№ 02
2021

world of tools

FEATURE: SPECIAL TOOLS

SPECIAL TOOLS
Customised and optimised
Three times faster

MICRO-MACHINING
Reliable in large-scale production

EMO, MILAN
Sneak preview

TOOL AND MOULD MAKING
Medal of honour for Lothar Horn

DEAR READERS,

Fortunately, 2021 has been a good year so far. In many sectors, business is back up to its usual levels or is well on the way to recovery, and industry events are back on the agenda – including EMO 2021, which is going ahead in October in Milan and which we are attending with our Italian partner Febametal. Join us at this major event on the industry calendar to get up close and personal with our latest products, experience our live practical demonstrations and chat to us in person. Metalloobrabotka, which was held in Moscow in May, gave us a taster of how large-scale events can become part of our lives once again.

In this issue of "world of tools", we explore the topic of special tools. To achieve optimum machining results in the shortest possible time frames, customers like Aeschlimann and Schwarzer are increasingly turning to customer-specific tools. It's not just the design of the tool that's important; creating customer-specific products requires us to take a holistic view of the entire application, from the machining process – including the machine, material, workholding equipment and control system – to the delivery times for the special tool. This issue also focuses on the topic of tool and mould making. We take a closer look at a component that we developed in partnership with SCHUNK and OPEN MIND, demonstrating how each party's expertise contributed at each stage of the process.

We hope you find this issue an informative and entertaining read.

Markus Horn, Lothar Horn and Matthias Rommel

world of tools
№ 02 2021

Imprint: world of tools©, the HORN customer magazine, is published twice per year and sent to customers and other interested parties. Publication date: September 2021. Printed in Germany.

Publisher: Hartmetall-Werkzeugfabrik Paul Horn GmbH • Horn-Straße 1 • 72072 Tübingen, Germany
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Circulation: 22,200 in German, 6,250 in English, 3,350 in French, 500 in Italian

Editorial staff/texts: Nico Sauermann, Christian Thiele, EMO Milano

Complete production: Werbeagentur Beck GmbH & Co. KG • Alte Steige 17 • 73732 Esslingen, Germany

SPECIAL

CUSTOMISED AND OPTIMISED

Special tools come into play in a variety of applications: from large-scale manufacturing right down to small-batch production and individual components. When a standard tool simply won't cut it for a specific machining operation, or when the production process for a series component needs to be optimised, special tools are the answer. The degree of customisation is also wide-ranging: from something as simple as a specific angle on the main cutting edge of a grooving tool, all the way up to a multi-level, complex milling tool. Special tool solutions always aim to reduce costs, increase process reliability and optimise production processes. With our large range of special solutions, HORN has the expertise to provide the answers to many machining challenges. We not only design and produce special tools, but also develop special machining processes.

Polygon turning? By adopting an axial feed approach, HORN tools enable you to produce non-circular contours on lathes consistently. 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 machining 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.

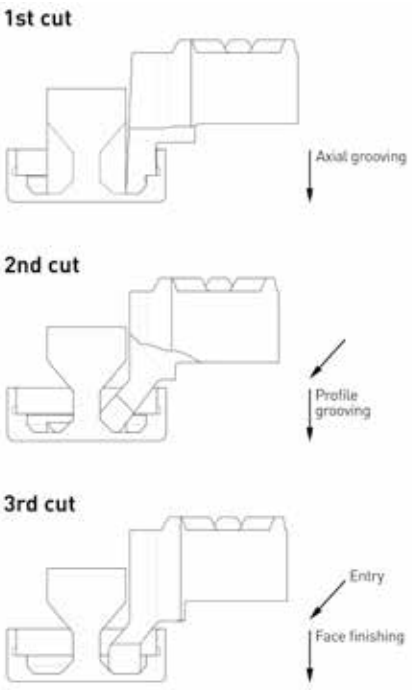
The technique is also suitable for series production because no jerky movements or reversals of motion occur during machining.

For face grooving of titanium sensor components, HORN engineers developed a machining solution based on the HORN Mini tool system. As well as being suitable for numerous standard versions of the system, the blanks can also be ground with customised cutting edge profiles. Three different customer-specific tools are used to create the profile for a face groove. The groove

SPECIAL TOOL SOLUTIONS ALWAYS AIM TO REDUCE COSTS.

contour, the very tight form and geometric tolerances of the small workpiece and the high surface quality to be achieved meant that sequential cutting operations were necessary. The initial tool cuts the first inner contour, leaving a finishing allowance on the face. The second tool copies the conical shape and inner diameter in two axes. The third cut is made – as a finishing operation – on the bottom face by tool number three. To achieve this, the insert moves into the workpiece along two axes so that it can machine the face by performing an axial motion. The face subsequently acts as a functional surface of the component and tight tolerances apply in respect of the surface quality to be achieved.

Another special tool solution is deployed in the production of a stainless steel component. The customer contacted the HORN sales team with a request to optimise the machining process. After analysing



Distribution of cuts during the face grooving process.

Special tool for making two grooves without changing tools, taking into account interference contours and optimal coolant supply.

the production strategy, the engineer recommended machining the contour with a double-edged special tool. The profile of the precision-ground cutting edges matches the workpiece contour, which means that the outer contour – including the face – can be machined in a single cut. The HORN engineers selected the type 316 triple-edged insert for the 5 mm (0.197") deep contour. The tool is designed to work like a counterbore to machine a contour in the workpiece in an axial motion. As it produces two identical cuts, the cutting pressure is balanced and the production line can run at double the feed rate.

Outstanding expertise

In addition to 25,000 standard solutions, the HORN range of over 150,000 special solutions means that we have the expertise required to precisely tailor tools to the customer's production process. Special tools can help to optimise machining steps in both large-scale series production and small-batch production. Virtually all HORN insert types can be customised; the tool holder is also tailor-made for the application. The only limits on the design are the tool interface, the design of the machine and the type of machining performed.

The type 316 tool is designed to work like a counterbore to machine a contour in a workpiece in an axial motion.

SPECIAL TOOLS

RELIABLE MICRO-MACHINING IN LARGE-SCALE PRODUCTION

“22,500 recesses with a diameter of 0.7 mm (0.028") – this is when we need a special insert”, explains Michael Diethelm. Diethelm is a machine operator at Aeschlimann AG in Lüsslingen, Switzerland. Since the process optimisation, the team – headed up by process expert Fabian Stampfli – has used HORN’s S274 grooving system for the profile grooving of an electronic component. “HORN is known for its solutions for micro-component machining. This special insert with a precision-ground profile is yet another example of an exceptional product from our friends in Germany – and here in Switzerland, we’re very satisfied with it”, says Dominik Läng, turning technology product manager at HORN's Swiss partner DIHAWAG.

Checking the cutting edges after 22,500 recesses.

From micro-sized watch components to parts for the medical sector and excavator hydraulics, Aeschlimann AG is a specialist in the production of high-precision, rotationally symmetrical workpieces. Originally founded as a screw factory in 1937, the company now manufactures complex CNC components and offers its customers a range of special finishing processes including honing, between-centres and centreless grinding and options for super-finishing. The 165 employees at the Swiss company primarily produce turned parts measuring up to 120 mm (4.724") in diameter. But the Aeschlimann team are also experts in machining, producing milled parts with lengths of up to 300 mm (11.811"). Its customers include companies in the watchmaking, automotive, hydraulics, machinery and electronics industries. Aeschlimann also supplies its high-precision Swiss products to the medical, measuring technology and bicycle sectors.

150,000 parts per year

Diethelm manufactures a connector in Arcap AP 1 D – a free-machining Cu-Ni-Zn alloy with lead as an additive (CuNi25Zn12Pb1) – for a turned part for the electronics sector. The component has a length of 5.8 mm (0.228") and a diameter of 0.7 mm (0.028") to 1.8 mm (0.071"). Aeschlimann produces around 150,000 of these workpieces a year. “Before switching to HORN tools, we produced the parts on our old cam-type sliding head lathes”, says Diethelm. The machines – which have been in use since the 1980s – are still commonplace in Switzerland. “These machines are essential in the large-scale series production of very small turned parts that require a high degree of precision and fast cycle times. If they’re correctly configured, they can run for days on end without intervention. We produce the cams for the machines ourselves”, explains process expert Stampfli. However, the company encountered an issue when producing this component: the material

The finished parts: shown after production on the left and gold-plated on the right. Also pictured: the Torx Z7PL for scale.

The tool edge is ground to a sharp and precise finish.

used is comparatively soft. Copying the 0.2 mm (0.008") deep workpiece profile resulted in small burrs forming on the edges and caused small "slugs" to be produced when parting off. "Minor damage to the surfaces was another problem. This damage was caused by the guide bush during the sliding-head turning process", says Diethelm. An absence of burrs, a high surface quality and a good finish after parting off are key criteria for the turned part.

To solve the problem, Stampfli and Diethelm switched the machining process over to a Tornos SwissNano CNC sliding-head lathe – which was specifically designed to machine micro-components with a high degree of precision. The workpiece profile would now be produced with a plunge cut instead of being copied. "There was another tool manufacturer in the running for supplying the tool concept alongside HORN. It was a tight race, but we didn't give the other company the contract due to chipping problems and limited tool life", explains Diethelm. Turning technology specialist Dominik Läng from DIHAWAG worked with tool engineers from Tübingen to develop a solution using the HORN S274 grooving system.

45,000 recesses per insert

"The quality of the tool edge is the crucial factor", says Läng. The microgeometry of the cutting edge is extremely sharp. With the help of the ground chipbreaker, it was possible to achieve reliable chip control. Diethelm was also able to use the tool system with higher cutting values. The service life of the double-edged insert was boosted to 45,000 recesses.

HORN IS KNOWN FOR ITS SOLUTIONS FOR MICRO-COMPONENT MACHINING.

The shape of the indexable insert is precision ground, and the profile depth is 0.2 mm (0.008"). The defined inner radii of 0.05 mm (0.002") are ground to chamfer the workpiece edges. "HORN really knows what it's doing when it comes to grinding inner radii. It's important to remember that it is not only the inner radius that needs to be considered. In form grinding, the side and front relief angles of the insert also require expert knowledge. We can even grind inner radii to a defined size as low as 0.025 mm (0.001") with tolerances of just a few microns", explains Läng.

The machining process for the turned part is as follows: First, the workpiece is machined to an initial diameter of 0.7 mm (0.028") in a sliding-head turning process. The surface is then pre-turned for subsequent form plunge cutting to a diameter of 1.46 mm (0.057"). "Due to the ratio between the length and the diameter, the soft material and the cutting pressure, we machine the diameter to leave a 0.06 mm (0.002") allowance", says Diethelm. Different feed rates are programmed for grooving with the wide insert; movement is faster during rapid travel and slows down during the grooving operation to prevent workpiece deflection. At the maximum grooving depth for diameters of 1.4 mm (0.055") and 1.2 mm (0.047"), Diethelm programmed a dwell time of half a second. "Grooving across a small diameter with a wide cutting edge creates high cutting pressure. This can cause the workpiece to be pushed away slightly. We optimised the HORN tool holder so that we can use a special thread to make tiny adjustments to the angle of the tool. This enables us to counteract any tapering of the diameter with a correction angle", says Diethelm. The workpiece is also parted off using a type S274 insert.

THE SERVICE LIFE OF THE DOUBLE-EDGED INSERT WAS BOOSTED TO 45,000 RECESSES.

Aeschlimann uses S274 system products for sliding-head turning and grooving.

Ticking over like a Swiss watch: Traditional cam-controlled sliding-head lathes are an essential part of large-scale series manufacturing.

Fast tool solution

After submission of the initial enquiry, it took around six weeks for a finished machining process to be developed and implemented. "We are very satisfied with how our requirements were dealt with. We're impressed with the performance and process reliability of the tools", says Diethelm. In addition to the tools mentioned in this article, Aeschlimann also uses a number of other HORN tool systems, including type S100 parting-off tools and Supermini inserts for internal profiling. The company also uses HORN µ-Finish tools for micro-machining of watch screws.

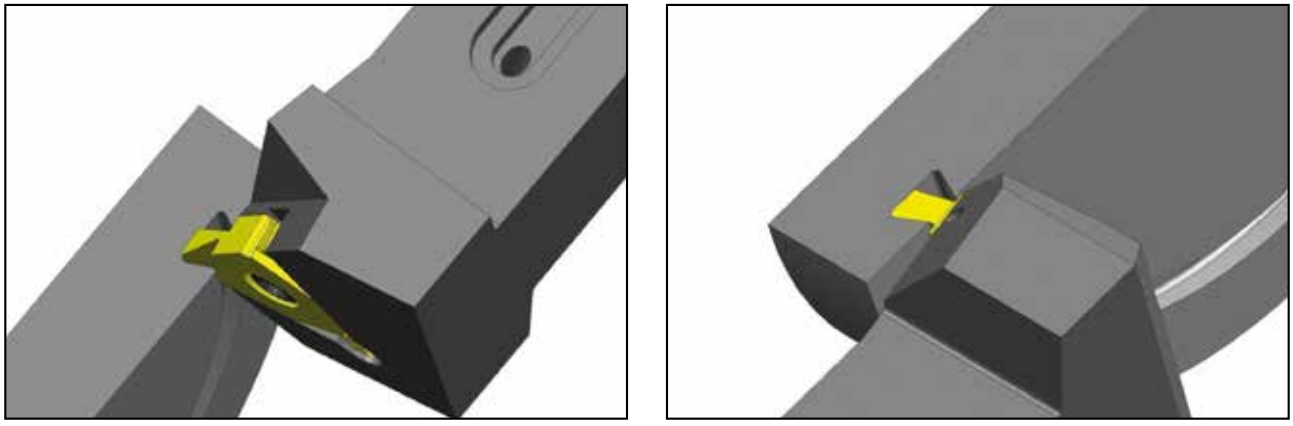
The µ-Finish tool system is primarily aimed at micro-machining users. Based on the S274 system, it features inserts that have been ground with outstanding precision. Every tool undergoes a comprehensive round of inspections during the production process to ensure that its cutting edges deliver excellent standards of quality. Together with the central clamping screw and the precision-ground profile of the indexable insert, the tool holder insert seat helps the system to achieve indexability to within microns. This in turn allows the insert to be indexed in the machine without the need to re-measure the centre height or any other dimensions. In addition to its extensive range of standard profiles, HORN offers custom-made inserts with special designs.

A successful partnership: Fabian Stampfli talking to Michael Diethelm (both from Aeschlimann), Dominik Läng (DIHAWAG) and HORN application engineer Dennis Engemann.

SPECIAL TOOLS

THREE TIMES FASTER

For manufacturers, optimising the processes used to produce recurring components – particularly in large batch sizes – is part of everyday life. As part of this constant drive to optimise, businesses continually analyse their production strategy and strive to find even more effective tooling solutions. For special machining applications in particular, the use of special tools can reduce machining time and produce higher quality results. Schwarzer GmbH from the city of Schloß Holte-Stukenbrock in the German state of North Rhine-Westphalia can testify to these results. After changing the material used for a turned part, the company began to encounter reliability problems in its face grooving process. Paul Horn GmbH solved the problem by adapting the production strategy to simultaneously machine a groove with two tool turrets and an optimised tool system.



Simultaneous machining, whereby now each insert takes care of one angle of the dovetail.

"Our customer switched its component material from an easy-to-process, very short-chipping alloy to stainless steel. Although this might not seem like a particularly problematic decision at first glance, we were faced with the challenges of long chips and reduced tool life", says Friedhelm Mittelteicher from technical advice and sales at Schwarzer. The focus of the task was the production of a dovetail groove on the face of a component measuring 250 mm (9.843") in diameter. Schwarzer produces various versions of the component in 1.4301 and 1.4571 steel.

Optimisation of strategy essential

Before the change of material, the company was already using a HORN tool system. "We used the dual-cutting 231 system for the face groove. But the geometries were designed for short-chipping material", explains HORN engineer Thomas Dück.

The switch to stainless steel had lengthened the machining time for the groove to around six minutes, as the cutting parameters needed to be adjusted accordingly. And the issues with long chips and shortened tool life were yet to be dealt with. The entire tooling system and production strategy would need to be optimised.

HORN SOLVED THE PROBLEM WITH AN ADAPTED PRODUCTION STRATEGY.

Switching to simultaneous grooving enabled the company to run its machining process three times faster.

Simultaneous machining using two tool turrets, an adjusted tool geometry and cut distribution were the solutions that Schwarzer was looking for. Dück replaced the double-edged 231 system inserts with triple-edged, type S316 indexable inserts. The HORN engineer adjusted the cutting geometry and the carbide substrate to suit the materials. "The decision to deploy two tool turrets simultaneously also played a critical role in the success of this process enhancement. The groove is now wider than the chip, which means that the chips now exit the groove very effectively", says Dück.

SIMULTANEOUS MACHINING WITH TWO TOOL TURRETS SIGNIFICANTLY ENHANCED THE PROCESS.

From six minutes down to ninety seconds

"HORN provided the first version of the new tool system very quickly. The initial tests went well, but we wanted to fully harness the potential for an even better machining process performance", says Mittelteicher. HORN raised the bar and delivered a new and improved version of the tools shortly afterwards. "With our Greenline system, we can produce up to 50 special inserts within five working days of the customer approving the drawing. Special tool holders are limited to two units and can be delivered within 10 working days", continues Dück. The team at Schwarzer were fully satisfied with the second iteration of the system. Machining time has been reduced from six minutes to just ninety seconds.

The dovetail is at an angle of 48 degrees; the inserts work simultaneously on either side, cutting at a 24-degree angle. The component is initially approached axially and then machined to the base of the groove at a depth of 4.5 mm (0.177") in two axes, copying the angle with a corner radius of 0.6 mm (0.024"). Using two inserts for grooving means that no recess is created at the base of the groove, as the widths of the main cutting edges overlap by approximately 0.1 mm (0.004"). The inserts are placed in the holder at a 10-degree angle. This is necessary to prevent the cutting edge from being weakened by the large lateral angle of 24 degrees.

THE INITIAL TESTS WENT WELL, BUT WE WANTED TO FULLY HARNESS THE POTENTIAL FOR EVEN BETTER MACHINING PERFORMANCE.

It also ensures that the machining forces are effectively transferred to the holder. For optimum cooling of the cutting zone and improved chip removal, the tool holders are equipped with an internal coolant supply that runs directly to the point of cutting. The coolant is fed in via the VDI interface to the square shank holder.

"We were once again completely satisfied with the support provided by HORN during this project. HORN

A long history of successful professional partnership: Friedhelm Mittelteicher (left) talks with Thomas Dück (right).

Switching to simultaneous grooving enabled the company to run its machining process three times faster.

keeps working to find a solution, even if the tooling doesn't quite meet the customer's expectations on the first attempt. HORN's engineers always come up with the right answer, despite minor setbacks: they always deliver a powerful tool solution", says Mittelteicher in conclusion. Thomas Dück, who completed his technical training with Schwarzer, is always happy to return to the company that taught him all he knows: "I'm always pleased when I get asked to work on a project for Schwarzer. Not just because I did my training here, but also because the company's friendly culture and constant drive to optimise its machining processes still fascinate me and mirror what I see at HORN".

Schwarzer: the company

"Complete solutions from cutting to assembly": This guiding principle has been at the forefront of Schwarzer GmbH since the company was founded back in 1969. The company's strength lies in its complete package of services, which includes turning, milling, drilling and grinding. Schwarzer promises that installing its components will give its customers the edge when it comes to quality. The company approaches even the most challenging of orders with a focus on reliability, care and precision, and on-time delivery. With batch sizes ranging from 1 to 10,000, Schwarzer delivers everything from individual components and assemblies up to complete small machines – based entirely on the design specifications of its customers.

PRODUCTS

TOP INNOVATION: DR-LARGE

PRODUCTS

MODULAR REAMING

Modular reaming for large bore diameters

The newly developed DR-Large reaming system from Paul Horn GmbH demonstrates the company's expertise in machining of bores. The tool offers easy handling and high precision thanks to the proven technology of the DR family of tools. The large number of cutting edges allows high cutting values, thus reducing cycle times and costs during machining. The modular construction and the solid carbide inserts of the tool system offer the user exceptional flexibility. Tool setting is not necessary when exchanging the cutter head. The highly versatile and powerful interchangeable reaming system is suitable for large bore diameters from 140 mm (5.512") to 200.2 mm (7.881"). HORN'S customer service offers quick and simple reconditioning.

The modular construction of the reaming tools means they can be extended to any size with beta module standard components, in theory without limit. The beta module interface is ABS-compatible. HORN offers six types of cutter head to cover the entire range of diameters in 10 mm (0.394") increments. Two sizes of head fit on each reamer shank. All types are equipped with direct internal coolant supply to each cutting edge. The interface of the insert seats has been completely redeveloped and offers highly precise interchangeability within a few microns.

Reaming is a very economical machining process. Compared to boring holes to tight tolerances, reaming is much faster and can significantly reduce unit costs. The motivation behind the development of the DR large range was the fact that users wanted to be able to ream larger diameters. Reaming tools of this size that have been available on the market up to now are either special brazed tools, or diameter-specific reaming tools with fixed inserts. With all these tools, replacing worn inserts is a complex process. For one thing, handling of these special tools, which are delicate and often heavy, presents a logistical challenge when replacing them. And the calibration of newly fitted tools can be a tricky process for many users. HORN offers the perfect solution with its customer service.

THE DR-LARGE REAMING TOOL IS EASY TO USE AND GUARANTEES A HIGH LEVEL OF PRECISION.

PRODUCTS

DYNAMIC HPC MILLING

Dynamic HPC milling with the HORN DS system

Paul Horn GmbH is expanding its portfolio of DS-type solid carbide end mills with a new, high-performance geometry. This system has been specially designed for use in HPC (high-performance cutting) milling of high-strength steels at high material removal rates. It particularly excels in dynamic roughing applications as well as in standard roughing cycles. The different helix angles create an irregular tooth pitch, making operation exceptionally smooth. The tools' optimised face geometry reduces the cutting pressure during circular or linear ramping. Improved chip spaces ensure optimal process reliability during chip formation and removal. The system also demonstrates its strengths during finishing. Extremely smooth operation means that high surface quality can be achieved during side milling, for example.

HPC milling of high-strength steels at high material removal rates places significant demands on the tools. New carbide substrates and new tool coating technologies make this process feasible. HORN relies on the ES3P grade with a HiPIMS coating for its milling cutters. High power impulse magnetron sputtering technology offers several advantages and new possibilities when it comes to coating precision tools: it enables the formation of coatings that are very dense and compact, as well as extremely hard and tough. The coatings have a very homogeneous structure and exhibit an even coating thickness, even with complex tool geometries. The coating demonstrates very high layer adhesion, thus ensuring good cutting edge stability. Thanks to its high temperature resistance, the coating serves as a heat shield and reduces the amount of heat transferred to the carbide.

THE SYSTEM ALSO DEMONSTRATES ITS STRENGTHS DURING FINISHING.

PRODUCTS

NEW HIGH-PERFORMANCE COATINGS

New high-performance coatings

They are less than 0.005 mm (0.0002") thick, yet still an essential part of modern tool technology: tool coatings extend the service life of carbide tools by over 1000 percent compared to their uncoated counterparts. The high-performance coatings IG6 and SG3 are testament to HORN's engineering expertise in tool finishing. IG6 – a copper-coloured aluminium-titanium-silicon nitride (AlTiSiN) coating – is designed for use in machining groups P and M with the S224 and S229 grooving systems. In conjunction with the adapted carbide substrate, the coating allows for faster material removal rates and significantly extended service life in steel machining applications in the aforementioned machining groups. The standard inserts are available from stock. For special designs, HORN Greenline orders can be delivered within five working days of the customer signing off on the drawing.

SG3 is designed for use with titanium and super alloys, as well as in hard turning and hard grooving applications. The coating can be applied at temperatures of up to 1,100 degrees Celsius (2012°F). The HORN coating is designed to deliver an outstanding performance when working with materials that are difficult to machine. Now that the advantages of the tool coating have been proven on selected HORN tool systems, the product is also available from stock for the type 105 Supermini system. The in-house coating ensures both high quality and fast delivery times.

HORN has developed a high level of expertise in the coating of precision tools over the last 15 years – starting with five employees and one coating system and growing to over 50 employees working across twelve coating systems and the accompanying peripheral equipment in the coating department. Engineers are also constantly researching and developing new and existing coatings – always with the aim of creating even higher-performance tool coatings. HORN is constantly investing in new, modern technologies. In 2015, the company CemeCon delivered the first of three HiPIMS systems to HORN, which happened to be the first in the world as well. High power impulse magnetron sputtering technology has several advantages and provides new opportunities when it comes to coating precision tools. It enables the formation of coatings that are very dense and compact, as well as extremely hard and tough. The coatings have a very homogeneous structure and exhibit an even coating thickness, even with complex tool geometries.

STANDARD INSERTS ARE AVAILABLE FROM STOCK.

PRODUCTS

CIRCULAR THREAD MILLING

304 milling system for small threads

HORN is expanding its circular milling portfolio for productive thread milling up to hole diameters of 8 mm (0.315"). Type 304 precision tools are available as partial and full-profile versions for the production of threads. With its triple-edged 304 milling system, HORN offers a versatile solution for groove milling, finish-boring and chamfering. The insert has a cutting circle of 7.7 mm (0.303"). In conjunction with the vibration-damping carbide shank, this makes it more flexible to use than solid carbide groove milling cutters. The substrate and geometry can be easily matched to the machining process. The shanks feature internal cooling for targeted cooling of the contact zone.

The HORN circular milling system offers users a host of process advantages: it is fast, reliable and achieves good surface results. During the process, the tool plunges into the material either at an angle or horizontally and is then 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 suited to groove milling, circular interpolation milling, thread milling, T-slot milling and profile milling processes.

THE SUBSTRATE AND GEOMETRY CAN BE EASILY MATCHED TO THE MACHINING PROCESS.

PRODUCTS

NEW BOEHLERIT HIGH-PERFORMANCE TOOLS

Intelligent turning and drilling

The universal turning-drilling tool Pentatec has already replaced up to five ISO tools and reduced machining times by up to 30 percent by saving tool change and idle times – but the new Quattrotec tool system is an intelligent machining solution that goes even further. The new Easy Safe System is just one advantage of the product: a groove on the underside of the indexable insert ensures that it can be installed in the insert seat with precision and speed. With the introduction of the Quattrotec tool system, the Austrian carbide and tool specialist is helping users to reduce their costs across a much wider range of materials. Thanks to the special design of the new system, four machining operations – drilling into solid material (including off-centre), internal profiling, facing and longitudinal turning – can now be performed with low vibration and with just one tool. The comprehensively tested Boehlerit portfolio includes substrates of a wide range of hardnesses, combined with either a wear-resistant CVD coating or a universal and reliable PVD coating.

THE NEW QUATTROTEC TOOL SYSTEM IS AN INTELLIGENT MACHINING SOLUTION.

The Boehlerit-HORN PARTNERSHIP

HORN and Boehlerit have entered into an exclusive sales partnership. The Tübingen company handles all sales of the carbide precision tools for milling and turning applications in the German market. The partnership is a direct response to the wishes of HORN customers, which have often requested a wider product range. Before teaming up with Boehlerit, HORN needed to work with a variety of different partners so it could act as a single-source supplier to its customers and cover a broad spectrum of tools. But these partnerships were not always a success – because HORN does not accept compromises. The tool manufacturer always strives to find the best solution for its customers – and Boehlerit's high-performance carbide tools make the grade.

New Boehlerit high-performance tools

As the company's sales partner for the German market, HORN is delighted to present the new, high-performance tools from Austrian tool specialist Boehlerit. Innovations in the fields of carbide, coating and chip flow have enabled the development of a brand-new generation of grades for turning steel. These parameters have been finely tuned to create the new grades for steel machining: BCP10T, BCP15T, BCP20T and BCP25T. The new Boehlerit steel grades offer high performance and machining reliability throughout the entire turning process. A specially designed chipbreaker with a modified chamfer suppresses a significant proportion of the vibration generated by the machining process and ensures reliable chip flow. The new AlTiN PVD coating is designed to meet the most demanding temperature and toughness requirements, while its golden colour allows wear to be detected. The PVD coating comes into its own when machining small components, working at low cutting speeds and when the tool is required to enter the material frequently.

Roughing geometry for stainless steel

With "MRM" – the latest generation of indexable insert geometry – Boehlerit has extended its ISO turning portfolio for medium to heavy roughing of stainless materials. The company can now offer the perfect indexable insert geometry for virtually any application with stainless steel. The new "MRM" chipbreaker is an extension of the established "BMRS" geometry; although the feed rate ranges are similar, the MRM boasts a deeper rake angle, resulting in significant differences in micro-geometry. This development reduces the cutting force, which increases process safety and extends service life on hard stainless steels.

A SPECIALLY DESIGNED CHIPBREAKER WITH A MODIFIED CHAMFER SUPPRESSES A SIGNIFICANT PROPORTION OF THE VIBRATION.

SNEAK PREVIEW

A PREVIEW OF EMO MILAN 2021

From 4th to 9th October 2021, EMO is coming to the city of Milan, Italy. This year's theme is "The magic world of metalworking".

To protect visitors, exhibitors and event organisers attending or participating in events, the exhibition centre has developed a protocol to prevent the spread of coronavirus. The protocol sets out a series of safety measures for exhibitions and events, in full compliance with national health regulations and protocols.

HORN WILL BE BRINGING A NUMBER OF EXCITING LIVE DEMOS TO THE EVENT IN MILAN.

The event – which focuses on machine tools, precision tools, production systems, core technologies, solutions for networked and digital factories as well as additive manufacturing – will see the organisers transform EMO Milan 2021 into the largest digital factory ever constructed on an exhibition site.

HORN in Milan

Paul Horn GmbH will be exhibiting at EMO Milan 2021 with Italian partner company Febametal on stand D15 in hall 4. In addition to enjoying a wide range of live demonstrations with HORN tools, visitors to the stand will be able to explore countless new products and product enhancements. Markus Horn, Managing Director of Paul Horn GmbH, tells us more: "We're really pleased to be getting back out there after many months away from trade fairs, to have the opportunity to engage with our customers and other interested parties and to present our latest innovations and solutions. EMO Milan 2021 is an important signal to the world that events of this type and on this scale are back on the agenda and can go ahead safely". Federico Costa, member of the Management Board at Febametal, adds: "We believe that EMO Milan will deliver real added value for attendees; a visit will definitely be worth it".

The halls will be packed with the very best international products from each sector; products that are increasingly 'connected' and that provide access to all the high-level technological functions that are now so essential to the manufacturing industry. Technological themes set to be showcased on EMO Milan 2021 stands and at various subsidiary events include preventive maintenance, remote support, sensor applications, data analysis, collaborative robotics, automation, connectivity and artificial intelligence.

Visualisation of the HORN trade fair stand for EMO 2021.

The EMO Digital exhibition and demonstration area will highlight the potential of digital factories and the extensive opportunities that IT technology offers the entire manufacturing industry, looking beyond the world of machine tools to the wider applications in which they are primarily used.

The Startup Area will promote dialogue between, and serve as a meeting point, for the established industrial models typical of traditional companies and the new business visions that characterise the approach of new companies.

The Speaker Corner will provide an opportunity for a more in-depth analysis of the technological topics that are of interest to attendees at this global trade fair. This area will be set aside in one of the exhibition halls for events arranged by the organisers and exhibitors.

INTERVIEW WITH FEBAMETAL

THE MARKET AND TRADE FAIRS IN ITALY

Trade fairs are finally back on the agenda and it's nearly time for EMO Milan – with hygiene protocols in place, of course. Is this year's EMO giving an important signal to the industry?
Paolo Costa: EMO Milan has always been an important date on the calendar, not just for Italy but for the entire European market and beyond. We're emerging from a period of a year and a half without real, live trade fairs in Europe. We all have a need to connect, to see one another and talk face to face rather than via a screen. There will be strict hygiene protocols in place during EMO 2021, including distancing rules, temperature checks at the entry points and masks mandatory at all times, to name just a few. These rules will enable visitors to enjoy the trade fair while staying as safe as possible.

What are your expectations for the event?
Paolo Costa: It's difficult to say how the event will be received, given its timing. Up to now, the vaccination drives across Europe have been very successful, the Green Certificate is now a reality and restrictions are slowly being lifted; everything is headed in the right direction for a potentially large-scale event. We very much hope that the COVID infection rate will be low enough to allow everyone who wants to attend to travel freely and safely. We are doing everything within our control to make EMO Milan a safe and successful event.

What's the situation in the Italian market?
Federico Costa: Italy suffered greatly in 2020 due to COVID-19. First the health of our country suffered, then our economy and society too. We had a surprisingly good start to 2021 at Febametal. Our market was showing clear signs of recovery.

Which sectors in Italy have recovered well and which are still suffering the effects of the pandemic?
Federico Costa: Not all sectors are recovering in the same way. Some, such as aerospace and parts of the automotive industry, are still suffering the effects of the pandemic, but generally we can be very positive about the current situation in Italy. Hydraulics, valves, the medical industry and general mechanical engineering all require high-quality tools to be delivered quickly. This is where Febametal and HORN can really showcase their expertise – by delivering powerful tools faster than the average turnaround times of the other manufacturers in the market.

Federico Costa, Sales Director of Febametal.

Paolo Costa, CEO and Founder of Febametal Spa.

How were you able to maintain this level of customer service while all the restrictions were in place?
Federico Costa: Like the rest of the HORN Group, we believe in building strong relationships with our customers – not only through the machines we supply, but also through our telephone and on-site support. Our work is highly technical, so the pandemic made it challenging for us to deliver on one of the most important aspects of our approach: being there for the customer. But in spite of the difficulties, our technical team was able to continue to support our customers every day, during phone calls and with video conferencing technology. Even though larger companies are still not allowing external parties to enter their sites unless absolutely necessary to resolve an important technical issue, small and medium size companies are able to be more flexible and allow external visitors. This means that our sales teams across Italy are in close contact with our customers and are always ready to support them.

Will you both be manning the Febametal and HORN stand?
Federico Costa: Yes, we will be there in person throughout the trade fair. We don't want to miss this important event and the opportunity to see our customers face to face, win new customers and showcase our latest innovations. In spite of the pandemic, HORN has launched a number of new products over the last few months and we're keen to present these products live.

EMO MILAN HAS ALWAYS BEEN AN IMPORTANT DATE ON THE CALENDAR FOR THE ENTIRE EUROPEAN MARKET.

What is your personal highlight among the new innovations at the EMO trade fair?
Paolo Costa: We believe that HORN'S innovative new coating technologies and careful research and development will take tool life to a whole new level for our customers. The IG3, IG6 and SG3 coatings are definitely major innovations for users. The new HPC-DS milling cutter for high-performance machining is another highlight. HORN solid carbide milling cutters are a high-performance, versatile tool. This addition makes the range even more competitive.

JOINT PROJECT

COMBINING EXPERTISE IN TOOL, MODEL AND MOULD MAKING

When three specialists come together and push the boundaries of their respective fields, they can achieve great results. A solution for tool and mould making was the culmination of one such project developed for an online seminar – and the result is testament to the group's expertise and successful partnership. The team comprised workholding equipment specialist SCHUNK, programming professionals from OPEN MIND and tool experts from HORN. New approaches were combined with tried-and-tested technologies: from zero-deformation magnetic workpiece clamping with mobile pole extensions through new HPC milling tools for fast processing and high machining volumes to efficient and cost-effective programming. The seminar was of interest not only for users in tool, model and mould making, but also to those in other areas of machining.

"When Uwe Weil from SCHUNK called me and told me about the idea behind this project, I was immediately interested. I agreed to take part shortly afterwards", recalls HORN product manager Andreas Jenter, whose speciality at HORN is milling with solid carbide tools. "Clemens Bangert from CAD/CAM manufacturer OPEN MIND also immediately agreed to take part in the project. The hyperMILL® expert developed and programmed the 3D model of the complex mould", explains Uwe Weil, who is responsible for product and technology training at SCHUNK. Weil continues: "After four days of close collaboration, we had a machining process in place. Some aspects might look different in practice, but we wanted to use different approaches to show how such a complex component could be machined in a cost-effective way".

Magnetic workpiece clamp

Although magnets are perhaps most commonly associated with surface grinding machines, magnetic clamping technology is also used in milling. "People still have misconceptions about magnetic workholding in milling applications, but we wanted to use this example to show that magnetic technology is actually very well suited to production", says Weil. The magnetic plate is attached to the SCHUNK zero-point clamping system on the machine table using an aluminium base plate and appropriately arranged zero-point clamping bolts. The magnetic clamp holding the workpiece is completely free from deformation. This is achieved by using a fixed pole extension to set the height of the workpiece in combination with pole extensions. They compensate for any unevenness in the surface of the component, which ensures that the part is not distorted by the clamps. Once the external dimensions have been face-milled, the workpiece is clamped in the fixed pole extensions. "The depth of penetration of the magnetic field in the component is around 10 mm (0.394")

The Tendo Zero clamping system offers precise adjustment of concentricity.

Magnetic workholding technology allows the workpiece to be clamped without risk of distortion.

at the highest level of magnetism. One of the misconceptions about magnetic clamping technology is that the workpieces themselves become magnetised once clamped. But this isn't

SPECIALISTS FROM SCHUNK, HORN AND OPEN MIND: A SUCCESSFUL TEAM.

the case. The low penetration depth of the magnetic field means that chips don't stick to the surface even when milling a deep mould", explains Weil.

Jenter uses the HORN DAH84 high-feed milling system to face mill the periphery. "The insert has eight usable cutting edges, resulting in a low cost per edge and a high level of cost effectiveness. Despite the negative mounting position, the positive cutting geometry ensures a smooth and soft cut combined with good chip removal", says Jenter. The large radius on the main cutting edge of the indexable insert results in a soft cut, ensures even distribution of the cutting forces and, in turn, extends the tool life. The tangential type 409 milling system was used to finish the surfaces.

Programming expertise

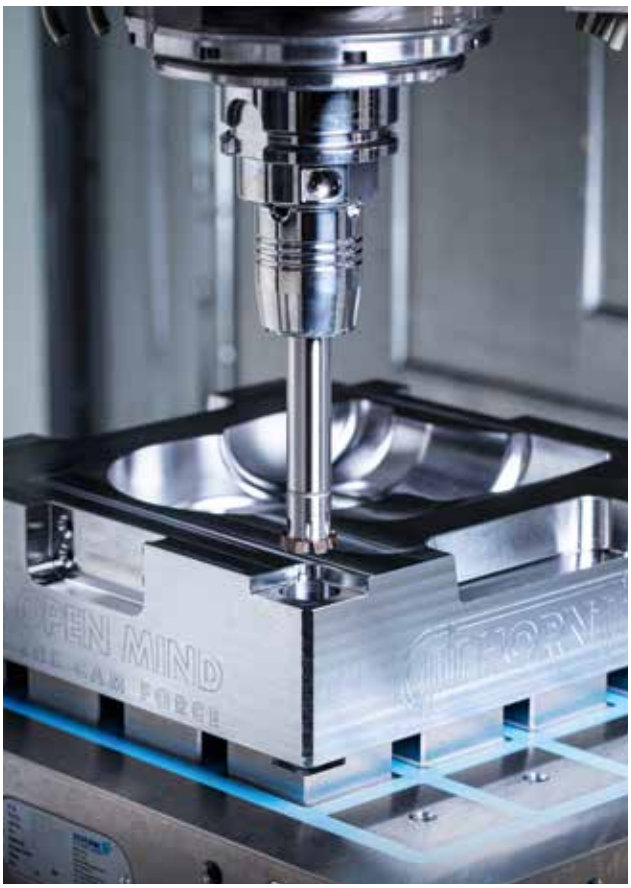
For roughing, Clemens Bangert made use of a function from the hyperMILL® MAXX Machining performance package. "To ensure the machining process was dynamic and efficient, I used 3D-optimised roughing. Machining takes place in trochoidal tool paths and the milling cutter ramps into the part helically. It's particularly important that we can program separate speeds for entry, the dwell after entry and cutting. This ensures that the process remains stable throughout", explains Bangert. The programmed dwell provides the spindle with sufficient time to reach the correct speed so that the pre-milling of the mould in trochoidal movements can commence. As far as possible, helical movements are used for roughing the mould. "This en-

The component itself is not magnetised after clamping.

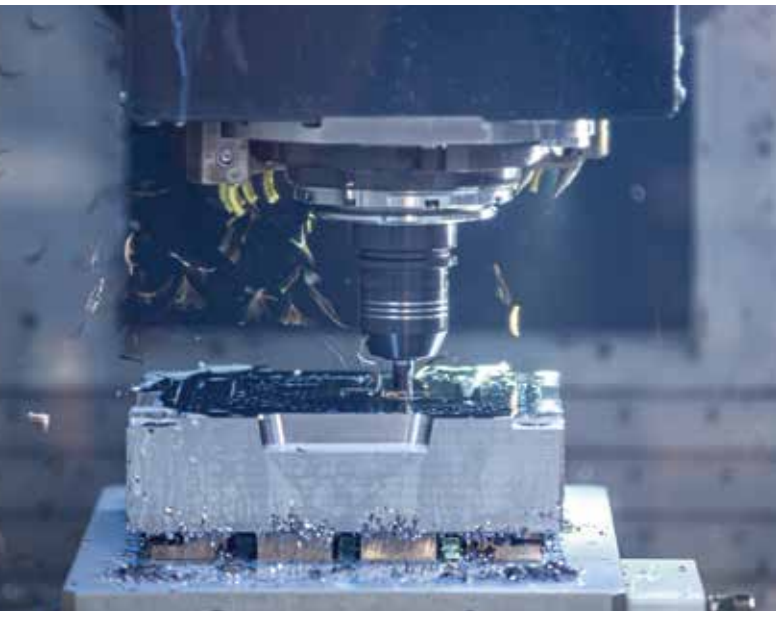
sures that the tool always cuts gently at a constant speed with no retraction, and that it never makes full cut contact", says Bangert.

Jenter uses a HORN VHM end mill from the DS system for roughing the cavity. "We developed HPC milling cutters specifically for the purpose of milling high-strength steels with high material removal rates", explains Jenter. The system particularly excels in dynamic roughing applications as well as in standard roughing cycles. The first roughing process uses an HPC milling cutter with a diameter of 12 mm (0.472") and four cutting edges. "Given the contour, we deliberately refrained from using a larger diameter to reduce rest machining", says Jenter. The cutter enters the workpiece in a helical movement at an angle of 5 degrees. The cutting depth is a_p = 20 mm (0.787"). The other cutting data are v_c = 140 m/min (5,511.81"/min) and f_z = 0.08 (0.003"), while radial depth of cut a_e = 3 mm (0.118"). The different helix angles create an irregular tooth pitch, making operation exceptionally smooth. The tools' optimised face geometry reduces the cutting pressure when circular or linear ramping. Improved chip spaces ensure optimal process reliability during chip formation and removal.

A high-feed milling cutter with a diameter of 12 mm (0.472") is used to rough mill the free-form surfaces. The milling cutters have a double radius geometry, which favours the flow of forces in the axial direction



The HORN DR reaming system is a high-performance solution.



Roughing the internal cavity using a HORN HPC milling cutter.

of the spindle and reduces the radial force. "Thanks to this geometry, we can maintain high feed rates even with long tool overhangs, without causing any vibration in the tool", explains Jenter.

TENDO E compact hydraulic expansion chuck

The tools are clamped in SCHUNK hydraulic expansion chucks for roughing. Weil uses the TENDO E compact series for roughing; the short design is ideal for this process. "I am often asked how much

HORN PRODUCT MANAGER ANDREAS JENTER USES THE HORN VHM END MILL FROM THE DS SYSTEM.

torque I need to apply to tighten the chuck. With SCHUNK, this is an easy question to answer: All you have to do is turn the clamping screw as far as it will go and this gives you the optimum concentricity and best possible torque transfer to the tool", says Weil.

To accommodate the guide bolts of the tool, four holes need to be reamed in the corners of the workpiece. SCHUNK uses the TENDO Zero hydraulic expansion chuck to clamp the reaming tools. The four opposing Torx screws on the collar of the clamping chuck can be used to adjust the concentricity to

The high-precision ball nose end mills from the HORN DS system guarantee high surface quality.

a high level of precision. The user can check the reaming tool using a presetter and then make the final adjustments directly on the machine using a dial gauge. This approach allows the concentricity to be set with micron precision. "With a reaming tool length of over 100 mm (3.937"), we can achieve run-out below 2 µm (0.00008"). This is a great result", says Weil.

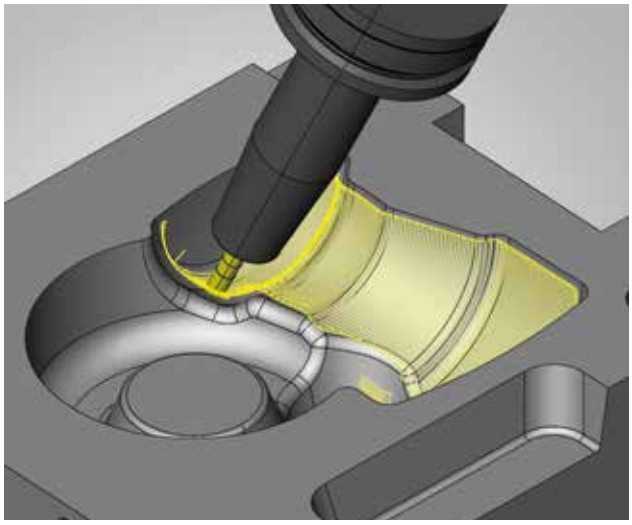
High-performance DR reaming system

The DR reaming system from HORN is used to ream the four holes. With an internal coolant supply, the cutting speed was v_c = 110 m/min (4,330.71"/min) with a feed rate of 0.84 mm/rev (0.033"/rev). The retraction feed rate was programmed at 4 m/min (157,48"/min). "With a long projection and a through bore, it is important that the tool doesn't protrude from the hole by more than 2 mm (0.079"). Otherwise, there is a risk of the tool oscillating", explains Jenter. The HORN reaming system features a modular design and can be combined with countless interfaces. The repeatability of insert position after changeover is just 4 µm (0.0002"). With standard inserts, the system is capable of reaming materials up to a hardness of 58 HRC.

"The four external threads were machined with three lateral infeeds to ensure an exact fit. I used the hyperMILL® 'Thread milling' function for machining. This function automatically calculates the value for the lateral feed based on the tool and thread, which means that it can support both single-edged or multi-edged tools", says the hyperMILL® expert. The HORN DC thread milling cutter machined the threads with a cutting speed of v_c = 80 m/min (3,149.61"/min) and a feed per tooth of f_z = 0.02 mm/min (0.0008"/min). The tool was clamped in a SINO-R expansion chuck. The clamping system is based on PU elements rather than being hydraulic. This provides excellent vibration damping, which ensures that the entire system remains stable during thread milling.

High-precision thread machining with the HORN DC milling system.

BEFORE PROGRAMMING THE FREE-FORM SURFACES, THE REQUIREMENTS FOR THE COMPONENT ARE CHECKED.



hyperMILL® 5-axis radial machining: high surface quality for workpieces such as bottle moulds.

High surface quality during finishing

"When finishing a mould with different ball nose end mills, there are three key factors that enable you to achieve the required surface quality: the precision of the tool, powerful CAM software for precise machining, and the accuracy of the workholding equipment. We produce the milling cutter radii with a maximum form deviation of +/- 0.005 mm (0.0002")", explains Jenter. The importance of this precision becomes clear when different milling cutters are used for finish machining a mould. Bangert has programmed the mould to be machined with a 6 mm (0.236") and a 4 mm (0.157") ball nose end mill: "Before programming the free-form surfaces, we always check the requirements for the component first. These include the required surface quality, the form tolerances and the transitions during finishing". The machine kinematics – the interplay between the workholding equipment, tools and machine control system – also play a key role.

The standard version of the hyperMILL® CAM software includes countless strategies for high-precision machining. The "High-precision surface mode" option, for example, boosts the quality of the surface finish. This function was used when machining the mould. Bangert explains: "We calculate the tool paths based on the actual CAD component surfaces rather than a mathematical model. This means that we can achieve tolerances to within microns. I also used the "Soft overlap" function to blend the transitions between different surfaces, even when these transitions had been machined with another tool or infeed. This is an efficient way to achieve a seamless surface finish". Clemens Bangert also deployed the "5-axis radial machining" function: "This strategy allows us to achieve the best possible surface quality. With a radial projection method, tool paths – for bottle moulds, for example – can be calculated much faster. It also allows the user to respond flexibly to the actual component in front of them".

TOOL AND MOULD MAKING 2021 MEDAL OF HONOUR FOR LOTHAR HORN

The tool and mould making medal of honour 2021 was designed by the WBA Tooling Academy Aachen and produced with HORN tools.

Lothar Horn, Managing Director of Hartmetall-Werkzeugfabrik Paul Horn GmbH in Tübingen, Germany.

Ever since the inaugural Moulding Expo at the Stuttgart exhibition and trade fair centre, the tool and mould making medal of honour has been awarded to persons of outstanding merit in the sector. Winners of the medal – who receive the award at the exhibitors' evening – are pioneers and visionaries whose work has served as a guide and example to the industry. The tradition was honoured at this year's virtual exhibitors' evening on 10th June as part of the German Association of Tool and Mould Makers' "MEX-Special" event. This year, the award winner was a businessman who has made an enormous impact on the sector: Lothar Horn, Managing Director of Paul Horn GmbH in Tübingen.

The tool and mould making medal of honour was created to recognise the efforts of persons of outstanding merit in the tool, model and mould making industry. The selected winners are people who have made – and continue to make – an impact in their sector. The medal of honour is expressly not a "lifetime achievement" award: the jury hopes that winners will continue to serve as an example for all those who are active in or wish to join the industry. Those chosen to receive the medal also set an example for young people and others outside their sector. For jury members Prof. Wolfgang Boos, Managing Director of the WBA Tooling Academy Aachen, Ralf Dürrwächter, Managing Director of the German Association of Tool and Mould Makers, Richard Pergler, owner of Pergler Media, and Alfred Graf Zedtwitz, Press Officer for VDMA Precision Tools, the candidate selection process always involves some careful decision-making. After all, there are many people who match the description of "outstanding merit" in the sector – all of whom would be worthy winners.

This year's winner Lothar Horn has established a one-of-a-kind internal toolmaking system for special processes and is consistently a pioneer in his sector. For many years, Lothar Horn was the chairman of the VDMA Precision Tools association and, alongside his main role, also acts as a representative and ambassador for the sector around the world.

The medal of honour wasn't just manufactured with any tool: After the jury's decision-making meeting, the WBA Tooling Academy Aachen – which designed and produced this year's award – secretly arranged for production to be completed in HORN's tool factory in Tübingen. According to the jury, they did an outstanding job of the medals – and of keeping the award a surprise for Lothar!

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