SIEMENS
Ingenuity for life

SINUMERIK live:
Turn-milling with C and Y axes

Principle of operation and application with SINUMERIK Operate

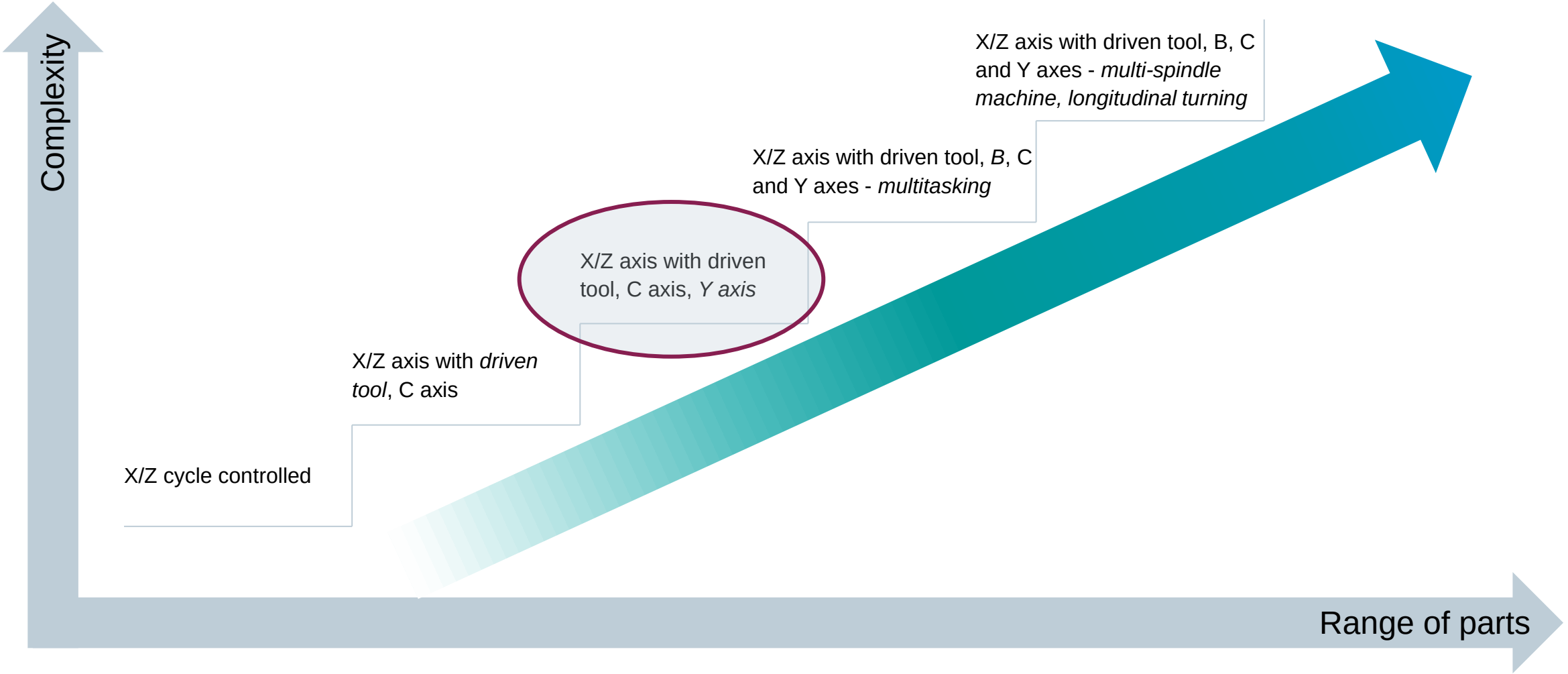
siemens.com/cnc4you

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

SIEMENS
Ingenuity for life

1 Fundamentals of turn-milling
Development of CNC lathes

SIEMENS
Ingenuity for life

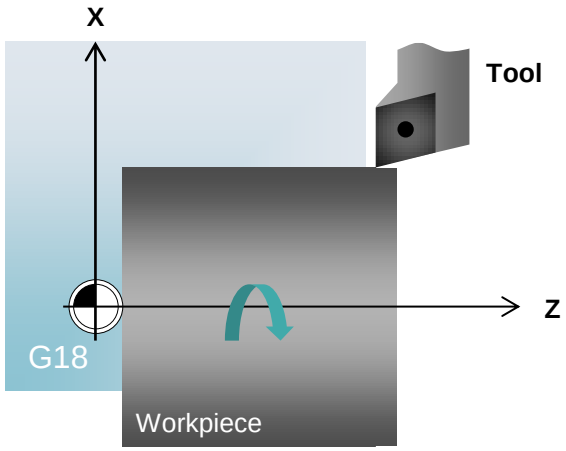


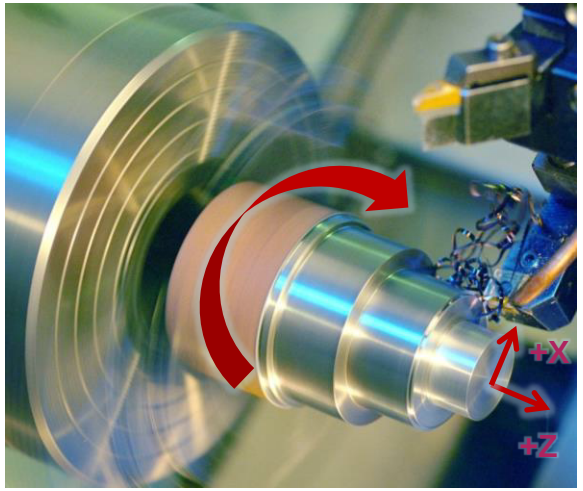
1 Fundamentals of turn-milling
Turning technology

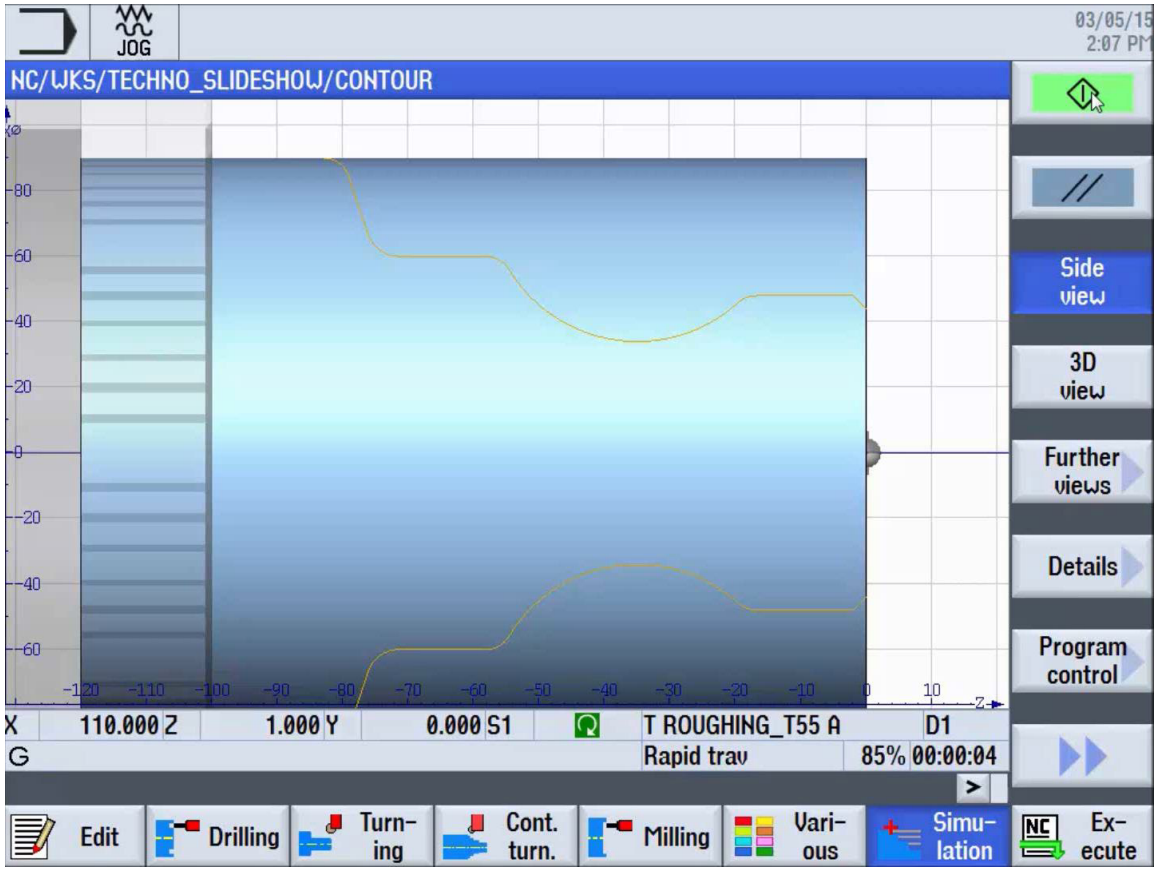
SIEMENS
Ingenuity for life

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**







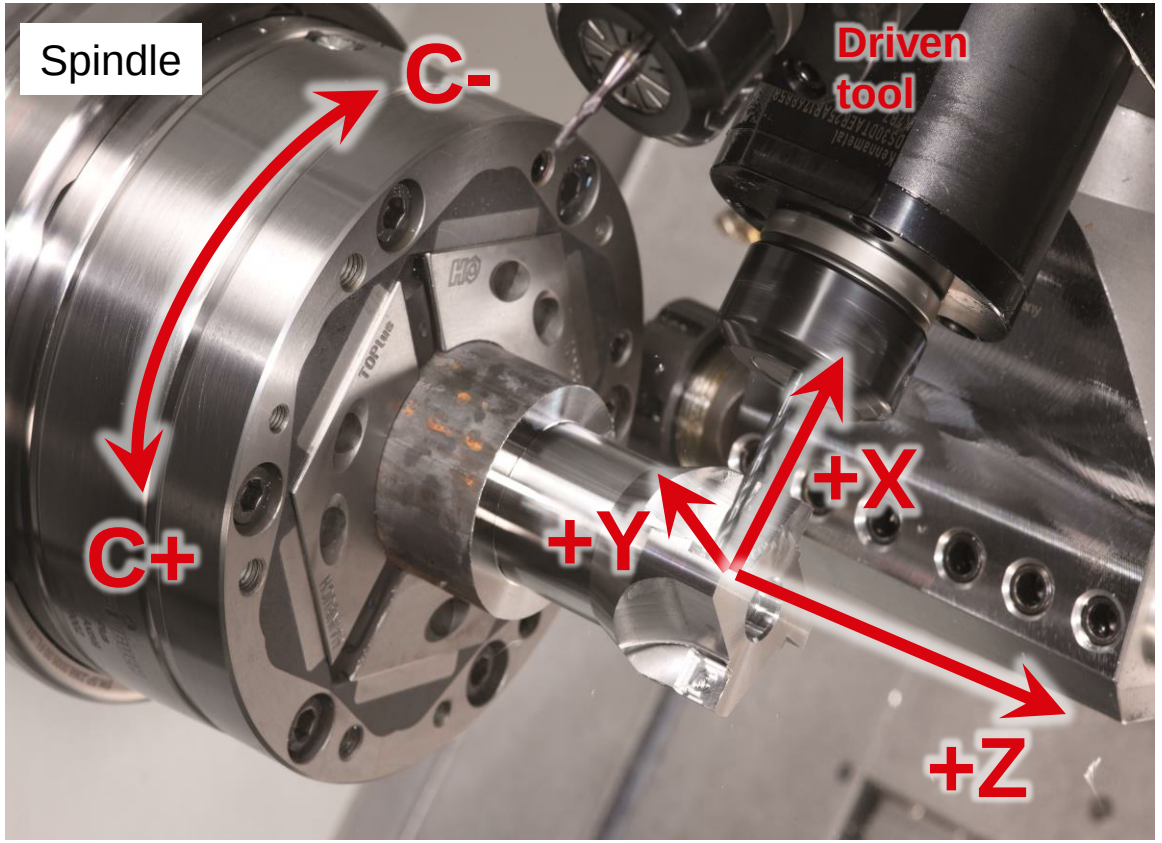
Turn-milling fundamentals
Turn-milling in detail

SIEMENS
Ingenuity for life

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**

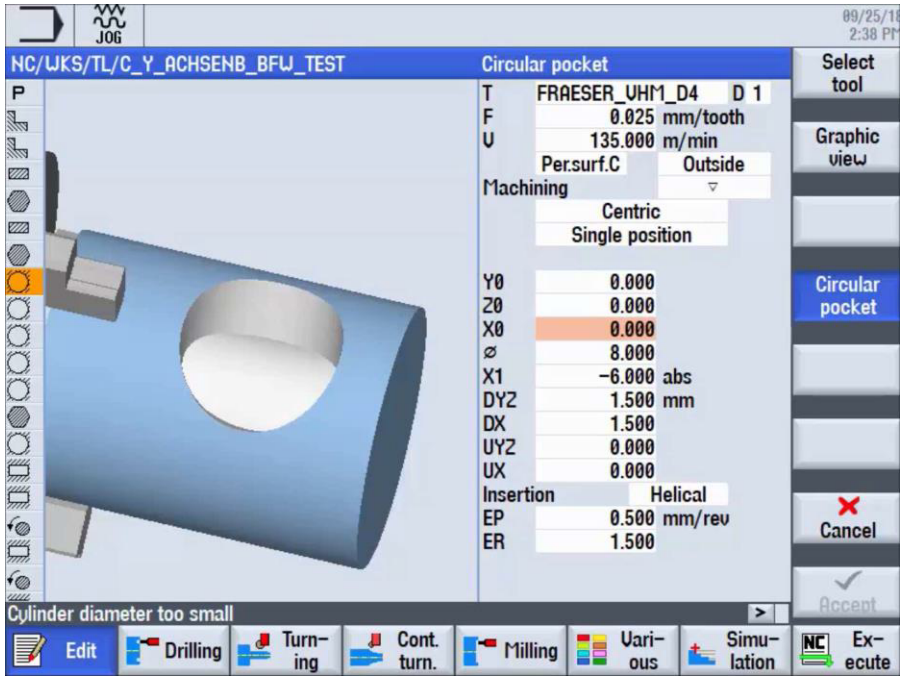
Y axis:
- Drilling and milling **outside** the workpiece center point
- The Y axis "rides" on the X axis - and is perpendicular to the X and Z axes

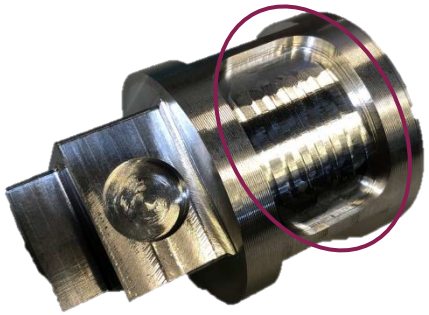


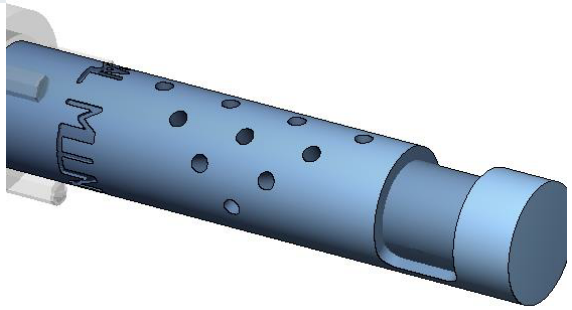
Turn-milling fundamentals
C-axis applications

SIEMENS
Ingenuity for life

- 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)





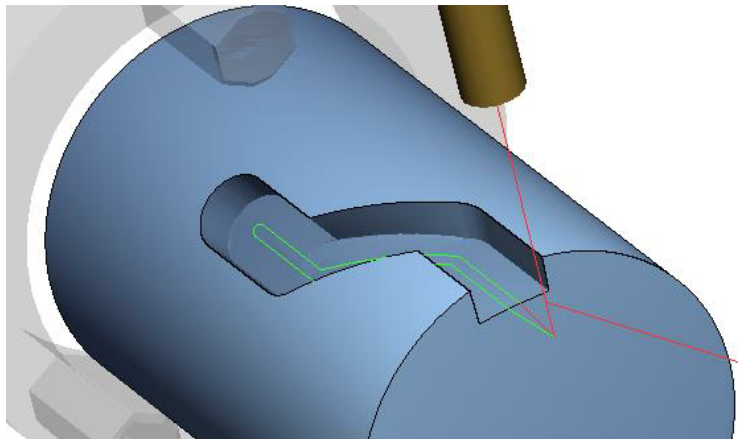


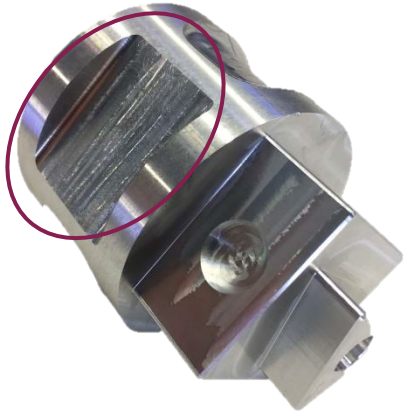
The C-axis already enormously extends machining options when using a lathe!

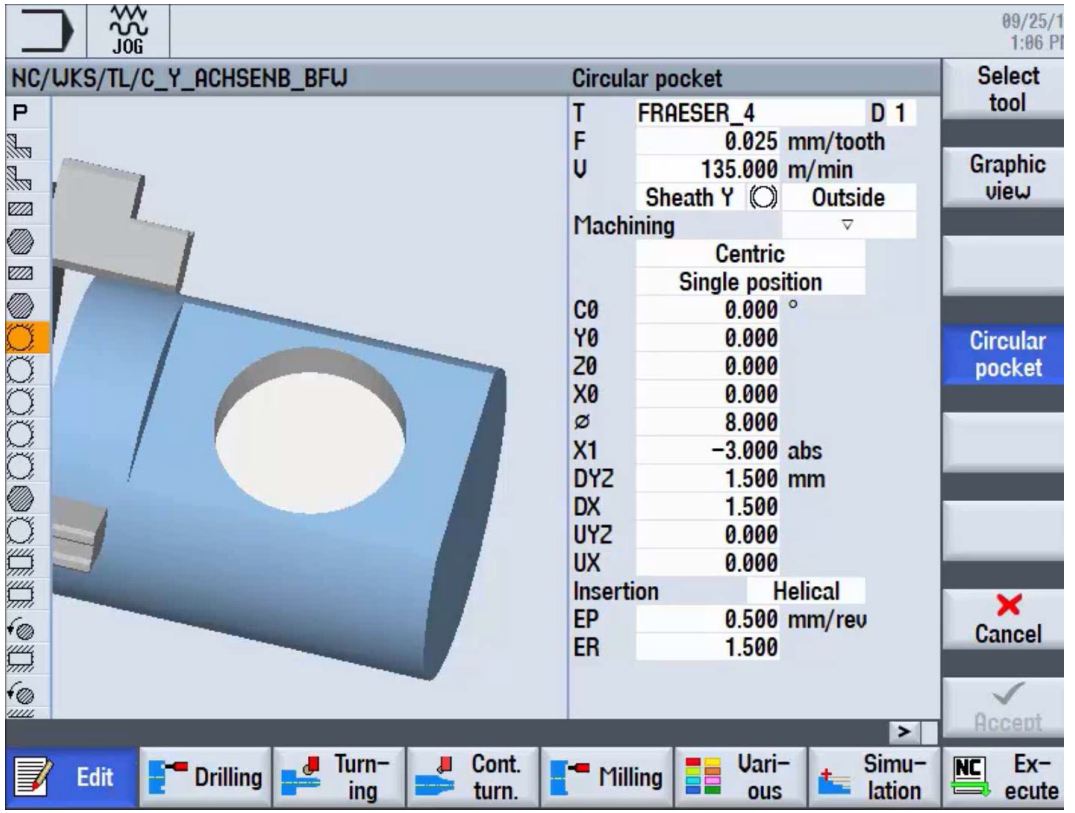
1 Turn-milling fundamentals
Y-axis applications

SIEMENS
Ingenuity for life

- 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





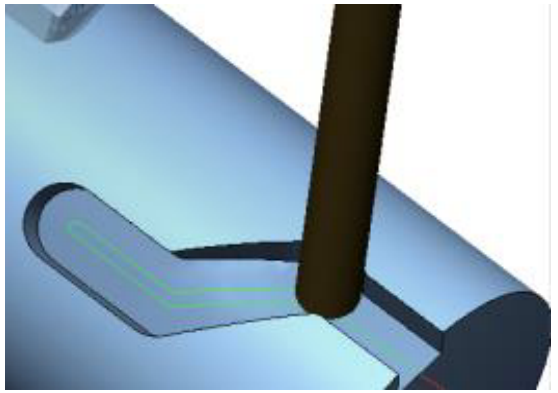


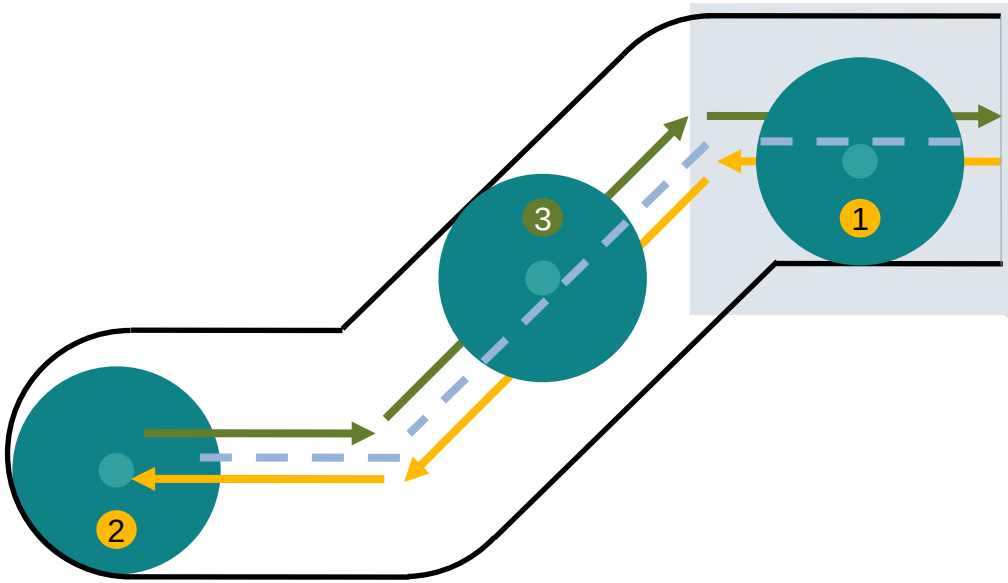
= 100% pure milling!

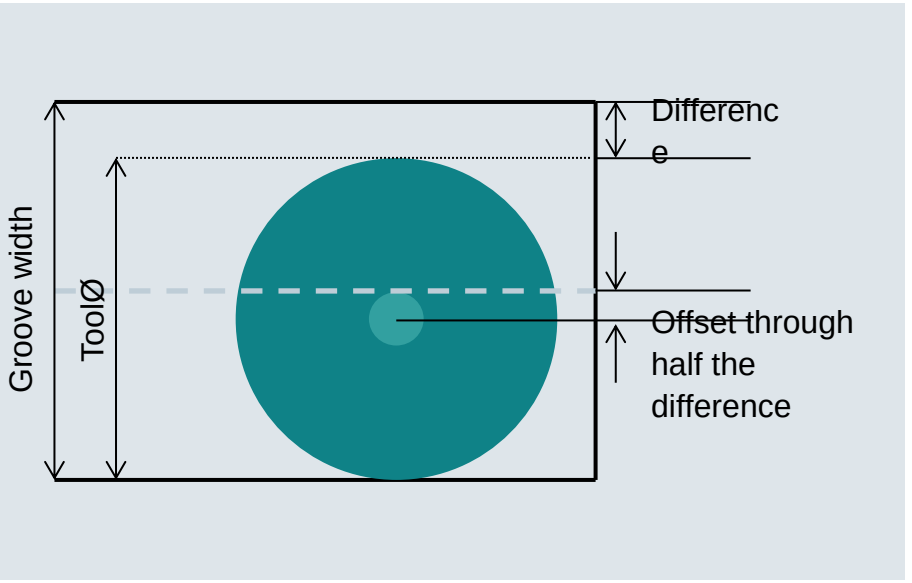
1 Turn-milling fundamentals
Y-axis applications?

SIEMENS
Ingenuity for life

Cutter radius compensation:
Compensation of the cutter tool data.



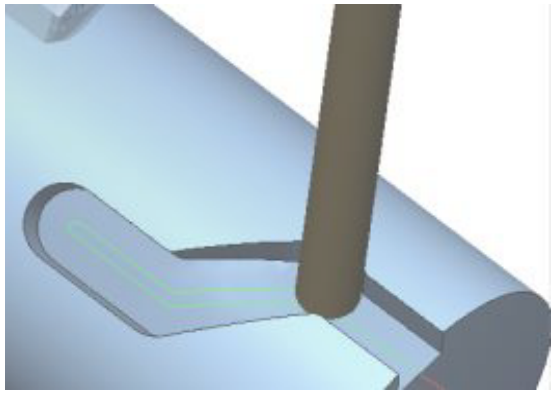


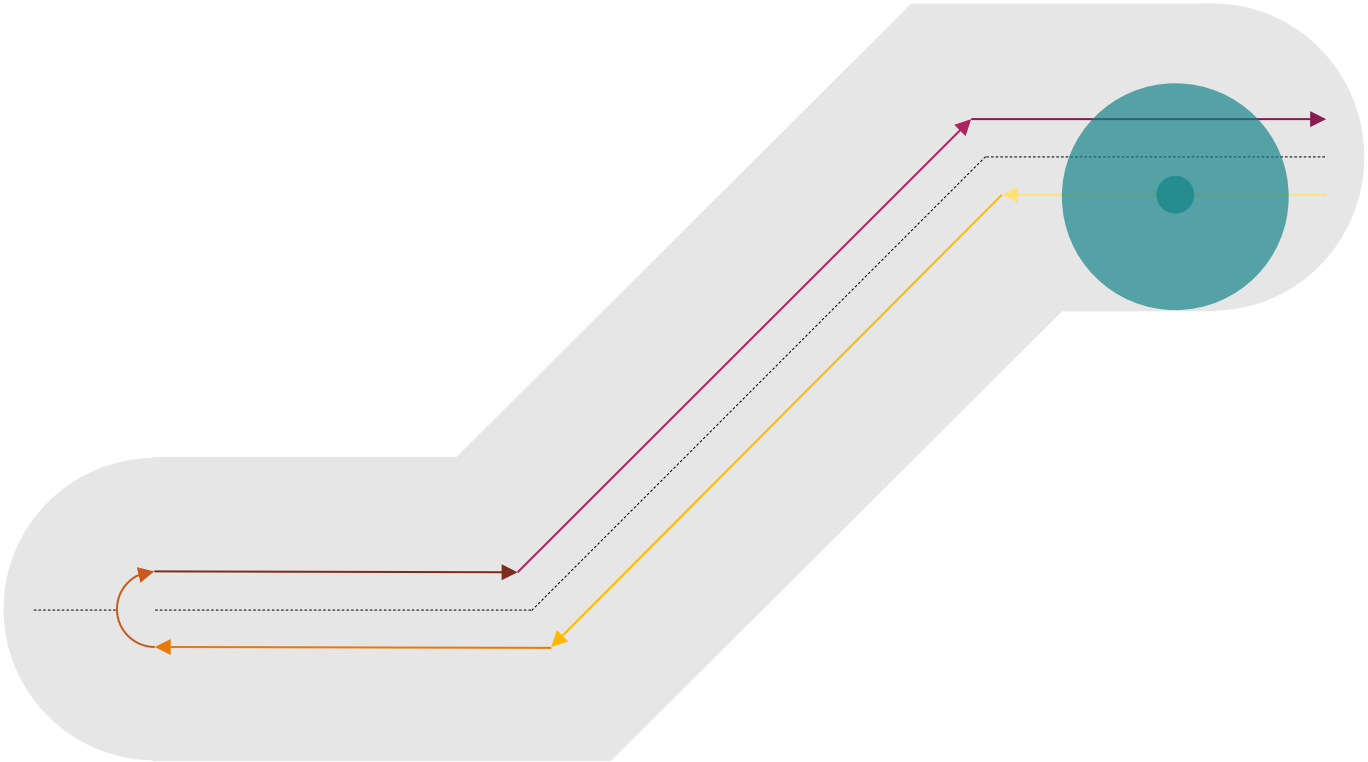


1 Turn-milling fundamentals
Y-axis applications?

SIEMENS
Ingenuity for life

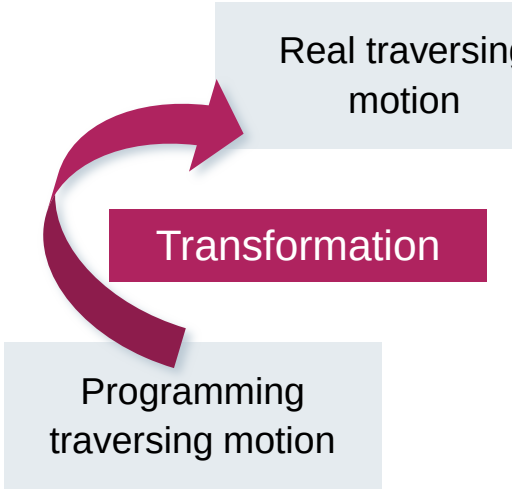
Cutter radius compensation:
Compensation of the cutter tool data.





Turn-milling with SINUMERIK Operate TRACYL and TRANSMIT

SIEMENS
Ingenuity for life



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)

TRACYL = cylinder surface transformation (**cyl**inder surface **tra**nsformation)
Allows the cylinder surface of a turning workpiece to be machined (= cylinder) – circular and also straight contours.

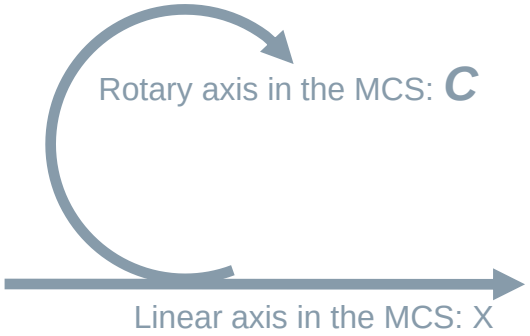
TRANSMIT = face transformation (**Trans**form **M**illing **I**nto **T**urning)
Allows contours at the face of a turned workpiece to be drilled and milled using axial tools.

Turn-milling with SINUMERIK Operate
Face side transformation TRANSMIT without Y axis

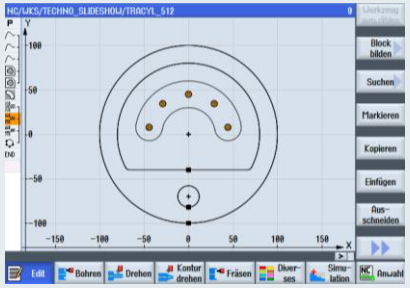
SIEMENS
Ingenuity for life

- 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!

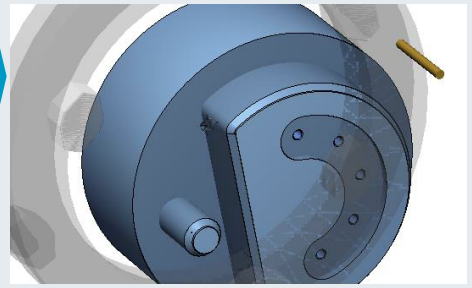


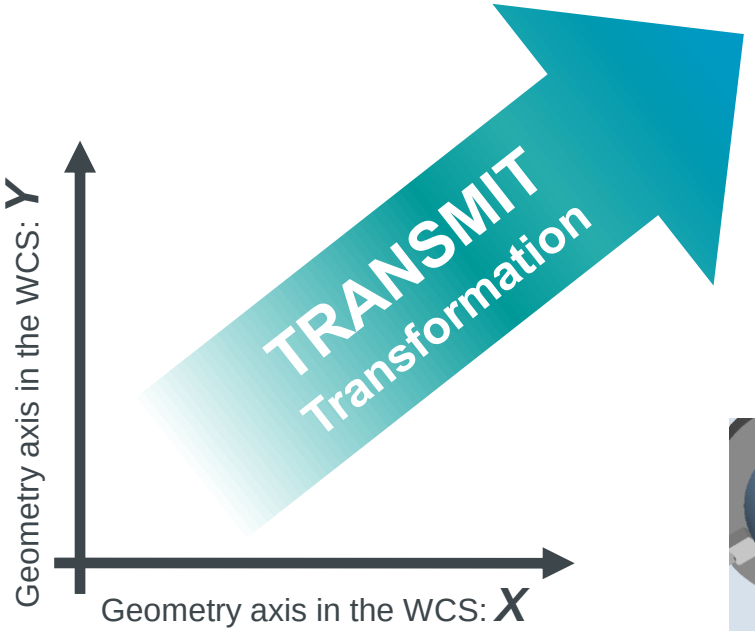
Cartesian (graphic) programming (WCS)

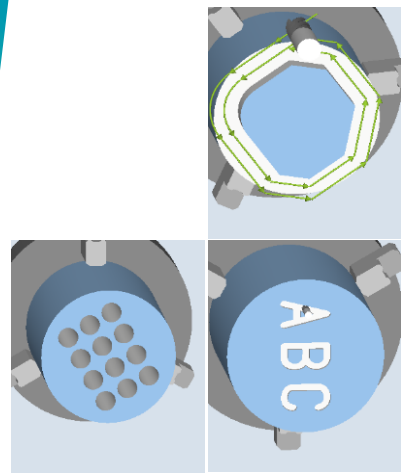


TRANSMIT

Machining on the face side in the real MCS





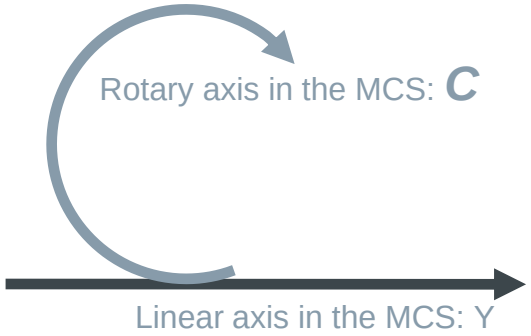


2 Turn-milling with SINUMERIK Operate
Cylinder surface transformation TRACYL

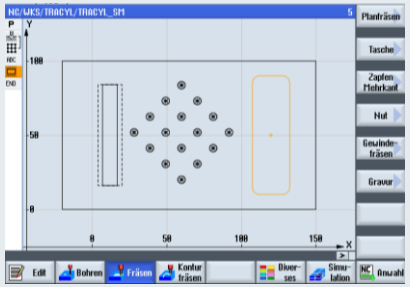
SIEMENS
Ingenuity for life

- 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!

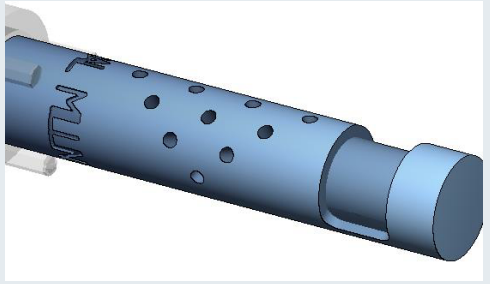


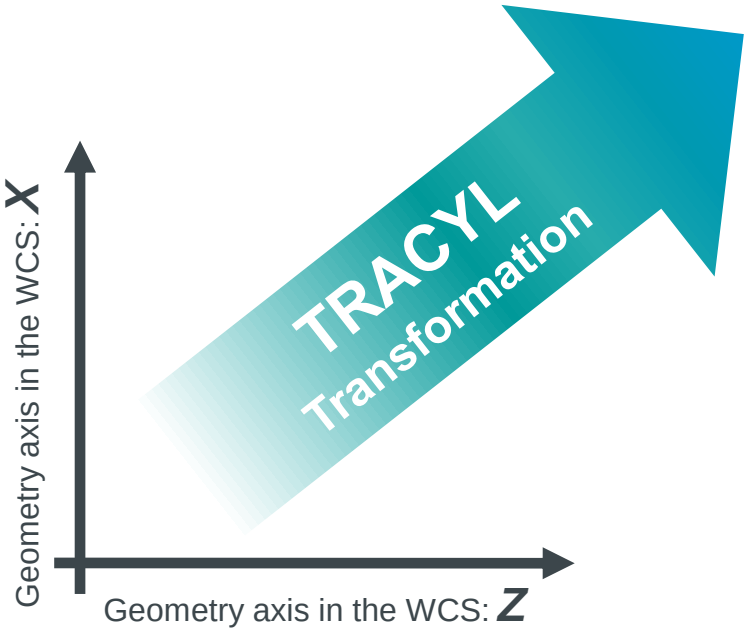
Cartesian (graphic) programming (WCS)



TRACYL

Machining on a cylinder (peripheral) surface in the MCS

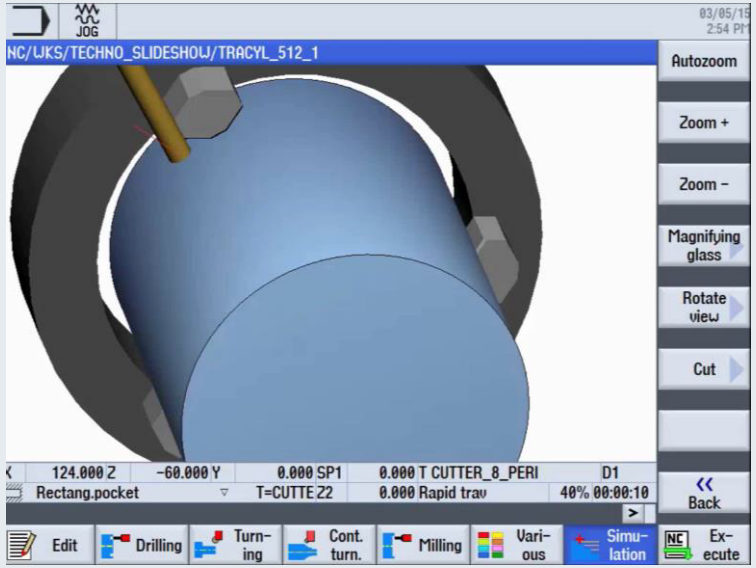


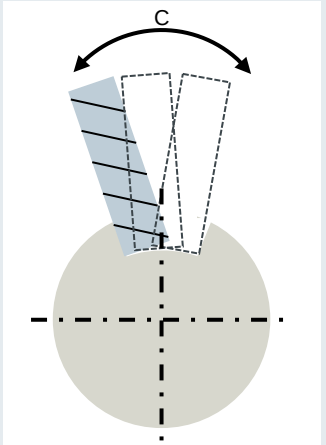


2 Turn-milling with SINUMERIK Operate
Cylinder surface transformation TRACYL

SIEMENS
Ingenuity for life

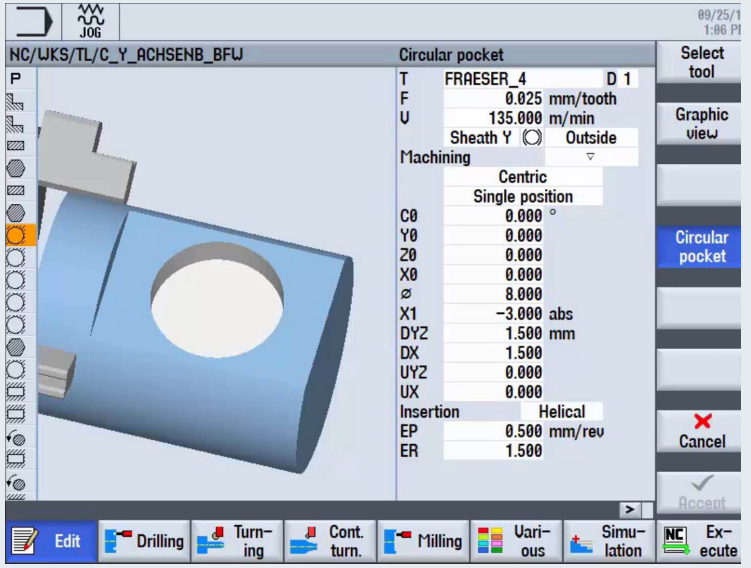
TRACYL without tool radius compensation

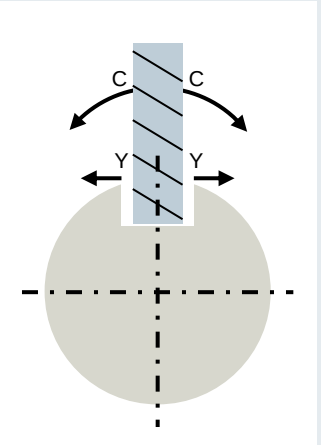




- Suitable for drilling and milling on cylinder surfaces **with curved pocket bases**
- In addition to the rotary axis, requires two geometry axes in the machine (X,Z)

TRACYL with tool radius compensation

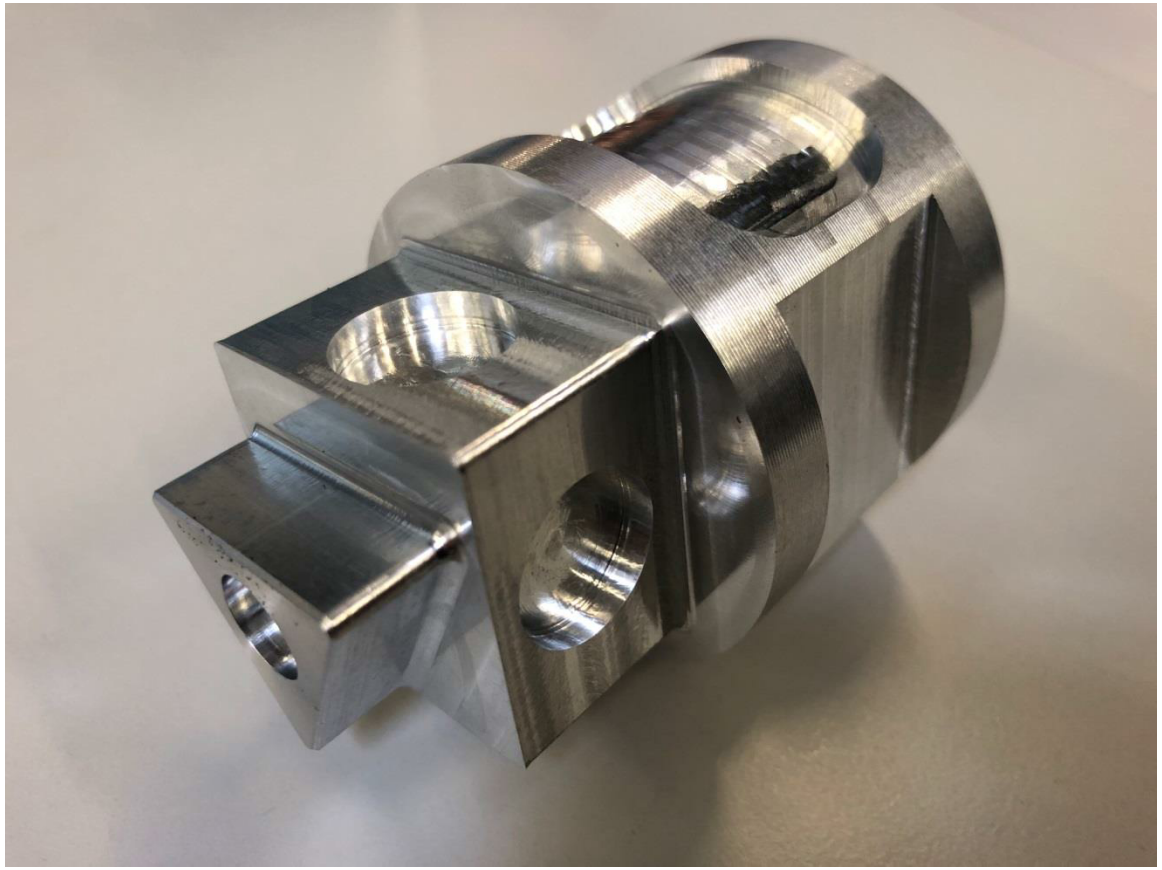




- Only used for machining **slots with flat bases** with parallel walls
- Requires a 3rd geometry axis (**Y axis**) in the machine

3 Practical experience at a DOOSAN machine tool
Sample workpiece

SIEMENS
Ingenuity for life



4 Summary

SIEMENS
Ingenuity for life

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

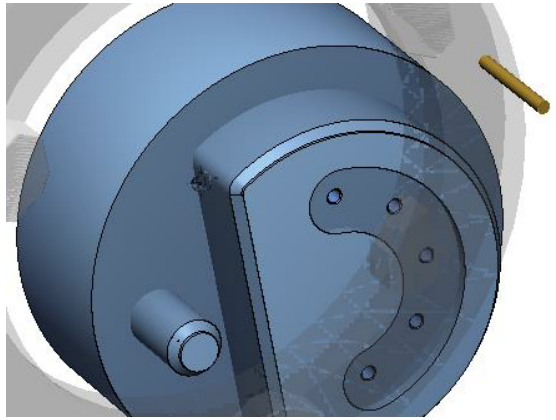
Increased...

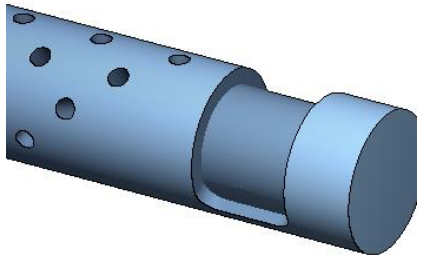
- capital investment and maintenance costs for the machine as well as the tools
- training costs for operators, wage levels

... possibly procurement of a CAD-CAM system for complex contours

Advantages for end users:

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

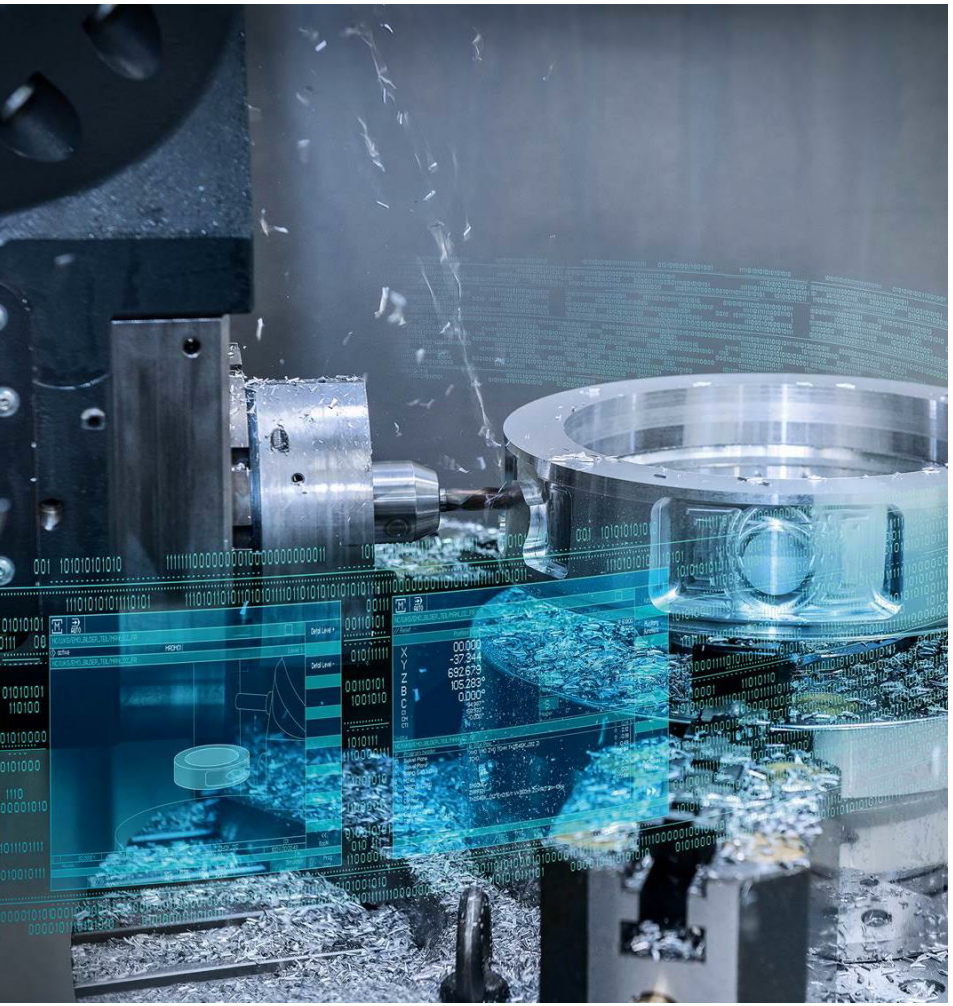




Increased **flexibility** regarding Range of machining operations

Thank you for your attention

SIEMENS
Ingenuity for life



Digital Experience and Application Center Erlangen

Link zum YouTube-Video:
https://youtu.be/oFt6kbIUiw8?list=PL45872A31E6FECBD0

siemens.com/cnc4you