



HEIDENHAIN

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Klartext

News from the World of HEIDENHAIN Controls

MANUALplus 620 lathe control

Easily programming turned parts



Retrofit of a CNC lathe

MANUALplus 620 speeds construction
of scientific equipment P. 7



Editorial

Dear Klartext Reader,

We hit the road for this edition of Klartext, and found something exciting: HEIDENHAIN controls being used in very different applications. The MANUALplus 620 lathe control played a feature role in these discoveries.

In a turning shop in Nuremberg we learned how the MANUALplus 620 asserts itself in contract manufacturing. The control makes it easy to react flexibly to the varied and usually urgent jobs for cycle lathes.

The mechanics workshops of the Laboratori Nazionali in Legnaro, Italy, also had a need for this control. A 25-year old CNC lathe was brought up to the current state of technology again by retrofitting it with a MANUALplus 620. Projects dealing with particle physics research can now be advanced more quickly.

We flew to Inmapa Aeronautica S.L., in northern Spain, where complex workpieces are manufactured for the aeronautics industry. The manufactured parts must fit together extremely well, and the iTNC 530 from HEIDENHAIN achieves this goal economically.

Back in Germany we visited the company BKK in Röfingen, near Munich, where two TNC 620 controls are used for toolbuilding. Here they prove their capabilities in the 5-axis machining of complex rubber molds.

By the way, have you seen the newly redesigned smart.Turn user interface of the MANUALplus 620? You can program cycles quickly and easily, thanks to help graphics and form entries.

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



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The MANUALplus 620 lathe control in a turning shop

Flexible contract manufacturing with high reaction rates

Thanks to a range of services that is as flexible as the quality is high, the turning shop DLS-Dreherei Lampret GmbH in Nuremberg asserts its position in a market flooded with service providers. The basis of success is a comprehensive and very modern machine shop. A large role is played by the 12 lathes from DMT Drehmaschinen GmbH & Co.KG, based in Lörrach, Germany, which are all equipped with controls from HEIDENHAIN. The Klartext staff met the managing directors of both companies in Nuremberg, in order to determine how the machines and controls function together.

Quick reactions and flexibility are decisive competitive advantages for DLS. Its customers are mainly general machine builders, and the workpieces, which usually differ greatly in size and shape, are typically ordered in lots of one to ten for corrective tool maintenance and repairs. The turned parts, such as sleeves, flanges and bearing seats, often do have simple contours, but a trend toward more complex machining operations is becoming noticeable. The parts are often produced and shipped overnight, since time is of the essence. That is why an appropriate machine must always be ready for the various tasks.

Single parts and small batches with cycle-controlled lathes

The particular demands placed on precision and high machine availability are decisive factors for DLS when choosing a machine-tool builder. DLS relies on the cycle-controlled lathes from DMT, equipped with easy-to-use controls from HEIDENHAIN, such as the MANUALplus 620 HSCI. For Stephan Lampret, Managing Director of the company, a uniform strategy for machines and controls is necessary, so that the machine operators can switch workstations without any problems. He therefore made a conscious decision in favor of the two German manufacturers of machine tools and their controls.

Cycle lathes have become indispensable in the turning shop, since in practice the information provided for machining the workpieces consists only of drawings, sketches or customer samples. Specialists can then turn simple parts directly on

the machine, just as with a conventional lathe. The control provides assistance both for manual turning as well as for the production of small batches and complex form elements. Therefore, when producing small batches, cycle-controlled lathes enjoy a significant cost advantage over CNC lathes, with their longer setup and programming times.

Programming as simple as possible

With the MANUALplus 620 the operator particularly benefits from the easily learnable cycle programming. Separate worksteps that occur repeatedly can be entered directly on the machine, saved in cycles, and combined with other cycles. The machine operator can also use

common, predefined cycles, such as area clearance, slot milling, recess turning, undercutting, cutoff, and thread cutting, that are already stored in the control. They can easily be adapted to the respective machining requirements, and then saved again. This way you already start saving time with the second part compared to purely manual turning.

When requirements become more stringent, DLS mainly programs in the smart.Turn operating mode. smart.Turn's convenient graphical contour description of complex workpieces is quite impressive, and you quickly learn how to use the form entries—it doesn't get any easier than this! An experienced machine operator can apply all his knowledge and experience, detect errors early on, and inter-

vene directly at the machine. The graphic simulation shows very exactly where each tool is positioned. This way you already have a clear overview of the entire process even before the first cut is made. That avoids faulty parts, saving valuable time and money.

A uniform strategy for machines paired with a uniform strategy for controls

"We focus on the newest technology for the controls and motors," emphasizes Friedrich Spohn, managing director of the lathe manufacturer. The current series of machines includes lathes with swings from 280 mm to 1100 mm, and distances between centers from 500 mm to 6000 mm, which allows a wide range of machining possibilities. This corresponds to the typical needs of the DLS turning shop. Almost every machine in DMT's product range is represented among the 12 lathes at DLS.

Stephan Lampret from DLS says that the long-standing partnership with DMT gives him a feeling of reliability. With its sturdy cycle-controlled lathes, DMT especially scores there where single parts and small batches must be produced quickly and efficiently. DMT is also well prepared for the even more demanding contours of the future: tool exchangers such as Multifix, tool turrets, and machines with C axis and driven tools all meet current demands, and have proven themselves in practice. As Friedrich Spohn says regarding the quality of his company's machines, "Having delivered over 2000 cycle lathes, which are characterized by precision and reliability, every detail of a new machine profits by the know-how we have gained over many years."



All DMT lathes are equipped with HEIDENHAIN lathe controls.



DLS uses cycle-controlled lathes and the MANUALplus 620 for very economical production of small lots.

A high machine availability is obligatory, as is spontaneous service assistance

One trademark of DLS, its highly responsive attitude, requires that the lathes are always in operating order. Should servicing ever be necessary, the personal contacts at DMT can be relied upon for electrical and mechanical issues.

However, a good and dependable service department is needed not just for the machines in the current product range. Quick and competent assistance is also expected for machines that have proven themselves for many years. This duty is taken very seriously at DMT: machine parts that are no longer current can still be manufactured at any time. At DLS this is proven by a lathe from 1990. It was retrofit with a current HEIDENHAIN control, and is now performing well as part of the employee training program.



The practical cycle programming enables the machinist to create and edit programs rapidly and efficiently on the lathe.

The MANUALplus for cycle lathes

A cycle-controlled lathe with a MANUALplus is either operated using the handwheels, like a conventional lathe, or with the assistance of cycles made available by the control. Cycles are canned subroutines that are adapted by way of parameters. These include clearance cycles, grooving cycles, thread and undercut cycles, as well as drilling and milling cycles or patterns. For difficult operations you can also use DIN/ISO macros, and integrate them in the cycles.

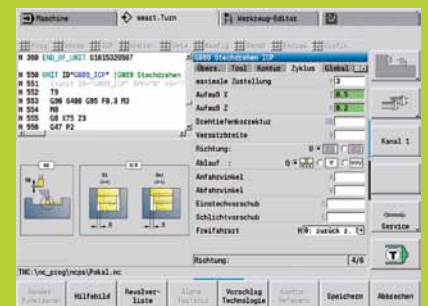


Use cycles for very easy programming.

When creating a new cycle program, you program each cycle in the following sequence of actions "Enter—Simulate—Execute—Save." The individual cycles form the cycle program. You can change cycle programs by simply editing the necessary cycle parameters, and delete or add cycles as required.

smart.Turn programming

With complex machining tasks you profit from the smart.Turn programming mode. The new smart.Turn interface is based on the proven HEIDENHAIN DIN PLUS interface. You program in a structured environment in the smart.Turn editor by defining the machining operations in units (= work blocks). These consist of clear forms with graphic aids.



It was just a brief flash: on July 2, 1967, the first gamma-ray burst was detected in outer space. Newest research shows that gamma-ray bursts most likely occur in supernovas. Gamma radiation is a form of high-energy radiation produced by the radioactive decay of atomic nuclei. Gamma rays are used in laboratories for scientific experiments. Proof of their paths and directions gives researchers important information.

Retrofit of a CNC lathe

MANUALplus 620 speeds construction of scientific equipment

TNC controls are used all around the world. But not only new machines are equipped with new controls: older turning machines and milling machines can be retrofitted with a current control from HEIDENHAIN, and can thus be just as productive by today's standards. The mechanics workshops of the Laboratori Nazionali di Legnaro (LNL) in Italy, 30 km southwest of Venice, also profit from this.

The CNC lathe's performance has increased significantly as a result of the retrofit. Production times for individual parts are shorter, which also reduces the time between planning and construction of the scientific equipment.

The machine shop of the institute for nuclear physics specializes in building very precise particle accelerators and gamma-ray detectors. Ten precision mechanics and engineers work together in this unusual environment, and manufacture high-precision devices according to the scientists' requirements. There are five conventional lathes with HEIDENHAIN positions displays on the shop floor, as well as five milling machines, three electrical-discharge machines, and one CNC lathe.

Shop manager Denis Conventi is glad that the lathe was retrofitted with a MANUALplus 620.



Retrofitting brings you up to date

The laboratory produces very demanding single parts with a high degree of precision. The 25-year old CNC lathe from Padovani was no longer up to this task. This was particularly the case for the technology of the lathe control. However, there were concerns that introducing a new control would make the operating procedures much more complicated. Of course modern controls are complex, but they offer numerous new functions and additional options that are indispensable for modern production.

The MANUALplus 620 from HEIDENHAIN makes it very easy to create workshop-oriented machining programs. That is why the control on the CNC lathe was replaced with one from HEIDENHAIN. This was a sensible investment: retrofitting an old machine tool with a HEIDENHAIN control is the ideal alternative to purchasing a new one. With the solid mechanics of the Padovani lathe as a foundation, its quality and precision were raised to the level of a new machine.

Nothing can be left to chance!

The institute's newest project is AGATA (Advanced Gamma Tracking Array), a gamma-radiation detector. As part of a collaborative European research project, AGATA was developed and manufactured in Legnaro. Since the middle of 2012, large European research facilities for nuclear physics and astrophysics have been able to borrow the prototype.

The main challenges in production are the necessary precision as well as the skills required for the machining of exotic materials. The unusual devices are usually produced from non-magnetic materials, such as germanium. Furthermore, they must be able to withstand a vacuum and temperatures down to $-196.5\text{ }^{\circ}\text{C}$. Any error, no matter how small, during production or when selecting the materials could have a negative influence on the highly-precise detectors.

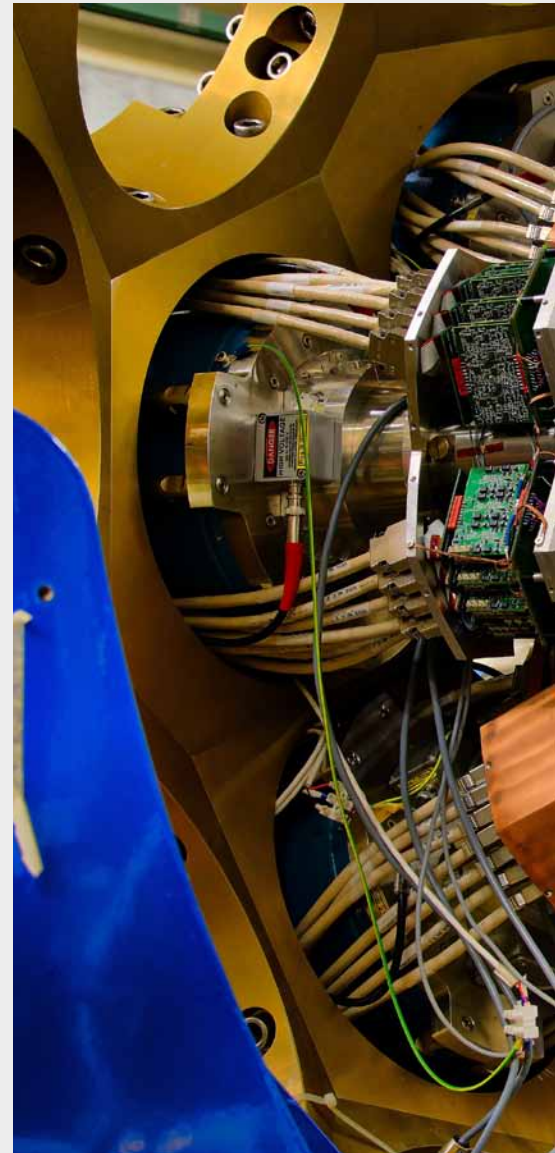
AGATA: the advanced gamma tracking array is a research spectrometer for nuclear physics and astrophysics. In the final stage, AGATA will consist of a hollow sphere with an internal radius of 23 cm, and 180 detectors made from very pure germanium. Perfected technologies make it possible to demonstrate the gamma radiation's position in the hexagon, and to reconstruct it. Gamma radiation is a form of high-energy radiation produced by the radioactive decay of atomic nuclei. Proof of the paths provides important scientific information.

Using the MANUALplus 620 to keep an eye on all machining steps

The devices are developed by the physicists and other scientists of the institute. They usually supply the workshop with detailed drawings, but sometimes they can only provide vague sketches. The machine operator is then faced with the challenge of implementing these demands, and producing high-quality workpieces. The new HEIDENHAIN control has made this task much easier. The MANUALplus 620 guides the user intuitively through the programming process, and a machining program is already created after just a few steps.

The powerful graphic simulation, in combination with the integrated diagnostic aids, offers a simple error analysis that detects risks of collision early on. The sequence of material removal, the proportioning of cuts, and the final contour are already checked before the first actual cut is made. Nothing is left to chance: the expensive raw materials are not supposed to become scrap metal.

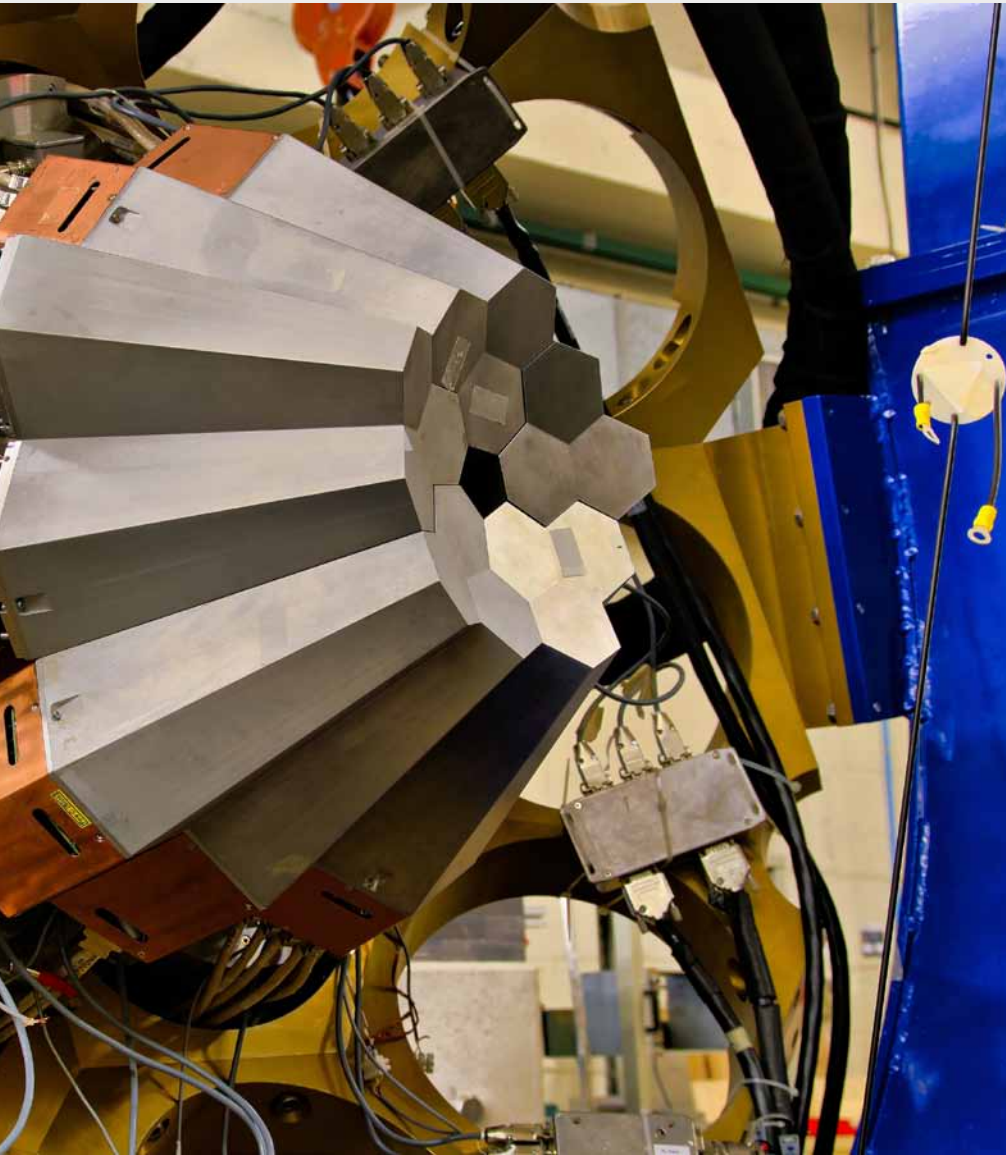
One new function of the MANUALplus 620 is the "teach-in" programming method. This function makes it easy to approach specific actual position values on the workpiece, and then load them to the control. Cycles are used for repetitive machining: after being created and stored, they can be used again, perhaps with modifications, on other workpieces that also require such machining. But what if things become more complicated?



The AGATA prototype from Legnaro with 15 germanium detectors.



Even the slightest error during production of the complicated workpieces can impair the scientific test results.



Thanks to various programming modes, such as cycle programming, smart.Turn and DIN PLUS, the MANUALplus 620 offers numerous possibilities for solving a wide variety of tasks. All this is necessary in order to encompass the workpieces in their entire complexity, and to machine them in just one operation.

Competent support from HEIDENHAIN

The employees of the Laboratori Nazionali di Legnaro (LNL) were convinced by the versatility and reliability of the MANUALplus 620 from HEIDENHAIN. The control was retrofitted and the institute employees were trained in just a very short time. Thanks to the simple and easily learned methods of programming the HEIDENHAIN control, the machine operators could soon apply what they had learned, and begin taking advantage of the new control's potential.

Institute of Nuclear Physics, Legnaro, Italy

The Italian Institute of Nuclear Physics (INFN) is concerned with theoretical and experimental research into nuclear physics. The Laboratori Nazionali di Legnaro (LNL) is one of the four national research facilities, and was founded in 1960. A total of 250 researchers, scientific colleagues, technicians and administrators work for the center. The members of the institute coordinate and head various European research projects dealing with fundamental nuclear physics. Using modern devices like particle accelerators, they investigate the interactions between energy and matter in order to discover the secrets of the universe. They develop and build some of these complicated machines themselves.





TNC 620 control from HEIDENHAIN asserts itself in toolbuilding

Rubber molds in shape

Snow groomers don't just operate on ski slopes in the winter. A protective rubber chain makes it possible to drive through forests and on meadows even in the summer, without damaging the ground. The high-quality rubber coating has a herringbone pattern, giving the chain the necessary grip. The company BKK Dämpfungselemente Kubina GmbH from Röfingen, to the east of Munich, produces chain parts for the PistenBully groomer, as well as a large variety of other rubber moldings. For over 30 years now the toolbuilding department of the company has produced the castings for the rubber parts, using milling machines equipped with HEIDENHAIN controls.

Highly-demanding toolbuilding for complex molds

Whereas other manufacturers of molds limit themselves to the production of the rubber parts, company owner Karl Kubina has a different philosophy: his company is a "one-stop shop" for everything from the mold to the finished rubber part. That way all necessary know-how is on site, giving him the advantage of being able to fulfill customers' wishes rapidly.

In the 36 years since the company was founded, the toolbuilding and moldmaking department has evolved remarkably. Along with turning machines and electrical discharge machines, BKK operates six milling machines with HEIDENHAIN controls. The two newest milling machines, a U5-1520 and a VC1000 from the machine tool manufacturer SPINNER, located to the south of Munich in Sauerlach, are each equipped with a TNC 620 from HEIDENHAIN.

An extreme variety of rubber parts

In Röfingen BKK mainly produces small- and medium-size batches using common manufacturing procedures, such as die-casting or injection molding. The order books are solidly filled. The enormous variety of the parts having very low unit numbers requires full dedication. One of the company's four halls is used solely as a warehouse for the molds. It is a repository for all sorts of steps, buffer stops, intake manifolds, rubber joints, bellows, and flat vacuum cups for automobile, aeronautics or packaging industries.

Moldmaking needs good planning

Moldmaking is a demanding and time-consuming process. Five employees in the toolbuilding department face new challenges every day, and must perform

"I've used various HEIDENHAIN controls for 30 years, and I'm happy with all of them."

Karl Kubina, Managing Director of BKK GmbH, Röfingen

all steps themselves—from programming the workpiece to operating the machine. "Every employee writes the programs and machines the molds himself. We don't have anyone who just sits in an office or works at a machine all day long; everyone here has to be able to sit and stand," says Kubina.

A machine tool can often take up to three weeks in order to produce a multi-part mold. The mold must therefore be well planned, in order for everything to work. The customer sends a 3-D CAD model of the finished rubber part. Based on this, BKK develops a cast model for one or more rubber parts on a PC. Then the appropriate machine tool is selected, and the model is programmed in the CAM system, or directly on the machine for simpler molds. Karl Kubina praises the simple and clear operation of the HEIDENHAIN controls. "The great thing," he explains, "is that the operating process from the first



Cast forms with complex contours—the TNC 620 machines them easily.



The finished cast rubber part right when it is being removed from the mold.

TNC 155 to the new TNC 620 controls is that it always follows the same principle. No matter which machine he is using, each employee knows right away which buttons he has to press."

The first control came from HEIDENHAIN

31 years ago, Kubina acquired his first CNC milling machine, equipped with a TNC 155. The machine toll has reached 59,000 operating hours, and keeps milling day in, day out. BKK's trainees gain their first experiences with HEIDENHAIN conversational programming on this machine,

and can later use this knowledge directly on the newer machines. This is possible because the basic principles of the HEIDENHAIN operational method also apply the newer, more complex function of the TNC 620: shop-oriented programmability with graphic support and field-proven cycles.

The TNC 620 utilizes a new software architecture

The system of the U5-1520 universal milling machine from SPINNER with the integrated HEIDENHAIN TNC 620 control encouraged Karl Kubina to make his pur-

chase. He praises the machine's advantages: the 600 mm rotary/tilting table enables 5-axis simultaneous machining, and when combined with the second, fixed milling table, large parts up to 1520 mm long can be machined in three axes.

The machine tool manufacturer SPINNER has put its trust in the TNC 620 since 2008. Ralf Platner, responsible for software development at SPINNER, accompanied the project right from the beginning, handled the project planning. He is convinced: The TNC 620 is a modern control that completely covers all functions of this milling machine, and utilizes the machine's full potential. Working together with HEIDENHAIN is very pleasant. Software management by HEIDENHAIN is well organized, and thanks to the unbureaucratic manner you always have competent partners, from the service department through to R&D."

The TNC 620 also fulfills special requests

Now that 5-axis machining is possible, BKK can respond to even more special requests from customers. The engraving cycle of the TNC makes it very easy to engrave logos on turned parts and on curved surfaces. Complicated three-dimensional contours and fine lines with curved contours can now be realized in a better manner. The TNC 620 provides ideal support. The various PLANE functions are used to define simple tilted working planes, such as those used on 5-axis machine tools.



Karl Kubina and his son at the new SPINNER U5-1520 milling machine: "The main factor when purchasing a machine: it has to have a control from HEIDENHAIN."



Karl Kubina at his "old Mikron" with a HEIDENHAIN TNC 155 control—still in operation after 31 years.

The surface definition of a mold is not only decisive in being able to get the rubber part out of the mold, but is also important for the optical impression of the final product. Often the dies had to be polished when they were finished, but the TNC 620 eliminates any need for this step. The TNC 620 uses specified path points for its motion control, permitting the highest degree of accuracy and surface definition while maintaining high traversing speeds. Setup and nonmachining times can be reduced significantly by multiside machining.

All milling machines are part of a network

BKK has been working with a CAD/CAM for 20 years. Linking the TNC controls via a network to the PC-based CAD/CAM system was a cinch, from the TNC 155 all the way to the TNC 620. "The interplay between the programming station and the transfer to the machine works like a charm, absolutely and without any losses," says Karl Kubina. Without any hurry, the machine operator uses a HEIDENHAIN programming station to write the part program for the milling machine while it is busy machining a different part. Machining of the workpiece is first simulated graphically in the CAM system, and possible collisions are also watched

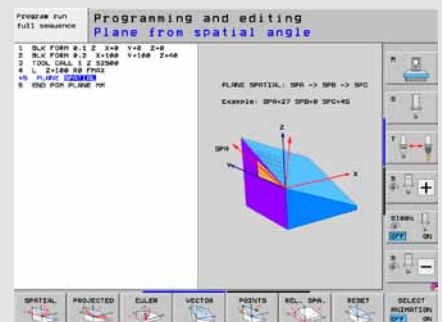
for. Once the program has been transferred, the machine gets to work—sometimes even for 200 hours at a time! And while the machine is busy, the machine operator is already preparing the next part on the PC.

BKK places its bets on controls from HEIDENHAIN

Karl Kubina has been working with HEIDENHAIN controls for over 30 years—out of conviction. His customers place demands for increasingly complicated molds. Thanks to his many years of experience he is able to fulfill their demands, and the TNC controls play a large role in that. BKK is technologically up to date with the SPINNER machines and the HEIDENHAIN TNC 620. And plans are already in the drawer should the old machine ever give up the ghost. Karl Kubina is sure of one thing: He will continue to rely on controls from HEIDENHAIN. "Anyone who's ever learned to use a HEIDENHAIN control to make something will never go anywhere else."

BKK Dämpfungselemente Kubina GmbH

As a mechanical engineer, Karl Kubina gathered his first experiences as chief designer in agricultural machine production, and then later as operations manager in a retreading plant. The tires were his introduction to rubber, and with this experience he founded his own company for rubber mold parts in 1987. The company grew slowly but steadily, and now has 60 employees. It is also already prepared for the future: all three sons are active in the company as managing directors, each responsible for a different sector. Karl Kubina is mainly engaged in sales, and cares for his clients of many years.



PLANE functions for the TNC 620

The PLANE function defines tilted machining planes. You simply specify a machining plane, regardless of the rotary axes that are actually present on the machine. There are various possibilities for doing so, depending on the information in the workpiece drawing. Specific help graphics make it easy to enter the values for this complex function.

For example, you can define a new plane with rotations around the machine-based coordinate system (PLANE SPATIAL), or by defining three points in the new plane (PLANE POINTS), or you use a further rotation to tilt an already active tilted working plane (PLANE RELATIVE).



The Inmapa group machines a wide range of complex workpieces with HEIDENHAIN controls

Flying high with the TNC

The demands regarding quality are very high in the aeronautics industry. After all, passenger safety is the most important thing when an airplane is up there above the clouds. The components' accuracy of fit places a decisive role. When the airplane is assembled, all parts must fit together perfectly, like a puzzle, and that is not easy. Read on to learn how controls from HEIDENHAIN help the Inmapa Group fulfill the highest quality demands regarding the machining of workpieces, both economically and repeatably.

The next time you fly off to vacation or on business in an Airbus, you can rest assured, because most likely you will be surrounded by the best engineering ingenuity "made in Palencia." Here, in this city in the northern Spanish community of Castile and León, Inmapa produces components for the A380 and A350 Airbus models, both for the airplane wings as well as for the interior. The Klartext staff was on site, visiting both of the company's production halls and interviewing the persons responsible for machining these parts.

State-of-the-art equipment for optimum machining

The Sagredo family founded Inmapa in 1967, as a metal shop for small companies in the region. At first the owner and two employees machined the various metal parts with simple milling machines. The workpieces often needed to be reworked, and this was of course all manual labor. But once the automobile manufacturer Renault joined the company's list of customers, HEIDENHAIN controls started being used, the production processes became automated, and the company has grown continuously.

The company's main field of business now is the production of all kinds of workpieces, including small components, large-surface workpieces, and prototypes for various industries, such as aeronautics, rail and automobile. If desired, Inmapa can also assume design and assembly duties. There are about 250 employees (and another 100 who can work on spe-

cific projects) available to master these challenges, and they have a very modern infrastructure to work with: a total of 100 machining centers, milling machines and turning machines, of which 85% are equipped with a control from HEIDENHAIN—and for good reason.

Many years of experience with TNC controls

"HEIDENHAIN controls are characterized by their reliability. I have to say, we've never yet lost a workpiece due to a TNC error," relates Gregorio Vián, head of quality at Inmapa. "This fact is remarkable when you consider that we've been working with a large variety of controls for over 30 years," he adds.

Vián has been with the company since shortly after its founding. He recounts how his employees have put many HEIDENHAIN controls to the test over the past decades. It all started with the compact TNC 135, and later the TNC 155 and TNC 426 were added. Now the high-end iTNC 530 is in operation alongside them.

The high degree of compatibility between the various controls is a significant advantage in production: "We can easily use programs now even though we already wrote them years ago. Often we just to make a few adjustments to the program before we can use it for new operations," emphasizes Vián.



The Inmapa Group produces all kinds of workpieces, including small components, large-surface workpieces, and prototypes for various industries, such as aeronautics, rail and automobile.



Since 2002 Inmapa has used only the iTNC 530 to produce high-precision parts for aircraft construction.

Even a compact TNC can understand very well those programs created with a high-end control, aside from a few special functions. This of course also saves time, helping Inmapa to increase its efficiency.

Simple operation

Asked about the operability of TNC controls, Roberto Gil, production manager at Inmapa Aeronáutica, becomes enthusiastic: "The conversational programming language is simply fantastic; it makes our lives much easier." The easy and simple operation of the HEIDENHAIN controls increases the company's productivity: "Any new employee can operate a TNC productively after just three days of instruction," Gil says.

Inmapa also benefits in another area from the TNC's user friendliness: the company can easily adjust to changes in the volume of work by increasing the number of machinists for a short time, and train them quickly with regard to the new production order. This is also an advantage when operating a different control. In this case the machinist does not have to learn everything anew—he simply has to become acquainted with the new functions. "Besides, the cycles are described very well, and the conversational guidance takes you through the necessary stages step by step," adds the production manager.

Higher accuracy and increased cost efficiency

Inmapa has been involved in aircraft construction since 2002. The group has a separate production hall dedicated to these activities. Here they machine workpieces of widely varying sizes, from just a couple of centimeters in diameter up to lengths of several meters, such as airplane wings.

All machine tools and machining centers in this hall are equipped with a iTNC 530 from HEIDENHAIN. They are used to manufacture high-precision parts, almost all of them with 5-axis machining. "Thanks to the iTNC 530 we have reached the level of precision that our customers demand of us," points out production manager Gil.

It must be possible to assemble numerous different components to each other precisely, and their production must occur with absolute repeatability. The holes drilled into the frame (the ribs in an airplane chassis or wing) must line up perfectly when assembled. This is a huge challenge, since Inmapa must ensure low tolerance values, with an accuracy permitting less than 15 μm of deviation.

The iTNC 530 is particularly well-suited for the accurate and simple programming of contours, and the high surface definition results in less need for reworking.

New materials, new challenges

Another challenge for the engineers in Palencia is to maintain a consistently high level of quality in light of the fact that they have to work with so many different metals. Materials for airplanes must be as stable as possible regarding static and dynamic loads, while at the same time being of low weight. Today, mainly steels and light-weight metal alloys are used.

For example, Inmapa produces the aluminum wing structures, rich in slots, which are later filled with carbon fibers and pressed by Airbus. Here the required precision is achieved thanks to the excellent motion control of the iTNC 530.

And when Inmapa began machining Invar, the coveted nickel-iron alloy of modern aircraft construction, the high-end control from HEIDENHAIN was also of great service: all contours were programmed on it, and then a long series of simulations run, before series production turned out just right.



Thin workpieces, such as as those for aircraft construction, require expert knowledge and exact programming with the iTNC 530.

Any new employee can operate a TNC productively after just three days of instruction.

Gregorio Vián, head of quality at Inmapa.

Highly versatile

“The versatility of HEIDENHAIN controls makes it possible for us to machine very different workpieces,” emphasizes Gregorio Vián. The large number of branches for which Inmapa fulfills the highest demands is the best proof of that.

In the case of the automobile manufacturer Renault, the production processes for the doors were automated. At first using the TNC 426, and now the iTNC 530, all curves and slots are programmed in order to transform the metal blank into a door. The subsequent assembly is generally as easy as pie, and the amount of reworking necessary was reduced to a minimum.

The company also manufactures wheels, axes and other metal elements for the rail industry. Submarines are also assembled out of components machines by Inmapa. But no matter which workpieces we are talking about, they all have one thing in common: the high level of precision resulting from the use of HEIDENHAIN controls.

Inmapa and HEIDENHAIN

Inmapa was founded in 1967 as a metal shop for small companies in the region. The company’s main field of business now is the production of all kinds of workpieces, including small components, large-surface workpieces, and prototypes for various industries, such as aeronautics, rail and automobile. The approximately 250 employees (and another 100 who can work on specific projects) have a very modern infrastructure to work with: a total of 100 machining centers, milling machines and turning machines, of which 85% are equipped with a control from HEIDENHAIN. Inmapa has put many HEIDENHAIN controls to the test over the past 30 years. It all started with the compact TNC 135, and later the TNC 155 and TNC 426 (both the original and the advance version) were added. Now the high-end iTNC 530 is in operation alongside them.

The new interactive HEIDENHAIN learning software in practice at a vocational school

It's a HIT in vocational school

HIT—HEIDENHAIN Interactive Training is the new interactive learning software from HEIDENHAIN offering comprehensive and practice-oriented training on everything about the controls. The Klartext editorial staff wanted to know how it functions in practice and visited the Oskar-von-Miller vocational training center in Schwandorf, Germany. We show how student and teachers profit from the didactic HEIDENHAIN learning solution.



By now, HIT belongs to their everyday routine in metal technology instruction.

The Oskar-von-Miller vocational school in Schwandorf emphasizes a type of vocational education that provides students with an optimal career start from modern equipment and motivated teachers. 3,580 students are educated here in various, predominantly technical occupations. Accompanied by the head of the Metal Technology Department, Alois Mayer, we visited the instruction of a precision mechanics class.

Lots of material, little time

A special challenge: only one 45-minute lesson is available per week for learning CNC programming. This is a short period of time that doesn't exactly make it easy to learn the necessary skills for program creation, much less to do the training needed to gain confidence in working with controls.

This is why there is a great need for a modern learning application that optimizes knowledge transfer in this very small instruction period. Alois Mayer learned about HIT during a teachers' seminar. He immediately advocated for its introduc-

"It used to be that our students learned how to program on paper. Now they learn interactively with the programming station."

Head of Metal Technology Department, Alois Meyer

tion. HEIDENHAIN offered his training center the opportunity to test the learning application free of charge.

The school in Schwandorf has been using HIT now since the spring of 2012 in order to teach theoretical and practical NC fundamentals effectively in a classroom environment. The attractive and flexible learning solution for HEIDENHAIN controls begins with the most important elements of a CNC machine and then trains the students in the fundamentals of CNC programming, directly on a programming station. The application optimally connects theoretical learning with practical exercises.

Johann Klein, the teacher and faculty advisor for the metal workshops emphasizes, "Without the programming station, many students would not have the possibility to gain practical NC experience from the very beginning."

Linking the classroom to the workshop

In the vocational school, almost all HIT learning modules are being used—depending on the students' previous knowledge. HIT is already being used in the first and second years in order to teach the typical layout of an NC milling machine, axis designations and functions, the meaning of datums and the fundamental use of touch probes. The students also learn the layout of part programs in conversational format.

With HIT; the vocational school in Schwandorf has succeeded in making a smooth transition from the classroom to the machine shop. The programming station is optimally integrated in the network: the programs created can be loaded to the machine tool and then tested under real conditions.

Interactive learning increases motivation

"The students' motivation has grown strongly thanks to this modern learning method," says Johann Klein. HIT simulated important aspects of program creation using concrete tasks. The user is guided toward solutions interactively through many realistic scenarios

But for the teacher, too, HIT offers a significant benefit: "Students can learn on their own and I can use that time to devote myself to individual questions and problems," says Klein.

HIT comes across!

The interactive training from HEIDENHAIN is "perfect for independent learning," says Thomas Riegler, future precision mechanic. "The application is designed in straightforward and easily understandable learning steps. The cycles, for example, are described very vividly. HIT always shows step by step what you have to do," says Riegler.

HIT improves the connection to daily practice. Department head Alois Meyer is very enthusiastic: "It used to be that our students learned how to program on paper. Now they learn how to handle the control right on the programming station." This is particularly important because the final exam can be taken either conventio-



Creating programs in the classroom—testing them on the machine.

nally on paper or on a HEIDENHAIN control. "However, most of the apprentices decide to do what they learned in school and so they choose to be tested on the NC-controlled machine."

It's an everlasting HIT

The example of the grade of precision mechanics students makes it clear how many benefits the interactive learning method has for practice-oriented knowledge transfer in vocational training. Opinions on the new learning software are consistently positive.

The use of HIT will be intensified in the coming school year. The Oskar-von-

"The students' motivation has grown strongly thanks to this modern learning method!"

Teacher and Faculty Advisor for the Metal Workshop, Johann Klein

Miller vocational center in Schwandorf already plans to introduce new NC technology in the machine shop so that the use of HIT will become even more important. Thanks to HIT, most of the precision mechanics take their final exam on HEIDENHAIN controls, which is certainly interesting for all participants as well as for future employers.

HIT—HEIDENHAIN Interactive Training

The new learning solution from HEIDENHAIN consists of three modules that enable users to independently acquire new knowledge: with practice examples, animations and control simulations, the software imparts fundamental knowledge on HEIDENHAIN controls both based on conversational programming and G-codes. The modules of the new learning solution are available in the Training Portal under <http://training.heidenhain.de>.

Oskar-von-Miller vocational school in Schwandorf, Germany

The Oskar-von-Miller vocational training center has its main facility in Schwandorf in the Upper Palatinate, Germany. Branch locations are located in Nabburg, Neunburg and Oberviechtach. A total of 3,580 students are educated here in various, predominantly technical occupations.

The "commercial advanced training school" was opened in 1902. In October, 1958, instruction began in the building on Glätzl Street. In July 1998, the Ministry of Education and Cultural Affairs bestowed the vocational school center with the name affix "Oskar-von-Miller."



The head of the metal technology department, Alois Meyer (left) and the teacher and faculty advisor for the metal workshop, Johann Klein (right) reports to the KLARTEXT editorial staff about the application of HIT in their school.

The length of a meter is defined in Traunreut

HEIDENHAIN calibration service

Linear and angle encoders from HEIDENHAIN provide machine tools and systems with the utmost precision. HEIDENHAIN has been producing ever-greater accuracy since 1952, with much metrological effort. Metrological competence characterizes HEIDENHAIN and has been used for the manufacture of encoders with absolute accuracy since 1952. HEIDENHAIN makes this same competence available to companies that went to calibrate their inspection equipment.

As part of a QM system (e.e. ISO 9001), companies must constantly monitor, maintain and regularly calibrate their inspection equipment used for quality assurance. Each company is responsible for setting its own testing intervals. Depending on the frequency of use, ambient conditions, and the required accuracy, the user decides when a test is necessary.

Accuracy of the inspection equipment

PTB (Germany's national metrology institute)

International / National standards

Accredited calibration laboratory

Reference standards

HEIDENHAIN measuring laboratory

Iodine-stabilized helium-neon laser for defining one meter

Company-internal calibration laboratory

Working standards

Company inspection equipment

It doesn't get more accurate than this

The HEIDENHAIN measuring laboratory has been accredited since 1994 to perform measurements as per DIN EN ISO/IEC 17025. The German Accreditation Body (DAkkS), which is the successor organization to the German Calibration Service (DKD), regularly inspects and monitors the measuring laboratory and certifies HEIDENHAIN its personnel and metrological competence within the framework of the accreditation.

The HEIDENHAIN measuring laboratory performs the calibrations specifically for digital linear encoders and digital angle measuring systems. If the highest possible accuracy is necessary, then measuring equipment identical to that of the PTB, Germany's national metrology institute (which has the last word on all measurements in Germany), is used. This accuracy reflects the quality expectations from the company in Traunreut, since that's as accurate as it gets!

Measurand	Measuring range	Smallest measurement uncertainty
Angles: Digital angle measuring systems (rotary encoders)	Up to 360°	0.02"
Digital linear encoders	0 to 3000 mm	6 nm + 50 x 10 ⁻⁹ x l (l is the measured length)

How long is a meter anyhow?



The original meter was first introduced in France in 1793, where it was defined to be the ten-millionth part of the distance from the North Pole to the equator, passing through Paris. It is

an X-shaped scale made of a platinum-iridium alloy, and is stored at the Bureau International des Poids et Mesures in Paris. The original meter was not replaced until 1960, when it was defined by way of physical constants. Today a meter is defined to be the length of the path travelled by light in a vacuum during 1/299,792,458 of a second. A practical realization of the highest accuracy of this definition is achieved with an iodine-stabilized helium-neon laser, such as the one HEIDENHAIN uses for calibration.

From the HEIDENHAIN NC program database

Chamfering like a champion

Machining of workpiece edges—can it be an easy task? Chamfers are encountered every day, at a certain angle on a circle or rectangle. KLAR-TEXT shows you a parameter program with which a chamfer is easily produced, using the lateral surface of an end mill. Of special interest: the program is machine-neutral, meaning that it is independent of the rotary axes actually present. This is possible with the TCPM command (Tool Center Point Management).

HEIDENHAIN certifies the accuracy of your measuring equipment

Call our Service Department if your equipment needs calibration. HEIDENHAIN will check the feasibility of the measuring task and prepare a detailed offer for a successful calibration. Calibration procedures have already been worked out for many HEIDENHAIN products, such as length gauges and rotary encoders.

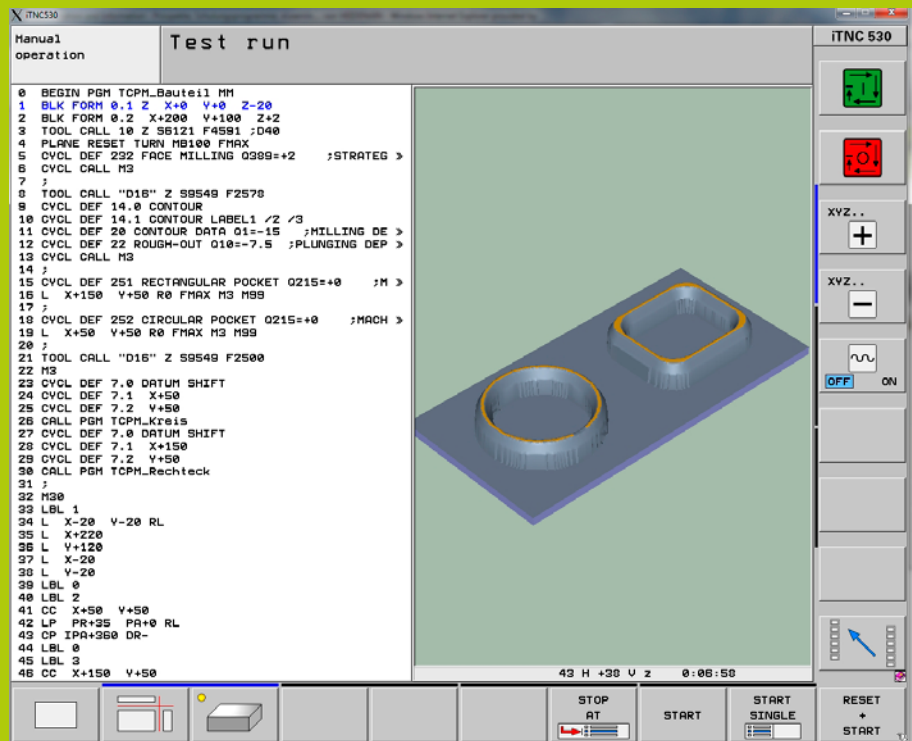
You then send your measuring device to HEIDENHAIN. The specialists in the HEIDENHAIN measuring laboratory calibrate your device and issue a calibration certificate as per DIN EN ISO/IEC 17025. On it the measuring properties of your equipment are described and documented. This way, an independent and neutral facility guarantees an internationally recognized traceability of your device.

Give us a call!

Please contact the free HEIDENHAIN helpline for a calibration:

+49 8669 313135 or

E-mail: service.order@heidenhain.de



The TCPM function is an enhancement of the M114 and M128 functions. With TCPM the control calculates the inclination of the rotary axes. An advantage of TCPM is that you decide how the feed rate is defined in the program, i.e. whether it refers to the tool tip (F TCP) or the associated axes (F CONT).

Use our parameter program to easily mill a peripheral chamfer on studs or pockets. The coordinates of the rotary axes are important: AXIS SPAT is used to specify that the subsequent axis positions are interpreted as spatial angles, so that the program can be used on any machine.

In the last entry you define the type of interpolation between the starting and

end position. Since we want to use hob milling, we select PATHCTRL VECTOR. This way we ensure that the upper and lower course of the contour are parallel to each other.

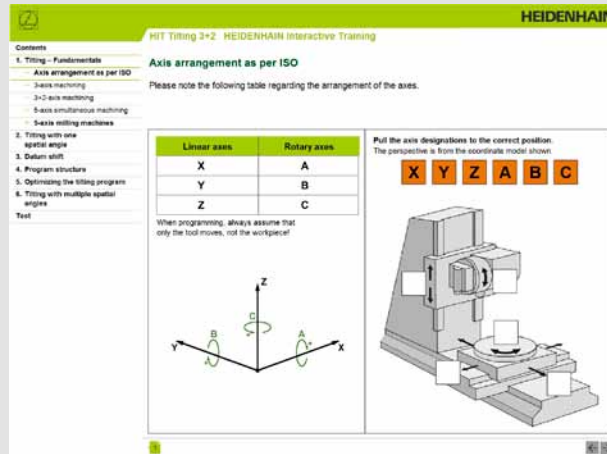
NC database

In the NC program database under <http://applications.heidenhain.de/ncdb>, HEIDENHAIN presents programming solutions for everyday milling tasks. Download these prepared programs from the Internet at no charge, and easily adapt them to your needs by just a couple of changes in the programming. The program described here ("Chamfers with inclined tool") is in Chapter 5 Deburring.

New application for HEIDENHAIN learning software: "HIT Tilting 3+2"

Programming of tilted machining made easy

HIT – HEIDENHAIN Interactive Training is the established interactive learning method gaining fundamental knowledge of CNC programming on HEIDENHAIN controls. This learning method was developed particularly for students, retrainees and apprentices. It explains the control functions with the aid of animations, small tasks and exercises. Once learned, the new knowledge can be verified through tests. HIT has now been enhanced with the important "HIT Tilting 3+2" package.



Fundamentals of tilting

The HIT learning method consists of three modules: HIT software, HEIDENHAIN programming station, and HIT workbooks. The basic version of the HIT software imparts the fundamentals of programming in HEIDENHAIN conversational format as well as with DIN/ISO.

This interactive training is perfect for independent learning, and is already very popular. Therefore, HIT has now been enhanced with the "HIT Tilting 3+2" package. Here you will learn the fundamentals necessary for programming of tilted machining operations.

New in "HIT Tilting 3+2":

Tilting fundamentals describes the axes of a CNC machine and the machining possibilities ranging from 3-axis machining to 5-axis simultaneous machining. Kinematics specific to certain types of applications are presented for 5-axis machines.

Tilting with a spatial angle (PLANE SPATIAL) shows how axes are tilted into position for the various sides of a workpiece.

You need to **shift the datum** when, for example, the workpiece reference point is not on a kink edge. Once the datum has been shifted to the kink edge, and the tilting has been programmed, you again have a reference point in the plane.

The typical **program structure** of a tilting operation can be divided into four steps: datum shift, tilting to a safe position, machining, and resetting.

Optimization of a tilting program with the M91 function. With it the traverse motions are relative to the machine datum, which can be completely different from the current workpiece datum. You need M91 when tilting in order to traverse to a safe position in the machine's working space.

Tilting with multiple spatial angles is needed, for example, to mill corners. Two spatial angles must be tilted here. This procedure is explained clearly.

In a **final test** the knowledge learned is tested interactively. This ensures that you have understood everything correctly.

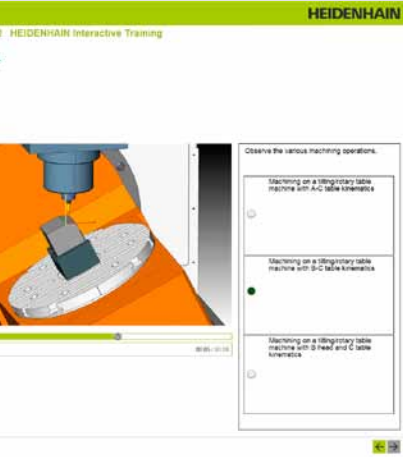
How can you acquire the HIT software?

You can purchase each learning package individually in the online shop. The workbook, with its learning tasks and programming examples, can be downloaded as a free PDF after the software has been purchased.

As you are already familiar with from "HIT Conversational" and "HIT DIN/ISO"; there is the regular workbook for students, and a version with solutions for instructors.

In order to visualize the directions of rotation and axis associations correctly in "HIT

Tilting 3+2," the original HEIDENHAIN coordinate system model can be ordered from CNC Verlag. The coordinate system model makes it easy to visualize the associations of linear and rotary axes with the directions of rotation, facilitating your entry into the world of PLANE functions.



Tilting with one spatial angle

Overview of HIT modules

Module 1: The HIT software uses interactive training examples, animations and control simulations, to teach you about HEIDENHAIN controls.

Module 2: The TNC programming station is the PC-based counterpart to a control for a machine tool. You can write and graphically simulate the NC programs, and then transfer them to the machine tool, just like on a real TNC. When you are finished ordering, you can download the programming station for free.

Module 3: Using the production of a workpiece as a guide, the HIT Workbook leads you through the PC-based HIT software and programming station modules. You will find many assignments and numerous programming examples here. When you are finished ordering, you can download a PDF of the workbook for free. The printed version (regular or with solutions) is available from the publisher CNC-Verlag: www.cnc-verlag.de

Conclusion

By introducing the important new learning package "HIT Tilting 3+2," HEIDENHAIN has enhanced its learning method by a very practical component, a genuine plus for the user: after this interactive training, you can program sophisticated tilted machining operations on multi-axis CNC machines better and more easily.

HEIDENHAIN

HIT Tilting 3+2 HEIDENHAIN Interactive Training

Contents

1. Tilting - Fundamentals
2. Tilting with one spatial angle
3. Datum shift
4. Program structure
5. Optimizing the tilting program
6. Tilting with multiple spatial angles
 - Preferred tilting sequence C-B-A
 - 1. Inclined face
 - 2. Front slot
 - 3. Right slot
 - Tilting sequence A-B-C

Test

Test - Datum shift

Shift the datum so that after the shift the coordinate origin is on the blue sphere on the kink edge.

CYCL DEF 7.0 DATUM SHIFT
 CYCL DEF 7.1 X
 CYCL DEF 7.2 Y
 CYCL DEF 7.3 Z

27 s

Final Test

Overview of the HIT software

Learning package	Contents	Price (validity)
HIT demo version	Fundamentals, chapters 1+2	Free (unlimited)
HIT Conversational	Conversational Programming	Single-station license (12 months): Cloud or download variant Network license for 20 workstations (unlimited): Download variant
HIT DIN/ISO	DIN/ISO programming	
NEW: HIT Tilting 3+2	Programming of tilted machining operations	

More information under training.heidenhain.de



The New High-End Control for Milling and Turning Operations



The new TNC 640: for the first time, milling and turning are combined in one TNC. Now users can switch as desired between milling and turning—within one and the same NC program. Switchover is independent of the machine kinematics. It automatically takes the respective operating mode into account and requires no additional action. This new simplicity is complemented by dialog-guided plain language programming, the optimized user interface, powerful programming aids as well as comprehensive cycle packets taken from widely field-proven HEIDENHAIN controls into the new TNC 640. **This is technological edge built-in.** DR. JOHANNES HEIDENHAIN GmbH, www.heidenhain.de