

Innovative event series

BENCHMARK- WORKSHOP

The P50 Accelerator

Are you prepared for the future requirements in
mold making?

in cooperation with

röders
TEC

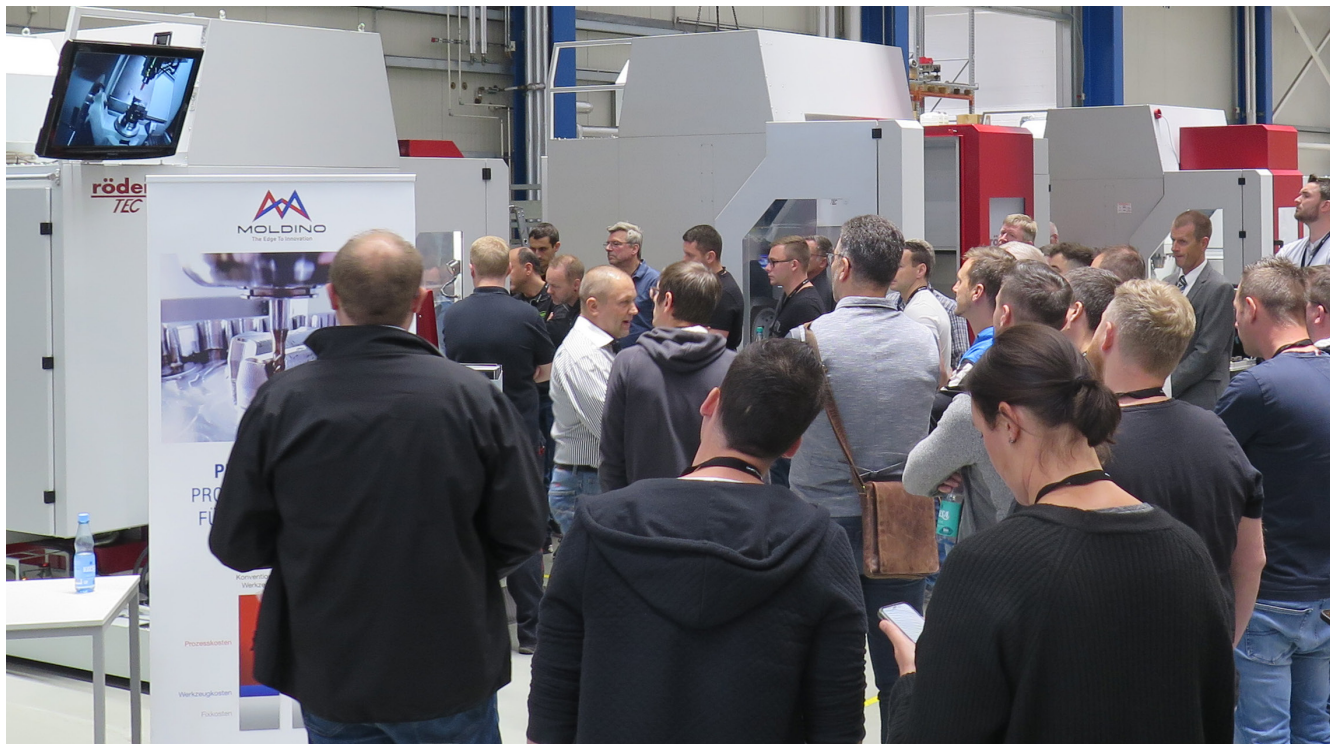
Complete machining of a mold insert in two clamping operations only

Production costs halved

In a series of workshops, MOLDINO demonstrates how a customer-specific analysis can combine previously separate production steps on a single machining center to optimize efficiency. At the kick-off event at Röders in Soltau, Germany, benchmarking with customer mold inserts provided the proof.

How many and, more importantly, what operations are required to assemble and test a given tool? Every mold maker will have a different answer, even for the same design. Mark Rotzoll of Japanese precision mold maker MOLDINO Tool Engineering knows the needs and challenges of both in-house and independent mold makers. As a process optimizer and application engineer, he supports many well-known customers in the region from his base in Herford, Germany. For example, Rotzoll cites the production of a mold insert typically found in the electrical in-

dustry and other industries with similar requirements. *"The production sequence here can comprise up to ten individual process steps according to standard procedures."* That begins with soft roughing of the stress-relieved annealed blank, followed by hardening. It is followed by grinding, hard roughing of the remaining material, pre-finishing, and finishing. *"After milling, the parts are often subjected to die-sinking and wire-cut EDM, including EDM drilling of the start holes,"* says Rotzoll, describing the classic process sequence, before finally being polished to the required surface quality.

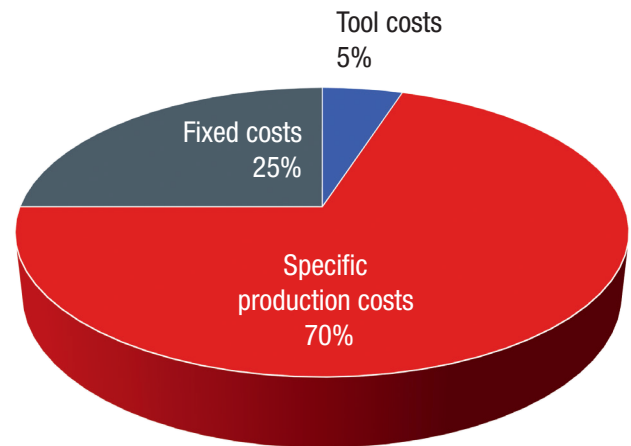


Well attended: Benchmark workshop participants at the Röders Tech Center in Soltau.

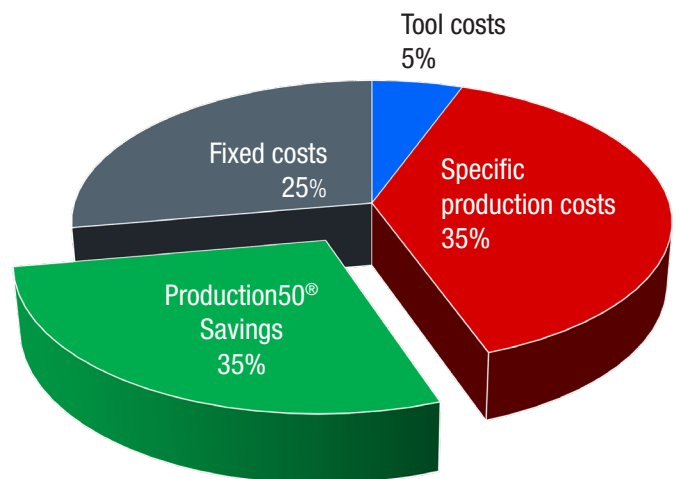
Traditional processes create inaccuracies

One of the biggest time wasters in this process is the unpredictable idle time between processing steps on different machines—the result is longer throughput times with a negative impact on costs and deadlines.

"Also, if I erode in between, I must measure afterward. I need the data to be able to approach the part correctly." In addition, the positioning inaccuracies of the machines can add up. *"Every time you clamp from one machine to another, you lose at least one micron."* Rotzoll, therefore, advocates combining as many machining steps as possible so that they can be performed on a single machine in a single setup. He cites hard milling as an alternative to grinding and die-sinking EDM and high-precision micro-hard drilling down to 66 HRC, which would often eliminate the need for wire EDM of fits. *"Ideally, idle and set-up times are reduced to loading the 5-axis machine with tools, clamping the workpiece, and reclamping it once."* When determining the right optimization strategy, Rotzoll and his colleagues always proceed according to the Production50 method (P50), developed by MOLDINO primarily for the mold & die sector. The existing machining processes are analyzed with the customer to gain a new perspective on the entire production process. On this basis, the economic efficiency of the machining can often be significantly increased. Finally, the changeover's added value is demonstrated by a profitability calculation.



Cost distribution in toolmaking: In the example project, the tool costs amounted to EUR 1,500, the fixed costs to EUR 7,500, and the specific production costs before optimization (Fig. 2a) to EUR 21,000 (300 h x EUR 70/h). The optimization (Fig. 2b) reduced the production costs to 10,500 euros (150 h x 70 euros/h). Thus, 10,500 euros were saved.



- Fixed costs
- Tool costs
- Specific production costs
- Production50® savings

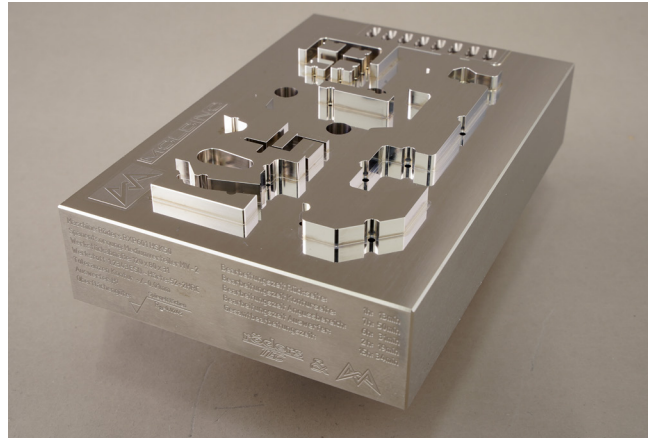
Benchmark workpieces produced by participants

MOLDINO has taken the topic of process optimization through complete machining as an opportunity to start a series of workshops throughout Germany in cooperation with Röders. The kick-off event took place at Röders in Soltau.

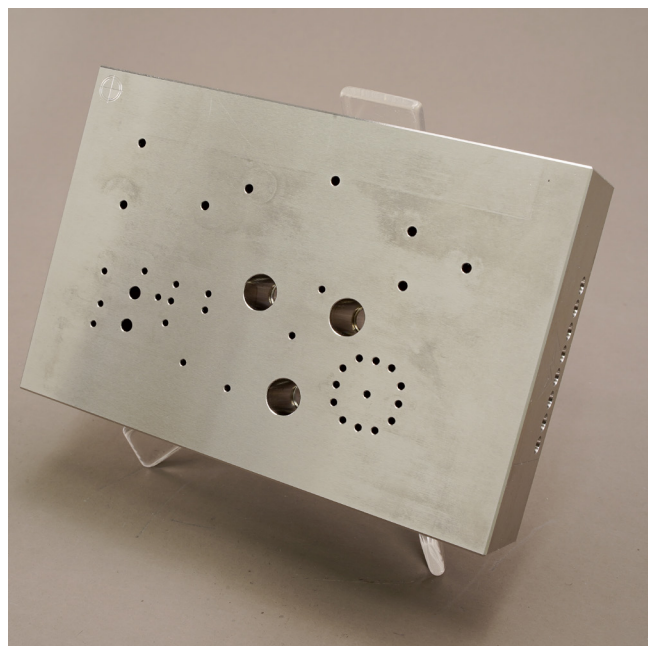
Rotzoll and his colleague Andreas Schadeck from Herford had devised something special for the well-attended event. Namely, a practical contour workpiece designed especially for this event, whose 3D CAD data was to be handed out to selected participants in advance. This was combined with the request to produce this sample part by taking the technologies commonly used in their company and documenting the required processing times and all associated idle and transport times. These were long-time MOLDINO customers who were known personally. The raw material was also supplied, pre-hardened to 52 HRC and pre-ground. The design in high-strength and pre-hardened hot work tool steel 1.2343 ESR (X37CrMoV5-1 ESU) was based on the ejector side of the mold insert, the conventional manufacturing process of which was already described above by Rotzoll.

The design presented several challenges: For example, 37 through-holes with a tolerance of H7 in diameters of 0.6 mm, 0.8 mm, 1 mm, 1.5 mm, and 2 mm had to be machined for the ejectors. Three additional 6-mm diameter fits had tolerance requirements of 0 to +3 μm . The side sealing areas of the mold insert were also challenging, mainly because of the high cylindricity requirements. This is also applied to the three optical surfaces (mirror surfaces) to be produced with a required average roughness value of $R_a\ 0.025\ \mu\text{m}$. For this reason, electro slag remelted (ESR) material was selected for the sample part because it is very well suited for producing high-gloss surfaces. Otherwise, the tolerance of the contour and base surfaces was $\pm 0.01\ \text{mm}$, which is typical for similar mold inserts.

"The selected participants produced the part using the available production technology, documented all the steps, and brought it to the workshop," explains Schadeck. They were promised an individual evaluation of the process as additional motivation.



The example mold insert designed by Mark Rotzoll is made of high-strength, ground hot-work tool steel 1.2343 ESR (X37CrMoV5-1 ESR) pre-hardened to 52 HRC.



Complete machining of the ejector holes also requires the appropriate clearance holes.

Complete machining in two set-ups

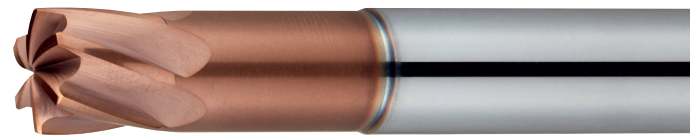
What was the result? *"No one among the customers had completely manufactured the benchmark mold insert on a single machine,"* he says. But that is precisely what Rotzoll and Schadeck did, with five axes in two set-ups. They did it on an RXP 601 DS in the Rödgers technical center, which, like all machines from this manufacturer, is known for its high dynamics and accuracy. *"Because good tools only run optimally if the machine can do the same,"* says Rödgers Sales Manager Oliver Gossel, who presented the new RMS6 control generation features in a separate part of the workshop program. The machines are, therefore, extremely rigid, vibration-resistant, and have a sophisticated temperature management system. Also critical is the high-speed control response, known as racecut. This means that the target/actual comparison takes place 32,000 times per second, resulting in a higher surface quality and the possibility of further machining reductions. *"We use these 32 kHz controllers in all three control loops, i.e., position, speed, and current,"* the Doctor of Engineering emphasizes. This makes us twice as fast as our competitors in terms of control.

But back to making the example part: All machining examples were produced before the workshop. All these steps were then explained in detail during the presentation. This included fundamental topics such as the advantages and disadvantages of hard machining, especially hard roughing. Or when and under what conditions die-sinking and wire EDM can and cannot be dispensed with according to the current state of the art. Highlights were also shown live on the Rödgers machine. For example, the new MOLDINO micro drills of the EMSBH-ATH series for the ejectors fit the hard drilling of the H7 tolerance.

Or to achieve the necessary cylindricity or angle tolerance for the walls, i.e., the lateral sealing areas demonstrated in Soltau using the lesser-known groove milling process. The three 6 mm fits were also produced by MOLDINO using this milling strategy. The low-wear hard milling of the three mirror surfaces of the example mold insert with the TH3-coated solid carbide polygon tool from the new EHHRE series also amazed many participants.



The contours were pre-finished and finished with the 4-flute EPDREH.



After hardening, the moldings were pre-milled to an allowance of 0.15 mm using the 6-edged EHHRE.

"We anonymized the data collected from the customers and used it to determine an average and the best," Rotzoll describes the process. *"Without knowing these values, we compared ourselves to the identical mold insert produced with our technologies."* All parts were fully measured on the contour and ejector side. *"We drilled all the diameters of the H7 fits."* On the other hand, all customers made the initial holes with an electrode and then wire cut the final dimension the traditional way. *"We were always within tolerance on all holes, as were many customers, but some were not."* This was in no way intended to send the message that they could do everything better, Rotzoll emphasizes. *"Rather, we wanted to show that we could maintain the tolerance in a fraction of the time."*

Completely mill and drill the sprue area

The production of the sprues in the workshop was out of competition, so to speak, says Schadeck. He points to the top of the mold insert, which was left out of the design for the customer attendees. *"We didn't want to make it any more complicated than it already was."* Making the sprue part was also intended to be an extra treat for the workshop.

The task was to produce eight tunnel sprues, four of which had a dust floor. This was done exclusively by drilling and milling with the EMSBH-ATH micro drills. For the latter, the nano-coated EPDBEH ball mentioned above was used. The EPDBEH-TH3 ball cutter was used to pilot the holes for the sprues. *"In addition to high repeatability and surface quality, low-burr milling is also important when milling sprues,"* said Rotzoll during the workshop. Once again, the swiveling circular plunge mill was used to finish the sprues and injection points. The radius of the tool diameter generates the required surface quality. This also allows for greater lateral infeed. *"With plunge milling, the feed rate is not subject to any dynamics, which is particularly effective for conical contours,"* he explains. *"With this strategy, it is possible to work in the direction of material flow in the sprues."* This later favors the flow behavior of the molded part. The tooling expert summarized the benefits of this milling strategy as follows: *"Grooving allows minimal*

chip removal, resulting in perfect contour accuracy, dimensional accuracy, and surface quality. Grooving in the taper direction was done with the fourth and fifth axes set." Compared to eroding, we saved 46 percent on the sprue part time.

MOLDINO dispensed with both coolant and conventional minimum quantity lubrication (MQL) for the complete machining of the benchmark part. Instead, the Rödgers machine is equipped with the MHT (Merz & Haag) medium distributor for all production steps, including drilling. *"With this system, I have the advantage that the air/lubricant mixture is directly at the cutting edge,"* says Rotzoll. This positively affects chip and dust removal, surface quality, and tool life. Because this system is lubricated with hydrocarbon, the workpiece has no oily residues, as with MQL. Rödgers also recommends the fluid manifold for its machines.



The mold insert was milled in two clampings on the 5-axis Rödgers RXP601 DS, equipped with the medium distributor from MHT.

Processing time reduced by 60 percent

So, what was the conclusion of the benchmark?

"In terms of pure machining time, we reduced the average time our customers needed for this part from about 28 hours without electrode milling to just under 10.5 hours," says Schadeck, summing up the difference. *"With the development of our process, we achieved an average time saving of about 60 percent."* If the idle times of an average of 300 hours are included, the difference in total throughput time becomes even more dramatic. Rotzoll points out another aspect: *"Molds of this size usually have 4-, 8- or 16-cavity molds. That's why we designed the process for eight inserts in terms of the tools required."* Eight inserts can be produced with one set of tools. This is an important consideration when comparing costs with alternative manufacturing processes. *"Because very few companies have only one insert in their day-to-day business."*

This aspect was also considered in the extrapolation presented at the end of the workshop. According to this, the previous production costs of the benchmark application amounted to a projected average of 6,832 euros for an assumed 8-cavity mold. After the "Production50® optimization", i.e., complete machining on a single machine, it is only 3,400 euros. This represents a saving of 3,432 euros or 49.8 percent.

Satisfied participants

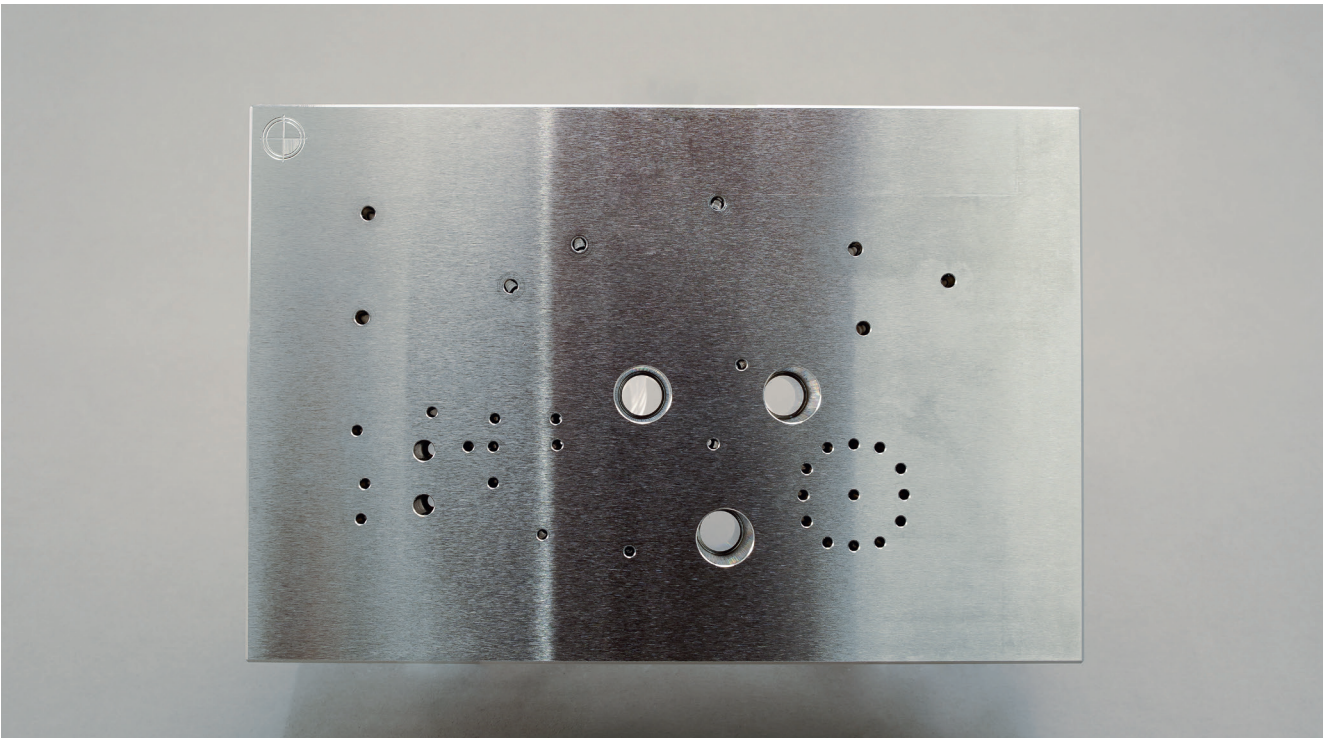
Visitors to the kick-off event learned a lot about optimized processes, production strategies, new tools and took home a lot of know-how. *"In addition to the milled mirror surfaces and the overall impression of the workpiece, I was very impressed by the cost-benefit ratio,"* says Jakob Kehler of Erwin Quader Systemtechnik in Espelkamp. *"We will continue to pursue the ability to drill ejector holes directly. It will probably become an integral part of our production in the future."* Toralf Gross of Körber Technologies in Hamburg, Germany, was particularly impressed by the Production50® evaluations directly comparing

machining strategies. *"But also the drilling, micro-drilling, and groove milling procedures were very impressive,"* emphasizes Gross. *"Especially since the surface finishes are very relevant to our day-to-day business."* Heinrich Berg from Harting Applied Technologies, also in Espelkamp, was impressed by the extremely precise micro-drilling with high surface quality, reliably produced with the new MOLDINO micro-drills. He was also impressed by the enormous possibilities of slot milling. This is already being used to some extent in the company's toolmaking department, which is now to be expanded. *"In the workshop, I was also impressed by the interaction of all the components used, i.e., machine, tools, tool holders, and cooling with the MHT media distributor."* For Lars Diekmann from WAGO's toolmaking department in Minden, Germany, the hard drilling and groove milling technology were also among the highlights. He also praised the Röders Tech Center, which was especially interesting. *"But the reduced idle times impressed me at the workshop."* For this reason, it is planned to analyze and implement more core topics in cooperation with MOLDINO in the future. The other workshop participants expressed similar opinions. *"We see the cooperation with MOLDINO as a partner for future process development as the key to success,"* summarizes Lars Diekmann.

Note: The quotes are personal opinions and not official statements from the companies where they work.



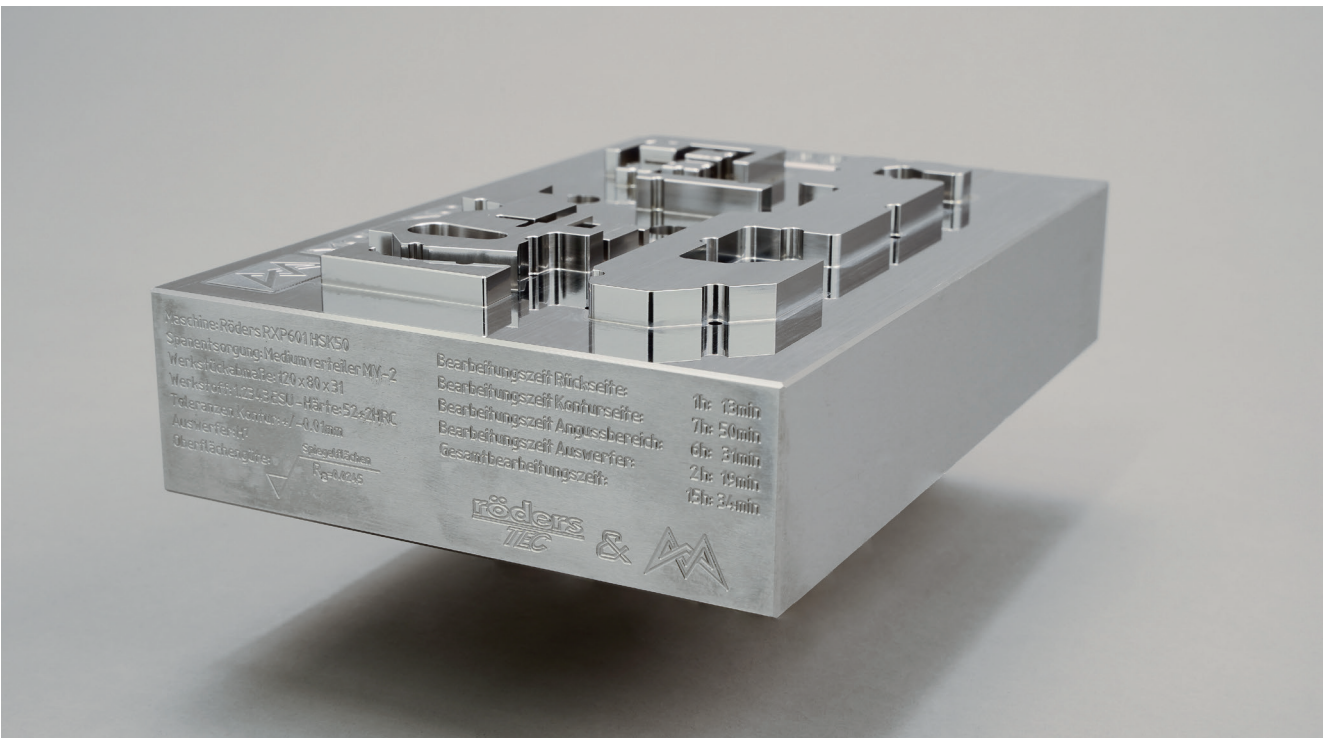
The sprue side of the example tool: All eight sprues were exclusively hard-drilled and milled. For example, the strategy of groove milling was used for the cone, which was also used for milling the three fits with a diameter of 6 mm



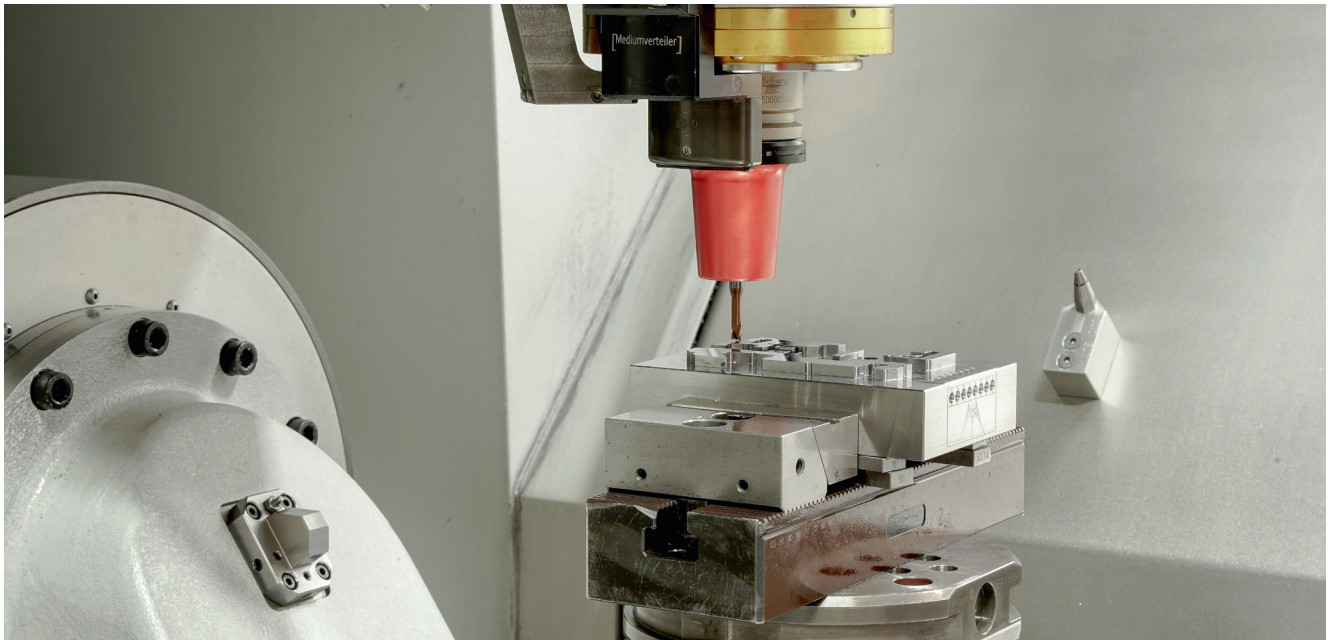
Next to it you can see the H7 ejector fits, which were exclusively hard-drilled.



The example mold insert designed by Mark Rotzoll is made of high-strength, ground hot-work tool steel 1.2343 ESR (X37CrMoV5-1 ESR) pre-hardened to 52 HRC.



Details of the material, surface finishes, and machining times were engraved using the DN2HC-ATH chamfer cutter.



The 5-axis Rödgers RXP601 DS and the example mold insert clamped on the table of the C-axis. The red medium distributor from MHT mounted here ensures optimum lubrication, cooling, and chip/dust removal.



With the medium distributor from MHT (Merz & Haag), a particular air distributor system is used to blow either pure compressed air with a bit of oil compressed air or hydrocarbon medium (MV-2) onto the tool in such a way that it is optimally cooled and the chips are reliably removed.

Cooperation is the key to success!

MOLDINO

MOLDINO Tool Engineering is one of Japan's leading tool manufacturers. The subsidiary MOLDINO is located in Hilden near Düsseldorf. For decades, the company has focused on mold and die makers as a target group and has a range of tools that cover the entire process chain. The company has over 40 years of experience in European mold and die making and currently employs 80 process optimizers working with customers to maximize production potential.

The specially developed TAR database with over 20,000 user reports is helpful here. The increasing time and cost pressure in mold and die-making require shorter process times and more efficient machining methods

The specially developed Production50® manufacturing concept addresses this need. MOLDINO offers innovative tool technologies and individual services to meet these high demands.

Röders GmbH

Röders GmbH is a 6th generation family business from Lower Saxony and looks back on more than 200 years of company tradition. Thirty years ago, Röders was one of the pioneers in developing high-precision HSC machines for 3D machining. With its control and regulation technology, Röders achieves exceptionally high precision and dynamic machining.

Axis controllers with a controller cycle of

32 kHz have been developed to increase the machines' performance further. A rigid structure and exceptional temperature stability also characterize Röders machines. These machines are predestined for hard machining in mold and die-making with excellent economic efficiency. However, other materials, from graphite to copper and carbide, can also be machined effectively. In addition to the machines, Röders also offers solutions for machining automation.

www.roeders.de

Talk to us and take advantage of our strengths; we look forward to your challenge.



Dr.-Ing. Oliver Gossel
Sales Manager Mechanical Engineering
+49 5191 603 43
Röders GmbH
www.roeders.de



Mark Rotzoll - Local Team Leader - Herford
+49 173 259 3160
MOLDINO Tool Engineering Europe GmbH
www.moldino.eu

MOLDINO Tool Engineering Europe GmbH

Itterpark 12 · 40724 Hilden · Germany · Telephone +49 (0) 21 03 – 24 82-0 · Fax +49 (0) 21 03 – 24 82-30

E-Mail info@moldino.eu · Internet www.moldino.eu