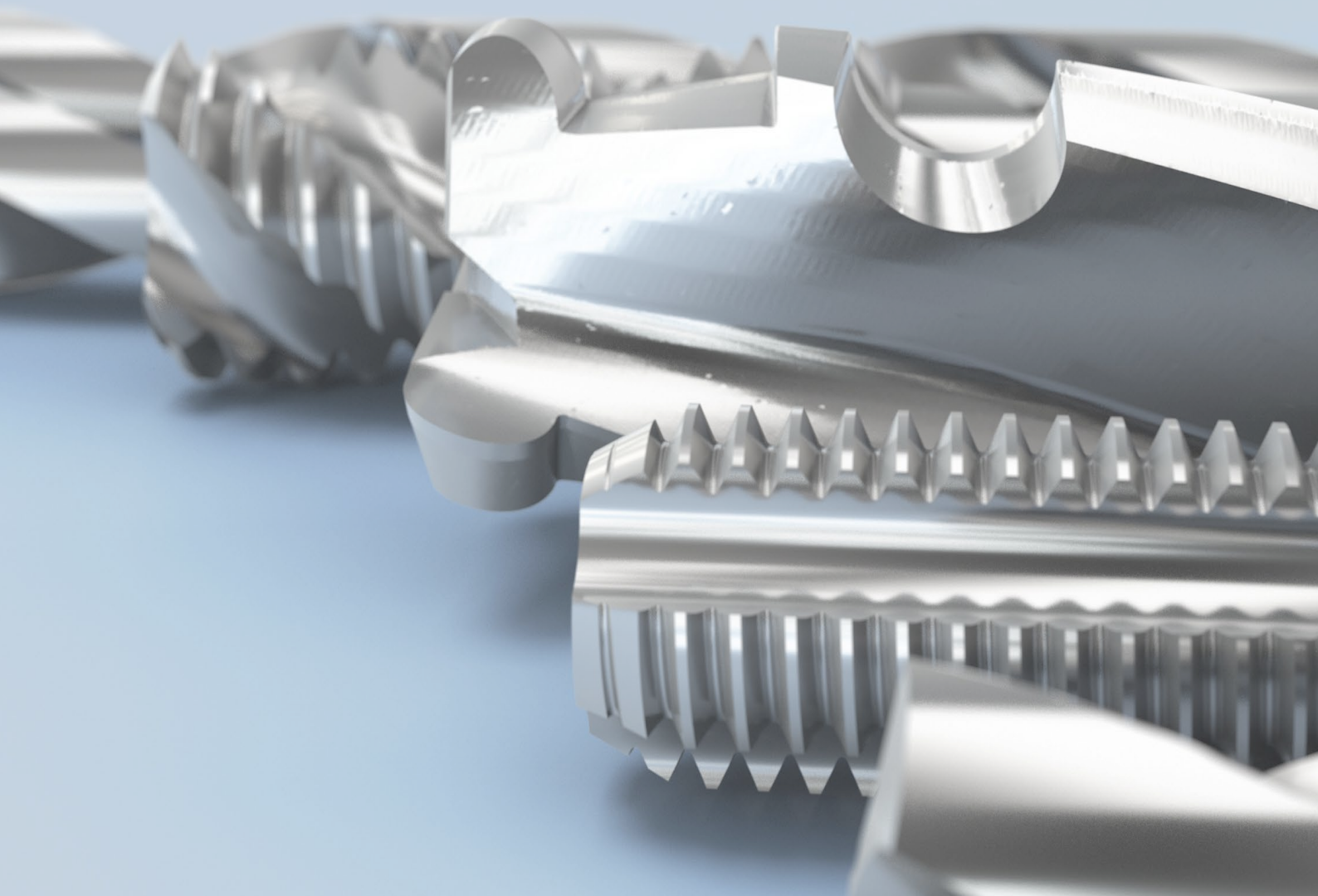


**num**roto

**COMPLETE SOLUTION  
IN TOOL GRINDING**



[www.num.com](http://www.num.com)

**NUM**  <sup>®</sup>  
CNC HighEnd Applications

# 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!**

- 02 NUM Solutions and Systems  
Established Worldwide
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- 04 NUM Solutions and Systems  
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setter in high-precision tool  
grinding for many years
- 06 NUMROTOplus® – Unlimited  
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- 08 Special Step Drills and  
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- 10 3D Simulation and 3D Collision  
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- 12 Jobmanager (NUMROTO-Control)
- 13 Flexium+ CNC System  
Flexibility, Productivity & Safety
- 14 NUM Motors  
Perfect for all Applications
- 15 NUM Services  
Worldwide at your Service

And 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 the most varied machinery. Our long, successful track record supports this finding in an impressive manner. We will continue to develop the readiness and flexibility of our systems in this direction and make the necessary investments in R&D 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 important flexibility and readiness of the systems to new market requirements even in the short-term.

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

# Customized Projects

**NUM supports you with your projects in the same way as it is ideal for your business and infrastructure. The goal of our cooperation, however, always remains the same: To find the most efficient solution for your project together with you.**



## 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 entire know-how in the 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**

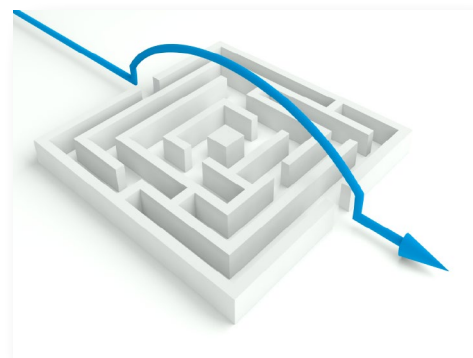
We assume the entire project management in the sense of a general contractor and are fully responsible for the successful implementation. Starting with the development of the requirements specification, over the development and commissioning, up to support and service.

# NUM Solutions and Systems

## Intelligent and Creative

**We have developed countless customer- and application-specific solutions for different industries and thus mapped out practical solutions for professional requirements. Based on this, our engineers have created groundbreaking total solutions for demanding applications.**

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

Today, NUMROTO is both a trendsetter and market leader in tool grinding – worldwide. For more than 30 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 NUMROTOplus® 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.

Continuity in the development of the complete solution and customer service, which is still active on site after many years, ensures a high retention of value.

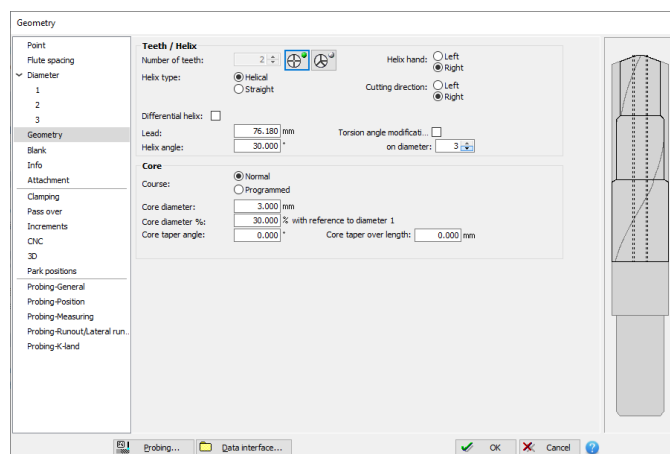
## NUMROTOplus® – first choice for tool grinding

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

NUMROTOplus® 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, NUMROTOplus® 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 for use in tool grinding and is clearly structured. Even the most complex shapes can be easily programmed and executed, which is also reflected in the many languages of the user interface. NUMROTOplus® works with and for the user.



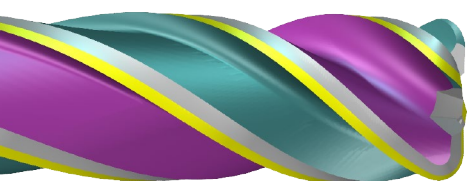
# NUMROTOplus® – Unlimited Opportunities

With NUMROTOplus®, 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 NUMROTOplus® 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.

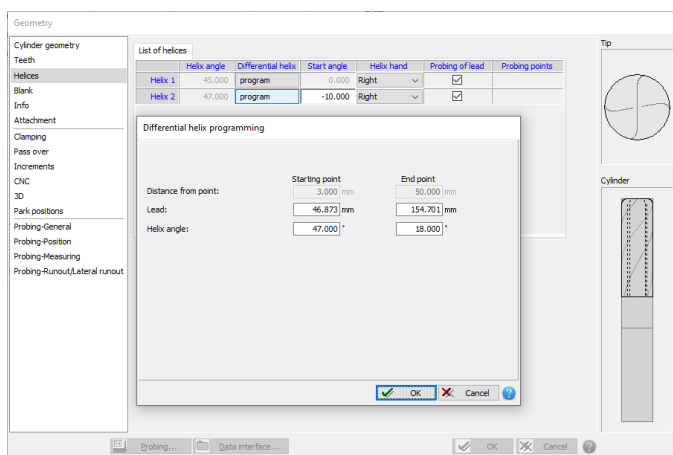
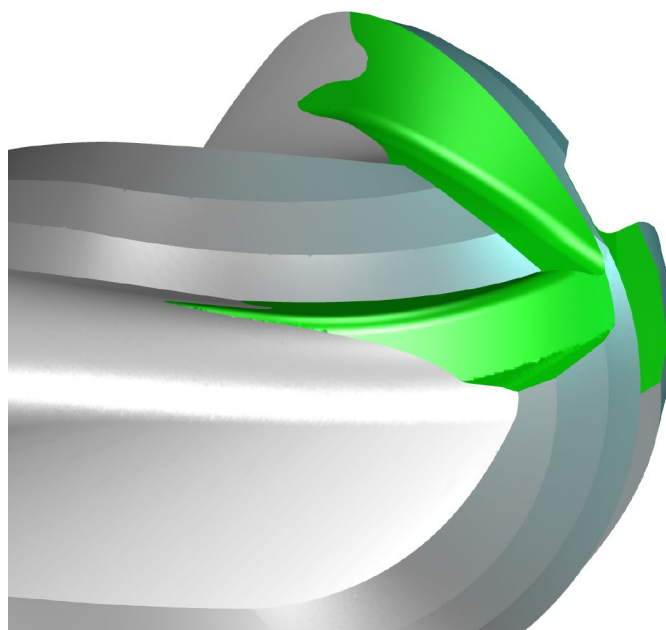
Each tooth is individually probed in resharpening mode. The lead and division angle of the tool are calculated at the end of the cutter. In resharpening mode, the lead type per tooth can also be constant or variable.



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

## 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.

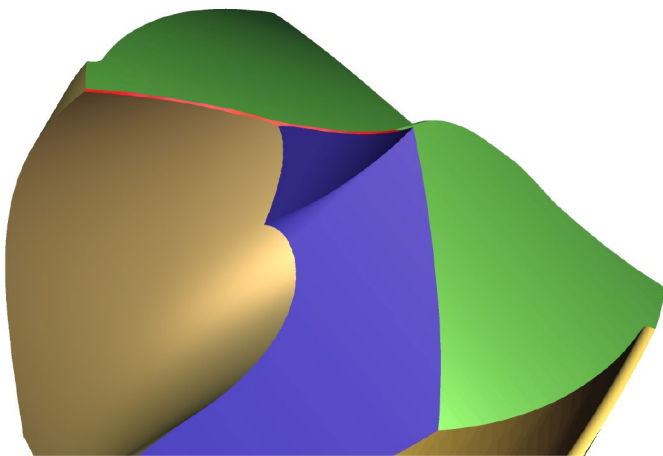


*Entry of the different helix angles.*

Please also visit our homepage [www.numroto.com](http://www.numroto.com). The NUMROTO gallery there has a comprehensive collection of tools that have been ground with NUMROTO.

### Drill Tips

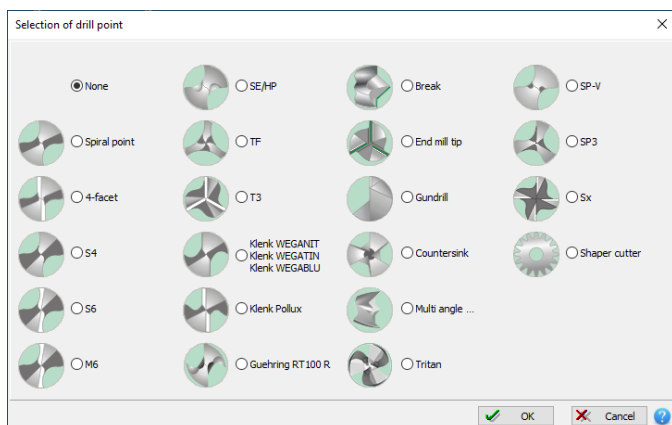
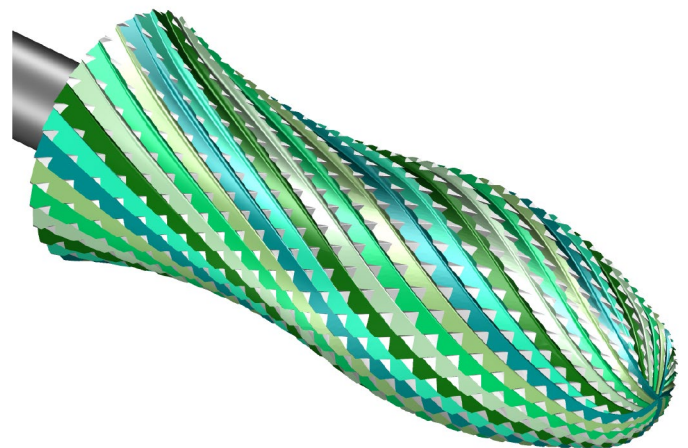
NUMROTOplus offers numerous well-known drill points. As with all geometries, which can be programmed within NUMROTO, also the drill points can be customized by many parameters for individual use. After grinding a drill point it is possible to probe the shape of the drill's main cutting edge, which allows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

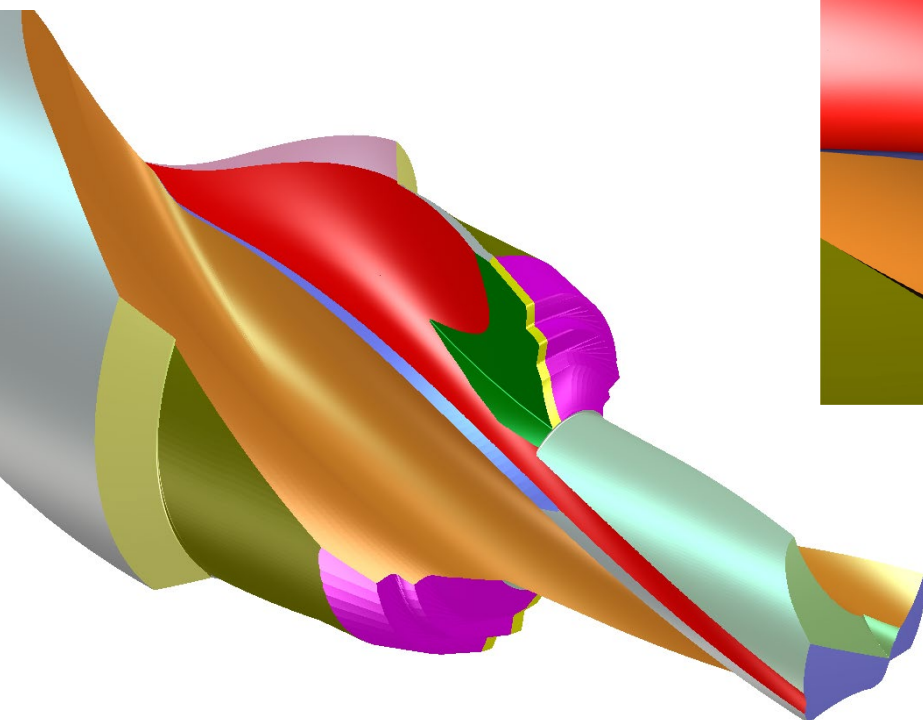
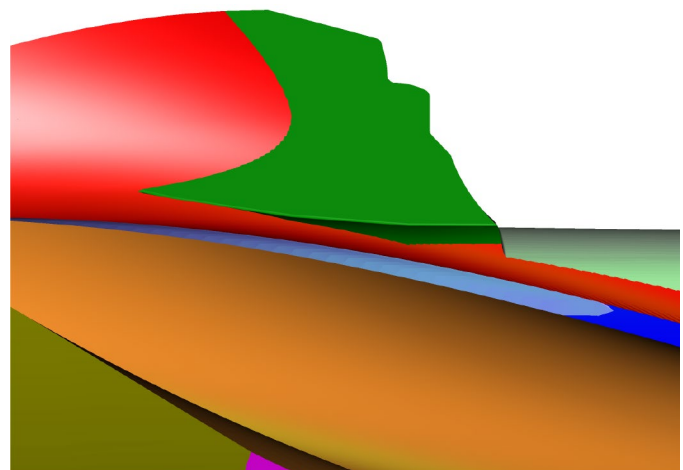
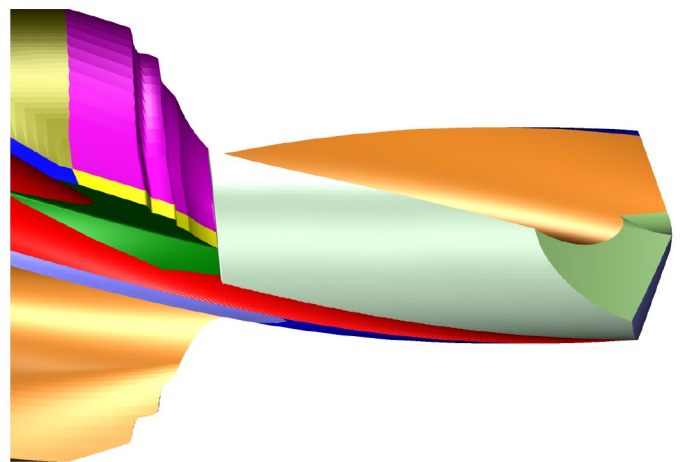


# Special Step Drills and Documentation

## 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 final customer.

The screenshot displays the NUMROTO-Draw software interface. The main window shows a 2D technical drawing of an end mill with various views and detail callouts. The interface includes a menu bar, a toolbar, and a navigation pane on the left. The drawing area shows a top view, a side view, and several detail views (Detail A, Detail B, Detail C). The drawing is dimensioned and includes a table of properties and a metadata table.

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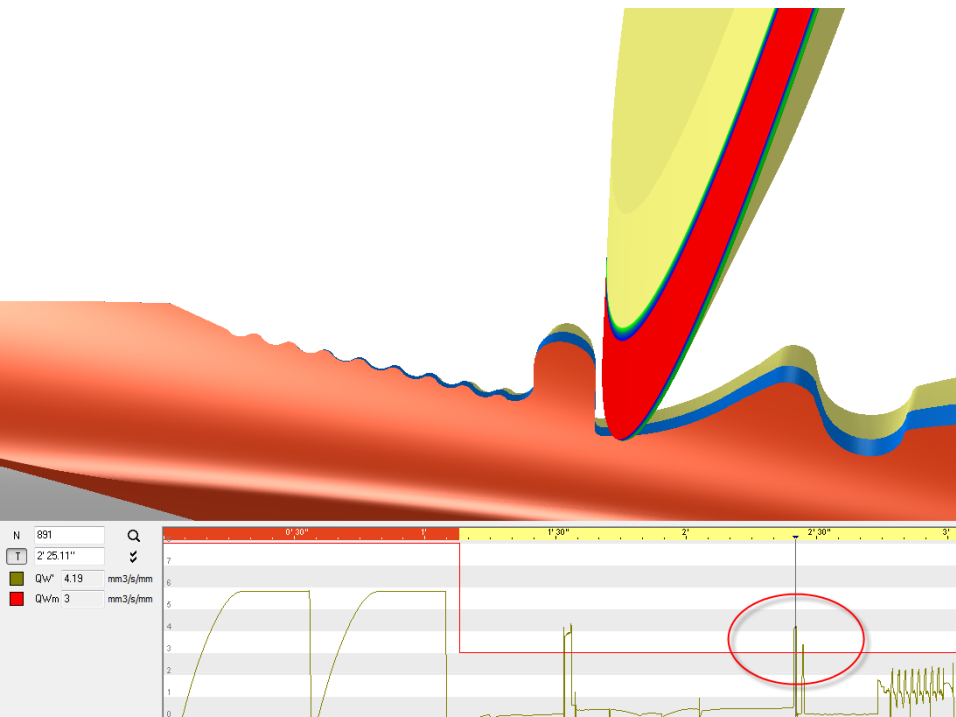
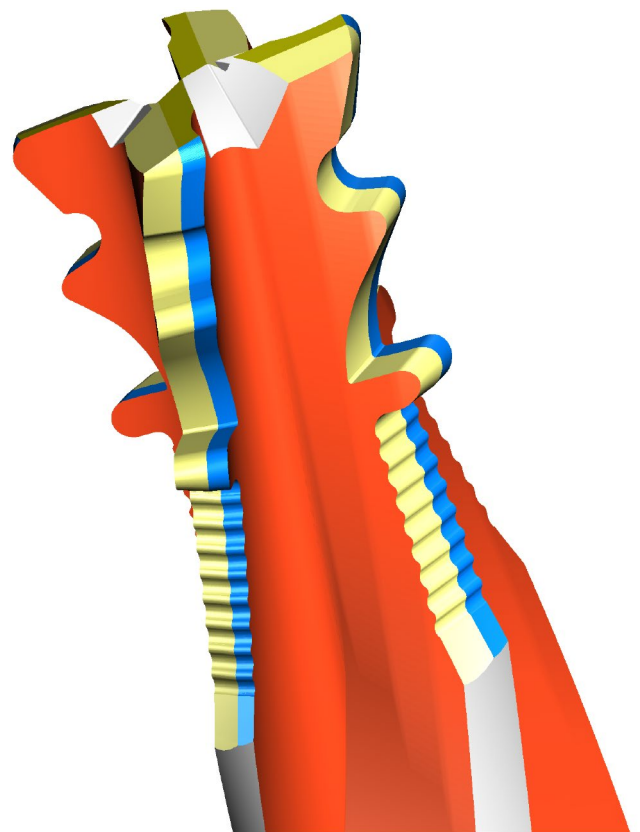
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# 3D Simulation and 3D Collision Monitoring

## 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 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

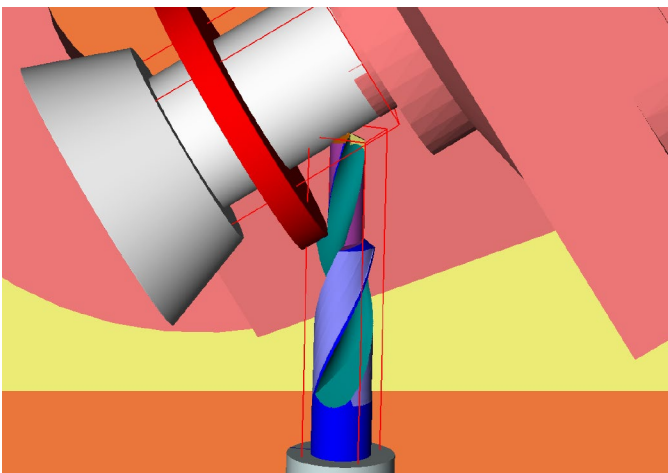
Even the most experienced grinder cannot always prevent a collision during grinding. A disc that is not in mesh, the spindle mandrel or mounted accessories (tailstock, support) can be the cause of a collision. To prevent this, NUMROTO has an integrated collision check together with NUMROTO-3D.

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.

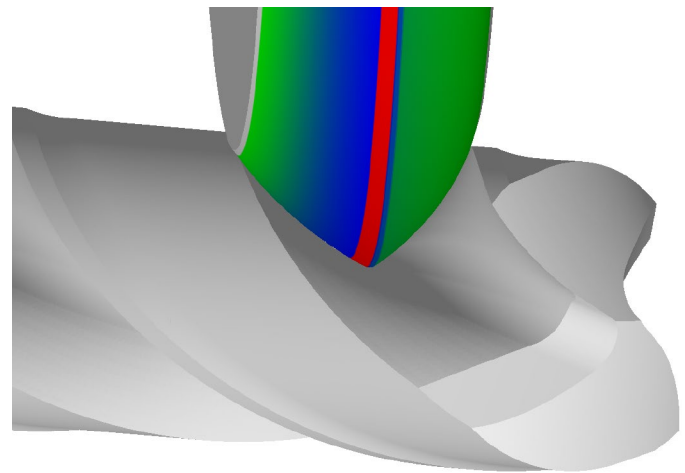
N	Operation	Collision state	Removal rate - mm3/min
1	S2/FLUTE	✖ Removal rate exceeded	6429.69
2	S2/CLEARANCE	✔ No collision	562.18
3	S1/CLEARANCE	✔ No collision	1083.13
4	S2/STEP FACE CAM	✖ Collision	1098.37
5	S1/RELIEF 1	✔ No collision	0.24
6	PT/GASH OUT	✔ No collision	873.94
7	PT/SPIRAL POINT	✔ No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

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

# Jobmanager – NUMROTO-Control

## Jobmanager – NUMROTO-Control

Many current machines are equipped with loaders so that un-manned 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

S.	Production step	Local	Time	Tot. time	Processing type
1	0259-2310-2019	1	02:17	02:17	!
2	0259-2310-2019	2	02:03	04:20	!
3	0259-2310-2019	3	03:06	07:26	!
4	0259-2310-2019	4	04:14	11:40	!
5	0259-2310-2019	5	04:14	15:54	!
6	0259-2310-2019	6	04:14	20:08	!
7	0259-2310-2019	7	04:14	24:22	!
8	0259-2310-2019	8	04:14	28:36	!
9	0259-2310-2019	9	04:14	32:50	!
10	0259-2310-2019	10	04:14	36:51	!
11	---PO0_10 (A)		00:30	37:34	
12	Stop point		-	-	
13	7379-2310-2019	11	18:35	56:09	!
14	7379-2310-2019	12	18:35	01:14:44	!
15	7379-2310-2019	13	18:35	01:33:19	!
16	7379-2310-2019	14	18:35	01:51:54	!
17	7379-2310-2019	15	18:35	02:10:29	!
18	---PO0_10		00:30	02:10:59	
19	---PO0_10 (A)		00:30	02:11:29	
20	5659-2310-2019	16	18:35	02:30:04	!
21	5659-2310-2019	17	18:35	02:48:39	!
22	5659-2310-2019	18	18:35	03:07:14	!
23	5659-2310-2019	19	18:35	03:25:49	!
24	5659-2310-2019	20	18:35	03:44:24	!
25	5659-2310-2019	21	18:35	04:02:59	!
26	5659-2310-2019	22	18:35	04:21:34	!

Remaining time  
**04:13:38 (29.10.2019 13:16:10)**

Visit [www.numroto.com](http://www.numroto.com) for more information about NUMROTO, a list of all machine manufacturers that offer NUMROTO on their machines and for more tool examples.

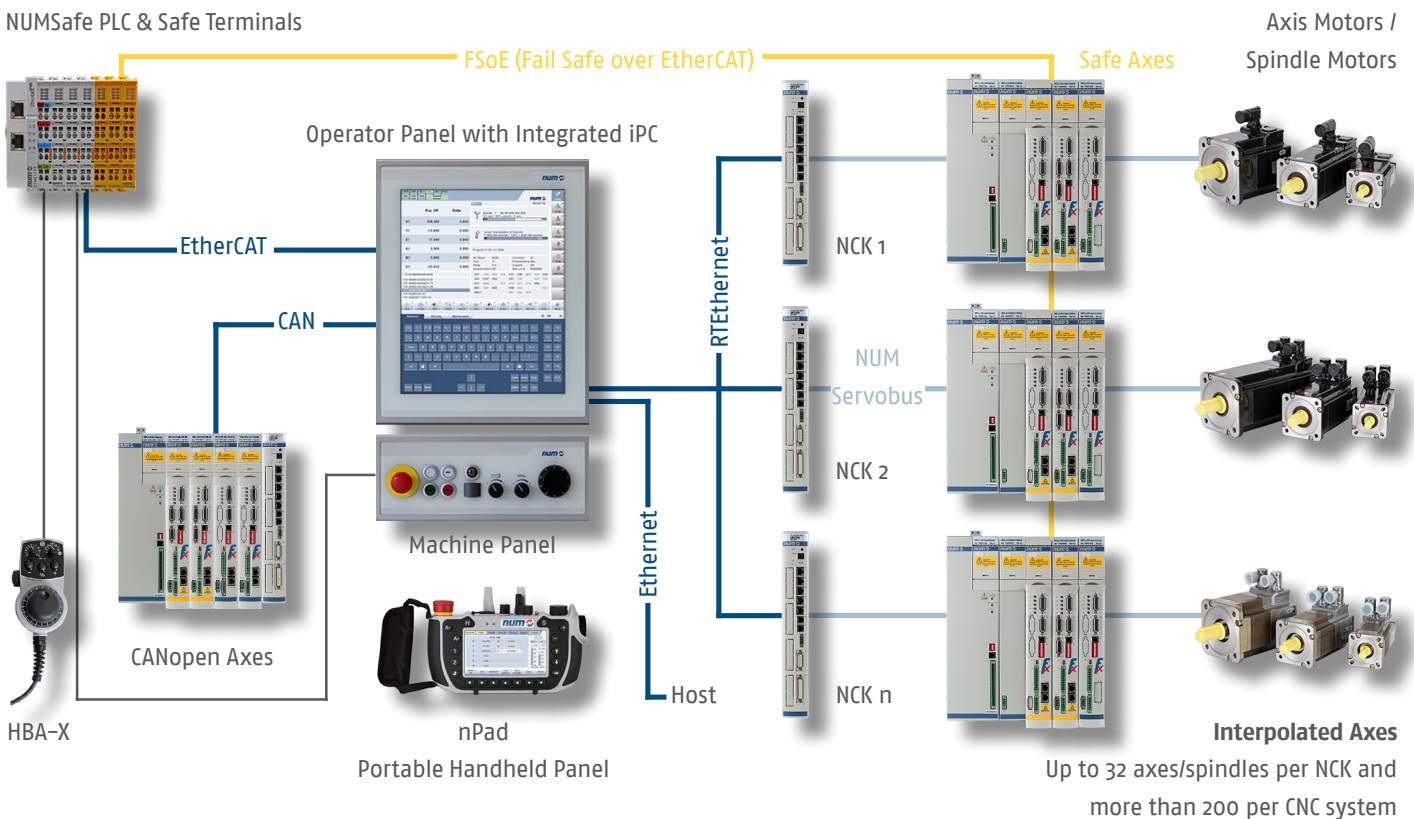
# Flexium+ CNC-System

## Flexibility, Productivity and Safety

### Flexium+ Extreme Scalability



NUM EtherCAT Terminals  
NUMSafe PLC & Safe Terminals



The control system is characterized by an extremely high scalability. It allows the perfect adaptation to the respective application solution. Thus, in a simple way, systems from 1 to over 200 CNC axes can be realized. The Flexium+ system has a secure PLC in addition to the normal PLC, which communicates via FSoE (Fail Safe over EtherCAT) with the secure inputs and outputs as well as with the NUMDrive X drive control systems. The system covers all necessary safety functions in a simple manner. The programming of the safety logic is carried out with the same software tool as the rest of the PLC. This same tool is also used for the entire system parameterization and commissioning of the machine.

The NUMDrive X drive solution is the result of more than 20 years of experience in the development of fully digital drive systems. It is available in different versions with different performance data. The wide range of drive amplifiers is available in single and dual axis versions and also in different performance levels (processing power). This allows a technical and financially optimum adaptation to every application. These modules are designed for rated currents of a few up to 200 amps. Another strength of the drive amplifier is its compactness and high energy efficiency.



# 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.

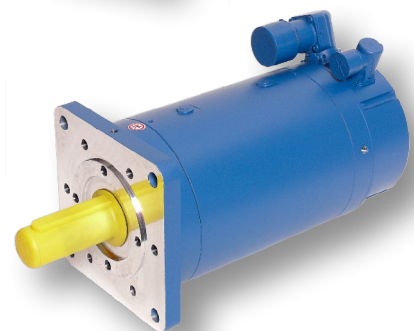
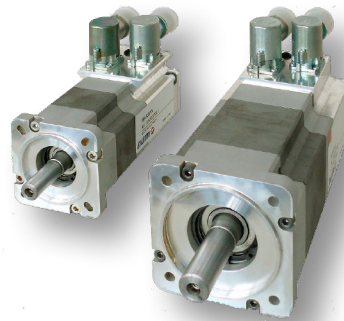
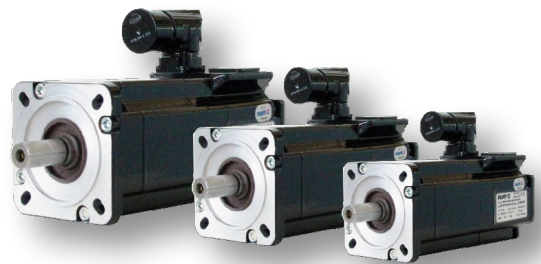
The comprehensive **servo-motor** series of NUM offer an excellent volume/output ratio, as well as first-class dynamic properties optimized for the machine tool industry. They, with perfect concentric run-out, satisfy even at very low speeds. The so-called "single cable" motors offer the advantage that the complete measuring system cable is eliminated. This simplifies the wiring of the machine significantly and thus saves 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  $S_1$  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 TMX motors are complemented by an extensive range of torque motors from our partner company Schaeffler Industrial Drives (IDAM), who's customers include many well-known European machine builders.

Key data of the motor series:

- Servo-motors from 0.318 to 160 Nm (IP65, IP67)
- Rated speeds of the servo-motors up to 8000 rpm
- Spindle motors up to 55 kW
- Special kit motors
- Liquid-cooled spindle motors
- Liquid-cooled servo motors
- Asynchronous and synchronous motor spindles (motor spindle)
- "Single cable" motors
- Custom motors



**SCHAEFFLER**

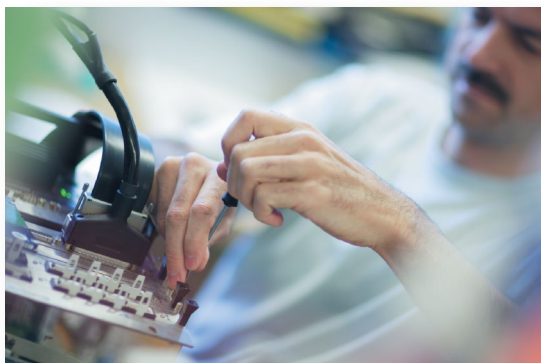
# NUM Services

## 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 via Internet. Of course, we will be happy to offer advice on site in your company.



### **Comprehensive training offer**

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

NUM provides a training offer matched to the customer needs:

- CNC operation
- CNC programming
- PLC programming
- Commissioning and servicing
- Preparation of custom surfaces
- 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, deployment on site, even for many years old installations. 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.

[www.num.com](http://www.num.com)

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



- [linkedin.com/company/num-ag](https://www.linkedin.com/company/num-ag)
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