

Numerical Control (NC) Defined

- **NC (numerical control) machine tools** are the machine tool, of which the various functions are controlled by : letters , numbers and symbols.
- The NC machine tool runs on a program fed to it; without human operator. The NC program consist of a set of instruction or statement for controlling the motion of the drives of the machine tools as well as the motion of the cutting tool.

▪ **NC machine tools , one or more of the following function may be automatic :**

- i. Starting and stopping of the machine tool spindle;
- ii. Controlling the spindle speed;
- iii. Positioning the tool at the desired location and guiding it along the desired path by automatic control of the motion of slides;
- iv. Controlling the feed rate; and
- v. Changing the tools.



CNC Laser Cutting Machine, Capacity upto 28 mm Thickness.



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Components of NC machine tool system

1. Part program:-

- Using the part drawing and the cutting parameters, the part program is written.
- The part program is a set of step by instruction to the machine tool for carrying out the operation.

• Method use for part programming

1. Manual part programming
2. Computer-aided part programming

2. Program Tape:-

- The part program is entered on the program tape.
- The program is entered on the tape in the form of punched holes. The holes are punched with the help of punching machine.

3. Machine Control Unit(MCU):-

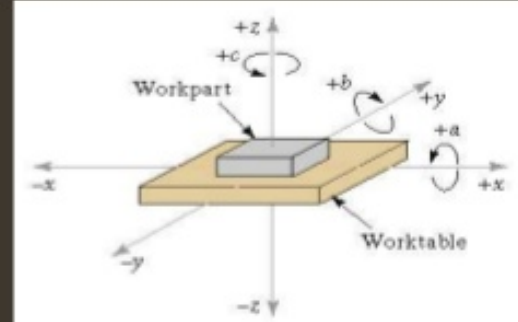
- The program tape is read by the tape reader.
- The controller takes input from the tape reader.

4. Machine Tool:-

- The machine tool is operated by the controller of the machine control unit.

NC Coordinate Systems

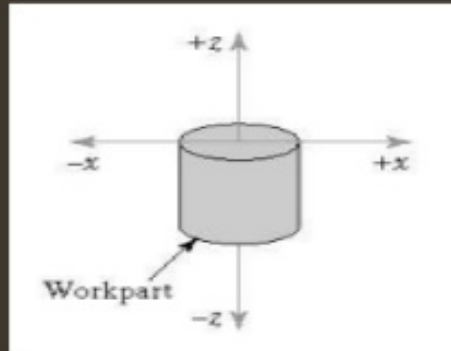
- For flat and prismatic (block-like) parts:
 - Milling and drilling operations
 - Conventional Cartesian coordinate system
 - Rotational axes about each linear axis



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NC Coordinate Systems

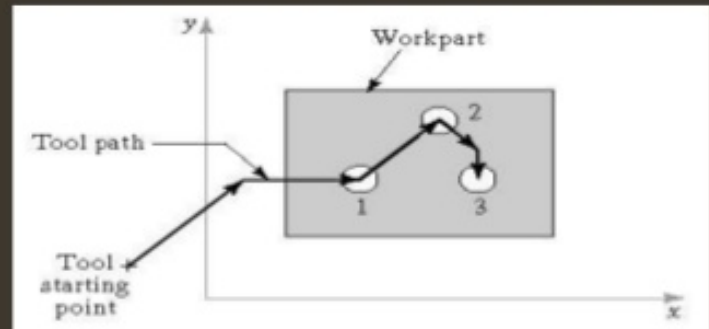
- For rotational parts:
 - Turning operations
 - Only x- and z-axes



Motion Control Systems

1. Point-to-Point systems

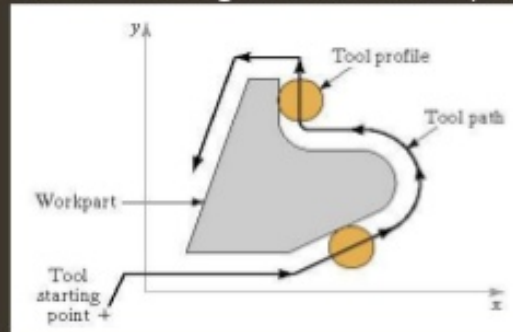
- Also called position systems
- System moves to a location and performs an operation at that location (e.g., drilling)
- Also applicable in robotics



Motion Control Systems

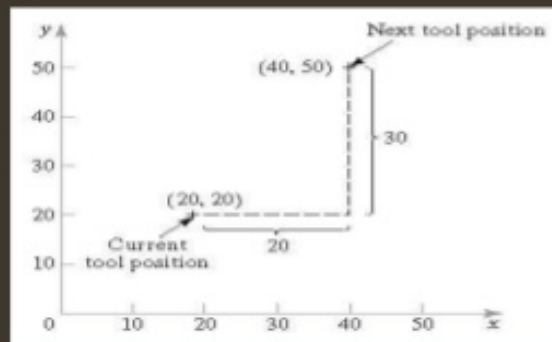
2. Continuous path systems

- Also called contouring systems in machining
- System performs an operation during movement (e.g., milling and turning)



Absolute vs. Incremental Positioning

- Absolute positioning
 - *Move is: $x = 40, y = 50$*
- Incremental positioning
 - *Move is: $x = 20, y = 30$.*



Advantages of NC machine tool

- Cycle time reduction
- Complex machining operation
- High degree of accuracy
- Less inspection required
- Reduction of scrap and wastage
- Increasing productivity
- Lower tooling cost
- Reduction of human error
- Greater operation safety
- Greater operation efficiency
- Reduction space required
- Operator skill-level reduced

Limitation of NC machine tool

- High investment cost
- High maintenance effort
- Need for skilled programmers
- High utilization required