

APPLICATIONS  
**POLYGON TURNING**

# POLYGON TURNING

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Polygon turning is a process through which flat planes are obtained on the part synchronising rotation of the spindle and the **live tool**. Polygon turning can be performed on our CMZ **CNC lathes**. It is an alternative process to milling each surface individually. It is more similar to **turning than milling**.

A **special tool** is necessary to perform this process. It is a cartridge with various cutting inserts. This cartridge is mounted on an arbour with a keyway, which is then mounted on a CMZ live axial toolholder. CMZ manufactures live axial toolholders for spindle and subspindle of up to **12,000 rpm** and with internal coolant (TL20/10400/06, TL20/10400/08,). There are also **specific toolholders for polygon turning** in which the cartridge is directly mounted, without the need to manufacture an arbour.

The relevance of the number of inserts on this cartridge together with the ratio of speeds between spindle and live tool is that it will create a different number of planes on the piece. The process can be carried out both for the main spindle and the subspindle.

The planes created using polygon cutting are **large radius curves** and for this reason **it is not recommended for milling that has strict flatness tolerances**. This process is generally used for hexagonal bolt heads and flat planes for clamping with a fixed wrench.

The polygon turning option is standard for CMZ's whole range of CNC lathes with live tools. It is not necessary for the lathes to have a Y axis.

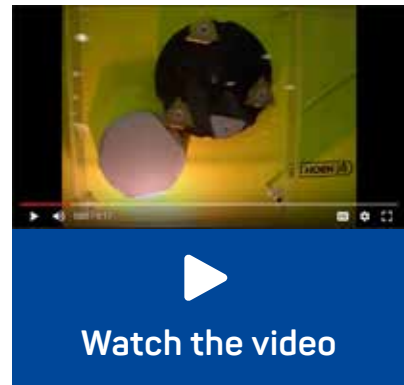


## PROCESS

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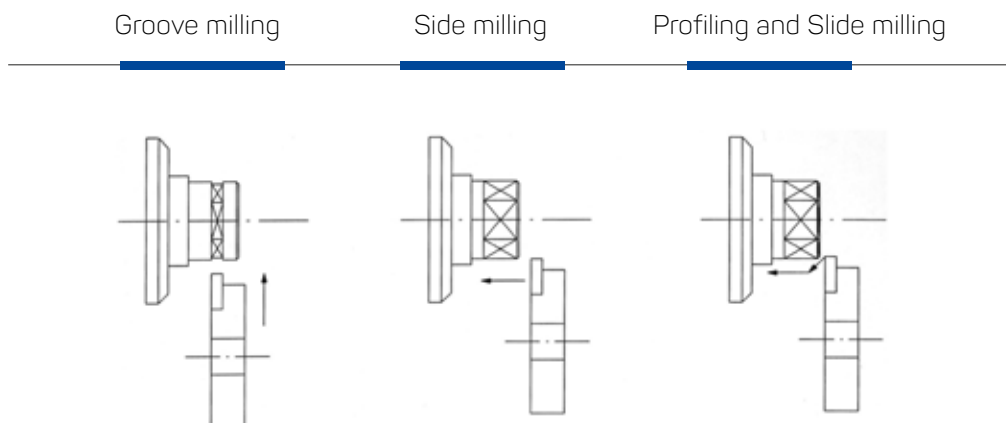
Polygon turning is a process where a **synchronisation** between **the spindle** and the **live tool** creates a **flat** in the workpiece. It is not a fully flat surface but a very convex one.

A **special tool** is required for the application. This cartridge needs to be mounted either on a custom-made arbour with a keyway that is later mounted on a CMZ live axial toolholder; or a special polygon cutting toolholder. Deliveries for polygon cutting toolholders are quite long (20-25 weeks).



There are two ways of cutting in the polygon turning process:

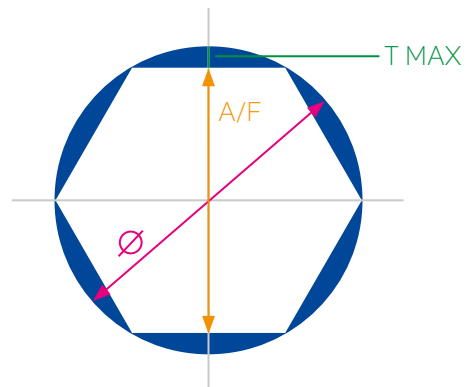
- ▼ **Groove milling:** it is similar to groove turning.
- ▼ **Side milling:** it is similar to standard turning (this process allows you to make chamfers).





In order to select the tool, it is important to take the difference between the OD and the A/F into account. This will define the T<sub>max</sub> dimension. If the difference is bigger than the T<sub>max</sub> value a collision will occur as the disc will hit the part.

Usually T<sub>max</sub> value is 5mm.



Polygon cutting tools can be left or right handed, this will define the sense of the spindle and live tool.



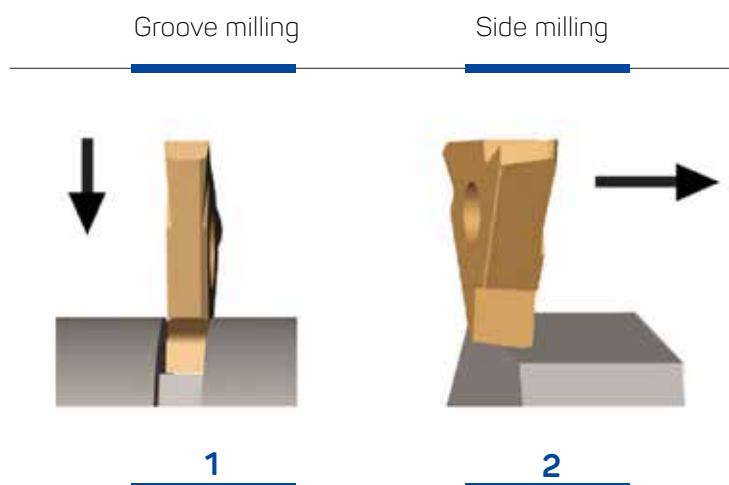
Left hand side



Right hand side

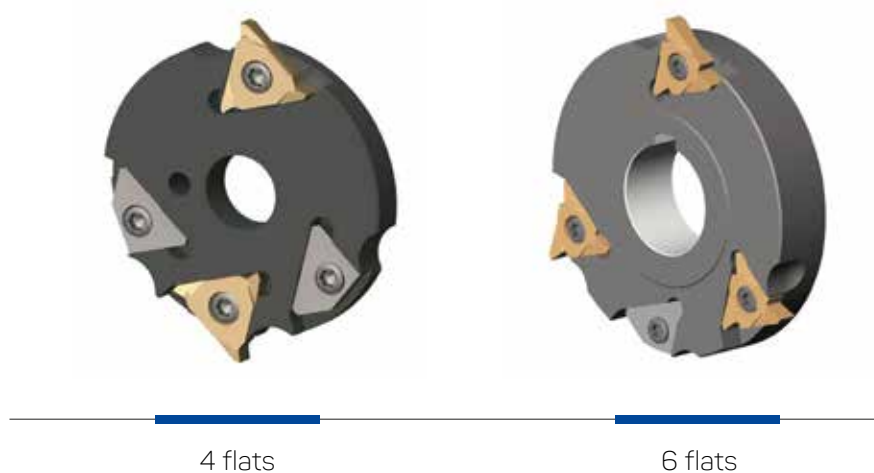
When selecting the insert, the polygon cutting type needs to be taken into account

- ▼ Grooving inserts
- ▼ Side turning inserts
- ▼ Versatile inserts (grooving and side turning)



The **number of flats** to be machined in the workpiece will define the **number of inserts to be mounted** in the cartridge.

Cartridges have several cavities to mount the inserts, insert have to be mounted in the correct position.



! Cutting conditions will depend on the material. However, when groove turning, cutting conditions need to be reduced around 30-50%, depending on the insert width. Please contact the tool manufacturer for adequate cutting conditions for your material.

# PROGRAMMING

To use the polygon turning you need to program the following codes:

**G97S\_**

**G51.2P\_Q\_R\_**

*"Machining program"*

**G50.2**

**G97S\_** (the spindle speed needs to be programmed before the cycle, M3/M4 will depend on the tool type used)






**G51.2P\_Q\_R\_** (call for polygon cutting)

The relation P\_Q\_ is usually 2:1

as it creates the best surface.

When Q1 live tool will rotate to the left and Q-1 to the right.

R allows to orientate the flats.

Form	No. of inserts on the cutter	Ratio = Tool:Spindel	Flats
	1	1 : 1	not suitable, heavily convex
	1	1 : 1 2 : 1	not suitable, convex very suitable, little convex
	3	1 : 1 1.5 : 1 3 : 1	not suitable, convex suitable, convex very suitable, little concave
	4	2 : 1 4 : 1	very suitable, little convex not suitable, concave
	5	1.66 : 1 2.5 : 1 5 : 1	suitable, convex very suitable, little concave not suitable, concave
	6	2 : 1 3 : 1	very suitable, little convex not suitable, concave
	8	2 : 1 4 : 1	very suitable, little convex not suitable, concave

*"Machining program"*

**G50.2** (end call for polygon cutting)

Manual Guidei has a cycle for polygon turning.

Turning cycles/ Special.

This cycle only allows for grooving type polygon turning.

**!**  
If polygon cutting is done in the subspindle or in a TX machine special programming is required. Certain parameters need to be changed in the program. Please contact CMZ for further information.

## EXAMPLE OF SIDE POLYGON CUTTING OF AN HEXAGON IN MILD STEEL

TA-25-YS  
 Machining in SP1  
 Turned diameter= 53,90mm  
 A/F=47,181mm  
 4 passes  
 Right hand side tool  
 Cartridge Horn R381.X090.27.04  
 Inserts Horn (Side turning) R314.MK50.20 Ti25

(POLYGON TURNING)  
 (T0909 Polygon turning)  
 T0909  
 M51(BREAK OFF)  
 M81(C AXIS OFF)

G97S450M4M8

G18

G0X53Y0Z-80

G51.2P1Q-2

G4X1

G1Z-110F0.15

G0X60

Z-80

X51

G1Z-109.7

G0X60

Z-80

X49

G1Z-109.6

G0X65

Z-80

X47.48

G1Z-109.5

G0X65

Z10

G50.2

G4X1

M09

G00G53X200Y0Z200

### Machining tips



- ▼ It is recommended to reduce the z lenght of each pass to avoid applying too much pressure in the insert.
- ▼ It is recommended to make an initial shallow pass and then make further deeper passes.
- ▼ Cutting depth recommendations are not to get deeper than 2,5mm in radius.
- ▼ Feed rate can be programmed in G98/G99

Polygon turning can be done in all our series equipped with live tooling:

## TA SERIES



Z400 MODEL



Z640 MODEL



Z1100 MODEL

## TX SERIES



Y3 MODEL



Y2 QUATRO MODEL

## TD SERIES



Z800 MODEL



Z1350 MODEL



Z2200 MODEL



Z3200 MODEL



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