

SINUMERIK live: Tool management – milling

Reference points, tool parameters and clamping options

SINUMERIK live

- Application technology explained in an easily understandable way:

SIEMENS



Series of videos with the aim of presenting individual topics on the practical use of SINUMERIK within a short time!

Consists of short slide presentations and **application in practice!**

Tool management – milling

Reference points, tool parameters
and clamping options



Tool management – milling

Reference points, tool parameters and clamping options

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1 The systematics involved with tool holders and the associated clamping options

1.1 Tool holder – the perfect connection to the machine

1.2 Clamping, pressing-in, shrinking

2 Tool management

2.1 Why tool management? – Everything must be organized

2.2 Emulation of the tool magazine and tool cabinet in the CNC

3 Tool management with SINUMERIK Operate

3.1 Creating and saving tools

3.2 Handling tools when generating the program

4 Summary

4.1 Customer benefits

4.2 What have we learned?

1 The systematics involved with tool holders and the associated clamping options

Tool holder – the perfect connection to the machine

Tool holders establish the connection between the tool and machine.

They must satisfy two requirements:

- **Fast and safe** tool changes
- High **accuracy** when machining the workpiece

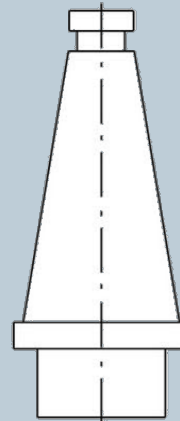
Tool holders are standardized in order to ensure that these requirements are satisfied.

In Europe, the two most widely established types of tool holders are **steep taper** and **hollow taper shank**. In Asia, this is the **BT tool holder** standard (similar to SK40).

Steep taper

These are drawn into the spindle by the draw bolts. Force is transmitted through the static friction between the peripheral surface of the taper and the spindle.

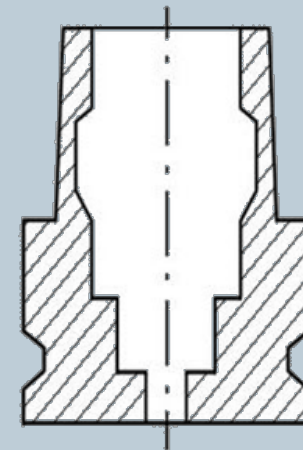
- + Ruggedness
- + High forces can be applied
- Not suitable for high speeds (Design of the clamping adapter)
- Different draw-in bolts



Hollow taper shank:

These are clamped at the inner surface. Torques are transmitted using surface friction and grooves.

- + High speeds are possible
- + Fast clamping and releasing
- + Flat surface contact
- Only limited lateral force can be applied



1 The systematics involved with tool holders and the associated clamping options

Clamping, pressing-in, shrinking

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Clamping

Collet chuck (using collet chuck and union nut)

- + Precise centric clamping
- + Perfect radial eccentricity (runout)
- More cost intensive version, several parts are required

Weldon tool holder (using clamping screw, Allen screw)

- + Can be very quickly used
- + Inexpensive
- The tool must have a clamping surface
- Imbalance at higher speeds

Morse taper (using contact/surface pressure)

- + Can be very quickly used
- + Inexpensive
- Tools with ejector lugs required



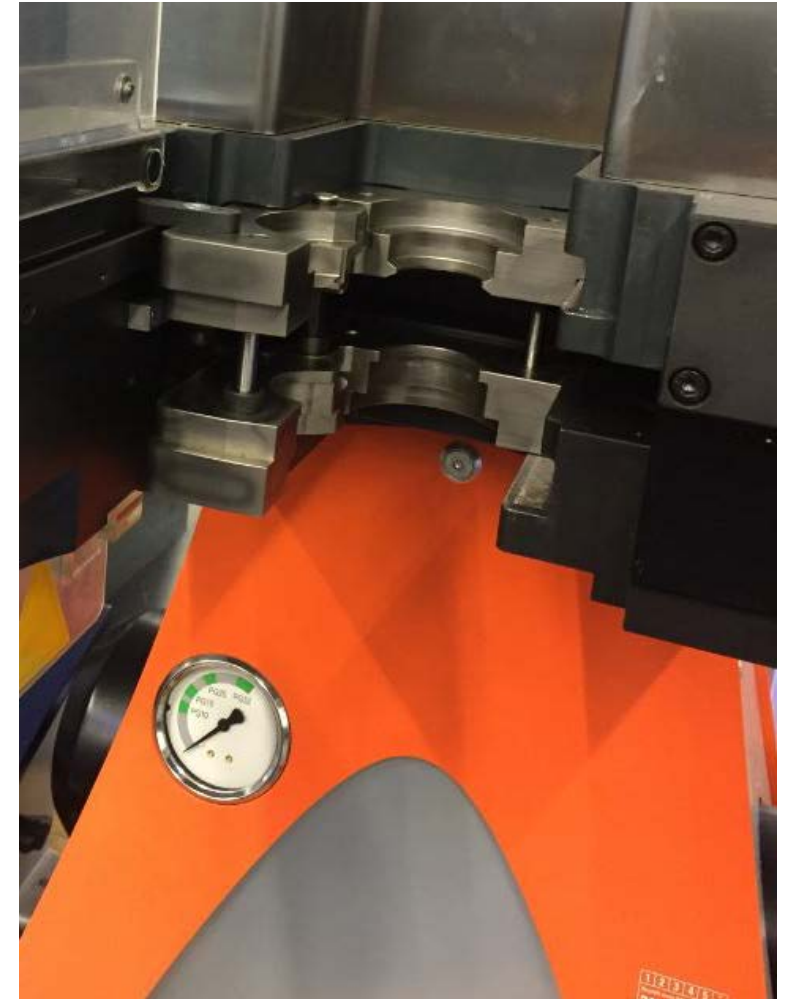
1 The systematics involved with tool holders and the associated clamping options

Clamping, pressing-in, shrinking

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Pressing-in:

- Clamp grip ("cold technique")
 - A device is required to press-in and release, generally, hydraulic
- + No temperature differences when connecting
- More cost intensive version, several parts are required
- ± Predefined friction connection that cannot be changed



1 The systematics involved with tool holders and the associated clamping options

Clamping, pressing-in, shrinking

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Shrinking

("Warm or hot technique"):

- + Precise radial eccentricity (runout)
- + Very high friction/form-locking connection
- + No force has to be applied
- Expensive equipment required to heat up and cool down
- Special safety working clothing (gloves) required and special care must be taken → High level of caution required!

Tools/toolholders are not immediately identifiable as being hot!

! RISK OF INJURY DUE TO BURNING



2 Tool management

Why tool management? – Everything must be organized

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A machine tool is designed and built for **effective and efficient** use in mechanical production environments.

The effectiveness of a CNC machine tool is also defined by the possibility of **automating tool changes**.

In order that tools are changed smoothly without errors, tools must be sorted (managed) both **virtually in the CNC as well as physically in the tool magazine**.
The CNC tool management must guarantee that the tools being used are correctly managed.

To ensure fast availability, all of the tools are located **centrally in a tool magazine**. The tools in the magazine must be **protected** against the effects of machining, for example, they must be protected from metal chips and cooling water.



2 Tool management

Emulation of the tool magazine and tool cabinet in the CNC

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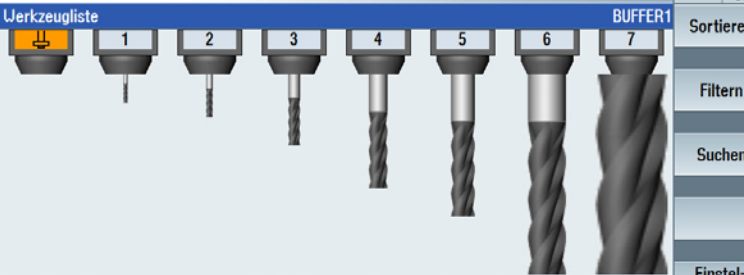
real

The **tool magazine** serves as an effective and protected storage location for tools in the milling machine and ensures that the required tool can be quickly accessed.

The **tool cabinet** is located outside the machine.

virtual

Tool management ensures that tools are saved in the control in a structured and transparent fashion. Tools from a magazine as well as mounted and measured tools in the cabinet can be emulated here.



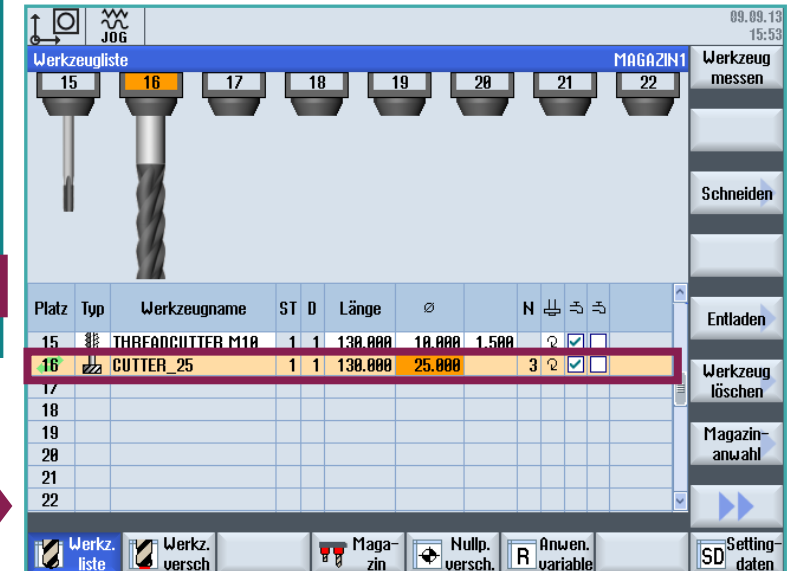
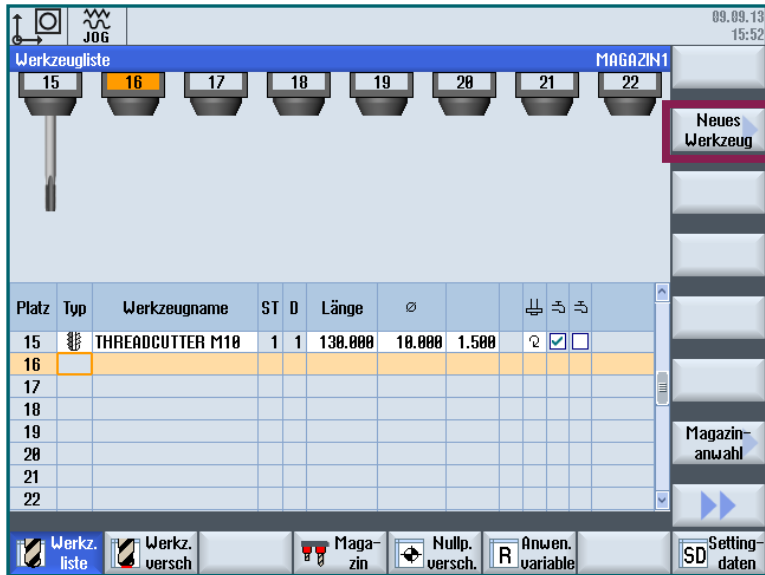
Platz	Typ	Werkzeugname	ST	D	Länge	Ø	1	2	3	4	5	6	7
1	1	CUTTER 4	1	1	65.000	4.000	3	2	✓				
2	1	CUTTER 6	1	1	120.000	6.000	3	2	✓				
3	1	CUTTER 10	1	1	150.000	10.000	4	2	✓				
4	1	CUTTER 16	1	1	110.000	16.000	3	2	✓				
5	1	CUTTER 20	1	1	100.000	20.000	3	2	✓				
6	1	CUTTER 32	1	1	110.000	32.000	3	2	✓				
7	1	CUTTER 60	1	1	110.000	60.000	6	2	✓				



3 Tool management with SINUMERIK Operate

Creating and saving tools

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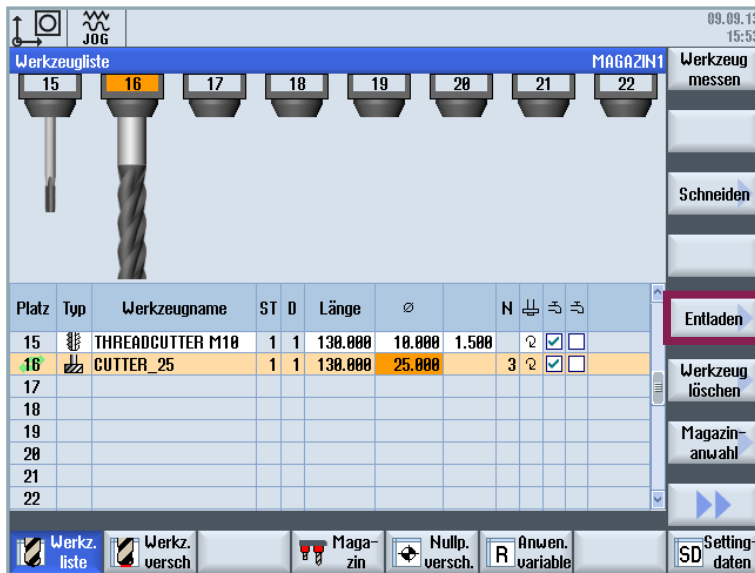
Creating a new tool (end mill)

3 Tool management with SINUMERIK Operate

Creating and saving tools

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Unloading



"Unloading" - i.e. virtually taking the tool from the **magazine** does not delete the tool with its associated data, but saves it outside the **magazine** in the **tool management**. This means that it can be "loaded" at any time to a free **magazine location** and used in the NC program.

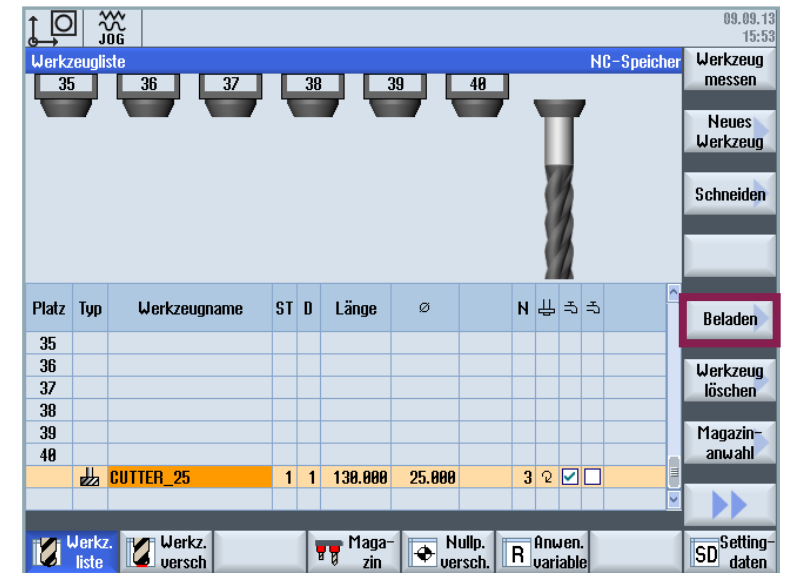
Absolutely essential:
The tool is physically removed when **unloading!**

Magazine



tool list

Loading



Tool list



magazine

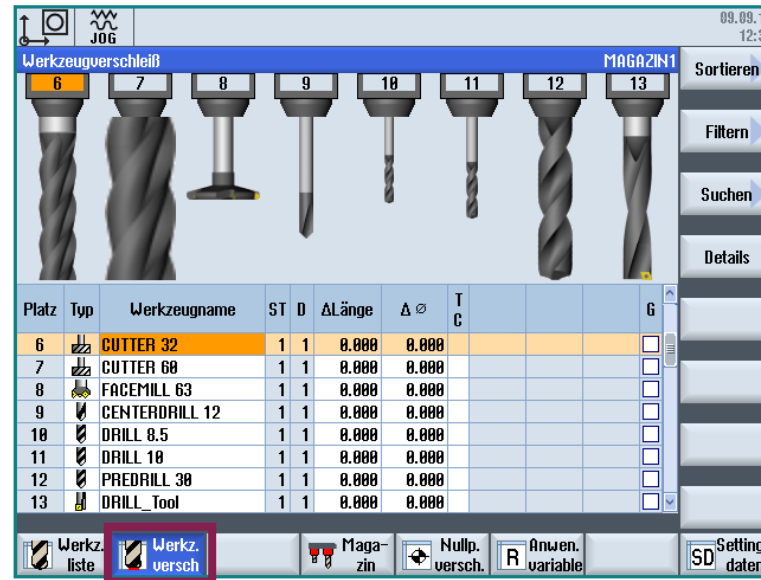
3 Tool management with SINUMERIK Operate

Creating and saving tools



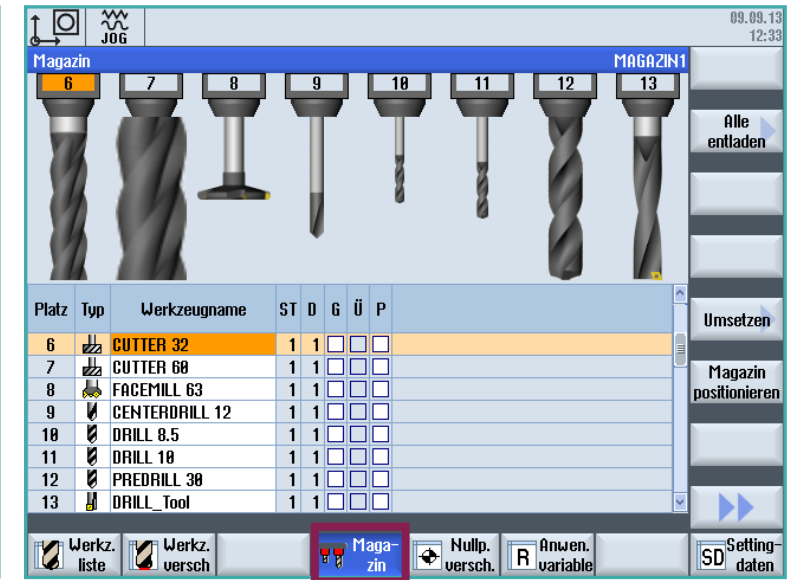
Tool list

- Tools represented as icons
- Readable tool names
- Tool data and magazine location data in one screen



Tool wear

- Tool lifetime monitoring (lifetime/unit quantity/wear)
- Optional management of replacement tools



Tool magazine

- Magazine location information
- Relocate tools
- Position magazine

3 Tool management with SINUMERIK Operate

Tool location coding



Fixed tool location coding:

- The tool is always changed at a permanently assigned location in the magazine
- For oversized tools: Reserve fixed locations and keep the neighboring/adjacent locations free
- 3D probes: To protect as far as possible the sensitive measuring instrument from the mechanical effects of continuous tool changes – with all of the associated effects, for example remains of chips and cooling water

Variable tool location coding:

- The tool is always changed at the next free location in the magazine, which is closest to the tool change point
- This is a time-saving and therefore effective method to keep tool change times short
- After they have been changed out, the tools are placed in the next free magazine location
- The control always knows which tool is located where



3 Tool management with SINUMERIK Operate

Handling tools when generating a program

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ShopMill

SIEMENS SINUMERIK OPERATE 12.12.16 14:28

NC/WKS/TEST/TEST_WZ

P

END

Planfräsen

T D 1

F 50.000 mm/min

S 2000 U/min

Bearbeitung

Richtung

X0 100.000

Y0 0.000

Z0 0.000

X1 40.000 ink

Y1 200.000 ink

Z1 5.000 ink

DX1 0.600 mm

DZ 0.500

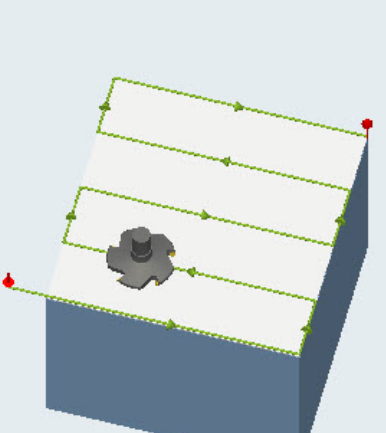
UZ 0.100

Grafische Ansicht

Abbruch

Übernehmen

Edit Bohren Fräsen Kontur fräsen NC Diverses Simulation Anwahl



SIEMENS SINUMERIK OPERATE 12.12.16 14:21

NC/WKS/TEST/TEST_WZ

P

END

Planfräsen

T D 1

F 50.000 mm/min

Werkzeugauswahl

MAGAZIN1

Platz	Typ	Werkzeugname	ST	D	Länge	Ø
1		CUTTER 4	1	1	65.000	4.000
2		CUTTER 6	1	1	120.000	6.000
3		CUTTER 10	1	1	150.000	10.000
4		CUTTER 16	1	1	110.000	16.000
5		CUTTER 20	1	1	100.000	20.000
6		CUTTER 32	1	1	110.000	32.000
7		CUTTER 60	1	1	110.000	60.000
8		FACEMILL 63	1	1	120.000	63.000
9		CENTERDRILL 12	1	1	120.000	12.000
10		DRILL 8.5	1	1	120.000	8.500
11		DRILL 10	1	1	120.000	10.000

Werkzeugdurchmesser

Magazin-anwahl

Abbruch

OK



3 Tool management with SINUMERIK Operate

Handling tools when generating a program

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ShopMill

SIEMENS SINUMERIK OPERATE 12.12.16 14:38

NC/WKS/TEST/TEST_WZ

P

END

Planfräsen

T **FACEMILL 63** D 1

F 50.000 mm/min

S 2000 U/min

Bearbeitung

Richtung

X0 100.000

Y0 0.000

Z0 0.000

X1 40.000 ink

Y1 200.000 ink

Z1 5.000 ink

DXY 0.600 mm

DZ 0.500

UZ 0.100

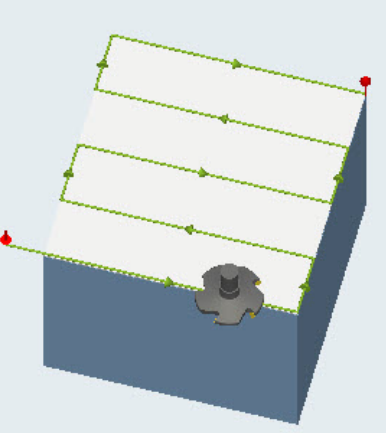
Werkzeug auswählen

Grafische Ansicht

Abbruch

Übernehmen

Edit Bohren Fräsen Kontur fräsen NC Diverses Simulation Anwahl



SIEMENS SINUMERIK OPERATE 12.12.16 14:31

NC/WKS/TEST/TEST_WZ 2

P Programmkopf G54 Quader

Planfräsen T=FACEMILL 63 F=50/min S=2000U X0=100 Y0=0

END Programmende

Planfräsen

Tasche

Zapfen Mehrkant

Nut

Gewindefräsen

Gravur

Edit Bohren Fräsen Kontur fräsen NC Diverses Simulation Anwahl

3 Tool management with SINUMERIK Operate

Handling tools when generating a program

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G code

SIEMENS SINUMERIK OPERATE 12.12.16 14:42

NC/WKS/TEST/TEST_WZ_ Planfräsen

PL **G17 (XY)**

RP 100.000

SC 1.000

F 0.100

Bearbeitung

Richtung

X0 15.000

Y0 20.000

Z0 0.200

X1 10.000 ink

Y1 15.000 ink

Z1 5.000 ink

DXY 0.600 ink

DZ 0.500

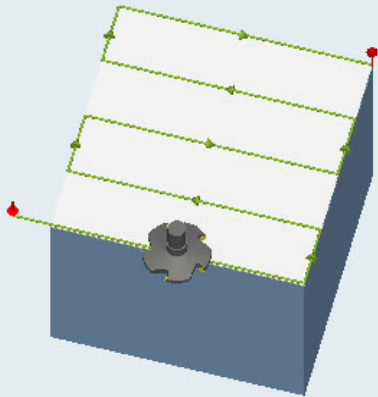
UZ 0.100

Grafische Ansicht

Abbruch

Übernehmen

Edit Bohren Fräsen Kontur fräsen Diverses Simulation Anwahl



SIEMENS SINUMERIK OPERATE 12.12.16 14:44

NC/WKS/TEST/TEST_WZ_ 6

T="FACEMILL 63"

M6

CYCLE61(100,0.2,1,5,15,20,10,15,0.5,0.6,0.1,0.1,31,0,1,1)

Werkzeug auswählen

Block bilden

Suchen

Markieren

Kopieren

Einfügen

Aus-schneiden

Edit Bohren Fräsen Kontur fräsen Diverses Simulation Anwahl

4 Summary

Customer benefits

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Intuitive:

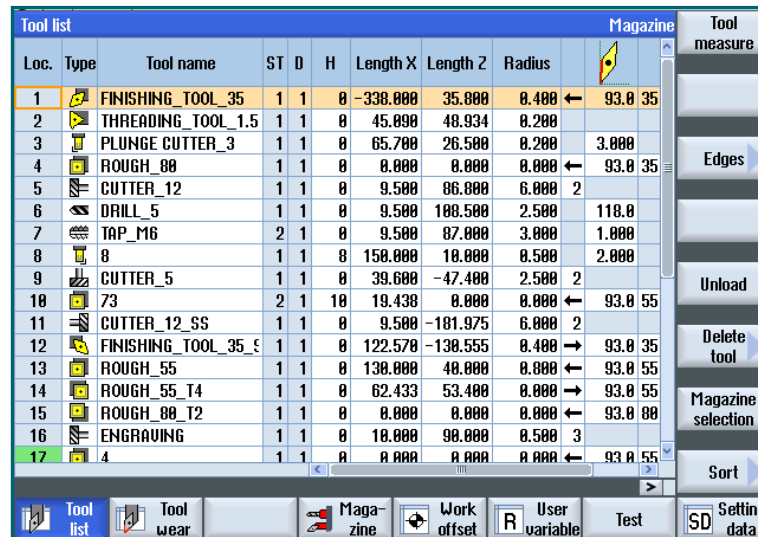
Tool types are shown as easy to remember and "catchy" icons

Perfectly arranged:

Magazine data and tool data are transparently shown on one screen

Readable:

Tools can be quickly found thanks to readable tool names



Loc.	Type	Tool name	ST	D	H	Length X	Length Z	Radius	Magazine	Tool measure
1	FINISHING_TOOL_35	1	1	0	-338.000	35.000	0.400	←	93.0	35
2	THREADING_TOOL_1.5	1	1	0	45.000	48.934	0.200			
3	PLUNGE CUTTER_3	1	1	0	65.700	26.500	0.200		3.000	
4	ROUGH_00	1	1	0	0.000	0.000	0.000	←	93.0	35
5	CUTTER_12	1	1	0	9.500	86.000	6.000	2		
6	DRILL_5	1	1	0	9.500	100.500	2.500		118.0	
7	TAP_M6	2	1	0	9.500	87.000	3.000		1.000	
8	8	1	1	0	150.000	10.000	0.500		2.000	
9	CUTTER_5	1	1	0	39.600	-47.400	2.500	2		
10	73	2	1	10	19.438	0.000	0.000	←	93.0	55
11	CUTTER_12_SS	1	1	0	9.500	-181.975	6.000	2		
12	FINISHING_TOOL_35_5	1	1	0	122.570	-130.555	0.400	→	93.0	35
13	ROUGH_55	1	1	0	130.000	40.000	0.000	←	93.0	55
14	ROUGH_55_T4	1	1	0	62.433	53.400	0.000	→	93.0	55
15	ROUGH_00_T2	1	1	0	0.000	0.000	0.000	←	93.0	00
16	ENGRAVING	1	1	0	10.000	90.000	0.500	3		
17	4	1	1	0	0.000	0.000	0.000	←	93.0	55

Buttons: Tool list, Tool wear, Magazine, Work offset, User variable, Test, Setting data

Powerful:

Up to 1000 tools can be managed

Productive:

Tool lifetime monitoring – and the management of replacement tools

Simple equipping:

Operator-friendly loading/unloading function for fast magazine assignment

The powerful **SINUMERIK tool management** functionality facilitates **highly productive production workflows** – and at the same time **simple and intuitive operation**.

4 Summary

What have we learned?

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What are the various clamping options for individual tool components?

Clamping, pressing-in, shrinking to combine tools, tool holders and tool adapters

What data does SINUMERIK require in order to determine the position of the tool tip in the coordinate system?

The machine/workpiece coordinates are used along with the tool data (e.g. tool length, diameter and radius)

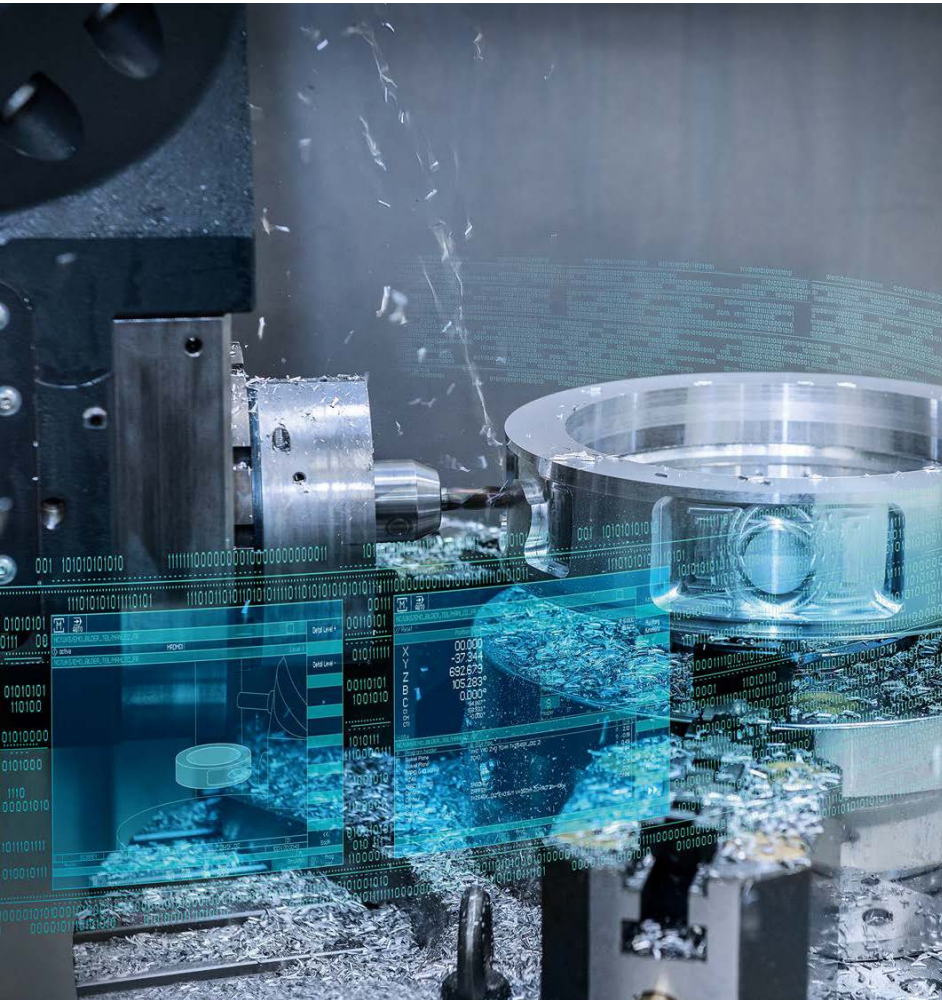
Why is tool management required?

Structured, virtual representation of tools and saving tool data

How is tool management applied in SINUMERIK?

- Classifying and creating tools
- Updating tool data sets (correction of data resulting from wear and/or replacement → replacement tool)
- Interaction between SinuTrain and SINUMERIK, exchanging tool data sets (offline programming)
- Using tools from the list (virtual tool cabinet)

Thank you for your attention!



Technology and Application Center

Video in YouTube:

<https://www.youtube.com/watch?v=eHYUxmVeEUA&list=PL45872A31E6FECBD0&index=1>

[siemens.com/cnc4you](https://www.siemens.com/cnc4you)