SINUMERIK live:
Turn-milling with C and Y axes
Principle of operation and application with SINUMERIK Operate
## Turn-milling with C and Y axes
### Principle of operation and application with SINUMERIK Operate

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fundamentals of turn-milling</td>
</tr>
<tr>
<td>1.1</td>
<td>Overview of turning fundamentals</td>
</tr>
<tr>
<td>1.2</td>
<td>Turn-milling in detail</td>
</tr>
<tr>
<td>1.3</td>
<td>C-axis applications</td>
</tr>
<tr>
<td>1.4</td>
<td>Y-axis applications</td>
</tr>
<tr>
<td>2</td>
<td>Turn-milling with SINUMERIK Operate</td>
</tr>
<tr>
<td>2.1</td>
<td>TRANSMIT and TRACYL</td>
</tr>
<tr>
<td>3</td>
<td>Practical experience at a Doosan machine tool</td>
</tr>
<tr>
<td>3.1</td>
<td>Sample workpiece</td>
</tr>
<tr>
<td>4</td>
<td>Summary</td>
</tr>
</tbody>
</table>
Fundamentals of turn-milling
Development of CNC lathes

1. Fundamentals of turn-milling
Development of CNC lathes

- X/Z cycle controlled
- X/Z axis with driven tool, C axis
- X/Z axis with driven tool, C axis, Y axis
- X/Z axis with driven tool, B, C and Y axes - multitasking
- X/Z axis with driven tool, B, C and Y axes - multi-spindle machine, longitudinal turning
Turning:

- A **stationary tool** (turning tool, specific cutting edge) is used to machine a **rotating workpiece** to the appropriate specifications.
- To machine parts that are **symmetrical around the axis of rotation**.
- Turning operations: **X and Z axes**
C axis:
- Switching from the spindle mode into the controlled C-axis mode

Driven tool:
- Expanded machining options by using rotating tools in the turret
- Drilling and milling only in the area around the workpiece center point

Y axis:
- Drilling and milling outside the workpiece center point
- The Y axis "rides" on the X axis - and is perpendicular to the X and Z axes
Face side drilling **outside the turning center of rotation** - however, the tool does not leave the turning center!

- Drilling on the **cylinder (peripheral) surface** (center point of the workpiece axis)
- Milling on the **face side**
- Milling on the **cylinder surface**
- Pockets/grooves automatically occur with **curved bases** (on the cylinder surface)

The C-axis already enormously extends machining options when using a lathe!
1 Turn-milling fundamentals

Y-axis applications

- Applications are mainly cubic on the cylinder surface
- Pockets/grooves with flat base
- Machining grooves/slots with parallel walls
- Drilling and milling outside the workpiece center axis in the radial direction
- Cutter radius compensation

= 100% pure milling!
Cutter radius compensation:
Compensation of the cutter tool data.
Cutter radius compensation:
Compensation of the cutter tool data.
**TRACYL** = cylinder surface transformation (cylinder surface transformation)

Allows the cylinder surface of a turning workpiece to be machined (= cylinder) – circular and also straight contours.

**TRANSMIT** = face transformation (Transform Milling Into Turning)

Allows contours at the face of a turned workpiece to be drilled and milled using axial tools.

**Kinematic transformation**

With a kinematic transformation, positions can be programmed in the Cartesian coordinate system.

The control transforms (= converts) the programmed traversing motion of the Cartesian coordinate system into traversing motion of the real machine axes (machine coordinate system - MCS).
Turn-milling with SINUMERIK Operate
Face side transformation TRANSMIT without Y axis

- All lathes with driven tool are suitable for face side machining
- For this purpose, the CNC control requires a kinematic transformation to map the workpiece coordinate system (WCS) to the machine coordinate system (MCS) without Y axis

TRANSMIT facilitates a full range of drilling and milling machining operations for the face side of turned workpieces!
• All lathes with driven tool are suitable for cylinder surface machining operations.

• Cylinder surface transformation TRACYL for interpolating the Z axis and rotary axis.

• A Y axis is required for cylinder surface transformation with tool radius compensation.

TRACYL facilitates a full range of drilling and milling machining operations for the peripheral surface of turned workpieces!
Turn-milling with SINUMERIK Operate
Cylinder surface transformation TRACYL

- Suitable for drilling and milling on cylinder surfaces with curved pocket bases
- In addition to the rotary axis, requires two geometry axes in the machine (X,Z)

TRACYL without tool radius compensation

TRACYL with tool radius compensation

- Only used for machining slots with flat bases with parallel walls
- Requires a 3rd geometry axis (Y axis) in the machine
Practical experience at a DOOSAN machine tool
Sample workpiece
Advantages for end users:

- Time saving through...
  - Shorter setup times
  - Shorter/less machine downtimes
  - Shorter machining times
- Shorter delivery times
- Optimized machine fleet

The following must be taken into consideration from an end users perspective:

Increased...
- capital investment and maintenance costs for the machine as well as the tools
- training costs for operators, wage levels
- possibly procurement of a CAD-CAM system for complex contours

Increased flexibility regarding Range of machining operations
Thank you for your attention

Digital Experience and Application Center Erlangen

Link zum YouTube-Video:
https://youtu.be/oFt6kblUlw8?list=PL45872A31E6FECBD0

siemens.com/cnc4you