

Industry-Leading Manufacturer of Solid Carbide Tools Standardizes on NUMROTO



TN Værktøjslibning, Denmark's second-largest precision tooling company, is deploying NUMROTO, the renowned programming system for tool grinding from NUM across its entire production floor. The company cites highly successful long-term experience of the software, together with excellent technical support from NUM, as the key reasons for choosing to standardize on NUMROTO.

Founded by Torben Nielsen in 1987 – which coincidentally is the same year that NUMROTO was launched – TN Værktøjslibning has grown steadily to become a leading player in the manufacture of special solid carbide tools, with an enviable reputation for the quality and precision of its products. Operating from a modern 2000 m² industrial facility in Bjaeverskov, some 50 km southwest of Copenhagen, the company serves the world market and currently exports about 70 percent of its production.

One of TN Værktøjslibning's prime business advantages is that it handles every aspect of manufacturing and can therefore track the movement of individual tools from initial order through to delivery. The company maintains a large stock of high quality "subnanograin carbide" materials in the form of rods with internal cooling channels and solid bars, ranging in diameter from 2 to 70 mm. Using multiple advanced CNC grinding machines, TN Værktøjslibning produces a comprehensive range of standard "TN" brand high-speed end mills, step drills and form cutters, the design and dimensions of which can be tailored to meet customers' needs for "exactly the right tool for the job".



From left to right: Gustav Heer, NUMROTO application engineer, Kent Nielsen and Henrik Larsen, both CNC operators at TN Værktøjslibning, and Torben Nielsen, founder, owner and CEO of TN Værktøjslibning



Polished special drill

TN Værktøjslibning also operates advanced in-house tool polishing and coating technology. Tools can optionally be coated both before and after polishing, to extend their service life and to help optimize chip evacuation. The company additionally offers tool regrind and recoat services. Provided that a tool is physically undamaged, it can often be returned to full service after regrinding and possibly re-coating, for less than 50 percent of the cost of a new tool.

Every aspect of tool manufacturing at TN Værktøjslibning is extensively automated. The main production hall is equipped with fifteen 5-axis CNC grinding centers, complemented by cylindrical grinding machines. All of these machines are controlled by NUMROTO software and are networked together to help simplify production management and software maintenance. Each machine has a dedicated programming station, enabling part programs to be created while grinding is taking place, and the company is also in the process of expanding its multi-user programming facility, which currently has capacity for seven users.

An interesting facet of TN Værktøjslibning's operational structure, which is quite possibly a factor behind the company's consistent year-on-year success, is that it deliberately has a flat hierarchy – there is no design department. Each CNC machine operator is responsible for programming, grinding the tools and fully documenting the process.

According to Torben Nielsen – who is still at the helm of the company, nowadays as TN Værktøjslibning's CEO as well as its owner, "We try to make work as interesting and satisfying as possible for people, and over the years we have built up a dynamic team of highly qualified and committed employees. Another important point is that by standardizing on NUMROTO for the bulk of our CNC machining operations,



High precision gear hob with Ø32 to be produced with very high accuracy in a single operation

we benefit immensely from our employees sharing a common pool of expertise and knowledge about state-of-the-art tool production technologies and processes. Many of our more specialist tools are only required in small batch sizes – sometimes just 2 or 3 – and yet we aim to supply these to customers within the same 9-day timeframe as our standard tools. To help meet this goal, our operators need fast, simple and unambiguous machine control facilities – which in turn demand very flexible, accurate and reliable software, with a modern user interface."

TN Værktøjslibning regularly enhances its machining capabilities to meet the changing tool needs of its customers. The company first started using NUMROTO software back in 2002, when it purchased two Deckel S20 CNC grinding machines, which have since been followed by a further ten Deckel S22 machines. The company's current complement of NUMROTO-controlled CNC grinding machines comprises the twelve Deckel machines, plus a UWS SF40 cylindrical grinder and two Vollmer VGrind 340S machines.

The programming and machining of special tools, which constitute the majority of TN Værktøjslibning's production output, is usually carried out during the day by skilled operators. Larger standard tools are processed at nighttime, using robotic part loaders and unmanned machining centers, but with a high degree of feedback such as in-process measurement and run-out compensation to ensure consistent product quality.



Microscope image of microtools (lollipop and thread milling cutter ball diameter 1 mm)



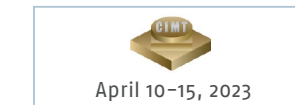
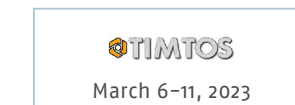
TN Værktøjslibning produces a comprehensive range of standard and custom high-speed end mills, step drills and rotary cutters

All tools produced by TN Værktøjslibning undergo thorough inspection prior to shipment. The company's quality assurance facilities include an air-conditioned, positively pressurized measuring room, equipped with a 5-axis CNC measuring machine and other precision optical measuring equipment.

We will leave the final words to Torben Nielsen. "Our experience with NUMROTO has been fantastic. The software is perfect for grinding both simple and highly complex tools and is extremely reliable. It is very easy to work with and the simulation is very precise. In a period of just over 21 years, there have been very few tools that we have been unable to create. Due to our very short delivery times, we rely on good support – and this has always been forthcoming from NUM."

www.num.com
www.numroto.com

Issue 26, March 2023 / An industry publication of NUM AG, CH – 9053 Teufen



Exhibitions 2023 NUMROTO is there

NUM will participate with NUMROTO in various trade fairs worldwide this year. We will present NUMROTO innovations and be available for interesting discussions. Please visit us at the above mentioned trade shows. Our team is looking forward to meeting you.

Prior to the fair, visit our website num.com, to find latest info on hall and booth numbers.

Of course, many machine manufacturers will again be on site with machines equipped with NUM CNC systems and NUMROTO.



Issue 26, March 2023

Seeking Perfection with a Digital Microscope

From NUMROTO's initial release, development has centered around the core principal that to achieve a comprehensive tool grinding solution, the analysis and optimization of the entire process chain plays a central role. To continuously optimize our solutions, at our NUMROTO Technology Center, we have a fully operational tool grinding cell including grinding machines, measuring machines and now also a digital microscope. On a measuring machine, the accuracy of the ground tools can be easily checked. Many details are often only revealed in the quality of the ground surface of the tool. We assess the surface finish with a bright, high-resolution Keyence digital microscope, which has a depth of field of several centimeters. The smallest deviations allow conclusions to be drawn about drives that are not optimally adjusted, poorly dressed grinding wheels, unfavorably selected technology data or other inadequacies. Our experienced specialists can precisely analyze all details of the entire grinding process, and incorporate related productivity enhancements into future NUMROTO releases.

the software, together with NUM's excellent technical support, as the main reasons for using NUMROTO.

The most important features of the new NUMROTO version 5.0.0 can be found in the release notes. The user administration of NUMROTO has been greatly expanded. User roles can now be individually configured and defined from a large selection of authorizations. This flexibility is an important prerequisite for professional work in a modern grinding operation. For example, it can ensure that only trained specialists can change or delete important information such as machine data, wheel data or master tools.

We hope to be able to welcome you in person soon, for example at one of our trade shows, and wish you an exciting read.

Best regards,

Andreas Hartig Managing Director
Peter von Rüti CEO NUM Group



The customer report is about TN Værktøjslibning. This is one of the largest Danish companies for precision tools, which relies on NUMROTO in its entire production. The company cites many years of very successful experience with



Perfect Workpieces Thanks to Analysis with Keyence Digital Microscope

Today, the paths of NUMROTO are calculated so precisely that theoretically micrometer-precise tools should always result. This high quality standard has been established over the years, on the one hand due to the perfectly calculated NUMROTO grinding paths, but also thanks to the very high resolution of the 3D simulation, which allows the machine-independent control of the calculated paths below one micrometer.

Unfortunately, this high accuracy does not always reach the ground tool. Mechanical limits and wear are primarily responsible for this. By measuring the tool on a measuring machine, such errors can be determined and generally corrected. However, details can often be better analyzed with a high-resolution digital microscope in order to be able to correct deviations in a targeted manner.



Fig. 1 Transverse cutting edge measured with the Keyence digital microscope (magnification 200:1)

This can be shown well on a cutter cross cutting edge. The transition of the S-cross cutting edge into the radius cutting edge should be exactly tangential. With the digital microscope, the precision of the cross cutting edge can be continuously checked during production and corrected with micrometer accuracy using the cross correction in NUMROTO.

It becomes more difficult when dynamic limits of the "CNC interpolation-drive-mechanics" process chain lead to geometry errors, such as small marks. Or when disturbance variables such as resonance frequencies, vibrations or imbalance of the grinding wheels cause surface problems.



Fig. 2 Keyence digital microscope in the NUMROTO Technology Center, Mr. Jörg Federer, Application Manager NUMROTO NUM AG and Mr. Michael Knorr, Application Engineer NUMROTO NUM AG with Mr. Schneider, Keyence Switzerland

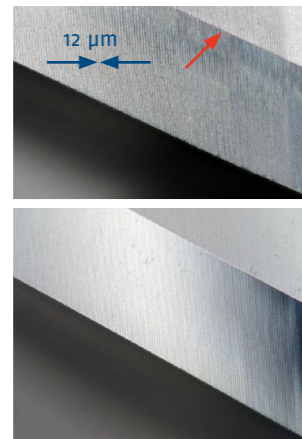


Fig. 3 Image of the 1st relief in 200x magnification, top with a non-dressed grinding wheel, bottom with a dressed grinding wheel

It can be very costly to find the causes of such non-idealities and to eliminate them. At the NUMROTO Technology Center in Teufen, such problems are analyzed with the help of a high-resolution digital microscope from Keyence.

Often underestimated are surface problems that arise due to grinding wheels that do not run completely true.

Regular grooves can be seen on the relief angle 1 and especially at the transition between the relief angles (red arrow). These occur when the grinding wheel is not dressed very cleanly and consequently

hits slightly during rotation. In the above case, the grinding wheel moved forward by 12 µm during one rotation. With the digital microscope, this groove pattern can be seen exactly at 12 µm intervals. After dressing, a much better surface is produced and only slight shadows and a very sharp transition between the relief surfaces remain. The digital microscope thus enables a quick check whether the grinding wheels are grinding optimally.

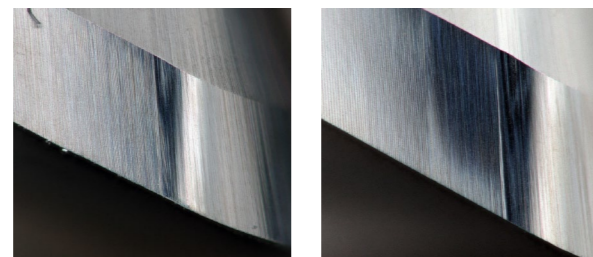


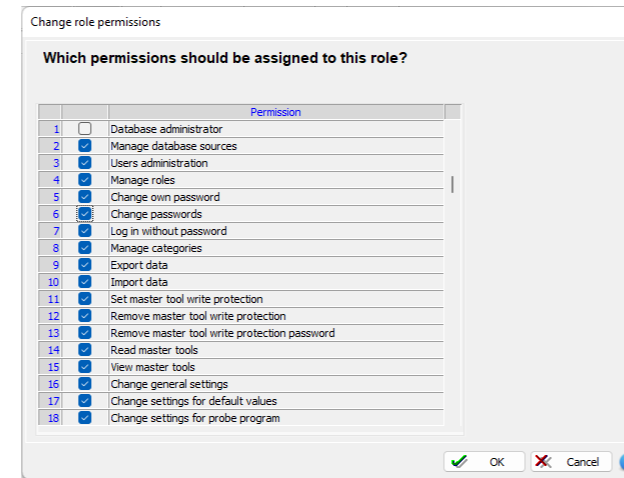
Fig. 4 Transition between radius and cylinder photographed with Keyence digital microscope at 200x magnification, no mark visible on the left and visible mark on the right

Dynamic limits often occur at transitions between geometry elements, for example in the case of the radius cutter between the ball nose radius and the cylinder. The critical area is often traversed in less than 0.1 seconds. During this time, the swivel axis stops and the rotary axis must accelerate strongly.

Excerpt of the Most Important Changes of Version 5.0.0 Compared to 4.3.0

General

- The user administration has been completely revised. User roles with very detailed authorizations can now be created, which can then be assigned to users accordingly.

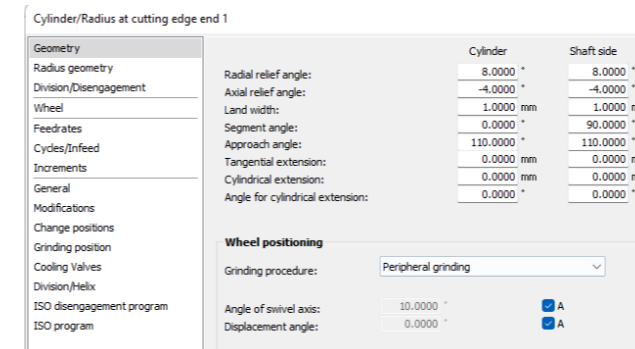
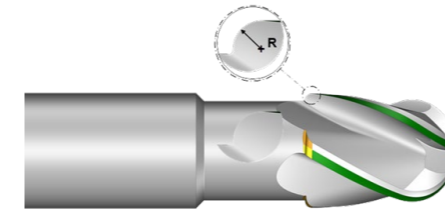


- Profile Editor X: As of version 5.0.0, the new Profile Editor X is used. This offers many advantages over the old profile editor. For example, it can convert splines to polylines, and already during the import of a profile there is the possibility to view all layers in a preview. Further advantages are, the possibility of the fast input of a profile train with the mouse, clear representation of all elements in table form. Note: The Profile Editor-X can be selected or deselected in the program options of NUMROTO.
- Various standard collets are now supplied in an export file. These can be imported if required.
- On the info page of a grinding wheel, a list of all tools in which the corresponding wheel is used can be displayed.
- Collets can now be assigned to a category.

If the mechanics are in perfect condition and the drives are optimally adjusted, there will be no visible mark in the surface. Otherwise, grinding-in (see Fig. 4) can occur: The Keyence digital microscope is therefore also an important tool for checking and optimizing the drive settings.

End Mill

- New operation "Radius at cutting edge end 1-3" for milling cutters: This operation can be used in the grinding process peripheral grinding or face grinding and the radius at the cutting edge end follows the programmed helix of the tool.



- The parameters length and transversal modification can now be used to fine tune the s-shaped chisel edge.

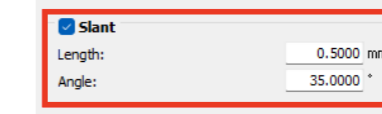


- For milling cutters there is now also the S-point as for the drill.
- For ball nose and corner radius cutters, the cutting angles and displacement angles of the reliefs can now be defined for each tooth group.

- Own increment for the chisel edge.
- Individual feed rates can now be programmed for the front and rear slant angles.

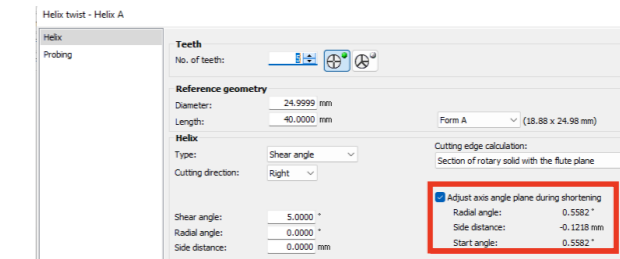
Drill

- For clearance grinding an exit slant can now be programmed.



Form Cutter

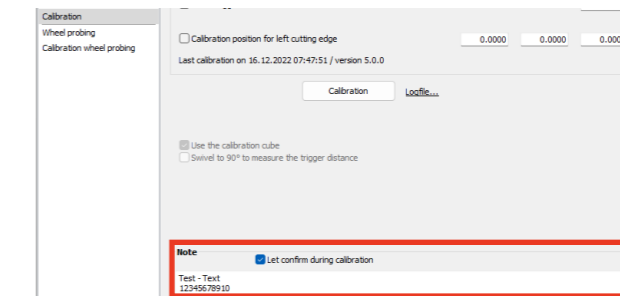
- The axis angle plane can now be automatically adjusted when shortening the tool.



- The clamping length per tooth can now be determined for form milling cutters with helix A. This is then also taken into account for each operation.

Probing

- Now you can also display a text comment when "Calibrate" or "Calibrate wheel probe". Similar to the info text in Geometry. Also you have the possibility to have to confirm the text before the calibration process is started.



NR-Control

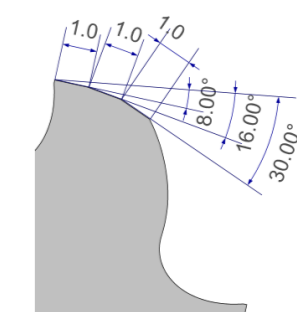
- There is a parking position "Program end with NR-Control". This is approached instead of the "Program end" parking position when working with NR-Control.

3D Simulation

- The tooltip view now also shows the corresponding tooth number of the operation.
- The label of a measuring line is now always displayed at the visible measuring point, regardless of whether only one or the other measuring point is visible.
- Various optimizations when simulating cylindrical grinding operations. The simulation results are now also correct if a cutting or displacement angle was used for cylindrical grinding.

NR-Draw

- Any number of tables can be stored as defaults per tool palette (end mills, drills, form cutters and burrs).
- A snap function can now be activated between the individual elements. This makes it easier to position them in relation to each other.
- With the new dimensioning "Relief reference - type 2", up to 6 reliefs can be dimensioned.



- A circle can now also be constructed in a simplified way using 3 points.

You can also find more information about new features of version 5.0.0 on our website.

www.numroto.com

We would be happy to present the NUMROTO version 5.0.0 live to you at one of the upcoming trade fairs. In addition, as usual, we offer training courses at your premises or at our company and explain the innovations in detail to your employees.

Phone +41 71 335 04 11
Email info@numroto.com