two different corner radii and cutting widths from 3 mm (0.118") to 6 mm (0.236").

After diamond, CBN is the second-hardest material known to man. Tools made from CBN wear much more slowly than other cutting materials when used properly. This makes it possible to achieve higher dimensional and shape accuracy and also means that hard materials (steel up to 70 HRC) can be machined reliably. There are no different types of CBN. Differentiation is made by the CBN volume fraction, the fillers, the grain size and the ceramic/metallic binder phase (cobalt/nickel). This results in different CBN substrates. Hard machining with CBN cutting materials is usually done without coolant. This is possible as the cutting material has a high heat resistance and the high temperature within the chip formation zone has a positive effect. An insufficient supply of coolant or interruptions in cutting lead to high, thermally induced stresses in the structure of the indexable insert. This can lead to cracks in the structure and possibly even destroy the indexable insert. During hard machining, most of the heat generated in the shear zone is dissipated via the chip. While carbide suffers a significant loss of hardness at around 800 degrees Celsius (1,472 °F), the hardness of CBN remains almost unchanged, even at temperatures up to 1,200 degrees Celsius (2,192 °F). Another significant advantage is chemical resistance, particularly at the prevailing temperatures.

ANOTHER SIGNIFICANT ADVANTAGE IS CHEMICAL RESISTANCE.

PRODUCTS

SLOT MILLING OF NARROW GROOVES

Slot milling of narrow grooves

HORN is expanding its circular interpolation milling system for slot milling of grooves. This addition to the tool system allows users to do away with the cost-intensive eroding process previously required for narrow grooves. HORN offers the tools in cutting widths from 0.25 mm (0.01") to 1 mm (0.039"), depending on the diameter. Depending also on tool diameter, the maximum milling depth (t_{max}) is between 1.3 mm (0.051") and 14 mm (0.551"). Inserts are available with different coatings to suit the material being machined. Thanks to its mass, the solid carbide tool shank ensures vibration damping throughout the milling process. All variants of tool shank have an internal coolant supply.

Circluar milling in general

The circular milling system offers users a host of process advantages: it is fast, reliable and achieves good surface finish. During the process, the tool plunges into the material either at an angle or horizontally and may then be driven on a helical path. This means that threads, for example, can be manufactured to a high level of reproducible quality. When compared to machining using indexable inserts on larger diameters or solid carbide milling cutters on smaller diameters, circular interpolation milling is generally more economical. Circular interpolation milling cutters have a wide range of applications: they are able to machine steel, special steels, titanium and special alloys. These precision tools are especially well suited to groove milling, circular interpolation milling, thread milling, T-slot milling and profile milling.

THE HORN CIRCULAR MILLING SYSTEM BOASTS A WHOLE HOST OF PROCESS ADVANTAGES.

SPECIAL

ALUMINIUM IS VERSATILE AND LIGHT – BUT HAS ITS DRAWBACKS

We come into contact with aluminium (Al) on a daily basis: in packaging, cars, electronics and mechanical engineering. After steel, aluminium is the most commonly used metal. Aluminium alloys are used in virtually every area of technology and everyday life. In manufacturing, Al alloys are one of the materials that are easy to machine. Nevertheless, it is possible for a hard spot to quickly occur when working the soft metal. Sticking, built-up edges, chip jams and even tool breakage can occur. But with the correct tools, cutting materials, cutting data and the right amount and type of coolant, Al alloys can be reliably machined. Drilling, reaming, grooving and milling: HORN offers a wide portfolio of optimised tools for economical machining of this light metal.

Aluminium smelters worldwide produce over 60 million tonnes of the light metal each year. Global demand for this metal has risen sharply in recent years – not least due to dynamic development in Asia. China has the largest production output of aluminium, ahead of Russia and Canada, with over 30 million tonnes annually. After oxygen and silicon, aluminium is the third most common element on Earth, making up 8 percent. However, it does not occur in its pure form in the earth's crust. Instead, the metal must be extracted from weathering products of lime and silicate rocks – bauxite. The raw material for aluminium production has a high aluminium oxide content of over 50 percent. The Bayer process can be used to extract pure aluminium oxide from bauxite. However, this is still so fine that it behaves almost like a liquid. Only in the melt of the oxide and the mineral cryolite does the mixture break down into liquid aluminium and oxygen. This process is called fused-salt electrolysis.

ALUMINIUM SMELTERS WORLDWIDE PRODUCE OVER 60 MILLION TONNES EACH YEAR.

Expert coordination

The tensile strength, elongation, hardness and rigidity of aluminium can all be influenced by alloying elements such as silicon, magnesium, copper, zinc and manganese. During machining, the material can become soft due to the heat generated, which can cause the cutting tool to stick, with the impaired chip flow even resulting in the tool being destroyed. Therefore, it is important to ensure that the material and cutting parameters are properly matched to one other. The determining factors are the aluminium alloy, the cutting tool, the grade, the feed rate and rotational speed, and the type and quantity of coolant used.

Given the strong adhesive tendency of aluminium, the most important features of the HORN tool range, including standard and bespoke tools, are the special geometries with sharp cutting edges, polished rake faces and coatings with excellent anti-friction properties. Moreover, our carbide grooving inserts are

Mirror finish over the entire surface. HORN and DMG MORI use a sine wave to demonstrate their expertise in brilliant-finish machining of aluminium.

The polished WA chipbreaker geometry enabled problems of long chips and built-up edges during aluminium machining to be resolved.

peripherally ground to ensure an extremely sharp cutting edge. To cope with aluminium alloys that have a high silica content, the cutting inserts are PVD-coated. For milling applications, the portfolio includes circular interpolation tools with coated or uncoated inserts and solid carbide milling cutters. To handle the considerable chip volume associated with high cutting data, single-edged milling cutters with a large chip space can also be used. To support long periods of use or more complex tasks, ultra-hard cutting materials are available, such as PCD and CVD-D with laser machined cutting edges and chipbreaker geometries. MCD-tipped tools are used, for example, for brilliant-finish machining of mirrors or aluminium blow moulds.

Grooving with polished rake faces

One machining example is the grooving of cooling fins on a pump housing used in the medical sector. The material was an aluminium alloy with a low silicon content that is difficult to machine, as it is long-chipping and causes built-up edges to form.

In order to solve the problems, the HORN engineers opted for the S224 grooving system with FY and WA chipbreaker geometries. To hold the cutting inserts, holders are used with a clamping cartridge and internal coolant supply via the clamping finger and through the support.

Cooling ribs and a wide groove are rough-machined using FY geometry. The form of the geometry enables controlled chipbreaking and the coolant pressure prevents the chips from fusing on the insert surface. The special WA aluminium grooving geometry ensures a high level of surface quality on the component when finishing the grooves. The polished chipbreaker geometry serves to counteract the formation of built-up edges whilst creating small, spiral chips, thereby ensuring good chip control and a high level of process reliability.

Tools with monocrystalline diamonds are used to produce the highest surface quality on workpieces made of aluminium or other non-ferrous alloys. The range of applications for brilliant-finish machining is huge. In the tool and mould-making industry in particular, the method saves polishing, while also increasing the quality of the surface and its flatness. It is therefore used in applications where the surface of the mould is reflected in the parts being produced.

THE RANGE OF APPLICATIONS FOR BRILLIANT-FINISH MACHINING IS HUGE.

For the machining of a wall mounted tap prototype, a user was tasked with looking into brilliant-finish machining. They received this task from a manufacturer of premium fittings. The clean geometry and flat surfaces of the prototype design require machining with MCD. Deviations in the surfaces and geometry would be visible through the subsequent chrome plating. Due to these quality requirements, polishing after

High surface qualities despite long throat depth.

Aluminium cooling fins were to be cut for a pump in a medical device – a challenge that had to be mastered reliably with the right tools and expertise.

machining was ruled out, as even slight irregularities in the surface would hugely affect the refraction of light in the chromium layer, which is only a few microns thick. Schirach did not have much time to find the best solution to this machining task. The difficulty in machining the brass casting was the long projection length of around 200 mm (7.874"). HORN found a solution by using an MCD-tipped ISO cutting insert. The surface finish required by the valve manufacturer's designers could then be achieved through strict quality control.

Due to its smooth surface and the resulting low adhesion tendency, as well as the high wear resistance, polycrystalline diamond (PCD) is also particularly suitable for machining aluminium alloys. In addition, the sharp cutting edges enable a high surface finish to be achieved. In addition to turning, the grade is also used for drilling. Thanks to the high cutting parameters that can be achieved, PCD-tipped drilling tools enable shorter process times and longer tool life compared to solid carbide drills. This is why PCD drilling tools are often used in series production; for example, for drilling aluminium wheel rims.

IN ADDITION TO TURNING, THE GRADE IS ALSO USED FOR DRILLING.

ABOUT US

HORN AT EUROSKILLS AND WORLDSKILLS GERMANY

In its capacity as a silver sponsor, Paul Horn GmbH supports the skills of CNC turning and CNC milling at EuroSkills 2021. The competition took place in Graz from 22nd to 26th September 2021.

Three young people competed in turning and seven in milling. All ten participants in the two trades each received a tool voucher worth 2,500 euros after the competition to ensure they are well equipped to continue to pursue their professional passion in the future. The winners in both disciplines were from Russia. Christian Thiele, Press Officer at Paul Horn GmbH says "All participants have demonstrated impressive performance and can take away an unforgettable experience for life. We at HORN are proud to have been part of this success."

EuroSkills is a vocational skills contest, usually staged every two years in the form of European championships (with the exception of EuroSkills 2021 due to COVID-19). The event revolves around young, highly talented specialists aged 25 or under (26 and under at EuroSkills 2021) who are performing at the top of their professions in around 45 European trades. Around 400 competitors battle it out in the contests, which cover vocational fields drawn from industry, the skilled trades and the services sector.

For the first time since the foundation of EuroSkills, this European Championship took place in Austria, in the Styria region. The event was an opportunity to make vocational training more attractive in the long term and to counteract the shortage of skilled workers by highlighting different career opportunities. The overall aim was to anchor the concept of skills in the hearts of as many people as possible, so that it would be carried on, even after the event.

The participants in CNC milling came from Germany, France, Lichtenstein, Austria, Poland, Portugal and Russia.

Preparation for pre-qualification started for four selected HORN trainees at the end of 2021. In this phase, the trainees are introduced to the requirements (professional aptitude, discipline, ability to concentrate, ability to work under pressure) they will need to display before the competition. In the next phase, selected experts impart special knowledge (CAD, CAM, and machine and tool training) for the next rounds in CNC milling. The aim is for the HORN trainees to first master the two qualifying rounds in 2022 and then to take part in the national competition and come out on top there, too. WorldSkills Germany, as a recognised network partner in the field of dual education, opens up new ways for young people to turn their passion into a profession and become the best in their field. For this reason, WorldSkills Germany is marketing vocational education and training and increasing the recognition of dual education occupations.

With the successful concept 'Learning in Competition', WorldSkills Germany boosts vocational education and training, increases its attractiveness and supports lifelong learning.

INTERVIEW WITH EUROSKILLS CNC TURNING WINNER

Danila Polozov (centre); winner of the CNC turning skill.

HORN RUS LLC, the Russian HORN subsidiary, spoke to Danila Polozov, the winner of the international EuroSkills 2021 competition in CNC turning. This is not Danila's first win. He already won a prize at the national WorldSkills championship held in Kazan in 2019.

First things first: Congratulations! What does it take to achieve such results at EuroSkills and WorldSkills?
First of all, you have to really enjoy what you do. The different elements of the tasks are complex, so you have to think through every step, come up with new concepts and adapt your strategy. There is a certain sequence to be followed. The first hour of the competition is just for programming and only when you've completed this step can you go to the machine and continue working on your strategy. A 3D model makes it easier to transfer the data.

How do you prepare for the championship?
For the turning and milling skills, you don't get any information about the task before the competition. You only find out the material. One day before the competition, the order of participation and the workstation will be drawn by lot. Only then can you examine and test out your work space. You can practise with the equipment and workpieces to see how you would like to process the task on the machines. Participants usually bring their own measuring equipment and cutting tools with them, but the organisers will also sometimes provide these.

Are there many people like you who are enthusiastic about this profession?
Every year there is a selection of young skilled workers who want to take part in the championship. This year, nine committed and highly motivated young people took part in the competition.

What prospects do you have for your future career?
I am currently preparing for the WorldSkills 2022 World Championship in Shanghai and studying at the same time. After college, I plan to continue my studies at the Polytechnic University as a part-time student majoring in metallurgy and then find a job in this field afterwards. I am really inspired by our team. We have an official WorldSkills forum, where experts discuss the tasks set in previous competitions and are always ready to help and share information.

We look forward to seeing you again after your participation in the 2022 event in Shanghai.
I look forward to that as well and to trying out the latest tools from HORN.

euroskills Graz 2021

HORN TRAINEES DONATE TO CHILDREN'S CANCER CHARITY

The trainees at Paul Horn GmbH have decided to forego their Christmas party in 2021 and donate the company allowance to charity instead.

The donation of 1,625 euros will go to the children's cancer charity, Förderverein für krebskranke Kinder Tübingen e. V., which Paul Horn GmbH has supported for a number of years. The donation cheque was presented by trainee Luisa Baur and youth training representative Eleftherios Papadopoulos, together with their trainer Daniel Baisch, to Anton Hofmann, the charity's chairman. Both trainees are learning industrial mechanics. Luisa Baur: "In our training, we all support one another as a matter of course. By making this donation, we want to show that we can also support people outside the company. I am pleased that we were able to take this action together and wish the charity continued success in its important work." "I am particularly pleased when young people see that there are other young people who do not have things as easy as them and want to support them", Hofmann said as he bid farewell to the trainees.

HORN is currently training 65 young people in Tübingen. As well as industrial mechanics, students also have the opportunity to study the profession of technical product designer and mechanical engineering.

Left to right: The two HORN trainees, Eleftherios Papadopoulos and Luisa Baur, with Anton Hofmann from the charity and HORN trainer Daniel Baisch during the donation presentation.

ABOUT US

ECTA PRESIDENT MARKUS HORN RE-ELECTED

Markus Horn, Managing Director of Paul Horn GmbH and ECTA President.

The European tool industry heads into 2022 with optimism. "Especially in such challenging times as we are experiencing currently, it is particularly valuable for companies in Europe to have a common platform for the exchange of information", said ECTA President Markus Horn, Managing Director of Paul Horn GmbH, after his re-election on 25th November 2021, adding: "Fortunately, the economic situation for ECTA member countries has recovered somewhat over the course of the year, albeit to varying degrees. Despite supply chain issues and the pandemic, tool manufacturers remain broadly optimistic about the future."

EMO in Milan in October 2021 was the first real opportunity for the industry to present innovations, meet customers and network in Europe after two pandemic years. Horn: "Many positive signs came out of EMO. It showed us that, despite the pandemic, there are ways to be able to hold important industry events if we have the right timing together with intelligent health and safety measures."

European manufacturers of cutting tools and workholding equipment and their national associations are all united in the European association ECTA – European Cutting Tools Association. Getting to know each other, sharing experiences, collaborating – there are numerous topics that European companies in the industry desperately want to discuss with each other and with their customers, suppliers and cooperation partners. ECTA is the ideal platform for this.

The main aim of ECTA is to act as the central organisation that promotes the interests of the entire European cutting tool industry and to initiate measures that are deemed necessary in the interests of the industry and members.

ECTA
EUROPEAN CUTTING TOOLS ASSOCIATION

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