



**HEIDENHAIN**

10/2012

# Klartext *Medical*

HEIDENHAIN Controls in the Medical Technology Sector

THE FAST AND ACCURATE WAY TO ACHIEVE  
PERFECT SURFACES FOR MEDICAL PRODUCTS

## THE iTNC 530 FOR HIGH-TECH MEDICINE



“Swab please, Nurse!”

## Manufacturing Parts to High Medical Standards with HEIDENHAIN Controls

Dear Klartext Reader,

Not just swabs are used in every operation, but also many high-precision components.

Prosthetics have to replace complicated structures within the human body, such as hip joints, jaws or teeth. Implants are produced with a high accuracy of fit to ensure that surgeons can insert them without tension. A very precise, even and homogeneous surface of the complex shapes is an essential prerequisite for preventing post-operative infections.

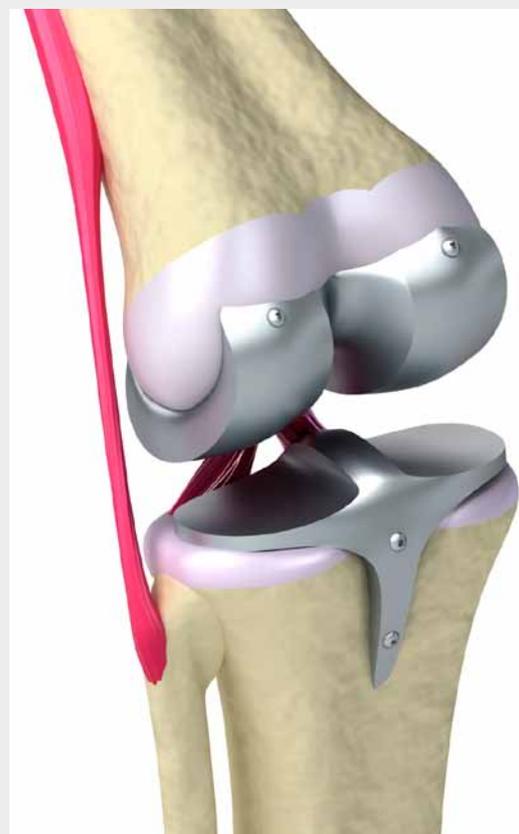
The demands on the surgical tools used are no less exacting: smooth surfaces and high precision are important quality characteristics of surgical instruments. Take-apart instruments that allow full cleaning and disinfection must be made to fit exactly.

Surgical techniques and the instruments needed for them are continuously evolving. The demand for implants and prostheses will continue to grow in our society, which has a high proportion of elderly people.

With numerous special functions for the contouring controls, HEIDENHAIN provides the key to a quick and cost-effective manufacture of high-precision joint replacements, surgical instruments or implants with high surface definition and dimensional accuracy. These functions include motion control for 5-axis milling operations, the dynamic collision monitoring of tools in the dynamic production process (DCM) and the compensation of axis deviations with KinematicsOpt, to name just a few.

Please read and enjoy, with best wishes for good health from ...

The Klartext staff!



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*The iTNC 530 high-end control for milling, drilling and boring machines, as well as for machining centers*



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Surface Quality in Medical Technology

## ... When Everything Has to Go Smoothly

*Modern medicine needs more and more "spare parts" for treating bone fractures. Whether for stabilizing cervical vertebrae or replacing whole joints—the demands on the functionality of these parts are extremely high. The quality is particularly apparent in the surface finish. Exceptional roughness values combined with high accuracy are required in this respect.*

### Mastering the dynamics

The workshop is buzzing with activity: the milling cutter is moving so fast that you can barely see it. Medical components are being machined on small to medium-sized machine tools. Dynamics are high: the tool is whizzing around the work envelope at about 50 to 60 m/min. The paths of traverse are correspondingly short. The danger: the machine may start vibrating, which could have a negative effect on the accuracy.

HEIDENHAIN controls play an important role in mastering these high dynamics. With its high-precision motion control, the iTNC 530 can deal with high speeds and follow the contour outlines with outstanding accuracy. Even at high feed rates, the control ensures ultra-accurate tool traverse over the workpiece surface.

### Avoiding collisions

Fast motion and little available space increase the risk of collisions. In these circumstances, machine operators have little chance to stop the machine in time. A crash will inevitably lead to scrap—but crashes are avoidable. With the dynamic collision monitoring (DCM) function the HEIDENHAIN control monitors all movements and issues a warning in time about an impending collision between the tool and fixtures or permanent machine com-

ponents. This "real-time protection" is also in effect during setup or while the program is interrupted, for example if the machine operator traverses the axes manually.

### Controlling motion

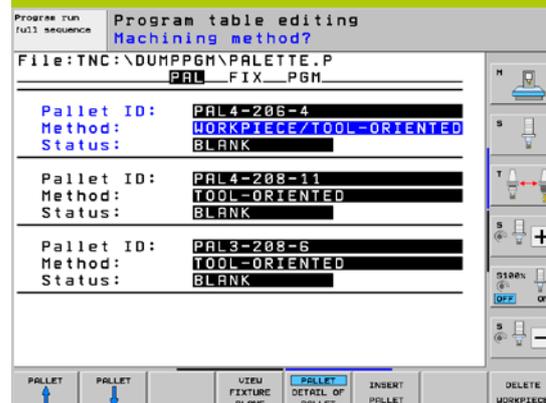
The process chain for creating intricate shapes involves potential sources of error from the interfaces between the systems. Complicated joint shapes are programmed on CAD systems, transferred to CAM systems that add the machining strategies and the parameters for spindle speed, feed rate, etc., and then translated to motion control in the iTNC 530. The control automatically smoothes the block transitions to achieve a high surface definition. The iTNC 530 also offers users possibilities to easily set the jerk and acceleration parameters for the feed axes, i.e. to directly influence the ratio of machining velocity to tolerance. As a result, users can adjust the contour deviation to suit their specific requirements.

HEIDENHAIN controls are therefore the best "medicine" against production interruptions and extensive reworking—also in medical technology.

### Pallet Machining for Series Production

With HEIDENHAIN controls you can easily organize the series production of your medical devices: the clear and straightforward pallet management feature helps you to do this. Using the pallet table, you can define the machining strategy for your workpieces in such a way that the NC program is optimally executed according to the tool changes. This has the key advantage that you can also apply the machining method to other applications, i.e. to other NC programs. By enabling the appropriate datum shifts and datum tables, the pallet table saves you valuable time when machining identical workpieces on multiple fixtures.

In real-world production, jobs are often interrupted to fit in more urgent workpieces. This requires flexibility. In such a case, the pallet editor stores the pallet file with a code. You can then use this code to reenter the program at the point of interruption.



## Migration to the iTNC Precision Starting from the First Workpiece

*First-class instruments are essential for surgical operations. Their surfaces and contours must be produced with exceptional quality. After all, nothing that could cause an infection should remain behind after an operation...*

### New territory—new challenges

Robert Ott AG is committed to combining a high degree of quality with cost-efficient production. This commitment is met by highly qualified employees and a modern assortment of machines. The Swiss company's core competence is the highly automated manufacture of workpieces and assemblies for a wide variety of industries. The company founded in 1989 only recently set its sights on the field of medical technology.

The certification according to the medical standard ISO 13485 fulfilled an important demand of the new customers. The company today successfully produces surgical instruments, which have especially complex shapes and are used in complicated operations. The challenge: the intricate shapes of the "new workpieces" require simultaneous machining in five axes. The machining programs are accordingly complex, and must be created quickly and efficiently, since the production lots are often only five to 100 units. In addition, the programs should be written directly at the machine. However, the controls used up until then were not suited to this task.

### Smooth migration

Managing Director Robert Ott found the appropriate solution in the iTNC 530 from HEIDENHAIN. The goal of programming directly on the shop floor was quickly implemented with the new machine and its iTNC 530 control. A short time later, the machining of complex contours with just a few setups was already a standard process.

KinematicsOpt helps maintain a consistently high level of precision when machining the workpieces. The software option is integrated directly in the iTNC 530. It eliminates deviations of rotary axes due to thermal influences, and compensates their drift. A laser system for automatic tool measurement also plays an important role in ensuring the dimensional accuracy of the finished workpieces.

### Positive review

When asked about their new experiences, the machine operators Robin Suter and Lukas Dietiker praised the strengths of the iTNC:

- The iTNC has a convenient editor with simple functions for copying, moving and structuring program blocks and program sections.
- The HEIDENHAIN cycles are indispensable. They permit rapid program creation for five-axis machining.

**"There were no problems in the migration to the iTNC. Our employees were quickly able to learn the necessary know-how, and could also immediately put their own experiences to use!"**

Robert Ott, Managing Director of Robert Ott AG

- Even complicated tasks, such as machining on an inclined plane, are made easy by the PLANE function.
- The iTNC's manual is easily understandable, and the functions being searched for are found quickly.

The success of the migration can also be measured in terms of time and costs. In the meantime Robert Ott has added a second machine with the HEIDENHAIN control, which already began production after just a couple of days.

The Swiss company is planning to further automate the production of medical instruments in the future, and also create the machining programs entirely with programming systems. The iTNC will also have no problems here—and thanks to HEIDENHAIN without any unnecessary doctoring around on the machine.



*Surgical instruments meeting high demands on surface quality and contours are produced with the iTNC 530.*

## iTNC 530 – Application for Innovative Medical Technology

*Every day Helmut B. gets on his bike at 6:45 am. It's a lovely October morning and it's still a bit dusky. He's cycled on his bike to work for years, just like today. After one kilometer, the field track goes through a forest. The track and the surrounding forest are both covered in leaves, making orientation more difficult. Suddenly a tree looms up in front of Helmut B.—he hits the brakes, the front wheel jams, the back wheel shoots upwards and Helmut B. crashes against the tree with his back. The diagnosis at the hospital is shattering: the fourth cervical vertebra is broken and compressed, the adjacent intervertebral disks have been compacted...*

In Salzburg, Austria, the company SYNTHES has a manufacturing plant, the Austrian sales office, and a subsidiary called the "SYNTHES Innovation Workshop" as part of the "Paracelsus Private Medical University." The objective of this laboratory is to evaluate new solutions for the operative treatment of injuries and skeletal degeneration. Miniaturization is the trend in medical technology as well, both in terms of implants as well as sections required for insertion of the implants. Health professionals refer to these as minimally invasive operation techniques.

### Innovation from interdisciplinary experience

In addition, difficult operations that can only be carried out by a handful of specialists should be simplified with technical aids so that less specialized surgeons are capable of carrying out the same procedures. The team working on the new ideas consists of two engineers: Alfred Niederberger from Grenchen (Switzerland), a SYNTHES employee for 15 years, and Johann Fierlbeck from Deggendorf (Bavaria), part of the team since October 2006. In addition to the mandatory "mechanical" skills, both also have corresponding medical knowledge and also talents that would be more suited to a surgeon. These capa-

bilities are absolutely necessary, because doctors from all over the world visit this superlatively equipped laboratory and can discuss their ideas with both of the engineers. One of the possibilities offered by the lab is to make a three-dimensional model of the bone to be repaired. The required data is captured by a 3-D capable C-arm in a computer tomography scan of the bone and transferred to a CAD system. Following that, the prototype to be prepared can be simply modified according to the 3-D model. An NC program is then created via Mastercam and postprocessor.

### Using the strengths of the iTNC 530

The prototypes are then prepared on two iTNC 530-equipped machines: one 3-axis machine for simpler pieces and one 5-axis machine with HSC setup for more complex pieces. The iTNC 530 can take full advantage of its strengths. On the one hand it can optimally execute the data created via the postprocessor and read in via the standard Ethernet interface. On the other hand a 2-D contour can quickly be created in plain language directly at the machine, and in particular can be quickly modified. Until now everything sounds rather familiar, just routine work in a "normal" workshop. But the laboratory has in addition to

Sports injuries, work accidents or traffic accidents: In today's world there are many ways to break a few bones. But on the other hand there were never as many possibilities to repair fractures or to support healing processes. The Swiss-American company SYNTHES specializes in the development, manufacture and marketing of instruments, implants and biomaterials for the surgical treatment of bone fractures. SYNTHES is a globally active company with more than 11,000 employees and a turnover of approx. 2 billion USD in just the first half of 2011.

**“With simple contours I create the program directly with the iTNC, and that happens so quickly and easily that I am not absolutely dependent upon CAM and postprocessor!”**

Johann Fierlbeck, SYNTHES

Report from the Field

the normal mechanical equipment an optimally equipped wet laboratory. After all, the prototypes have to be “field-tested” and also in particular have to be optimized. Working with anatomical specimens is something that has to be gotten used to—and it's not something for everyone. But this task definitely cannot be avoided if optimal products are to be developed and if an essential contribution to improving the health and quality of life of patients is to be made.

### From the operating table to prototypes

At the beginning of a project a wet laboratory is frequently necessary if several surgeons discuss a mechanical problem. Doctors' opinions often differ greatly. “In examples like that it is absolutely essential for a timely decision to discuss different views at the operating table in order to clear up uncertainties or differences of opinion. That works really well, because otherwise when the idea is put into practice, unproductive time intervals



*SYNTHES products for stabilization of the cervical and lumbar spinal regions*

would occur, and we cannot really afford that”, explains Alfred Niederberger. After a prototype has run through several optimization phases and passed a realistic practical test, and if it is considered fit for series production, then the idea is passed on to the corresponding SYNTHES development departments. All further steps are taken there to turn the idea into a marketable product that can successfully exist in the market.

*... Helmut B. today rides his bike again. Thanks to SYNTHES products, his vertebrae are now stable again.*

Manufacturing operating-room lamps with the iTNC 530

## Precision in the spotlight

*Light and color play an important role in a hospital operating room. The doctor has to see clearly and must not get tired, not even in long operations. The primary benefit of this goes to the patient. The illumination of the operation field provides an important contribution. The SIMEON Medical GmbH & Co KG in Tuttlingen, Germany, has specialized on exactly that. HEIDENHAIN controls do precision work in the manufacture of operating-room lamps and help to ensure high production quality.*

### Optimal light with modern design

SIMEON is a young company that specializes in the manufacture of modern medical operation lamps. These innovative products use LEDs as the light source. For many years, LEDs have been used as indicators or for background lighting. However, LEDs for white light with a high light output, an appropriate color temperature, and a long service life have only been available in recent years.

Modern LEDs provide dramatic benefits for the new generation of medical operation lamps:

Instead of a relatively large halogen lamp, they use many small light sources that produce a perfect light field through numerous reflectors. This opens entirely new possibilities for operating-room lamps: large clunky lamps with a one-eyed reflector are becoming a thing of the past in operating rooms. Today, they are being replaced—as in the case of SIMEON—

with attractively designed, flat lamps.

### Sophisticated manufacture of the lamp housing

The concisely formed housing is supplied as an aluminum casting. Its special form already presents a challenge during its casting. It is then machined with a Hermle C 30 U that is controlled by a HEIDENHAIN iTNC 530. The 5-axis machine tool completes its work on the casting in only one setup.

In detail: after the workpiece has been set up, the iTNC 530 uses a 3-D touch probe to measure defined positions on the lamp housing. This exactly ascertains the position of the casting in space. Then the program generated with a CAD/CAM system can do its work precisely.

In the area where the housing is connected to handles, there are pockets and holes

that have extremely thin walls on the inside. Small inaccuracies at this connecting point can quickly turn the relatively large component into scrap. For this reason, the combination of machine tool and NC control has to ensure high machining accuracy.

### KinematicsOpt makes an important contribution to an optimal light field

The exact alignment of the holders for the LED blocks on the inside of the housing is particularly critical: the angular position of the round surfaces is calculated so that the light cones of the LED blocks that are to be fastened to them join up to provide a homogeneously illuminated light field. Any deviations would result in disturbing light and dark spots in the light field. The 5-axis machining of the holder must therefore be very precise. Here the accuracy of the tilting axes is crucial. With KinematicsOpt, the cycle for fast calibration, the



*The exact alignment of the holders for the LED blocks is an important contribution to a homogenous light field*



*Assembly aids programmed right on the control*



*Thin-walled structures require high accuracy in machining*

deviations of the centers of rotation are checked regularly and the compensation values are transferred to the kinematic model. Recalibration takes only a very short time and can be performed by the machine user without help. This ensures high and lasting accuracy in tilting operations.

### High machining accuracy is essential in medical technology

High machining accuracy and high surface definition are often of primary importance in the manufacture of medical technology products. HEIDENHAIN controls are known for their high accuracy in motion control. One of the many functions that make high accuracy possible is the optimal execution of NC programs that have been generated in a CAD/CAM system. This is also the case with the lamp housings from SIMEON. Such programs usually consist of very many straight-line blocks whose contour transitions are each affected by a chord error. The HEIDENHAIN TNC automatically smoothes the contour between any contour elements very effectively and with a definable tolerance. This is the only way to attain high surface definition with the required accuracy.

### Reliability in series and single-part production with DCM

SIMEON has committed itself to DCM, the iTNC's dynamic collision monitoring function. In 5-axis simultaneous machining it is particularly useful for effective collision protection: the more axes a machine moves simultaneously, the more difficult it is for the NC programmer and the



*The casting is machined in only one setup.*

machine operator to visualize their movements. For this reason the actual danger of collision is hardly predictable during programming and setup.

DCM is not only effective for workpiece machining operations generated by CAD/CAM. The function can also prevent collision damage during setup, manual intervention, or the execution of programs that were written directly at the machine.

### Fast and safe manufacture of single parts

Apart from the series part for the lamps, SIMEON also occasionally programs single parts, such as assembly tools, right at the machine. For cases like this, the machine operator learns to appreciate the convenience in operation of HEIDENHAIN controls. The easily understandable plain-language programming makes it very easy to create machining programs for complex parts. The people at SIMEON are quite familiar with this: As a result, they seldom have to refer to the well-structured control documentation, as the workers on the machine assure us.

### Conclusion

SIMEON makes use of new LED technology for the manufacture of innovative medical operation lamps that combine a modern, compact mechanical design with optimal illumination. The new design, however, is possible only with precise and powerful manufacturing technology that can fulfill the high quality requirements of today's medical technology. The milling machines at SIMEON are therefore uniformly equipped with HEIDENHAIN TNC controls.



# HEIDENHAIN



## How large is a critical difference?

Those like HEIDENHAIN who manufacture micrometer-precise measurement technology know: it's the details that make the vital difference. This applies to our products—and to our company. HEIDENHAIN has been engaged in metrology since 1889. We find this unparalleled performance to be worth investment: more than 10 percent of our revenue is allocated to research and development. The human side is also an important distinguishing feature. Mutual respect, fairness and trust are important to us—particularly when dealing with our customers. These “inherited traits” make our products that decisive tad better, and make HEIDENHAIN the world's preferred partner in measurement technology.

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