M552

General geometry basics

1 Brief description

Objective of the module:

Working through this module you learn to understand the programming planes and also how to specify points in a DIN conforming coordinate system.

Description of the module:

This module explains the assignment of the axis and plane descriptions to the coordinate system of the machine and also teaches the definition of points in relation to the work space.

Content:

Right hand rule

Explanation of the axis assignments

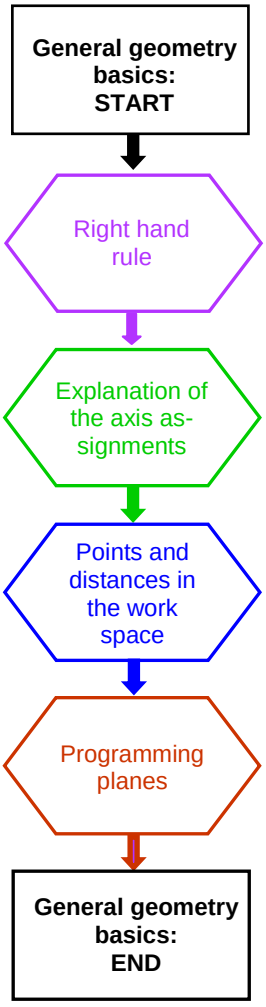
Points and distances in the work space

Programming planes

828D/840Dsl SINUMERIK Operate

General geometry basics: Description

This module explains the assignment of the axis and plane descriptions to the coordinate system of the machine and also teaches the definition of points in relation to the work space.



Notes

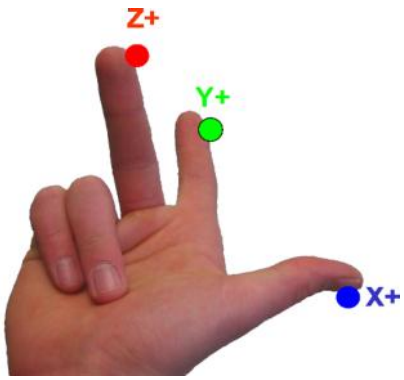
Notes

Explanation:

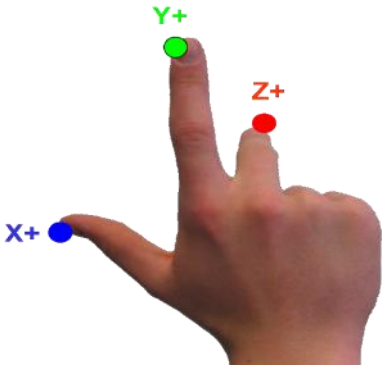
According to DIN standard the various axes of motion within work space of CNC machines are addressed by alphabets. The rules for the assignment of the axes are determined in this DIN-standard.

The machine coordinate system that is derived from the DIN-standard is the base for the geometrical description of work pieces which allows us to clearly determine the points in a plane or in space.

The cartesian (rectangular) spatial coordinate system can be best described with the **"Right hand rule"**. Here the fingers of the right hand represent the axes: "X" (thumb), "Y" (first finger) and "Z" (middle finger). The finger tips point in the positive direction.



Vertical turning machine



Horizontal milling machine

The position of the machine coordinate system is specified by the machine manufacturer keeping the following in mind:

Definition of axis according to DIN-standard:

- **Z-Axis**: Is aligned parallel to the working spindle or coincides with it. The positive direction points away from the work piece. In case of more than one spindle, one of them will be declared as the main spindle.
- **X-Axis**: Is aligned parallel to the set-up plane or coincides with it. If the Z-axis is vertical, the positive X-axis is directed towards the right. If the Z-axis is horizontal, the positive X-axis is directed towards the left.
- **Y-Axis:** Is perpendicular to the **X-** and **Z**-axis, in such a way that a spatial cartesian coordinate system results.

The direction "**FROM**" the work piece "**TO**" the tool is "**PLUS**"

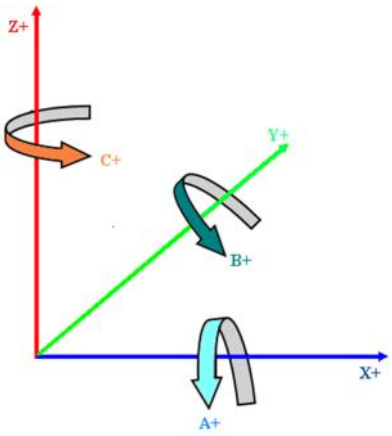
The tool movement is "**ALWAYS**" to be programmed!

Notes

Explanation as per DIN 66217 or ISO 841:

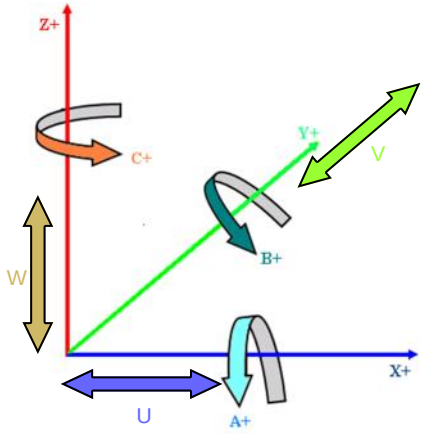
However defining only three axes is not enough on modern machine tools. For instance if the milling head of a milling machine is to be swivelled by a certain angle or the quill of a tailstock is to be moved, a further definition of these axes is required.

The DIN standard provides the following variants for such cases.



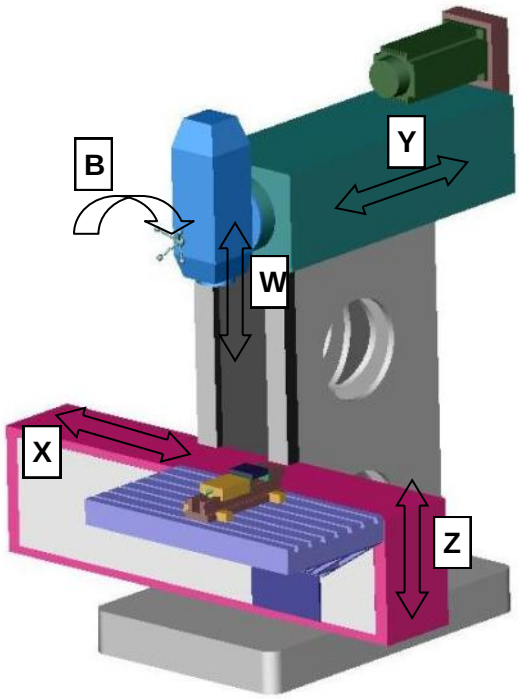
Here the rotational axes A/B/C are associated with the X/Y/Z axes.

Looking in the positive direction of the linear axis, a clockwise rotation equals a positive rotation of the associated rotary axis.



The axes U/V/W are parallel to the axes X/Y/Z.

The positive direction is that of the associated main axis.



Notes

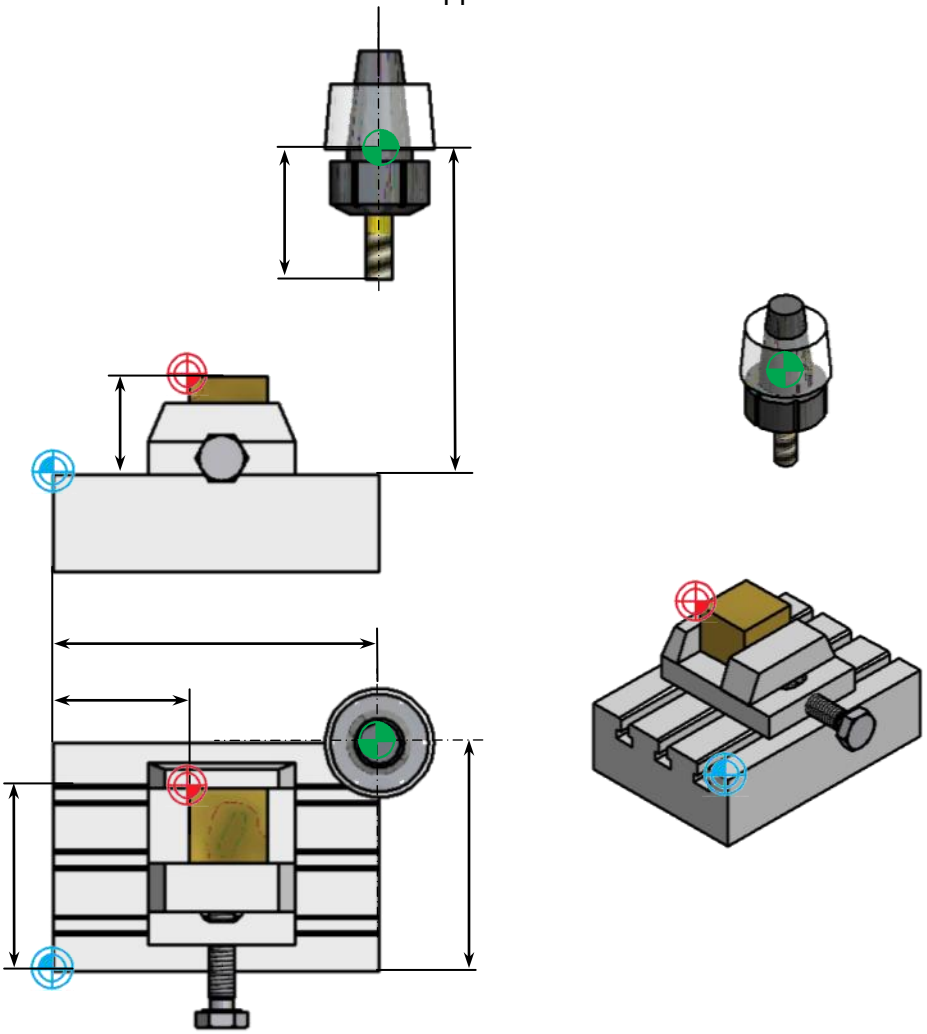
Explanation:

For the determination of all points within the work space, the control unit requires a zero point of the coordinate system. This has been determined by the machine manufacturer. All other points have either fixed distances from the machine zero point or else the distance must be defined.

The **machine zero point** (M) is determined by the machine manufacturer and cannot be altered. On milling machines point is usually set on the work table, and on turning machines on the spindle flange.

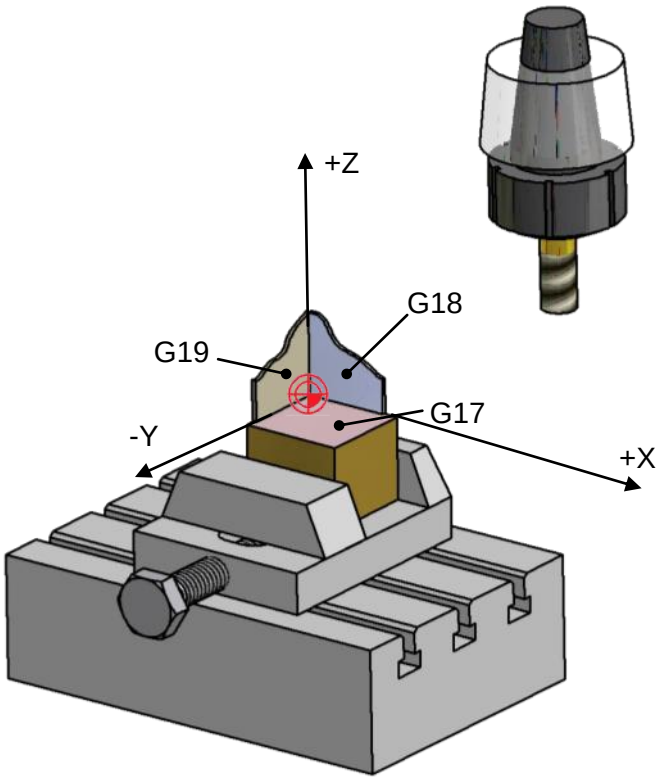
The **work piece zero point** (W) is the origin of the work piece coordinate system. This can be specified by the programmer and should always be chosen in a way that the least calculation work is required to determine points on the contour given the dimensioning of the drawing. For turning work it lies mostly on the turning axis and the right hand planar face.

The **reference point** (R) is approached for initializing the path measuring system, which means that at this point all axes are set to zero. This is necessary since generally speaking the machine zero point cannot be approached.



Notes

Continuous path control units can control slides and tool carriers simultaneously along 2 or more axes at a programmed feed rate. For this the speed of the individual drives must be matched to one another. This job is taken over by the interpolator of the CNC-control unit. This is a software program for the evaluation of intermediate positions and speed conditions of the individual axes such that the slides can follow the programmed path. Starting with a 2 ½-D Continuous path control unit the interpolation can be switched between the three different planes.



A selection of **the plane** is made with the associated programming instruction:

- XY-Plane - programming command **G17**
- XZ-Plane - programming command **G18**
- YZ-Plane - programming command **G19**

Note:
The standard plane being used for working with CNC-Turning machines is G18. With CNC-Milling machines the programming plane G17 is being used.

The working plane should either be programmed at the beginning of the NC-program, or before programming an operation in the relevant working plane.

The active programming plane is modal and remains active until changed by another programming instruction.