

COMPLETE SOLUTION IN TOOL GRINDING

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www.num.com

NUM Solutions and Systems Established Worldwide

Outstanding solutions in machine automation have one thing in common: They are always the product of outstanding performance, exceptional technologies and a high degree of creativity!

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NUM has earned its exceptional reputation in the machinery and tools industry exactly with that. We develop customized automation solutions that ensure a high degree of added value both to the machine manufacturer and the user. With our expertise that we have developed over decades, we put our motto "NUM automation solutions provide machine builders with a competitive advantage" into practice. NUM had already developed the first CNC controller in 1961, i.e. 10 years before CNC- or NC control systems found a wide acceptance among users. With the launch in 1964, NUM was one of the first CNC providers in the world. Since then, we have maintained our position as a technology leader in this segment and are eager to expand it further. Today's systems, with their flexibility and our expertise, enable us to automate a large variety of machinery. Our long, successful track record supports this finding in an impressive manner. We will continue to develop the performance, functionalities and flexibility of our systems in this direction and make the necessary investments in our products, our research & development, as well as in our staff

As an **international company** headquartered in Switzerland; we have sales, application development and service locations all over the world (see back cover) from which we operate worldwide. Our research and development departments are located in Switzerland, Italy and France. Our main production facility is located in Italy.

It is our clearly defined vision that we keep the development and manufacture of the core products in the CNC system, including the drives and motors, under our control. This enables us to adjust the performance, functionalities and flexibility of our systems to new market requirements very quickly and without delays.

The ready and flexible NUM automation systems combined with our locally available engineering expertise and the machine manufacturer, results in a uniquely flexible and powerful team.

Customized Projects

NUM tailors its support to your projects, ensuring it aligns perfectly with your business and infrastructure needs. Regardless of the specifics, our ultimate goal remains unchanged: collaboratively finding the most efficient solution for your project.



Project facilitation PRODESIGN

Efficient consulting for optimal application solutions

This model is ideal for companies with their own development teams and automation specialists. As an external partner, we provide our expertise and resources in field of CNC automation and take on an advisory role.

Project cooperation CODESIGN

Merging knowledge – potentiating results

Your development team will be combined with our team of specialists. Together we will realize the automation of your machine with clearly defined responsibilities. This form of cooperation has proven to be extremely efficient in many projects.

Total solutions ALLDESIGN

Delegating responsibility – controlling result

We assume the entire project management in the sense of a general contractor and are fully responsible for the successful implementation. Starting with the development of the requirements specification, over the development and commissioning, up to the support and service of the machine, and beyond

NUM Solutions and Systems Intelligent and Creative

We have developed countless customer- and application-specific solutions for different industries as well as pioneering complete solutions for various industries, thus creating practical solutions for challenging applications and professional requirements.

All of our solutions are based on a wide range of perfectly matched proprietary products such as CNC, drive amplifiers and motors. The partnership with our customers in the evaluation, project and installation phase is further maintained by our training, support and other services even after commissioning. We attach importance to ensuring that our customers are served by our professionals with specific knowledge.



numroto

NUMROTO – successful trendsetter in high-precision tool grinding for many years

numspecial

NUMspecial – creative and practical solutions for your specific applications

numcut

NUMcut - a complete solution for advanced cutting machines

numgear

NUMgear – intelligent total solutions for new machines or as a retrofit in the field of gear machining

numtransfer

NUMtransfer – economical and flexible for all lot sizes for transfer, rotary transfer and multi-spindle machines

numhsc

NUMhsc – excellent quality at the highest speeds on machines with 5 or more axes

numgrind

NUMgrind – grinding and dressing cycles, with intuitive shop floor entry screens and 3D visual validation

nummill

NUMmill – flexible solution with a graphical interface for extensive milling cycles, including full 3D simulation

numwood

NUMwood – long tradition with powerful complete solutions in woodworking

numretrofit

NUMretrofit – rational extension of the service life of your machine by years

NUMROTO – Successful Trendsetter in High– Precision Tool Grinding for Many Years

NUMROTO is both a trendsetter and market leader in tool grinding – worldwide. For more than 35 years, tool manufacturers and tool resharpeners have relied equally on the proven software. Innovative high-tech solutions, continuous further development and comprehensive user know-how guarantee quality and cost-effectiveness for all standard and special tools.

The team behind NUMROTO consists of specialists with interdisciplinary knowledge in all areas of tool grinding on CNC-controlled machines. Further developments are the result of close cooperation with users and machine builders.

NUMROTO complete solution

In addition to the NUMROTO*plus* software – the programming system – a complete NUMROTO solution also includes many other functions to manufacture or regrind a tool as efficiently as possible. With functions such as 3D simulation, extensive and precise touch cycles for tool and wheel, wheel dressing (also in process), job control, creation of elevation drawings, adaptive grinding and more, the system can be expanded. The complete solution includes the software, CNC, servo amplifier, motors and optionally the complete control cabinet. Training courses specifically tailored to requirements, industry 4.0 capabilities and remote diagnostics round off the range.

The continuity of the overall solution is also evident in the latest advancements of NUMROTO X, ensuring the preservation of expertise and technology for the future.

NUMROTOplus - first choice for tool grinding

NUMROTO*plus* facilitates sensible and needs-based investment in machines. The tools and machines required by the market may vary, but NUMROTO*plus* remains a constant.

NUMROTO*plus* is in use in more than 50 countries on more than 50 different machine types from 20 renowned international manufacturers. This means that you can invest in exactly the machine that is ideal at the time of evaluation. The operation remains the same and therefore the training effort for the operating personnel is low. In addition, production orders and personnel can be deployed flexibly according to requirements. Based on current Windows systems, NUMROTO*plus* can be integrated into the company network. Central storage and administration of part programs and extended back-up functions are therefore easy to implement.



The operation has been developed specifically for tool grinding and is intuitively structured. NUMROTO*plus* is designed to work seamlessly with the user, a feature that's underscored by the availability of the user interface in multiple languages.

NUMROTOplus – Unlimited Opportunities

With NUMROTO*plus*, a wide range of tools can be manufactured and resharpened. Each tool detail can be adjusted to suit individual needs.

Flute-X Multi-Helical End Mills with Constant Land Width

With NUMROTO*plus* cutters with up to twelve different helix angles on the same tool can be manufactured and resharpened. 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.

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 transi-



tion 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



NUMROTO*plus* 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 individu-

al use. After grinding a drill point it is possible to probe the shape of the drill's main cutting edge, which allows for the grinding of a K-land along the probed cutting edge.



NUMROTO*plus* for Burrs

Burrs are ground using the NUMROTO*plus* "Burrs" software package. The number of different shapes is practically unlimited, since the outer form of the tool can be defined with the NUMROTO*plus* profile editor.



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

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.



Indexable Inserts / Profile Inserts

Indexable inserts/profile inserts are frequently ground within a dedicated production clamping system, regardless of the intended tool (such as a milling head or turning tool holder). The desired profile for the tool is created using a profile editor or imported if available. Once ground, the insert/profile plate is securely fastened into the target tool, allowing for precise production of the intended profile. This process enables the grinding of profile inserts for milling heads of any diameter and with freely adjustable radial/axis angles.



Jobmanager – 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.

- 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
- Industry 4.0 Ready

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With NUMROTO X, NUMROTO is making another product line available, that will provide our customers with the usual high standards of NUMROTO technology in the long term. The software has been redesigned from scratch, with particular attention paid to modern technologies and flexible expandability. This allows not only the implementation of demanding requirements for tool grinding, but also prompt adaptations to changing market needs.

Like NUMROTO*plus*, NUMROTO X is also designed as a desktop application and is also available on the workstation PC as an application on the grinding machine. Proven concepts such as the multi-user database, 3D simulation and 3D collision check as well as product documentation with NUMROTO-Draw can also be found in NUMROTO X.

During the development of NUMROTO X, various innovative development priorities were implemented. The focus was on the optimized production of complex standard milling cutters. NUMROTO X not only offers an extended number of configurable geometry elements, but also provides completely new options for production and process planning. Grinding operations and probing cycles as well as dressing and calibration processes can be organized in sequences. With the option of executing sequences from within other sequences, these can be combined as required, allowing complex production processes to be configured and still clearly displayed.

These innovations are complemented by an integrated job manager. This provides the user at the machine, as well as in work preparation, with new possibilities in production planning. Job lists can be changed and expanded "on the fly", allowing uninterrupted production operations. Instead of nested dialogs, the interface relies on scrollable areas that clearly display the numerous parameters. User input is immediately evaluated and converted into machining paths, which enables rapid visualization of the workpiece. This makes it possible to observe the effects of parameter changes in real time. The innovative visualization calculates a pixel-precise image for each zoom level, making every detail visible, no matter how small.

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The machine's movements are computed using a kinematics module, which also supports the interpolation of 6-axis movements. Efficient strategies have been implemented for transferring movement between two grinding operations, ensuring optimal axis control.

When creating a new workpiece, the user is supported by an extensive default value system. The default values can be configured as required by the user and adapted to the requirements of the tool range to be produced.

The guiding principle of "faster and more precise" is implemented by the NUMROTO development team with great ambition. In addition to the above-mentioned optimizations, which allow faster and more efficient programming and production of the tools, algorithms have been implemented which deliver even more precise results.



For example, the flute calculation can maintain the programmed tool core exactly, even if the cutting angle of the grinding wheel is large, regardless of whether it is calculated automatically or defined manually. For the reliefs, the user can choose whether the relief angle should be maintained at the cutting edge or over the programmed relief angle width, analogous to the measuring depth when calculating the flute. NUMROTO X will be available in its first version with the range of functions for manufacturing complex standard milling cutters. The new software package boasts many functions and innovative solutions and is constantly being further developed to cover the entire range of NUMROTO*plus* functions over time. It is important to us to supply our customers with the proven and high-quality NUMROTO technology in the long term, which is why NUMROTO*plus* and NUMRO-TO X will be available and usable in parallel for several years.

Documentation with NUMROTO Draw

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 final 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 with NUMROTO 3D

3D Simulation

Today, NUMROTO is always used 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

3D Collision Monitoring / Monitoring of Removal Rate

Even the most experienced grinder cannot always prevent a collision during grinding. A disc that is not in mesh, the spindle mandrel or mounted accessories (tailstock, support) can be the cause of a collision. To prevent this, NUMROTO has an integrated collision check together with NUMROTO-3D.

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 - mm3/mir
1	S2/FLUTE	Removal rate exceeded	6429.69
2	S2/CLEARANCE	No collision	562.18
3	S1/CLEARANCE	No collision	1083.13
4	S2/STEP FACE CAM	술 Collision	1098.37
5	S1/RELIEF 1	No collision	0.24
6	PT/GASH OUT	No collision	873.94
7	PT/SPIRAL POINT	No collision	217.16





Detected collision between drill tip and grinding spindle



Removal rate exceeded during flute grinding

CNC-Systems Flexibility, Productivity and Safety

Flexium+ and FlexiumPro – Extreme Scalability



flexium^{pro}

NUM control systems offer remarkable scalability, enabling a precise fit for each specific application. As a result, systems ranging from 1 to more than 200 CNC axes can be effortlessly implemented. In addition to the normal PLC, both the existing Flexium⁺ and new FlexiumPro systems have a safe PLC which communicates via FSoE (Fail Safe over EtherCAT) with the safe inputs and outputs as well as with the NUMDrive X or NUM DrivePro drive controllers. The systems cover all necessary safety functions in a simple way. The safety logic is programmed with the same software tool as the rest of the PLC. The same tool is also used for all system parameterization and machine commissioning.

The NUMDrive X and NUM DrivePro drive solutions are the result of more than 30 years of experience in the development of fully digital drive systems. The drive amplifiers are available in various versions with different performance data. The wide range of drive amplifiers is available in single-, dual- and quad-axis versions, with different computing power and supports rated currents from a few up to 200 amps. Another strength of the drive amplifiers is their compactness and high energy efficiency. Our experts will be happy to help you make a technically and financially optimal selection from the wide range of products, in coordination with your application.



to 32 axes/spindles per NCK and more than 200 per CNC system

NUM Motors Perfect for all Applications

Excellent volume/performance ratio and great dynamics, so that our motors can satisfy almost all applications.

NUM has more than 50 years of experience developing servo and spindle motors. We pioneered the development and production of AC brushless servo motors, as well as synchronous spindle motors with flux weakening.

The comprehensive **servo-motor** series of NUM offer an excellent volume/output ratio, as well as first-class dynamic properties optimized for the machine tool industry. They, with perfect concentric run-out, give great performance even at very low speeds. The so-called "single cable" motors offer the advantage that the complete measuring system cable is eliminated. This simplifies the wiring of the machine significantly and thus saving time and money.

The **asynchronous motors** of the AMS series offer excellent quiet running at low speed, quick and accurate positioning and are ideally suited as a C-axis and for spindle indexing.

The TMX series **torque motors** have an extremely low cogging torque as well as a very high S1 torque density. They are ideal for applications that require very smooth and precise motion, especially at low speeds. Typical applications are direct drive rotary tables or workhead axes of machine tools.

The NUM LMX linear motors are specially designed for machine tools. Among other features, they are characterized by a fully enclosed primary, a cooling circuit with large diameters to accommodate fluids with low specific heat capacity, a short pole pitch to increase the force density and reduce temperature, and many other interesting features.



Motors of the series SPX "single cable"



Motors of the BPX series



Motors of the series SHX "single cable"



Motors of the BHX series



Motors of the AMS series



LMX linear motors



TMX torque motors

NUM Services Worldwide at your Service

The decision for NUM is also the decision for a customer service that will support you long after the initial investment as on the first day – even after 20 years and on–site. Our specialists can ensure an extended life for your good (but old) machinery with NUM retrofits.

Worldwide support by experts

For professional analysis and trainings, a perfect infrastructure is available to our experts in all centers of excellence. So that we can assist you quickly and efficiently around the world, we also rely on the advantages of the most modern communication technologies, e.g. for remote maintenance. We can also offer on-site support and consultation services out of our regional branches



Comprehensive training offer

We orient our training to your indivual needs – whether its operator training, maintenance, repair and service training, HMI; CNC or PLC programming, or adjustment of servo drives etc.

NUM provides a training offer matched to the customer needs:

- CNC operation
- CNC programming
- PLC programming
- Commissioning and servicing
- Creation of a custom HMI
- Customized customer training

Technically always up to date

Our team of specialists will actively inform you on the latest

hardware- and software developments and provide you with useful technical information.

Repair- and spare parts service

If an error unexpectedly occurs in your CNC system in spite of proper maintenance, you can trust that this will be fixed by dedicated service employees of our global network.



Customer service

For you and your markets, we have a worldwide service organization. The International customer service provides telephone consultation and deployment on site, even for machine installations that are many years old. With a retrofit from NUM, the operating time of an excellent machine can be extended by many years.

Our customer service is available and responsive to help even with cutting edge products and custom developments. We carry local inventory and have your materials and components in stock ready to meet your requirements for quality and delivery times.

Complete CNC Solutions Worldwide





NUM systems and solutions are used worldwide.

Our global network of sales and service locations guarantees professional service from the beginning of a project to its execution and for the complete life cycle of the machine.

NUM has service centers around the world. Visit our website for the current list of locations.

Follow us on our social media channels for the latest information on NUM CNC Applications.



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