#### **CNC Power Engineering - Always on the move**





# **The solution for tool grinding**

## **NUMROTO-Presentation**

GrindingHub in Stuttgart - 14. - 17.05.2024

## New features in NUMROTO 5.0.0, 5.0.1 and 5.1.0





#### End mills

- Drills / Step drills
- Form cutter
- 3D-Simulation
- NR-Draw
- Other topics
- Planned innovations

## **Ball clearance**



#### (Special grinding functions, 5.1.0)

New operation 'Ball clearance'.

- Optimally adapted to the chamfer of the reference relief.
- Straight clearance (surface) or clearance with radius of curvature selectable.
- Swivel angle selectable or automatically according to number of teeth and helix angle.

Tip/Ball clearance Geometry Wheel Feedrates Cycles/Infeed General Modifications Change positions Grinding position Cooling Valves	Swivel angle:	27.00000 * 12.00000 mm 1.88408 mm 7.53630 mm 3.00000 mm	A
Division/Helix ISO disengagement program ISO program	Reference relief:	5 Cylinder/Relief 2	✓ ▲ A

## **Chisel edge: New longitudinal correction in center**





- The geometry of the chisel edge may deviate from the ball radius due to wheel wear.
- The parameter 'Transversal modification' and 'Length modification' allow a clean and true radius transition between the chisel edge and the ball chisel.
- To make sure the chisel edge is also exactly at the ball radius in the center, it is possible to use the longitudinal correction in center now. This modification is available for S- and straight chisel edge.





#### (Special grinding functions 5.0.1)

For end mill with ball nose, the helix course on radius 'helix angle linear increasing' has proven itself technologically very well. With a new reduction factor, the helix course in the center of the ball can be made more straight. At 0%, everything remains as before. At 100%, the helix angle at the center of the ball is more straight. Intermediate values are also possible. In all cases, the cutting edge is always continuous.



Reduction factor 100%

Reduction factor 0% (same as before)

## **Up & Down Cutters**



(new option, 5.0.0)

#### New Cutter type 'Up & Down'



## **Up & Down Cutter**



(new option, 5.0.0)

With customized, simple geometry dialogue.

Geometry						
Geometry Blank Info Attachment Clamping Pass over Increments	Number of teeth per helix: Center cutting teeth: Outside diameter: Taper (0):		Number of helices Helix type: Cutting direction:	2 Constant lead Right	> > >	Tip
CNC 3D Park positions Probing-General	Dish angle: Tip rotation angle	-1.00000 *	✓ Cutting angle 1	✓ Updat deper	te / calculate ndent values	Cylinder
Probing-Position Probing-Measuring Probing-Runout/Lateral runout	Cutting edge length: Cutting angle: Overlap amount:	Helix 1 calculated mm 4.00000 * calculated mm	Start length:	Helix 2 25.00000 m 4.00000 * calculated m	<b>im</b> im	
	Helix hand:	Right 🗸	Start angle: Modification of diameter:	-5.00000 * 0.00000 m	m	_
	Lead: Helix angle (cylinder start): Rake angle: Core diameter:	33.00000 56.71453 8.00000 12.00000	\$ \$	33.00000 m 56.71453 ° 8.00000 ° 12.00000 m	ım ım	
	Probing Data interface		Ľ	🖉 ок	🗶 Cancel 🤇	3





## New operation 'Radius at cutting edge end' for end mill



(complex end mills, 5.0.0)

At the end of the cutting edge, a radius can be ground.



## Other innovations end mill



- Flute-X: Show calculated cutting angle (5.0.0)
- New default values for chisel edge on a ball nose. (5.0.1)
- Calculating cutting edge length on taper end mills (5.0.1)
- Multi-helix end mill Multiple helix probing
- Relief with surface contact of the cup or periphery wheel (5.1.0)

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The flute-X can now also be used for drills and step drills.

This allows a constant land width to be achieved, even if a differential helix or a variable core diameter is programmed.

Diameter 1/Flute-X				
Flute				
Core				
Flute washout		Front	Rear	_
Wheel	Rake angle:	8.00000	8.00000	
Feedrates	Measuring depth:	0.42000 💭	0.42000 mm	Α 💟
Cycles/Infeed				_
AC	Rotation angle:	0.00000	0.00000	
Increments	Transv. displacment:	100,00000	0.00000 mm	
General	Opening angle:	100.00000	100.00000	88
Modifications	Length medification.	9.00000 mm	0.0000 mm	Δ
Change positions	Extension type:	Smart V	Smart V	<b>2</b> 0
Grinding position	Extension type:	Sinart	Siliart	

# Probing core value course with automatic compensation

The programed core diameter can now be probed at different positions.



(5.1.0)

Every probe point has a separate modification. Course of Core diameter This option is available for 'MIP' and for the 50 40 30 20 Calculation method: Ramp 'In-Process-measurement'. Split distance evenly Diameter 1/Flute Points Modification Core taper angle Distance from .. Core diameter Flute 8 7.00000 4.80000 -0.10000 Core diameter Measurement task: Core 15.06667 4.80000 0.50000 2.12985 1 🚔 (only for loader operation) Number of tools till execution: Flute washout 23.13333 4.80000 0.14000 -1.27829 Probe core value course 31.20000 4.80000 -0.20000 -1.20729 Wheel 39.26667 4.80000 -0.05000 0.53269 Feedrates 47.33333 4.80000 -0.20000 -0.53269 Reduction 55,40000 4.80000 -0.30000 -0.35513 Cycles/Infeed AC Increments 8 General Add start angle correction -20.00000 ° Rotation before measuring: Modifications Change positions 0.00000 mm Modification of probe result: Grinding position Point of probe  $\sim$ Probing procedure: Cooling Valves Division/Helix Search deepest point F74 B\_ Bx2 🚯 € ⊖ ISO disengagement program Retract tailstock before probing ISO program Retract support before probing 1 OK X Cancel Probing

## **Other innovations drills**



Faster calculation of the manual flute for drills. (5.0.1) For long tools (e.g. 40 x D), the calculation of the manual flute can take relatively long time (1-2min). The calculation is now up to 4 times faster.

- K-land on point also works now with transition shape 'chamfer'. (5.0.1)
- Shaper Cutter: Length modification gets not duplicated anymore. (5.0.0)
- Scale additional values (e.g., Rounding angle S-Gash out). (5.0.0)
- S-Gash out Feedrate optimization (5.0.0)

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## **Calculate relief direction according torsion**





- New option for calculating the form reliefs: 'Calculate relief direction according to current reference diameter, shift to cutting edge and take torsion into account'.
- This variant behaves in the front area (near the center) in the same way as 'Calculate relief angle according to current reference diameter', i.e. the relief angle direction remains parallel.
- The desired relief angle relative to the cutting circle is maintained on the profile. (independent of the profile diameter)

Form A/Form relief 1					
Geometry Range Oscillate Division/Disengagement Wheel Feedrates Cycles/Infeed AC	Positioning and grine Grinding with definition of rotation angle	ding proc.	Grinding with swivel Cutting angle relative to form	Grinding with definition of rotation and swivel angle	Grinding in helix direction
Increments	Radiusing: Value for radiusing Calculation of the relie Calculation of the relie Calculation of the relie Calculation of the relie Calculate relief direction	f angle always at f angle always at f angle at the ref n according to re	Wheel corner radius 0.27500 mm the corresponding form diam the corresponding form diam erence diameter, afterwards is ference diameter, move to cu	eter eter shifted to the cutting ed tting edge and take tor	✓ dge diameter. sion into account

## Shorting form cutter with shear angle





If a form cutter with pre-machined flutes and shear angle is shortened, the position and side distance will be changed. In order for the software to track this, the checkbox below must be activated.

Helix twist - Helix A				
Helix Probing	Teeth No. of teeth:	4 ➡ 🕀 🖉		
	Reference geometr Diameter: Length: Helix Type: Cutting direction:	Y 14.00000 mm ♥ A 20.00000 mm Shear angle ♥ Right ♥	Form A (angenäh $\checkmark$ (13.) Cutting edge calculation: Section of rotary solid with	85 x 14.00 mm) the flute plane
	Shear angle: Radial angle: Side distance:	5.00000 * 0.00000 * 0.00000 mm	✓ Adjust axis angle plane of Radial angle: Side distance: Start angle:	during shortening 0.21483 ° -0.02625 mm 0.21483 °

## **Duplicate selected form and relief angle**





Any form / relief angle / helix etc. can now be duplicated and deleted within the list.

This also works for clamping system transformation and wheel dressing.

Geometry	
Forms	List of helices
Relief	Note
Helix	Haliy A C C Achewinkal 1
Tip	
Blank	Heix b (C)
Info	Heix C & C Dupindic the selected chary

Geometry			
Forms	List of relief angle defi	initions	
Relief		Geometry	Note
Helix	Relief angle A 🐼	() ····	R12
Tip	Relief angle B 😵	···	R12
Blank	Relief angle C 😵	() 	R12
Info			

Geometry				
Forms	List of forms			
Relief			Geometry	Note
Helix	Form A 🔕 🤇	œ		angenähertes Profil durch Radien und eine Gerade
Tip	Form B 😣 🤇	œ		Original profile without adding radius for comparision in 3D
Info	Form C 🛞 🤇	(Đ		Original profile without adding radius for comparision in 3D

Form compensation - Automatic alignment for measuring profile. (5.0.0)

- Form relief grinding in helix direction, the grinding point offset direction is now selectable (5.0.0)
- Measure in process for form relief and multi-axis oscillation. (5.0.0)
- Rake surface along form own increments in operation. (5.1.0)
- Flute 'Along the form' increments like in form relief. (5.1.0)



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New checkbox in wheel data 'Brush (non-cutting)'.

- Such a wheel / brush does not remove any material in the 3D simulation..
- This allows to precisely analyze the position and orientation of the brush in relation to the cutting edge.





(5.0.1)

Possibility to reduce the blank to a defined cuboid with mouse, fast and directly in the image.



- Cooling hole correction angle for display in 3D simulation. (5.0.1)
  - The removal rate for small tools is calculated more exactly (5.0.1) This was particularly noticeable with tools with a large shank geometry and very small geometry of the cutting part.

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#### (5.0.1)

- Tables can now be rotated.
- It is possible to rotate them clockwise , counterclockwise or 180 degrees.



## **Other innovations NR-Draw**





- Additional tables per tool range.
- Simplified alignment of drawing elements
- New dimensioning type for relief on outside diameter
- Optimized dialog for printing
- New element 'Circles' available
- Move elements with keyboard arrow keys

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### **Probing run-out-error as an operation**





The run-out-error can now also be probed between machining steps (e.g. after grinding the flute).



## **Probing clamping length as an operation**



The clamping length can now also be probed between machining steps.



## Copy and paste of multiple operations





- Within the same range, it is now possible to copy any number of operations at the same time and paste them into another tool.
- Select the necessary operations in program [A] (checkbox [O] = activate).
- Via the menu 'Operation' or right mouse, select: [Copy all that are active for NC].
- Open the program [B] and paste the copied operations using key combination 'Ctrl+V' or via menu selection.
- Only permitted operations can be inserted in the target program.



## Parameter input with simple calculator





- Calculator opens with right click on the parameter.
- Simple calculations but also trigonometry (triangle calculation) possible

Cylinder/Flute													
Flute		🕑 Grind flute	on the plane										
Teeth													
Core		Front	Rear										
Flute washout													
Wheel		e peccel											
Feedrates	Cutting angle:	0.20000	Undo										
Reduction	Rotation angle:	0.00000											
Cycles/Infeed	Transv. displacment:	0.00000	Cut		Cullin day / Elucity	C. Jandra / Deta	Culie des / Dute	Culleder/Date	C. Serder (Thete	C. Kadas (Theta	C. Kadas (Theta	C. Kadas //Inda	C. Ender/Dista
AC			Сору		Cylinder/Flute	Cylinder/Flute	Cylinder/Flute	Cylinder/Flute	Cylinder/Flute		Cylinder/Flute		
Increments			Paste		Flute	Flute	Flute Grind flute	Flute Grind flute on the plane	Flute Grind flute on the plane	Flute Grind flute on the plane	Flute Grind flute on the plane	Flute Cirind flute on the plane	Flute Sind flute on the plane
General			Delete		Teeth	Teeth	Teeth	Teeth	Teeth	Teeth	Teeth	Teeth	Teeth
Modifications	Totomodiate asiat		Original value 0	20000	Core	Core	Core Front	Core Front Rear	Core Front Rear	Core Front Rear	Core Front Rear	Core Front Rear	Core Front Rear
Reference			Original value 0.	20000	Flute washout	Flute washout	Flute washout	Flute washout	Flute washout	Flute washout	Flute washout	Flute washout	Flute washout
Change positions			Default value 0.5	0000	Wheel	Wheel	Wheel	Wheel	Wheel	Wheel	Wheel	Wheel	Wheel
Grinding position			Min. value -90.0	0000	Feedrates	Feedrates Cutting angle:	Feedrates Cutting angle: 0.20000 =	Feedrates Cutting angle: 0.20000 0.20000	Feedrates Cutting angle: 0.20000	Feedrates Cutting angle: 0.20000 - 0.20000	Feedrates Cutting angle: 0.20000 0.20000	Feedrates Cutting angle: 0.20000 0.20000	Feedrates Cutting angle: 0.20000 0.20000
Cooling Valves			Max. value 90.00	000	Reduction	Reduction Rotation angle:	Reduction Rotation angle: 0.00000	Reduction         Rotation angle:         0.00000         0.20000+sin(30)/2	Reduction Rotation angle: 0.00000 0.20000+sin(30)/2	Reduction Rotation angle: 0.00000 0.20000+sin(30)/2	Reduction Rotation angle: 0.00000 0.20000+sin(30)/2	Reduction Rotation angle: 0.00000 0.20000+sin(30)/2	Reduction         Rotation angle:         0.00000         0.20000 +sin(30)/2
Division/Helix					Cycles/Infeed	Cycles/Infeed	Cycles/Infeed	Cycles/Infeed Iransv. displacment: 0.0000	Cycles/Infeed Iransv. displacment: 0.00000	Cycles/Infeed	Cycles/Infeed	Cycles/Infeed Iransv. displacment: 0.00000	Cydes/Infeed
ISO disengagement program			Calculator		AC	AC	AC	AC	AC Control Con	AC CITE CONTRACT OF CONTRACT.	AC CONTRACT ON CONTRACT OF CONTRACT.	AC CITY CITY CITY CITY	AC

## **Profil editor-X**





- Quick editing of the profile with mouse
- Easy-to-read table with all elements
- Multiple Layers
- Conversion Spline  $\rightarrow$  Polyline
- Consistent application of attachment tangency



## **Other general innovations**

- Grinding wheel show list of tools. (5.0.0)
- Filter according to operation (Search filter). (5.0.1)
- Replace wheels according to a fixed rule based on the wheel name (e.g. to replace master wheels). (5.1.0)
- Display the tool comment in the window of machining steps. (5.1.0)
- Scaling of diameter-dependent values after diameter has been probed. (5.1.0)
- Probing coolant holes as an operation, without probing Clamping length before. (5.1.0)
- New user role 'Check configuration'. (5.1.0)
- Variable feedrate is now identified by the letter 'V'. (5.1.0)





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## Planned innovations and changes > 5.1.0



- Definition of tables generally in respect to start-/endpoints of profile elements (similar to range in form reliefs)
- Consider form wheel profile for flute X
- Wheel type 11V5 also suitable for radial reliefs (end mill and form cutters)
- Around end of 2024 (probably with NUMROTO version 6.0, maybe 5.2) Windows 7 and 8 will no longer be supported. The minimal Windows version will then be Windows 10.



## Thank you for your attention

## **Coolant hole correction angle for 3D simulation**



- A cooling hole correction angle for the 3D simulation can now be defined for each tool. This angle is used to correct a possible deviation between the effectively ground tool and the representation in 3D.
- This angle is not used to correct the angle of the cooling hole on the ground drill. This must still be done by adjusting the cooling channel angle.

Geometry		
Forms	- Automatic 3D collision check before each tool	
Relief	(Always execute collision check, regardless of settings for th	he tool)
Helix		
Tip		
Blank	Automatic 3D collision check:	Before making the CNC file <a> </a>
Info	3D online simulation data:	Do not create ~
Protection	Cooling channel correction angle:	12.00000 *
Attachment	C-llining	
Clamping	Collision	
Clamping system transformatio.	All values according to settings	
Pass over	Calculate and take into account 3D-model when doing the	collision check
Increments	Additionally monitor removal rate during the 3D collision ch	eck
CNC	Monitor QW' and wheel rim during collision detection	
3D		
Park positions	Model resolution:	100 ~



## Filter according to grinding operation



#### Tools can now be filtered according to grinding operations.

Filter		Value selection
ilter name: Flute X , Relief 1 and Chamfer 1		all on Flute Supplementary flute Body clearance
At least one of the following conditions must be complied		Manual flute
All of the following and there much be accepted		Rough profile
All of the following conditions must be complied		Rough profile on ball hose
Filter conditions		Tadapandant Buta
riter conditions		Independent magual flute
Crinding operation	Flute-V Pelief 1 Chamfer 1	Flute_V
		Relief 1
Please select V		Relief 2
		Relief 3
		Relief 4
lanage filters	🗸 OK 🗶 Cancel 🕐	Relief 5
		Relief 6
		Radius at cutting edge end 1
Tool list		Radius at cutting edge end 2
		Radius at cutting edge end 3
Category:		Radial relief
outegory.		Tip gashout
Quick search: FSD F11	All tool types	Tip relief 1
🦓 😰 🛛 Bearbeitung Nut-X und Fre	eiffaeche 2	Tip relief 2
		I IIP Notch
A DAME A	N Ø No Helix Helix Num Used on	Chamfar 1
KLB 12 40 num	√ 40.00 12 Ri/Ri Cons 44 22.01.2022	Chamfer 2
Kugel 5 Grad Sprung	* 12.00 4 Ri/Ri Cons. 0	Manual tip relief 1
Kugel-mit-Ausspitzung-V-Elach-Kombination	* 12.00 4 Pi/Pi Cons 0	Manual tip relief 2
		Tip gash out X
Karaka	* 20.00 3 Ri/Ri Cons 33 24.02.2017	Rake surface along radius X
Nut-Test		The same of All
IN C Deckland Facility has been been been a state of the second		
Probleme-Freihaeche-bei-hochgenauer-Autoesung	* 1.00 2 RI/RI Cons 0	

## **Rake surface along form – own increments**



- The 'rake surface along form' operation on form cutters often causes special movements that require a fine increment.
- To avoid having to set the increment much finer in general (in the basic geometry), it should also be possible to use a separate increment for this operation.

Form A/Rake surface along form				
Geometry				
Range		2D-Sim	CNC/3D	Auto
Wheel	1 DXF reliefs straight lines	0.01000	0.20000 m	m 🗌
	2 DXF reliefs circles (R=1mm)	0.50000	0.50000 •	
Feedrates	3 Minimum number of points on straight lines	20	5 Pt	s 🗌
Cycles/Infeed	4 Minimum number of points per circle segment	50	2 Pt	ts 🗌
Increments	5 Minimum number of points for circles (360°)	50	20 Pt	is 🗌



## Flute 'Along the form' – increments like in form relief



If the cylinder course is set to 'Along the form', the machining increments can be programmed in the same way as for form relief.

Cylinder/Flute			
Flute			
Teeth	University of the second	Lieber A	
Core	Helix selection:		
Flute washout	Cylinder course:	Ocylindrical	
Wheel		<ul> <li>Along the form</li> </ul>	Form A 🗸
Spindle		OProgrammed	
Feedrates			
Reduction			
Cycles/Infeed	Path extension at front:	10.00000 mm	Direction: 0.00000 * A
Increments	Length modification at rear	r: 0.00000 mm	

Cylinder/Flute					
Flute					
Teeth		2D-Sim	CNC/3D		Auto
Core	1 DXF reliefs straight lines	0.01000	0.20000	mm	
core .	2 DXF reliefs circles (R=1mm)	0.50000	0.50000	•	
Flute washout	3 Minimum number of points on straight lines	20	5	Pts	
Wheel	4 Minimum number of points per circle segment	50	2	Pts	
Spindle	5 Minimum number of points for circles (360°)	50	20	Pts	
Feedrates	S minimum number of points for circles (500 y	1	,	ΓG	
Reduction					
Cycles/Infeed					
Increments					



# Relief with surface contact of the cup or periphery wheel



- Radial clearance on the cylinder continuously merging into the ball center (straight reliefs are created in the ball section).
- Cup wheel or periphery wheel selectable.
- Operation can also be used for brushing. (Orientation perpendicular to the cutting edge).







You can now have all the wheels of the tool replaced according to certain rules.

For this a new symbol has been added to the sequence of operations. It opens up the selection for replacing the wheels.

® 🖄	F10	F11 Maria	F12	<u>sF12</u> ✓ _	
Zeit	Herstellen	Bestückung	NCI	Zeichnung	
🔶 O 🛃	Ponline		⊏‡≈		
				Scheibe	Dr
			] [ ] -	P00_10_R	5

Schleifscheiben ersetzen		
Regeln Anzahl übereinstimmende Zeichen am Anfang des Namens Anzahl übereinstimmende Zeichen am Ende des Namens Nur Scheiben der Bestückung 'Test' Vur ähnliche Scheiben		
Aktuelle Scheibe	Ersetzen durch	
1P00_10_R0.1	(15 stehen zur Auswahl)	
2P45_06_R0.1	(6 stehen zur Auswahl)	
3P45_08_R0.3	(15 stehen zur Auswahl)	
4T01_R0.1	(41 stehen zur Auswahl)	)



## S-Gash out – feedrate optimization





Feedrates got a better description (for grinding position inside and outside)

Explanation of each feedrate in a clear help image.

Spitze/S-Ausspitzung	
Geometrie Scheibe Vorschübe Auftelung/Zustellung Inkremente Allgemeines Korrekturen Umlenken Schleifposition Kühlventile Teilung/Drall ISO-Ausfahrprogramm ISO-Programm	Scheibeneingriff innen Scheibeneingriff aussen In Position 2 schleifen   Bearbeitungsrichtung   von aussen   Vron innen
Spitze/S-Ausspitzung Geometrie Scheibe Vorschübe Aufteilung/Zustellung Inkremente Allgemeines Korrekturen Umlenken Schleifposition Kühlventile Teilung/Drall ISO-Ausfahrprogramm ISO-Programm	Anfahren: 30.00 mm/min S-Radius: 30.00 mm/min S-Radius: 30.00 mm/min Grundradius: 50.00 mm/min Querfahren: 30.00 mm/min Ausfahren: 2000.00 mm/min ] Im Eilgang ausfahren



### Display the tool comment in the 'List of machining steps'





- You can now choose whether you want the tool comment to be permanently displayed below the operations in the main window or not.
- This must be activated in the settings.

NUMROTOplus® 5.1.0c End mills - [Machining o	erat Geometry				
Tool data Operation View Wheel Machine	Cylinder geometry	Name:	4N-Kugel		
	Blank	Drawing number:			
Range Tools Wheels Packages Geometry	Info	Revision:			
	Protection	Job number:			
	Attachment	Measurement program:			
O 3D C	sho Clamping	-			
1 Cylinder 🛛 🖓 🛃 Flute-X	Simu Pass over	State:	Released	V Number	
2 Tip 🛛 🖬 Ball dea S	ock a Increments	Category:	DEMO	<ul> <li>New</li> </ul>	
3 Tip 🛛 🖓 🔽 Tip dear B	ank: CNC	Grinding time:	11m06s		
4 Tip	3D	Weight blank/tool:	0.00g 52.84g D	)iff: -52.84g	
	Park positions				Keep a wheel category active after one has been chosen
5 Tip I Tip Note	Probing-General	History			Only show custom operation name in grinding operations (if available)
6 Cylinder 🛛 🖓 🔤 Relief 2	Bla Probing-Position	Action	Date	User	Using the Enter key will immediately adopt the selected entry from tool and wheel list
7 Cylinder 🛛 🗹 🗖 Relief 1	Probing-Measuring	1 Created	28.03.2003 14:59		🔽 Use profile editor X
Ci	ular Probing-Runout/Lateral runout	2 Import	23.09.2015 16:40	DBA	Automatically select the last machine used when opening a tool
W	hout	4 Last changer	14.09.2018 13:45	OFM	Display the tool comment in the window of machining steps
: Se	tings	5 Last used	08.05.2024 10:14	OEM	
4N-Flach Demo 4 Nuten, Kugel, Stirn-Hinterlegung Anhang zu Besch	eibur	Note:	Show automatically when one of the second	opening	
Senio matery ragery sam filleregalig Annalig za besch		4N-Flach Demo 4 Nuten, Kurel	Stirn-Hinterlegung Anhang z	zu Beschreibund	
werkzeug-kommentar für Grinding Hub					
		Werkzeug-Kommenta	r für Grinding Hub		