



HEIDENHAIN

64 + 9/2016

Klartext

The magazine for the world of HEIDENHAIN controls



TNC Forges Ahead

Controls from HEIDENHAIN unite simple operation with very high accuracy

Editorial

Dear Klartext Reader,

Reducing workloads and saving time in production are the central focus of this edition of Klartext.

Among other things we will show you how you can simply and securely network the workshop control with all areas of your enterprise that accompany production. Our TNC controls provide various functions for this, to which we have given the collective name of Connected Machining. These functions support uniformly digital order management in manufacturing.

Product quality and productivity should, of course, go hand in hand in your manufacturing. That is why we are presenting you with functions of the TNC controls that keep dynamics and accuracy in unison. Along this journey you will get to know a number of functions from a completely new perspective.

Furthermore, also in this special edition we will continue our reports on TNC controls in everyday working situations. Read fascinating user reports and interesting anecdotes about how even old machines can still provide exciting perspectives with the right retrofit.

Talking about TNC controls on an everyday basis: The new TNC Club provides its members with special support for the daily handling of HEIDENHAIN controls. Join today to learn to operate your machines better and solve complex cutting tasks with greater professionalism and efficiency. This edition of Klartext includes more information about membership and the services of the TNC Club.

Read and enjoy, with best wishes from the Klartext staff!



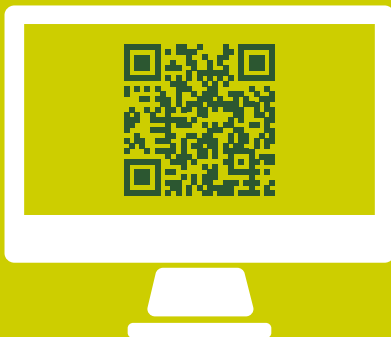
Tool and mold making in small series with the TNC 640 at Krenhof AG.



Replication of a unique locomotive using HEIDENHAIN controls.

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The website
for TNC operators



www.klartext-portal.com

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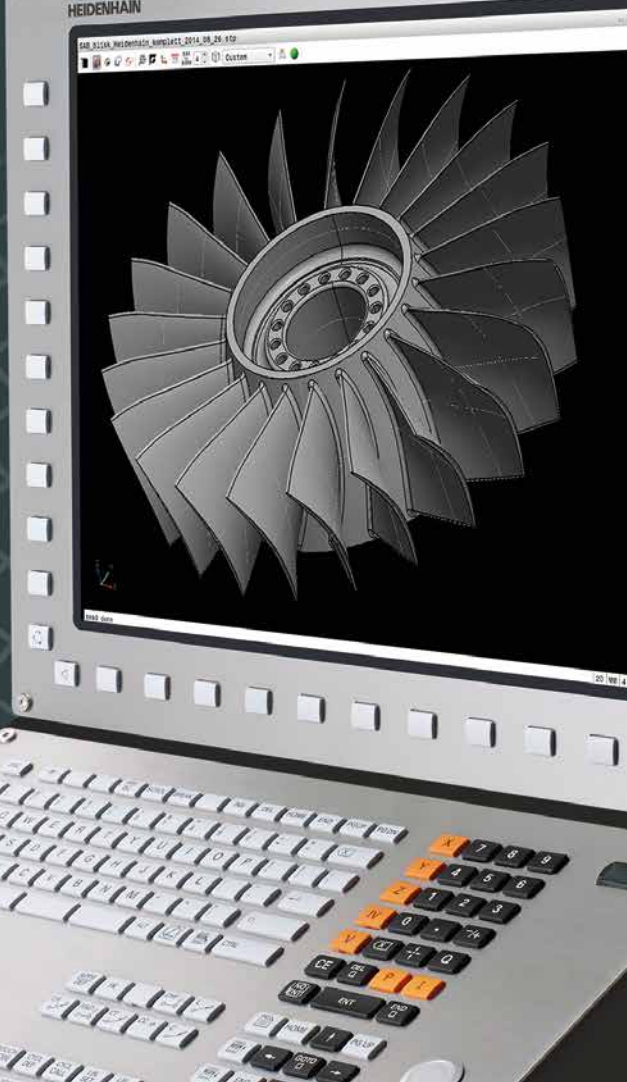
Increase your product quality and productivity with Cycle 32 TOLERANCE and ADP.



09



connected + machining



FUNCTIONS PACKAGE

Transparent networked processes save time

Connected Machining for uniformly digital order management

Experienced machinists have always known that the center of every company is its workshop. In terms of data technology, however, the workshop is often still just a lonely outpost at the margins of its company's network. HEIDENHAIN is changing that now with its Connected Machining package of functions. It supports connection of the control in a network with all areas of the enterprise that accompany production. The benefits include a reduced workload thanks to easy data access, time-saving workflows and transparent processes.

With Connected Machining, TNC controls from HEIDENHAIN support uniformly digital order management in production and the networking of the control with all the areas of the enterprise that accompany production. In this way you can turn the workshop from an outpost into a full-value component part of an efficient process chain.

With Remote Desktop Manager you have direct access from the control to all the data that you can use at the machine: technical drawings, CAD data, NC programs, tool data, work instructions, parts lists, warehouse information, and e-mails. That saves time, for example, when you can use the control

to call missing data from CAD/CAM applications. You no longer need to rely on others to find information—an enormous advantage particularly on night and weekend shifts when the design and management people are gone. But of course you can also send feedback to all those involved in the process, e.g. about cutting data or infeeds that you've adapted in the workshop.

The HEIDENHAIN DNC interface connects the machine tools with TNC controls to the resource planning and control console systems. The data flow to the machine tool and control level can be made fully automatic via this high-performance interface – a neces-



Sometimes, it's just little things that hold up productivity in manufacturing. Then the remedy is to have information that can be called directly by e-mail at the machine.

sary requirement for the vertical integration of machine tools into the IT systems of manufacturing. This increases transparency in manufacturing even with a batch size of one and supports timely order management.

The benefits of such connections are immense. Let's say that you've increased the cutting data and infeeds for an operation in the workshop. It makes the operation faster than originally planned. To avoid wasting this time advantage, you need to inform the logistics people of the new situation—a classic task for your merchandise management system. The system ensures that new workpiece blanks and replace-

Connected Machining increases transparency and supports timely order management

ment tools are provided to the machine more quickly than originally planned. It also sees to it that the finished parts are moved from the machine sooner. And it informs your shipping department that the product will be ready sooner. In this way you can avoid bottlenecks in your manufacturing chain and ship your product faster. This will make your customer happy while giving you additional room for planning other orders.



Tools for forged workpieces: For Krenhof the future of tool making lies in small batches.

A simple start to complete machining

Krenhof Werkzeugbau achieves high accuracies with the TNC 640

“We have to be capable of making very many new tools available,” said Franz Krammer, tool making manager at the Austrian company Krenhof AG. The strategy of producing more modular forging dies and tool carriers in greater quantities led to the purchase of two Alzmetall milling/turning machining centers equipped with HEIDENHAIN TNC 640 controls. The introduction of 5-axis machining and a new CAM system is a major advance for Krenhof AG. Taking the plunge certainly paid off. “We manufacture tools that simply fit,” confirmed Franz Krammer, “and we’ve also become more flexible and reliable.”

Challenge

“Customers want the 10,000th unit to look exactly like the first one,” said Krammer about the requirement for forged parts in the automotive sector. He emphasizes that this market can only be served with the most accurate forgings, because the requirements regarding price and quality are becoming increasingly strict. Krenhof AG, located in the Styrian town of Köflach, has been producing forged components for the last 300 years, currently in mid-sized and large-scale series of 2,000 to 500,000 units.

The motto at Krenhof is “a little better every day.” For this reason, Krenhof is meeting the high demands in tool making with a new strategy—modular carrier tools will be used in the future that accommodate replaceable die inserts. This enables optimum tools to always be used in the forging process.

For in-house tool making this change in strategy means starting up with small batches, which is rather untypical for toolmakers. The focus is placed on precision and accuracy. Workpieces are to be machined in a maximum of two setups. The logical step for Krenhof was complete machining: the components are first turned and then milled in the same setup.

Project

Krammer and his young team were keen to get started on the new topic of 5-axis machining. “We’re not afraid of complexity.” Following the search for the right machine, the Alzmetall GS 1200/5 FDT machining center with HEIDENHAIN TNC 640 milling/turning control won the race. “We believed that Alzmetall could deliver across the board. And that includes a control that knows what it’s doing.”



Krenhof AG produces maximum quality thanks also to a consistent wear protection strategy. The target: exact forged parts from the 1st to the 10,000th piece.



Krammer was enthusiastic about the ease with which his team familiarized themselves: Following a one-week training course the team installed a further CAM system and rapidly got used to both the machine and control. It wasn't long before the colleagues were producing the first components.

As luck would have it, new requests and jobs came in that could only be mastered with the new investment—such as producing hypoid gears and constructing a new die carrier system.

Accuracy

“Small inaccuracies in tool making lead to large inaccuracies on the finished forged part.” Franz Krammer explains the aspects leading to maximum accuracy: The basis is a stable machine achieving high axis rigidity with 4-fold linear guides among other factors, which in turn enables the HEIDENHAIN TNC 640 control to exploit the complete potential of its dynamic and simultaneously precise motion control.

The handling of the control scored points with the Krenhof team. Reading the NC program from the CAM system into the control via TNCremo, for example, was quick and easy. Simple oper-



“Here we saw milling and turning working in unison.” The two new Alzmetall GS 1200/5 FDT machining centers with the HEIDENHAIN TNC 640.

“The universal factor was important for us. The TNC 640 can do both well: milling and turning.”

Franz Krammer, tool making manager at Krenhof AG

ation of the TNC 640 also allowed the Krenhof team to run complex programs. The structuring into the subprograms proved popular.

The young team had no problems at all with programming directly on the machine in HEIDENHAIN's Klartext conversational language. They are particularly keen on the many cycles, such as the drilling cycles that are simply and quickly parameterized. "HEIDENHAIN has managed to design the operation in a very clear way so that the wide functional range doesn't irritate us," confirmed Franz Krammer.

Functions

The TNC 640 makes it particularly easy to handle turning and milling in a single program: Changing between milling and turning is possible at any time simply by calling up the appropriate short subprogram.

For components requiring multi-sided machining the technicians use the PLANE function to define an inclined surface and to position it above the tilting table. Programming and machining is then in the usual X/Y plane. Probing a reference point on a tilted plane is also simple and frequently used.

Summary

"Our original doubts have vanished," said Franz Krammer. The team is also enthusiastic. Daring to dive into the major topic of 5-axis machining with all its consequences is possible thanks to technology that can be relied on. It is of great help, of course, when the HEIDENHAIN control features all the functions needed as standard—and it's easy to learn.

Implementing the new strategy for tool making opens up new potential: A modular tool holder system is planned for

the new forging line that is currently under construction. Future automation solutions are also feasible to further shorten setup times.

Franz Krammer is satisfied. In addition to the plus in terms of flexibility, the change in tool-making strategy also brings with it long-term dimensional accuracy and above all reliability in the forging process.



Franz Krammer, tool making manager at Krenhof AG, introduced 5-axis machining to his team.



Apprentice training as corporate culture

Krenhof puts its money into training when it comes to the sophisticated tasks demanded of the machining center and HEIDENHAIN controls. Krenhof AG currently has 17 apprentices training for the professions of tool making, mechanical engineering and electro-engineering. In the rural region around Köflach the forging enterprise relies on its own training programs and does everything for them: Krenhof presents itself as an attractive employer in school partnerships and joint projects with other companies.

+ www.krenhof.at

Dynamics and accuracy

in unison

ADP (Advanced Dynamic Prediction) improves the surface quality of milled workpieces even with restricted data quality in the NC program.

Enhance product quality and boost productivity. Here you can find out which TNC functions can best help you to exploit the full potential of your machine.

Cycle 32 TOLERANCE

With Cycle 32 TOLERANCE you can control the accuracy, surface quality, and speed of your free-form machining. The settings can be quite different for this depending on whether you are roughing fully engaged, pre-finishing or fine finishing. You simply assign the optimum machine setup for each machining step.

When roughing in multiple steps with different tools, saving time is of primary importance. Final finishing sometimes requires keeping strictly to specified tolerances.

TNC controls offer this possibility with Cycle 32 TOLERANCE, which is a standard feature. Depending on your machining task you define the parameters below.

- The maximum permitted tolerance of the contouring deviation: With roughing for example, select the tolerance to be greater than the standard defined by the machine manufacturer.

- Machining mode: Switch from finishing to roughing to better exploit the available tolerance.
- Rotary axis tolerance: Define the maximum permitted tolerance of the rotary axes if one of the machining steps includes concurrent motion of the rotary axes.

This reduces the machining time for roughing and pre-finishing. For fine finishing you specifically define your desired contour accuracy and surface quality.

Nothing could be simpler: just place Cycle 32 before the beginning of a machining step.

Machine-specific setups

You can save even more time if your machine tool has manufacturer-specific setup cycles and functions in addition to Cycle 32. With roughing for example you can not only increase contour tolerance and switch the machining mode to roughing, but also increase the jerk parameters and jerk limiting. This

saves time in the case of highly dynamic machining with multiple changes in direction.

In addition, it cuts down tool wear by reducing feed problems. Particularly when machining difficult-to-cut materials the tools do not dull so quickly or fail prematurely.

Advanced Dynamic Prediction (ADP)

For even more stable motion control you can use the Advanced Dynamic Prediction (ADP) function. ADP expands previous pre-calculation—the Look Ahead function—of the permissible maximum feed rate profile. This gives you clean surfaces and perfect contours.

Limited data quality from the NC program may under certain circumstances lead to poorer surface quality on the milled workpiece. How this is counteracted by ADP can be seen for example with bidirectional finish-milling. The symmetric feed rate behavior on the forward and return contours is especially advantageous here.

Dynamic Precision

HEIDENHAIN brings together options for TNC controls under the name of Dynamic Precision that raise the apparently contradictory requirements for accuracy and high surface definition as well as short machining times to previously unknown levels. These include the following options that you can also combine in applications according to your specific needs:

- CTC for compensating position errors
- AVD for active vibration damping
- PAC for position-dependent adaptation of controller parameters
- LAC for load-dependent adaptation of controller parameters
- MAC for motion-dependent adaptation of controller parameters

All these functions counteract the dynamic errors of machine tools—meaning the negative effects of deformations and oscillations—with intelligent controller functions. This enables you to also increase the dynamic parameters for finishing. Dynamic Precision also improves the accuracy and surface quality. According to the emphasis of the requirements, the options enable variously weighted combinations of higher dynamic parameters with improved accuracy and surface quality.

Until now, the maximum permitted deviation at the Tool Center Point (TCP) usually defined the upper limit for dynamic parameters. It was only possible to entirely exploit the complete dynamic potential of the machine with roughing operations and greater permitted deviations at the TCP. In many cases, though, the machine components could take significantly higher loads. Dynamic Precision offers additional controller functions that enable this unused potential with high-performance machines to be more efficiently exploited. These pages detail two application examples.

✚ Further information is available here:
www.klartext-portal.de/programmierung/funktionen/dynamic-precision/



Case example: A combination of CTC plus AVD

Milling a lizard? What's the good of that? To show what's possible with a TNC 640 and Dynamic Precision, of course. The challenges in this case are the special form, desired surface definition, and requisite contour accuracy—particularly with high feed rates and no reworking.

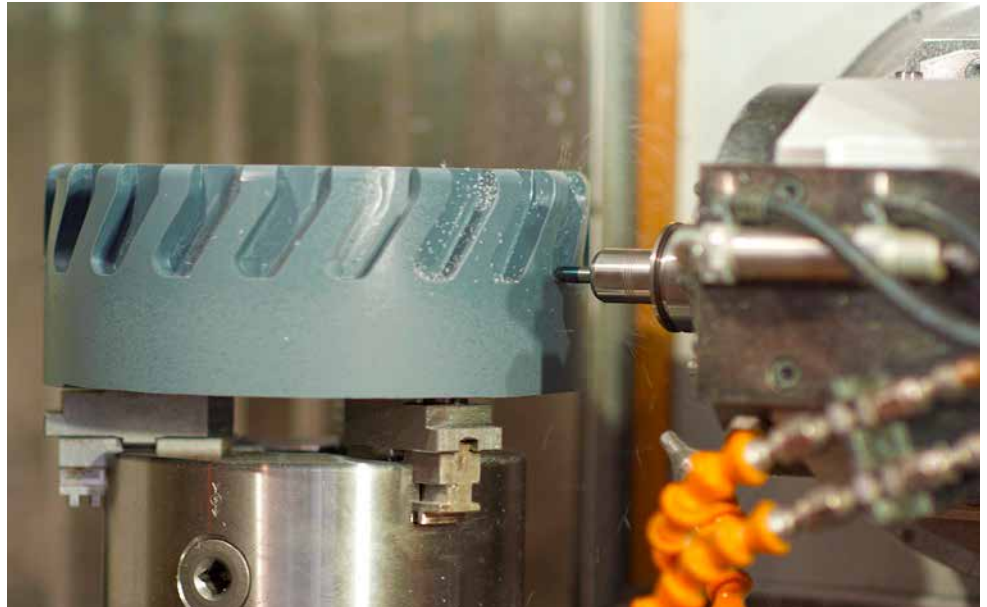
The finished lizard looks cute and harmless, milled from a single aluminum block with the use of CTC (Cross Talk Compensation) for compensating dynamic position errors and (Active Vibration Damping) for vibration absorption. The animal and the preconditions with which it was milled don't make it simple though—the curved shape with many



Case example: LAC with 4-axis simultaneous machining

LAC, the function for adapting controller parameters according to load, significantly accelerates the deburring of a plastic tread pattern. The load hardly changes at all during deburring. So where does the time gain come from?

In this machining example a particular side-effect of LAC is positively noticeable: Generally higher jerk values are possible for a rotary axis if LAC is used, because LAC improves the dynamic accuracy of the axis for each specific loading situation. This in turn leads to shorter machining times because the rotary axis reaches the desired position more quickly. Instead of slightly over 4 seconds without LAC, deburring the tread section with LAC takes just 3.48 seconds—representing a time saving of around 15 % with simultaneously improved accuracy of 30 %.



+ This video shows more information about LAC and the deburring process: www.klartext-portal.de/mediathek/mediathek/videos/



sharp edges needing to be precisely machined, the shiny surface without reworking, and the high targeted feed rates demand the complete spectrum of performance from the machine and control.

Finishing the lizard was carried out with a spherical cutter with 3 mm diameter, a spindle speed S of 42,000 rpm, and a feed rate F of 5460 mm/min. CTC and AVD enable the use of significantly higher jerk values compared to conventional machine configurations. For machining of the lizard this achieved a time saving of 10% with identical cutting parameters thanks to shorter braking and acceleration distances.



Conclusion

The more dynamic machining is, the more changes in direction the tool implements during machining, and the higher the demands on surface quality, the greater are the advantages provided by the CTC and AVD functions. They bring together the contradictory requirements of accuracy and rapidity to an astonishing degree, achieving more efficiency in practice when milling high quality free forms.



HERRENKNECHT TNC 640 REPORT

Gripper tunnel boring machine for the Gotthard Base Tunnel, Switzerland; diameter: 8,830 mm.

TNC shortens throughput times

How the Components Factory of Herrenknecht AG found an easy way into combined machining

The construction of the Gotthard Base Tunnel that opened June 1, 2016 is currently the talk of the town. With two main tubes and a length of 57 km it is the longest railway tunnel in the world. Four Herrenknecht Gripper tunnel boring machines were used for the mechanized tunneling of the two main tubes. This construction project is an enormous success for the Herrenknecht AG company, headquartered in Schwanau, Baden-Württemberg, Germany. The cutter heads drilled their way through over 85 km of rock.

To construct the machine components out of wear-resistant steels Herrenknecht invested in a new RT-T 30 bed-type milling machine from MTE with HEIDENHAIN TNC 640 milling/turning control. With this the company succeeded in simultaneously milling and turning in one setup components weighing up to 15,000 kg each. For the Herrenknecht Components Factory this means a shortening of throughput times for continuous production.

“The milling-turning combination is the current challenge for us and the users. It is completely different to the previously separate turning and milling processes,” explains Gunther Borbonus, Managing Director of MTE Deutschland

GmbH. The new bed-type milling machine with integrated rotary table can produce components with diameters up to 2100 mm and lengths of up to 1500 mm that are turned as well as milled: inclined pockets from all sides or machining with swivel head.

Herrenknecht now uses combined machining for plane surfaces with recesses, for example. Here a slowly rotating milling cutter with 5 to 8 inserts is used. Previously you turned this interrupted cut with reduced cutting power and used up at least 3 or 4 indexable inserts. “We achieve interesting cutting performances and also spare the tool,” confirms Stephan Göggel, Technical Manager of the Components Factory.



Milling or turning, it doesn't matter—with the cycles of the TNC 640, the machining operations are quickly and optimally programmed in the workshop.

Programmer Uwe Liedl at the front plate of a drill head: "With the milling-turning combination machining we can achieve high cutting performance levels with interrupted cuts."

TNC 640 makes the entry into milling-turning easy

Combined machining was completely new for all concerned: MTE as manufacturer of heavy-duty machines offered Herrenknecht specific support for gathering practical experience in the field of turning. Intensive training courses using Herrenknecht's own test workpieces helped in becoming familiar with the process. Lathe operator Vitali Hegert supported the milling team and—without any previous experience with HEIDENHAIN—immediately figured out the HEIDENHAIN turning and milling cycles.

On site at Herrenknecht a competent HEIDENHAIN trainer imparted the new control know-how. The machine operators were very enthusiastic about how quickly things went. Programmer Uwe Liedl: "It is amazing the machining that can be done with the control in one setup."

TNC 640 makes fascinating machining operations easier

The MTE machine and TNC 640 master these combination machining processes in such a way as to make operating easy for the user. It is important for Herrenknecht that the operators work independently and program all the standard machining operations themselves on the TNC control: grooves, recesses, hole patterns and inclined holes. Only the basic program comes from the CAM system. Uwe Liedl: "The TNC 640 makes complicated machining transparent so that our machine operators can easily follow the movements of the control." Here the TNC always gives the operator the choice between different strategies. Complicated machining processes become clearer.

The new finely detailed 3-D motion simulation gives even more confidence. Machine operator Vitali Hegert checks

all the machining runs beforehand. Here he very simply sets the options of the preview graphics to suit his requirements: depiction of tool paths, blank edges, or transparent views.

TNC 640 achieves shorter throughput times for projects

Every year the Herrenknecht Components Factory, with a current workforce of 462, delivers components worth 60 million euros for assembly: drill heads, cutting tools, transmission housings, rings and much more—single parts of wear-resistant steel or fine-grained steel like Hardox® 500 and S690 respectively. The strategic goal of the investment was to achieve continuous production with short throughput times. Thanks to the new and stable MTE machine with TNC 640, Stephan Göggel is much closer to that goal.

TNC 640 supports agile production

Apart from standard components, the Components Factory also produces spare parts immediately when there is a failure on the construction site. In such cases a part has to be taken from the clamping table in the middle of machining in order for the spare part to be manufactured as quickly as possible. The TNC 640 makes it easy to pick up the work again: With the mid-program startup the control resumes machining at the point in the program where it left off.

The interaction between the bed-type milling machine and the HEIDENHAIN TNC 640 milling/turning control makes it possible to perform complex machining tasks in just a few setups. For example, a blank of 800 mm in length, 960 mm in diameter, and weighing 4000 kg was milled and turned on the new machine. The requirements included pocket cross holes, face milling with tilted head, knurling and much more. 80% was cut off, leaving just 850 kg.

As manufacturer of tunnel boring machines, Herrenknecht AG operates its own Components Factory on its site in Schwanau-Allmannsweier. There it produces almost exclusively project-specific parts. This is why Herrenknecht sets great store by machines that are flexible, like the

RT-T 30: a dynamic bed-type milling machine with integrated rotary table and automatic swiveling milling head. A heavily ribbed-surface cast design makes for a stable machine with few vibrations.

+ www.herrenknecht.de



All eyes on the machining operation:
The Herrenknecht Components Factory produces almost exclusively project-specific parts.



The MTE RT-T 30 bed-type milling machine with integrated rotary table can produce components of up to 2100 mm dia. x 1500 mm.

FUNCTIONS

How accurately can you measure with a touch probe?

Compensating deviations of the triggering characteristics of workpiece touch probes

The 3-D ToolComp option is actually intended for compensating deviations from the ideal circle of radius cutters. However, in conjunction with the probing cycle 444, 3-D ToolComp also improves the accuracy of your touch probe.

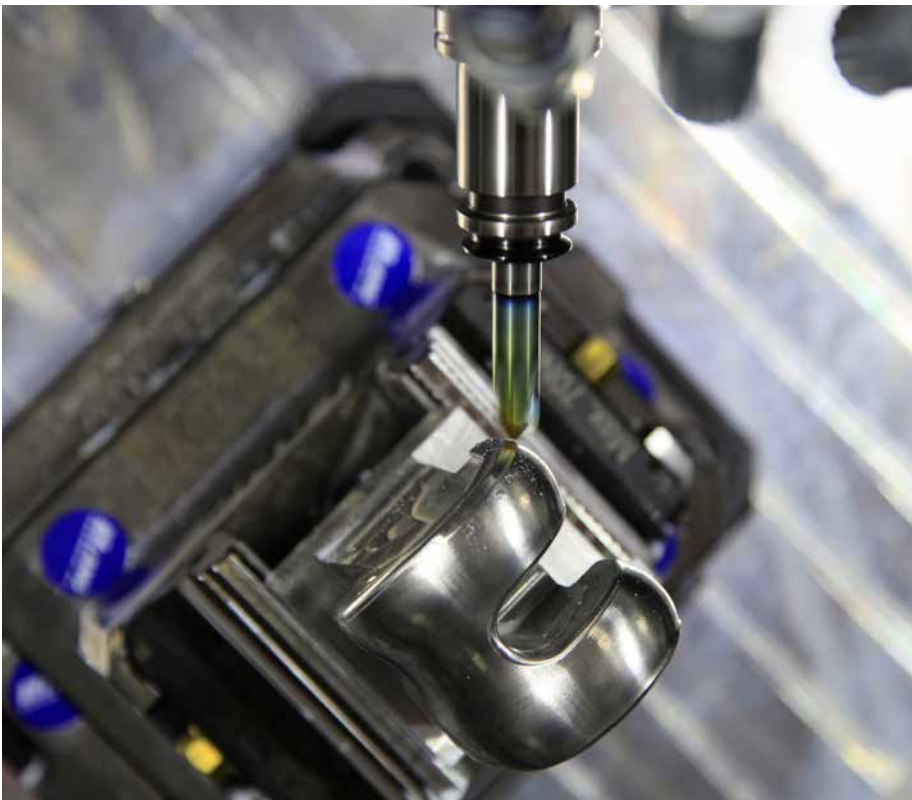
If you have to measure free-form surfaces after machining with high accuracy, then you should do a three-dimensional calibration of your workpiece touch probe beforehand. In this way you can compensate deviations of the triggering characteristics in any direction. For this you use 3-D ToolComp and a calibration sphere to do an initial 3-D calibration of

your workpiece touch probe. 3-D ToolComp automatically generates a compensation value table in which the deviations of the triggering characteristics are recorded. Depending on the touch probe used and the length of the stylus, the deviations can reach hundredths of millimeters. The measuring error might then be correspondingly large if you measure without prior calibration.

If you use your 3-D calibrated workpiece touch probe with the new probe cycle 444, for example for measuring a machined free-form surface, the control takes the stored compensation values into account. You attain higher accuracy when measuring the surface. Fur-

thermore, you yourself can define the tolerance values that the probe cycle 444 uses to directly analyze the finished quality. You can of course have the measurement data logged automatically. This is useful for recognizing surface quality deviations that occur during machining through tool wear, programming errors or deflection.

Improved measuring accuracy with 3-D ToolComp and probing cycle 444.



Breathing new life into a historical steam locomotive

Replication of a unique locomotive using HEIDENHAIN controls

You can see the enthusiasm on the faces of the employees of Wimmer Maschinenbau GmbH & Co. KG in Übersee on Lake Chiemsee, Germany. The reason is the successful completion of an exciting job: the 1:5 scale replica of an attractive steam locomotive, the LAG 64, of which only one original was built by J. A. Maffei. To date there is no knowledge of any other replica of this unique locomotive.

Not only in traditional model and mold making have HEIDENHAIN TNC controls earned their reputation for combining particularly easy operation with very high accuracy. The model making that we are talking about here gets the hearts of large-scale

model railway fans racing. The Walhallabahn put the steam locomotive LAG 64 into service in 1926. With a track gauge of 1000 mm the so-called "Vierkupppler" (four coupled axes) first transported sightseers and later also goods. Hans-Peter Porsche will use the replica in his TraumWerk (Dream Factory)—a museum and theme park in Anger, Germany, not far from Salzburg, Austria. The model had to look as authen-

tic as possible and also function like the original: An extraordinary challenge for the Wimmer engineering specialists.

Faithful replica in appearance and function

To ensure that the locomotive doesn't run out of steam even on long trips, the team at Wimmer wanted to reproduce the operation of the LAG 64 as faithfully as possible and optimize it for service as a rideable miniature railway. A demanding task, considering that all they had to go on were an original assembly plan with three main views and a few pictures. Months of research were required to properly understand the mechanical functions like drive control, valve regulation and valve timing. Old manuals like "The Steam Locomotive Service Guide" and other historical sources provided valua-

Wolfgang Wimmer demonstrates the performance of his LAG 64.



ble information about the design. Markus Maier: "We first had to understand the workings of a steam locomotive ourselves. In doing so we discovered the outstanding design and metalworking of the time—all without CAD and controlled machine tools."

Markus Maier set up the steam locomotive with all its components in the SolidWorks CAD program. The programs for the complicated machining with the iTNC 530 were created with the HyperMILL CAM software. From the outside the model is an exact scale replica of the original. However, the internal works had to be changed. Managing director Wolfgang Wimmer: "Hot exhaust gases cannot be reduced on a scale of 1:5. We therefore had to adjust the scaled-down boiler tubes to the physical reality. Nevertheless, it all operates as closely as possible to the original."

HEIDENHAIN controls help build the replica

The wonderful model consists of over 5400 parts, 1061 of which were manufactured by Wimmer. Many of the components with simple geometry were programmed directly on the iTNC 530 or the MANUALplus 4110 lathe control. Machine operator Markus Ager: "Setup and datum setting were easy with the touch probe cycles." For machining the workpieces "we very often used Cycle 22, ROUGHING, and Cycle 23, FLOOR FINISHING. The PECKING cycle made manufacturing the steam cylinders so much easier."

The team made the devices needed for manufacturing themselves—including the molding die for the copper steam domes, which was produced with 5-axis simultaneous machining.

In addition to the choice of high-quality materials for a long service life, Wimmer set great store on the safety of each functional group. The department responsible for steam at the Munich TÜV (German Technical Inspectorate) had to test and approve the boiler prior to manufacture. The TÜV also tested and approved the steam boiler upon completion.

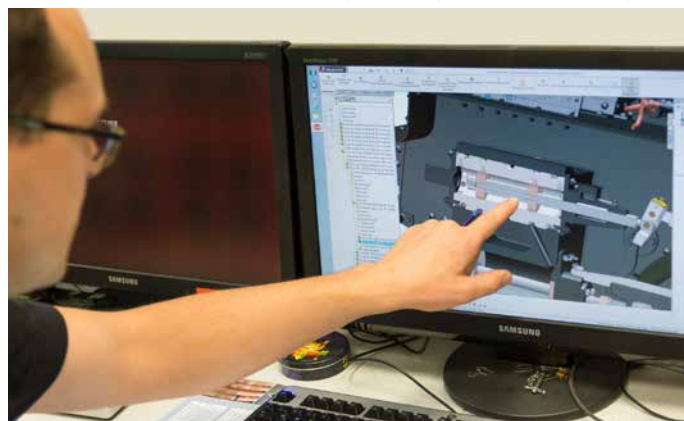
Perfect function was worth the effort

The fully assembled locomotive bore witness to the team's extraordinary performance: The first time it was filled and fired, the locomotive set itself in motion immediately—everything fit and functioned perfectly. Everyone involved still enthuses about this maiden journey.

Wolfgang Wimmer attached great importance to the quality and long service life of this one-off production.



Markus Maier shows the setup of the cylinder in the CAD system.



Drive system just like the original.

High safety for passengers

Passengers riding on the miniature railway naturally sit in historical replicas: The trailers are modeled on WB 312 freight cars of the Waldenburg Railway. A sophisticated chassis compensates for unevenness of the rails. The adjustable inertia braking system ensures fast and reliable deceleration of all axes. This is quite important, since a fully laden miniature railway train can weigh up to two tons.



REPORT

Attractive and energy-efficient

Young engineers from Turin construct successful fuel-saving prototypes

Team H₂politO built the IDRAkronos, the best looking prototype for this year's Shell Eco-marathon Europe and climbed the winners' podium in the hydrogen fuel cell category.

This year's Shell Eco-marathon Europe took place in London, UK from June 30 to July 3. Two-hundred-and-twenty teams from Europe and elsewhere lined up to start in what has been called the Formula One of fuel saving. The winners here are not the fastest vehicles but those with the lowest fuel consumption. The participants start in two categories: prototypes and street-legal UrbanConcept vehicles. Different types of propulsion were also judged: gasoline, diesel, LPG, ethanol, electric motor, and hydrogen fuel cell. The winner is the ve-

hicle that completes the eight rounds on the race track within the permitted maximum time with the lowest consumption of fuel or alternative energy.

Successful teamwork

Team H₂politO from the Politecnico Di Torino, Italy, has been participating in the Shell Eco-marathon since 2008. At that time, the founders of the team—twelve young engineers from different disciplines of the automotive sector—decided to enter the prototype competition with a hydrogen-driven IDRA08. Successive teams of students have remained true to this tradition and have continued to develop prototypes year in, year out. This year they presented their fourth prototype with hydrogen drive.

Their efforts and many years of continuous development work were rewarded this year with first place in the fuel-saving category for prototypes with hydrogen fuel cells. The IDRAkronos achieved this with a theoretical mileage of 737 km per m³ of hydrogen. The vehicle also won the Prototype Design Award. The jurors were just as impressed by the aerodynamic form of the IDRAkronos as by the technical execution of every detail.

Practical implementation

The development and manufacture of the wheel rims show just how close to practice and trends in mechanical engineering the work of Team H₂politO is. Extremely light-weight vehicles like the IDRAkronos are designed for optimally

low energy consumption. That is why wheel rims play a crucial role. Since they must have as little mass and inertia as possible and yet ensure the required structural stability, the team chose to use Ergal, the aluminum alloy with the highest strength values.

HEIDENHAIN coordinated the manufacture of the rims according to the specifications of Team H₂politO. The project, set up together with various rim producers for digital manufacturing, was presented at the MECSPE trade fair in Parma, Italy, in the spring of 2016. Planning began with the dynamic analysis of the vehicle using Multi-Body Software. This was to find out the loads to which the rims are subjected. Then came the machining. Rims weighing only 1160 g each were milled from blanks weighting 23 kg.

Demand for milling know-how

HEIDENHAIN provided its milling know-how to support the various machining phases. The crucial point here was to reduce as far as possible residual stress and deformation in the material. These can occur during milling and diminish the performance of the finished part. The rims developed and produced for the IDRAkronos weigh the same as those for the team's predecessor vehicle. However, higher rigidity and less deformation in the proximity of the contact zone with the ground improve the performance of the vehicle when racing.

A light but solid rim is decisive for energy consumption—produced from a solid block with a TNC control.

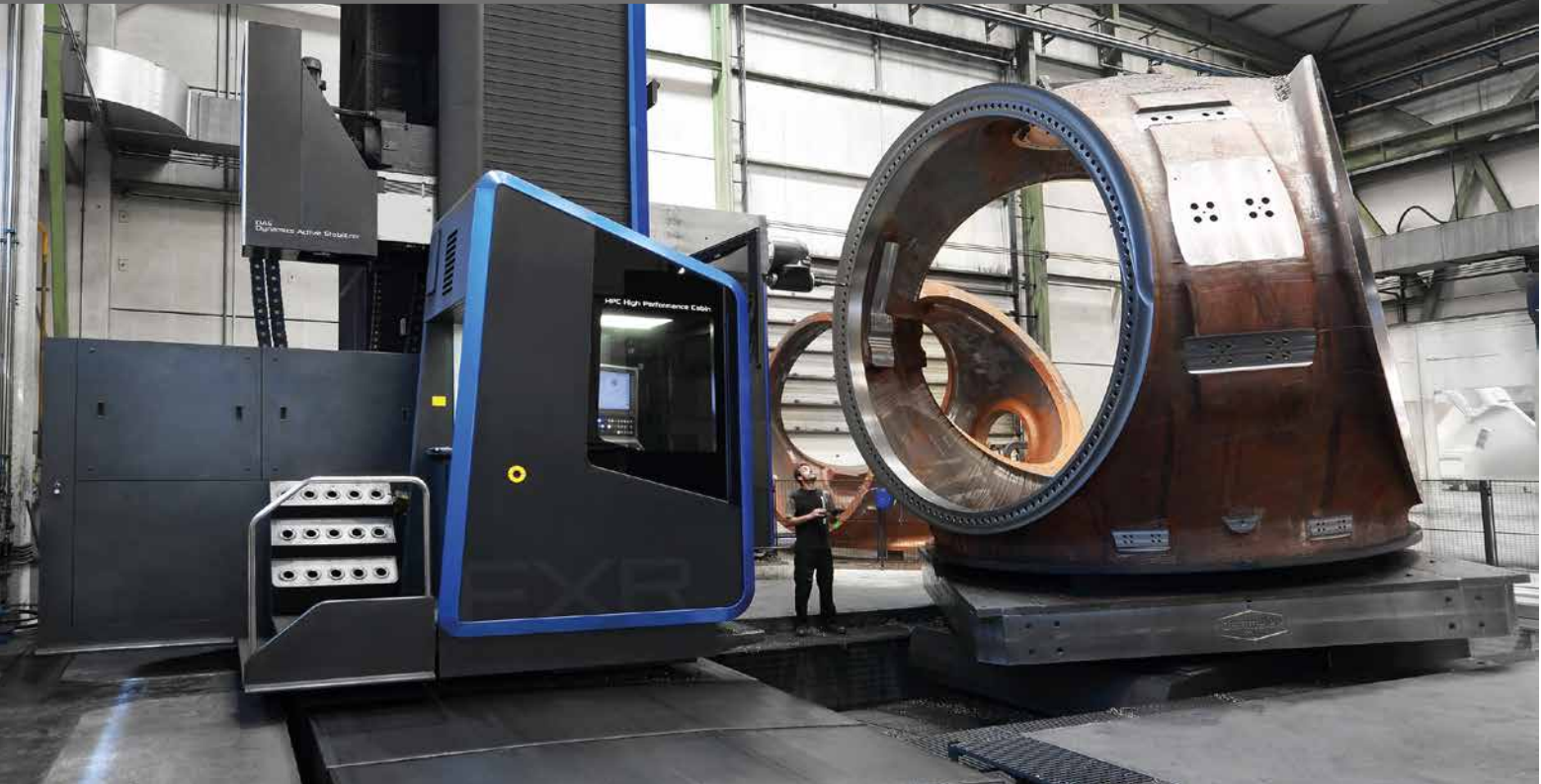
This was made possible through specially adapted 5-axis machining on a high-precision machining center equipped with a HEIDENHAIN TNC control. The control produced excellent results, thanks in part to the functions PLANE SPATIAL for swiveling the machining plane, KinematicsOpt for automatic calibration of the rotary axes, and Cycle 32 TOLERANCE. The machining center's closed-loop position measuring system, via angle and linear encoders, was ideal for the high-precision machining operations.

Shell Eco-marathon Europe

The Shell Eco-marathon Europe is an energy performance competition for school and university students that took place this year in London. The aim is to construct a vehicle that covers a specific distance consuming as little fuel as possible. The idea of the eco-marathon goes back to two US scientists who held a competition in 1939 to see who could get the furthest on one liter of fuel.



Forward-looking combination



SORALUCE traveling column milling and boring centers with controls from HEIDENHAIN machine very large parts for wind turbines flexibly, accurately and on time

The Grupo SAKANA located in the northern Spanish town of Lakuntza is specialized in the production of large castings, among other things the hubs and mounting frames for wind turbines. Lakber Mecanizados, S.L., a member of this group of affiliated companies, deals with the machining of the parts. Standing ready for this are the mighty SORALUCE machines with HEIDENHAIN controls.

Very large machines and components are nothing special for Lakber, nor are high accuracy requirements. Five SORALUCE FR and FX traveling column milling and boring centers have been providing reliable service since the company was founded in 2008. They provide vertical traverse paths of up to 4800 mm and a cross traverse path of up to 1600 mm. But in the meantime this is no longer enough. Therefore Lakber has ramped up its machine park: a SORALUCE FXR-1200-W traveling column milling and boring center now enables the company to machine workpieces weighing 100 metric tons with a vertical traverse path of 6500 m on a rotary table of 4000 mm x 4000 mm. The rotary table has a tilting function for 3-D alignment. In the case of heavy-duty

machining this permits paraxial machining, which makes the milling process more stable.

Simple operation and flexibility

To control the machines Lakber chose HEIDENHAIN from the very outset, starting with the iTNC 530. When machining large workpieces, the simple operation and flexibility of this control are important features for successful task management. They ensure that Lakber delivers the required product quality on time. This applies not only for the series production of parts. On request Lakber also manufactures prototypes for its customers, including the development of new tools, mounting systems and

machining methods, as well as complete component measurement.

Flexibility plays a role already when creating the programs, because massive castings are often one-off special productions. Inhomogeneous material properties—typical for castings—and high accuracy requirements add to the extraordinary demands. This means that it must be possible for the operator to intervene manually at any time. Apart from that, flexible parameters should be available with CAD/CAM-generated NC programs. For this reason the NC programs are boosted at critical points with HEIDENHAIN cycles. This permits easy intervention to change milling settings or cut parameters, for example.

Setup with intelligent support

The setting up of the large components plays an important role in job processing on the machine. An essential performance factor in the process is fast and reliable setting up with scanning cycles and manual alignment functions like 3-D basic rotation to meet the challenge of different geometries and the required multi-sided 3-D machining. Here Lakber also appreciates the compatibility of the TNC controls. Now, with the new SORALUCE FXR-1200-W, the iTNC 530 controls have been joined by a TNC 640 of the latest generation that fits seamlessly into production at Lakber.

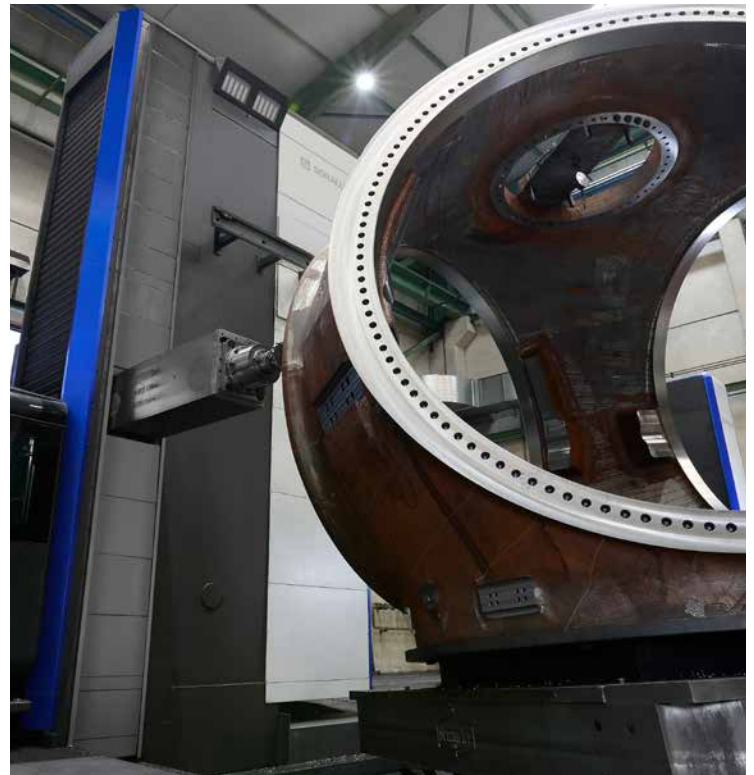
The new SORALUCE FXR and the TNC 640 are a forward-looking combination at Lakber. Active players here are the TNC 640 technologies like parallel axis functions for quill control and the turning functions for radial facing slide heads and boring heads. The result is a complex machining center with compatible programming and clear, convenient operation. In addition, the networking of the plant via the HEIDENHAIN DNC interface permits Lakber to configure real-time feedback about the process currently running on each machine, e.g. about the status of the NC program, the tools being used, as well as axis and spindle speeds.

“The new cycles of the HEIDENHAIN TNC 640 enable us to use advanced machining functions on the SORALUCE FXR traveling column milling and boring center.”

Julen Razkin, Application Engineer at SAKANA-Lakber



The machine operator can intervene manually during machining via the TNC controls.



Enormous components with high accuracy requirements are part of everyday manufacturing at Lakber.

Retrofitting for safe turning

MANUALplus 620 modernizes Boehringer VDF 400 CM lathe

The company Mechanische Fertigung Burghardt GmbH & Co. KG, located in Dahme/Mark south of Berlin, Germany, machines large parts for the railways, ship construction, and custom-built machines. Peter Burghardt was looking for a large lathe for machining large parts and came across a VDF 400 CM from Boehringer—overhauled and in top mechanical condition. The first attempts at operating the existing control did not meet up to the parts manufacturer's expectations. It quickly became clear that only a HEIDENHAIN MANUALplus 620 will permit working in the familiar manner. Time for a retrofit!

Retrofitting leads to a perfect machine

Christian Brüning of Brüning CNC Werkzeugmaschinen-service in Berlin, Germany, specializes in this sort of work. The service company equipped the large lathe with a state-of-the-art MANUALplus 620. Peter Burghardt is full of praise: "The retrofit with Brüning went off very smoothly. We worked well together and we are all pleased with the result."

In addition to retrofitting the control, Brüning further optimized the functions of the machine: With new HEIDENHAIN ROQ 425 absolute rotary encoders the customer no longer needs to do long reference runs. Previously the tool turret had been controlled by a separate PLC. Brüning removed that control, fitted a HEIDENHAIN ROC 413 rotary encoder, and ran the turret functions as a PLC axis. After its easy retrofit to the Boehringer lathe the MANUALplus 620 demonstrated its full potential.

First trials

There are not many who trust themselves to handle the expensive blanks—the very first attempt has to succeed. The machine operators must be able to rely completely on the new control for programming, simulation and machining.

The machine operator Jan Haufe had experience with the earlier controls CNC PILOT 3190 and CNC PILOT 4190. The operating principle is upheld on the MANUALplus 620, simply with more cycles and new functions.

Which characteristics of the new control does the machine operator appreciate most? On the one hand he likes the "us-



A retrofitted HEIDENHAIN lathe control gets the best out of the overhauled machine (managing director Peter Burghardt left, machine operator Jan Haufe, and Christian Brüning right).

er-friendly operator control and program generation,” and on the other hand he says “all we need is in the cycles.”

The machining cycles often start with a contour definition in the ICP editor (Interactive Contour Programming) and are then completed via form entries. If customers deliver the drawings in the correct format, the DXF converter speeds up entry of the contours in the ICP editor.

Much appreciated are the finely detailed graphic simulations of the MANUALplus 620. The control displays the individual machining steps and ma-

chining results in full detail. This means that deviations and errors can be reliably recognized before machining starts.

Focus on the essentials

When procuring new machinery and equipment, Peter Burghardt uses alternatives—as long as the main requirements are met. A retrofit enhanced the second-hand purchase of the Boehringer lathe, resulting in a more powerful and more accurate machine. Another new large lathe has been ordered. In this case too he's making no compromises—this time ex works.



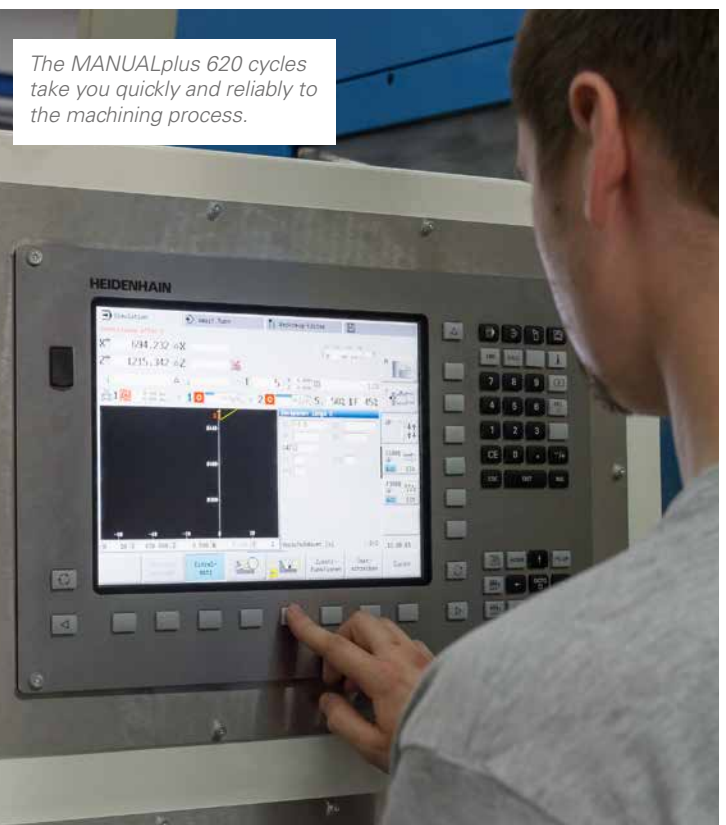
“All we need is in the cycles.”

Jan Haufe, machine operator at Mechanische Fertigung Burghardt

Machine modernization with HEIDENHAIN

A retrofit makes a worthy machine fit for the future. For a sustainable retrofit, HEIDENHAIN recommends modernizing old control components and drives.

Get in touch with the retrofit specialist in Sales: +49 8669 31-3132 or hd@heidenhain.de



The MANUALplus 620 cycles take you quickly and reliably to the machining process.



HEIDENHAIN

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From the beginning of time, there has been no transfer of knowledge and no progress without communication. Well interconnected communication makes knowledge available more rapidly to provide for intelligent solutions. So why not provide your workshop, too, with all the information and intelligence available in your company? The **Connected Machining** range of functions in our TNC controls enables your workshop to access all areas that accompany the production process. That's how **Connected Machining** integrates your workshop into the process chain and makes it more efficient, so that you can improve productivity, quality and flexibility.

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