Tornos Machining Macros
Machines ISO

Contents

1 Introduction

For some years now, Tornos has offered its customers its famous program sequencing macros *(G910, G912, G913, ...)* which automate a part cycle according to basic parameters such as: the part length, the bar diameter, the cutting tool number, etc..

Tornos is now going one step further, offering macros for its ISO machines that are referred to as "machining" macros and "unproductive" macros.

These macros can lead to:
- ➢ An enhancement in your machining possibilities
- ➢ Simpler and faster programming
- ➢ Secure processes
- ➢ A decrease in your cycle times

1.1 Enhancement in your machining possibilities

The machining macros enhance your machining possibilities and allow you to tackle more complex parts.
Certain macros may even avoid you having to purchase costly CAM software to perform machining by interpolation of the 3 axes (G960/G962).
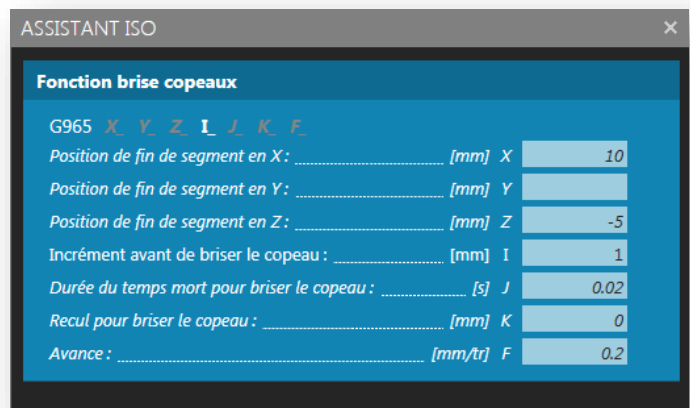
1.2 Simpler and faster programming

Your programming is much simpler and faster. You will no longer need to program machining over dozens or even hundreds of code lines. You will also no longer need to spend hours calculating a series of points.
A simple call of the macro G9xx followed by parameter arguments will suffice.

```
G965 X10 Z-5 I1 J0.02 K0 F0.2
```

Tornos macros teamed with the programming wizards of our "TISIS" software makes complex machining programming accessible to all.

ASSISTANT ISO		
Fonction brise copeaux		
G965 X_ Y_ Z_ **I**_ J_ K_ F_		
Position de fin de segment en X :	[mm] X	10
Position de fin de segment en Y :	[mm] Y	
Position de fin de segment en Z :	[mm] Z	-5
Incrément avant de briser le copeau :	[mm] I	1
Durée du temps mort pour briser le copeau :	[s] J	0.02
Recul pour briser le copeau :	[mm] K	0
Avance :	[mm/tr] F	0.2

1.3 Secured processes

Certain Tornos macros also allow you to secure your machining process, for instance by handling your chips better (G918/G965/G977), but also improving your tool movements during unproductive movements (G903/G980).
What's more, if the software detects an inconsistency in the macro parameters set, an alarm blocks program interpretation to avoid all risk of tool breakage.

1.4 Decrease in your cycle times

Certain Tornos macros also allow you to decrease your cycle time, for instance by optimising your tool approaches as much as possible (G980), by handling your chips better (G965) or by having perfect machining processes (G904/G977).

2 Machining macros

Machining macros are functions that allow you to machine part of your part by removing chips. Let's look at some of these macros.

2.1 Polygoning from the decentred position [G917]

The special geometries of the polygoning attachment may prove to be a problem for part polygoning.
This function is interesting when it is not possible to work on the material horizontally (on the X axis) owing to insufficient stroke.
This macro makes it possible to work on the material obliquely on 2 simultaneous axes (X and Y).
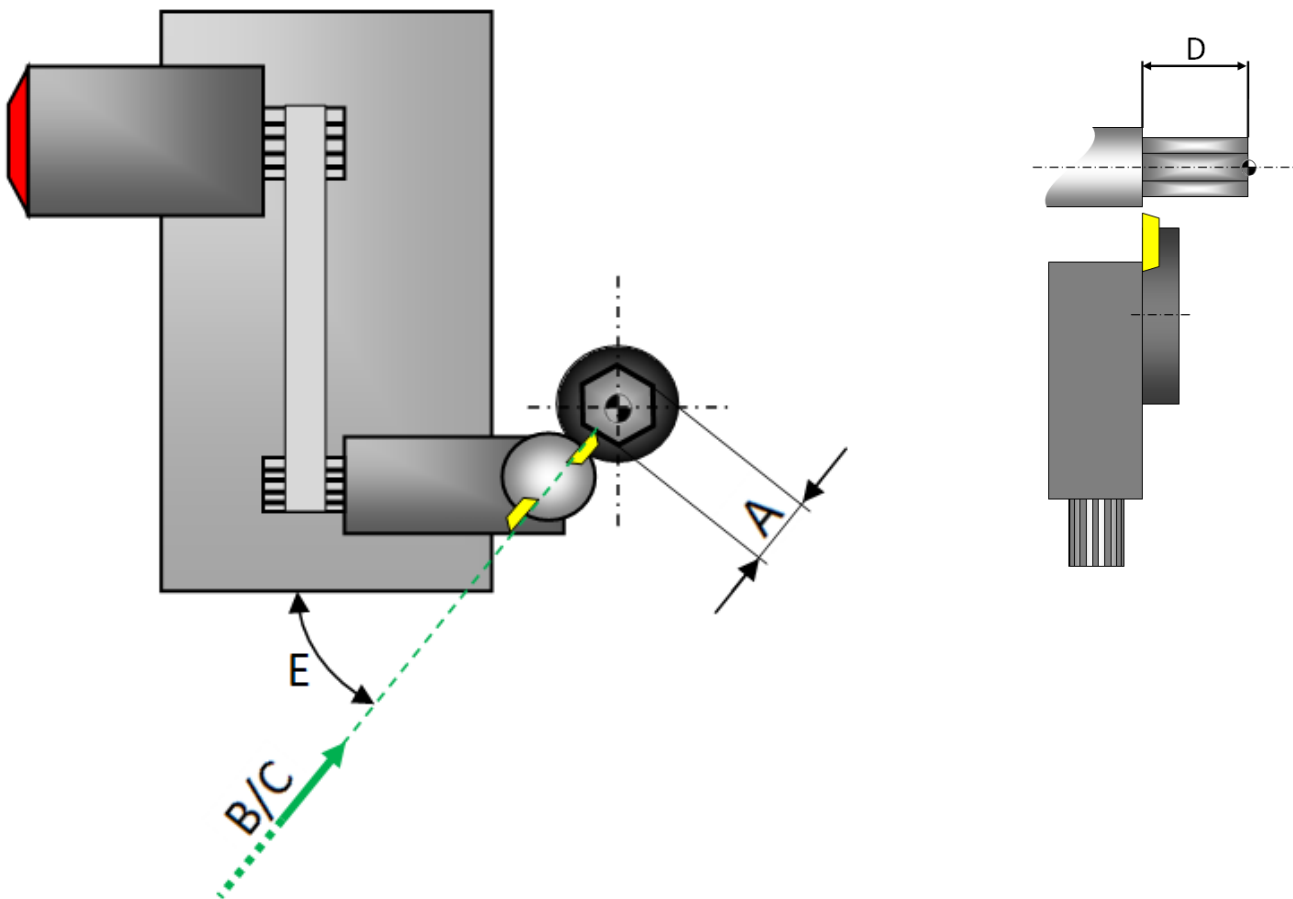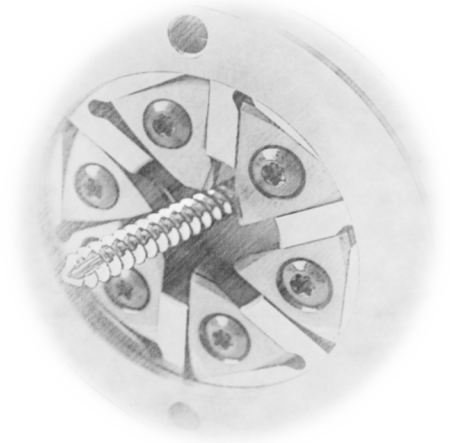
2.2 External thread whirling [G954]

This function makes it possible to machine an external thread using the thread whirling device. If allows you to program this machining very simply without having to make any calculations whatsoever.

__Why thread whirling?__
Materials that are difficult to machine, such as titanium and stainless steels for implants, require ideal and adapted cutting conditions. The shape of the threads intended for implants is generally specific to this domain and must not feature any burring. Once machined, the thread must be both very sharp and hard-wearing to allow perfect implanting in the bone matter without posing any risk for the patient. Thread whirling of threads authorises higher cutting speeds with respect to traditional threading operations. The different cutting edges engaged in the material at such high rotation speeds guarantee management of chips and of their shape, thus facilitating their evacuation.

2.3 Internal thread whirling [G960]

This function consists of powerful algorithms and it allows you to perform longitudinal, cross or inclined internal thread whirling with interpolation on 3 axes.
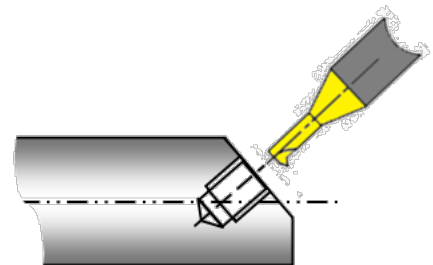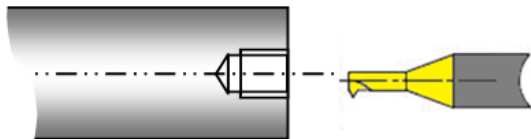
__Advantages of the process:__
- Weak cutting efforts
- Overall quality of the upper surface finishes
- Performance of the thread in a single stroke
- Perfect chip management (fine particles)
- Prolonged tool life and possibility of tool resharpening
*- Thread whirling length of up to 200 mm*
- No burring
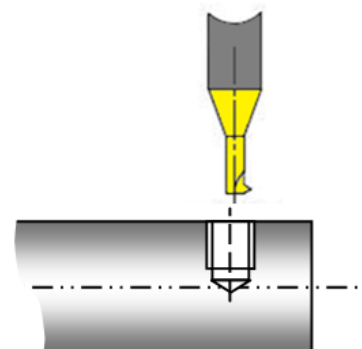
## 2.4 Milling for internal hexalobe print [G962]

This function makes it possible to perform internal hexalobe milling very simply.
The machining occurs with a micro mill at the end by interpolation of 3 axes (helicoidal plunge).
The macro works equally well when machining with the X-Y-Z axes as well as with the X-C-Z axes (polar coordinates).

You can choose the number of hexalobe prints directly according to standard 10664 or you can set the size and number of lobes yourselves for more specific applications.
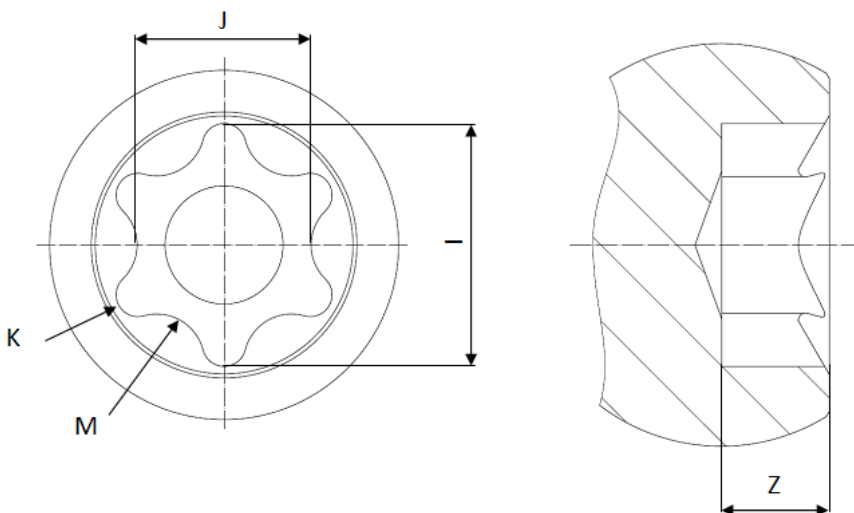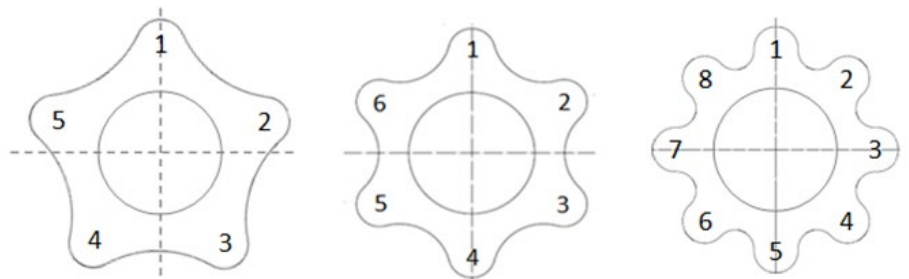
2.5 Chip breaker [G965]
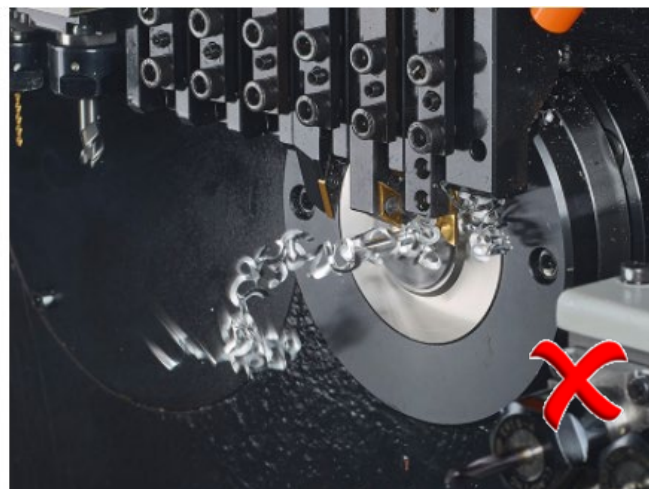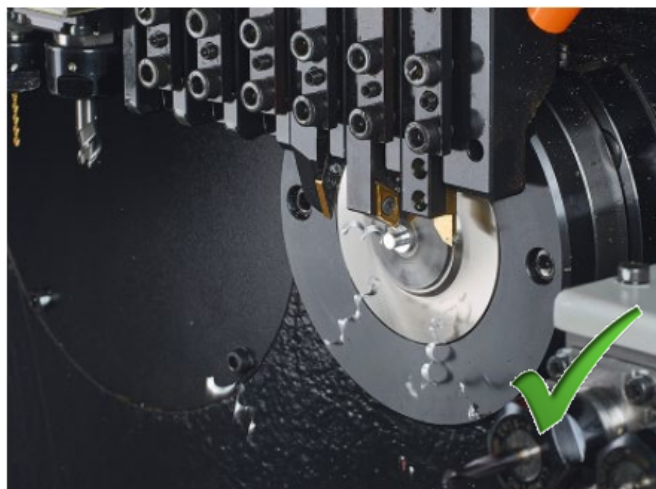
This function makes it possible to machine a linear segment by breaking the chip at regular intervals.

It works equally well for turning, drilling, milling operations, etc...

The fact that you can set the length of your chips is a major advantage, as it grants you, among other things:

> ➢ a reduced risk of fire
> ➢ a reduction in machine stoppages
> ➢ an increase in tool life duration
> ➢ an improvement in chip evacuation
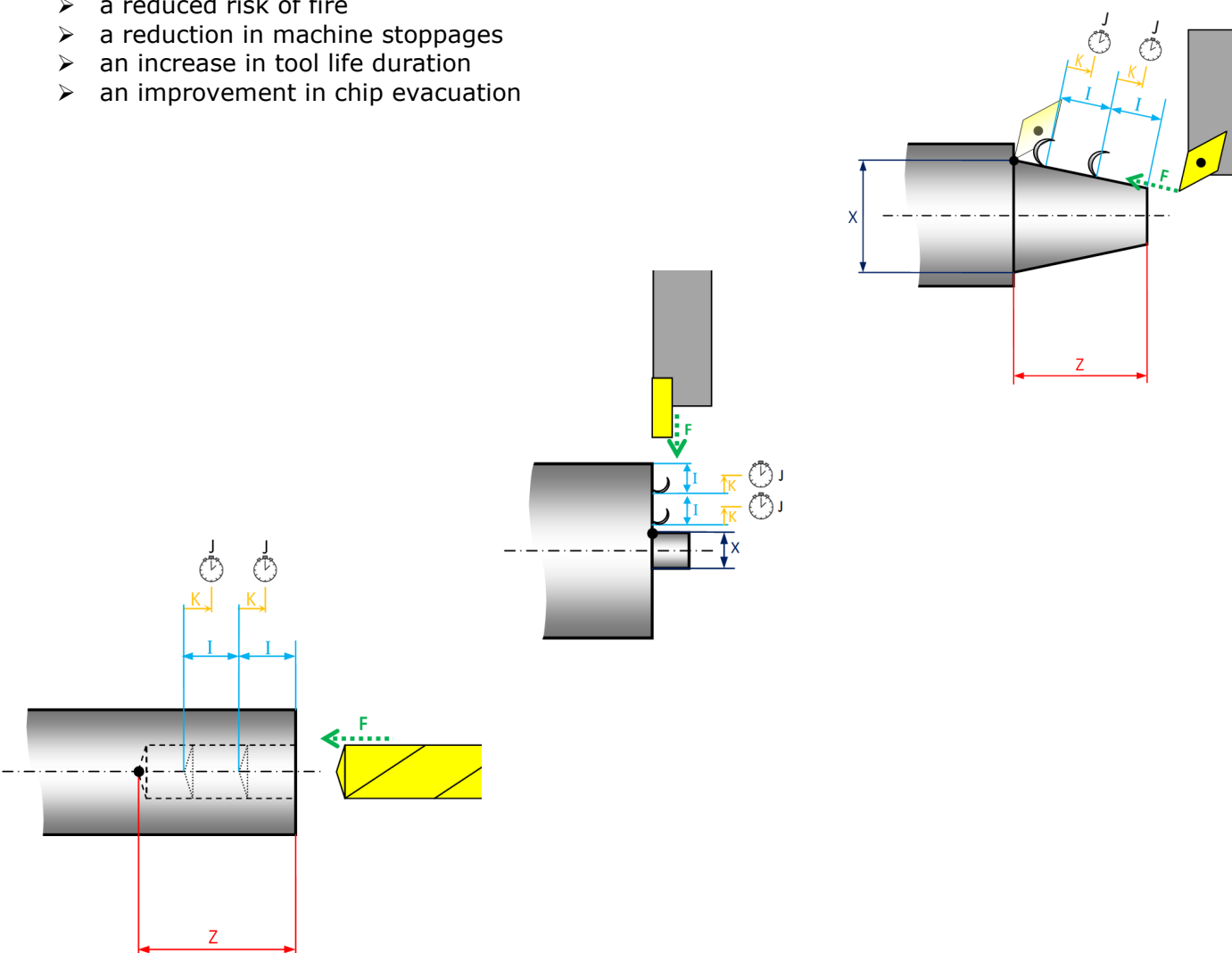
2.6 Drilling-deburring in progressive steps [G977]

This function is very interesting because, unlike the classic drilling-deburring cycle, it allows you to decrease the stroke depth progressively to ensure the straightness of your drilling, as well as optimum cycle time and extremely efficient chip evacuation.
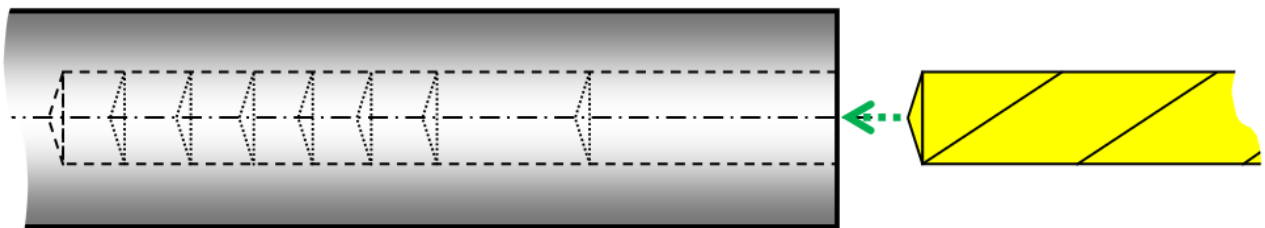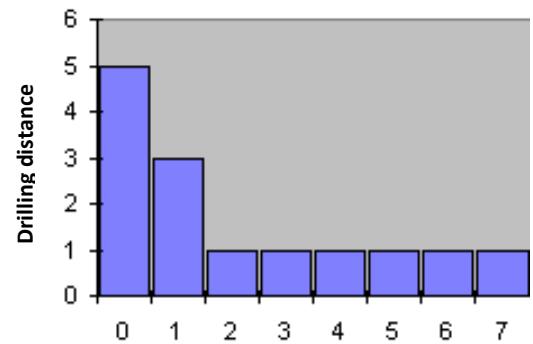
3 Unproductive macros

Unproductive macros are functions which do not generate any chips directly, but which prepare the machine for subsequent machining. Let's look at some of these macros.

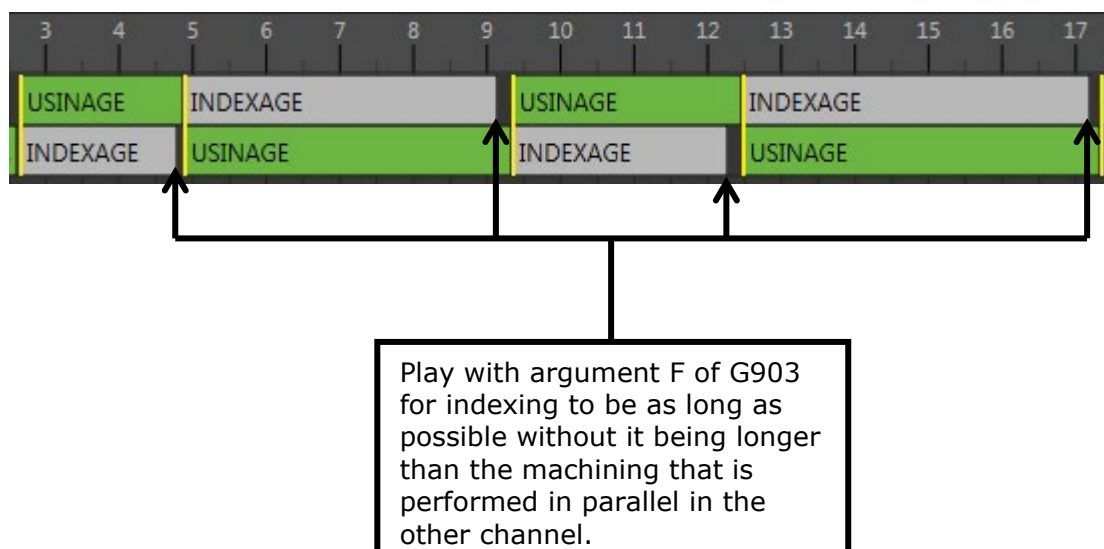## 3.1 Tool indexing by circular interpolation [G903]

On machines fitted with several independent tool systems, we recommend you index the tools in the second system while the first system is machining. This will allow you to have optimal cycle times. Having said this, this method poses the inconvenience of sudden movements in the machine when the tool is in the material. This last phenomenon may cause some marks on the part as well as premature wear of the tools used for machining.

Tool indexing using function G903 poses the advantage of smoothing the path of the axes and with a wisely chosen indexing feed, you can avoid juddering in the machine completely.

The other advantage of this method is that it considerably reduces the risk of collision during machine adjustment.

Indexing by circular interpolation   Traditional indexing
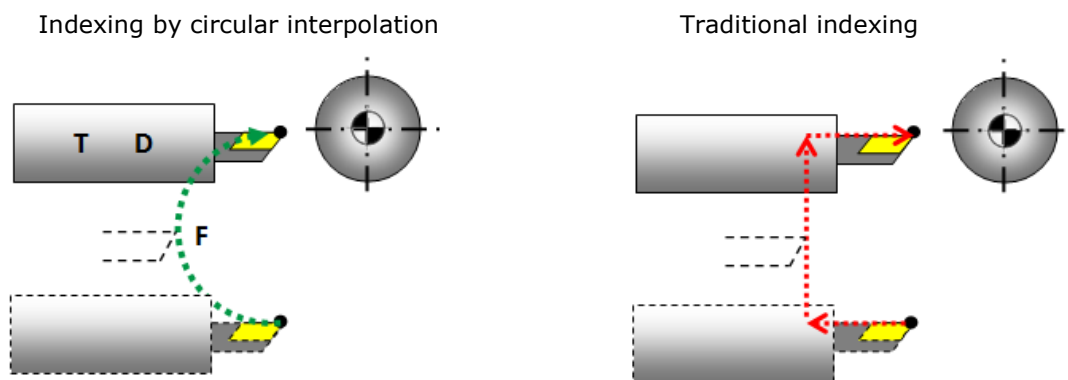
Please note that the Gantt diagram of the TISIS software allows you to determine very easily the ideal indexing feed in order to reach the machining position at the right moment.

Play with argument F of G903 for indexing to be as long as possible without it being longer than the machining that is performed in parallel in the other channel.

3.2 Operating mode: counter spindle on mainwork gang [G904]

This function activates a mode allowing work with the counter spindle on a mainwork gang tool, as if it were a backwork tool.
Once the mode is activated you can program your machining simply as if you were programming machining with a backwork tool.
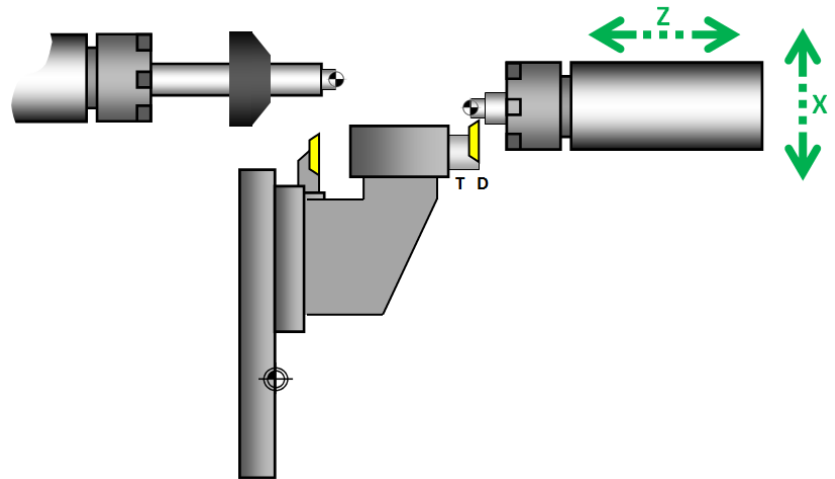

3.3 Early stop [G918]

This function makes it possible to perform programmed stops at regular intervals.
It is sometimes useful to stop cycles, for instance every 200 cycles, when manual intervention by the operator is required to remove chips from inside the machine.
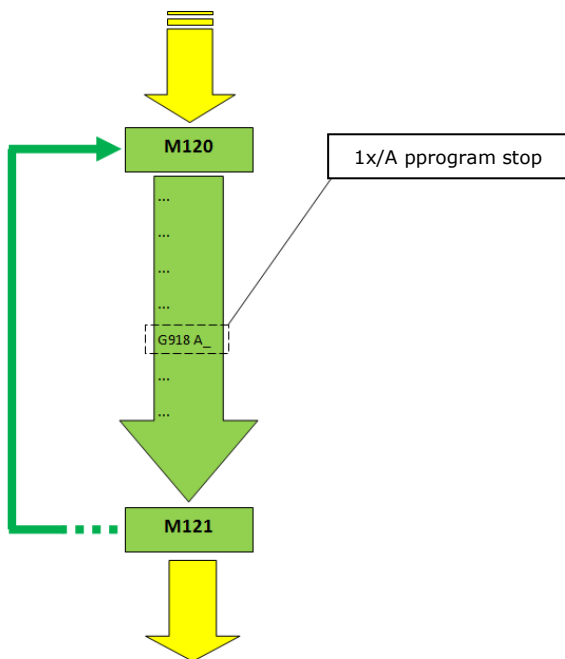

If you have the "Connectivity Pack" option, you will be informed directly on your PC or smartphone that your machine has stopped and is awaiting human intervention to remove the chips.

3.4 Double tool approach position [G980]

This function allows you to have two different tool approach positions between the adjustment phase and the production phase of your machine. The switch from one phase to the other is possible by a check box on the CNC screen (T-MI).
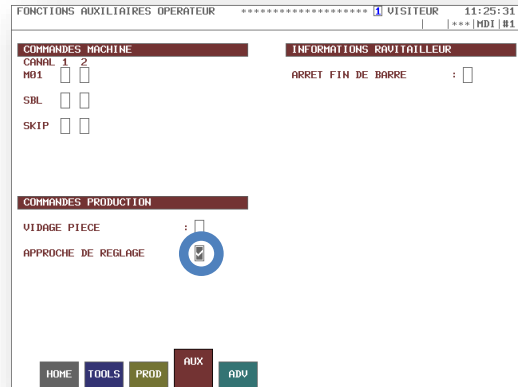
This principle allows you to position your tools extremely close to the rapid-feed material, without risking contact thanks to a more distant approach when you are adjusting your tools.

Approach position in setting mode
Approach position in production mode
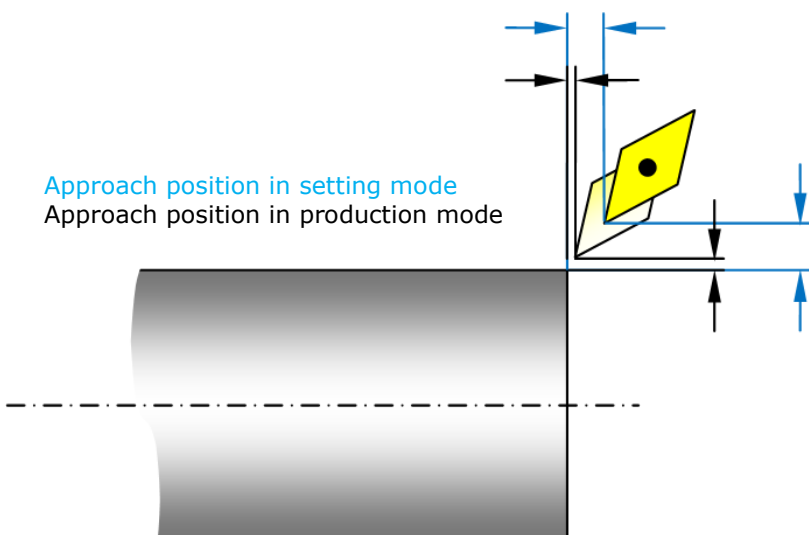
4 Future Tornos macros

To offer additional opportunities to its customers at all times, Tornos has already envisaged developing the following macros:
  ➢ Internal hex screw milling
  ➢ Elliptical milling (bent implant)