SINUMERIK live:
Tool management – milling
Reference points, tool parameters and clamping options
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

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**
- **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**
The systematics involved with tool holders and the associated clamping options
Clamping, pressing-in, shrinking

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

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

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

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

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.

**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.
3 Tool management with SINUMERIK Operate
Creating and saving tools

Creating a new tool (end mill)
"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!
### 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
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

ShopMill
3 Tool management with SINUMERIK Operate
Handling tools when generating a program

ShopMill
3 Tool management with SINUMERIK Operate
Handling tools when generating a program

G code
4 Summary
Customer benefits

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

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?

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

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