

Complete Solution in Tool Grinding

numroto®

- Development
- Simulation / Monitoring
- Manufacturing
- Measurement
- Resharpening
- Documentation



www.numroto.com

NUM ®
CNC HighEnd Applications

NUM Solutions and Systems Established worldwide

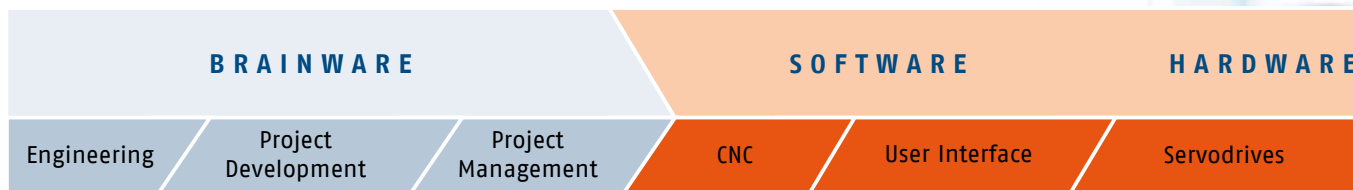
All outstanding solutions in machine automation share something in common: they are the result of diligence, exceptional technology and a high degree of creativity!

And this is exactly how NUM has earned its reputation in the tool and machine industry. We develop the most sophisticated, custom-made CNC automated solutions that guarantee both the machine manufacturers as well as the users of the machines the highest added value. Your wish for productivity is our command.

Our strengths as a recognised CNC specialist begin where those of our rivals end: with expertise in creating applications for CNC-controlled production machines. All of the solutions we create reflect the many interdisciplinary skills we have acquired in decades of research and development, all of which benefits you – the customer, the user and partner – and enhance your competitive edge within the industry.

Accompaniment and support during the entire product life cycle

When you select a system and a solution from NUM, you are making a long-term investment. As your partner, we take part through the entire process: from the conception of the idea to its execution, from on-site customer service to retrofitting years later, giving new life to quality used machines.



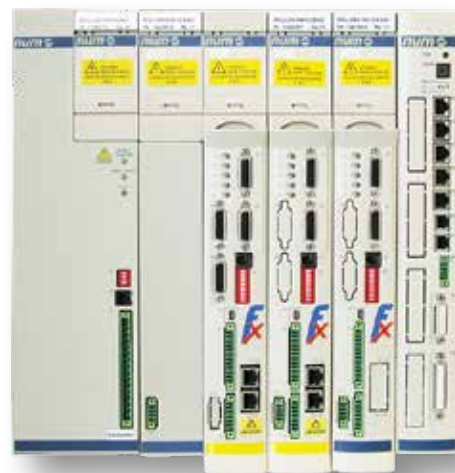
Your solution partner for sophisticated processes in machine automation

Brilliant automated solutions don't just happen: they are based on brilliant ideas! This is why we don't just focus on optimising software and hardware but also build on the innovative abilities and creativity of our specialists.



As companies try to distinguish themselves in the market, using innovative high-tech solutions with the highest added value to their customers, comprehensive know-how is required in diverse areas – this is our strength.

This brainware expands on our software and hardware range, which was specially developed for sophisticated applications such as precision tool grinding. One example of this are our digital servodrives, which offer excellent dynamic characteristics for the highest levels of precision.



NUMROTOplus®

Trendsetter in Tool Grinding

NUM Complete Solutions: intelligent and creative

We have developed countless customer- and application-specific solutions for diverse industries – practical solutions for professional needs. With this in mind, our engineers create groundbreaking complete solutions for demanding applications.

NUMROTO was NUM's first complete solution, and is now the market leader and trendsetter in tool grinding. Our proven software range has been the first choice of tool manufacturers and grinders for over 25 years. Since then, innovative high-tech solutions, continuous development and comprehensive user know-how have guaranteed quality and economy for all standard and special tools.

The NUMROTO team is made up of specialists with comprehensive cross-departmental knowledge of all tool grinding and CNC controlled machine areas. Product development is made in close cooperation with users and machine manufacturers alike.

NUMROTO Complete Solution

NUMROTO complete solution combines the NUMROTOplus software programming system and all elements used to transfer this system to the tool. The system can be expanded with functions such as 2D and 3D simulation, comprehensive probe cycles for tools and wheels, wheel truing during the process, job control and much more. The complete system solution is comprised of the CNC, servodrives, motors and complete switching cabinet. The system is rounded off by training according to customer needs and remote diagnosis methods.

Continuous systems and customer service development and an experienced on-site customer service team ensure long-term value conservation.

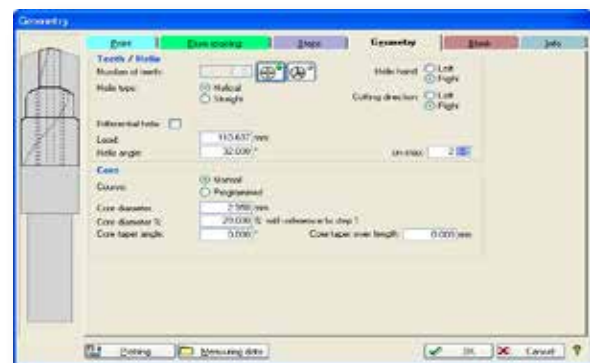
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NUMROTOplus® – Your first choice for tool grinding

NUMROTOplus was created as a sensible and tailored machine investment. Tasks and machines may change over time, but NUMROTOplus remains constant.

NUMROTOplus is used in over 40 different machines from 15 renowned international manufacturers in 50 countries worldwide. This allows investment in the exact machine that meets current needs. Machine operation remains unchanged, meaning training times for operating personnel are kept low. In addition, tasks and personnel can be assigned flexibly according to requirements. This provides optimal efficiency with low operating expense for economic operation.



Based on current Windows systems, NUMROTO can be integrated into the corporate network. Central storage and administration of part programs and extended back-up functions can be made quickly and easily.

The machine operation was developed for use in tool grinding and is clearly structured. Even the most complex forms can be programmed and executed with ease – all in many languages. NUMROTOplus works both for and with the operator.



NUMROTOplus®

Unlimited Opportunities

With NUMROTOplus, a wide range of tools can be manufactured and resharpended. Each tool detail can be adjusted to suit individual needs.

On the following pages, a number of tools ground with NUMROTO are introduced, together with the diverse extended functions of NUMROTOplus, such as simulation possibilities or probe functions.

Please also visit our homepage www.numroto.com. The NUMROTO gallery there has a comprehensive collection of tools that have been ground with NUMROTO.

Flute-X

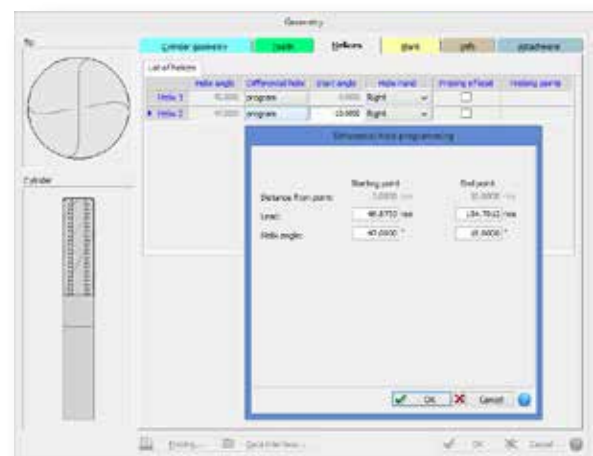
Multi-helical end mills with constant land width

With NUMROTOplus, cutters with up to twelve different helix angles on the same tool can be manufactured and resharpended. The lead type can be constant, variable or a differential helix. In addition, the cutting edge geometry can be configured differently for each edge. In this way it is possible, for example, to choose different rake angles or core diameters at the front and rear of the tool.

Each tooth is individually probed in resharpening mode. The lead and division angle of the tool are calculated at the end of the cutter. In resharpening mode, the lead type per tooth can also be constant or variable.



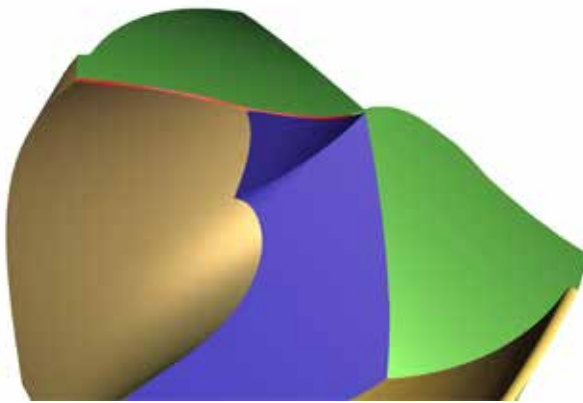
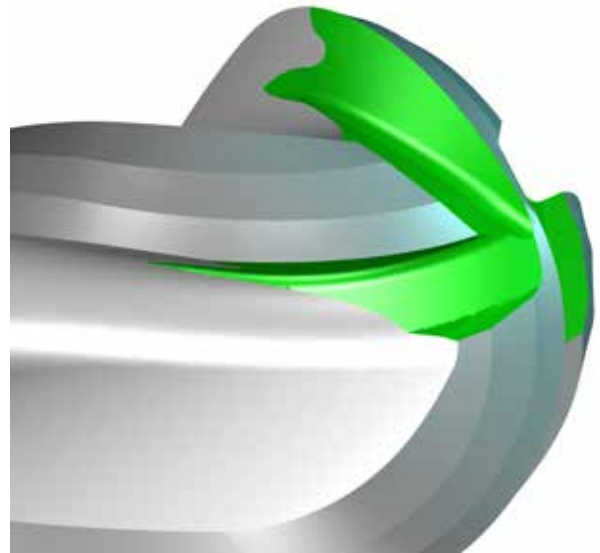
Multi-helical end mills with differential helix, variable core geometry and constant land width.



Entry of the different helix angles.

Gash out-X

NUMROTO can grind the rake surface of the gash out optionally either straight (with the flange side of the wheel) or rounded concave (with the corner radius of the wheel). The base of the gash out is specified with a gash out angle and a transition radius in the cylinder. The rake angle can be programmed separately in the center and in the transition to the cylinder. If required, even a K-land can be ground on the ball nose with the gash out-X.



Drill Tips

NUMROTOplus offers numerous well-known drill points. As with all geometries, which can be programmed within NUMROTO, also the drill points can be customized by many parameters for individual use. After grinding a drill point it is possible to probe the shape of the drill main cutting edge which afterwards allows to grind a K-land along the probed cutting edge.

NUMROTOplus for Burrs

Burrs are ground using the NUMROTOplus „Burrs“ software package. The number of different shapes is practically unlimited, since the outer form of the tool can be defined with the NUMROTOplus profile editor.

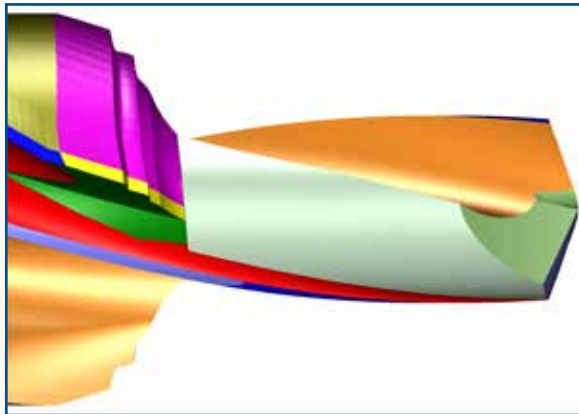
The flute and burr relief are ground in one operation only. This is executed with a normal peripheral wheel which, depending on the flute depth and rake angle required, usually has an angle of between 0° and 30°. The wheel is adapted by NUMROTOplus automatically, so that the required external geometry can be created immediately.



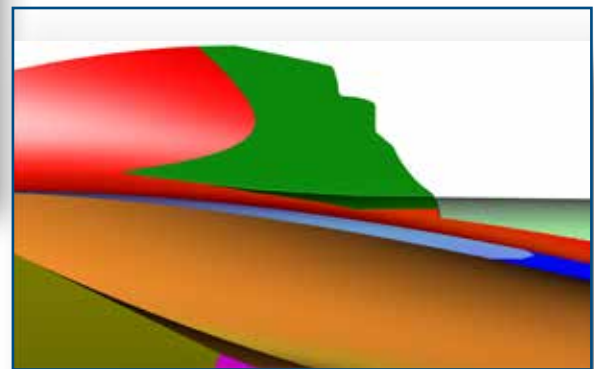
Special Step Drills and Documentation

Special Step Drills

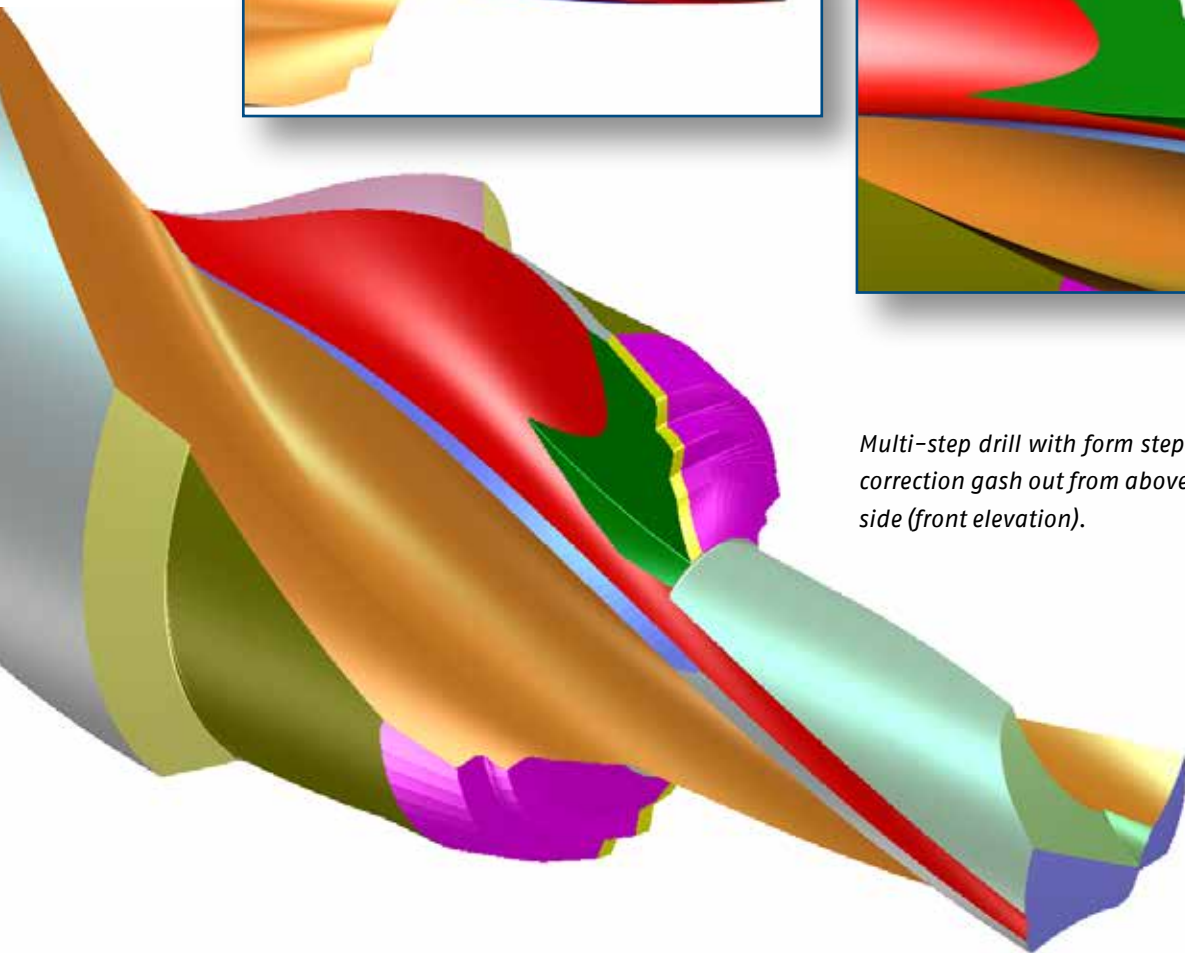
With NUMROTO, the programming of normal step drills and special step drills is simple.



This example shows a sub-land flute step drill with a complex step transition. As a further special feature, the form step is not ground along the helix. Instead, it is projected onto a separately ground surface. The form can then be created without any distortions. In this way, the helix angle in the step transfer area is simultaneously reduced, which brings several technological advantages.

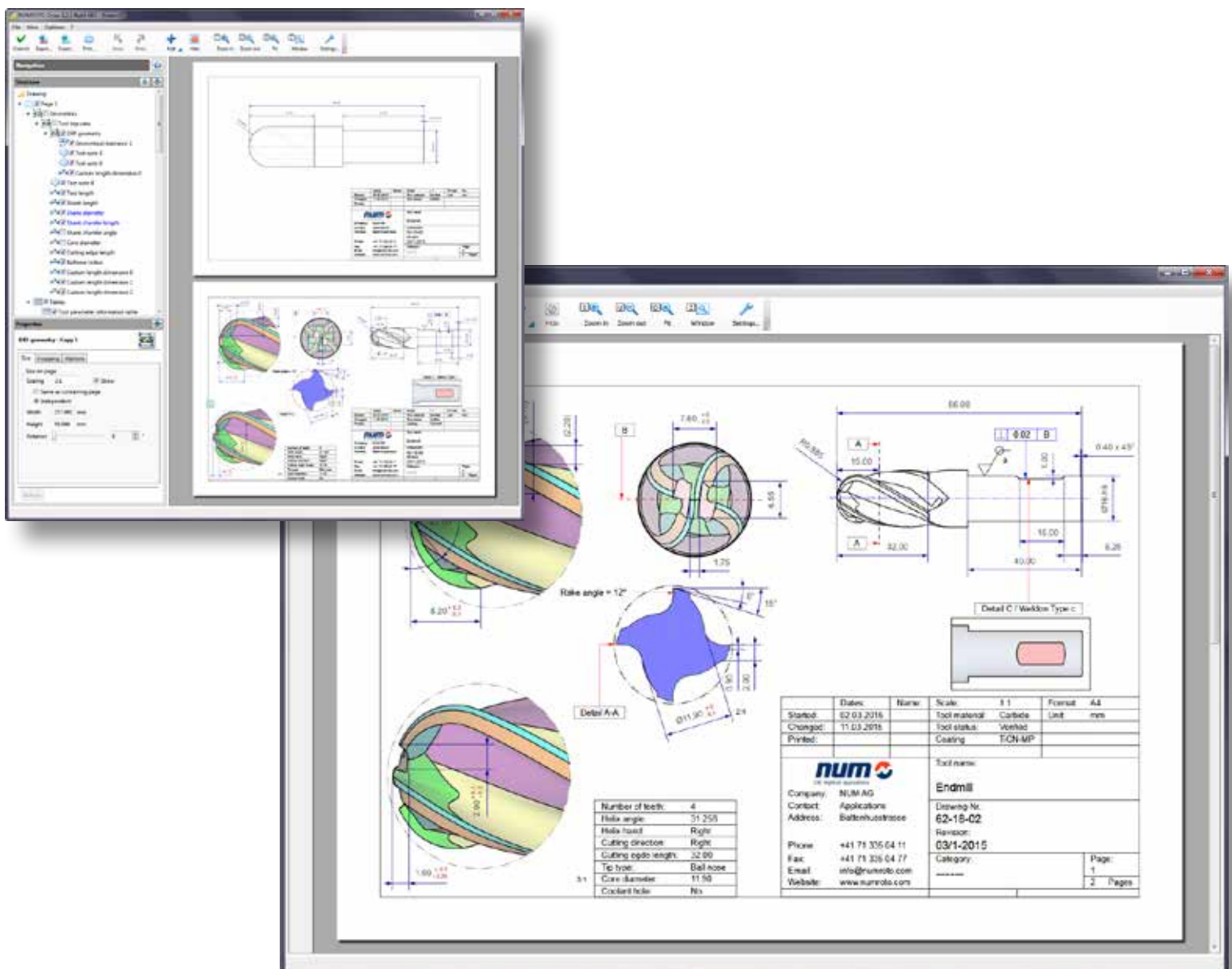


Multi-step drill with form step. Additional views: Step correction gash out from above and form step from the side (front elevation).



Documentation

After entering all geometry parameters a dimensioned projection drawing can be created automatically. Next, the drawing can be supplemented with scalable detail views, which are taken as true-to-scale color graphic image or DXF drawing from the 3D simulation. Even cropping is possible so that, for example, a special part of the geometry can be highlighted. This yields a representative product documentation, which can be supplied with the ground tool to the end customer.



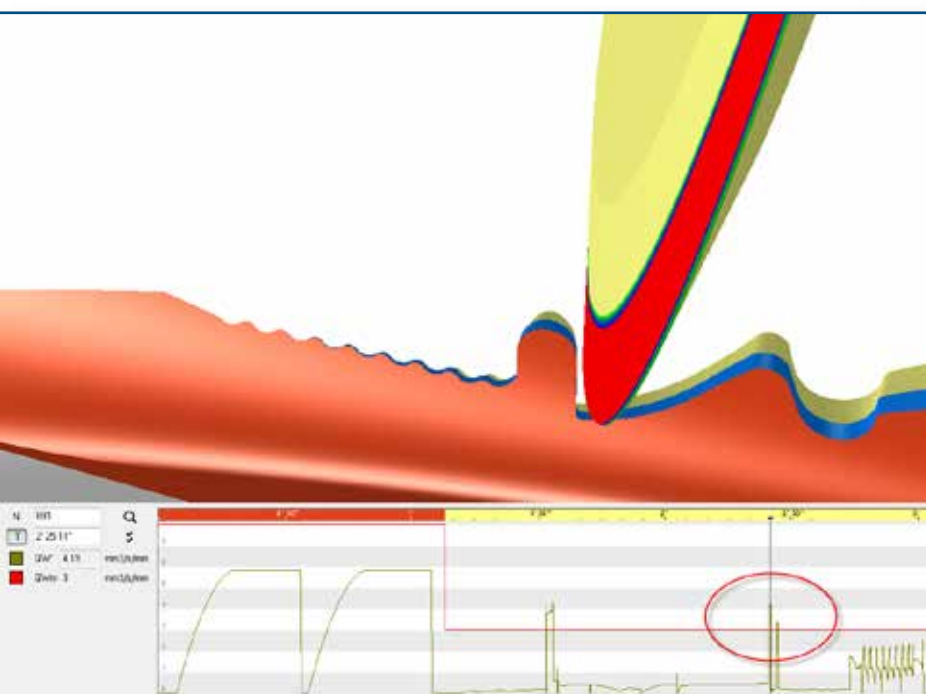
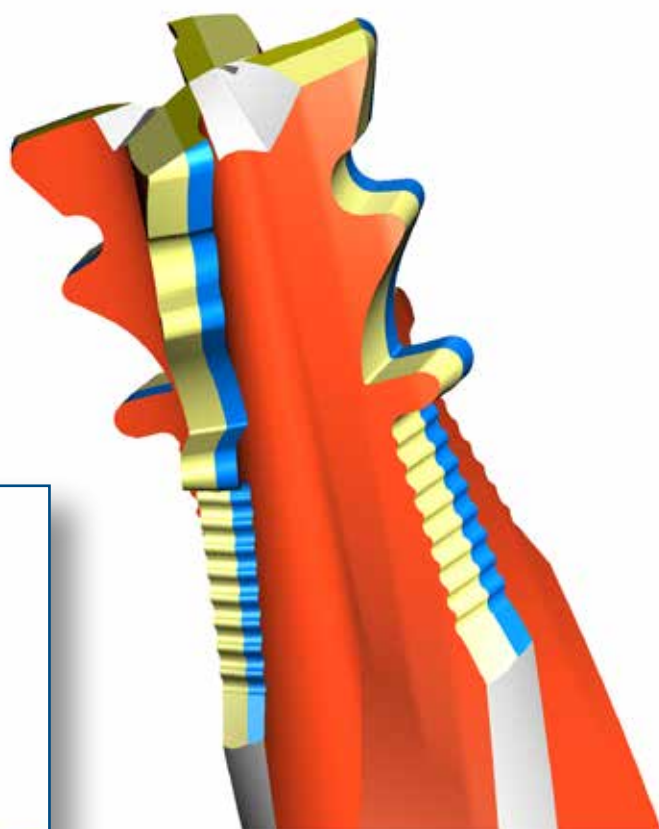
This document may consist of several pages. Apart from the automatic dimensioning, various options are provided for dimensioning and captioning by hand. Even form cutters can be documented efficiently in this manner. After finishing a drawing, it can be printed out or exported in various formats and edited or processed for further work by the customer.

3D-Simulation and 3D-Collision Monitoring

3D Simulation

NUMROTO is practically always used at present together with the integrated 3D simulation. This includes:

- True-to-scale simulation of the complete tool
- Dimensioning geometry characteristics and creating cross sections
- Monitoring the entire machine for collisions
- Analysis of the stock removal volume and monitoring the grinding wheels for overload
- Determining the mass center of gravity to prevent imbalance



Comparison of removal rate during flute grinding as well as when rough and finish grinding the form reliefs. Within this example the removal rate during rough grinding of the form reliefs is at some spots higher than the nominal value of the grinding wheel (red curve). Without adapting the grinding strategy the grinding wheel would break down quite fast.

3D Collision Monitoring / Monitoring of removal rate

Even with the best software and experienced personnel, collisions are sometimes unavoidable. An unused wheel, spindle arbor or attached auxiliary device (tailstock, support) are all possible causes of a collision. To prevent this, NUMROTO and NUMROTO 3D come complete with an integrated collision check, which can also be fully automated.

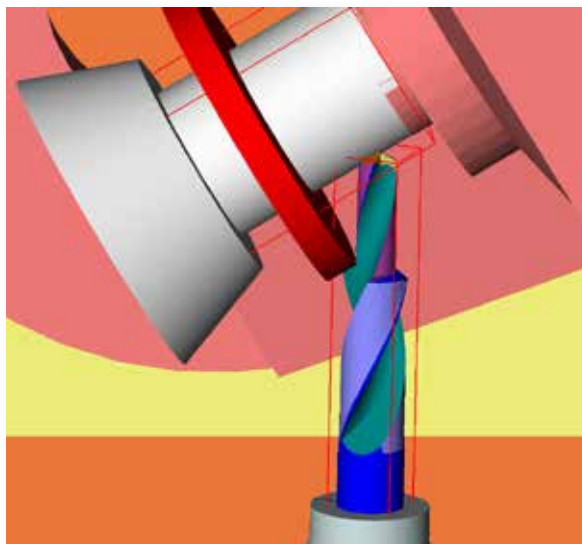
The complete grinding procedure is checked in the background, either on request or during CNC file transfer. If the system detects a collision, the grinding is not started and a relevant warning is displayed. This collision check can also be used together with the loader, meaning each tool is checked for collisions after measurement (probing) but before grinding.

The collision check only takes a few seconds on an average tool.

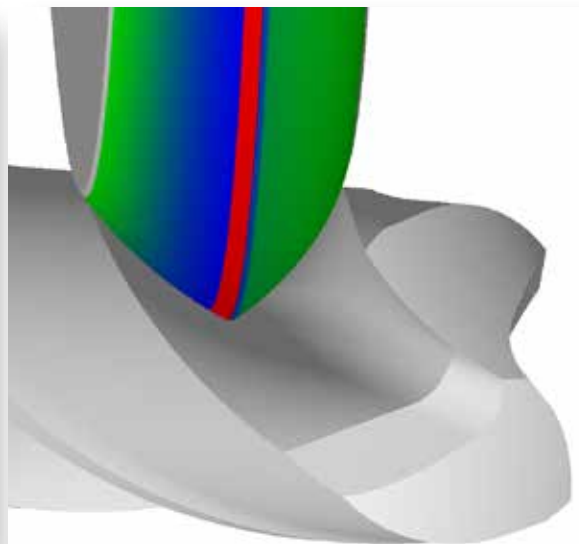
N	Operation	Collision state	Removal rate - mm ² /min
1	S2/FLUTE	Removal rate exceeded	6429.69
2	S2/CLEARANCE	No collision	962.18
3	S1/CLEARANCE	No collision	1083.13
4	S2/STEP FACE CAM	Collision	1098.27
5	S1/RELIEF 1	No collision	0.24
6	PT/GASH OUT	No collision	873.94
7	PT/SPIRAL POINT	No collision	217.16

1 Collisions found 2.09s 13m 13s

List of all operations with collision status



Detected collision between drill tip and grinding spindle



Removal rate exceeded during flute grinding

In-Process Measurement Job Manager

In-Process Measurement – the modern quality control method

Modern grinding machines work precisely to high standards of quality. The NUM software and CNC control for grinding machines guarantee that tools can still be ground more precisely with absolutely exact data. However under certain circumstances, accuracy problems can occur (e.g. when a large number of tools are ground with the loader).

The main reasons for this are wear to the grinding wheels and changes in machine dimensions due to temperature deviations. Preventative measures such as periodic wheel measurement with the probe are of limited use.

Therefore, NUM has integrated a new function in NUMROTO:

In-process tool measurement with instant correction.

This function allows the measurement of a diameter with the probe directly after the grinding operation. If the tool is too large, the grinding operation is repeated until the desired diameter is reached. By doing this, the tolerance (even in micrometres) of a complete batch is sustained.

Programming of compensation

The screenshot shows a software dialog box titled "CG Step 1/Straight-line grinding - Other machining data". It has several tabs: "General", "Change positio.", "Grinding positi.", "Cooling Valves", "ISO program", "Probing", and "Compensate". The "Compensate" tab is active. The dialog contains the following fields and controls:

- Compensate by: New calculation (dropdown)
- Compensation action: at current tool (dropdown)
- Compensation system: Weighting (dropdown)
- Weighting: 100.000 %
- Maximum number of repetitions: 5 (spin box)
- Pitch diameter: 9.990 mm (input field) with a checked checkbox and a small 'A' icon.
- Upper diameter tolerance: 0.005 mm (input field)
- Lower diameter tolerance: -0.010 mm (input field) with a checked checkbox and the text "Stop grinding process if the tool is too small (lower tolerance)".
- Target diameter: 9.988 mm (input field)
- Current compensation (Ø): -0.0130 mm (input field) and maximal: 1.000 mm (input field)

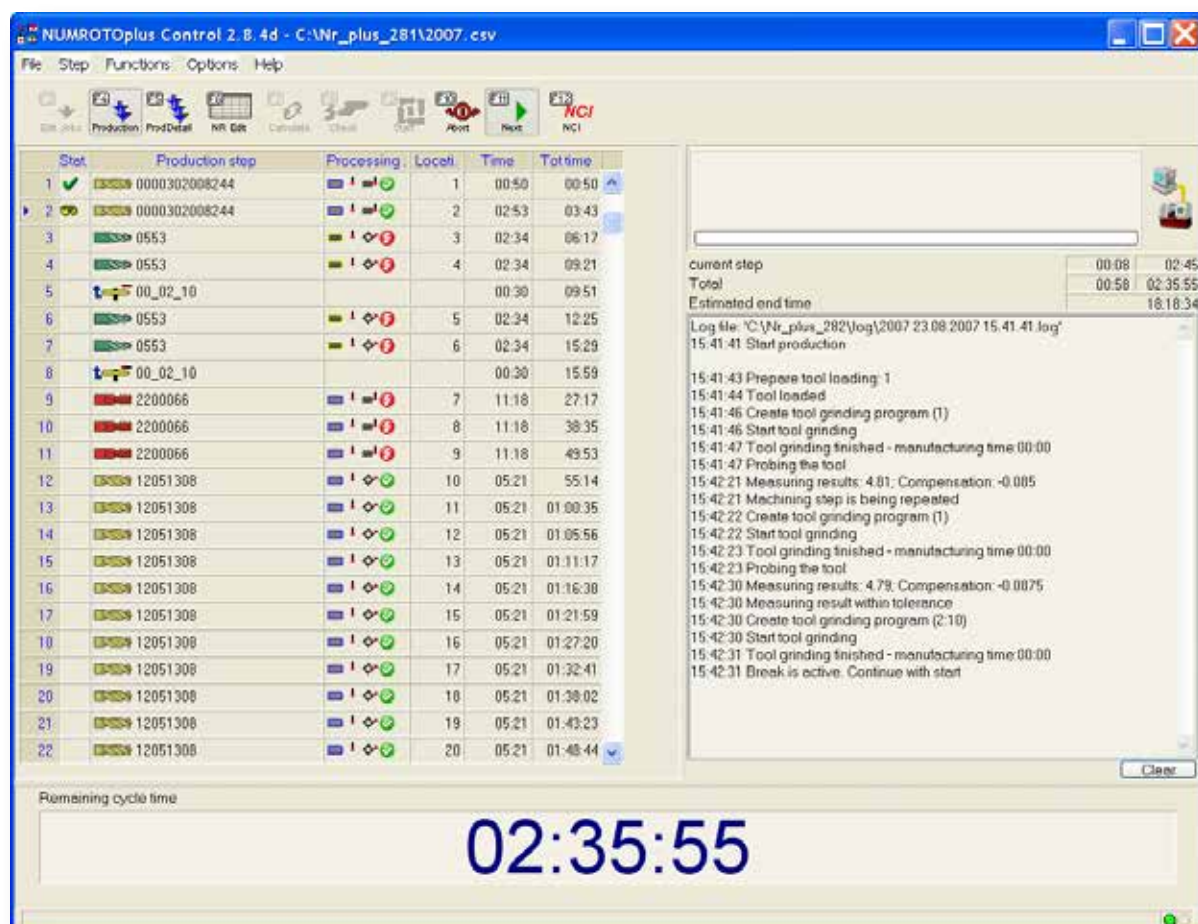
At the bottom, there are function key icons (F7, F9, F10, F8) and buttons for "OK" (with a green checkmark), "Cancel" (with a red X), and a help icon (question mark).

Job Manager – NUMROTO–Control

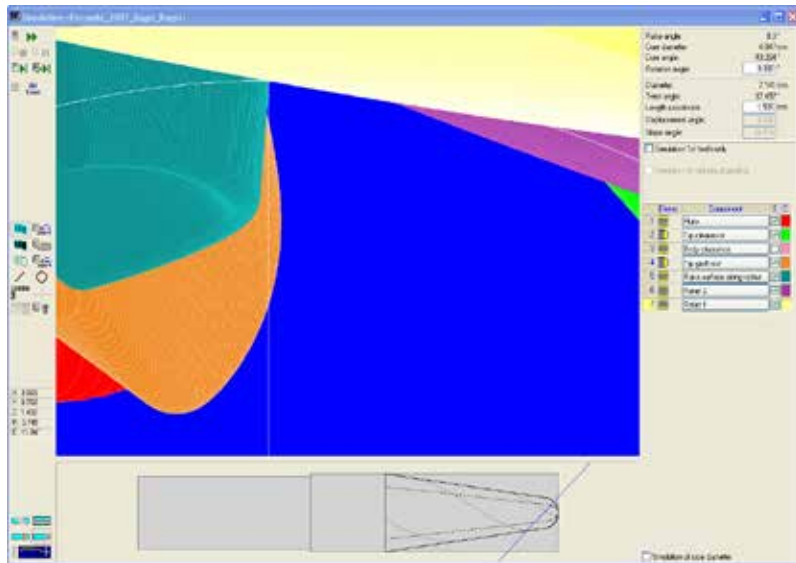
Many current machines are equipped with loaders so that unmanned operation is possible. NUMROTO control software has been developed to create order lists for loaders as simply as possible and to log and monitor the system during operation.

The most important highlights are as follows:

- Direct communication with NUMROTO for integration and alteration of tools in the job list
- Addition of tasks between the tools (e.g. grinding wheel probing, trueing etc.)
- Connection of tool programs
- Setting of checkpoints
- Non-critical errors can be ignored
- E-mail (or SMS) alarm for malfunctions or before production end
- Calculation of complete process time
- Display of the current remaining running time (constantly updated)
- Collision monitoring for each tool in connection with NUMROTO 3D
- Process interruption (i.e. due to wheel or tool data adjustment)
- Logging of all messages and measurements including time stamps



Further Functions



2D Simulation

The 2D simulation is an integral component of NUMROTO. Details can be analyzed quickly and accurately to the nearest micrometer with it.

Further Functions

NUMROTOplus offers more additional options than can be detailed here. The following list details further functions, though even this list is not exhaustive.

- Automatic calculation of trueing cycles for grinding wheels
- Data interface to measuring machines or other external data sources
- NUMROTO optimal wheel profile calculation for a defined flute profile
- Calculation of grinding time per tool
- System for automatic runout error monitoring and compensation (also in loader operation)

- Shaper cutter module for resharpening shaper cutters
- Module for forming taps and other tools with polygons on diameter
- Comprehensive range of functions for cylindrical grinding
- Multi-user system for central administration of all machine data. Includes comprehensive user administration system
- Competitively priced dongles for offline programming and work preparation

If you require additional information, please do not hesitate to contact us or your machine builder.

Maintenance of value NUM – Decades of support

When you choose NUM, you are also choosing customer service which will continue to serve you just like new long after you have made your initial investment. Regular updates and developments ensure long-term value conservation.

Good, quick customer service ensures that waiting time is kept to an absolute minimum. Thanks to its new logistics structure, NUM is constantly working to reduce response times. NUM offers new solutions for older systems. Our specialists use their knowledge and skills to restore even older systems as quickly as possible – new or old we are on the case.

Global support from professionals

A perfect infrastructure is available to our experts in all competence centers for conducting professional analyses and training seminars. In order to support you around the globe in the most efficient way possible, we employ the latest communication equipment, for example, for remote maintenance via Internet. We can, of course, also advise you on-site, directly on your company premises.

Comprehensive training programs

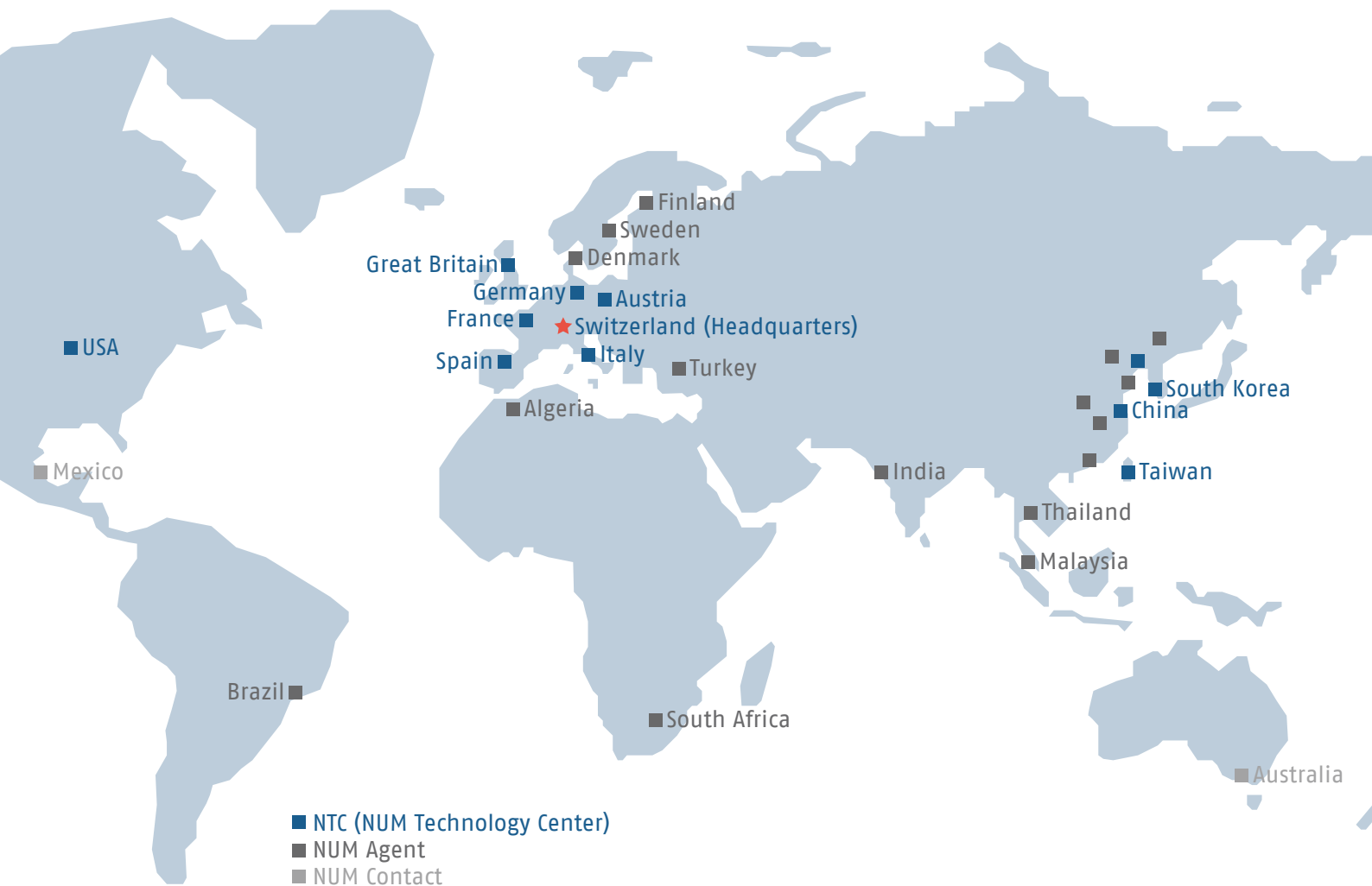
Our training programs are adapted to the needs of our customers. The focus of NUMROTOplus training is on operation and programming.



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