



SINUMERIK live

Cylinder surface transformation
with SINUMERIK

Technical insight into the topic of cylinder surface transformation with SINUMERIK

- Basic information on cylinder surface transformation (TRACYL)
- Basic types of cylinder surface transformation
- CNC programming with SINUMERIK
 - TRACYL on the turning machine
 - TRACYL on the milling machine
- Summary

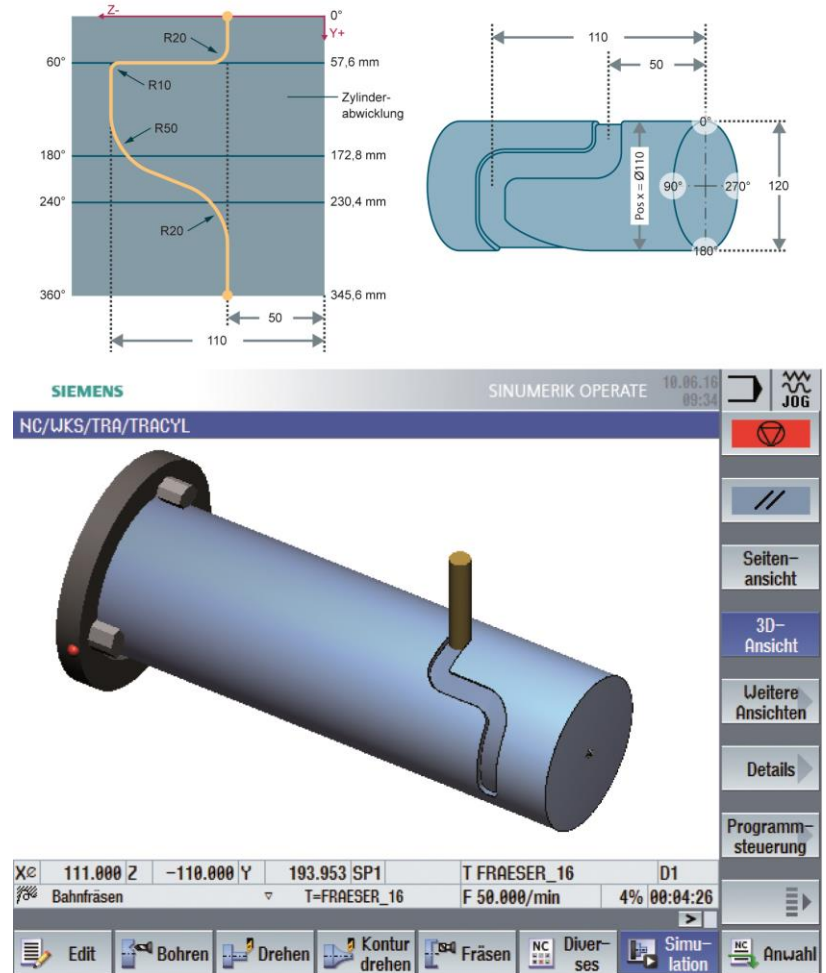
Basic information on cylinder surface transformation (TRACYL)

Definition of cylinder surface transformation

Cylinder surface transformation allows milling operations on the surface of a cylinder (winding off the cylinder). Both straight line and circular contours can be programmed. An interpolation of the Z axis and of the rotary axis takes place.

The cylinder surface transformation is programmed in a **fictitious** (Cartesian) coordinate system. The machine movements themselves are carried out in the **real** machine coordinate system.

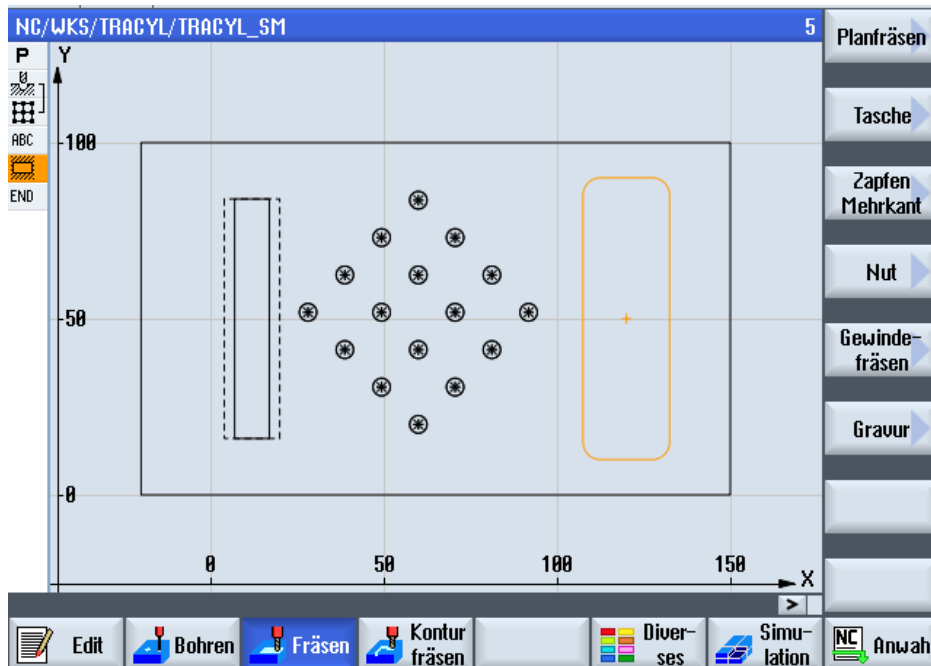
For programming, an unwinding of the contour to be milled is required. The unwinding refers to the machining diameter on the cylinder.



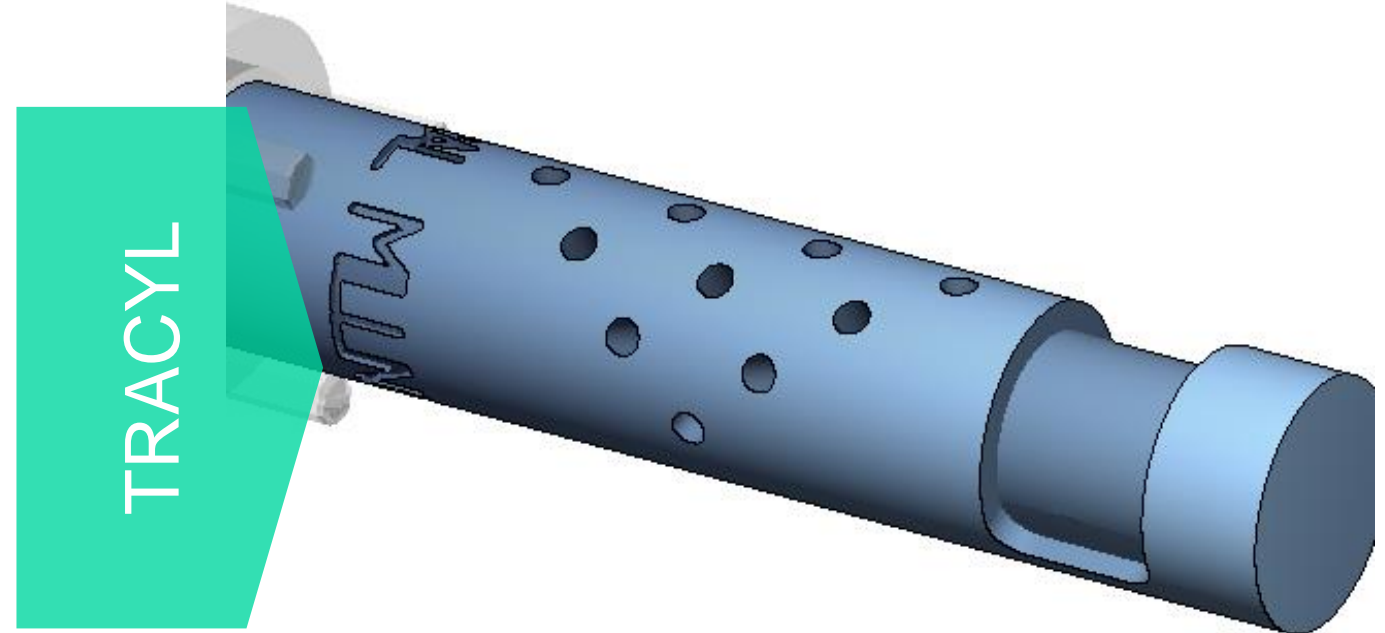
CNC programming

- simply in the Cartesian coordinate system

Cartesian programming



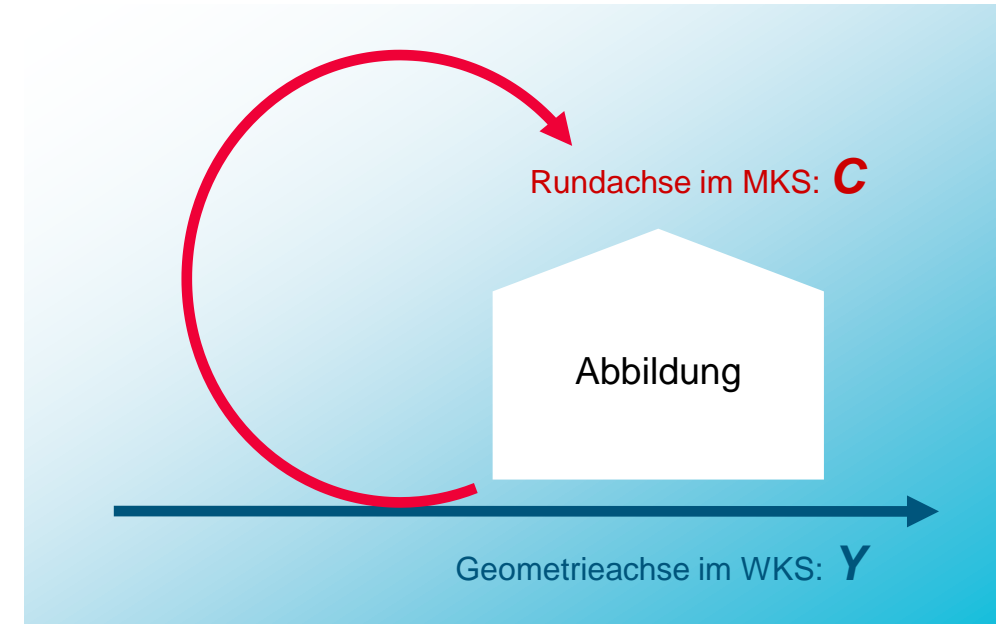
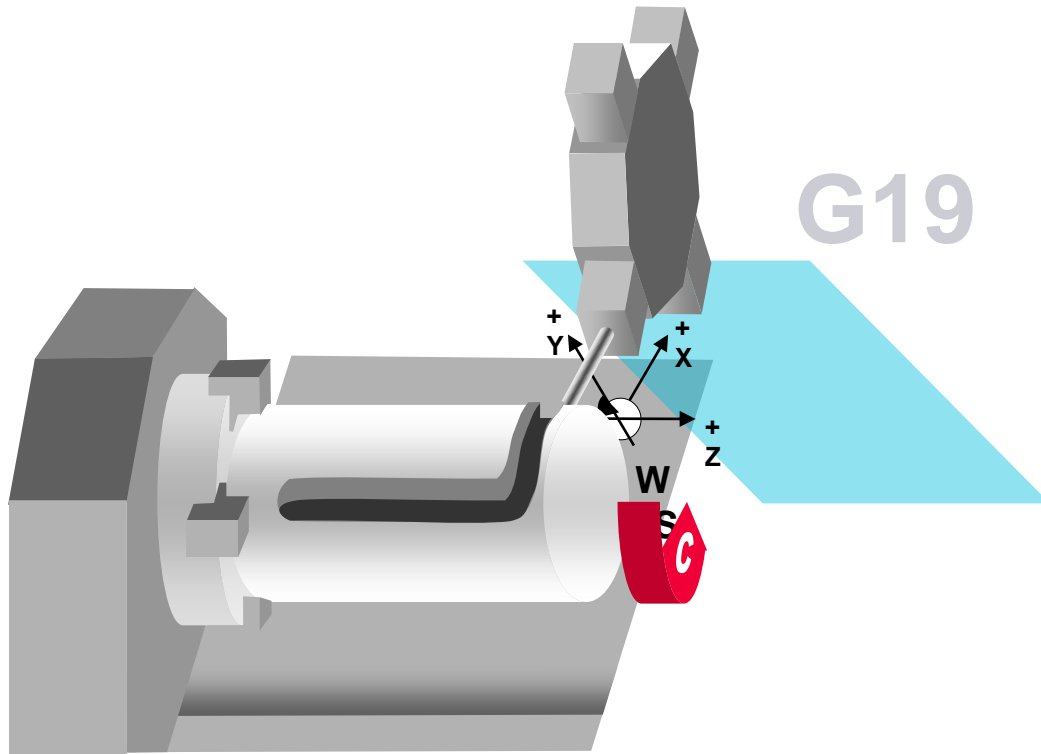
Machining on the cylinder surface



Programming takes place in the **Cartesian workpiece coordinate system**. The TRACYL transformation generates **motions in the machine coordinate system**, consisting of the rotation axis and two linear axes.

Cylinder surface transformation on the turning machine

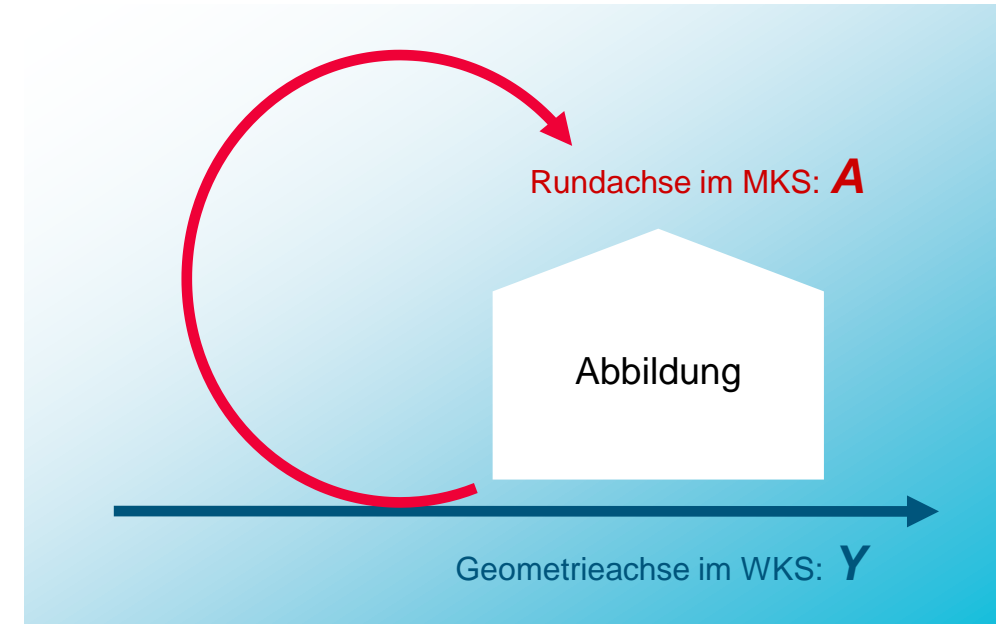
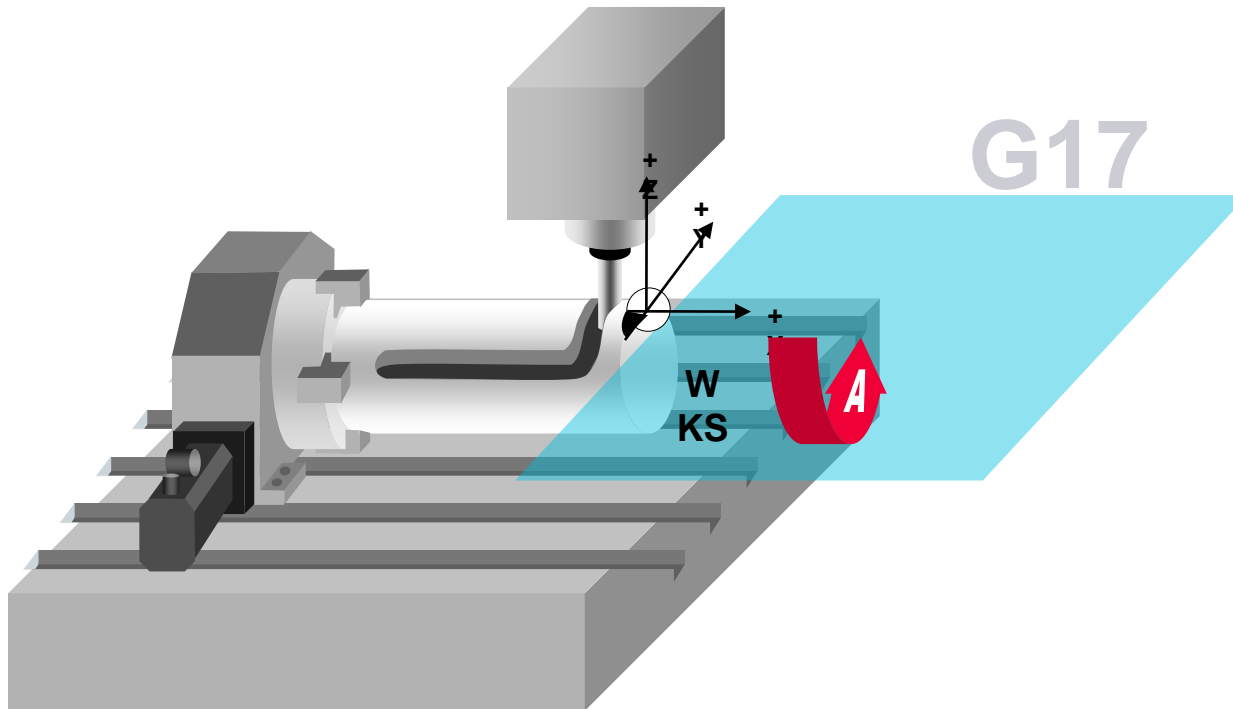
- with and without Y axis



Generally, **all turning machines with driven tools** are suitable for **cylinder surface machining**. However, a **Y axis** is required **in the machine** for cylinder surface transformation with **slot side offset**.

Cylinder surface transformation on the milling machine

- typically an A axis



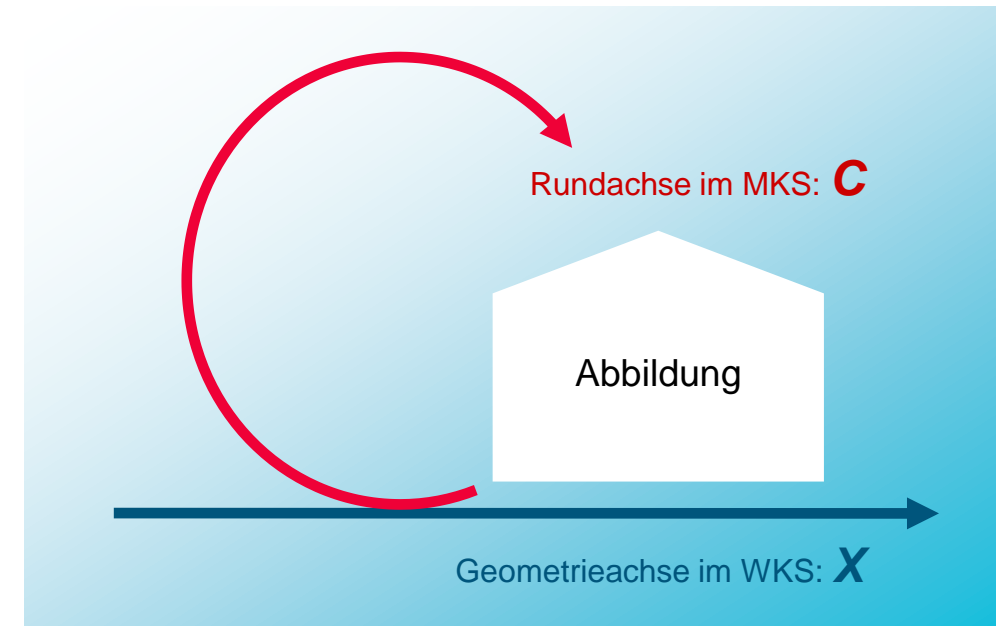
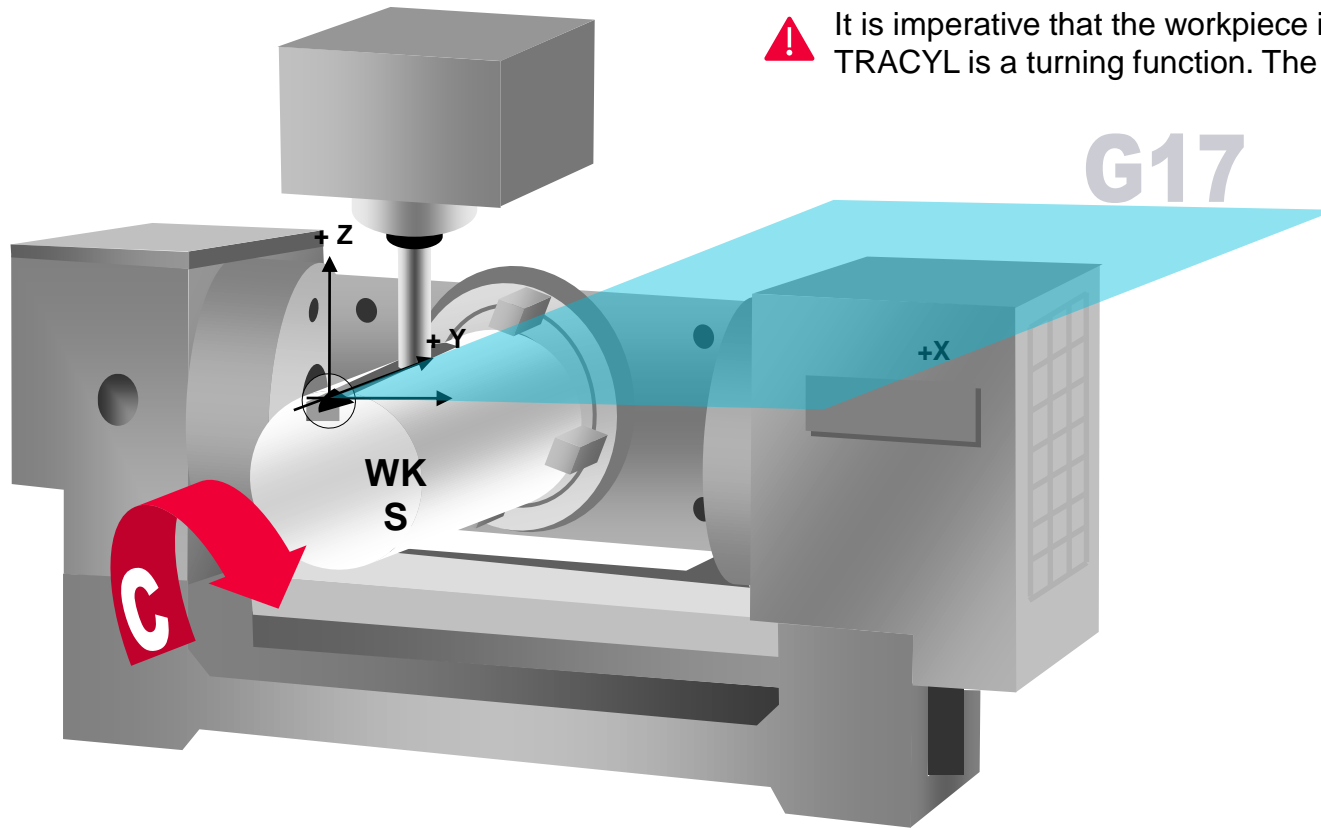
With the **installation of a dividing unit** (usually A axis), **cylinder surface machining** can be carried out on any commercially available milling machine. The **generally available 3rd geometry axis** (Y) automatically permits the **machining of parallel-walled slots**.

Cylinder surface transformation on 5-axis machines

- swiveling included



It is imperative that the workpiece is clamped centrally on the rotary table.
TRACYL is a turning function. The center point of the X / Y axes is the center point of the workpiece.

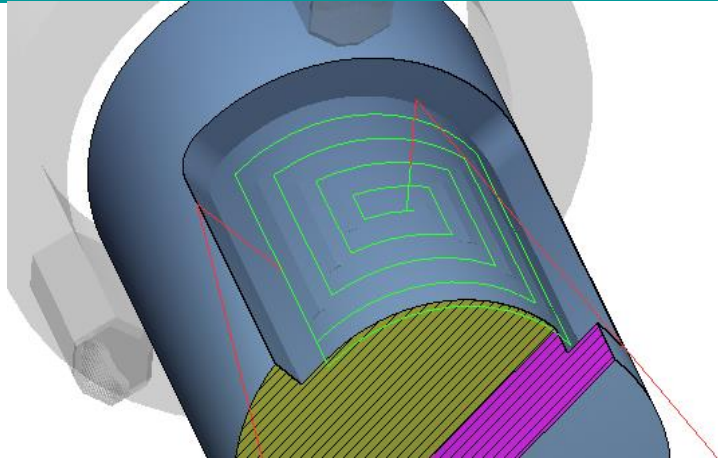


Machines with **rotary/swivel tables** or **mixed head/table kinematics** are suitable for **cylinder surface transformation**. The **"dragging" of the work offset** when swiveling the machining plane is an **advantage** when machining cylinder surfaces.

The basic types of cylinder surface transformation

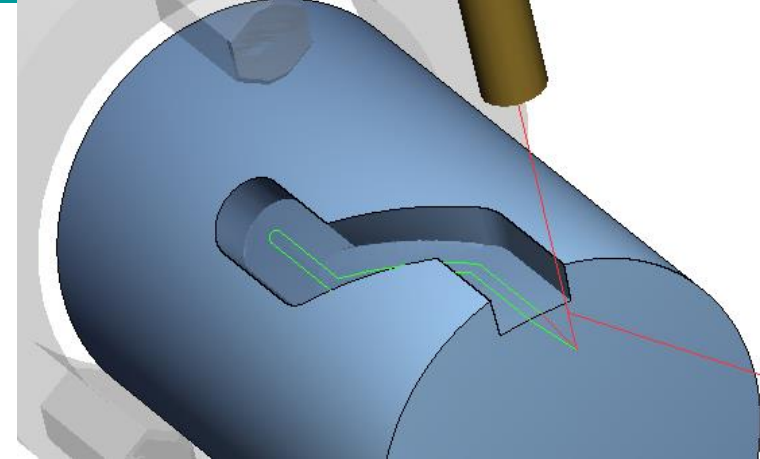
- with and without slot side offset

TRACYL without slot side offset



- Suitable for drilling and milling on the cylinder surface
- Milling with "curved" pocket base
- Requires two geometry axes in the machine in addition to the rotary axis

TRACYL with slot side offset



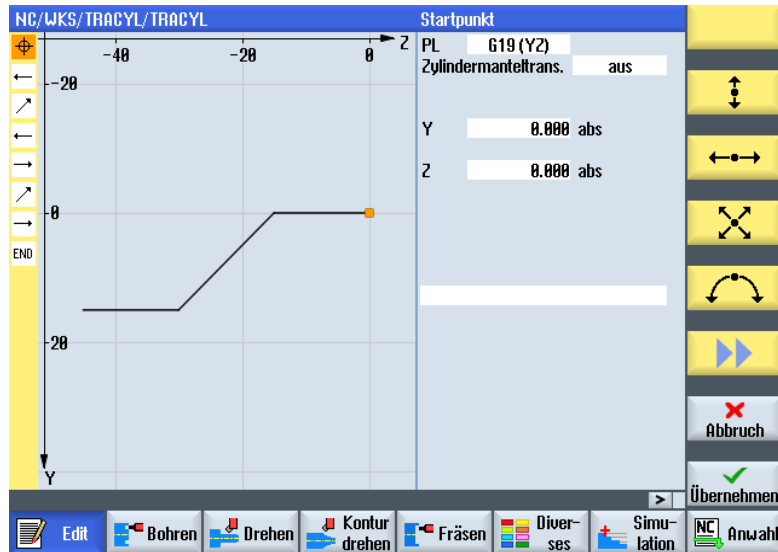
- Exclusively for machining parallel-walled slots
- Slots with "flat" slot base
- Requires a 3rd geometry axis in the machine

Thanks to **cylinder surface transformation**, any drilling and milling operations can be performed on the **surface of cylindrical workpieces**.

Programming the parallel-walled slot

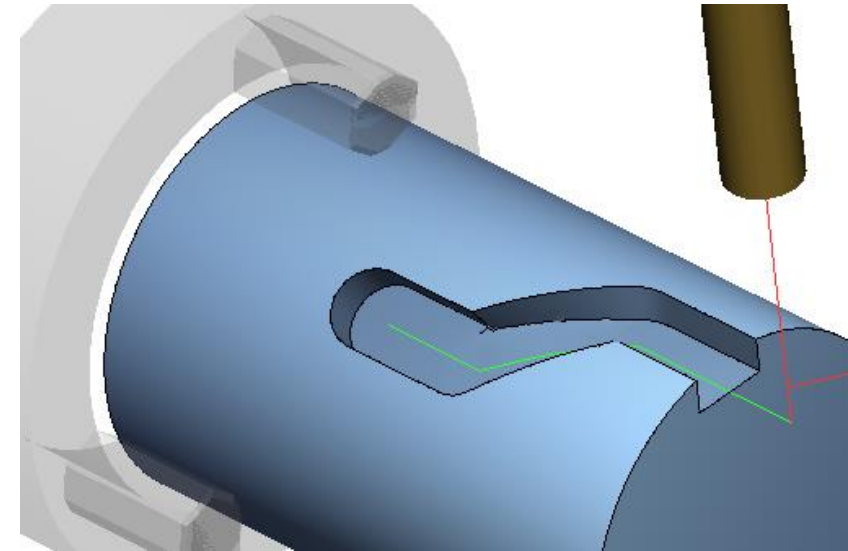
- always within line

Programming the center path of the slot



- Programming the center path forward and backward

The result



- Parallel-walled slot with flat slot base

For the production of parallel-walled slots, the **center path of the slot** is programmed.

Cutter radius correction

- the trick with the "pseudo milling tool"

```
TRACYL(50,2)
```

```
OFFN=5
```

```
G0 X50 Z10 Y0
```

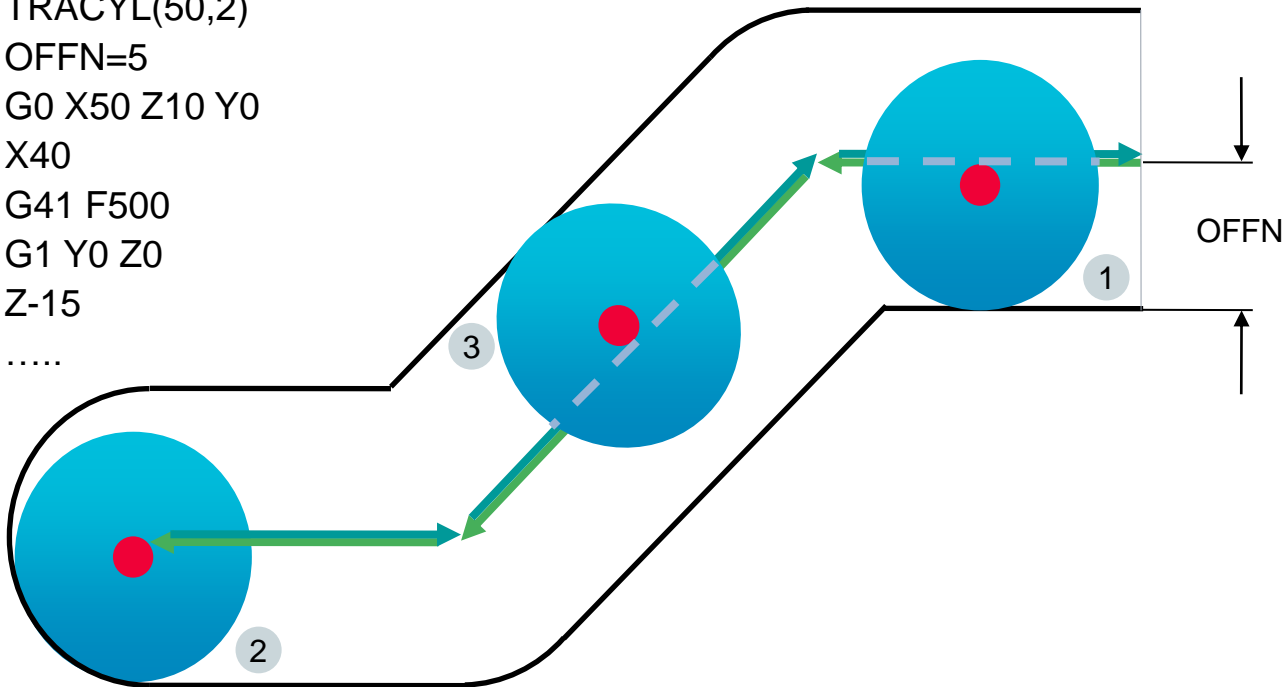
```
X40
```

```
G41 F500
```

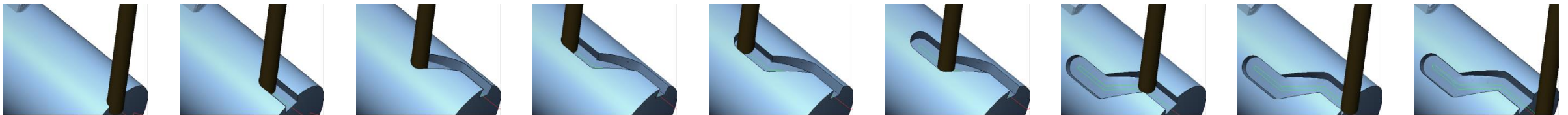
```
G1 Y0 Z0
```

```
Z-15
```

```
.....
```



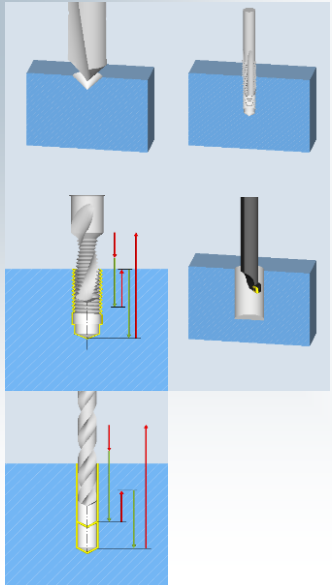
- The parameter OFFN corresponds to half the slot width
- The CNC calculates a small "pseudo milling tool" (red) from the difference between the slot width and the actual tool diameter.
- This "pseudo milling tool" traverses along the center path (In the example G41 → to the left of the contour)
- The real milling tool mills the left slot wall
- The center path must therefore be programmed forwards and backwards so that the slot is machined completely.
- The milling tool diameter must be approximately equal to the slot width (~90%) to achieve maximum machining accuracy.



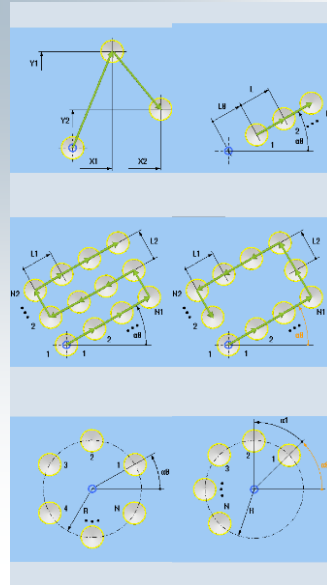
CNC programming

TRACYL for drilling – unrestricted drilling on the cylinder surface

Drilling

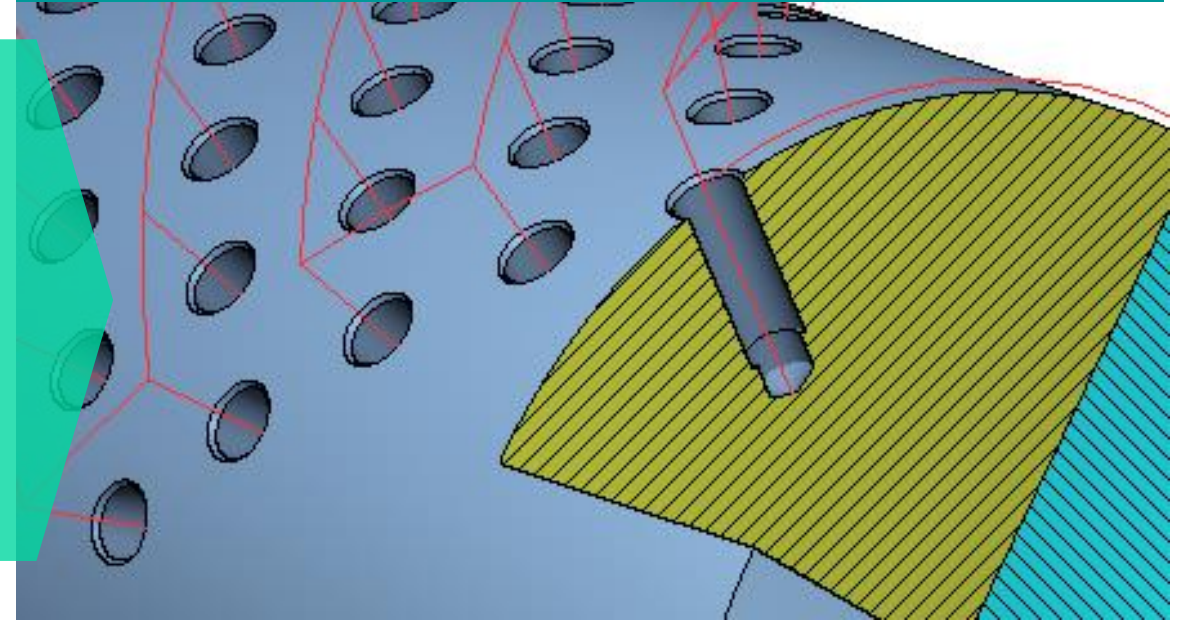


Position pattern



TRACYL

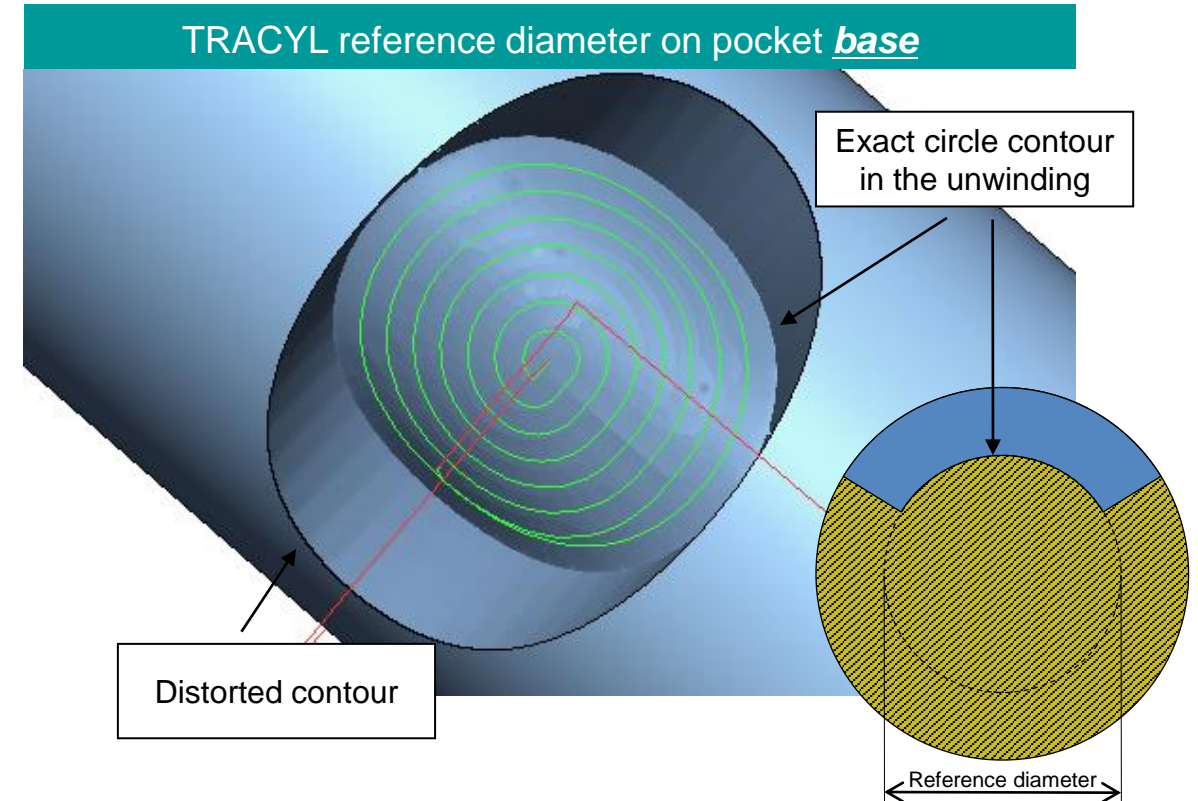
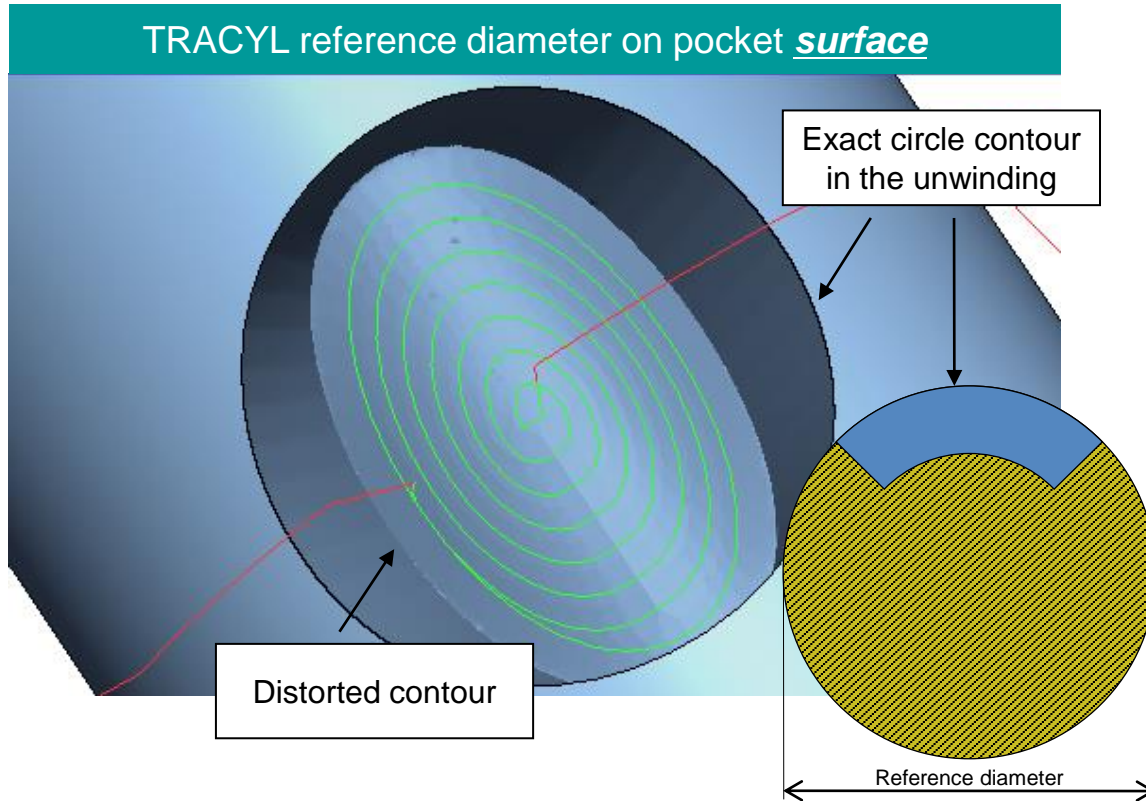
TRACYL – Drilling on the mantle surface



Drilling on the cylinder surface is a **pure radial movement** without any machining movements in the plane. Therefore, all drilling operations can be **used without restrictions**.

CNC programming

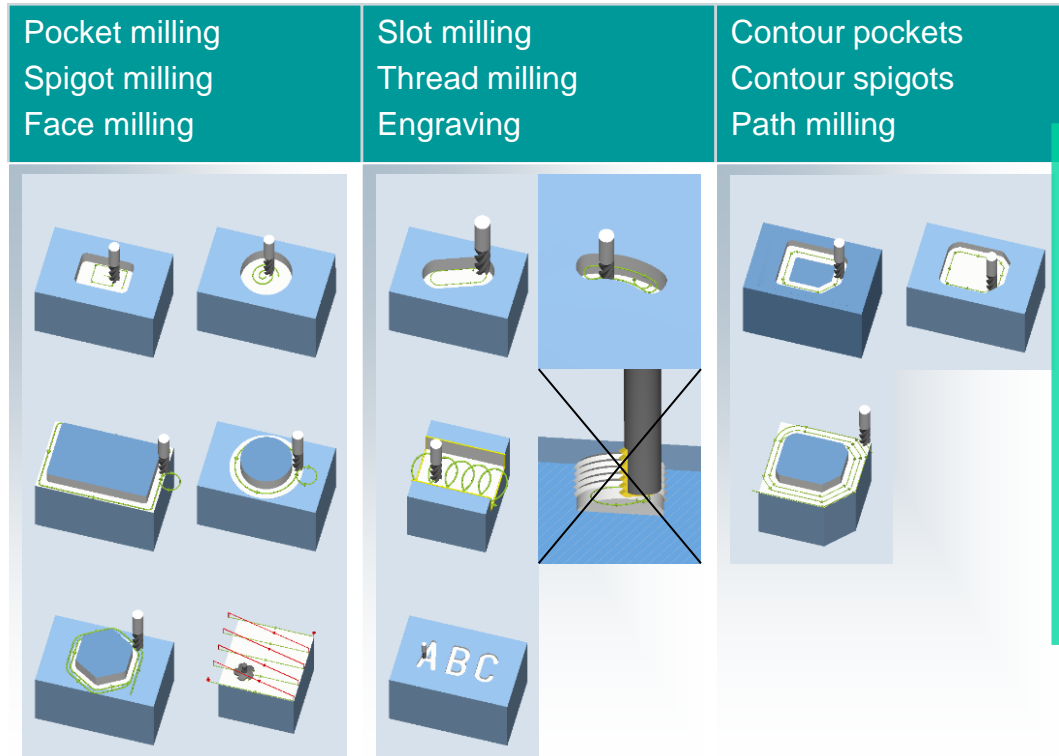
TRACYL for milling - a matter of point of view



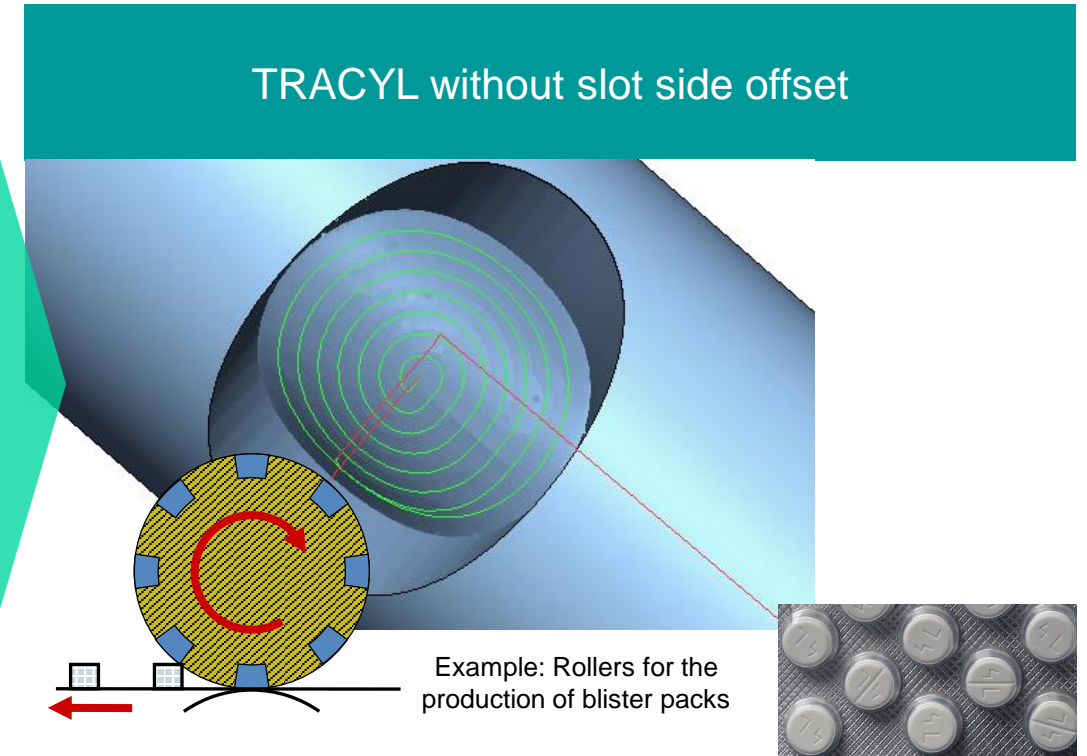
Machining in a **plane different from the reference diameter** inevitably leads to **distortion**. This must be **taken into account** when **determining the reference diameter** for the cylinder surface transformation.

CNC programming

TRACYL and milling cycles - in principle yes, but...



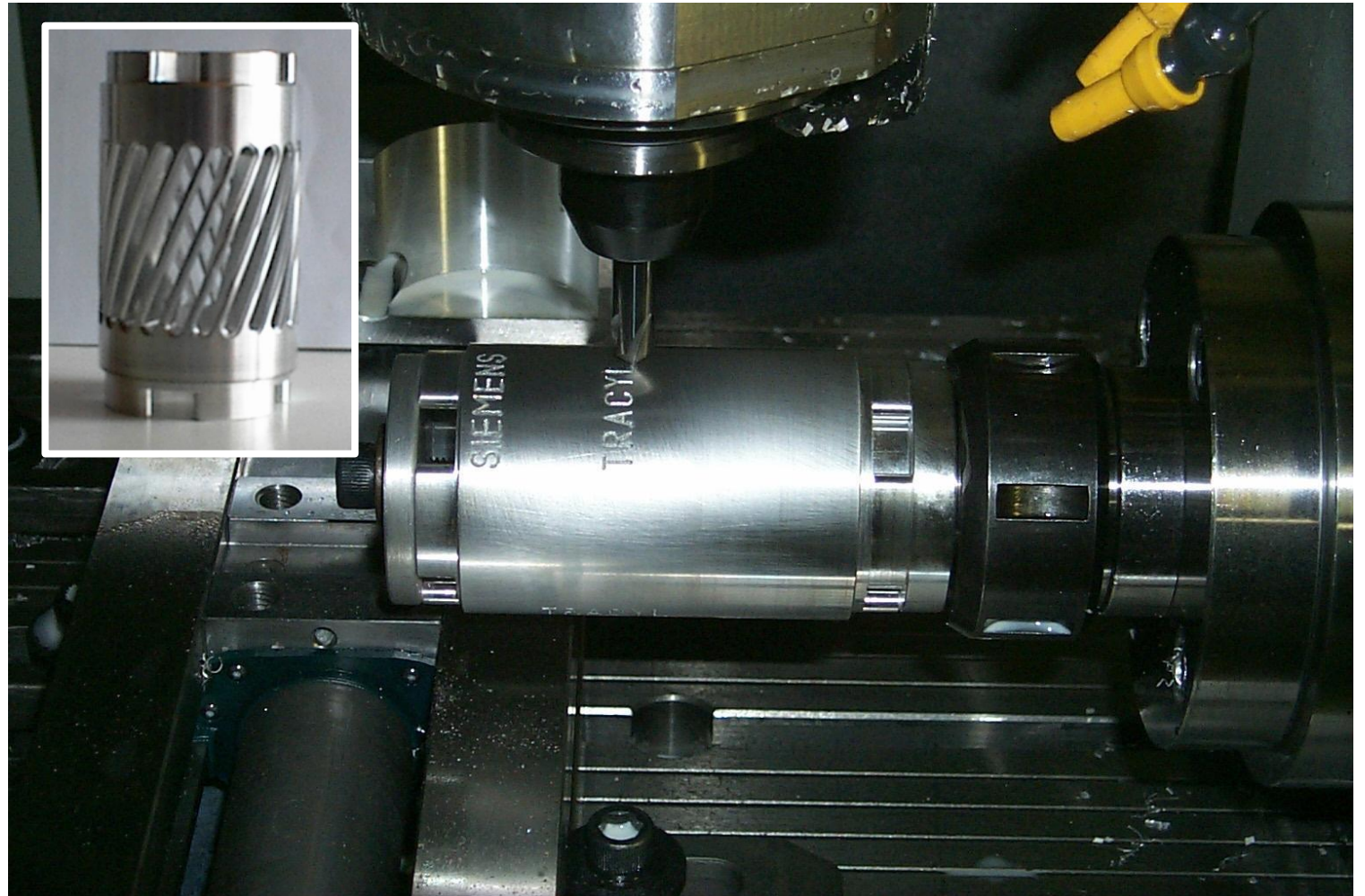
TRACYL



In principle, all **milling cycles** can be used for **cylinder surface machining** without slot side offset. However, due to the distortions in the milling pockets, **practical applications** are **limited**.

Summary

- Simple programming on the machine with Sinumerik Operate.
- Sinumerik Operate optimally supports programme creation with practice-oriented dialogs and informative help screens.
- For standard machining operations, but also for complex applications, operators have access to a wide range of cycles for machining or coordinate conversion
- Flexible use of the existing machine park of milling machines and lathes.
- Workpieces that require machining of the cylinder surface are usually complex and are therefore paid for accordingly well by the contract manufacturer's client. Due to the simple programming, for example without CAD/CAM, directly at the machine, these subcontracted orders can be processed efficiently.



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