



# Klar text

News from the World of HEIDENHAIN Controls

Issue 48 + 4/2008

5-Axis Machining:  
Speed and Quality  
in Harmony

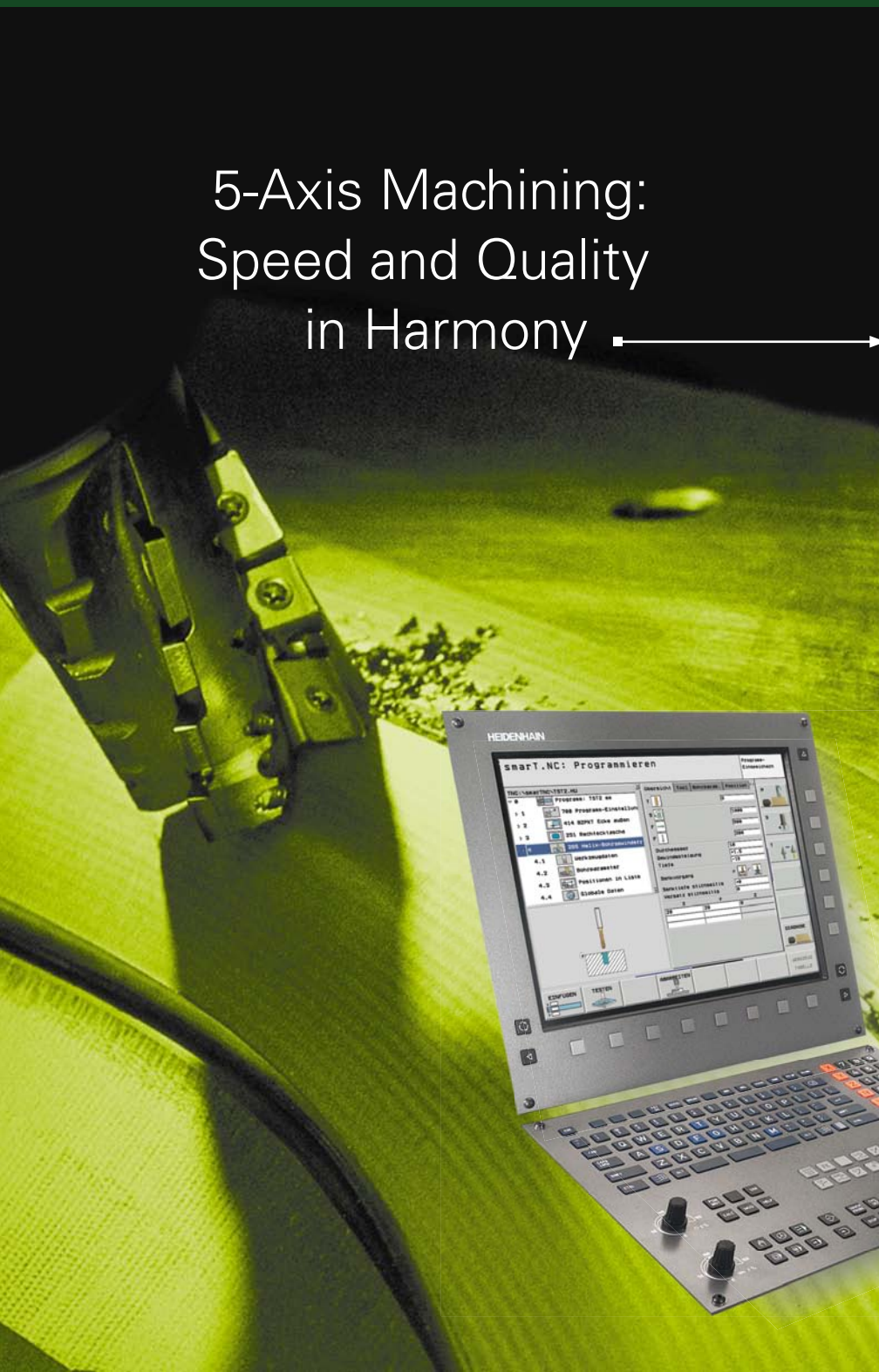
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## Editorial

### Dear Klartext Reader,

The **lead article** explains the benefits and requirements of 5-axis machining. Although this is also of interest to machine operators, the article mainly addresses those entrepreneurs who are the decision makers in tool-and-die-making companies. Decisions about **investments** and **innovations** are difficult, since they often have long-term consequences. This issue of KLARTEXT describes options for businesses that must offer a range of services appropriate for the market to meet the increasingly complex tasks and demands for high quality from their customers.

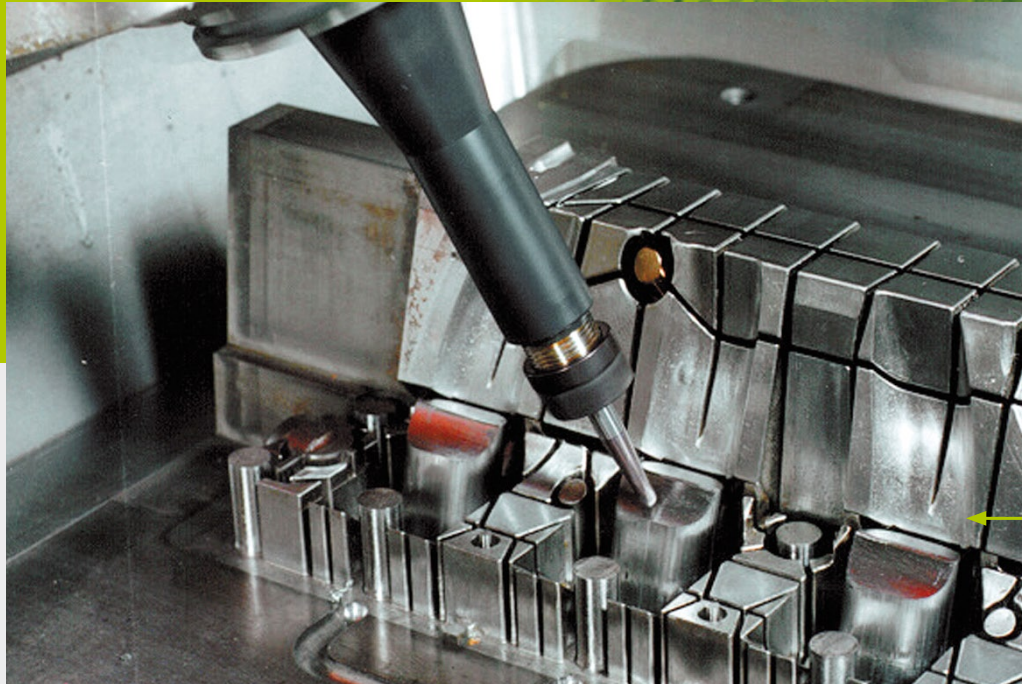
The Roque de los Muchachos Observatory on La Palma (one of the Canary Islands) is one of the largest astronomical stations worldwide.

Read the **Application Report** to see about HEIDENHAIN's role in "High System Accuracy Leads to Farsightedness."

The term **upward compatibility** describes the useful property of hardware or software to be compatible with the subsequent version after an upgrade. We will show you how HEIDENHAIN accomplishes this task despite ever shorter product cycle times.

And since our customers may expect more than just competence and reliability from a trustworthy brand, namely intangibles such as added value and dedicated efforts, you will not only find enthusiasm for new technologies and innovation in this issue of KLARTEXT, but also an article on the economic retrofitting of machine tools.

So please read and enjoy! We at Klartext are convinced you'll be glad you did.



*You must remain master of five-axis machining processes – the control assists you with intelligent support.*

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*Machine tools retrofitted with HEIDENHAIN products give an engineering shop the potential to produce quicker and more economically.*

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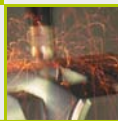


Also check out our interactive KLARTEXT e-magazine, with even more background information, animations, and expert knowledge. Take a look at [www.heidenhain.de/klartext](http://www.heidenhain.de/klartext)



*HEIDENHAIN manages the balance act between compatibility and modernity for both hardware and software.*

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# 5-Axis Machining: Speed and Quality in Harmony

*“Problems are only opportunities in work clothes” – In the spirit of this quote, HEIDENHAIN develops solutions to meet the requirements of 5-axis machining. The result: The iTNC 530 control from HEIDENHAIN with functions and strategies for bringing short machining times and high surface quality into harmony.*

Demand for five-axis machining centers has been rising in recent years. The enhanced possibilities for producing complex parts speaks for these machine tools. For example, even undercuts in the workpiece geometry can be machined. Milling with five feed axes moving simultaneously makes it possible to produce complex sculptured surfaces with high surface definition. In addition, the number of fixtures needed for a workpiece, as well as the total number of tools, can often be reduced. This way you can reduce your costs per unit.

## Much is demanded of the control

The more axes there are, the more sources of interference there are. These relevant influences are of increased importance regarding the result of machining with the more complex kinematics involved in 5-axis machines.

This means that the control technology must meet high demands:

- + The control must relay demands regarding contour accuracy and surface definition to the motion profiles of the five feed axes, and at the same time reduce the production time to a minimum.
- + The regulation of the feed drives must suppress the effects of interferences on the relative motion between the tool and workpiece.

Being able to produce high-quality parts on five-axis machines with minimum machining times – this does not have to be a contradiction.

The iTNC 530 control from HEIDENHAIN uses methods that have been coordinated with the mechatronic properties of the machine tool. HEIDENHAIN improves the quality of the machining result

- 1) in the specification of the movement profiles,
- 2) and with the regulation of the feed drives.

## Specifying the movement profiles

When generating nominal positions for the feed drives from the data blocks of the NC program, the criteria to be taken into account must especially include vibration properties of the machine frame. Due to the forces involved, any change in the contouring speed includes the risk of exciting vibrations in the machine frame, which could negatively affect the surface definition of a workpiece. The iTNC 530 avoids excitation of machine vibrations, even at high contouring feed rates. The course of the jerk over time (second derivative of the velocity with respect to time) has an equal amount of influence on the workpiece surface definition and on the machining time.

The motion control of the iTNC 530 improves the quality of the finished part—while simultaneously optimizing the machining time – by limiting and smoothing the jerk.

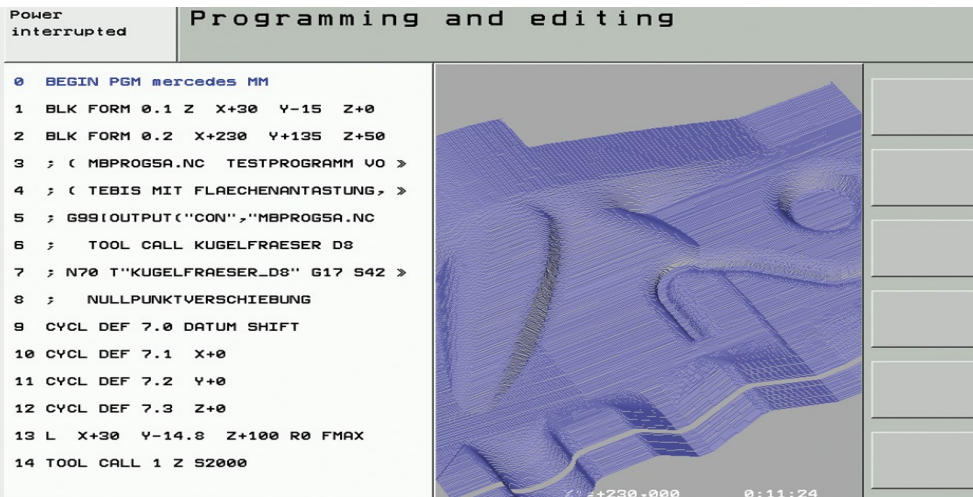
**The control provides assistance for the operator to remain master of five-axis machining processes.**

## Influence of the feed drives

Along with the motion control, the regulation of the feed axes also has a significant influence on the quality of the machining result. Proper movement of the milling cutter relative to the workpiece requires precise position measurements in the feed drives of the machine tool. If the actual positions, required for regulation, are generated by photoelectrical linear and angle encoders, significant improvements can be achieved in productivity and workpiece quality. System accuracy, thermal stability, high traversing speeds, tolerance to contamination and flexibility in interfacing the control enable their use in all applications.

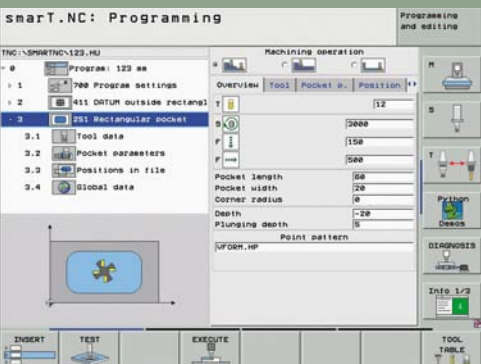
*Changes in the contour speed are already smoothed during the necessary course of the jerk by the extraordinary motion control offered by HEIDENHAIN. This can suppress machine vibrations very effectively. If necessary, the control automatically reduces the programmed feed rate to reduce the excitation of vibration to a minimum.*





### Example: graphically supported dialog language

Certain geometries, such as pockets or drill holes, are sometimes not added to an NC program for complex parts until directly at the control. Workshop-oriented cycles, which are adapted to the production of typical contour elements and also support machining in a tilted working plane, are necessary for programming tasks directly at the machine.



Dialog-guided program creation on the machine via smarT.NC

### Demands on the machine operator

The more complex the parts are, the more effort the programming tasks require.

Therefore, the control technology must also support the operator, since five-axis machining processes must always remain controllable.

The iTNC 530 control from HEIDENHAIN assists the machine operator with numerous functions for program creation and testing:

- + Functions for editing and testing of NC programs or program sequences
- + Enhanced functions for monitoring machine movements regarding possible collisions

+ Graphically-supported dialog language simplifies the corresponding parameterization of the cycles (enhanced assistance during program creation) (see example)

+ Possibility of visual inspection  
 This task is a special challenge to the machine operator if the program is very complicated, especially for workpieces to be machined with five axes. The iTNC 530 control from HEIDENHAIN offers the possibility of visually inspecting the programmed tool contour before machining actually begins. To facilitate inspection of the program, the workpiece surface is reconstructed as line graphics from the NC data blocks. In order to locate individual data blocks, the data points of the NC program are shown in the line graphics.



The effect of different strategies for path generation on the result of a workpiece machined with five axes.

The type of path generation resulted in significantly different machining times for the same NC program.

The high surface definition of the workpiece at left was achieved during a brief machining time with the special motion control of the iTNC 530 control from HEIDENHAIN.



## Safety for the machine and the tool

The more axes involved, the greater the risk of a collision between machine components during milling with five axes in motion.

The iTNC 530 control from HEIDENHAIN offers practical functions for this:

### + DCM—Dynamic Collision Monitoring

In order to reduce the risk of collisions to a minimum, and at the same time optimize the use of a machine's work envelope, it must be possible for the machine control to dynamically – i.e. in real-time – detect and avoid collisions.

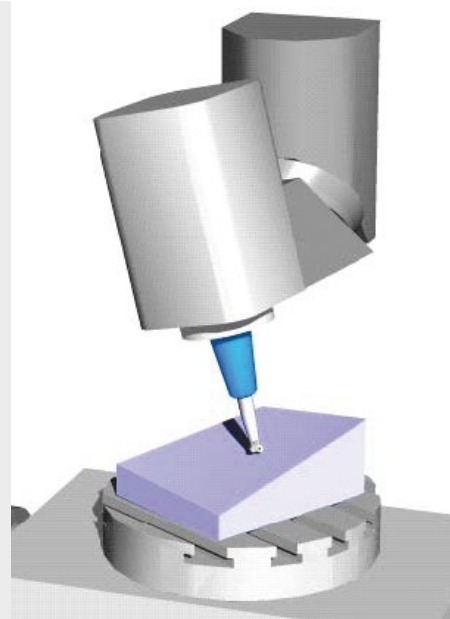
The dynamic collision monitoring function of the iTNC 530 control from HEIDENHAIN continuously checks the machine movements for possible collisions between machine objects, while taking the currently inserted tool into account. This way the flexibility of the machine regarding changes to the program or tools is maintained.

*Dynamic collision monitoring (DCM) in the machine control*

### The decisive distinction from CAM programs:

CAM programs often offer the possibility of detecting collisions while creating the program. However, the reliable prediction of a program running without collision requires that the exact geometry of the machine objects and of all tools be saved in the CAM system. If any tools are exchanged on the machine, or if the NC program is later changed at the machine, then the collision monitoring function offered by the CAM system is no longer reliable.

Not everything always remains the same. The dimensions, position or orientation of machine objects sometimes need to be changed. For example, the configurations of pallet changers and changing arms for tool exchange may vary from time to time. These changes are entered via an advanced feature, and the dynamic collision monitoring is thus adapted to the changed circumstances. The work envelope of the machine can then still be optimally used, for example.



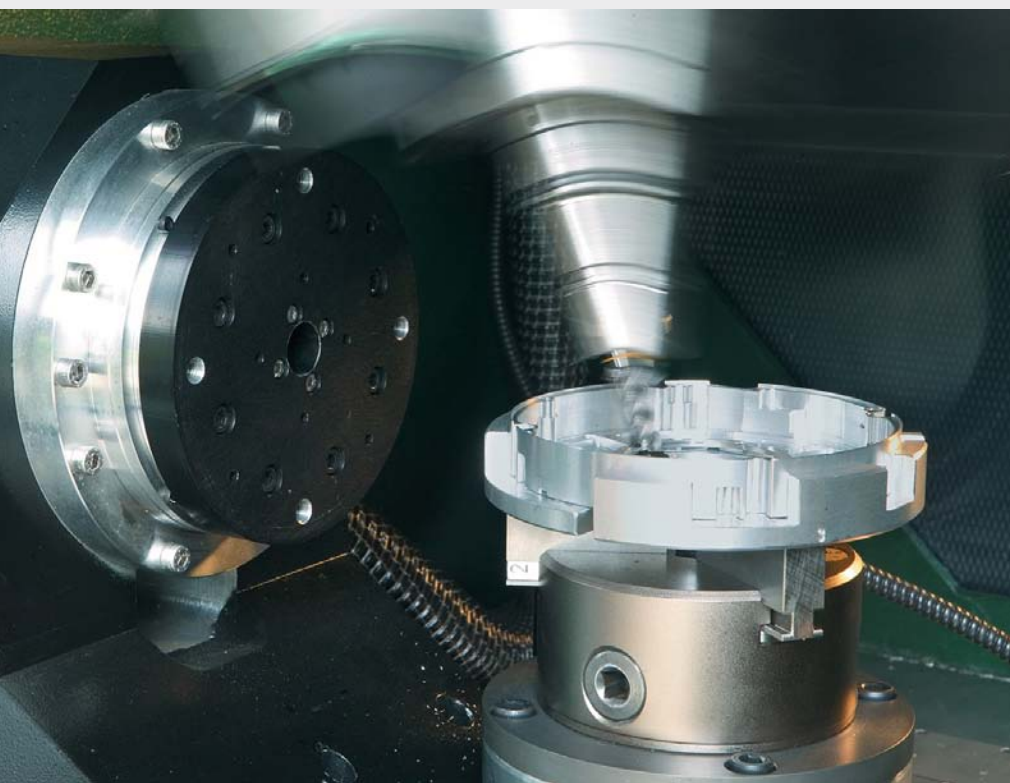
*Liftoff function: retraction of the tool in case the power fails*

### And if everything should come to a stop ...

Unintended interruptions of machine operations can lead to very high costs, especially for extremely large workpieces with extended machining times. For example, if a power failure or emergency-stop situation should lead to the feed motors and spindle being switched off, the workpiece or machine can become damaged. The tool may also remain stuck in the workpiece, which makes retraction of the tool very difficult if the workpiece is being machined with five axes.

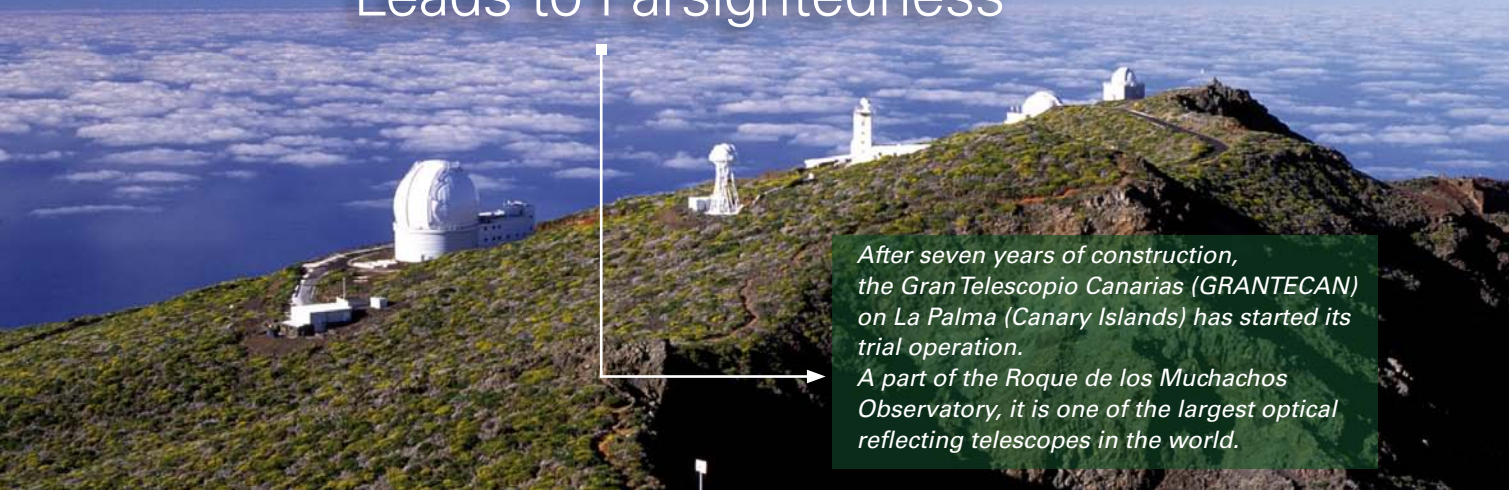
The liftoff function of the iTNC 530 control from HEIDENHAIN is a real boost in these cases. If the power supply should collapse during operation, the liftoff function makes it possible to retract the tool from the workpiece via the appropriate motions in the tool axis.

The distance to the workpiece can be selected via a machine parameter. The energy for this motion is won from the energy remaining in the dc-link as well as from the rotation of the spindle as it coasts to a stop.





# High System Accuracy Leads to Farsightedness



After seven years of construction, the Gran Telescopio Canarias (GRANTECAN) on La Palma (Canary Islands) has started its trial operation. A part of the Roque de los Muchachos Observatory, it is one of the largest optical reflecting telescopes in the world.

Application

The small Fiat Panda only needs about 40 minutes to bring us through three vegetation zones, from 0 m up to 2426 m. OK, we didn't really exert ourselves, but the panoramic view over several hundred kilometers certainly takes our breath away. We are there – and our gaze sweeps over the futuristic white domes of the Roque de los Muchachos Observatory.

The Roque de los Muchachos Observatory is one of the largest astronomical stations in the entire world. International astrophysicists from 19 countries and approximately 60 institutions use the ideal climatic conditions on the highest mountain of La Palma.

## Not a cloud in the sky

The incomparably low amount of light pollution and the clear air offer optimum conditions for astrophysical observations. Also, the sky above "the Roque mountain" is cloudless on most nights.

## Positioning with HEIDENHAIN

HEIDENHAIN model ERA 780C angle encoders are used to position the Gran Telescopio Canarias – a solution that has already proven itself in numerous telescope projects. The telescope is rotated about two axes – the elevation (vertical motion) and the azimuth (horizontal motion). In addition, the motion of the earth has to be compensated during the sometimes hour-long observations.

When ready for operation, the telescope will focus four million times more accurately than the human eye. It will enable astronomers to detect more details than ever before. The 105 million euro system is now in a test phase lasting one year. The hyperbolic telescope mirror consisting of 36 hexagonal segments will be expanded segment by segment until it reaches the total diameter of 10.4 meters. At the same time, all instruments will be adjusted.

*So that the Who's Who of astrophysicists can work effectively and without disturbances, a law on La Palma prohibits illuminated advertising, and specifies that outdoor lamps may only emit a certain type of light, which is only permitted to shine downward.*

## High accuracies with ERA 780C angle encoders from Haidenhain

The angle of the azimuth axis is measured over a diameter of about 15 meters, which requires a scale tape with a length of 48.48 meters. 1,212,000 lines with the scale-tape grating period of 40 µm are available for the angular measurement. Thanks to the high quality of the measuring signals, each grating period can be interpolated by a factor of 4,096 to provide 10-nanometer measuring steps for positioning the azimuth axis. This results in an angular resolution of 0.0003 arc seconds. Calibration and compensation of systematic errors bring a system accuracy of 0.06 arc seconds over 13.2°. The scale is installed in a slot about the respective axis of motion and is provided with a suitable number of measuring heads.



Scanning head of the ERA 780C angle encoder from HEIDENHAIN with scale tape

Not just the technology but also the vast and unfamiliar view, which makes you forget how cold this high Alpine plateau is, are impressive on Roque de los Muchachos ...

# {Upward compatibility} Tongue Twister or Magic Words

*The development of hardware and software is a challenging affair. But HEIDENHAIN manages the balance act between compatibility and modernity for both hardware and software.*

*The term upward compatibility is often used to describe the pleasant property of hardware and/or software to be compatible with the subsequent version. This is frequently an essential demand made by users.*

But it's not as easy as it sounds, at least regarding the hardware: In ever shorter cycles, brochures from the various PC manufacturers inform us of their latest quantum leaps in processor performance, RAM sizes and hard-disk capacities.

It's understandable that you expect the same from an iTNC 530.

But at the same time, the business manager in you places the justified demand that your iTNC should run in a stable manner, and that you can receive an exchange control in five or ten years, should a serious problem ever occur.

In order to satisfy all demands, products from HEIDENHAIN feature industrial processors whose product cycles last several years.

As opposed to standard PCs available in stores, there are no new versions every four or six months here. The industrial processors – currently from Intel – guarantee stability and reliability.

Additionally, the processor upgrades usually also involve a more or less complicated redesign of the circuit board. HEIDENHAIN uses this circumstance for its modular concept, which is both quick and powerful.

## Continual improvement

Does this mean that upward compatibility, demanded by all conversational programmers, is really nothing more than a complicated tongue twister?

This seems to be the case with the processor developers, at least. HEIDENHAIN faces up to this task, and continuously works on improvements. In the table below you can see that quite a lot has happened regarding the development of hardware for the iTNC 530.

**Continuous improvement is a matter of course for HEIDENHAIN – to the customer's benefit.**

Hardware designation	Processor	Main memory (RAM)	Hard-disk size (NC programs, depending on the software version)
<b>MC 420</b>	Intel Celeron 400 MHz	64 to 512 MB	2 to 25 GB
<b>MC 422</b>	AMD K6 II	64 MB	4 GB
<b>MC 422 B</b>	Intel Pentium III 800 MHz	128 to 512 MB	25 GB
<b>MC 422 C</b>	Intel Pentium III 800 MHz	256 to 512 MB	25 GB

*Hardware developed by HEIDENHAIN doesn't need to hide itself.*



# Software Never Stands Still – Efficiency and Quality Rise Steadily

## Getting an overview

The first iTNCs were shipped in 2001. The third software version is now available for the iTNC 530, and so are numerous new functions. Since 35,000 iTNCs have been shipped in the meantime, many users would like to know which functions are available in which software versions.

## History

At the beginning, with **NC software 340 420**, stabilization of the software was the main focus of development. But with the second version, **NC software 340 422**, it was possible to introduce very powerful user functions. **NC software 340 490**, the third and current version, is also known as the **smarT.NC** software, since this version introduced the new, form-based **smarT.NC** operating mode in 2004. Motion control, which is of extreme importance for HSC machining, has consistently been a topic of development over many years and for all series of controls. These programming improvements to the software, which are deep down inside the iTNC and therefore not easily visible for the operator, have significant effects on the machining speed, the achievable

surface definition, and especially on the achievable contour accuracy. Tests have shown that the iTNC 530 sets standards in this area.

## Practice-oriented innovations

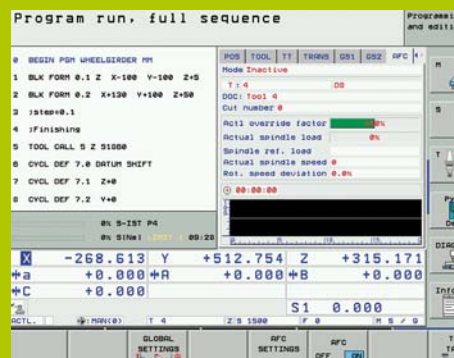
New and powerful functions are available for 5-axis machining. For example, you can use the **PLANE** function to easily and practically perform machining operations with a tilted tool in a tilted working plane. **FUNCTION TPCM** is a further development of the **M128** function with which you can optimize the machine behavior during positioning of rotary axes. The newest function in this area, **handwheel superimposed traverse** in the "current tool axis direction" (virtual axis), opens new areas of application for the iTNC in large-scale mold making.

Other innovative functions, such as integrated dynamic collision monitoring (**DCM**), adaptive feed control (**AFC**) and the **TNCguide** context-sensitive help system permit reliable and flexible operation of the iTNC 530. Furthermore, functions such as the **DXF** converter considerably speed up program creation. Numerous functions that facilitate interfacing the iTNC 530 with the machine

were integrated for the machine tool builder. The large number of different machine designs demand that the control be very flexible regarding this topic. One example is the **KinematicsDesign** PC software, with which you can simply, graphically and interactively develop and manage machine kinematics.

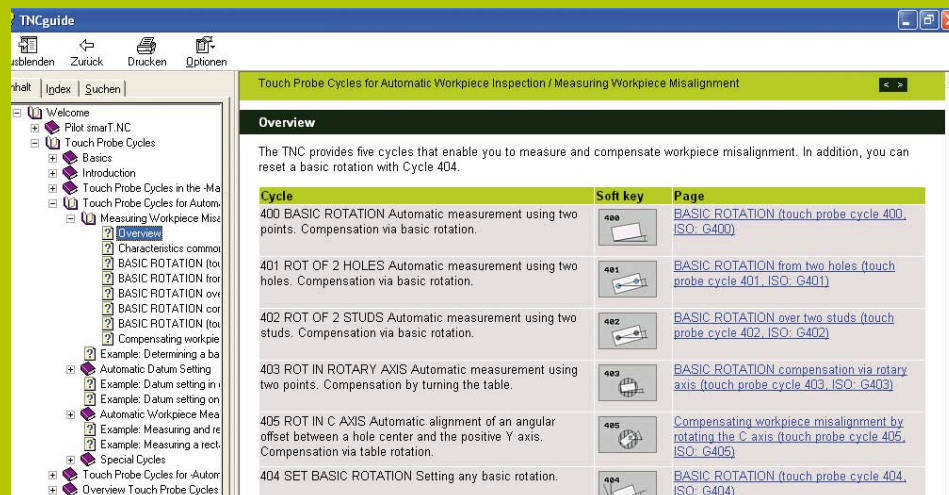
Recent issues of **KLARTEXT** presented in detail a large number of powerful functions in the series entitled "New Innovative Functions for the iTNC 530." If you don't have these issues at hand, you can simply download the **KLARTEXT** newsletter from the **HEIDENHAIN** website: just click "Services and Documentation" and then enter the Information Portal.

*You will find a complete overview of the software history in the interactive KLARTEXT e-magazine at [www.heidenhain.de/klartext](http://www.heidenhain.de/klartext)*



**Adaptive feed control (AFC)** – now with a dynamic bar graph in the status display – optimizes the contouring feed rate depending on the tool-spindle performance and other process data.

*The TNCguide is a context-sensitive help system, meaning that it displays information for the context of the element in question, so that you immediately receive the relevant information.*



Proof that Säckl Maschinenbau is a competent company, full of ideas and with a high standard of quality, is shown by awards such as the "Supplier of the Year" award from VTA Verfahrenstechnische Anlagen GmbH, as well as by its assortment of machines. The HEIDENHAIN controls on their machines play a central role in this.

## Economical Retrofitting – with Lots of Savvy and Modern Control Technology

Back in 1989 already the company operated its first CNC machine with a TNC 355 control from HEIDENHAIN. Machine tools that had once been completely different – without servo drives, without HEIDENHAIN linear encoders, but especially without modern contouring controls such as the iTNC 530 or the MANUALplus 4110 for lathes – are now used here.

They modernized their first machine on their own in 2000. On the one hand, even back then they wanted to save money compared to purchasing a new machine, but on the other hand they also couldn't find a new machine that was suited for the demands of the upcoming production job.

The company has remained true to this idea, of adapting and modernizing used machines for specific production jobs on their own, ever since.

For example, the Zerbst lathe, built in 1988, came from East Germany. It used to be operated purely manually, and was only equipped with a position display.

The modernization of all cutting machines was and is a do-it-yourself program: **Arno Säckl**, master precision machinist, **Horst Säckl, Jr.**, skilled electrician, and company founder **Horst Säckl, Sr.** (from left to right).

An external specialist has been in charge of programming tasks and control interfacing for years now.

The company then retrofitted the machine for controlled lathe machining. Nowadays, equipped with a MANUALplus 4110 from HEIDENHAIN, it can machine workpieces up to eight meters long and with a diameter of 2.1 meters.

### HEIDENHAIN is essential

Even should an exception occur, and Säckl Maschinenbau should purchase a new machine tool, it is essential that it be equipped with HEIDENHAIN products. When the company purchased a Geminis GHT 5, it was mandatory that it feature a MANUALplus 4110 control from HEIDENHAIN, even though this machine model had until then only been shipped with controls from other manufacturers.



**„All of our machines are equipped with HEIDENHAIN controls, and we are completely satisfied with them. Nearly every employee can operate every machine.“**

**Horst Säckl, company founder**

### Masterpieces with HEIDENHAIN controls

Time and again the job shop produces true masterpieces: one job required internally turning a 7-m long cylindrical part with a diameter of 860 mm, which tapered in the last third of the tube. The company then simply built a specialized internal turning machine.

It is suitable for workpieces with diameters up to 1500 mm and lengths up to 7 m, and features a MANUALplus 4110. After 250 hours of turning (material: explosion cladding made from Hastelloy), the part described above, which is used in the manufacture of bullet-proof vests, was completed on this unique machine. Säckl is also capable of internally turning smaller parts on other machines: diameters starting from 120 mm are possible, as are lengths from one meter.





Machining of a generator shaft (eight metric tons) on a Zayer lateral milling machine controlled by an iTNC 530

### Remaining flexible and profitable thanks to retrofitting

The modernized, and in some cases individualized, machine tools give the company the potential to react quickly and with low costs to the demands of its clients, who come from Germany and other countries. Being able to build its own machines gives the company the following advantages:

- + Much lower investment costs compared to new investments, and therefore
- + More latitude when calculating the price for the customer
- + No long delivery times as would be the case for a new machine
- + No "childhood illnesses"
- + An absolutely rigid machine bed, and therefore precision machining at a high level for a long machine lifetime
- + Ecologically worthwhile actions. Why dispose of or scrap old machines, when savvy and modern control technology can bring them to perform on par with new machines?
- + The specific machine optimally adapted to the respective production tasks is available

### Säckl Maschinenbau GmbH

Founded in 1981 by Horst Säckl

#### Location:

Weiding, Cham district  
3000 m<sup>2</sup> production area

#### Fields of activity:

Turning, milling and grinding machine parts.

The range of services even includes the assembly of an entire machine or line. The company specializes in large parts, single-part production and very small production runs.

Workpieces weighing up to 32 metric tons, parts for turning with diameters up to 2.1 m and lengths up to 9 m, and parts for milling, up to 17.5 m by 4.5 m, can be machined.

[www.saeckl-maschinenbau.de](http://www.saeckl-maschinenbau.de)



Flying lathe machining (above)  
Machining of a 2.1-m diameter mixing drum (below)

## Ideal controls for this strategy

Single-part production provides the daily bread. This demands a high degree of flexibility from the employees and from the machines – a flexibility that is ideally supported by the controls from HEIDENHAIN. The advantages offered by shop-floor programming in conversational format are immediately noticeable, especially with the complex contours that this company often must produce. Retrofitting with modern controls is of use to the company on many levels:

- + Faster programming
- + Other and quicker programs and work sequences become possible
- + Short setup times, even with very large workpieces, thanks to field-proven setup functions
- + Increased production efficiency

*This way the company, for example, was able to achieve production times shorter by 10 to 20% for inclined drill holes (on the original controls it was very difficult to manufacture inclined drill holes in shafts).*

Internal machining of a tube for a centrifuge



- + Time-saving processing of DXF files supplied by customers is possible after retrofitting, and will be introduced shortly
- + All employees can operate nearly all machines, so that bottlenecks due to illness or vacation do not occur
- + Arno Säckl even determined that life-times for tools increased

## Spare parts service put to the test

Excellent support has been attributed to HEIDENHAIN's spare parts service. Whenever it is necessary, the replacement of parts works wonderfully. The company was pleasantly surprised recently by our headquarters in Traunreut: a service specialist was needed in Weiding. So what happened? Arno Säckl was given the contact data for the HEIDENHAIN agency in Plzeň, which is much closer. The support provided from the Czech Republic worked out great, and showed that HEIDENHAIN can be relied upon, even across borders.

## The next project

In the next several weeks a centralized iTNC programming station will be installed, with a network connection to the machines. With the planned iTNC programming station and DXF file processing, the company is taking another step toward the future, and is remaining true to their own slogan: "Progress shapes the future," in this case together with HEIDENHAIN.

*HEIDENHAIN recommends only having qualified companies carry out retrofitting projects. Upon request we can inform you of competent partners in your area. Contact: [hd1@heidenhain.de](mailto:hd1@heidenhain.de)*

*HEIDENHAIN supports apprentice and advanced training in CNC technology at vocational schools and other institutions of vocational education, with the goal of machine operators becoming as familiar as possible with the features and functions of HEIDENHAIN controls.*

The project is a partnership between schools, and is intended for the exchange of experiences between the schools as well as to improve the methods and contents of professional CNC training courses. The program thus plays a role in ensuring the high quality of general and vocational education.

24 schools in 21 countries are taking part in this multilateral project. As an associated industrial partner, HEIDENHAIN supports this project for developing a European CNC network.

## The task

The participating countries will develop and produce a train for EUROPE, consisting of three powered locomotives with many train cars.

## The locomotives

Three teams will each develop a different locomotive. One locomotive will have a steam engine, and the other two will be powered by an electrical motor. All parts of the locomotives are to be manufactured with as much aid from CNC technology as possible. Each partner school prepares different components for the locomotives. Good coordination of the technical drawings is important during the planning phase, so that all parts will actually fit together in the end.

## The train cars

Each participating school develops the design of a train car typical for their respective country. The train cars will be individually designed by the participants, and will incorporate unique characteristics representing the different countries.



# HEIDENHAIN Supports COMENIUS – ▪ A Train for EUROPE

## The conditions

- + Outside dimensions  
(100 mm wide and about 300 mm long)
- + Rail gauge (90 mm)
- + Coupling
- + Position of the buffers on the train cars and locomotives

Students at the partner schools are to complete all tasks and worksteps by themselves, with instruction and support from their teachers. By the time that the "Train for EUROPE" is finished, over 1,000 students will have participated in the project. The project is completely integrated in the guidelines of the syllabi for industrial metal-working career instruction

**This project symbolizes the idea of a unified Europe on many levels, and thus clearly expresses how useful European cooperation can be.**

## The organization

Over 60 participants from the European schools organized themselves in several workshops into individual teams in three parallel working lines.

Each team designated a person responsible for the team's task. Each participant is a member of three teams, and therefore is involved in tasks from all three working lines.

1. *One working line will develop the locomotives.*

2. *A second working line has the task of producing identical assemblies. Here teams have grouped together for calculations and development of tracks, wheels, couplings and the chassis.*
3. *The third working line will tackle general tasks. Tasks for these teams include production of an illustrated technical dictionary, comparing the different training courses for careers in metal-working, and gathering and preparing instructional material.*

## The follow-through

The partners use CAD systems to develop the required design drawings, create the corresponding CNC programs for the milled and turned parts, and produce the various parts with CNC-controlled machine tools. The CNC programs for all milled and turned parts can be created simply and easily by the students using the freely available demo versions of the software for the HEIDENHAIN programming station.

The HEIDENHAIN eLearning program "TNC Training" was distributed to all participants to facilitate their entry to the world of CNC technology. Further support for questions regarding TNC programming was ensured.

Many schools are able to take advantage of the HEIDENHAIN Training Network in this case: in many European countries the students can visit HEIDENHAIN TNC programming courses, and have their questions regarding TNC programming be answered in their own language.

Regardless of the controls available to them, the partners' aim is to create all CNC parts for the locomotives and train

cars using the HEIDENHAIN programming station software. This way the students attain fundamental knowledge regarding the operation of HEIDENHAIN controls, and all parts are created in a uniform programming language visible to all participants.



Education and Culture DG

Lifelong Learning Programme

## The goal

At the end of this two-year project, early in the summer of 2009, a large event will be held with all partner schools in attendance. The locomotives and train cars will be assembled, and the train itself will be joined together and set in motion.

Because of the large number of participating schools, the entire train will be over seven meters long.

## For more information

The basis for communication is a multilingual Internet platform, including an open forum:

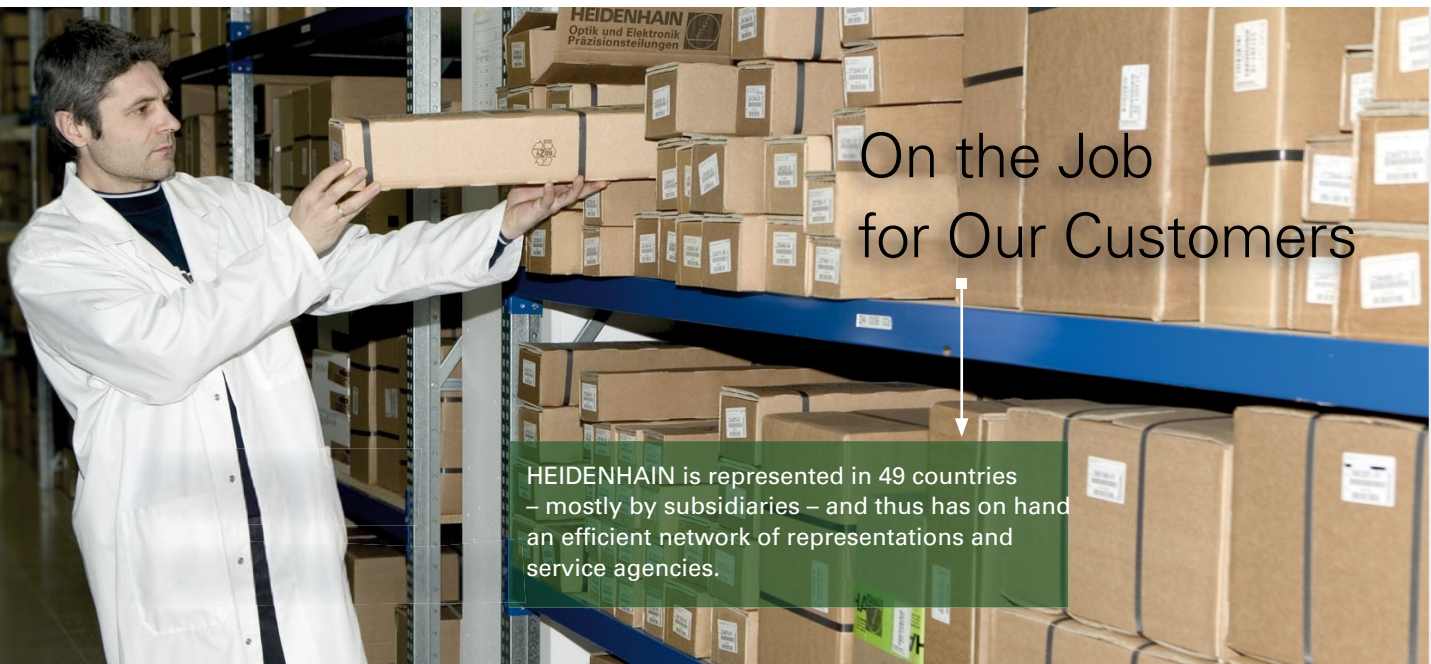
[www.cnc-netzwerk.eu](http://www.cnc-netzwerk.eu)

[www.cnc-netzwerk.eu/forum/index\\_forum.htm](http://www.cnc-netzwerk.eu/forum/index_forum.htm)

[www.kmk-pad.org](http://www.kmk-pad.org)

## HEIDENHAIN TNC Training

[www.heidenhain.de/schulung](http://www.heidenhain.de/schulung)  
→ eLearning



# On the Job for Our Customers

HEIDENHAIN is represented in 49 countries – mostly by subsidiaries – and thus has on hand an efficient network of representations and service agencies.

A demanding technology requires qualified services. And as a customer you justifiably expect safe, reliable, and highly productive systems. Therefore, a well-structured service organization present throughout the world is of particular importance regarding support and service.

Sales engineers and experienced service engineers provide solution-oriented services in a globally positioned service network. We locally support you as a machine tool builder or operator by giving advice and service.

**As our customer, your requests and demands are at the center of our attention.**

Just because we have finished providing a service or shipped our products doesn't mean that our work is done. We also offer you comprehensive after-sales service, and our expert knowledge is at your long-term disposal.

Our HEIDENHAIN helpline is here to assist you. You will find all of our contact data on our Internet site at [www.heidenhain.de/kontakt](http://www.heidenhain.de/kontakt)

*Rapid assistance is important to us! The HEIDENHAIN service department's warehouse is both well-assorted and well-organized. This makes short delivery times possible for replacement devices.*

## Our exchange service

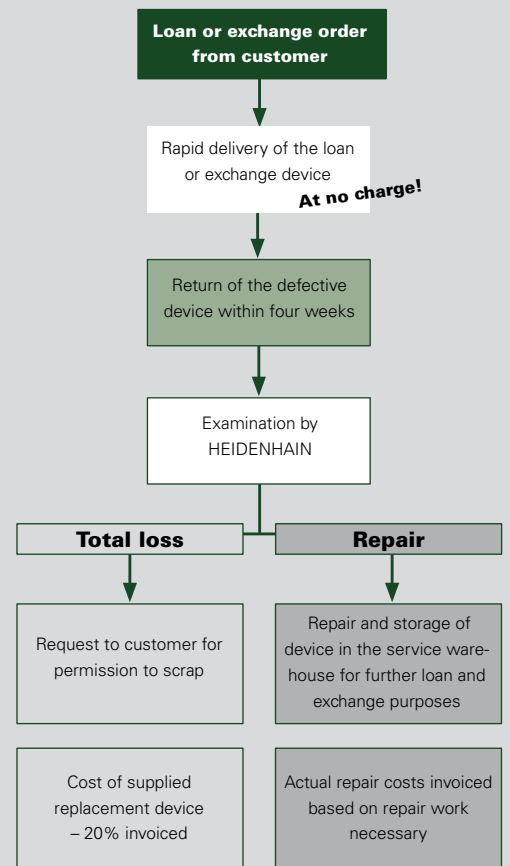
As part of its comprehensive service package, HEIDENHAIN offers you a rapid exchange service, even outside of normal business hours.

Our central exchange-unit warehouse stocks all control components, drives and higher-value encoders from the current sales program, as well as the HEIDENHAIN components that have been used on machine tools in the past 20 years.

We will immediately send you the required device at no charge, so that production can resume if the machine has come to a standstill.

Once the defective device has been returned, we will simply charge you for the repair costs incurred.

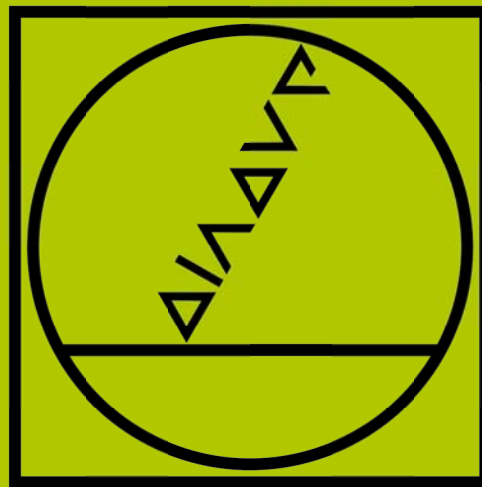
You get to keep the replacement unit, **with a warranty period of 12 months.**







**Attention! Machine tools without linear encoders may be inaccurate.**



**HEIDENHAIN shows the way to precision.**

Machine tools without linear encoders use the pitch of the ball screw as the measuring standard. But at the same time, the ball screw transfers enormous forces at high traverse speeds and deforms due to thermal changes. Result: the position values become inaccurate. Machine tools with linear encoders are statically, dynamically and thermally more precise – advantages that we symbolize with a sign. Most linear encoders installed on machine tools have it: our sign of precision. For more information, visit: [www.heidenhain-shows-the-way.eu](http://www.heidenhain-shows-the-way.eu)