SAFETY PRECAUTIONS

1) Be sure that all machines have effective and properly working guards that are always in place where machines are operating.

2) Do not attempt to oil, clean, adjust or repair any machine while it is running.

3) Do not operate any machine unless authorized.

4) Do not try to stop the machine with your hand or body while running.

5) Always check whether the work and cutting tools properly clamped on the machine before starting.

6) Keep the floor clean of metal chips or curls and waste pieces.

7) When working with another, only one should operate machine or switches.

8) Concentrate on the work, avoid unnecessary talks while operating machine.

9) Get first aid immediately for any injury.

10) Wear safety shoes, if heavy work has done.

11) Wear clothing suited for the job, wear shoes with thick soles.

12) Do not wear rings, watches, bracelets or other jewellery that could get caught in moving machinery.

13) Do not wear neckties or loose turn clothing of any kind.

14) Wear shirts or uppers with sleeves cut off or rolled above the elbows.

15) Always remove gloves before turning on or operating a machine.

16) Keep the floor always clean.

17) Passage should be clear, at all time to avoid accident.

18) Do not leave tools or work on the table of a machine even if the machine in not turning. Tools or work may fall off and cause the fact of injury.

Switch off the machine immediately when supply fails

1. CNC MACHINE

INTRODUCTION

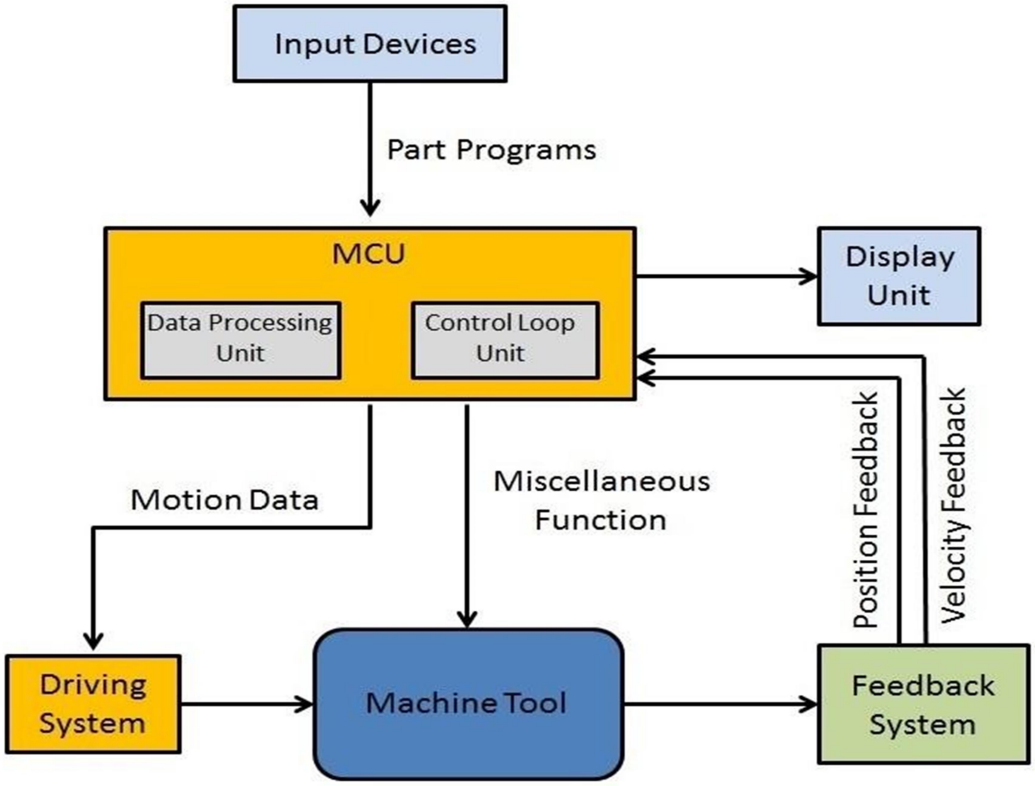
The term CNC stands for 'computer numerical control', and the CNC machining definition is that it is a subtractive manufacturing process that typically employs computerized controls and machine tools to remove layers of material from a stock piece—known as the blank or workpiece—and produces a custom-designed part. This process is suitable for a wide range of materials, including metals, plastics, wood, glass, foam, and composites,

Subtractive manufacturing processes, such as CNC machining, are often presented in contrast to additive manufacturing processes, such as 3D printing, or formative manufacturing processes, such as liquid injection molding. While subtractive processes remove layers of material from the workpiece to produce custom shapes and designs, additive processes assemble layers of material to produce the desired form and formative processes deform and displace stock material into the desired shape. The automated nature of CNC machining enables the production of high precision and high accuracy, simple parts and cost-effectiveness when fulfilling one-off and medium-volume production runs. However, while CNC machining demonstrates certain advantages over other manufacturing processes, the degree of complexity and intricacy attainable for part design and the cost-effectiveness of producing complex parts is limited.While each type of manufacturing process has its advantages and disadvantages, this article focuses on the CNC machining process, outlining the basics of the process, and the various components and tooling of the CNC machine. Additionally, this article explores various mechanical CNC machining operations and presents alternatives to the CNC machining process..

Evolving from the numerical control (NC) machining process which utilized punched tape cards, CNC machining is a manufacturing process which utilizes computerized controls to operate and manipulate machine and cutting tools to shape stock material—e.g., metal, plastic, wood, foam, composite, etc.—into custom parts and designs. While the CNC machining process offers various capabilities and operations, the fundamental principles of the process remain largely the same throughout all of them. The basic CNC machining process includes the following stages:

- Prepare the CNC program by manually or Designing the CAD model
- Converting the CAD file to a CNC program
- Preparing the CNC machine
- Executing the machining operation

Block Diagram of CNC Machine



CNC MACHINING PROGRAMMING

CNC (Computer Numerical Control) is the general term used for a system which controls the functions of a machine tool using coded instructions processed by a computer. Conventionally, an operator decides and adjusts various machine parameters like feed, depth of cut etc, depending on type of job and controls the slide movements by hand. In a CNC Machine, functions and slide movements are controlled by motors using computer programs. Tools that can be controlled in this manner include Lathes, Mills and Grinders.

Under CNC Machining, machine tools function through numerical control. A computer program is customized for an object and the machines are programmed with CNC machining language (called G-code) that essentially controls all features like feed rate, coordination, location and speeds. With CNC machining, the computer can control exact positioning and velocity.

Advantages

- High Repeatability and Precision.
- Volume of production is very high.

- Complex contours/surfaces can be machined.
- Flexibility in job change, automatic tool settings, less scrap.
- More safe, higher productivity, better quality.
- Less paper work, faster proto type production, reduction in lead times.

Disadvantages

- Costly setup, need skilled operators.
- Computer programming knowledge required.
- Maintenance is difficult.

Direct numerical control (DNC)

Direct numerical control (DNC), also known as distributed numerical control (also DNC), is a common manufacturing term for networking CNC machine tools. On some CNC machine controllers, the available memory is too small to contain the machining program (for example machining complex surfaces), so in this case the program is stored in a separate computer and sent *directly* to the machine, one block at a time. If the computer is connected to a number of machines it can *distribute* programs to different machines as required. Usually, the manufacturer of the control provides suitable DNC software. However, if this provision is not possible, some software companies provide DNC applications that fulfill the purpose. DNC networking or DNC communication is always required when CAM programs are to run on some CNC machine control.

Wireless DNC is also used in place of hard-wired versions. Controls of this type are very widely used in industries with significant sheet metal fabrication, such as the automotive, appliance, and aerospace industries.

Data Required For Programming:

Machine Tool Specification.Cutting Tool Specification.

Work measurement.

Work Material Specification.

Speed.

Feed.

Sequence of Operation..

MAIN PARTS OR ELEMENTS OF CNC MACHINE SYSTEMS

A CNC machine system comprises several basic parts or elements that work together to carry out precise and automated machining operations. These elements include:

Input Device

A CNC machine's "input device" is the device through which CNC programs are loaded into the machine. This input device might be a keyboard (for directly inputting G-code commands), a USB flash drive (for transporting the completed program from another computer), or wireless communication (if the program is to be downloaded from another computer over the local network).

Machine Tool

The machine tool is the physical equipment that performs the actual machining operations. It can be a lathe, milling machine, router, or machine capable of cutting and shaping materials.

The CNC machine tool often has a sliding table and a spindle for position and speed control. The machine table is generally controlled in the X and Y-axis direction, while the spindle is controlled in the Z-axis direction.

Machine Control Unit (MCU)

The MCU (machine control unit) is the system's brain. It receives instructions, typically in a G-code program, and translates them into precise movements and actions for the machine tool. MCU manages the motion control, spindle speed, tool changes, and other parameters necessary for machining operations.

Servo Motors

Servo motors are used to drive the axes of the machine tool. They receive signals from the MCU and provide precise and controlled movements along the X, Y, and Z axes or any additional axes the machine may have. Servo motors ensure accurate positioning and motion control.

Feedback Devices

Feedback devices, such as encoders or linear scales, are used with servo motors to provide positional feedback to the MCU. These devices enable the MCU to monitor

and adjust the actual position of the machine tool during machining operations, ensuring accuracy and precision.

Tooling

Tooling refers to the various cutting tools and accessories used in machining. It includes drills, end mills, inserts, collets, and other tool holders. Tooling selection depends on the specific machining operation and material being processed.

Workholding Devices

Workholding devices secure the workpiece in place during machining. They can include vises, clamps, chucks, fixtures, and other specialized devices. Workholding is crucial for maintaining the stability and accuracy of the workpiece throughout the machining process.

Operator Interface

The operator interface allows the machine operator to interact with the CNC system. It can be a control panel, a computer screen, or a combination of both. The operator interface allows the operator to input commands, monitor machining progress, and adjust the machining parameters as needed

CNC PROGRAM PROCEDURE:

1. Planning Stage.
2. Programming Stage.

1. Planning Stage:

- Suitability of the machine.
- Tooling Requirement.
- Sequencing of machine.
- Optional Stop.
- Cutting Speed.
- Feed rate.
- Depth of cut.
- Finish Requirement.
- Offset Requirement.

2. Programming Stage:

- Draw the component to scale showing the cutter path.
- Select a work piece datum and dimensioning the drawing as per the method.

- Draw the tool layout showing the tool and station number.
- Write a program.
- Start the program by simulation

MODE SELECTION

1. Edit.
2. Single auto.
3. Auto control
4. MDI
5. Hand feed at X axis Z axis.
6. JOG
7. ZRN(Zero Return/Reference point/Home position)
8. MPG(manual pulse generator)

Edit

This option is used to edit, alter, change, and write new program.

Single Auto:

This option is used to operate and read a single block.

Auto control:

This button is used to operate the M/C for production due to the knob is in this option, we will press the cycle start button.

MDI-(manual data input):

This option is used to input the manual data's. Buttons are mainly sused at setting. By using this we can rotate main spindle and move the tailstock to the required distance and rotate turret to the required position.

Hand feed at X ,Y & Zaxis

I should move turret and bed to the required distance in X and Z axis mainly by using hand wheels. It's mainly used at m/c home position and job setting also.

JOG:

This option is used to turret Indexing and move turret and job settings, to control the coolant flow also.

ZRN (zero return):

This option is used to send the machine to home position.

MPG(manual pulse generator)

MPG is a device for generating electrical pulses (short bursts of low current) in electronic systems under the control of a human operator (manually),

Feed rate override:

This is used to move the tool and feed rate. This feed already mentioned in program.

Rapid override:

This one is used to move the turret at rapid override.

Spindle speed override:

This is control the spindle rotation.

Handle step feed.

This one control the handle feed movement of turret.

Optional stop

This button is used to temproverly stop the program to the required position.

Dry run

This is used to check the program tool path is correct or not.

Program check:

This one is used to check the program is correct or not.

Machine lock:

This button is used to stop all actions and check the programs.

Feed hold:

This button is used to stop the tool at current point in feed

NC RELATED DIMENSIONING:

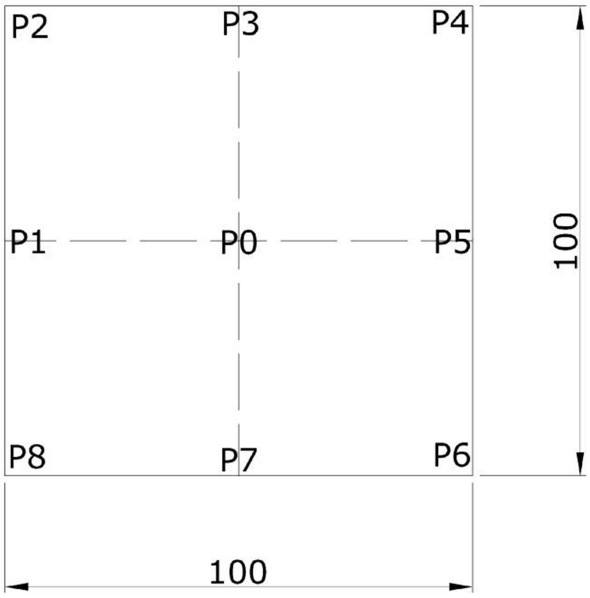
There are two methods of Dimensioning system in a program.

1. **Absolute Dimensioning:**

The next location of tool is given with reference of the zero Point.

2. **Incremental Dimensioning:**

The next location of the tool is given with respect to the previous tool position of the origin.



Absolute Dimensioning.

Points	**X**	**Y**
P0	0	0
P0-P1	-50	0
P0-P2	-50	50
PO-P3	0	50
P0-P4	50	50
PO-P5	50	0
P0-P6	50	-50
PO-P7	0	-50
P0-P8	-50	-50

Incremental Dimensioning/Relative.

Points	**X**	**Y**
P0	0	0
P0-P1	-50	0
P1-P2	0	50
P2-P3	50	0
P3-P4	50	0
P4-P5	0	-50
P5-P6	0	-50
P6-P7	-50	0
P7-P8	-50	0

WORK ZERO AND MACHINE ZERO

In CNC (Computer Numerical Control) machining, **work zero** and **machine zero** refer to two different reference points used to define the positioning of the tool and workpiece. Here's how they differ:

Machine Zero (Home Position)

Definition: Machine zero, also known as the home position, is the reference point for the entire CNC machine. It is where the machine's axes return to when it is initialized or reset.

- **Location**: This point is usually at the physical limits of the machine's travel, often at one corner of the machine's working area (e.g., the maximum negative X, Y, and Z positions).
- **Purpose**: It serves as a consistent reference point for the machine's movements and is critical for calibration and ensuring the machine operates correctly.

Work Zero (Part Zero or Work Offset)

- **Definition**: Work zero is the reference point for the specific workpiece being machined. It defines the starting point for the tool's movements relative to the workpiece.
- **Location**: This point can be set anywhere on the workpiece, such as a corner, center, or any feature of the part, depending on the machining requirements.
- **Purpose**: It allows the programmer to dictate where the machining operations will begin in relation to the part, accommodating for different sizes, shapes, and setups.

Key Differences

- **Reference Point**: Machine zero is a fixed point for the machine, while work zero is variable and can be adjusted based on the workpiece.
- **Usage**: Machine zero is used for machine calibration, whereas work zero is used for part programming and setup.
- **Adjustment**: Machine zero typically does not change, while work zero can be set or modified for each new workpiece.

TYPES OF CNC MACHINES

- Milling CNC Machine
- Lathe CNC Machine
- Router CNC Machine
- Plasma Cutting CNC Machine
- Laser Cutting CNC Machine
- Electric Discharge CNC Machine
- Waterjet Cutting CNC Machine
- Grinding CNC Machine
- Drilling CNC Machine

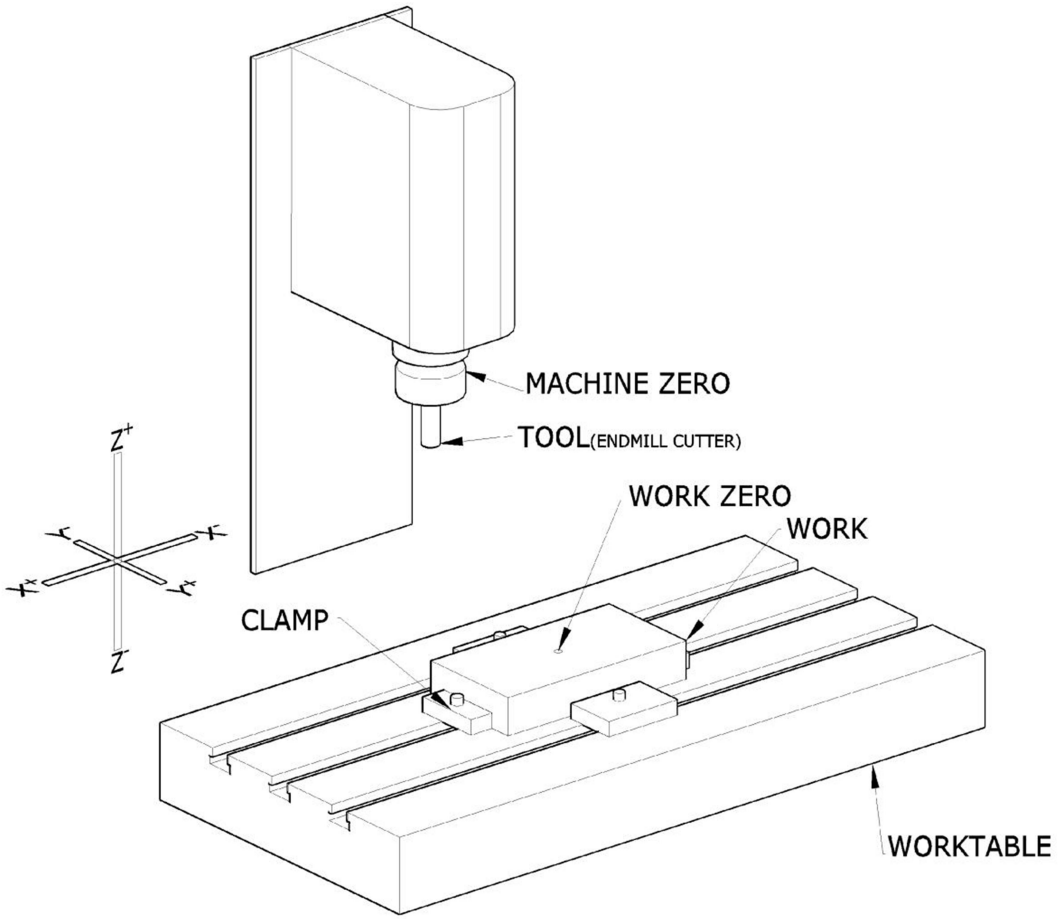
MILLING CNC MACHINE

CNC milling machines employ cutting tools to remove material from a workpiece and precisely shape it according to specifications. The workpiece is typically held in place

CNC mills can have various cutting tools, each with a specific purpose. End mills, reamers, face mills, taps, and drills are common cutting tools. These machines are available in both vertical and horizontal configurations.

Vertical milling machines feature a vertically oriented spindle that holds and rotates the cutting tool. Horizontal milling machines have a horizontally oriented spindle, allowing for more aggressive material removal and better chip evacuation. Horizontal milling machines can also accommodate larger workpieces than vertical milling machines.

Some typical applications of mill CNC machines include cabinets, furniture, prototype models, signage, and musical instruments. CNC milling machines offer high precision and versatility and can produce complex shapes that would be nearly impossible to achieve with manual machining. However, the size of these machines can process depends on the maximum travel distance of the tools and the size of the enclosure.



CNC Milling Tools

CNC cutting tools are one of the most utilized sets of tools in the CNC industry. Even though they are called cutting tools, there is no procedure named cutting in CNC. Instead, we have the milling procedure. This is why CNC cutting tools are also known as CNC milling cutters/CNC cutters.

Examples of the cutting tools

End Mills

It helps to cut holes into materials even without a pre-drilled spot. There are also various types of end mills which differ by the number of flutes and the type of nose they have.

Slab Mills

It is used to mill flat surfaces. They are mostly suited for heavy-duty operations. To use slab mills, you must place the workpiece surface parallel to the CNC mill table.

Face Mills

Face mills are CNC cutters with flat faces with replaceable cutting edges made with carbide., face mills can only cut workpieces in the horizontal direction

Fly Cutters

Fly cutters are CNC cutters that consist of a tool body and cutting bits. Their function is to make shallow or broad cuts on workpieces. They could either have one or two cutting bits.

Hollow Mills

Hollow mills are CNC cutters with a pipe shape and look like inverted end mills. They are commonly used in creating form radii and full points on workpieces.

Syntax of a block in a CNC program:

Character	Meaning
A	Rotation about X-axis
B	Rotation about Y-axis
C	Rotation about Z-axis
D&E	Rotation about additional axes
F	Feed function
G	Preparatory function

H	Tool length offset designation
1	Interpolation parameter/Thread pitch parallel to X-axis
J	Thread pitch parallel to Y-axis
K	Thread pitch parallel to Z-axis
M	Miscellaneous function
N	Block numbers
O	Used to assign program number.
P,Q,R	Thread movement parallel to X, Y& Z ates respectively. P&Q are also used as parameters in cycles, R is used to give Radius
S	Spindle speed function
T	Tool function
U,V,W	Second movement parallel to X, Y, Z axes respectively.
X	Movement in X-axis
Y	Movement in Y-axis
Z	Movement in Z-axis
;	End of Block

IMPORTANT „M" CODES

M00	Program Stop
M01	Optional Program Stop
M02	Program End
M03	Spindle ON Clockwise
M04	Spindle ON Counter Clockwise
M05	Spindle Stop
M06	Tool Change
M08	Coolant ON
M09	Coolant OFF
M10	Clamps ON
M11	Clamps OFF
M19	Spindle orientation
M30	Program STOP, RESET to START
M98	Sub program call

M99 Sub program exit

IMPORTANT „G" CODES

G00 Rapid Transverse

G01 Linear Interpolation

G02 Circular Interpolation, CW

G03 Circular Interpolation, CCW

G04 Dwell time

G17 XY Plane

G18 XZ Plane

G19 YZ Plane

G20 / G70 Inch units

G21/G71 Metric Units

G28 Home position

G40 Cutter Compensation Cancel

G41 Cutter Compensation Left

G42 Cutter Compensation Right

G43 Tool length compensation (plus)

G44 Tool length compensation (minus)

G49 Tool length compensation cancel

G54 Work coordinate system 1selection

G55 Work coordinate system 2selection

G56 Work coordinate system 3selection

G57 Work coordinate system 4selection

G58 Work coordinate system 5selection

G59 Work coordinate system 6selection

G73 Peck drilling cycle

G80 Cancel canned cycles

G81 Drilling cycle

G82 Counter boring cycle

G83 Deep hole drilling cycle

G84 Tapping cycle

G85 Boring cycle

G90 Absolute positioning

G91 Incremental positioning

G94 Feed mm/min

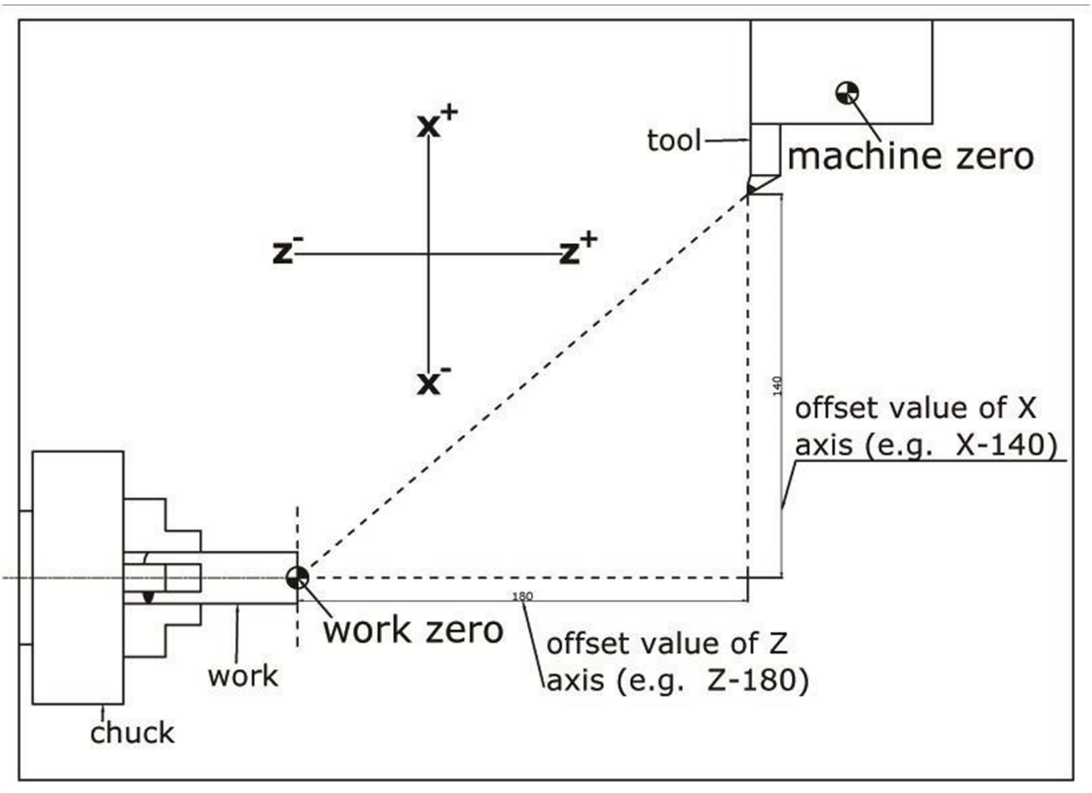
G95 Feed mm/rotation

LATHE CNC MACHINE

CNC lathes operate by rotating the workpiece material around a central axis. The workpiece is then cut with cutting tools to remove material and shape it as needed. CNC lathes include turret lathes, engine lathes, and special-purpose lathes.

CNC lathe machines are perfect for various processes such as cutting, sanding, facing, drilling, turning, knurling, etc. A non-rotary tool travels linearly on a rotating workpiece to provide a helical/spiral cutting path in CNC turning.

Generally, CNC lathes can only create symmetrical components. It can make products like camshafts, automobile parts, gun barrels, crankshafts, baseball bats, musical instruments, dining tables, and furniture legs



Basic Types of Lathe Tools

Turning tools

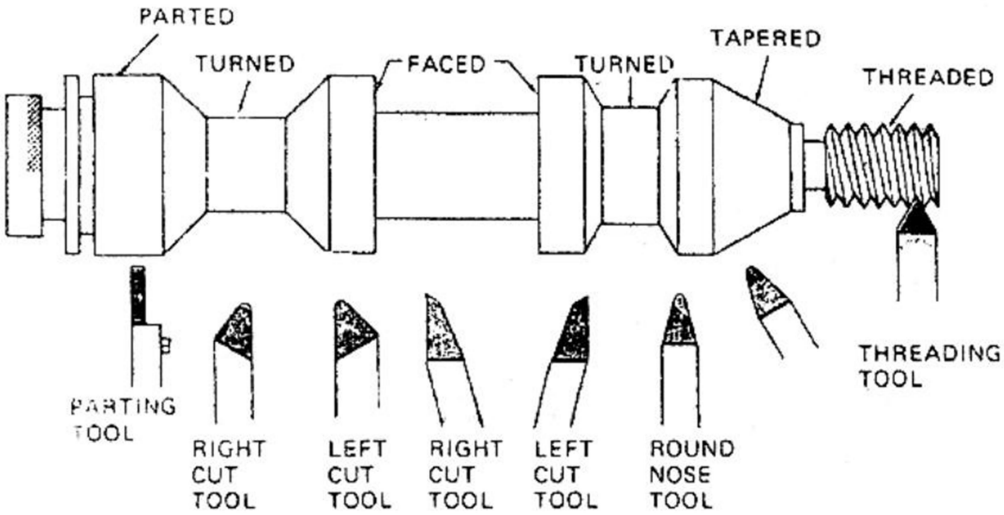
Facing tools

Boring tools

Thread Cutting tools

Knurling tools

Different Types of Tools for Turning



CNC LATHE TOOLS BASED ON MATERIALS

Cutting tools for metal lathes can also be classified based on their material makeup. Common materials used in making different types of lathe tools include:

High-speed steel

Lathe cutting tools made from high-speed steel are hard, strong, and wear-resistant. The material contains elements like carbon, tungsten, chromium, and vanadium and can work well at a temperature of about 588^0C.

Carbide

Carbide lathe cutters stand out for their exceptional hardness and durability, outperforming traditional high-speed steel tools. Manufacturers can enhance these properties by adding elements like tungsten, carbon, vanadium, and chromium. Additionally, applying coatings of materials such as Aluminum Oxide and Titanium Nitride further increases their effectiveness. Their key benefit lies in maintaining a sharp cutting edge at high machining temperatures, making them ideal for high-speed and heavy-duty machining applications

Diamond

Diamond tools for lathe machines, known for being the hardest material, Their primary benefit is exceptional wear resistance, enabling them to maintain sharpness and accuracy over extended periods, even at high cutting speeds. These tools are ideal for machining highly abrasive materials like composites, aluminum alloys, and ceramics, ensuring smooth finishes and dimensional accuracy.

Ceramic

Ceramic CNC lathe cutters stand out for their exceptional heat resistance and durability, ideal for high-speed machining of hard-to-machine materials like hardened steels, nickel-based alloys, and titanium.

Cubic Boron Nitride

Cubic Boron Nitride (CBN) lathe tools are renowned for their hardness and wear resistance, second only to diamond, making them ideal for machining hard materials.. These tools are particularly effective in machining hardened steels, high-speed applications, and finish machining, offering high-quality surface finishes and precision.

IMPORTANT „G" CODES

G00	Rapid traverse
G01	Linear interpolation
G02	Circular interpolation CW
G03	Circular interpolation CCW
G04	Dwell
G20	Input in inch
G21	Input in mm
G28	Return to reference position
G40	Tool nose radius compensation cancel
G41	Tool nose radius compensation left
G42	Tool nose radius compensation right
G70	Finish machining cycle
G71	Multiple Turning cycle
G72	Multiple Facing cycle
G73	Pattern repeating cycle
G74	Peck drilling cycle
G75	Grooving cycle
G76	Threading cycle
G90	Box turning cycle
G94	Box facing cycle
G96	Constant surface speed control
G97	Constant surface speed control cancel
G98	Feed mm/minutes
G99	Feed mm/ revolution

ROUTER CNC MACHINE

A CNC router machine is similar to a CNC mill. However, it is normally used for softer materials and is typically less accurate than CNC mills. CNC routers cut a variety of forms and designs on flat surfaces made of any material. In carpentry and metalworking workshops, these machines replace manual tools, such as boring machine tools, panel saws, and spindle molders.

CNC Router machines can cut complex shapes, and their applications involve carved wood furniture, moldings, interior and exterior decorations, door carvings, signage, musical instruments, and so on. They decrease waste, improve productivity and accuracy, and speed up production. But the machine's high noise is a point that should be considered.

.

PLASMA CUTTING CNC MACHINE

A CNC plasma cutting machine employs an electrical discharge arc (such as a plasma torch) to ionize the air and melt the material where the arc impacts. The method is limited to conductive materials because it operates via an electrical arc. Brass, copper, aluminum, steel, and stainless steel are common materials used in plasma cutting.

The applications of CNC plasma cutters can often be found in automobile manufacturing, automotive repairs, fabrication shops, salvage, and scrapping. CNC plasma cutting machines offer high speed and precision. They can cut through any conductive material. However, plasma cutting works by melting the material; its produced heat would leave visible heat-affected zones on the cut area.

LASER CUTTING CNC MACHINE

CNC laser cutters cut sheets of any material with a highly concentrated laser beam. A CNC laser cutting machine creates even more precise cuts than plasma cutting. The two most common varieties of lasers are CO2 and solid-state. Solid-state lasers can cut any material. Hence CNC laser cutters are not restricted to conductive materials.

CNC Laser Cutters can find applications in aerospace parts, automobile frames, medical equipment, engraving materials, etc. Because there is no mechanical contact or force exerted on the material, high-quality clean edges can be achieved without secondary finishing. One of the limitations of CNC laser cutting machines is that they are limited to the maximum thickness of the material you can cut with them.

ELECTRIC DISCHARGE CNC MACHINE

CNC Electrical Discharge Machines (EDM) use electric sparks to remove material from conductive workpieces to reshape materials. The sparks vaporize minute bits of material, removing thin layers of metal. CNC electrical discharge machines work only for conductive materials and have a slow cutting rate. They can be used for manufacturing injection molds, die casting, blanking punches, and prototyping.

Two main types of CNC EDM machines are wire EDM and sinker EDM. Wire EDM machines use a continuously moving, electrically charged wire to cut through conductive materials. These machines are ideal for cutting intricate shapes, narrow slots, and small holes and producing tight tolerances and smooth surface finishes.

Sinker EDM machines use a shaped, electrically charged electrode to remove material from a workpiece by creating a series of electrical discharges. These machines are suitable for creating complex cavities, molds, and dies with high precision and accuracy.

WATERJET CUTTING CNC MACHINE

CNC waterjet cutters use an extremely high-pressure jet of water mixed with abrasives to cut various materials precisely. The high-velocity water jet easily cuts through metals, stones, glass, composites, etc. A waterjet CNC machine cuts all types of materials with no heat damage. It can be used for cutting parts for aerospace, automotive, electronics, arts, etc. But the speed of this machine is slower, especially around corners and curved cuts. In addition, the thickness of the material suitable for waterjet cutting is high.

GRINDING CNC MACHINE

CNC grinding machines are employed to achieve high precision and surface finish in the grinding process. These machines utilize rotating grinding wheels to remove material from the workpiece and create the desired shape. CNC grinding machines are commonly used for camshafts, ball bearings, transmission shafts, and other parts that require a precise and correct finish. They are extensively used in the automotive, aerospace, and tool manufacturing industries.

DRILLING CNC MACHINE

CNC drilling machines use rotating drill bits to drill holes in materials. They can drill holes in exact locations quickly and accurately to meet screws, secondary assembly, or aesthetic requirements. Typical drill bits available include spotting drills, peck drills, screw machine drills, and chucking reamers.CNC drilling machine is suitable for automobile, shipbuilding, astronautics, engineering machinery, mold making, woodworking, and furniture making.

TYPES OF CNC MACHINES ACCORDING TO THE NUMBER OF AXES

The types of CNC machines can be further segmented according to the number of axes. Here are some common types:

2-Axis CNC Machine

2-axis CNC machines are the most fundamental CNC systems available. They have two movement axes: the X-axis (vertical axis) and the Y-axis (horizontal axis).
These machines often make basic straight-line cuts or drill holes in boards or process only one workpiece surface without relocating it. These machines operate on a fixed workpiece.

3-Axis CNC Machine

The most prevalent form of CNC machine is a 3-axis CNC machine. They can manufacture parts in 2.5 dimensions and have three axes of movement: the X, Y, and Z-axis (depth axis).

This machine may operate on all six surfaces of a conventional square or rectangular material block, but the block must be repositioned. These machines, too, operate on a fixed workpiece.

4-Axis CNC Machine

In addition to the X, Y, and Z axes, a 4-axis machine includes a rotational axis. This axis of rotation is called A-axis. A-axis permits the rotating cutting tool to move along the X-axis. This machine is perfect for creating cutouts and cutting in an arc.

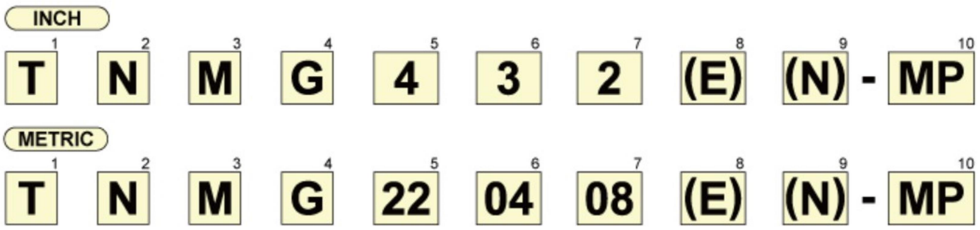
5-Axis CNC Machine

The 5-axis machine has a pivoting motion of the cutting tool (or the work table) along the Y-axis. The axis of pivoting is known as C-axis. Because of its capacity to operate on five surfaces of a workpiece concurrently without relocating the work surface, these machines can produce complex and accurate parts.

CLASSIFICATION OF CUTTING TOOLS

- **Single-point cutting tools**: These are cutting tools that have a single cutting edge, such as turning tools, boring tools, and threading tools.
- **Multi-point cutting tools**: These are cutting tools that have multiple cutting edges, such as milling cutters, drills, and reamers.
- **Abrasive cutting tools**: These are cutting tools that use abrasives, such as grinding wheels or cutting discs, to remove material from a workpiece.
- **Shearing cutting tools**: These are cutting tools that use a shearing action to cut the material, such as scissors or sheet metal cutters.
- **Burnishing cutting tools**: These are cutting tools that use a burnishing or polishing action to smooth the surface of a workpiece, such as honing tools or lapping tools.
- **Electronic cutting tools**: These are cutting tools that use electrical or electromagnetic energy to remove material from a workpiece, such as wire EDM machines or laser cutters.

TURNING INSERTS IDENTIFICATION



1. Insert Shape
2. Relief Angle
3. Tolerance Class
4. Chipbreaker and Clamping System

5. Insert Size
6. Insert Thickness
7. Insert Corner Configuration
8. Cutting Edge Condition
9. Cutting Direction
10. Chip Breaker