HEIDENHAIN

Klartext

Large Tools in Automotive Engineering

Be in Top Shape with the iTNC 530

Lathe Controls

The User-Friendliness of the MANUALplus 620 ➔ **Page 10**

Modernization in Heavy Engineering

Retrofitting—without Complications ➔ **Page 18**

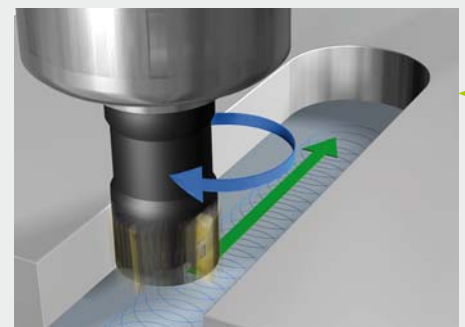# Editorial

Dear Klartext Reader,

Wherever HEIDENHAIN controls are running, exciting stories develop in many places. The stories are not only about accuracy, speed and operating convenience. Above all, they deal with the **challenges and achievements of our TNC users**. To break new ground they need many a special function, as in the case of large-scale toolmaking in the BMW Group. But the center stage is manned with dedicated metalworkers who are unsatisfied with the status quo and are continually redefining the limits of the possible!

This is the kind of motivation that drove the HSC users at GEMÜ and the heavy manufacturer Schade to accept nothing but the very best solutions and place their bets on the iTNC 530. Read these two **entertaining field reports** with entirely different requirements that are sure to get you thinking.

If machines and NC controls are becoming ever more powerful, then the **education of the metalworkers** has to keep up. Our reporting here has a European flair: an educational project and the TNC training network—two extraordinary stories!

And any news from the HEIDENHAIN controls? You bet! Just page through.

Read and enjoy, with best wishes from ... The Klartext staff!

With the new features in the 340 49x-06 software it's full speed ahead.
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Production

Also, check out our interactive KLARTEXT e-magazine, with even more background information, animations, and expert knowledge. Take a look at **www.heidenhain.de/klartext**

Pilot project for more efficiency in large tool-making
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Big Tools—Big Challenges

The Chinese philosopher Lü Buwei once said, "The difficulty in a matter is not based on its size, but on recognizing the proper time." On this note, the iTNC was faced with new challenges in a pilot project for toolmaking at the BMW Group's location in Munich, and it demonstrated that the time for a change in large toolmaking has come.

iTNC 530 XXL

Automobiles move—and they move us emotionally. Impressive dynamics and fascinating style elements are meant to get our hearts beating. And the prerequisite for this effect is a powerful toolmaking capability. This capability profits—like the product itself—from its efficiency. In other words, the imperative is to increase quality while lowering production times and cost. This is a high priority for toolmakers because they make an important contribution to creating value.

Pilot project for more efficiency in large toolmaking

It takes tools with impressive dimensions to make it possible to manufacture car body parts, and they are both expensive and one-of-a-kind. Opulent material removal and large, sculptured surfaces require correspondingly long machining times. This job is made even more difficult by the fact that these complex tool sets have a modular design: everything has to fit together perfectly.

These complex factors all have to be calculated into the effort to increase efficiency:

- The drawn-out workings steps have to become fewer and the machining cycles themselves shorter. **And that is why the tandem of a large machine and an NC control must provide excellent performance**.

- The process needs to eliminate any possibility of costly and time-consuming mechanical rework. This is only possible if the finished product has outstanding surface definition. In addition, the modular design requires very tight tolerances of the tools to be manufactured. **And this turns accuracy and surface definition into decisive factors**.

- Because these parts are unique and very expensive, manufacturing faults and downtime have a devastating effect on the efficiency of the production process! **The control software therefore needs to be absolutely stable and the total system has to guarantee process reliability**.

In the course of an intensive situation analysis, the toolmakers of the BMW Group discovered an attractive combination for this task: New large machines from Droop + Rein could meet their demands perfectly. And they wanted to marry the machine to the HEIDENHAIN iTNC 530 NC control.

The decision makers of both companies sat down at a table and specified in a short time the central requirements: the first priority was process reliability. Process reliability, they realized, could secure their gains in machining speed, surface definition, and the optimized features associated with them. In addition, the complex tool sets require new, complex control functions for machining.

> **As Dr. Hanrath says, "Of course the first machine cost us a certain amount of effort for familiarization—but right with the second machine everything was running smoothly."**
>
> *Dr.-Ing. Georg Hanrath, Dörries Scharmann Technologie GmbH*

Being where the rubber meets the road: Even in automated operation, the operator has to be able to make manual changes and superimpose traverse with the handwheel.

The straightforward and configurable screen layout, together with intelligent machine functions, makes it easier to operate a large machine.

A toolmaking game with other rules

The manufacture of large tools is fascinating not only because of the dimensions of the workpieces—here referred to as tools. Direct interventions by the machine operator in the machining process might seem unfamiliar to many NC specialists, and they require considerable skill. They need to deal with traverse in virtual axes, the machine movements are superimposed with handwheel feed (and this while the part program is running), or inaccuracies are compensated with superimposed datum shifts. The machine operators want to directly influence the course of the part program through global functions and superimpositioning, such as coordinate transformations, without having to change the program itself. These were new game rules for the iTNC 530—but it learned them thoroughly in the course of the project. See "New Functions for Large-Tool Making."

With so much complexity in machining, the operation of the NC control should stay as easy as possible. The HEIDENHAIN controls are well known in the industry for convenience in operation and that was a positive factor in the decision to buy. →
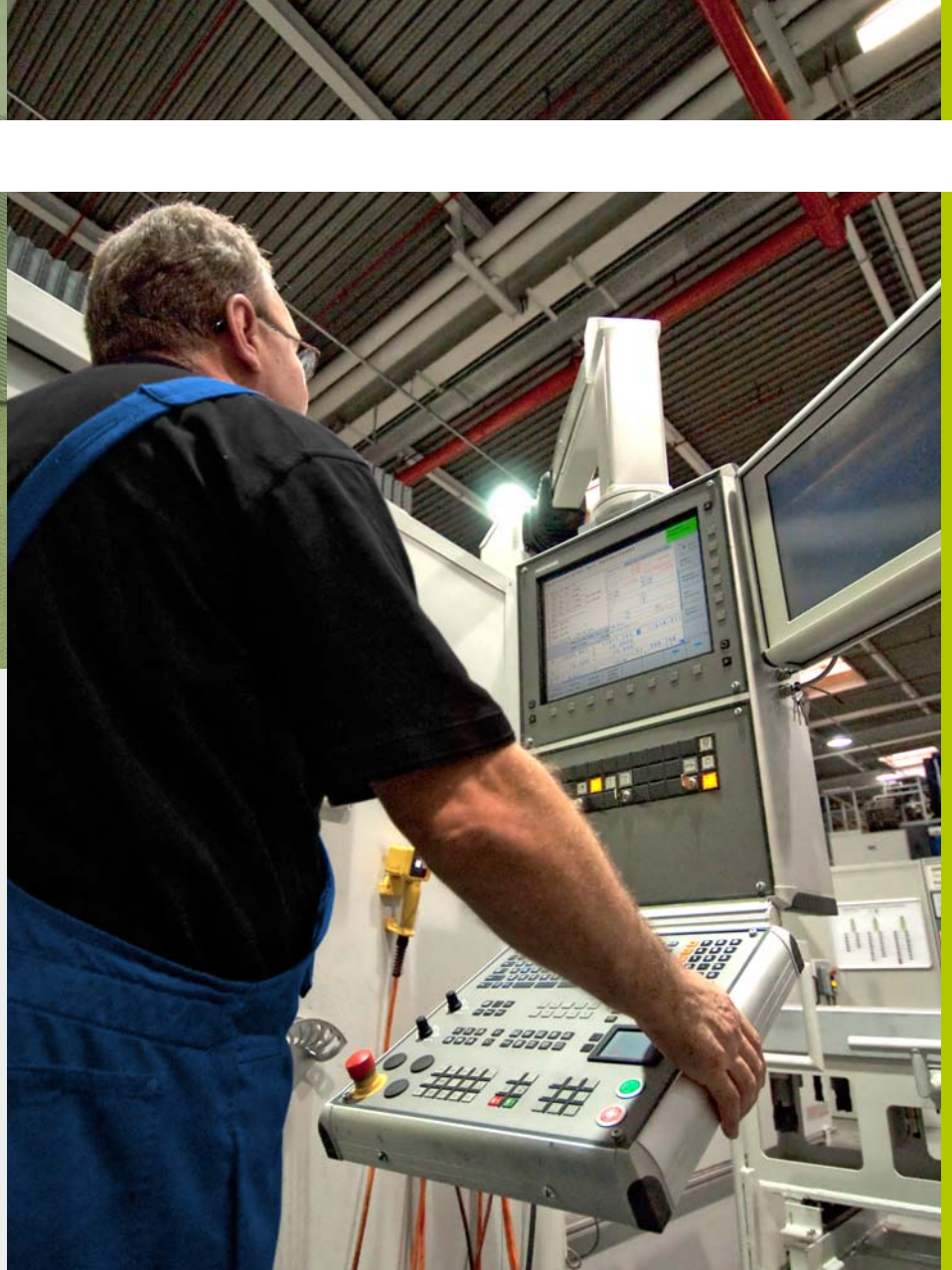
The iTNC 530 achieves a new, high level in large toolmaking.

New Environment—Familiar Qualities

When used for toolmaking, the iTNC 530 is operating in its own element, but in this new environment everything's a bit larger. CAM systems generate huge NC programs in which sculptured surfaces are approximated using many small line segments. This is a home game for HEIDENHAIN controls, whose powerful and highly dynamic, jerk-free motion control produces an optimum surface from the line segments. Functions for multi-axis machining, such as Tool Center Point Management (TCPM) or three-dimensional tool compensation have also proven to be indispensable.

To enable the user to navigate quickly through the large machining programs, the iTNC 530's programming editor was adapted to be able to make technology changes in the program quickly and easily. The control loads the extremely large programs quickly over its Ethernet interface.

Perfect Teamwork

During the project, two large machines from the Droop & Rein Company were integrated with the HEIDENHAIN iTNC 530. One machine was a FOGS 2550 PT M40 C machining center, the other a T2550 PT R50 C portal machining center (see "Machine Portrait").

From the manufacturer's point of view, other criteria also influence the chances of success: the control has to "fully support the machine's complexity without blowing the budget." The guarantee is also a topic: "the control needs to run safely, reliably and with process stability. Worldwide support is also indispensable. In the initial testing, HEIDENHAIN immediately demonstrated these qualities in its iTNC 530.

The integration of the new control model required a good deal of work by the machine tool builder: The R&D and production departments had to become familiar with the technology from HEIDENHAIN and integrate it in the features of their own product. Dr. Hanrath, Plant Technical Manager at Droop + Rein, admitted to "a considerable investment" that would turn out to be well justified. The challenges were met and problems solved by intensive cooperation with the HEIDENHAIN team. As Dr. Hanrath says, "Of course the first machine cost us a certain amount of effort for familiarization—but right with the second machine everything was running smoothly."

HEIDENHAIN had to make adjustments in its NC control software: Besides the user functions (see "New Functions for Large-Tool Making"), various technical adjustments were necessary for application on large machine tools, for example in order to be able to perform a complex, fully automatic cutter-head change without a control restart.
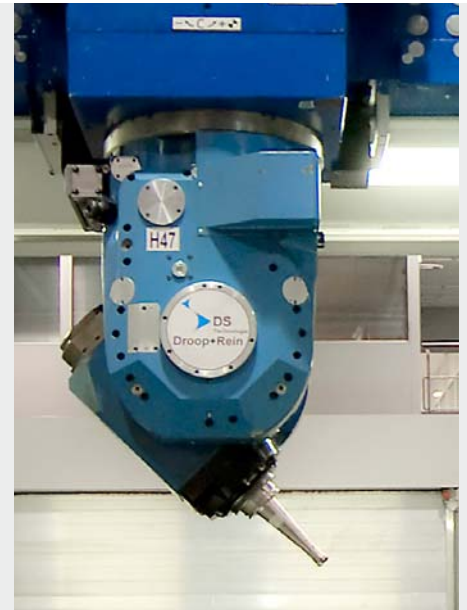
*The control's capability of saving and providing standardized operations with the **CycleDesign** cycle editor was particularly appreciated. It enables the user to adapt the iTNC 530 even more perfectly to his working conditions, thereby accelerating and simplifying his daily work.*
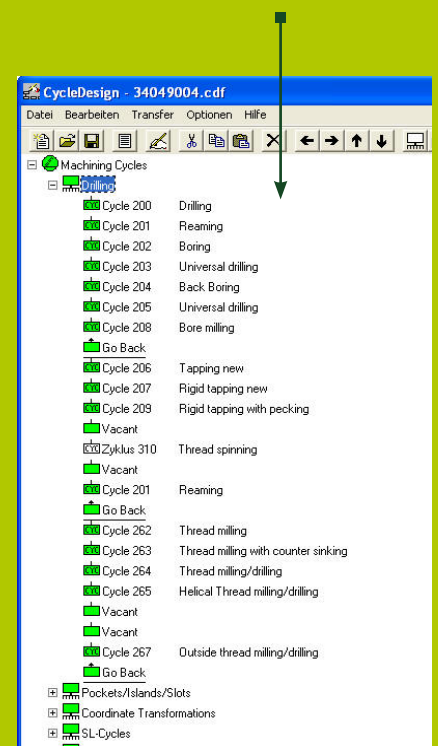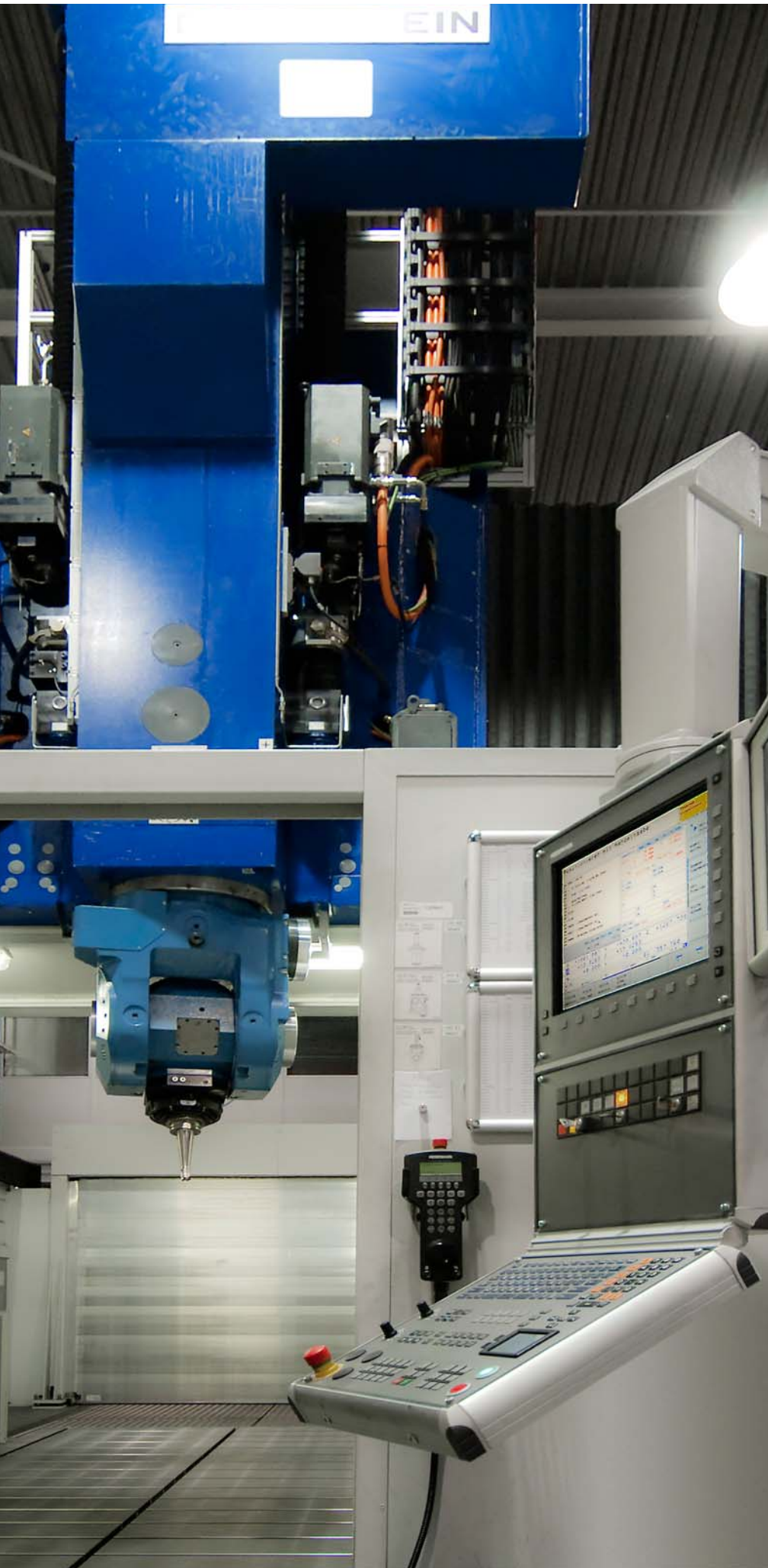
Setting examples for more efficiency in large toolmaking

The results of the project should come as no surprise because all those involved are well known for their powerful and highly accurate products. Only the combination was new. Quite according to plan, the two new machines from Droop + Rein with the HEIDENHAIN controls started operation in the large toolmaking section of the car manufacturer's plant.

The documents show that, right from the beginning, the friction-free cooperation yielded outstanding results. The machine manufacturer confirms this: "Immediately after putting the NC machine in operation we had excellent surface finish and high machining speed." Small adaptations that became necessary during testing were rapidly completed by both Droop + Rein and HEIDENHAIN.

The initiators also expressed their satisfaction with the implementation of the new control functions, which functioned stably and reliably from the very beginning and met the stringent requirements for process safety and reliability. They spoke of the "unusually smooth and problem-free progress" of the project.

A further advantage of the HEIDENHAIN controls is their flexibility: HEIDENHAIN controls are now represented on machine tools of all sizes, and users who work with large machines for the first time do not have to relearn. Now the machine operators have more flexible skills and no longer have to grapple with a mixture of different controls.

The results of this pilot project set an example, because the car manufacturer's large-tool making effort profits from a step forward in efficiency: in this case, process safety, machining speed, workpiece accuracy and surface definition have reached a new, higher level! →

New Functions for Large Tool Making

One special feature for large tool making is the new "global program settings" software option*: This feature enables users to define various coordinate transformations and settings that function globally and are superimposed on the active NC program. The program itself remains unchanged. The global program settings can be adjusted during a program stop, for example. After the program starts, the iTNC then moves, if necessary, to a new position—with a positioning logic modified by the user.

The iTNC 530 has also learned to let the machinist use the handwheel for superimposed traverse in a virtual axis direction. This function, which is particularly indispensable for inclined milling, is the daily bread for the toolmakers of all car manufacturers.

*) Available in the Program Run modes and the MDI mode

The HEIDENHAIN handwheel also makes it possible to move virtual axes.

You can apply the following functions in global program settings:

■ **Paraxial handwheel superimposition**
This function has been integrated in the TNC for many years with the miscellaneous function M118. It enables the machinist to use the handwheel to superimpose axis traverse—during program run—on the programmed traverse. The TNC always moves the principal axes X, Y and Z parallel to the machine axes X, Y and Z. A special advantage of handwheel superimposition is that the TNC saves the values of the handwheel traverse. These values remain active until they are reset by the user, even if the program has been repeated several times.

■ **Handwheel superimposition in virtual axis direction**
With Tool Center Point Management active (TCPM), the user can move the tool manually in the currently active tool axis direction with superimposed traverse, for example to run the entire part program with a constant oversize. In heavy toolmaking, this function is also used when an outline is manufactured with an inclined tool that does not move at a constant height. In this case, the user has to adjust the tool in the tool axis direction so that the tool's

cutting edge is always at the right position. Of course, handwheel superimpositions in a virtual axis direction and paraxial handwheel superimpositions can be run in any desired combination, and that applies not only for linear but also for all rotary axes on the machine.

■ **Exchanging axes**
This function makes it easy to exchange axes. You can use it, for example, to "redirect" the paths of the X axis to the Y axis if you have to machine a mold on another machine with a longer axis in Y.

■ **Additional, additive datum shift**
With the additive datum shift function you can compensate any offsets in all active axes.

■ **Superimposed mirroring**
This feature does the same thing as the Cycle 8 (mirroring) and runs the defined operation with mirrored axes.

■ **Axis locking**
With this feature you can lock all active axes. Then when you run a program, the TNC does not move any of the axes you locked.

An electronic handwheel with a display enables you to get closer to the workpiece during handwheel superimposition. There you can address the virtual axis (VT) directly over the soft keys. At the same time, you can see in the handwheel's display the value of the distance moved in the virtual axis direction. The wireless handwheel HR 550 FS will be available from HEIDENHAIN in mid-2010. It makes is even easier for operators of large machine tools to get close to the workpiece. And finally, of course, you no longer need to worry about your handwheel cable.

New features for tool and die making are now available in the iTNC as software options. These features also expand the iTNC 530's area of application for mid-size machines in tool and die making. +

Do you know this function?

iTNC 530: Special Functions—Clearly Explained

The structuring function and fast editor

Are you editing a huge program? Keep a good overview! With the structuring function you always know where you are.

What is the structuring function?

With this feature you can add brief texts as comments to part programs. These comments can function as bookmarks describing the program lines following them. Then you can jump from bookmark to bookmark to quickly go through large sections of the program in a few steps.

How do I insert a structuring item?

In the structure window, simply press the INSERT SECTION soft key to insert a comment at any location in the part program.
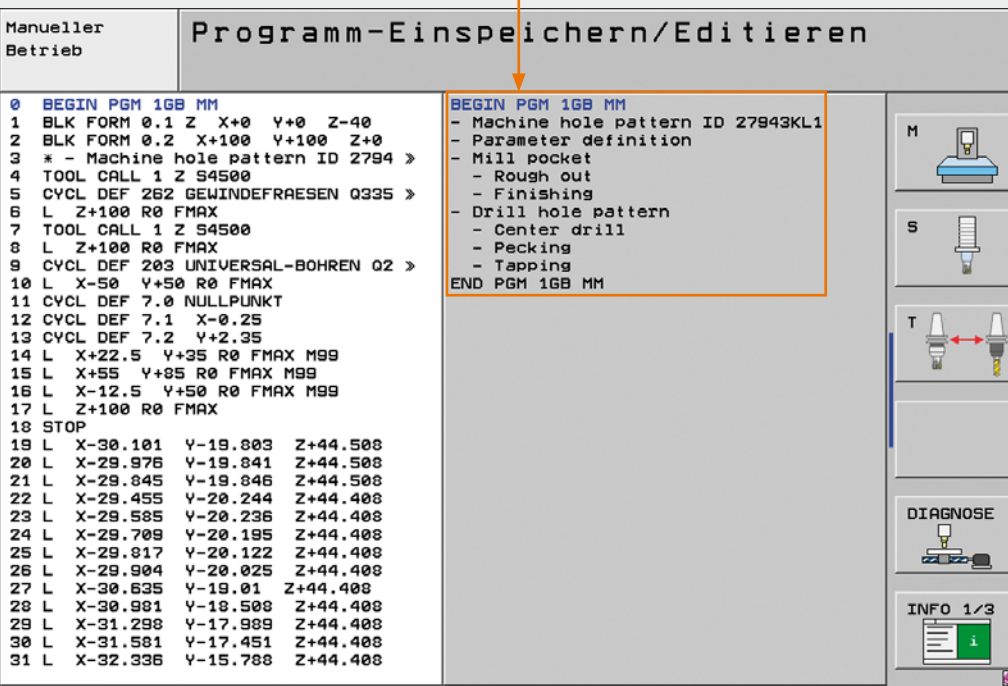
What are the benefits?

Complex programs can be clearly laid out and made more understandable. When you need to make a change in a long and complex program you can quickly find your way to the desired location.

The fast new editor

While we're on the subject of huge programs: Anyone who has tried to open an ASCII file with 100 MB on a PC can appreciate how fast it happens on an iTNC. Because not only can large programs be quickly and reliably transferred over the Ethernet interface (a standard feature of the iTNC)—the fast editor also ensures high efficiency for handling data.

Example of a structure block, which shows the structure of the program


```
Manueller          Programm-Einspeichern/Editieren
Betrieb

0  BEGIN PGM 1GB MM                    BEGIN PGM 1GB MM
1  BLK FORM 0.1 Z  X+0  Y+0  Z-40      - Machine hole pattern ID 27943KL1
2  BLK FORM 0.2  X+100  Y+100  Z+0     - Parameter definition
3  * - Machine hole pattern ID 2794 »  - Mill pocket
4  TOOL CALL 1 Z S4500                    - Rough out
5  CYCL DEF 262 GEWINDEFRAESEN Q335 »     - Finishing
6  L  Z+100 R0 FMAX                    - Drill hole pattern
7  TOOL CALL 1 Z S4500                    - Center drill
8  L  Z+100 R0 FMAX                       - Pecking
9  CYCL DEF 203 UNIVERSAL-BOHREN Q2 »     - Tapping
10 L  X-50  Y+50 R0 FMAX               END PGM 1GB MM
11 CYCL DEF 7.0 NULLPUNKT
12 CYCL DEF 7.1   X-0.25
13 CYCL DEF 7.2   Y+2.35
14 L  X+22.5  Y+35 R0 FMAX M99
15 L  X+55  Y+85 R0 FMAX M99
16 L  X-12.5  Y+50 R0 FMAX M99
17 L  Z+100 R0 FMAX
18 STOP
19 L  X-30.101  Y-19.803  Z+44.508
20 L  X-29.976  Y-19.841  Z+44.508
21 L  X-29.845  Y-19.846  Z+44.508
22 L  X-29.455  Y-20.244  Z+44.408
23 L  X-29.585  Y-20.236  Z+44.408
24 L  X-29.709  Y-20.195  Z+44.408
25 L  X-29.817  Y-20.122  Z+44.408
26 L  X-29.904  Y-20.025  Z+44.408
27 L  X-30.635  Y-19.01   Z+44.408
28 L  X-30.981  Y-18.508  Z+44.408
29 L  X-31.298  Y-17.989  Z+44.408
30 L  X-31.581  Y-17.451  Z+44.408
31 L  X-32.336  Y-15.788  Z+44.408
```

How are section comments managed?

The inserted structure comments are managed by the TNC in a separate file (extension: .SEC.DEP for "section dependent"). In the file manager you can see in your program from the status "+" whether such a dependent file exists. Storing the comments in an external file increases speed when you navigate in the structure window. +

Now Even User-Friendlier: The New Improvements to the MANUALplus 620

For years, MANUALplus controls have been known for their convenience of operation. An additional step in the direction of user friendliness was made with smart.Turn programming, which made it possible to expand the control's range of applications to single-spindle CNC lathes. HEIDENHAIN also used this opportunity to greatly expand the functions of the MANUALplus 620 once again. The new software supports machining with the Y axis, recognizes multipoint tools, monitors tool life and much more.

The MANUALplus 620— a model of user-friendly operation

Facing a part on a lathe using a driven tool

New functions for drilling and milling in the C and Y axes

The new software substantially adds to the control's capabilities in drilling and milling operations: machining with the Y axis, for example, makes it possible to machine slots or pockets with even floor surfaces and vertical groove edges.

The user can choose between various infeed strategies for milling: direct infeed, infeed in a pilot hole or a 3-D approach arc, and helical (spiral) or reciprocating plunge. Appropriate predrilling cycles with calculation of the predrilling position supplement these new strategies.

Other new cycles are for deburring with the C and Y axes as well as for inscriptions by engraving on a face or lateral surface (XY or YZ plane). For all of these cycles you only need a few parameters to get the job done.

Speaking of getting your job done: the graphical interactive ICP contour editor supports work with the C and Y axes in smart.Turn programs. For standard figure such as slots, circles or polygons you only need a few parameters. Holes and figures to be milled can be arranged in linear or circular patterns, and even hierarchical arrangements such as figures within other figures are no problem for the MANUALplus 620. One example: the user defines a pocket and, within the pocket, a slot, and then holes within the slot. And all of that without any long-winded computations, because ICP finds the positions of these figures and holes automatically.

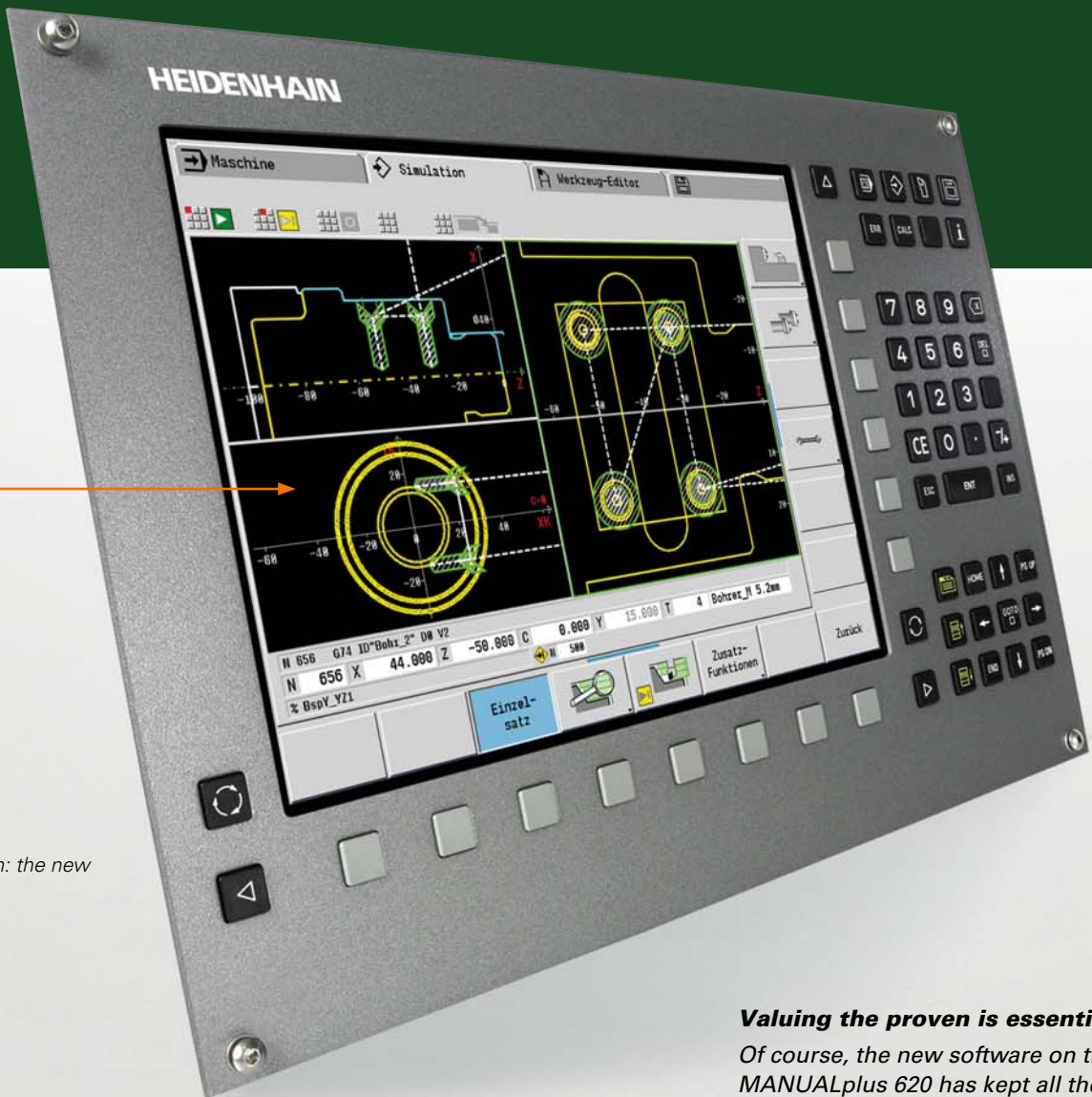## Gaining new perspectives: simulation the program run

The numerous graphical simulations for material removal, the proportioning of cuts, and the finished contour have always provided valuable support for program verification. Now, with the new software, the control has been expanded with new views and a convenient, well arranged multi-window depiction of the simulation. Besides the "turning view," for operations with the C axis it offers the face and lateral surface views, and for working with the Y axis the XY and YZ views. The user simply selects a window combination with up to four views that give him an optimal perspective for checking the program code and the machining operation.

During simulation of an NC program, the control calculates the unit times for the programmed operation. A table clearly shows the machining time and idle time of each working step. That not only helps in calculations, for example to make a quotation for a customer, it also provides a great perspective for finding opportunities for optimization.

Straightforward simulation of the machining times of an NC program

Control

Clear-cut simulation: the new multi-window view

Short setup times, long production times

The new "tool measurement by touch probe" function saves setup time. Finding tool dimensions has become surprisingly easy with the HEIDENHAIN touch probe and the new preprogrammed measuring cycles: simply pre-position the tool, select the measuring direction and start the measuring cycle. From the positions measured, the MANUALplus calculates the tool lengths and loads the dimensions in the tool database.

Another new feature is the tool life monitoring with replacement tools. The permissible tool life in terms of time or number of finished workpieces can be individu-

ally defined. If the "interchange chain" is also defined, the MANUALplus has all the information it needs to automatically switch to a "sister tool" when an older tool is worn out. The MANUALplus does not stop production until all of the tools in a "chain" have been exhausted.

Do you use tools with more than one cutting edge? No problem. The cutting edges can be individually dimensioned and assigned to a tool. If such a multipoint tool is placed in the turret, the MANUALplus knows every cutting edge and regards them individually—even for the tool-life monitoring. +

Valuing the proven is essential

Of course, the new software on the MANUALplus 620 has kept all the features that for years have made it so valuable in its daily work on cycle and CNC lathes.

→ *Powerful **teach-in function**: machine your first part interactively while saving your cycle program for the rest of the batch.*

→ ***smart.Turn** programming mode: you can use "intelligent" updating and DIN PLUS for special tasks.*

→ ***ICP** interactive graphic **contour editor***

→ ***Tool and technology database**: simplifies the definition of tool parameters and proposes the appropriate feed rate for each machining step (in a three-dimensional table with workpiece materials, cutting materials, and operating modes).*

News from the HEIDENHAIN Touch Probes

Better and Easier Measurement

Tool calibration is standard

Tool wear needs to be kept under control. No one can afford tool breakage. This is no problem for the machine operator: you simply clamp a tool touch probe on the machine table and your worries are over.

But what happens in a 5-axis machining center with a moving rotary table? Or a tilting table? Here the cable is usually in the way. Not so with the new HEIDEN-HAIN **TT 449 tool touch probe and wire-less infrared transmission**. It sets your machine free. There's no cable to worry about when the worktable tilts or rotates. Place the compact **TT 449** wherever you wish. The tool is measured quickly. After all, the customer's waiting.

No transmission without reception

Communication is the greatest strength of the new **SE 642 transmitter/receiver unit**. Besides from the new TT 449 tool touch probe, it also receives signals from a TS workpiece touch probe and forwards them to the control. And it calls attention to itself. With multicolor LEDs, the **SE 642** shows the quality of the infrared signal and the status of the touch probes.

TT 449 Touch Trigger Probe for Tool Measurement on Machine Tools

- For measuring and inspecting tools right on the machine
- With infrared and 360° transmission
- With rated breaking point in the connection pin (prevents damage from operator error)
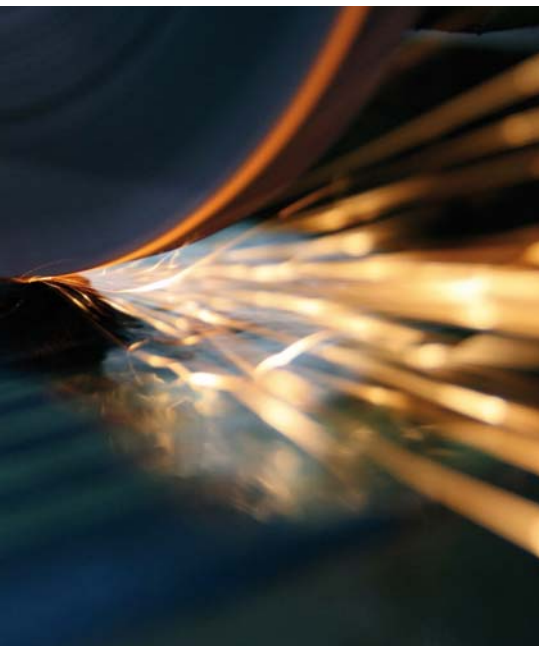- With spare connecting pin

Probing directions	±X, ±Y, +Z
Probe accuracy	≤ 15 µm
Repeatability	2 σ ≤ 1 µm (at a probing velocity of 1 m/min)
Probing velocity	≤ 5 m/min
Power supply	Two 3.6 V/ 2/3 AA lithium batteries, operating period approx. 200 h or rechargeable or nonrechargeable batteries, each 1 to 4 V
Angle of transmission	0°
Mounting	On the machine table with two fixing clamps or mounting base (accessory)

No cable—the new HEIDENHAIN TT 449 Tool Touch Probe

Compatible and repeatable

The applications are varied but the quality has to be high, whether in 5-axis machining centers ...

... or in lathes and grinding machines.

A workpiece needs to stay within its tolerances. And so does the entire series. This requires a workpiece touch probe with high signal quality. This is where the new HEIDENHAIN **TS 249 workpiece touch probe for grinding machines and lathes** comes in, working with the proven HEIDENHAIN sensor—wear-free and accurate, even over many measurements. And it almost doesn't matter what control you're working with, because the **TS 249** provides trigger signals that are ready for processing by many controls. Besides the standard HTL signal, there is also a floating trigger signal for the "high speed skip" input of the control. What's especially convenient: the electronics are entirely integrated, and the device is connected directly to the control.

Any other advantages? With its compact design and a 30 mm outside diameter, the **TS 249** fits almost everywhere. That provides many opportunities: both on NC-controlled cylindrical grinding machines and tool grinding machines due to the tight workpiece tolerances and the necessary process reliability, as well as on surface grinders or lathes.

Fastened by outside thread

Compact design with 30 mm outside diameter

Proven HEIDENHAIN sensor

TS 249 Touch Trigger Probe
for NC controlled grinding machines and lathes

- For the measurement and inspection of workpieces
- Power supply and signal transmission by cable
- Optical deflection display
- Standard stylus with M3 thread (adapter available for styli with M4 threads)

Probe accuracy	≤ ± 5 µm (with standard stylus)
Repeatability	2 σ ≤ 1 µm (at a probing velocity of 1 m/min)
Probing velocity	≤ 3 m/min
Power supply	15 to 30 V / ≤ 100 mA
Output signals	HTL and floating trigger signal
Electrical connection	M12 flange socket, 8-pin
Mounting	With fastening kit to tilting element of machine manufacturer
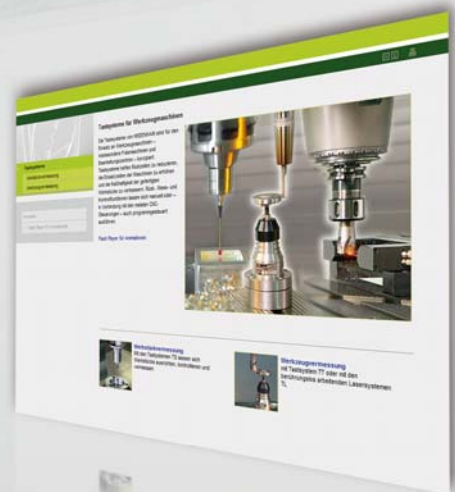
You will find more information about HEIDENHAIN touch probes in the Web under:
www.heidenhain.de/touchprobes

HSC Cutting with the HEIDENHAIN iTNC 530

Speed in Top Form

GEMÜ in Ingelfingen, Germany, uses the expertise of its toolmaking people for the manufacturing of innovative valve, measuring and controlling systems. Not only is the highest possible surface quality important. The toolmaking department has long seen itself as the "tool production department" for GEMÜ's own needs and as a partner for outside customers. It's all about the fastest possible door-to-door times and the highest possible productivity. Fast 5-axis simultaneous machining with an Exeron HSC 600 milling machine, controlled by a HEIDENHAIN iTNC 530, plays an important role here.

For some time now, direct High Speed Cutting (HSC) has been gaining in importance compared with classical die-sinking EDM. Precise control of the enormous acceleration and deceleration processes along a programmed path is a prerequisite for fast, accurate contouring. The path control of the CNC control has a decisive influence on the optimization of machining times under given requirements for accuracy and surface definition.

Careful comparisons result in an optimal solution

Ralf Herrmann, manager of mold design and tool production, searched the market intensively to find a solution that meets stringent requirements for surface definition while at the same time ensuring high productivity. After all, in 2008 he had to manage the production of 73 new tools and numerous tool changes. Ralf Herrmann says, "With the combination of the Exeron HSC 600 and the HEIDENHAIN iTNC 530 we observed the shortest non-cutting time in comparison with other systems. The machine has been producing for about six months and we're getting ever better at exploiting the opportunities of 5-axis technology. There were other controls in the competition, but our highly trained specialists need only a short time to familiarize themselves with operating the HSC 600 thanks to their previous experience with the iTNC." Walter Oechsle,

foreman in the GEMÜ tool production department added, "My people were able to work with the new equipment after a two-day course at Exeron. They needed almost no new training on the controls. After all, the CNC machines for tool production are already equipped with HEIDENHAIN controls. Only some special machine functions such as the laser calibration were new for them." "One old advantage of the HEIDENHAIN control," said Oechsle, "becomes apparent in 5-axis machining: I can't have everything programmed offline for the toolmaking department. On the Exeron HSC 600, too, we often use the convenient shop-floor programming of the iTNC."
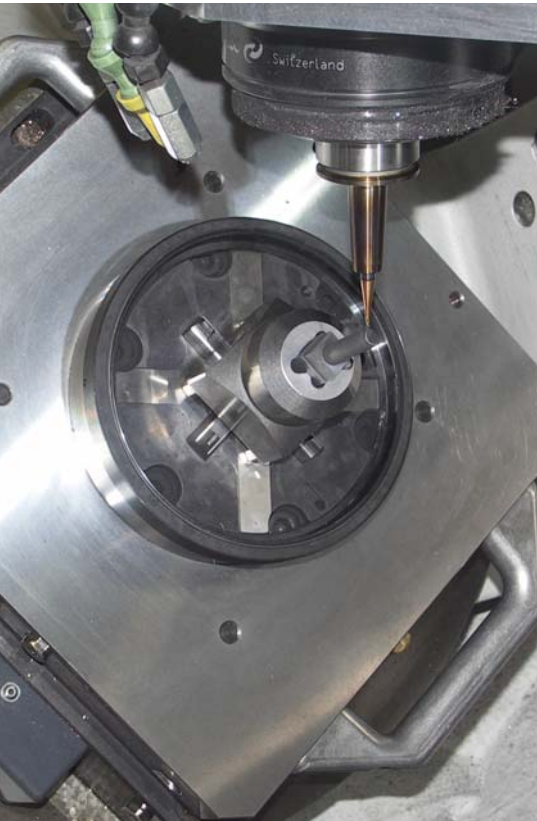
One of the GEMÜ tool production department's responsibilities is still the manufacture of electrodes for use in EDM machines. And many of the electrodes take up to 30 minutes of machining time, of which tool changing represents a considerable share. Productivity will be increased even further by a pallet system that will be installed in the upcoming months. Ralf Herrmann is also thinking about integrating HSC milling machines in the production process in order to manufacture serial parts and save on polishing. After all, the GEMÜ tool production department is both a test center for future technologies and it prepares for serial production. With the Exeron 600 HSC series, controlled by the HEIDENHAIN iTNC 530, GEMÜ has a good horse in its high-tech stall.

Safe from collision and easy to recalibrate

Collision monitoring has become an important feature at the feed rates involved. GEMÜ has found the function to be very reliable—even in manual operation!

Then there's the gain in accuracy thanks to **KinematicsOpt.** Rather than editing the NC program, this feature of the iTNC 530 adapts the kinematic model saved in the machine. Changes in the kinematics are measured and, if desired, automatically compensated with the aid of a high-accuracy HEIDENHAIN touch probe and the absolutely precise HEIDENHAIN calibration sphere. With this compensation information for recalibration, with takes only a few minutes, the machine can move the tool more accurately along the programmed contour. The error of the calibration sphere center is logged for all rotary axes, and statistical evaluations inform the user whether the required accuracy can be maintained through recalibration or whether an entirely new calibration is necessary. To really understand how up to five axis move simultaneously, to always know which zero point has to be active for which side, requires a great deal of skill and demands your complete attention. This is where KinematicsOpt helps: the user only needs to place the calibration sphere correctly on the machine table to be able to machine precisely in the long term or to reduce running-in periods.

The figure at upper right shows a slide mold that was manufactured with the Exeron HSC 600.

This injection molding die (figure at lower right) is used to manufacture a valve body of PFA (Teflon).

Glance into the machine room: precise HSC milling

"The toolmaking department is also a test center for future technologies."

Ralf Hermann,
Tool & Die Production Manager

It depends on the control strategy

The high feed rates in HSC machining inevitably require higher axis accelerations on curved workpiece contours. Each machining task must be performed so that highly dynamic movements do not cause disturbance from machine vibration and reduce the quality of workpiece surfaces. Motion control for 5-axis machining places especially high demands on the control. At the same time, the machining time has to be minimized and the surface definition optimized while fulfilling given accuracy requirements. To keep the production times in an acceptable range, freeform surfaces are frequently milled with path directions reversed between passes. Meanwhile, the control must generate reproducible tool paths when approaching contour elements from opposing directions. The deviations between adjacent milling paths must remain significantly smaller than the defined path tolerances.

NC programs for free-form surfaces are usually created with a CAM system and consist of simple line segments. HEIDENHAIN controls automatically smooth the block transitions while the tool moves continuously on the workpiece surface. This automatic smoothing is controlled by an internal function that monitors the contour deviations. This function (Cycle 32) enables the user to define the permissible contour deviation. Without smoothing of the nominal path data, the axes of the machine would have to accelerate abruptly at the transition points. The resulting jerk would excite intensified oscillations of the machine. Contouring deviations would inevitably occur that, depending on the change of curvature and path velocity, would reach dimensions that cannot be tolerated in micrometer-precise machine tools. The path control of the iTNC 530 smoothes the jerk and complies with the given contour tolerance even with strong changes in contouring speed. +

GEMÜ Gebr. Müller Apparatebau GmbH & Co. KG

From the very beginning, more economy, consistent, reliable product quality at affordable prices and more benefit for the customer were the motives for industrial valve manufacture at GEMÜ. The invention of the world's first directly controlled electromagnetically actuated seat valve made of plastic (PVC) in 1963 enabled design engineers to take their first economic steps toward automation in the field of galvanic systems. In his parents' garage and kitchen in Ingelfingen, Germany, Fritz Müller manufactured the first of the plastic process valves he had invented. This was followed in 1977 by the development of the plastic variable-area flow meters in the GEMÜ 800 and GEMÜ 850 series. One important milestone in the company's development was the inauguration of the new GEMÜ DOME innovation center in January 2009. Today, GEMÜ enjoys great respect as an innovative, owner-managed company with over 400,000 product variants and 12 subsidiaries worldwide.

➕ *www.gemue.de*

New User Functions for the iTNC 530

With its new software 340 49x-06, HEIDENHAIN is introducing the type of improvements that make a user's heart beat faster!
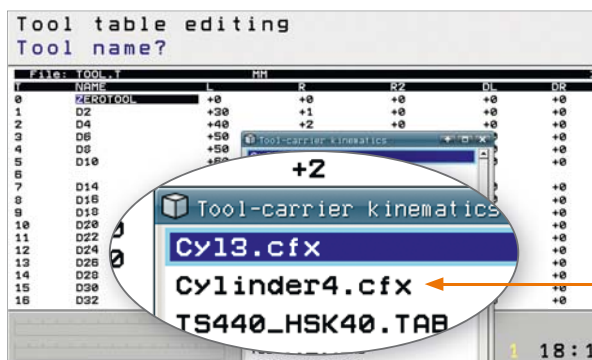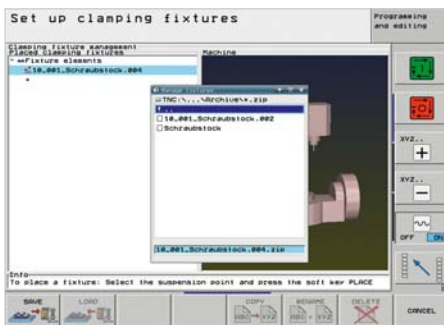
Improvement

Improvement

N E W

Dynamic Collision Monitoring (DCM—software option)

Save **entire clamping situations** and restore them at a later time. This possibility is a great advantage for integrated fixture systems, since the measurement process otherwise necessary when the fixture system is placed on the machine again can be omitted entirely.

Another new feature is **ToolholderWizard**, which enables you to enter parameters for tool carriers, e.g. angle heads simply and with conversational guidance.

This protects the housings of the various touch probes from collision with fixtures and permanent machine components: simply assign the appropriate file to the touch probe in the tool table.

KinematicOpt: inspecting and compensating machine error (software option)

Now also measure the **misalignment of an angle axis** (head or table). For head axes the rotary axes are measured twice, each time with a stylus of a different length. In addition, the new **calibration cycle 460** is available because the styli must be changed between the two measuring cycles. With the new calibration cycle 460 you calibrate using the HEIDENHAIN calibration sphere already in place.

Support for the **measurement of Hirth-coupled spindle heads** has also been improved. Positioning of the spindle head can now be performed via an NC macro that the machine manufacturer can integrate in the calibration cycle.

Possible backlash in a rotary axis can now be ascertained more precisely. By entering an angular value in the new **Q432 parameter of Cycle 451,** the TNC moves the rotary axis at each measurement point in a manner that its backlash can be ascertained.

New Cycle 275, TROCHOIDAL SLOT

This new cycles enables you to manufacture closed and open slots and any desired contour slots quickly and efficiently. The cycle begins with a roughing operation that is also know by the term **trochoidal milling**. In the subsequent operation the side walls are finished in order to remove the "saw teeth" produced during roughing.
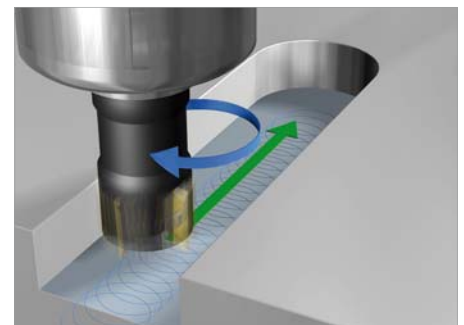
How does trochoidal milling work? The roughing process consists of trochoidal motions (Greek "trochos" = wheel). This means that the TNC calculates the milling path by superimposing a linear forward motion over a circular motion of the cutter. With trochoidal milling, large cutting depths and high cutting speeds are possible because the equally distributed cutting conditions prevent wear-increasing influences on the tool. Quite the opposite: when tool inserts are used the entire cutting length is exploited to increase the attainable chip volume per tooth. Not only that, but it's easier on the machine mechanically. Enormous amounts of time can also be saved by combining this milling method with the integrated adaptive feed control (AFC) software option.
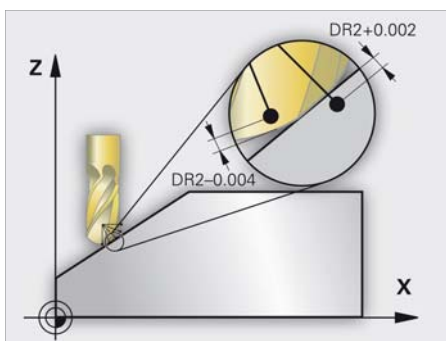

For the touch probes, HEIDENHAIN provides appropriate parameter files.

New
NC software
340 49x-06!

NEW

Improvement

New 3-D radius compensation with 3D-ToolComp (software option)

Make a compensation-value table defining angle-dependent delta values that describe the tool deviation from the ideal circular shape. **3D-ToolComp** then corrects the radius value defined for the workpiece's current point of contact with the tool. In order to determine the point of contact exactly, the NC program must be created with surface-normal blocks (LN blocks) by a CAM system. The surface-normal blocks specify the theoretical center point of the radius cutter, and in some cases also the tool orientation relative to the workpiece surface.

Enhanced tool management (software option, machine-specific function)

Enjoy a much better perspective of your tools and magazines. Many new features are offered: You can use your mouse to load and unload tools through drag-and-drop. The tool usage list informs you how long each tool has been cutting workpieces. Another new feature is clearly structured tables that use color coding to indicate various tool statuses.

Deviation of the tool from its ideal circular form

Well organized and easy to read: The tool usage list

The best method is to define the compensation-value table fully automatically by way of a special cycle that uses a Blum laser system to measure the form of the tool so that the iTNC can then use this table directly.

With the new features in the 340 49x-06 software it's full speed ahead.

+++ Even more improvements +++

Program selection

And now, when you call a program using PGM CALL, you can select the desired program in a pop-up window. The TNC automatically enters the path name.

3-D line graphics

The 3-D line graphics can now also be displayed in full-screen mode to improve clarity of detail.

PLANE function

When tilting to position using the TURN function, enter an MB retraction path (move back), which if desired can extend to just before the limit switch (MB MAX).

Manual alignment

In the manual probing cycles you can compensate measured workpiece misalignment by a movement of the rotary table.

Q parameter programming

Now you can define jump addresses through QS string parameters, e.g. IF = 0 GOTO LBL QS99.

You'll find more information in the interactive Klartext e-magazine

www.heidenhain.de/klartext

HEIDENHAIN iTNC 530 in Heavy Machine Manufacturing

Heavy Machining—
Easy Programming

Schade Maschinenbau GmbH in Wildeshausen, Germany, has consistently relied on TNCs. Their latest purchase, a PCR150plus traveling column milling machine from Union, was equipped with the iTNC 530. Used machines were retrofitted with the iTNC 530 and new drive technology from HEIDENHAIN. This makes even old machines suitable for the stringent requirements on today's high-precision heavy engineering. Further benefits for Schade GmbH: because the controls are the same, each employee is able to write NC programs on all machines, which enhances productivity. Also, all employees can access a central program data pool.

"Over recent years, our costs from maintenance and the increasingly frequent downtimes of the old controls on our machines had grown dramatically." Dirk Schade (Dipl.-Ing.), Chief Executive of Schade Maschinenbau GmbH, remembers, "It was definitely time to modernize the controls." The company employs 40 people, specializes in machining, drilling and milling, and is active in heavy steelwork and its complete assembly. Its customers include enterprises in the space and aeronautics industry, manufacturers of wind power plants, ships' propellers and compressors, as well as in the auto and construction industries.

First there was a period of intensive research, but then the decision was clear: to upgrade the machines to the iTNC 530 from HEIDENHAIN. "When we knew that we would modernize our machine tools I specifically asked my business partners about their experiences. All of them praised the operating interface and the wide range of functions in the HEIDENHAIN controls as well as the good after-sales service. The especially mentioned the idea of exchanging units when service becomes necessary," said Schade. They manager of mechanical production, Di-

eter Bramkamp, also favored an upgrade to HEIDENHAIN controls. "My son works at a machine tool manufacturer where they've been using HEIDENHAIN controls for years. Although that company is working with high-speed machines while we're in heavy engineering, the programming work at the machines is similar. When we would talk shop in the evenings after work, I was surprised over and over again to hear how effective the programming at HEIDENHAIN controls is in the workshop and all the additional capabilities they give us." With this knowledge, Bramkamp— who for 30 years had worked exclusively with controls from another manufacturer—recommended that the executive management retrofit their machine tools to HEIDENHAIN controls.

Then they were ready to rock: since 2007 a Butler Elgamill HE 5000 CNC universal milling machine and two Butler Elgamill HE 5000 CNC table-type boring mill. That was followed in August 2009 by a Scharmann Ecocut 2 CNC boring mill, and then another one—a Scharmann FB 160 Opticut. In addition, Schade Maschinenbau GmbH invested in a PCR 150plus traveling column milling machines from Union, which can machine components of up to 40 metric tons from five sides in one set-

"The simple and fast operability impressed us right from the very first workpiece."

Dirk Schade, Chief Executive,
Schade Maschinenbau GmbH

up. This new machine was ordered from the manufacturer with a HEIDENHAIN control already integrated. "The sales rep from Union was amazed when we even presented him with the keyboard layout we wanted on the control. It's simply extremely important to us that the same conditions can be found on all machines, so that every employee can work on every machine and they can support each other and learn more easily," said Schade. "This way of working ensures, for example, that a job can continue during the late shift even if there are problems, because the operators are better prepared to solve them and understand each others programming."

Implementation without complications

Chief Executive Dirk Schade got in touch with HEIDENHAIN in Traunreut about retrofitting the existing machines. HEIDENHAIN always recommends letting the job be done only by qualified machine retrofitters and is glad to name contractors in the region who offer this service. "I interviewed three recommended retrofitters and then asked them to write me a quote. We finally decided on the contractor with the most experience, considering that they had to do the upgrade while production otherwise continued," said Schade. Before each retrofit Dirk Schade worked with the contractor to devise a detailed flow chart. →

Of course, Schade ordered the Union PCR 150plus with a HEIDENHAIN control (8000 mm X traverse, 3000 mm Y traverse).

Forty years of Schade Maschinenbau

In 2009 the employees, customers and friends of Schade Maschinenbau GmbH celebrated its 40-year anniversary. During the celebration, which took place last year in June, the contract manufacturer in the heavy engineering sector introduced a new acquisition for its machinery: a Union PCR 150plus traveling column milling machine (equipped with a HEIDENHAIN iTNC 530), which can machine workpieces as heavy as 40 metric tons on five sides in one setup. This was a significant expansion to the range of service offered by the company, which was founded in 1969 by Kurt Schade. Schade Maschinenbau GmbH specializes in heavy machining, drilling and milling, and is active in heavy steelwork and its complete assembly. Its customers include enterprises in the space and aeronautics industry, manufacturers of wind power plants, ships' propellers and compressors, as well as in the auto and construction industries.

*Schade Maschinenbau
GmbH & Co. KG
Visbeker Str. 31
27793 Wildeshausen*
➕ *www.schade-maschinenbau.de*

The results at a glance

The consistent upgrade of the machinery to iTNC 530 HEIDENHAIN controls has brought Schade Maschinenbau GmbH the following benefits:

➔ The plain language programming of TNC controls from HEIDENHAIN controls is extraordinarily well designed for the shop-floor programming practiced at Schade.

➔ The programming times have already been reduced by up to 30 percent thanks to the easy operability of the control and the numerous ready-made programming cycles.

➔ The setup times have been reduced by about 20 percent through the use of touch probes with new HEIDENHAIN controls, and the machining times were reduced by about ten percent through faster execution and the optimal path control of the TNC.

➔ Since the upgrade, Schade has been offering its customers higher accuracy. The tolerance zone of the finished workpieces has increased from H8 to H7.

➔ Maintenance costs and downtime of the control has been dramatically reduced.

➔ A well-thought-out production schedule prevented the retrofitting work from hurting the production volume.

The Real World

Left to right: Chief Executive Dirk Schade, Machinist Jens Luthardt, Production Manager Dieter Bramkamp

The machines were upgraded during the summer main vacation period. At the same time, a second shift was run on another machine to compensate the downtime of the machine being retrofitted. Because of this planning and the careful selection of contractors, after six weeks all machines had been upgraded without complications. At the same time they replaced not only the old control with an iTNC 530 from HEIDENHAIN, but also exchanged the wiring, the measuring technology and the motors. Schade also uses the HEIDENHAIN TS 640 touch probe on his machines. This enables the control to recognize the position of the workpiece on the machine and use it to calculate the positions for drilling holes and cutting. So the employer is no longer forced to align

Jens Luthardt, a Schade employee, is already operating the upgraded Wotan Rapid II.

Milling in heavy steel construction, that's the know-how you'll find at Schade Maschinenbau

the tool on the table to the nearest millimeter, and this reduces setup time by about 20%. "Beyond that, by retrofitting our machines we're now attaining tolerance reductions from H8 to H7 quality specifically in the circular milling area," explained Production Manager Dieter Bramkamp.

A short learning phase

After retrofitting each machine, the retrofitter trained the operators for a few days in the use of the new control. Key users additionally participated in a five day course at HEIDENHAIN in Traunreut. These courses are consistently oriented to the day to day work in the production department, so that the participants can immediately apply everything they learn. At Schade Maschinenbau GmbH, the programs run here for a quantity of one piece are written directly at the machine with conversational programming. For machining arrangements like hole patterns, this heavy engineering company is glad to use the alternative operating mode "smarT.NC." Graphical simulation of the workpiece machining provides the machinist with

an additional verification capability and improves safety. The programs are archived on a central server over a network of all the CNC machines. In this way they can access existing programs and quickly adapt them for similar jobs. Schade says, "From the very first minute, our operators were convinced of the workshop orientation and, above all, the fast and simple operability of the HEIDENHAIN control." This has reduced programming times consistently by 20 to 30 percent. In the future, Schade Maschinenbau GmbH intends to create the technical conditions required for a direct transmission of DXF files to the controls. +

COMENIUS School Partnership Project: **European CNC Network** project with the "Train for Europe"

Europe is Growing Together—How Trade-School Students Put the European Spirit into Practice

A vision became reality. Over 1000 vocational school students and their teachers from 24 schools in 21 countries worked on a common project. This was the largest school project ever supported by the European Union. After two years, the impressive result was presented in the European Parliament in Brussels, Belgium.

The rolling result of the school project, named COMENIUS, is a "train for Europe." And it really moved. Pulled by three locomotives, a total of 25 individually designed cars got traveling: everything was designed by the students and the many individual parts were manufactured on NC-controlled machine tools. The project depended on intensive teamwork, which—thanks to the "European CNC Network"—met with outstanding success.

Enthusiasm was the passenger

Communication between the students of the various countries was the key for the project's strong start. And HEIDENHAIN, too, was pulling vigorously. As a partner of industry, HEIDENHAIN participated with programming training at the conferences and a cost-free TNC programming course in Traunreut for participants from Malta, Hungary and Croatia. HEIDENHAIN provided the programming station software and training documentation. It also equipped the coordinating schools with altogether four cost-free programming stations. HEIDENHAIN was in fact so excited, that it hitched on its own car so that a group of its own apprentices could par-

ticipate. Like all the other participating students, the apprentices designed and manufactured the car entirely by themselves. They made the drawings, wrote the CNC programs and made all the parts on their own TNC-controlled machine tools. So the "HEIDENHAIN car" was created from the astonishing number of 261 components, which was entirely intentional, because the railroad passenger car was supposed to be a close to the original as possible.

Will the train keep rolling?

The course for continuing the project has already been set (Train for Europe—Reloaded), and HEIDENHAIN is on board. The project resulted in a great number of contacts for advancing the cause of CNC training all over Europe. Perhaps we'll see other countries pick up on the "Train for Europe" idea, for example as a "Train for China," "Train for India" or "Train for Russia." A bon voyage for CNC basic and advanced training, and not only for Europe.

HEIDENHAIN's contribution
In September 2007, HEIDENHAIN joined the multilateral school project as a partner from the industry. Right from the first international meeting, the cost-free programming software met with great interest. All participants had already received the HEIDENHAIN e-learning program "TNC Training." Programming courses offered at the regular meetings dealt with programming questions, new control features as well as documentation and support. HEIDENHAIN's technical support was active throughout the entire project. During the final results presentation in Brussels in April 2009, the invited guests and EU representatives marveled at the Train for Europe.

Project conclusion
HEIDENHAIN was able to provide full support to the goal of improving the methods and contents of CNC vocational training. And the students, who created more than 60 plain-language programs (even turning programs and one 5-axis program) clearly showed that qualification is fun—as additional homework and a thank you to HEIDENHAIN.

www.cnc-network.eu

Precision from the very start— an apprentice assembling the HEIDENHAIN car...

... that rolled with the others in the "Train for Europe."

10 years of the TNC Training Network

Locations for learning

Everybody's talking about "networking"—which means making new contacts, building relationships, finding partners. HEIDENHAIN had very practical reasons for getting into networking.

Since 2000, HEIDENHAIN has continuously been building a TNC training network. Part of the network includes educational institutions that, as authorized training partners, offer TNC basic and advanced courses. Here users learn everything about the real-world creation and execution of CNC programs. And the benefits are many: the courses can be visited locally, without long waiting periods, and the quality of the courses is guaranteed by HEIDENHAIN.

Learning it right

To ensure the quality of the offered training, HEIDENHAIN places specific requirements. The training partners have to show plenty in regard to equipment, quality and activities (see sidebar). The idea met with success, and the demand for training grew. Even some freelance CNC trainers can become "mobile" authorized training partners if they fulfill certain criteria.

The net is getting denser

Already in 2003, the network started cooperating with training partners in the neighboring European countries. Today,

29 authorized partners in Germany and in neighboring European countries belong to the HEIDENHAIN training partner network. And of course, HEIDENHAIN strives to make it even easier for users to take part in TNC training. Already in 2009, six more declarations of intent to cooperate were signed.

How did it happen?

About 10 years ago, two trends resulted in the development of a training network. On one hand, an increasingly strong demand emerged for TNC courses. Many CNC machine tool builders refer their customers directly to the control manufacturers for

Basic requirements of authorized training partners

Equipment
Courses are conducted on original HEIDENHAIN programming stations and with a CNC machine equipped with a HEIDENHAIN control.

Quality
The trainers have to visit the HEIDENHAIN standard courses and annual upgrade courses.

Activities
Conduct of TNC basic and advanced course and (since lately, if the opportunity arises) the integration of TNC training topics in vocational measures that include CNC.

State of the art equipment ensures the quality of training—the new CNC training hall of the training partner GLW Velbert.

questions regarding training. On the other hand, the situation changed with the training providers. The focus turned more toward on-site courses because government support for educational measures was reduced and training providers wanted to enhance practical relevance and sought cooperation with the industry.

Networking is therefore very successful as long as the participants keep the quality of TNC programming training in mind. And that's what HEIDENHAIN does. +

Qualification pays!

Since July 2009, all HEIDENHAIN courses are certified according to AZWV (Recognition and Authorization Ordinance for Continuing Education). You, too, could profit from support by the Federal Employment Office for continuing education measures.

Zertifiziert nach AZWV

ZERT ✔ PUNKT

Trägerzulassung

Registriernummer: A90601

Zertifiziert nach AZWV

ZERT ✔ PUNKT

Maßnahmezulassung

Prompt and nearby TNC programming courses—they make it easy for TNC users to increase their skills.

+++ News from the training partners +++

One training partner who invests in training and continuing education is the **GLW (community training workshop of industry in the greater Velbert area)***, who inaugurated a new CNC machine shop in September 2009.*

The **Educational Institute of Industry and Commerce in Saxony (BSW) in Mylau***, a training partner from day one, celebrated its 10th anniversary of training partnership with HEIDENHAIN in September 2009. The BSW, too, invested in these years: altogether 650,000 euros for trainers, machines, tools and measuring technology.*

Also in September 2009, the **TREMAC BVBA** *company—an authorized training partner since 2003—took responsibility as exclusively authorized training partner for TNC programming courses in Belgium.*

The newest member of the TNC network is the **AGIE CHARMILLES GmbH in Schorndorf, Germany***, as a qualified training partner of HEIDENHAIN.*

You can find more information at the HEIDENHAIN training portal:
✚ **www.heidenhain.de/training**

You'll also find all authorized training partners in the KLARTEXT e-magazine under:
✚ **www.heidenhain.de/klartext**