numgrind

TOTAL SOLUTION FOR GRINDING

num
CNC Solutions

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!

num
CNC Solutions

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

numhsc

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

numspecial

NUMspecial – creative and practical solutions for your specific applications

numgrind

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

numcut

NUMcut – a complete solution for advanced cutting machines

numstone

NUMstone – a complete CNC solution for stone and marble

numgear

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

numwood

NUMwood – long tradition with powerful complete solutions in woodworking

numtransfer

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

numretrofit

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

NUMgrind – Shop Floor Programming Solution

NUM has a great deal of experience in grinding applications and is one of the world's leading suppliers of CNC solutions for tool grinding. NUM also supports external and internal cylindrical grinding (GC), including non-circular grinding (NCG) , surface grinding (GS) as well as centerless cylindrical grinding, with CNC systems specially tailored to the respective application. Each application solution offers corresponding cycles and a matching and easy-to-use HMI.

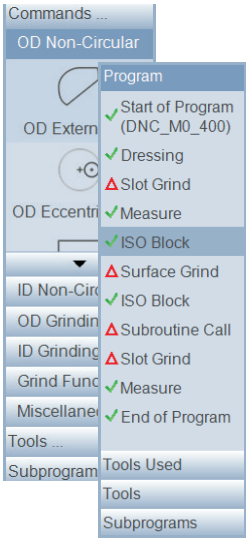
NUMgrind is suitable for all aspects of the cylindrical grinding process (Cylindrical Grinding Pack 1), for the non-circular grinding process (Cylindrical + Non-circular Grinding Pack) as well as for the surface grinding process (Surface Grinding Pack 1). It offers a complete "off the shelf" solution, with embedded grinding and dressing cycles governed by a user-friendly menu-driven data entry system that includes 3D simulation and wizard-guided setup. In short, NUMgrind not only saves OEMs years of development time, but also significantly reduces operators' training time.

NUMgrind HMI for Grinding

The Flexium CAM-based programming process is extremely user-friendly. Entry screens provide the machine operator with a comprehensive graphical programming approach that depicts the grinding wheel, workpiece, and associated setup data in a clear and concise manner. Operators do not have to rely on ISO or G-code programming; they simply fill in the data fields presented by the program. After completion of the data entry session, the grinding program is automatically generated, stored, and ready for execution.

Example page from Cylindrical Grinding

The architecture of the NUMgrind HMI is ergonomic and offers a comfortable programming experience with a very intuitive interface:



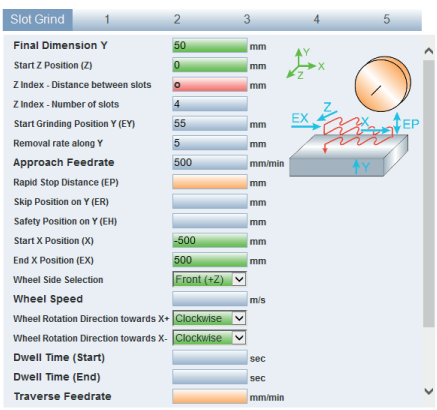
Command Tree and Program Sequence

On the left-hand side is the "command tree" (Example from GC) with all available functions (general definitions, tool selection, cycles, etc. depending on the technology). The user interface can work with mouse, keyboard and touch screen.

The middle frame shows the "Program sequence" (Example from GS). The selected commands are inserted directly in the order in which they should be sequentially be executed. Whether a command is complete and plausible is indicated by a green tick or red cross directly next to each command.

On the right-hand side we have the input page with graphic support. Orange fields are mandatory fields, blue fields are optional entries. If the fields are green or red, the entry is accepted or not accepted.

The grinding wheel data can be specified on custom HMI pages and allows the specification of complex grinding wheel geometries.



Input Page from Surface Grinding

NUMgrind – Non-Circular Grinding

A specialty in cylindrical grinding is non-circular grinding, such as the grinding of camshafts, punches, cams, eccentric shafts, polygons and more. Non-circular grinding is an complex grinding application, as the non-circular contour leads to changing engagement and movement conditions on the workpiece to be ground. Special software is therefore required to make non-circular grinding a success.

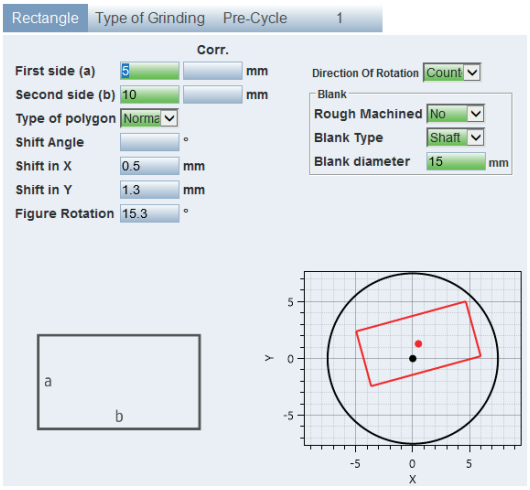
With NUMgrind, the closed shape of the workpiece is defined in the XY plane. However, grinding is done by interpolating or synchronizing the X axis with the C axis (workpiece spindle). The Flexium+ control transforms the contour from the XY plane into an XC plane and calculates the corresponding compensation and infeed movements, taking the grinding wheel diameter into account. The speed profile is also transformed, whereby the controller automatically adapts the speed and acceleration to the physical limits of the machine. NUMgrind offers all the non-circular grinding cycles ready to use.

OD Eccentric Circle	Ellipse	Rectangle
Reuleaux triangle	Super circle	Stadium
Trapeze	Rhombus	Wrench width
Egg shape	Polygon	Oval
Circle segment	OD External XPI	Triangle
ID Eccentric Circle	Pitch Circle	ID External XPI

Available External and Internal Non-Circular Shapes (last row)

A large number of predefined shapes for external as well as two for internal are available in the HMI, which makes programming much easier. In addition, for non-circular grinding, it is possible to load custom shapes into NUMgrind via an external part program (external XPI) with the shape for internal as well as external non-circular grinding. The shape can be programmed in Cartesian coordinates (XY) as well as in polar coordinates (XC). This is very useful for editing cam profiles, which are often available in polar coordinates.

After filling out the dialog pages and determining the machining sequence, NUMgrind creates the necessary part program, which can then be run on the machine.



Definition Page for the Rectangle Shape

Summary

NUMgrind software has an exceptionally easy-to-understand graphical user interface that radically simplifies machine operation by employing interactive, dialog-supported operator guidance.

The operator determines the sequence of the grinding process via the HMI and enters the necessary data for the grinding operations, grinding wheels and dressing operations in the dialogue pages. The work piece program is then created fully automatically and stored in an executable form.

The NUMgrind package for non-circular grinding offers the full set of grind cycles for OD/ID grinding and the extension for non-circular grinding. A wide range of shapes can be chosen. NUMgrind is supplied as a complete turnkey package, but can be extended with additional cycles and functions.

NUMgrind – Cycles and Functions

Cylindrical Grinding

NUMgrind for cylindrical grinding includes outer/inner diameter (OD/ID) grind cycles for 2-axis (X/Z) grinding machines. The dressing station can be table-mounted or rear-positioned to accommodate all existing machines.

A standard set of nine external grind cycles as well as a set of nine internal (ID) grinding cycles gives the operator a library to quickly define and implement the external and internal grind process.

G Code	Cycle Description
G200	External plunge/multiplunge cycle
G201	Internal plunge/multiplunge cycle
G202	External angular plunge cycle
G203	Internal angular plunge cycle
G204	External oscillating plunge/multiplunge cycle
G205	Internal oscillating plunge/multiplunge cycle
G206	External cylindrical traverse cycle
G207	Internal cylindrical traverse cycle
G208	External profile grinding cycle
G209	Internal profile grinding cycle
G210	External conical traverse cycle
G211	Internal conical traverse cycle
G212	External oscillating shoulder cycle
G213	Internal oscillating shoulder cycle
G214	External shoulder traverse cycle
G215	Internal shoulder traverse cycle
G216	External shoulder cycle with fillet
G217	Internal shoulder cycle with fillet

Non-Circular Grinding

NUMgrind for non-circular grinding includes outer/inner diameter grind cycles for 3-axis (X/Z/C) grinding machines. The dressing station can be table-mounted or rear-positioned to accommodate all existing machines. This includes the above mention cycles for cylindrical grinding.

One external grind cycle as well as one internal grinding cycle

G Code	Cycle Description
G220	External non-circular grinding cycle
G221	Internal non-circular grinding cycle

gives the operator a library to quickly define and implement the external and internal grind process. In addition, there are two cycles for corrections/compensations during non-circular grinding.

G Code	Cycle Description
G234	Error compensation cycle
G235	Shape correction cycle

Surface Grinding

NUMgrind for surface grinding includes grind cycles for a 3-axis (X/Y/Z) grinding machine. The dressing station can be mounted on or below the table to accommodate all existing machines A standard set of two grind cycles gives the operator a library to quickly define and implement the surface grind process.

G Code	Cycle Description
G220	Slot grind cycle (with and without oscillation)
G221	Surface grind cycle

Common

A number of additional grinding functions allow the operator to quickly define the entire grinding process. Among other things, functions such as the reduction of air grinding (gap elimination cycle for GC and NCG only), tool change cycle, measuring cycles, wheel speed calculation cycle, wheel dressing and shaping cycles, and more are also included

If your machine requires specific grinding cycles, the system allows you to create custom G- and M-functions. It also allows you to integrate special cycles into the real-time kernel of the CNC.

Of course, the system also allows direct ISO code programming, which further increases flexibility.

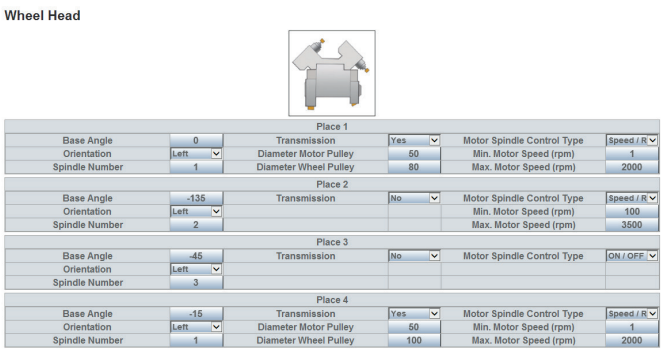
NUMgrind – Cycles and Functions

Wheel Head Axis B1

The B1 axis is the swivel axis of the grinding wheel head and can be used as an extension for the cylindrical grinding or the non-circular grinding.

This extension include the following features:

- Head Setup
  - Calibrating the B1 axis and the wheels
  - Local and global calibration of the grinding wheels on the grinding wheel head
- Swivel around active grinding wheel edge
  - Additional command in the HMI
  - Additional cycle
- Swivelling in of the grinding wheel during tool change
- Positioning of the grinding wheel at any angle. Angle depends on the mechanical limits of the machine and the design of the B1 axis (Hirth joint or direct drive)
- Automatic recalculation of the OP positions in X and Z after a swivel movement of the B1 axis



Wheel Head Page

Wheels

NUMgrind supports the following types of grinding wheels

Type	Icon	Description	Package
Wheels for profile dressing roller		The profile is transferred via a profile dressing roller onto the grinding wheel.	GC, NCG, GS
Standard Wheels		Various geometric parameters for a straight grinding wheel.	GC, NCG, GS
Special Wheels		The profile on the circumference is defined by 1 or 2 profiles in ISO code.	GC, NCG, GS
Angular Wheels		Various geometric parameters for an angular grinding wheel.	GC, NCG
Special Side Wheel		The profile on the left side is defined by 1 profile in ISO code.	GC, NCG

Dressing Units

The following supported dressing systems are available in NUMgrind (GC, NCG and GS):

- Fixed 2 Diamond Dresser
- Fixed 3 Diamond Dresser (Tiles and Tips)
- Profile Dressing Roller
- Form Dressing Roller
- Form Dressing Roller for CBN Wheels
- Special Side Dressing Units (only GC and NCG)

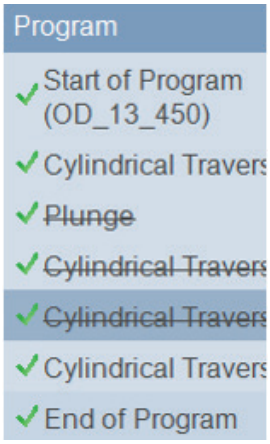
Semi-Automatic Grinding Mode

Special mode that does not require an actual NUMgrind grinding part program. It enables the operator to manually overgrind/regrind an existing workpiece in a very simple manner. It is started via an M command in Manual Data Input (MDI) mode or via a button on the machine control panel. There is a guided instruction on what needs to be done step-by-step (questions and input prompts on the HMI). Available in GC, NCG and GS.

1. Teach oscillation limits/axis positions
2. Oscillation with programmed feed rate
   a. Cylindrical: along X or Z axis
   b. Surface: along X and/or Z axis
3. Manual infeed with hand wheel/jog
4. Interrupt process x times -> measure -> continue again or stop grinding

Skip Entries in the HMI

Makes it very easy to skip one or more commands in NUMgrind HMI and not execute them after a program download, the next time the program is started. Available in GC, NCG and GS.



Example of Program Tree with skipped Entries

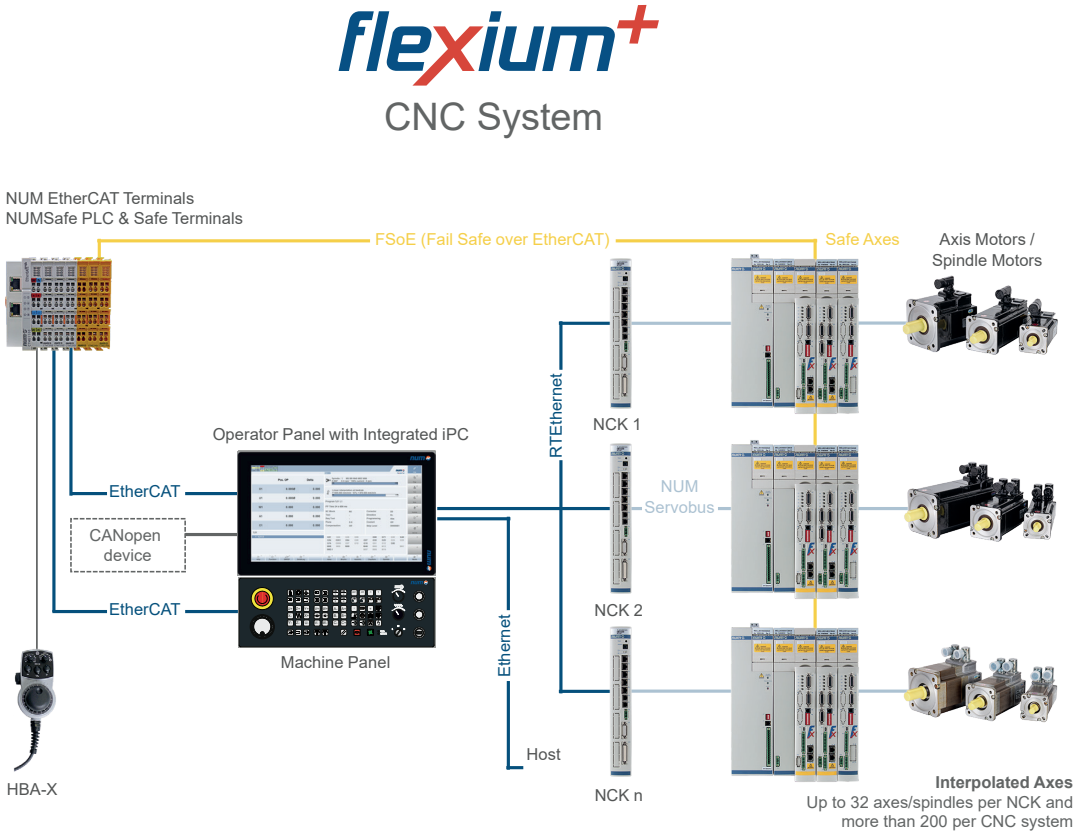
Cycle Correction

A cycle correction can be applied to each grinding command. This allows precise corrections to be made in the program/on the workpiece where they are needed. A total of 49 corrections are available. The correction is only valid for the current grinding cycle. Available in GC, NCG and GS.

Example of Cycle Correction in GC

CNC-System
Flexibility, Productivity and Safety

Flexium+ – Extreme Scalability



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, Flexium+ 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 equipped with optional NUM-SAMX 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.

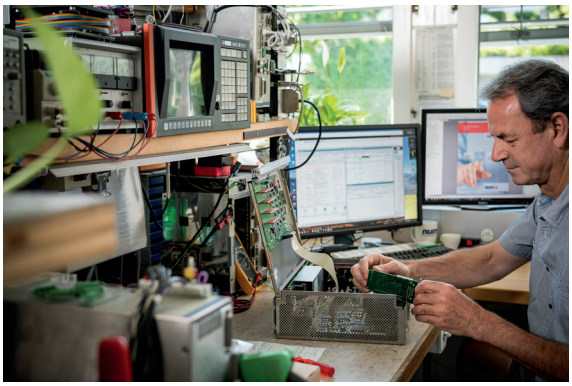
The NUMDrive X drive solutions are the result of more than 30 years of experience in the development of fully digital drive systems. The drive amplifiers are available in various versions with different performance data. The wide range of drive amplifiers is available in single- and dual-axis versions, 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.

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

CNC Solutions

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.

www.num.com

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