Klartext

HEIDENHAIN

Innovations in CNC Machining and Digital Manufacturing

Digital networking

Relaxed machining

Editorial

Dear Reader,

The COVID-19 pandemic confronts us all, each and every day, with new developments and challenges: how can you maintain your customer contacts? How do you maintain your supply capability in order to fulfil existing and newly incoming jobs? How can you organize your processes more efficiently?

In finding answers to these and other questions, we normally would support you — the users of HEIDENHAIN controls —with certification and expertise, in-person at training courses, trade shows, and user days. However these are the activities most noticeably affected by the current restrictions. Our training center in Traunreut, Germany, was unable to offer in-person courses from March to May 11, and since then only with a reduced offering in compliance with current hygiene restrictions. Visitor contact is also currently limited across the board, preventing us from coming to your company.

In response, we are providing training courses and user consultation through digital media. You can install and use the HIT 3.0 multimedia learning system, for example, on PCs, tablets, and smartphones in the office, at home, or on the road for your apprentice training and continuing education in Klartext NC programming. The premium classroom versions offer ideal functions for instructors and teachers, including functions for easy enrollment administration, group work organization, distribution of self-created content, and even online tests. This solution is already in use by many vocational schools, vocational training institutions, and training shops deploying HIT 3.0 as a platform for their digital instruction.

In addition, all of our helplines are at your disposal for questions about HEIDENHAIN products and their application. And of course, the TNC Club team is also there for you. For critical production matters, we also offer Webex sessions to find solutions with you online.

Digitization offers many new communication and training solutions that we are currently using to stay in touch with you! All the more reason for us to look forward to seeing you in person again soon.
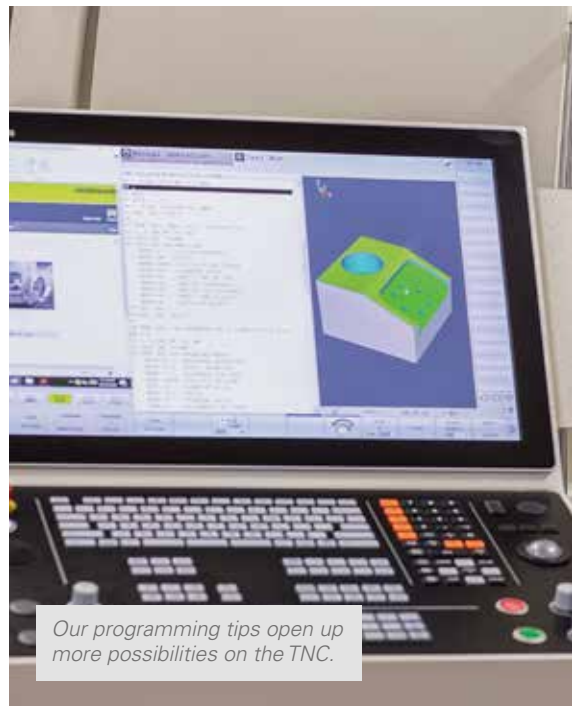
Stay healthy! Enjoy your reading!

At Sehnde Penitentiary, practical training creates prospects.
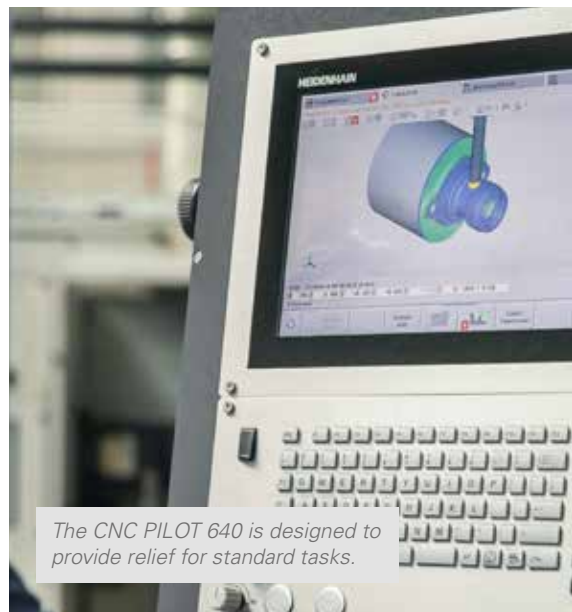
The CNC PILOT 640 is designed to provide relief for standard tasks.

Our programming tips open up more possibilities on the TNC.

Klartext

71 + Fall 2020 North American Edition

Content

+ All helplines at a glance:
www.klartext-portal.com/contact

+ This way to HIT 3.0:
www.klartext-portal.com/hit

A great one-two punch

A rare American builder of large machine tools with 'strong bones' adds a superior control to bring new benefits to many.

With the need for high-quality contour surface milling on the rise in manufacturing, one of the rare large machine tool builders based in the U.S. has now met that challenge and is making an impact in those industries that need it most. Welcome TARUS. Established in the Detroit, MI, area in 1969, TARUS is already well known by those in the automotive, aerospace and mold & die manufacturing industries. They have made significant new investments in innovations, spearheaded by now including the state-of-the-art HEIDENHAIN TNC 640 CNC control on many of its large equipment offerings.

"We are excited about the changes made here over the last couple of years that give our manufacturing customers the edge they need to compete in today's global marketplace," explained Doug Greig, TARUS co-owner with brother Dave. "TARUS has always been known to have great build on its machines, many say 'strong bones'. And we've now upped the game with machine performance levels of increased speed and accuracy highlighted by 5-axis capabilities with the HEIDENHAIN TNC controls and linear and rotary encoders predominantly. We believe this is a great one-two punch!" added Dave Greig.

TARUS' large and durable American-made bridge and gantry milling machines boast an average large work envelope ranging 7' x 10' up to 14' x 60' as examples. "We are one of the few U.S. machine tool manufacturers making machines of this size. We have hundreds of customers including many in automotive such as GM, Ford, FCA and Toyota, as well as those in aerospace and mold & die. (See page 8.)

Changing the game

"We at TARUS have some great machines with great features, but when it comes down to it, the customer really only cares about how fast they can complete their job, what is the uptime on their machine and how does their end product look," explained Brad Kleinow, Director of Service at TARUS. "The fast speed, strong reliability and superior surface quality that HEIDENHAIN brings to the TARUS machines has proven to be a game changer."

"There is a night and day difference in part surface finish with the TNC 640 when compared to the older TARUS machines equipped with our previous TARUS CNC," explained Doug Greig. "With our current TNC 640 equipped machines, it is so much smoother and cleaner."

Doug added that TARUS is now predominantly using the TNC 640 on its large high performance machines because its cutting and performance went through a thorough testing process and performed even better than expected, as well as the fact that many in their main markets now require the HEIDENHAIN. "The TNC 640 control is our preferred choice for these applications because of the reliability and performance it provides as a result of pairing it with the highly-reliable HEIDENHAIN motion control feedback encoders," said Doug Greig. "We believe that this coupling allows us to be the best at serving our machining markets in the long run."

Overall, the HEIDENHAIN TNC 640 control is particularly well suited for milling-turning, HSC and 5-axis machining on machines with up to 18 axes. It is a workshop-oriented, high-powered and user-friendly control featuring numerous functions. Some of those for TARUS customers include:

- 3D Tool Compensation through surface normal vectors
- Tool Center Point Management (TCPM) that uses a handwheel to change the angle of the swivel head during program run without effecting the position of the tool point
- Tool Radius Compensation: normal to tool direction
- Tilting working plane transformation coordination
- Speed: 0.5ms block processing speed
- Kinematics Opt for automatic measurement and compensation of positions in rotating axes

TARUS TBM5 Gantry equipped with TNC 640, HEIDENHAIN glass scales and ETEL torque motor/direct drive ballnuts.

ETEL torque motor-equipped direct drive ball-nut assembly at TARUS.

"The combination of features on the TARUS machines promise to provide users with increased performance, faster speeds, more flexibility, reduced set ups and more uptime," said Doug Greig emphasizing that all those benefit the bottom-line of manufacturers.

Innovations from day one

The innovative nature of TARUS began at its inception with Doug Greig Sr. in 1969 who invented and went door-to-door successfully selling an add-on electronic hydraulic servo control for EDM machines. From there, he built his own EDM machines, gun-drilling machines and copy-milling machines.

In the mid-1970s, development then began on the TARUS CNC which was used for all new TARUS milling, gun-drilling and measuring machines until 2008 when TARUS started building machines with customer-specified CNCs. In 2017, TARUS decided to make a shift towards the HEIDENHAIN TNC 640, with the first machines delivered in 2018.

Also, TARUS has also been a long-time customer of ETEL, a supplier of linear and multipole torque motors owned by HEIDENHAIN. One of the signature innovations at TARUS is its development and use of ETEL torque motors in a direct drive ball nut assembly found in its PMT Bridge and TBM Gantry CNC machines.

These unique torque motor assemblies are used to drive each machine axis (X, Y and Z), and result in improved efficiency, less wind-up and increased overall axis stiffness/rigidity. And because this direct drive assembly has no belts or extra pieces, it results in a more reliable machine since there are less parts to fail.

"Many of our machine users don't even know much about these built-in innovations! They just know the machines are fast, dependable and accurate," said Doug Greig.

Kleinow added: "Overall, we believe TARUS now does things better than any other large 5-axis machine manufacturers. Besides marrying the newest high-level

TARUS' Brad Kleinow

CNC technology with strong dependable machines, TARUS also now provides a unique Quality Control service team that stays with each machine at development through installation and service (no distributors used). This is unusual."

Outlook and opportunity

"We believe the changed philosophies and revamping done here at TARUS over the last few years is exactly what the manufacturing industry needs to excel in today's marketplace," said co-owner Dave Greig. "And we are proud to manufacture these large machine tools right here in America.

"We are also proud of our long history and the successful use of HEIDENHAIN encoders that were helpful during our transition to current improved 5-axis control technology," said Dave Greig. Kleinow added: "In fact, in the near future we expect to be involved with retrofitting many of our current machines in the field with these latest generations of HEIDENHAIN controls, drives, motors and feedback."

To support the overall increase of HEIDENHAIN controls in the field, staff at the HEIDENHAIN's North American offices are at the ready. This includes providing on-site application training at the end user by arrangement or by attending any of a number of TNC training classes held via the TNC-CNC Academy at the HEIDENHAIN offices in Schaumburg, IL.

The Greigs also mentioned that besides the new pairing with the class-leading HEIDENHAIN TNC 640 for improved surface quality and speed, their TARUS machines also now feature new state-of-the-art cables, connectors and cable chains to improve reliability and simplify servicing. This, along with the culture shifts at the TARUS and new quality and ISO 9001 certification processes now in place, are meeting the changing needs of today's manufacturers.

"We are seeing much traction at TARUS starting now," said Dave Greig. "We also have new and exciting 5-axis products currently in development that we expect to launch within the next year or so. These products will be more game changers!"

" *The fast speed, strong reliability and superior surface quality that HEIDENHAIN brings to the TARUS machines has proven to be a game changer.* "

Brad Kleinow

Innovative TARUS machines

Besides large CNC milling machines, TARUS builds combination deep-hole drilling (gun-drilling) and milling machines for mold makers, as well as specialized multi-spindle deep-hole drilling machines. These deep-hole drilling machines are used in the nuclear industry for drilling critical steam generator tube sheets.

TARUS also builds machines for another niche resulting from its convenient location in Detroit, MI. In the 1980s, many local customers were using TARUS CMM and TARUS milling machines in their tooling and pattern/model operations. The Big 3 U.S. automakers and the local engineering companies approached TARUS to modify their existing TARUS machines to CNC mill and scan clay models for the design studios. This became very popular and now TARUS is one of the world leaders in CNC milling and scanning machinery for automobile design.

TARUS' MM5 high-speed 5-axis CNC machine is for milling clay models of automobiles in design studios. The first TARUS machines equipped with TNC 640 (pictured here) were MM5 machines installed at Geely Design Studio in Gothenburg, Sweden. The large direct rotary tables are equipped with ETEL torque motors. A similarly equipped MM5 was recently installed at Navistar in Lisle, IL.

Maximizing
spindle run times

In Bartholomä, Germany, on the eastern edge of the Swabian Alps, Schubert Fertigungstechnik's high level of automation is inseparably linked to StateMonitor.

High cutting performance: 95% of machining at Schubert Fertigungstechnik is done in aluminum, primarily starting with blanks.

The efficient automation of single-part and small batch production, with batch sizes rarely exceeding 20 pieces, is the driver for success and innovation at Schubert Fertigungstechnik. The company's machines must achieve the highest possible spindle run times despite constantly changing production jobs. For Managing Directors Jens and Marc Grieser, and Technical Director Bernd Fuchs, this also includes a detailed analysis of jobs and processes. StateMonitor delivers the data.

Since the first automated machine moved into the production halls of Schubert Fertigungstechnik in 2008, the company has consistently followed this course with success. Whether on a milling, turning, or grinding machine, automation is implemented wherever possible and advisable. In order to maintain flexibility, Schubert relies on single machines or machining islands of two to three machines fed by pallet systems and robots.

To establish an overview over all of the machines, StateMonitor has been in use at the company since last year. Eighteen machines have now been connected, with the goal of networking the entire production fleet: "Each new acquisition is connected, so that in the medium term we'll be able to keep an eye on all of our roughly 30 machines via StateMonitor," says Marc Grieser, explaining his digitization strategy.

Open standard and cross-OEM solution

The decision for StateMonitor was made primarily because of its openness. "We predominantly have HEIDENHAIN controls on our machines, so using the already available HEIDENHAIN DNC interface was an obvious solution. We also wanted a setup that would network machines across manufacturers. Since StateMonitor is open for various interfaces and even surpasses the evaluation options we wanted, the decision was, in the end, an easy one," says Grieser about the main benefits.

StateMonitor is now indispensable for Schubert Fertigungstechnik. "When I come into work in the morning, I switch on the computer and the first thing I do is check the status of all the machines," says Bernd Fuchs about his morning ritual. "That way, I know what happened on

Green is the preferred color in the status overviews of the Schubert Fertigungstechnik machine fleet.

the late shift and the unattended night shift before I even set foot in the shop." This helps him decide where to go first in the shop based on possible events during the night shift.

Clearly structured, dependable data

For Schubert Fertigungstechnik, the close link between automation and StateMonitor arises from the need to optimally monitor the company's automated processes for achieving maximum spindle run times. Bernd Fuchs sees an essential task for StateMonitor: "The software shows us very quickly when a machine is not running perfectly." Thanks to the detailed information provided by StateMonitor about a wide variety of events, troubleshooting is now much simpler and more reliable. "When problems occurred in the past, we had

"StateMonitor makes subjective impressions quantifiable."

Jens Grieser

Managing Director Jens Grieser appreciates the information provided by StateMonitor for the optimization of production processes.

> "Instead of bothersome root cause analysis I get meaningful, dependable messages."
>
> Bernd Fuchs

Bernd Fuchs's first route in the morning always takes him to the office and to StateMonitor.

to do a lot of research to find out what happened and when. Back then, we examined the components in order to infer causes based on changes between the first part to the last," Fuchs remembers. "Nowadays, I get dependable StateMonitor messages." The team at Schubert uses them as the basis for finding the fastest possible solutions. Measures can range from a simple mention during a team meeting, or a note on the team board, to even an alteration to an entire process.

Live view instead of history

The StateMonitor users at Schubert Fertigungstechnik are particularly pleased that the software operates at the machine level, thereby providing a real-time view of current processes. "Not only do I get recordings of long-completed processes for later evaluation but also a live view of my machines. This allows me to respond quickly in critical cases," says a pleased Marc Grieser. "StateMonitor features a depth of information and evaluation for this purpose that actually exceeds our day-to-day operational needs."

For businessman Marc Grieser, controlling and the reliable post-calculation of jobs on the basis of StateMonitor data is the crucial point: "I don't have to painstakingly collect the job data and request it from different employees. In the office, I immediately see the run times on my screen for each individual set-up and for each part type, and I know whether the planned time for a job has been exceeded." He then uses the data obtained from the post-calculations to provide feedback to the production department for process optimization or for adjusting the basis for future calculations. Grieser generally performs a detailed analysis on first-time and large jobs and looks at familiar standard jobs as part of ERP evaluations.

Specifically used for process optimization

The software has already saved the company hard cash: "Since we have many recurring jobs that run on different machines, we can compare the data of the individual jobs really well. For example, we discovered that a job ran about 15 percent longer on one machine than on the previous one," says Jens Grieser about the benefits of StateMonitor. "On a few occasions, we had suspected that jobs were running for different lengths of time on different machines. These subjective impressions are now measurable thanks to StateMonitor." Bernd Fuchs adds: "But we don't use this knowledge merely to plan these jobs on the faster machine; we also use the comparison capabilities of StateMonitor to track down potential process optimization."

To do this, the shop employees deliberately test other milling strategies, switch to machines with other postprocessors, or simply switch to a newer machine to evaluate and analyze the effects with the help of StateMonitor. Sometimes, the results show that an old machine is no longer efficient or performing properly: "The evaluations also help us to infer the amount of wear based on the error patterns of a machine and to decide on repairs, part replacements, or even a new machine tool," continues Jens Grieser.

+ Find out more about StateMonitor:
www.heidenhain.com/statemonitor

+ StateMonitor in action:
www.schubert-fertigungstechnik.de

"With StateMonitor, information is just a click away."

Marc Grieser

Openness removes fear

How are the production employees responding to the new networked landscape? "We actively and openly communicated the topic within the company from the beginning. The employees and the works council were involved as early as the test phase, and we now also have a works agreement on the use of StateMonitor," says Grieser about the company's communicative approach. In the next stage, StateMonitor data will also be available on the shop floor. Centrally located monitors in the individual production areas will then let everyone see the data collected and provided by StateMonitor. "Every employee can then use the data to make his own work easier."

Managing Director Marc Grieser uses StateMonitor for the post-calculation of jobs alongside his ERP systems.

Cooling plates of up to 3.20 m in length, with coolant channels for the electrical cabinets of Schubert Group packaging machines are a typical example of the company's many recurring jobs.

A chance to qualify

Among other production equipment, the shop features two DMG milling machines with HEIDENHAIN iTNC 530 controls for training purposes.

The HIT interactive learning system and Sehnde Penitentiary pursue the same objective: the qualified training of NC users for improved job prospects.

Instead of locking doors, Marco Gieseke wants to unlock new opportunities for inmates who complete the training program at the Sehnde Penitentiary metalworking shop, in Sehnde, Germany. To this end, he is also active beyond the walls of the penitentiary, such as on the chamber of commerce examination board and as a member of the editorial content team of the elis learning platform (eLearning in prisons), through which the new HIT 3.0 is available as an interactive learning system for NC programming.

The metalworking shop at Sehnde Penitentiary mainly produces parts for the "Office Art" office furniture range of the Lower Saxony judiciary system. This primarily includes base frames for height-adjustable desks. Grills and accessories are also produced and sold to the public online. Two metalworking technology trainees specializing in machining technology turn and mill fixtures and jigs. "The modern penal system is organized to be self-sustaining. Detainees are also legally required to work, by which they earn money and contribute to financing the penal system," says Marco Gieseke, explaining the economic justification for his shop.

More important however is the resocialization aspect: "In everyday life at the penitentiary, the work—especially the training program—is an important instrument in providing inmates with structure." After all, the lack of daily structure in their previous lives is a frequent reason for delinquency. Gieseke is convinced: "With our training program, they not only learn a vocation but also how to cope better with everyday life. This doubly improves their future prospects upon release."

Lessons from the HIT toolbox

Marco Gieseke also develops teaching units himself in order to meet the requirements of the training and examination rules. He likes to use sample parts from HIT in order, for example, to integrate probing cycles into the training program. It's also why he's pleased that HIT 3.0 has been available at Sehnde Penitentiary since the beginning of 2020. On the same computer on which the programming stations are installed, a secure connection enables access to HIT 3.0 and other approved data. Gieseke describes the complex project: "For HIT 3.0 to be used on the elis platform, the Moodle learning platform had to be mirrored in a slightly modified form to meet the requirements of the penitentiary," he says. "Luckily, HEIDENHAIN, and particularly the training team, supported us well." As a result, HIT 3.0 can now be used in all prisons within participating German federal states and in the Republic of Austria.

The training content at Sehnde Penitentiary includes Klartext conversational programming, the operating modes of the control, simulation tools, and free contour programming. For teaching digitalized processes in a networked shop, CAD data can be processed by a CAM module and then transferred to the controls. CAD-CAM software is available for this purpose.

A productive, useful training project

The current training project consists of a welding template for a PC holder on the height-adjustable desks. "A part like this that will really be used in our downstream production always makes our trainees happy," says Marco Gieseke, describing the eagerness with which the two trainees work. "Firstly, it's productive work, so they see the benefits directly here in the shop, and secondly, they also get feedback from their colleagues as to whether the part they machined really serves its purpose and how it might be improved the next time around."

Honors: a newspaper article on the pinboard documents training successes at Sehnde Penitentiary.

Marco Gieseke designed the welding template himself and created the necessary drawings. He pays special attention to any details that are important for the training program and, if necessary, also incorporates one or two other training-relevant tasks that, strictly speaking, would not be necessary for the part itself. "For me it's important to impart knowledge that can later be applied outside," he says regarding the additional effort.

Based on this design and the drawing, the trainees then programmed the necessary machining cycles: the second-year trainee did the base plate and his first-year colleague programmed the clamping blocks for the shear clamps. There are three programming stations for this purpose at Sehnde: two for milling and one for turning. Because the shop possesses a small, independent network, the data can be transferred from the programming station to the control with TNCremo. Simulation of the programs on the two machines with the iTNC 530 controls is also very important. "We can use this to compare the results directly with the drawing before we actually start machining," explain the two trainees about the benefits of the preview.


Inmates have access to HIT 3.0 through the elis platform. On the same computer, they can also create their NC programs with the programming station.

Manufacturing the welding template

The PC holder consists of two parts: a curved bracket and a mounting unit welded from three parts. Up to now, the mounting unit was welded in two steps. Two templates were required for this, and the mounting had to be rechucked once. With the newly designed template and the corresponding shear clamps, all of the seams can now be welded in one setup.
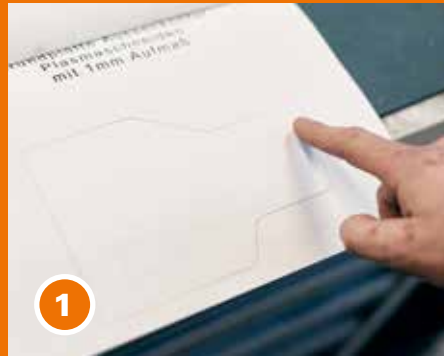
❶ The base plate is plasma cut out of the raw material with a 1 mm oversize.

❷ Eight clamping holes are drilled to match the grooves of the milling machine table.

❸ Four fits are created for the second clamping of the base plate.

"Education creates the best prospects for inmates and their families after detainment."

Marco Gieseke

Profile

Marco Gieseke is a master precision mechanic in the German trade sector and completed his training as a CNC specialist during his master tradesman studies. He has been working as a foreman in the metalworking shop of Sehnde Penitentiary since 2008. His love of teaching is primarily what drew him to this job. As a master tradesman, he had already gained experience setting up a training program in his previous job.

To keep himself up to date in terms of machine operation, he regularly attends training courses at DMG and HEIDENHAIN. "It's

At the Sehnde Penitentiary metalworking shop, master precision mechanic Marco Gieseke is currently training two inmates to become metalworking specialists.

④ The outer contour is milled, and the oversize and carburized margin areas are removed. The windows in the base plate are intentionally not plasma cut. The unavoidable heat input could lead to unwanted warpage.

⑤ Rechucking for the second clamping

⑥ Drilling of through holes including countersink

⑦ M5 and M8 tapping

⑧ Production of H7 reamed holes for accurate positioning with repeat jobs

Test assembly of the welding template with shear clamps and inserted mounting unit.

not only the knowledge gain that's important for me. I particularly like coming into contact with the other participants and looking behind the scenes at production setups in the real economy," he says, referring to the goals of his continuing education. For him, this interaction is important in helping him design a practice-oriented and realistic training program at the penitentiary. The success is apparent: "Our trainees are usually very committed. And because they can hardly take part in any other activities, they learn intensively even on weekends." It's the reason why they complete their education with grades averaging above a C. In the prison officers' break room, there is even a newspaper article reporting on the best Germany-wide trainees of graduation year 2010. The best metalworker came from Sehnde Penitentiary.

+ All information about HIT:
www.klartext-portal.com/hit

+ The HEIDENHAIN programming station:
www.klartext.com/pc-programming-station

+ Sehnde Penitentiary products:
jva-shop.de

+ Sehnde Penitentiary:
justizvollzugsanstalt-sehnde.niedersachsen.de

+ E-Learning in the penal system (elis):
www.ibi.tu-berlin.de/projekte/
259-e-learning-im-strafvollzug

Semi-automated machines

The POSITIP 8000 makes it possible: intelligent and reliable solutions for simple automated tasks on coordinate drilling and milling machines.

Machines for training, troubleshooting, toolmaking, and prototype machining: manually operated machines are still an integral part of modern shops. If they have a motorized table, the POSITIP 8000 ACTIVE digital readout even allows NC-controlled operation for simple automated drilling and milling tasks.

Manually operated machine with a motorized table and the POSITIP 8000 ACTIVE: the FEHLMANN PICOMAX 21-M can thereby replace basic CNC machines.

A typical example of this machine class is the FEHLMANN PICOMAX 21-M, where the M at the end of the name denotes the motorized table. In combination with the POSITIP 8000 ACTIVE and the Fehlmann-specific functions in the OEM bar of the digital readout, it can be used as a machine tool with positioning control. Interpolating movements are not possible, because the machine's open design, among other factors, does not comply with the machinery directive. Nevertheless, rectangular pockets, circular hole patterns, and even linear hole patterns can be machined semi-automatically.

Intuitive and user-friendly programming

Programming the desired machining operation is easy and intuitive. Along with simple positioning or drilling sets, sets for machine functions or machining patterns are also available. Required machining parameters such as drilling depth, milling depth, infeed, and target position are conveniently entered by the user into the touchscreen of the POSITIP 8000 ACTIVE. Immediately

thereafter, the entered data are graphically displayed on the 12-inch screen. This realistic preview of the created program provides great assurance for the subsequent machining operations. Users immediately receive informative feedback about their entries and can make corrections at any time before machining begins.

In fact, the POSITIP 8000 ACTIVE supports the user during programming across the board. In milling operations, for example, after tool selection from the tool table, the digital readout automatically applies the saved data and takes the tool's radius into account during subsequent programming and machining. Similarly, during programming of a rectangular pocket, the digital readout prompts the user for the required data so that no information is lacking: clearance height, depth, center point, etc. For the final path in the creation of a rectangular pocket, the user can even specify a finishing operation with an appropriate finishing allowance. Thus, the digital readout combines rapid roughing of the initial paths and perfect final dimensions.

Reliably execute machining sequences

In this way, the user can program not only individual machining steps such as a hole, but also machining sequences such as hole circles or rectangular pockets. The POSITIP 8000 ACTIVE automatically saves the last task temporarily so that the user—to return to the circular hole pattern example—can mill threads based on the drilling operation. Users can also manually save programs they will probably need again, either locally in the POSITIP or centrally in the network. Along with the machining steps, the tools and options used can be saved as well. In this function, the user can even manage frequently used presets for standard setups. Thus, different users can repeatedly execute the same pre-programmed machining operation, with the POSITIP 8000 ACTIVE delivering all of the necessary data.

In automatic mode, safety considerations require the user to press a button on the operating panel before executing each machining step. During machining, the machining preview supports the
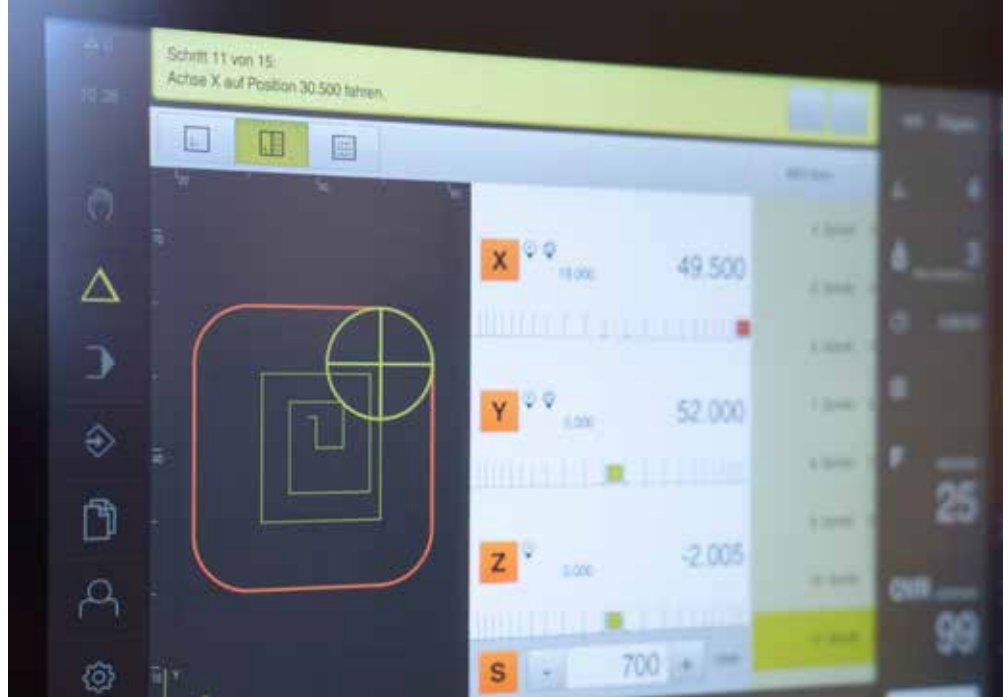
An exact view of the machining status: the graphical display of the HEIDENHAIN POSITIP 8000 ACTIVE accurately displays the completed and pending machining steps.

"The advantage of the touchscreen is that I can enter data and operate the machine at the same spot. The POSITIP's graphics are also so detailed that you can really assess the programming. "

Pascal Schärer, application engineer at Fehlmann AG

user just as it does during programming. The POSITIP 8000 ACTIVE shows the already completed steps as well as the next pending step. Specific machining steps can be either executed or skipped, and the user always receives information about the next machine movement.

Preprogramming frequently used functions

The user can call up standard machining parameters via the OEM bar. These include frequently used spindle speeds saved by the users themselves, as well as functions such as automatic reversal of the rotational direction upon reaching the selected thread depth, coolant settings, or the clamping of individual axes to prevent accidental manual operating errors with the handwheels (useful for milling operations in order to maintain path accuracy in a single traversing direction).

+ **The POSITIP 8000 ACTIVE:**
  www.heidenhain.de/positip

+ **A typical application:**
  www.fehlmann.com/de/produkte/fraes-maschinen-bohrmaschinen/picomaxr-21-m

IMTS Spark

Key motion control information is available at this online event, updated regularly through March 15, 2021.

See HEIDENHAIN now at the new IMTS Spark, an online digital platform allowing visitors to research, find and gather the best information about manufacturing that today's world has to offer. All the information and announcements planned for the cancelled International Manufacturing Technology Show 2020 (IMTS) in Chicago are available in an exhibitor company showroom.

On Monday, September 21, the IMTS Spark Ignites live interaction of the online event began and will last until March 15, 2021. Online visitors can view live product demonstrations, as well as engage in online chats or set up WebEx meetings with company experts. Information will be updated regularly. Ignite allows visitors to view what was planned for the IMTS show floor from the safety of an internet device. The newest in motion control products will be showcased at this international event. HEIDENHAIN North America represents and distributes eight brands of precision measurement components, so information and experts from ACU-RITE and ETEL, among others, will also be available at varying times.

Forward-Looking Technology for Machine Tool Users

HEIDENHAIN is excited to bring to market its new Gen 3 version of its high-end TNC 640 control for machine manufacturers and end users looking for forward-thinking manufacturing capabilities. This control is useful for machines ranging from 3-axis milling to 5-axis simultaneous machining with milling, turning and grinding operations with up to 24 axes.

With its new Gen 3 drives, the TNC 640 boasts powerful inverters and controller technology that are key components in the complete system of its control package. Now providing even higher spindle and axis dynamics during the manufacturing process, these drives also require less space in its electrical cabinet, and result in reduced storage, mounting costs and servicing time.

Also the new StateMonitor 1.3 makes it very easy to remotely monitor efficiency improvements and ROI of the new CNC functions.

New ACU-RITE TURNPWR Control Debuts

Offering lathe machinists a new easy-to-use turning control with state-of-the-art features as standard, HEIDENHAIN presents the highly-anticipated ACU-RITE brand TURNPWR — a workshop oriented turning control that enables the user to program conventional machining operations right at the machine in an easy-to-use conversational programming language. It is designed for turning machine tools with up to two axes.

TURNPWR was developed to satisfy the wants and needs of lathe machinists where manual and automated operation are both useful and needed. It enables the user to maximize throughput by significantly reducing set-up time, scrap and other non-productive operations, thereby increasing efficiency, productivity and profitability.

IMTS Spark is now in the early stages of offering first-rate experiences to all of us in manufacturing that are effective, yet safe, in a wide-ranging and time-sensitive format. HEIDENHAIN staff is excited to be a part of this new digital event and to continuing to connect with its visitors in this new way in this new age. This exchange of information in the manufacturing world is possibly now more important than ever. Come visit with us there!

ETEL TMB and TMK series Torque Motors

At IMTS Spark, the very latest information on ETEL'S TMB+ and TMK torque motors will be available. The TMB+ is an evolution of the renowned TMB torque motor that provides a combination of increased performance and new features while maintaining the interfaces of existing motors. The TMK products are a unique type of very high-speed torque motors for the most demanding applications.

All ETEL motors benefit from ETEL's patented very low cogging design. This construction enables an exceptional peak force density in the magnetic gap, as well as unparalleled thermal efficiency, which is a significant advantage for thermal-drift-sensitive precision machines.
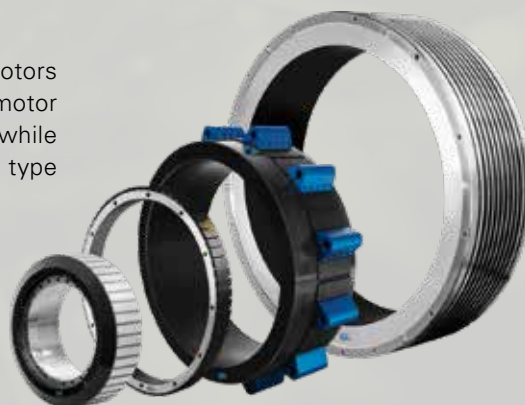
Links that may interest you:

+ For more information:
www.imts.heidenhain.com

+ Join the conversation:
www.imts.com/spark/

+ Visit HEIDENHAIN's virtual showroom:
www.directory.imts.com/8_0/
exhibitor/00000664/HEIDENHAIN-
CORPORATION

+ See the TURNPWR in action:
www.acu-rite.com/videos/
Introducing_TURNPWR.mp4

Fit and ready

The mobile stand for the new TNC 640 gives the user full mobility within the huge hall.

Tamsen Maritim houses the largest 5-axis milling machine in Europe. After a retrofit, a TNC 640 now controls one of the two portals.

Factory hall = Work envelope. This simple equation is probably the best way to describe the huge 5-axis portal milling machine at the Tamsen Maritim shipyard. Installed nearly 20 years ago, one of the two portals has now been given a comprehensive retrofit, including a HEIDENHAIN TNC 640.

"In terms of enclosed space, our machine is the largest 5-axis CNC milling machine in Europe," says Jörg Wicklein, head of Design at Tamsen Maritim in Rostock, Germany, as he proudly describes the impressive structure made up of two portals floating through the huge shipyard hall at a height of nearly 10 m.

Thanks to their slender carbon lattice structure, each of the gantries weighs only 3 t, with a traversing range of 65 m in the X axis and 12.5 in the Y axis. The portals split the maximum machining height of 7 m: Portal 1, where the retrofit took place, services the lower machining heights from 1 m to 4 m, while Portal 2 machines the upper heights. The two height ranges overlap for 1.5 m. "We can't attain the complete height of 7 m with a single portal because of the required spindle traversing ranges," says Jörg Möller, the user of this enormous machine, explaining the two-portal solution. For smaller parts, there is therefore also a 4 m high machining table, on which workpieces can be placed within the overlapping range of the two portals for simultaneous machining.

A major wish: getting closer to the point of machining

Möller also had many wishes for the planned retrofit. For despite its size, the machine is mainly operated by him alone. Additional colleagues provide assistance only on projects that require machining across multiple shifts. "Flexibility was very important to me. When using the control, I like to be as close as possible to the actual point of machining," says Möller, describing one of his most important requirements.

For this purpose, the TNC 640 is operated on a movable stand and is connected to the control cabinet located halfway

20

The entire hall is the work envelope: the largest 5-axis CNC milling machine in Europe.

This completely revamped portal machines the lower workpiece heights of approximately 1 m to 4 m.

down the hall by 100 m long cables. As a result, Möller can go anywhere in the hall with the control. If necessary, he even hangs it from a crane in order to move it to a platform or place it on the workpiece. "I now also have a wireless handwheel, which saves me a lot of legwork and often the need for a second man because it allows me to control numerous functions during setup," he says, pleased with new the capabilities. After all, "There is nothing better than an unobstructed view of the workpiece."

Greater stability and accuracy

The control wasn't the only component replaced during the retrofit; the retrofit team from the HEIDENHAIN agency TEDI also replaced the four motors that move the portal, as well as the way in which the motors act on the gear rack—a design developed by Tamsen Maritim itself.

"What can I actually see when my cutter is working on something 80 meters away? Nothing! I need to be closer to the point of machining."

Jörg Möller, machine user

Also part of the retrofit: the portal's motors.

A third bearing was also installed for each carriage, thus ensuring considerably smoother motion and permitting adjustment of the contact pressure between the drive belt and the gear rack, as well as allowing the individual motors to be mutually tensioned. "The belt is now in better contact with the gear rack, resulting in less play," says Wicklein, explaining the reason for the measures. "Even though the accuracy requirements in shipbuilding and large-part construction are not the highest, our post-retrofit goal was a machine accuracy of 0.3 mm to 0.4 mm over a machining length of 80 m."

However, mechanical modifications are not the only factors in achieving this. Following the retrofit, the entire machine will be measured by the Fraunhofer Institut for the creation of compensation tables. This is because the extremely long guide rails are not absolutely straight, and the huge portal also exhibits a certain amount of sag. All of these factors will be measured in order to be compensated for by the control, which is one of the strengths of the TNC 640 with its KinematicsOpt and KinematicsComp functionality. "It was precisely these compensation calculations that pushed the old control system to its limits," reports Möller. "It simply lacked the computing power, which took a noticeable toll on performance."

the technicians from TEDI are already configuring the axes on the new control and tuning the spindle.

What the portal milling machine produces

Tamsen Maritim predominantly uses its enormous machine to manufacture master models and master molds for large plastic components, including 35 m long wind turbine blades and ship hulls. More than one of the huge, predominantly rigid-foam workpieces are often machined in the hall simultaneously. From Rostock, the master models and prototypes are then shipped throughout the world, including to Asia and the U.S. The sheer size of these parts makes not only their production but also the shipping logistics a challenge for Tamsen Maritim. As a shipyard, the company can use its location on the water to its advantage.

The vast hall dwarfs the TEDI technician team as they set up the control.

Cautious approach

Despite these noticeable limitations, Tamsen Maritim initially decided to convert only one of the portals. "There were three key reasons for this," explains Wicklein: "Firstly, we didn't want to completely shut down the plant for the duration of the retrofit. Secondly, no one at our company had experience with such an extensive project, so we wanted to wait for the outcome of optimizing the first portal. And thirdly, a retrofit like this incurs enormous costs, which we wanted to avoid for two portals at the same time." Wicklein can hardly wait to complete the project: "The Fraunhofer Institute is already in the starting blocks to measure the system." Wicklein won't have to wait much longer:

Ready to receive: high above the ground, the receiver for the touch probe is attached to the spindle.

"The handwheel saves me a lot of legwork or a second man during setup."

Jörg Möller, machine user

Now, thanks to the handwheel, Jörg Möller can always get very close to the Tool Center Point.

+ **KinematicsOpt: perfectly calibrated machine kinematics at all times:** www.klartext-portal.com/kinematics-opt

+ **Your partners for a retrofit:** www.heidenhain.de/services-in-your-region

+ **Find out more about Tamsen Maritim:** www.tamsen-maritim.de

User support

Reliable and fast from the drawing board to the finished workpiece—that's the particular strength of the HEIDENHAIN CNC PILOT 640

Innovative programming options, intuitive operation, and intelligent user support make working with the CNC PILOT 640 in the shop easy, convenient, and efficient. Designed to relieve the user of standard tasks, the lathe control creates time and space for the optimization of production processes.

In the future, users of the CNC PILOT 640 will have even more capacity for the really tricky tasks. That's because the new Generation 07 of this lathe control offers new and enhanced functions and options for operator support. These innovations and enhancements focus specifically on the three essential factors of every production process: NC programming, actual machining, and the machine itself.
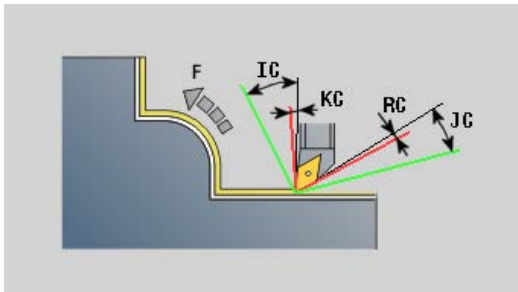
Simultaneous finishing: always turn at the optimum tool angle.
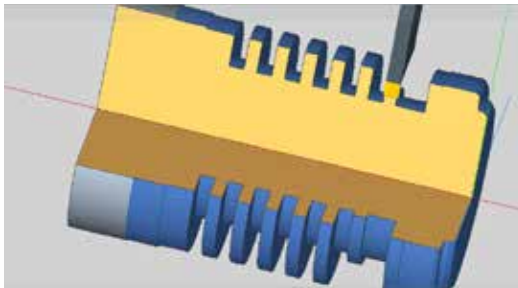
Grooving: 30 % to 50 % higher feed rates due to optimum machining parameters.

New cycles: simultaneous finishing and grooving

The new turning cycle for simultaneous finishing ensures that the angle of tool engagement on the B axis is simultaneously adapted to the workpiece contour during the turning process. Of course, this also includes the monitoring of complex tool movements in order to avoid collisions between the tool or tool holder and the workpiece. Because the entire machining operation takes place at an optimum angle of tool engagement, finishing complex contours with the new cycle leaves behind no visible transitions. Simultaneous finishing also reduces the amount of tool wear by using a larger area of the indexable insert. The savings are two twofold: as the operating time of the tools increases, fewer tools are used, and less time is needed for tool changes.

Among the recessing cycles, there is now a grooving variant that minimizes lateral deflection of the tool. This can yield feed rates that are thirty to fifty percent higher than with conventional recessing. With grooving, the cycle automatically plans the groove cuts, taking into account the grooving width and depth of the available tools. Grooving uses appropriately optimized feed rates for the different work steps: full recessing, ridge removal, and contour finishing.

Fit for the future: software support for Gen 3

The new NC software of the CNC PILOT 640 also includes the necessary support for the inverter and control technology of the new Gen 3 drive generation. The Gen 3 components offer innovative interface technology with improved performance specs and increased controller performance. To this end, they combine purely digital transmission technology; optical fiber technology; and intelligent, practical connection technology. In combination with the Gbit HSCI interface, Gen 3 represents a future-proof hardware platform for new functions of the HEIDENHAIN controls.

The new inverter and control technology is a key component for machines made to meet rigorous availability, surface quality, and machining time requirements. This is because motion control and control strategies have a direct impact on a machine tool's manufacturing results. The new HEIDENHAIN Gen 3 drive generation is a complete system offering outstanding control quality for highly dynamic motors and short acceleration phases for spindles and axes.

Gen**3**

Reliable machining: advanced 3-D simulation and component monitoring

The machining preview of the 3-D simulation can now display multiple contour groups at the same time. This very useful function permits the display of the contour groups on the main and counter spindles simultaneously during single- and multi-channel machining. It is now also possible to simulate machining in the sectional and workpiece transparency views. With these realistic preview options, the CNC PILOT 640 offers even greater certainty prior to actual machining that all of the processes will run as planned and that the desired outcome will actually be achieved.

To prevent unexpected malfunctions during machining, the new generation of the CNC PILOT 640 also features component monitoring. Depending on the implementation by the machine manufacturer, this monitoring functionality determines the load and wear on machine components based on internal control signals. Component monitoring can thereby detect machine malfunctions in advance. It also provides relevant notifications, allowing the user to react early and avoid unforeseen downtimes. Component monitoring can handle multiple monitoring tasks:

- Cyclic monitoring tasks are parameterized so as to be repeated at fixed intervals.
- Manual monitoring tasks are executed only by the G functions "Measure machine status," "Individual measured-value acquisition," and "One-time component test."
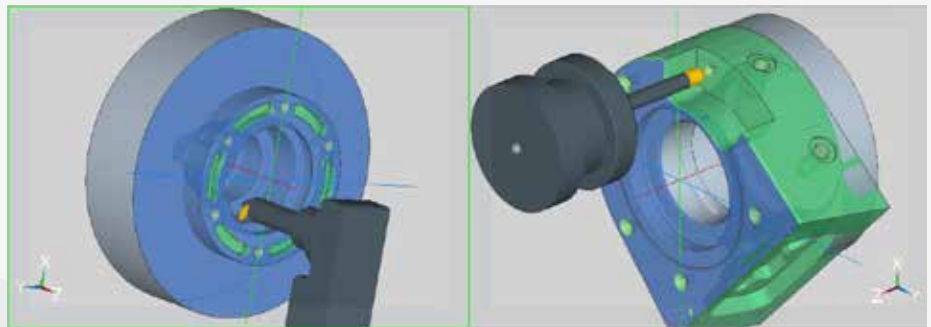
Advanced 3-D simulation for multiple contour groups: simultaneous display of the main and counter spindles.

An all-round success: the new generation of the CNC PILOT 640

With the innovations of Software Generation 07, HEIDENHAIN is continuing its consistent development of the CNC PILOT 640 as a practical and user-friendly lathe control for the shop:

- Intuitive multitouch operation
- Clear, context-sensitive display of information
- Automatic program generation with TURN PLUS, with up to 90% time savings compared with conventional DIN programming
- Full-surface machining with B axis and counter spindle
- 5-axis simultaneous machining
- Turning and milling
- Up to three channels for asynchronous multi-slide machining

+ Get to know the CNC PILOT 640:
www.klartext-portal.com/cnc-pilot640

+ NC solutions: solutions for frequently occurring turning tasks:
www.klartext-portal.com/nc-solution

Up to pace with the industry

HEIDENHAIN innovations offer greater process reliability
for machine users and machine manufacturers.

Reliable mastery of highly complex milling and turning processes gives you a clear competitive advantage. This includes not only the actual machining process, but also the complete process chain, from your customer's inquiry to shipping of the finished part.

HEIDENHAIN innovations provide you with comprehensive support through:

- *New TNC functions*
- *Intelligent data management (e.g., for production planning)*
- *New measurement, motor, and controller technology*
- *Opportunities for the certification of TNC users*

This puts perfectly dovetailed solutions at your disposal, allowing you to achieve efficient and reliable production to meet the highest accuracy and quality standards.

TNC 640 with a 24-inch widescreen and Extended Workspace Compact

With its sleek black design, the new TNC 640 is a real eye-catcher featuring two work areas with a large split screen. Other applications can be displayed alongside the control screen, allowing the user to fully organize his jobs digitally right on the control.

+ HEIDENHAIN experts present process reliability:
www.youtube.com/watch?v=W09qUHhWFtk

"The TNC 640 provides the best technological basis for process reliability, both in terms of operation and machining. The 3-D test graphics, for example, let the user determine ahead of time whether the machining operation will work. "

Martin Ditz, product manager for TNC controls

Grinding

One of the highlights during the live demonstrations at the HEIDENHAIN trade show booth was grinding. In addition to milling and turning, TNC controls are set to add jig grinding to their repertoire of machining processes. In a single setup, difficult parts can be given a high-accuracy surface finish, thus eliminating the need for specialized grinding machines.

OCM

Also showcased in live demonstrations was the new Optimized Contour Milling (OCM) option. This option makes it possible to apply highly efficient trochoidal milling to a wider field of applications. Directly on the TNC control, the user can now program any pocket and island at higher machining speeds and with reduced tool wear thanks to OCM.

Component monitoring

Through pinpoint monitoring, this new TNC control option protects machines from failure due to overloading and wear. The continuous monitoring of the spindle bearing load prevents the exceedance of defined limit values, thus preventing damage to the spindle. Meanwhile, cyclic monitoring of the feed axes provides insight into ball-screw wear and anticipated failure.

+ OCM: video of trade-show part production: www.youtube.com/watch?v=MzJ7TZn2l9s

Gen**3**

The new Gen 3 drives

Not only machine manufacturers but also many machine users were very interested in the new inner workings of future machine tools. Gen 3 is a perfectly harmonized, self-contained system featuring new components for drive system and controller technology. Machine users will benefit particularly from increased controller performance, greater enhanced motion control, and further optimized surface qualities.

"The response to the new Gen 3 drives was impressive. Innovative interface technology, improved performance data, and increased controller performance led visitors to anticipate clear benefits for machines made to meet high availability, machining quality, and performance demands."

Michael Weber, product manager for machine-tool drive system technology

Intelligent data management in automated production

At the "mav industrie 4.0 area," HEIDENHAIN partnered with OPS-Ingersoll and Haimer to provide a live demonstration showing just how reliable, efficient, and flexible a digitally networked production environment can be. Along with job data, special focus was placed on the exchange of tool data. The demonstration included the use of Batch Process Manager, StateMonitor, and Remote Desktop Manager. A world premiere was the RFID code integrated into the tool holder for carrying tool presetting data. The machine scans the tool magazine, reads the data from the tool database via the RFID code, and writes this information directly to the tool table of the control. This saves time and enables transparent tool management.

+ Video of the live demonstration:
www.youtube.com/watch?v=QxMAR6pe3LI

+ StateMonitor in detail: collect, evaluate and visualize machine data:
www.heidenhain.com/statemonitor

HEIDENHAIN
StateMonitor

StateMonitor: your machinery at your fingertips

The StateMonitor software brings greater transparency to operational processes, optimizes production sequences, and provides a real-time view of the machines' production status. StateMonitor demonstrated this functionality at the EMO trade show by networking machines located throughout the exhibition site with the HEIDENHAIN booth. Visitors could see for themselves how accessibly StateMonitor displays information and how easy it is to evaluate.

TNC Club Lounge

Once again in Hannover, trainers and application consultants answered questions about the operation and programming of controls in a relaxed club atmosphere. During and immediately after the trade show, the team signed up thirty new members: a clear sign that the TNC Club, its inviting image, and its competent user support offerings are spot on for the intended target group. What also drew considerable interest was the newest apprentice-level training program offered by the TNC Club: the TNC Specialist certification program.

Torque motor demonstration unit

How important is the proper selection of an angle encoder for the given characteristics of a rotary axis? This question was tangibly answered at the trade show through a demonstration unit consisting of an ETEL torque motor operated with different angle encoders. The measured values recorded for each device clearly revealed the strengths and weaknesses of the various encoder designs. On board the demo unit were the new RCN 2001 optical angle encoder and the new generation of ERA modular optical angle encoders from HEIDENHAIN, as well as the WMKA modular scale-tape solution from AMO.

Making it easy

Clamping pyramids, VirtualBox, and OCM:
Our training experts give you practical application tips.

You can easily increase the efficiency of your machining processes with these TNC functions. In doing so, you use very different aspects, including intelligent data handling, a reduction in tool changes, the extending of unattended periods, and a significant increase in cutting performance.
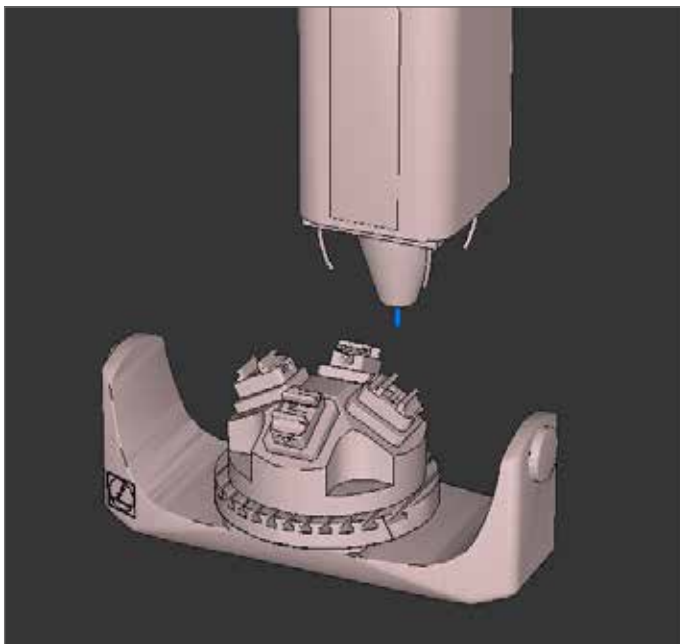
The clamping pyramid: more parts and more possibilities on the machine

Benefits

- Machining of several components in one run
- Longer unattended production times
- Use of 3-axis, 3+2-axis, and up to 5-axis simultaneous machining
- Simple programming of the machining operation using the 3-D basic rotation in the preset table
- Time savings through tool-oriented machining with fewer tool changes

Starting point: A typical clamping situation

Adaptation of the preset table

Enter the appropriate spatial angles, viewed from the front, right, left, and rear, in the preset table. The values SPA, SPB, SPC (3-D basic rotation) from the preset table are now included by the control for every programmed spatial angle.

Programming

3-axis machining

Before each machining operation, program PLANE SPATIAL SPA+0 SPB+0 SPC+0 to position the tool perpendicular to the active side of the clamping pyramid.

3+2-axis machining

During tilted machining using the following functions, the 3-D basic rotation is calculated with the spatial angle and the workpiece is tilted correctly.

- PLANE SPATIAL
- PLANE PROJECTED
- PLANE EULER
- PLANE VECTOR
- PLANE POINTS
- PLANE RELATIV

Tilted machining all the way up to 5-axis simultaneous machining

For these operations, you must also program the spatial angle. This is possible either via FUNCTION TCPM ... AXIS SPAT or via a vector program (LN X.. NX.. NY.. NZ..TX.. TY.. TZ.. in combination with TCPM or M128). Each rotary axis position is calculated with the 3-D basic rotation and the tool's angle of incidence is set. Please note that a program with L A, B, or C in combination with M128/TCPM ... AXIS POS calculates with axis angles and does not consider a 3-D basic rotation!

2 — The VirtualBox: making optimum use of the programming station on the PC

Ideally, you should not install the programming station for HEIDENHAIN controls directly in Windows, but instead in a virtual environment: the VirtualBox.

And this is how it's done:

Download the programming station software for your TNC control from the HEIDENHAIN Filebase under PC Software > Programming Station VirtualBox.

- Unpack the ZIP file on your PC.
- Be sure to read the "ReadMe.txt" files and the User's Manual, which are both included in the ZIP file.
- Open the EXE file to start the installation.

Choose the type of installation:

- When installing the first programming station, confirm the default settings.
- When installing additional programming stations, you do not need to reinstall the VirtualBox. Select the menu item "User-defined" and disable the "Install Oracle VM VirtualBox" check box. If you leave this menu item enabled, any data of existing installations will be overwritten or deleted!

3 — OCM: always mill with optimum cutting parameters

Benefits

- Programming any pockets and islands in a shop-oriented manner on the control
- Taking advantage of uniform engagement conditions
- Working with precisely maintained path overlaps; even at inside corners you can increase the processing speed significantly
- Noticeable reduction of tool wear
- Creating more chips in less time

Programming

1. Define contours
- Closed frame
- Partially open frame (screen)
- Open frame
- Island
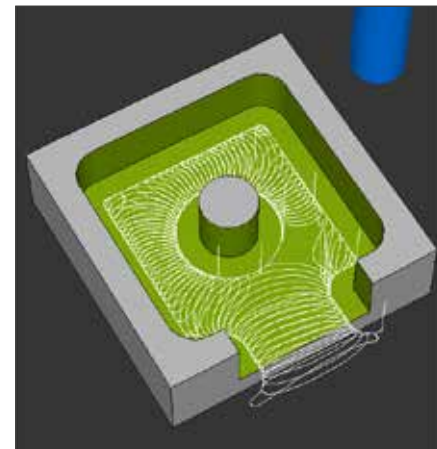
The installation now continues automatically. In the meantime, you can make the following settings:

- Assign a name for the programming station
- Common folders for access to TNC and PLC, so that programs can be viewed even when the programming station is switched off.

After completion of the installation process, please confirm the security prompt by checking the check box "Always trust software" and confirm "Install."

The TNC software is now automatically installed the first time the machine is started up.

Benefits

- Direct use of the NC software including HEROS, the operating system of HEIDENHAIN controls
- Starting several programming stations in parallel
- Accessing a control on a machine directly via a share
- Creating backup points for your programs

**+ Your direct path to the Filebase:
www.heidenhain.de/de_EN/software**

## More tips about VirtualBox and the programming station

Use the various options to adapt the programming station software via the VM VirtualBox Control Panel and the VM VirtualBox Manager to achieve optimum results on your PC:

- Screen resolution, use of multiple screens, 3-D acceleration
- Allocation of memory space for main memory, processors, and graphics memory
- Presetting of folders for file storage
- Setting a backup point to undo changes to NC programs

2. Define cycle for roughing
Roughing taking into account the optimum path overlap at a constant tool angle.
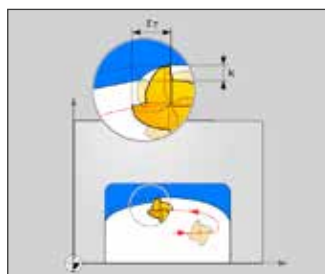
3. Define roughing of the remaining material
Set Q parameter 438 = –1 to transfer the tool radius from Cycle 272. In this way the TNC recognizes the residual material for the second roughing operation with a smaller cutter.
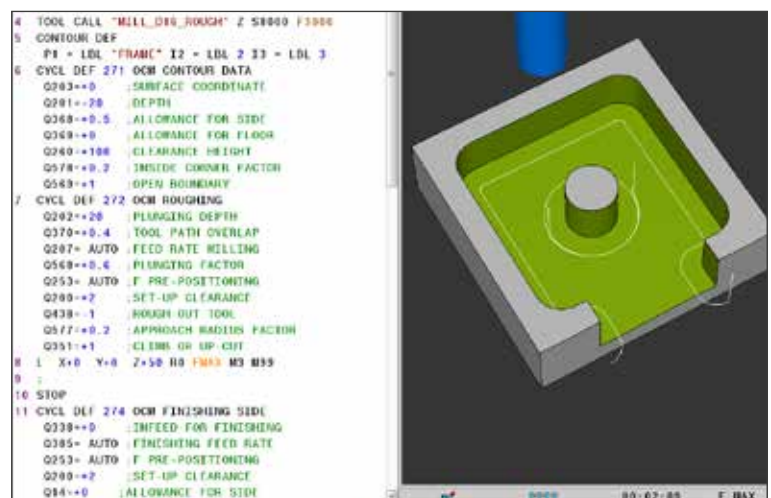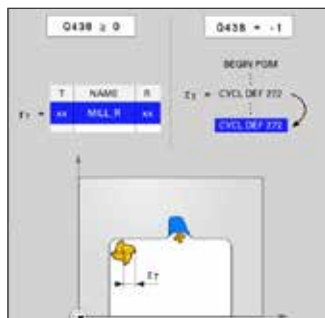
4. Define finishing operation
The control calculates a strategy with optimum approach and departure paths for the remaining contours.

Exploring the Sun

In order to observe the Sun with unprecedented accuracy, research and industry are working closely together on the DKIST solar telescope project.

The Sun. It seems nearly close enough to touch and ensures that life on Earth grows and flourishes. Nevertheless, we know surprisingly little about what goes on inside this star. Solar researchers want to change that dilemma with the new DKIST solar telescope in Hawaii. The Leibniz Institute for Solar Physics in Freiburg, Germany (formerly the Kiepenheuer Institute for Solar Physics), has developed a visible tunable filter for the DKIST. The filter adjustment is controlled by HEIDENHAIN linear encoders with an accuracy down to under one nanometer.

Details visible for the first time

Current solar research capabilities are limited. Up to now, we have been able to observe only accrued changes on the Sun, with solar researchers unable to identify details. The DKIST in Hawaii is about to change this. With a mirror diameter of 4 m, it will be the largest solar telescope in the world, providing a high-resolution view of solar surface structures as small as 20 km in size.

A simple example illustrates the enormous optical performance needed for this view of the Sun's surface: looking from Earth at solar surface structures 20 km in size is comparable to reading a newspaper from 40 km away. With the DKIST telescope, the solar researchers could read this edition of Klartext in the port kiosk at Dover from across the English Channel in Calais!

The VTF examines sunlight

The Visible Tunable Filter (VTF) developed at the Leibniz Institute for Solar Physics (KIS) in Freiburg will enable the examination of precisely defined, very narrow wavelength bands of light radiated from the Sun's surface. With this, solar researchers can glean information about plasma temperature, pressure ratios, magnetic field strengths, plasma movements, and more on the Sun's surface, as well as acquire data about changes in its magnetic field.

In principle, the design of the VTF is quite simple. Sunlight is guided through an air gap between two coated, semi-transparent glass plates. The repeatedly reflected light within the air gap creates interference, thereby filtering out certain wavelengths. The specific spectral range filtered out depends on the width of the air gap and thus on the distance between the glass plates.

Accurate selection of a wavelength requires highly accurate and perfectly parallel positioning of the two plates. But researches don't want to study only one wavelength all of the time. Much more interesting are the changes between the different wavelengths, which is why the plates are continuously in motion.
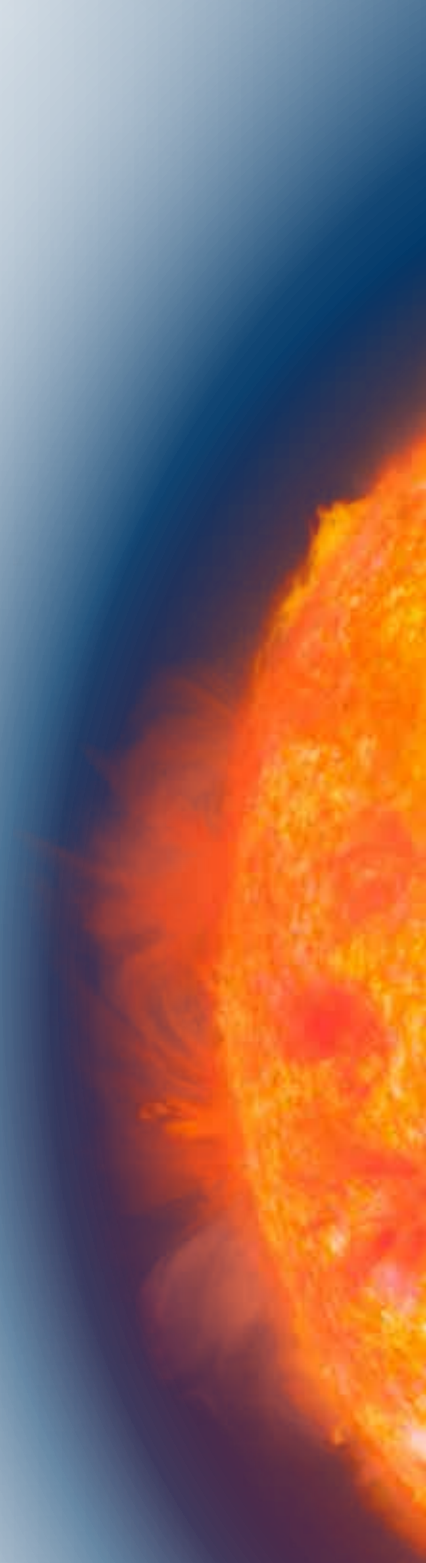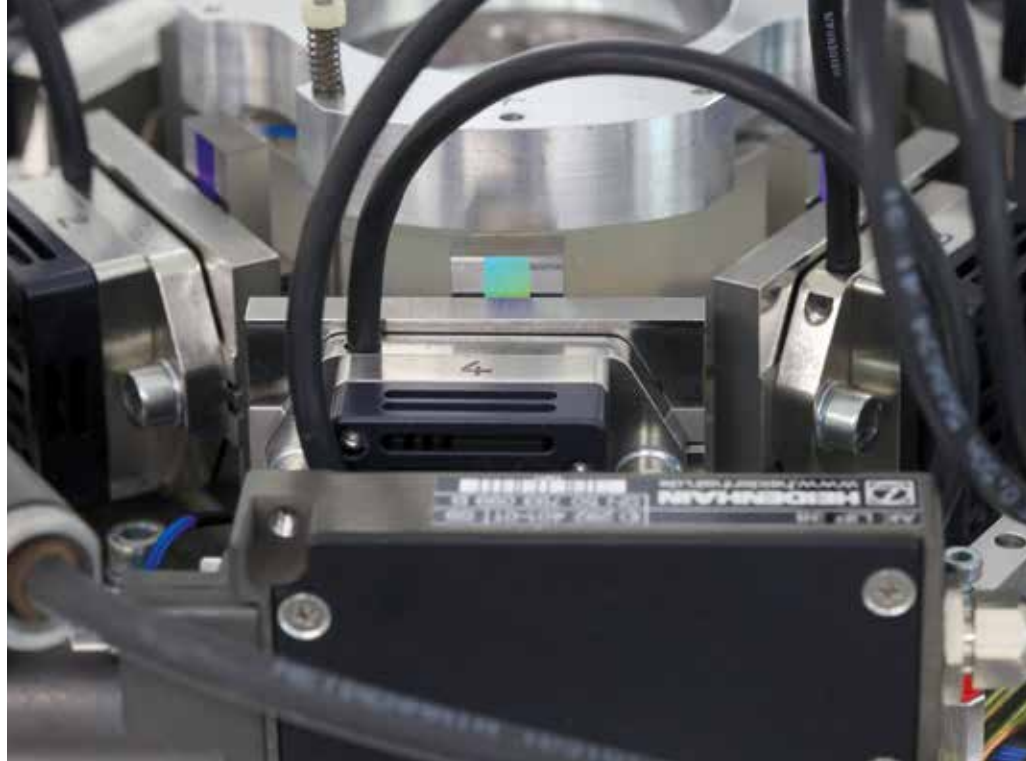
> "It is important, but unfortunately nowadays far too rare, that industrial firms actually support scientific research. It's great that HEIDENHAIN and its employees haven't taken up this challenge with such commitment and dedication."
>
> Dr. Michael Sigwarth, VTF Project Manager at the KIS

Encoders on all sides: six HEIDENHAIN linear encoders surround the glass plates of the filter.

Accuracy down to atomic dimensions

What seems so simple on paper demands maximum performance from the measuring system to be used. In order to repeatedly obtain the required positioning accuracy for each step, measuring steps of 20 pm are required. In addition, the measurement errors must not exceed a total of 100 pm over the course of an hour. Dimensions on this scale are equivalent to the diameters of atoms. By way of comparison: 120 pm is the commonly stated size of a hydrogen atom.

"The crux of the whole setup is the distance measurement," confirms Dipl. Ing. (FH) Clemens Halbgewachs from the KIS, explaining: "We initially determined the position of the upper plate with only three linear encoders. Unfortunately, we weren't satisfied at all with the accuracy. So we searched for and found the causes. A temperature deviation of just one hundredth of a single degree Celsius affects the position of the lower plate." The solution is now a total of six HEIDENHAIN LIP 382 linear encoders featuring a standard scanning head and customized scale, with three encoders on the lower plate and three on the upper one.
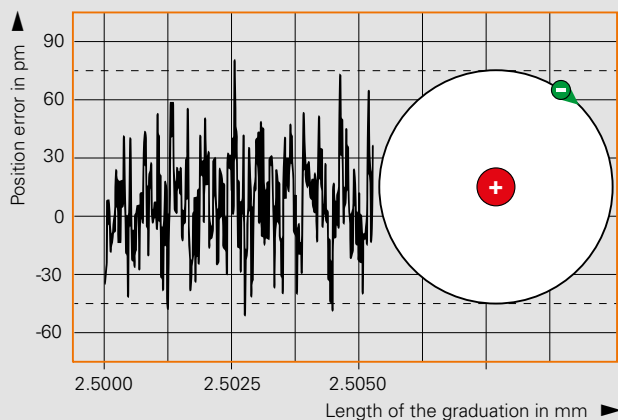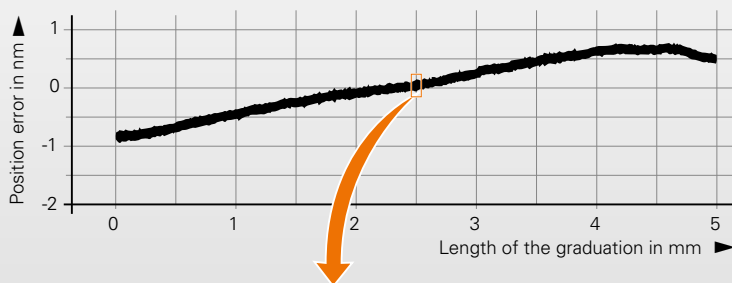
Accuracy of the graduation relative to the size of a hydrogen atom: the accuracy over a traversing distance of 5 µm is critical.
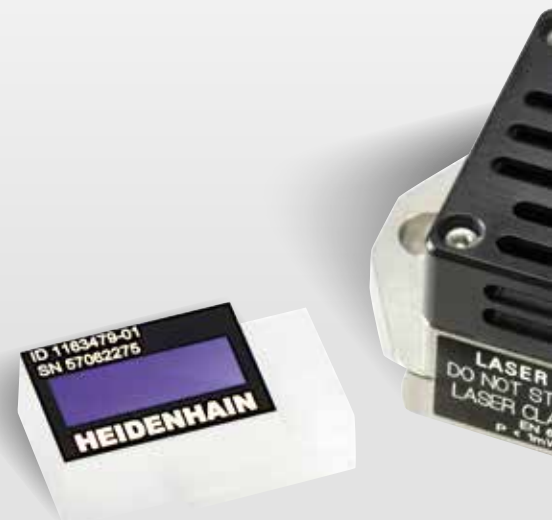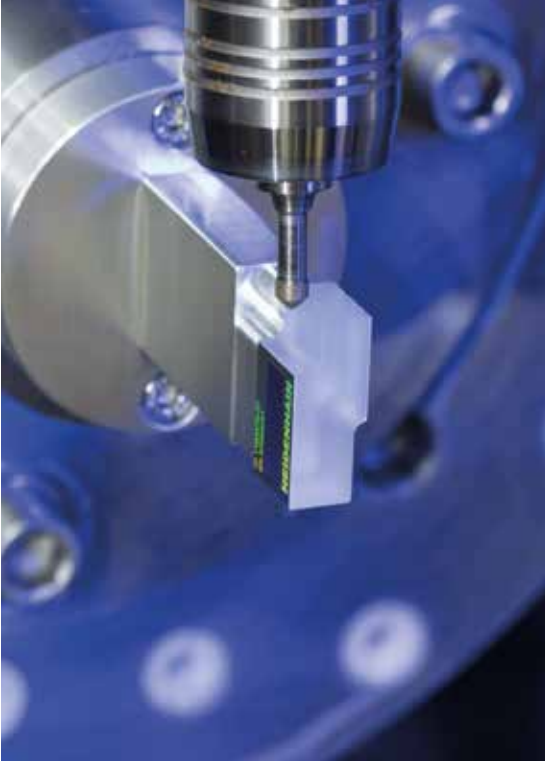
The DKIST solar telescope is being completed at an altitude of over 3000 m atop Haleakalā, the highest mountain on the Hawaiian island of Maui (photo: Dr. Michael Sigwarth, KIS).

The specialized LIP 382 scale and LIP 38 scanning head for the Visible Tunable Filter (VTF).

Getting there step by step

The development and manufacture of these special scales for the VTF required expertise from many fields stretching all the way into the R&D and Production departments at HEIDENHAIN. A new and enhanced dividing engine met the necessary conditions for the KIS requirements. Even so, the accuracy of the machine had to be pushed to extremes by all available means, thus posing a unique challenge to staff members, who nevertheless mastered it with creativity.

Mounting the scales in the VTF also required new approaches. Many of the adhesive bonding processes typically used by HEIDENHAIN for this type of bond were unsuitable. Nevertheless, an adhesive bonding process was successfully developed that could be performed under laboratory conditions at the KIS and meet its rigorous standards. In order for the bonding process to be properly performed in Freiburg, the KIS technicians received an adhesive bonding seminar tailored to their bonding process at HEIDENHAIN in Traunreut. Particularly important was the practical part of the course, in which participants could perform the bonding process on scrap parts under realistic conditions.

+ LIP exposed linear encoders:
www.heidenhain.de/exposed-linear-encoders

More information and news about the DKIST telescope:

+ www.leibniz-kis.de/de/projekte/
visible-tunable-filter

+ www.nso.edu/telescopes/dki-solar-telescope

Find out more at
www.klartext-portal.com/hit

HIT
HEIDENHAIN
Interactive Training

Intuitive learning system for NC programming