

Mechanical Workshop AMEW 101

CNC

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CNC DEFINITIONS

- **Computer Numerical Control**
- **The idea of computer numerical control is to position a computer right at the machine tool. Most, if not all machine tools that are numerically controlled are CNC machine tools.**

What are the advantages of CNC?

- **Greater accuracy and repeatability**
- **More complex part geometries are possible**
- **Flexibility**
- **Inspection requirements are reduced**
- **Lower operator skill requirements**

What are the disadvantages of CNC?

- **Higher investment cost**
- **CNC machines don't program themselves**
- **High maintenance cost**
- **Not cost effective for low production levels**

Two Types of Positioning

- **Absolute positioning**
Locations are always defined with respect to origin
Locations are always defined with respect to origin of axis system
- **Incremental positioning**
Next location is defined relative to present location

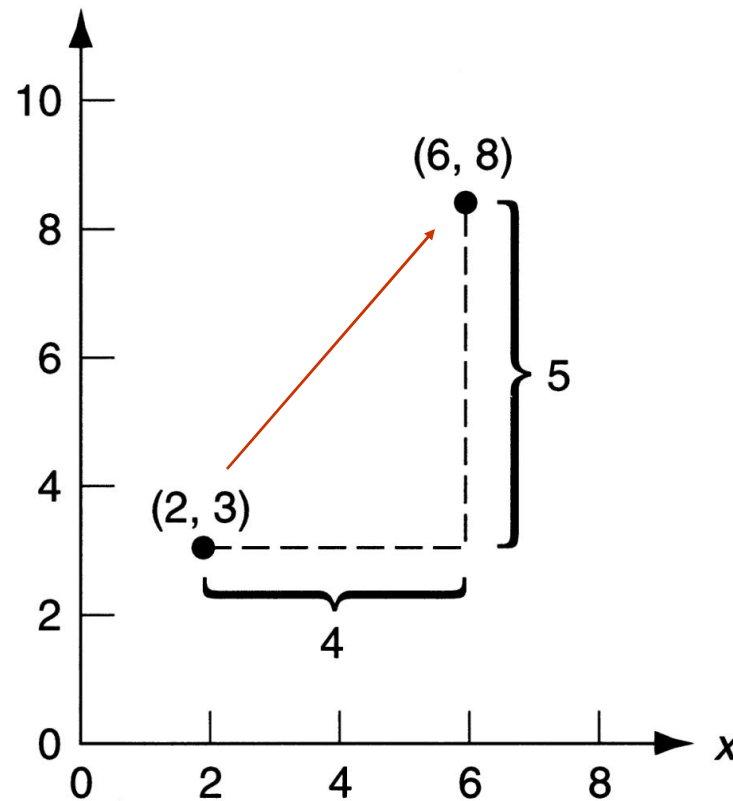
ABSOLUTE MODE

- **When Working From Program Zero, You Are Programming In The ABSOLUTE MODE.**
- **G90 Specifies The Absolute Mode.**

INCREMENTAL MODE

- **In The Incremental Mode, Movements Are Given From The Tool's LAST POSITION.**
- **G91 Specifies The Incremental Mode**

Absolute vs. Incremental Positioning



**The workhead is presently at point (2,3) and is to be moved to point (6,8).
In absolute positioning, the move is specified by $x = 6$, $y = 8$.
In incremental positioning, the move is specified by $x = 4$, $y = 5$.**

Advantages of the Absolute Mode

- **Coordinates are Easier To Calculate**
- **Programmed Coordinates Make Sense**
- **Mistakes Are Not Compounded**

CNC Programming

- **O Program Number**
- **N Sequence Number**
- **G Preparatory Function**
- **X X Axis Coordinate**
- **Y Y Axis Coordinate**
- **Z Z Axis Coordinate**

CNC Programming

- **A/B/C Rotary Axis**
- **R Radius**
- **I/J/K Circle Center Coordinates**
- **F Feedrate**
- **S Spindle Speed**
- **T Tool**
- **M Miscellaneous Functions**

G-Codes

- **G00 Rapid traverse positioning**
- **G01 Feedrate Movement Linear**
- **G02 Feedrate Movement Circular clockwise**
- **G03 Feedrate Movement Circular counterclockwise**
- **G90 Absolute Coordinates**
- **G91 Incremental Coordinates**

M-Codes

- **M00 Pause**
- **M02 or M30 End of Program**
- **M03 Spindle Motor on**
- **M05 Spindle Motor off**
- **M06 Tool Change**

CNC or Part Program

- **Example command for linear motion:**

N10 G01 X70 Y85.5 F175 S500

N10 = a sequence number

G01 Linear motion

X and Y = Coordinate positions (mm)

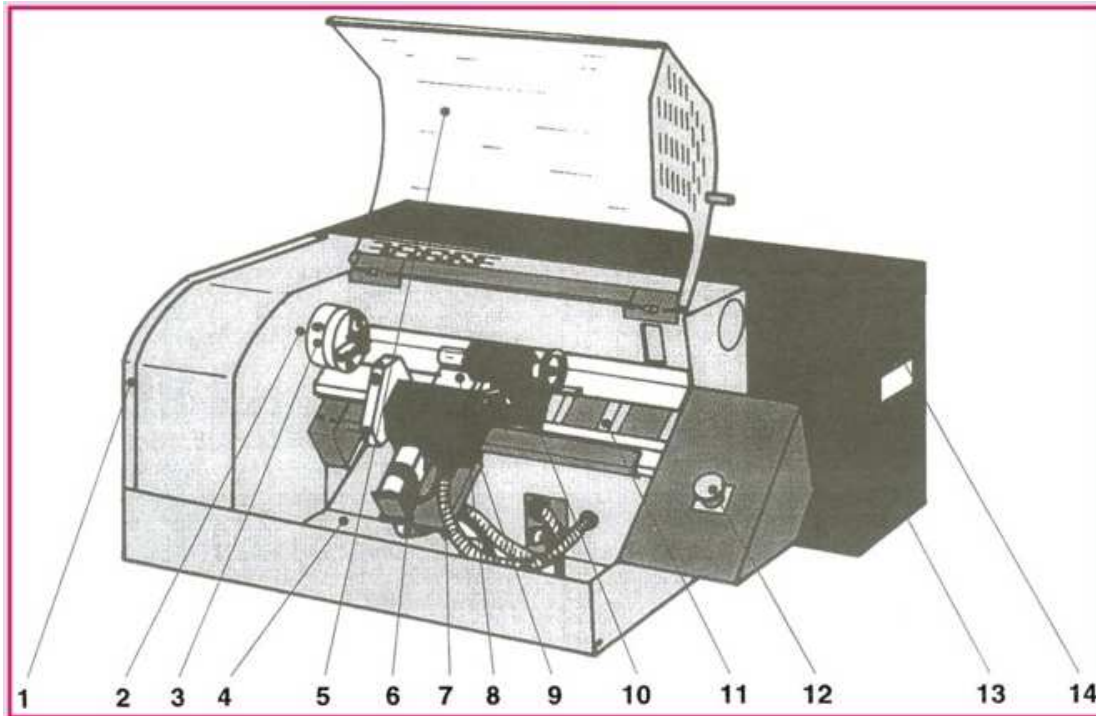
F = feed rate (175 mm/min)

S = spindle speed (500 rev/min)

Computer Numerical Control (CNC)



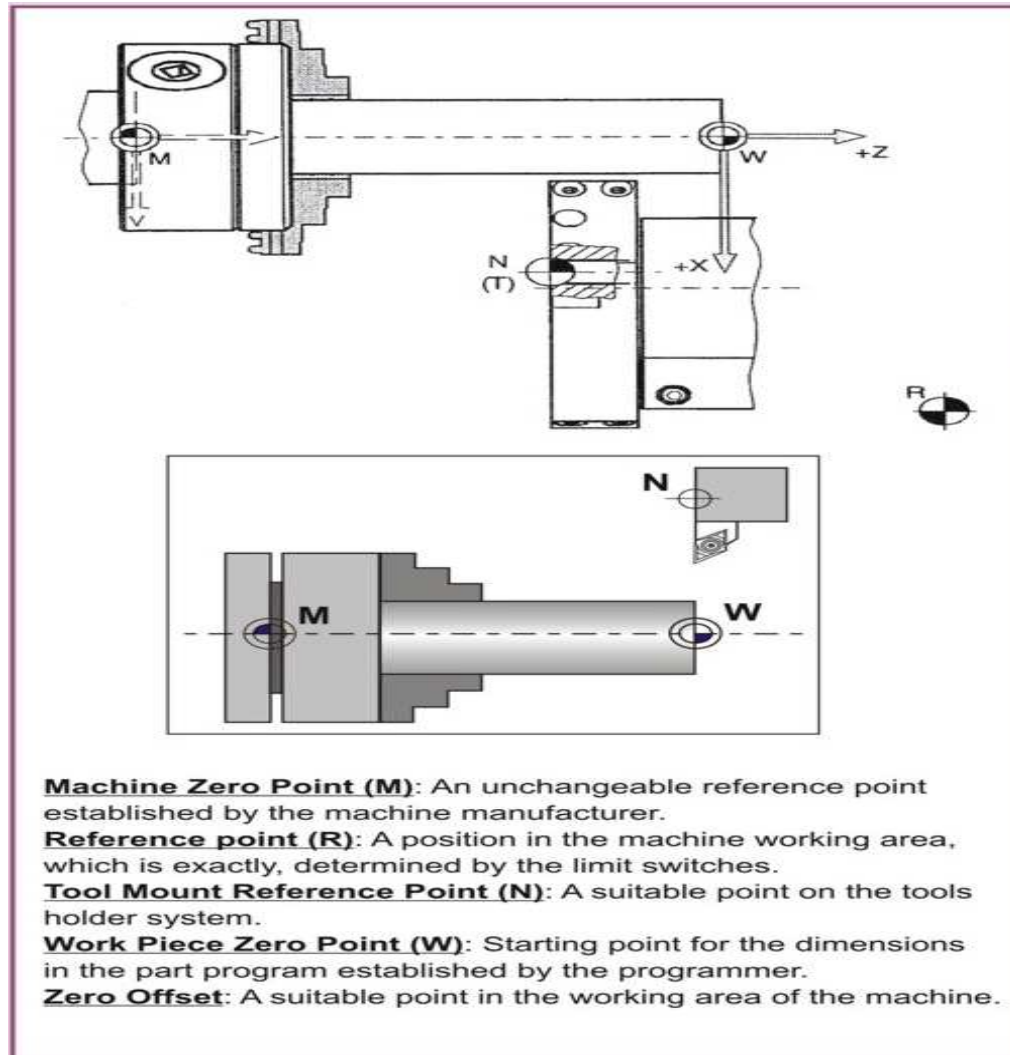
CNC TURNING MACHINE



Machine description

- | | |
|--------------------|-----------------------|
| 1. Wheel cover | 8. Cross slide |
| 2. Tailstock | 9. Longitudinal slide |
| 3. Three-jaw chuck | 10. Headstock |
| 4. Chip tray | 11. Machine bed |
| 5. Chip guard | 12. EMERGENCY-OFF key |
| 6. Step motor | 13. Electric cabinet |
| 7. Tool turret | 14. Key switch |

Working area and coordinate system



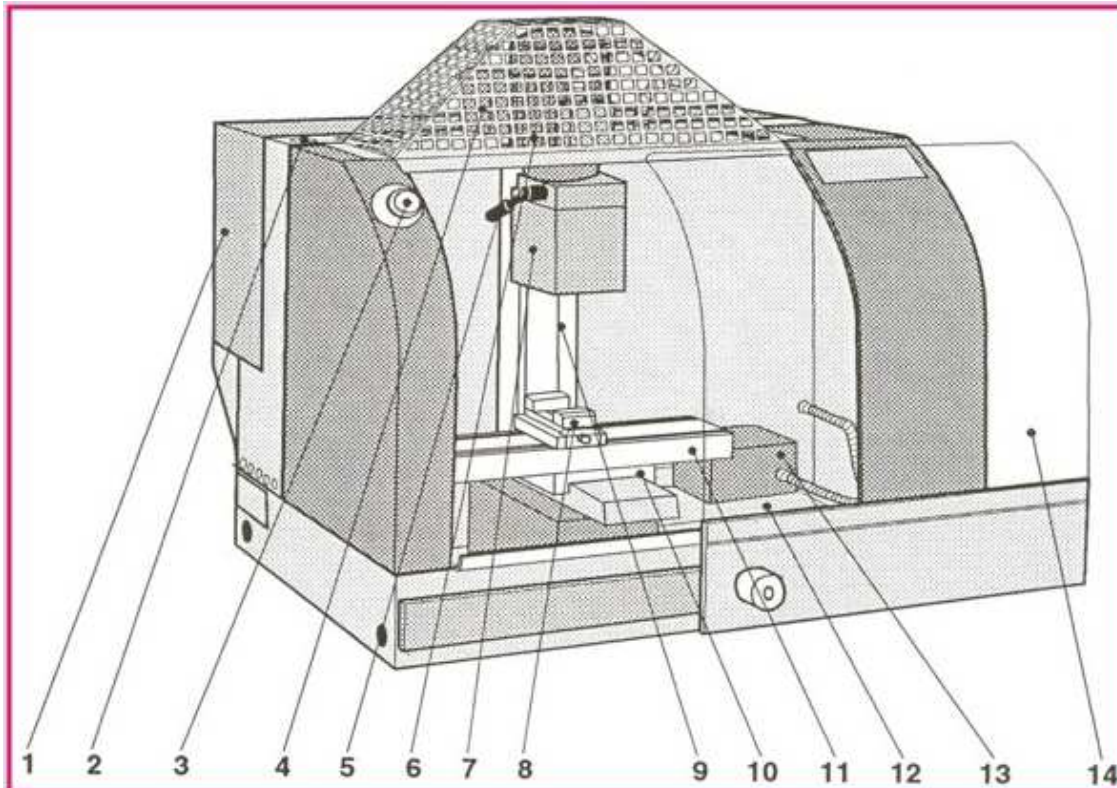
Technical Data & Main operating modes

Technical Data		
Speed range	120-4000	rpm
Operating feed rate	0-2000	mm/min
Step/output resolution	0.5	μm
Maximum part length	215	mm
Maximum turning diameter	52	mm
Maximum feed force X/Z	1000/1000	N
Maximum spindle torque	14	Nm

Main operating modes

MEM	For working off part program the control calls up block after block and interprets them
MDI	You can switch on the spindle and swivel the tool holder. The control works off the entered block and deletes the intermediate store for new inputs
EDIT	Program modification
JOG	With the JOG keys the slides can traversed manually
POS	Indicates the current position
PROG	Program functions
REF	In this mode reference point will be approached
GRAPH	Graphic display
OFFSET SETTING	Setting and display of offset value
SYSTEM	Setting and display of machine parameter

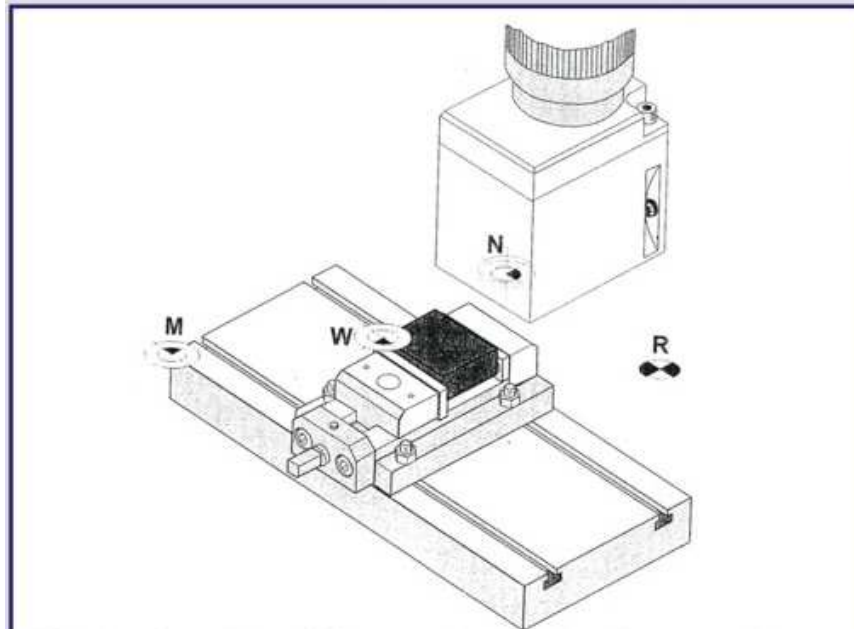
CNC MILLING MACHINE



Machine description

1. Electric cabinet
2. Tool support for 4 tools
3. EMERGENCY-OFF key
4. Protection cap
5. Clamping lever for tool clamping
6. Drive motor for milling spindle
7. Milling head with milling spindle
8. Machine vice (accessory)
9. Z-guide
10. Y-slide
11. Milling table (X-slide)
12. Chip tray
13. Step motor X-axis
14. Chip guard door

Working area and coordinate system



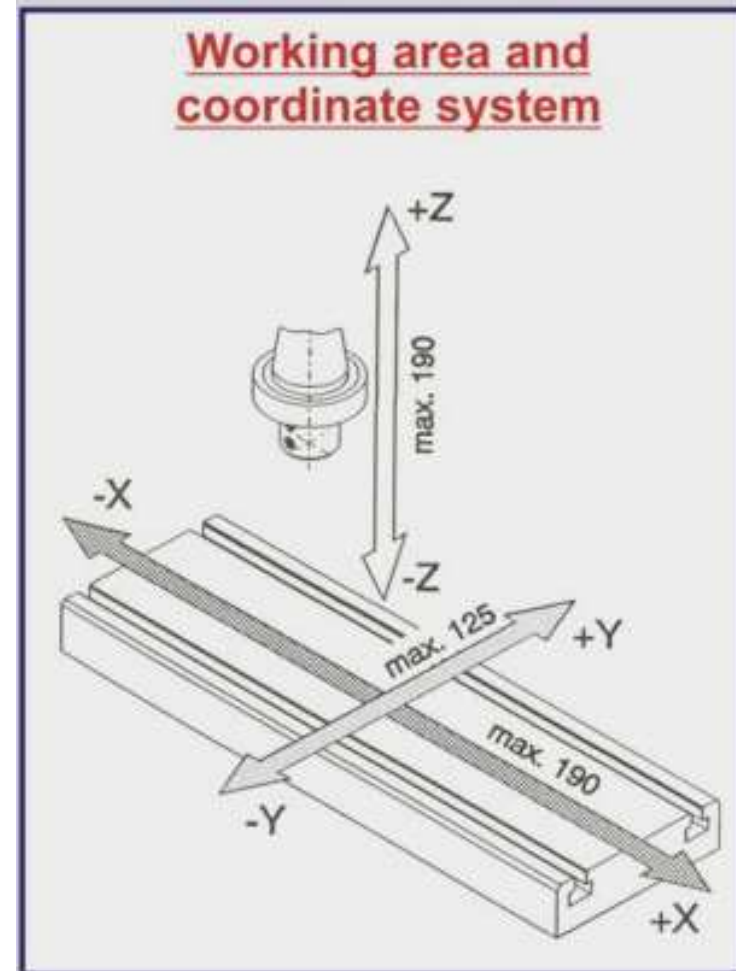
Machine Zero Point (M): An unchangeable reference point established by the machine manufacturer.

Reference point (R): A position in the machine working area, which is exactly, determined by the limit switches.

Tool Mount Reference Point (N): A suitable point on the tools holder system.

Work Piece Zero Point (W): Starting point for the dimensions in the part program established by the programmer.

Zero Offset: A suitable point in the working area of the machine.



Technical Data & Main operating modes

Technical Data		
Speed range	100-3500	rpm
Operating feed rate	0-2000	mm/min
Step/output resolution	0.5	μm
Working area X/Y/Z	190/125/190	mm
Maximum feed force X/Y/Z	800/800/1000	N
Maximum spindle torque	8	Nm

Main operating modes

MEM	For working off part program the control calls up block after block and interprets them
MDI	You can switch on the spindle and swivel the tool holder. The control works off the entered block and deletes the intermediate store for new inputs
EDIT	Program modification
JOG	With the JOG keys the slides can traversed manually
POS	Indicates the current position
PROG	Program functions
REF	In this mode reference point will be approached
GRAPH	Graphic display
OFFSET SETTING	Setting and display of offset value
SYSTEM	Setting and display of machine parameter