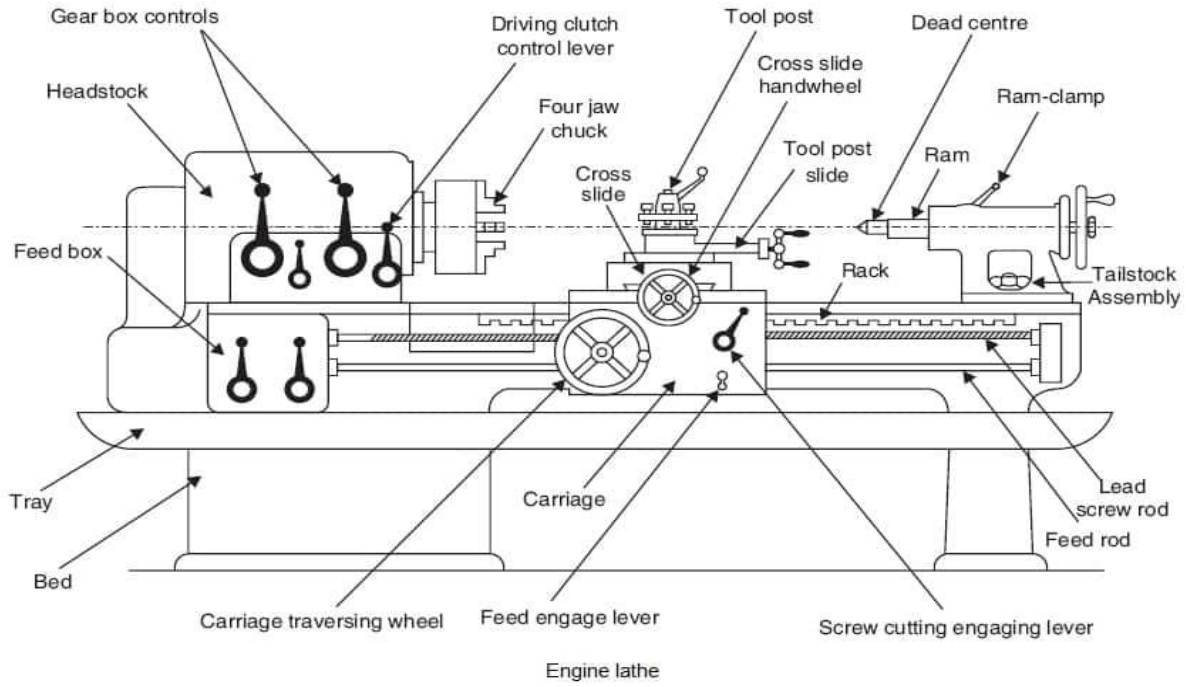
Workshop Safety Precautions

- Wear tight clothes. Loose clothing or long hair will bring danger
- Wear covered footwear. Never use sandals or chapels.
- Never use files, screw-drivers without a handle. Do not use a hammer without the wedge.
- Never operate a machine unless otherwise you thoroughly its mechanism.
- Wear goggles while chipping, welding or grinding.
- Always wear safety hand gloves, an apron or dungaree and leather shoes in the Workshop.
- Never touch overhead lines unless you are sure that it is properly earthed and dead.
- Don’t touch /operate power tools without aid from instructors
- Do not throw water on the equipment. It will be harmful since water is a good conductor of electricity.
- Do not touch the electrical circuits of the welding machine

Machine-Shop

Lathe Machine

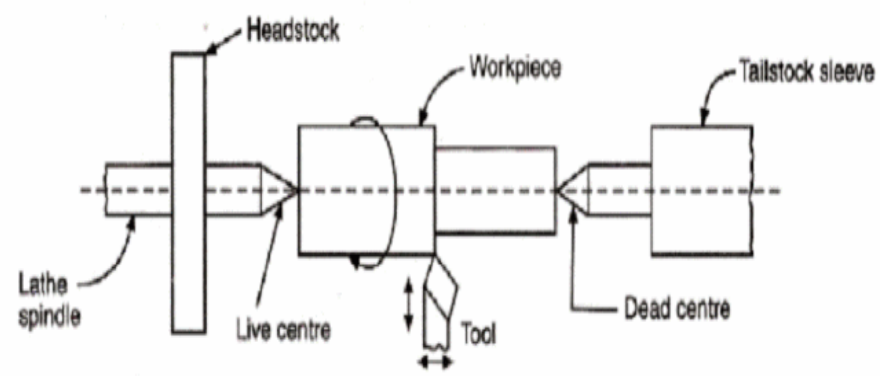
A Lathe machine is a machine tool which is used to remove metal pieces to give a desired shape and size. In other words, it is a machine tool that is used to hold the workpiece to perform various metal-removing operations.



Lathe machine

Working principle:

The lathe machine holds a workpiece between two rigid and strong supports called the centre or in the chuck or faceplate which revolves/rotates. The cutting tools feed either parallel or at right angles to the axis of the workpiece or job.



Working principle of lathe machine

Types of Lathe Machines

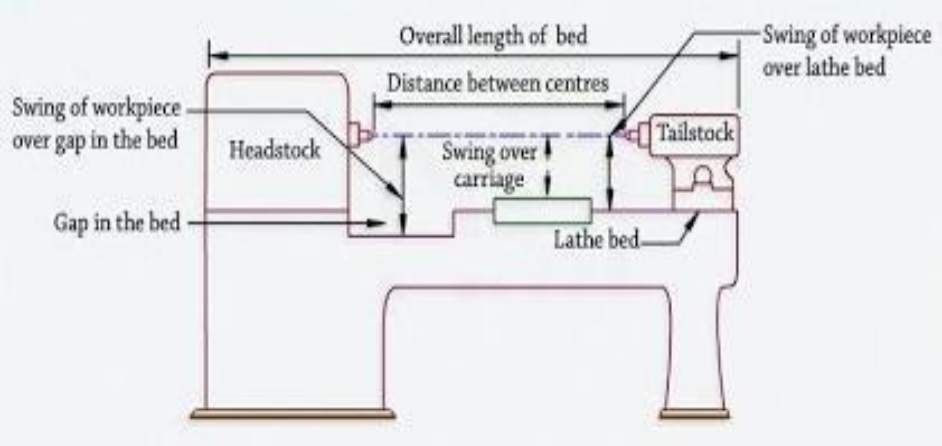
1) Speed Lathe Machine.
2) Center Lathe or Engine Lathe Machine.
3) Turret Lathe Machine.
4) Tool room Lathe Machine.

5) Bench Lathe Machine.
6) Automatic Lathe Machine.
7) Special Purpose Lathe Machine.
8) CNC Lathe Machine.

Lathe specification

A Lathe machine is specified by the following:

1) The height of the centres measured from the lathe bed.
2) Swing diameter over bed. This largest diameter of the workpiece which will revolve without touching the bed. It is equal to twice the height of the centres from the bed.
3) Swing diameter over the carriage. It is the largest diameter that can revolve over the cross-slide. This is always less than the swing diameter over the bed.
4) Maximum bar diameter. This is the maximum diameter that will pass through the headstock spindle.
5) Length of the bed.



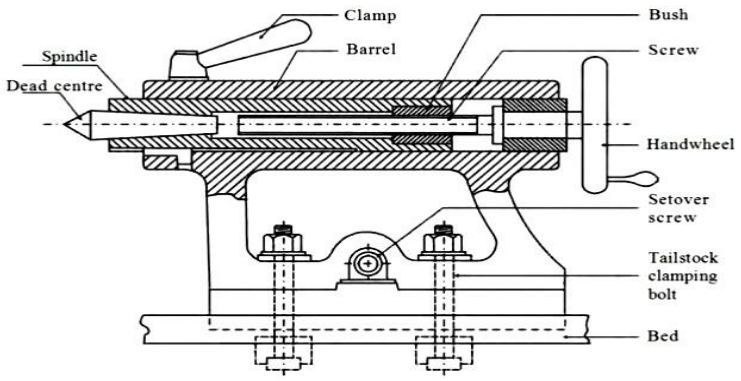
Specification of a lathe machine

<u>The main parts of a lathe machine are:</u>

- Head Stock
- Tail Stock
- Bed
- Tool post
- Legs
- Carriage

<u>Head Stock:</u> The headstock is clamped on the left side of the bed and it serves as housing for the driving pulleys, back gears, headstock spindle, live centre and the feed reverse gear.

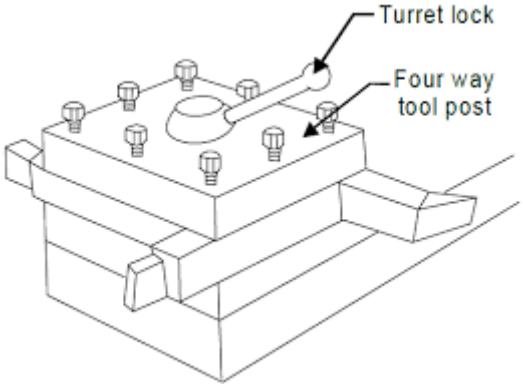
<u>Tail Stock:</u> The tail stock is a movable casting located opposite the headstock on the way of the bed. The tailstock can slide along the bed. A tail stock can be set at any desired position.



Tailstock

Bed: The bed is a heavy casting in which working parts of the table are mounted. It carries the head stock and tail stock for supporting the workpiece and provides a base for the movement of carriage assembly which carries the tools.

Tool Post: The tool post is mounted on the compound rest and it rigidly clamps the cutting tools or tool holder at the proper height related to the work centre.

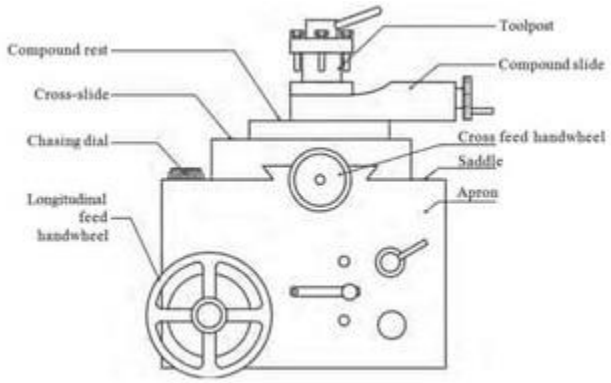


Tool post

Legs: The legs carry an entire load of the machine and the firmly seared floor by foundation bolts.

Carriage

The carriage is the part of the lathe which slides over the bed-ways between the headstock and the tailstock. It provides various movements for the cutting tool manually as well as by power feed. The carriage can be locked on the bed at any desired position by tightening the carriage lock screw.



Cutting Parameters

1. Cutting speed

It is defined as the speed at which the material is removed and is specified in meters per minute. Ti depends upon the workpiece material, feed, depth of cut, type of operation and so many other cutting conditions. It is calculated from the relation,

Spindle speed (RPM) =cutting speed x 1000 / (πD), Where D is the workpiece diameter in mm.

2. Feed

It is the distance traversed by the tool along the bed, during one work revolution. Its value depends upon the depth of cut and surface finish of the work desired.

3. Depth of cut

It is the movement of the cutting tool's tip, from the work pieces' surface and perpendicular to the lathe axis. Its value depends upon the nature of the operation like rough turning or finish turning.

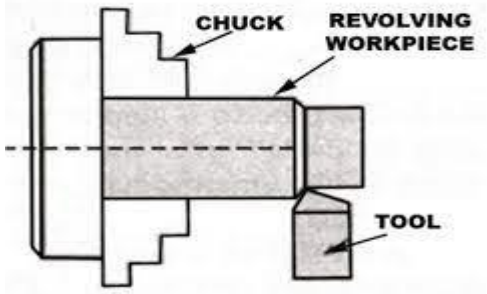
Operations performed on a lathe machine:

List of operations that can be performed on the lathe machine:

1) turning
2) facing
3) grooving
4) parting
5) threading
6) drilling
7) boring
8) knurling
9) tapping

1. ***Turning:***

It is the most common type of operation in all lathe machine operations. Turning is the operation of removing the excess material from the workpiece to produce a cylindrical surface to the desired length.

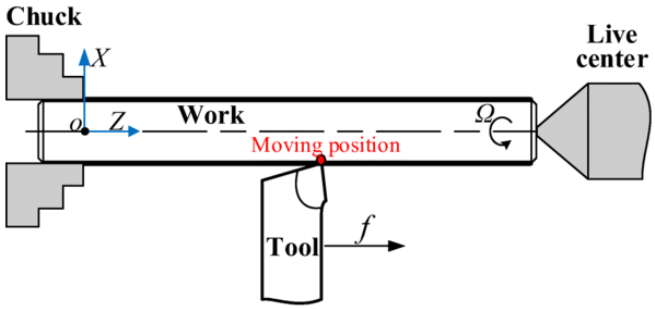


Plain Turning

The job held between the centre or a chuck and rotating at a required speed. The tool moves in a longitudinal direction to give the feed towards the headstock with proper depth of cut. The surface finish is very good.

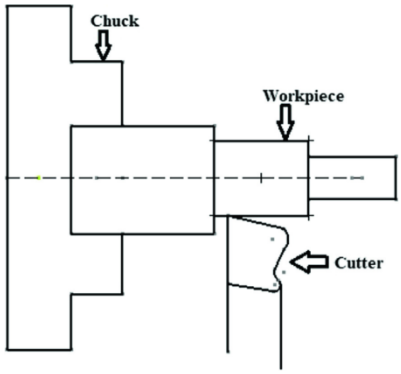
2. Straight Turning:

The workpiece is held on the chuck and it is made to rotate about the axis, and the tool is fed parallel to the lathe axis. The straight turning produces a cylindrical surface by removing excess metal from the workpiece.



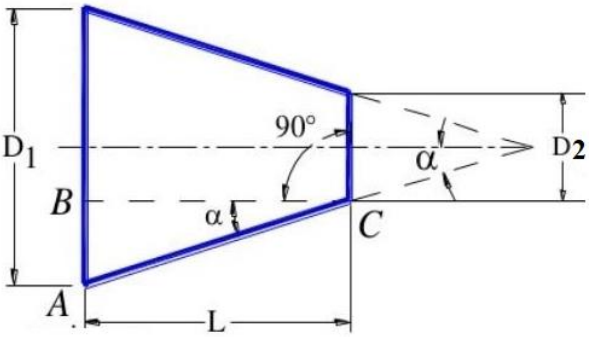
3. Step Turning:

Step turning operation is a type of turning operation in which a series of steps are created on the surface of the workpiece. This is done by adjusting the position of the cutting tool during the turning operation. Step turning is commonly used in the production of parts that require a series of stepped surfaces.



4.**Taper Turning:**

- A" taper" is the uniform increase or decrease in the diameter of the workpiece and measured along with its length.
- Taper turning means to produce a conical shape by a gradual reduction in diameter from a cylindrical workpiece.



The amount of taper in the workpiece is usually specified based on the difference in diameter of the taper to its length. It is known as a cone and it is indicated by the letter K.

It has the formula $K = D_1\text{-}D_2 / 2L$ to produce the taper on the workpiece.

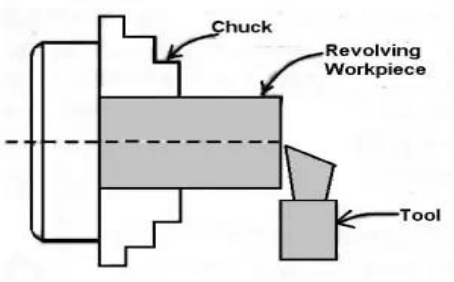
- D = Larger diameter of taper.
- d = Small diameter of taper.

In the case of a lathe, the taper on a given workpiece is obtained by tuning the job and feeding the tool at an angle to produce a gradual increase or decrease in the diameter of the workpiece.

- The two important types of tapers are,
  - ” More taper” here, the angle is very small and varies from 1.4 to 1.5°.
  - ” Metric taper” is available in seven standard sizes with standard taper angles.
- **Methods of taper turning,**
  a) Form tool method
  b) Combined feeds method
  c) Compound rest method or swivelling compound rest method
  d) Tailstock set over method
  e) Taper turning attachment method

Facing:

It is an operation of reducing the length of the workpiece by feeding the perpendicular to the lathe axis. This operation reduces a flat surface on the end of the workpiece. For this operation, regular turning tool or facing tool may use. The cutting edge of the tool should set to the same height as the centre of the workpiece.

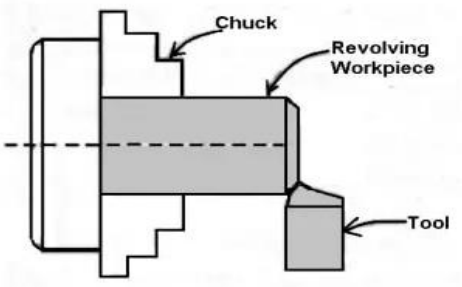


Facing Operation

- Facing consists of 2 operations
- Roughing: Here the depth of cut is 1.3mm
- Finishing: Here the depth of cut is 0.2-0.1mm.

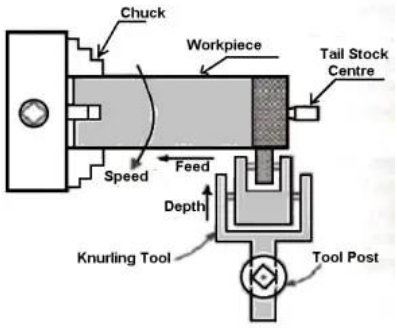
Chamfering operation:

It is the operation of getting a bevelled surface at the edge of a cylindrical workpiece. This operation is done in the case of bolt ends and shaft ends. Chamfering helps to avoid damage to the sharp edges and protects the operation from getting hurt during other operations. Chamfering on the bolt helps to screw the nut easily.



Knurling operation:

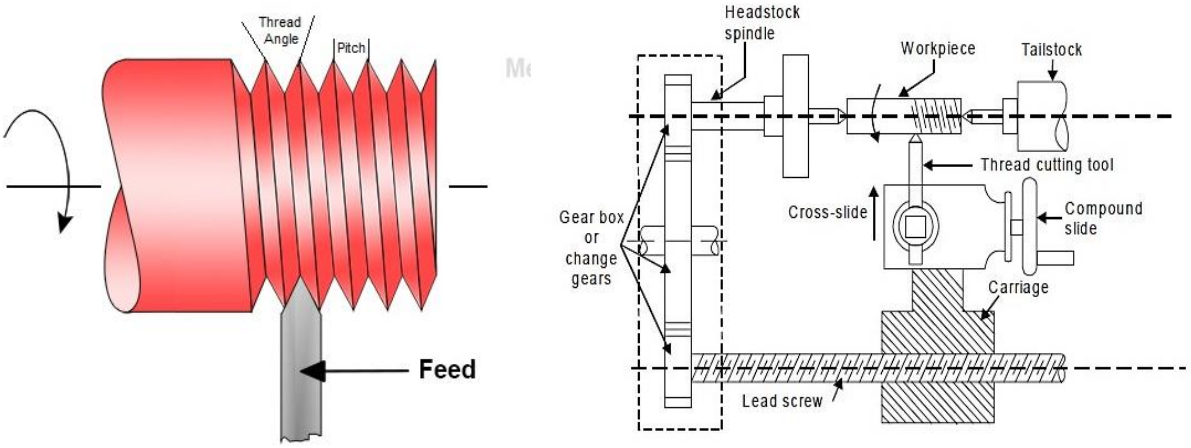
It is an operation of obtaining a diamond shape on the workpiece for the gripping purpose. This is done to provide a better gripping surface when operated by hands. It is done using a knurling tool. The tool consists of a set of hardened steel roller, and it is held rigidly on the tool post.



Knurling

Thread cutting:

It is the important operation in the lathe to obtain the continuous "helical grooves" or " threads''. When the threads or helical grooves are formed on the out surface of the workpiece is called external thread cutting. When the threads or helical grooves are formed on the inner surface of the workpiece is called internal thread cutting. The workpiece is rotating between the two centres i.e., live centre and dead centre on the lathe.



Here the tool is moved longitudinally to obtain the required type of thread. When the tool is moved from the right to the left we get the left-hand thread. Similarly, when the tool is moved from the left to the right we get the right-hand thread.

Here the motion of the carriage is provided by the lead screw. A pair of change gears drives the lead and by rotating the handle the depth of cut can be controlled.

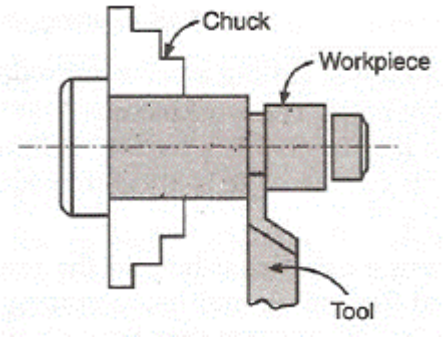
Filling:

It is the finishing operation performed after turning. This is done on a lathe to remove burrs, sharp corners, and feed marks on a workpiece and also to bring it to its size by removing a very small amount of metal. The operation consists of passing a flat single-cut file over the workpiece which revolves at a high speed. The speed is usually twice that of turning.

Polishing:

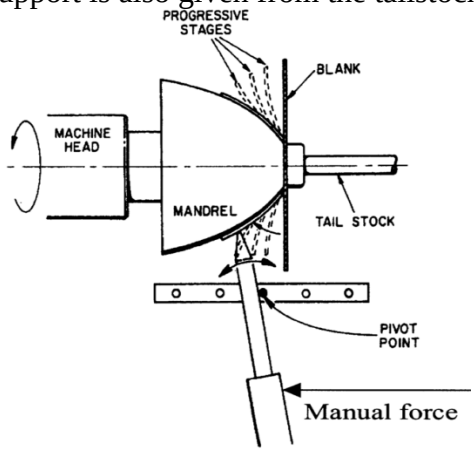
Grooving:

It is the process of reducing the diameter of a workpiece over a very narrow surface. It is done by a groove tool. A grooving tool is similar to the parting-off tool. It is often done at the end of a thread or adjacent to a shoulder to leave a small margin.



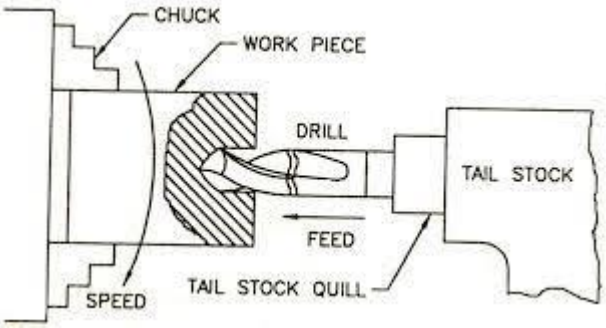
Spinning:

it is the process of forming a thin sheet of metal by revolving the job at high speed and pressing it against a headstock spindle. Support is also given from the tailstock end.



Drilling:

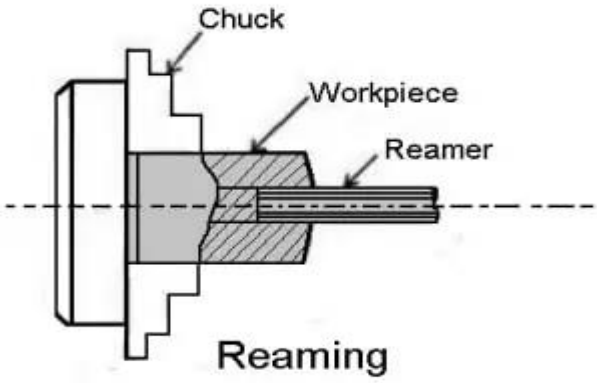
Drilling is the operation of producing a cylindrical hole in a workpiece. It is done by a rotating tool, the rotating side of the cutter, known as a drilling drill. In this operation, the workpiece is revolving in a chuck or a faceplate and the drill is held in the tailstock drill holder or drill chuck.



The feeding is adopted is affected by the movement of the tailstock spindle. This method is adopted for the drilling of regular-shaped workpiece.

Reaming:

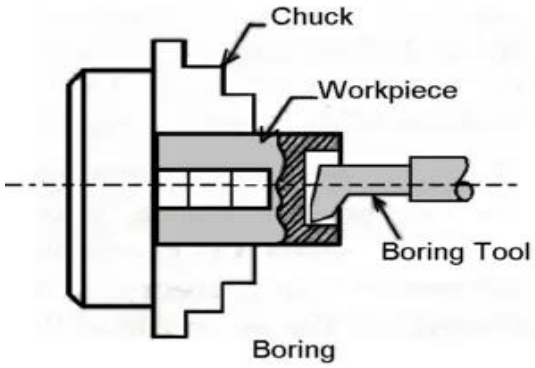
Reaming is the operation of finishing and sizing a hole which has been already drilled or bored. The tool is used is called the reamer, which has multi-plate cutting edges.



The reamer is held on the tailstock spindle, either directly or through a drill chuck, and is held stationary while the work is revolved at a very slow speed.

Boring:

Boring is the operation of enlarging the hole which is already drilled, punched or forged. It cannot produce a hole. Boring is similar to the external turning operation and can be performed in a lathe. In this operation, the workpiece is revolved in a chuck or a faceplate and the tools which are fitted to the tool post is fed into the work.



It consists of a boring bar having a single-point cutting tool that enlarges the hole. It also corrects out of the roundness of a hole. This method is adopted for boring small-sized works only. The speed of this process is slow.

Counter boring:

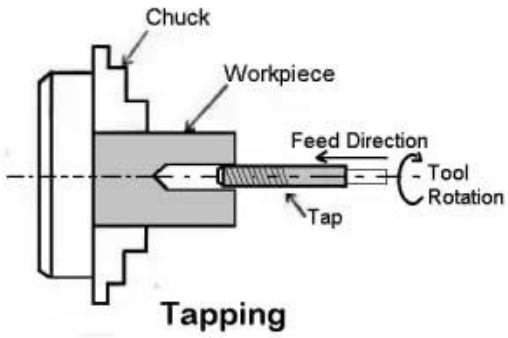
Counter boring is the operation of enlarging the end of the hole through a certain distance. It is similar to shoulder work in external turning. The operation is similar to boring and plain boring tools or a counterbore may be used. The tool is called a counterbore. The speed is slightly less than drilling.

Taper Boring:

A boring tool is mounted on the tool post and by swivelling the compound slide to the desired angle, a short taper hole is machined by hand feeding.

Tapping:

Tapping is the operation of cutting internal threads of small diameter using a multipoint cutting tool called the tap. In a lathe, the work is mounted on a chuck or a faceplate and revolved at a very slow speed. A tap of the required size held on a special fixture is mounted on the tailstock spindle.



Tapping

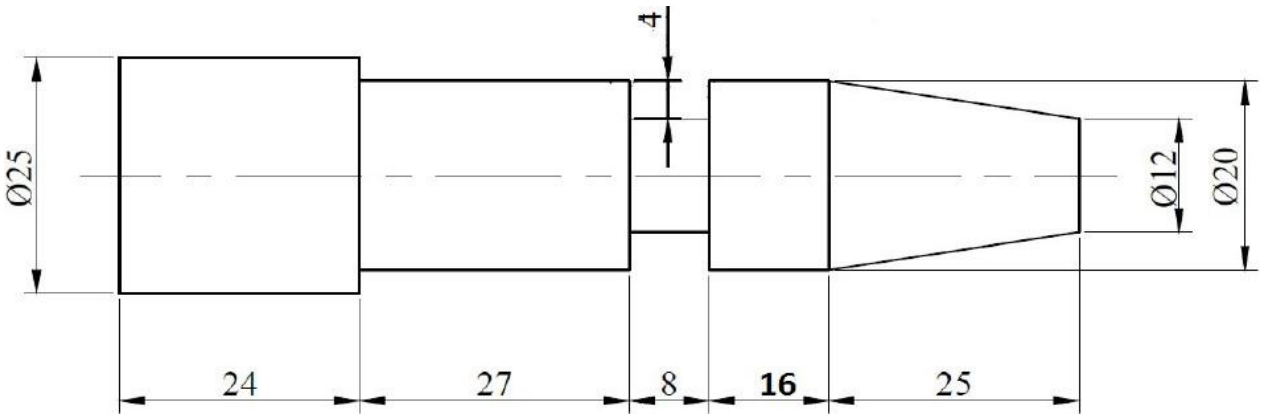
Undercutting:

Undercutting is similar to a grooving operation when performed inside a hole. It is the process of boring a groove or a large hole at a fixed distance from the end of a hole.

This is similar to the boring operation, except that a square nose parting is used. Undercutting is done at the end of an internal thread or a counterbore to provide clearance for the tool or any part.

Machine Shop Experiment No.1

Object: To study and perform various operations on a given mild steel job by a lathe machine.



Materials used: Mild steel rod of Ø 25 mm X 100 mm

Tool used: Lathe machine, single-point cutting tool etc.

Procedure:

(a) Place the round bar in the chuck (three jaws self–centring chuck) of the lathe machine and tighten the chuck using the chuck key.

(b) Mount the single-point cutting tool on the tool post with the help of the tool post key.

(c) Now face both the ends of the round bar by facing operation so that the length is brought to 100 mm. Check the length by Vernier calliper.

(d) Start turning operation to obtain the different steps on the round bar, i.e. 100× ϕ 25 mm. Check the diameter and length by Vernier calliper.

(e) Set the cross slide to about 450 and give a small feed-in longitudinal direction. Move the tool using the cross slide to chamfer the ends.

(f) Mount another grooving tool on the tool post with the help of the tool post key.

(g) Start grooving operation to obtain the desired dimensions

Conclusion: Then the final job is prepared as shown in the figure.

Precaution:

a) Loose clothes should not be worn.

b) The job must be fixed tightly in the chuck using the chuck key.

c) The chuck key must be removed from the chuck before starting the machine.

d) The machine should not be left in the running position when the operation is not being done.

e) Use a brush for removing chips instead of using hand.

f) The last cut for facing and turning should be done with the smallest feed to ensure a smoothfinish.

Shaper Machine

A shaper machine is a vertical machine which is used to produce a flat plane surface which may be horizontal, vertical or angular is also used to produce a contour of concave/convex or a combination of these.

Working Principle:

In a shaper machine, the job is rigidly held in a machine vice tool. The ram reciprocates end to end so the forward stroke cuts while the return stroke is idle. The job is given index feed normal to the line of action of the cutting tool.

The main parts of a Shaper Machine:

- Base
- Ram
- Tool Head
- Cross Rail

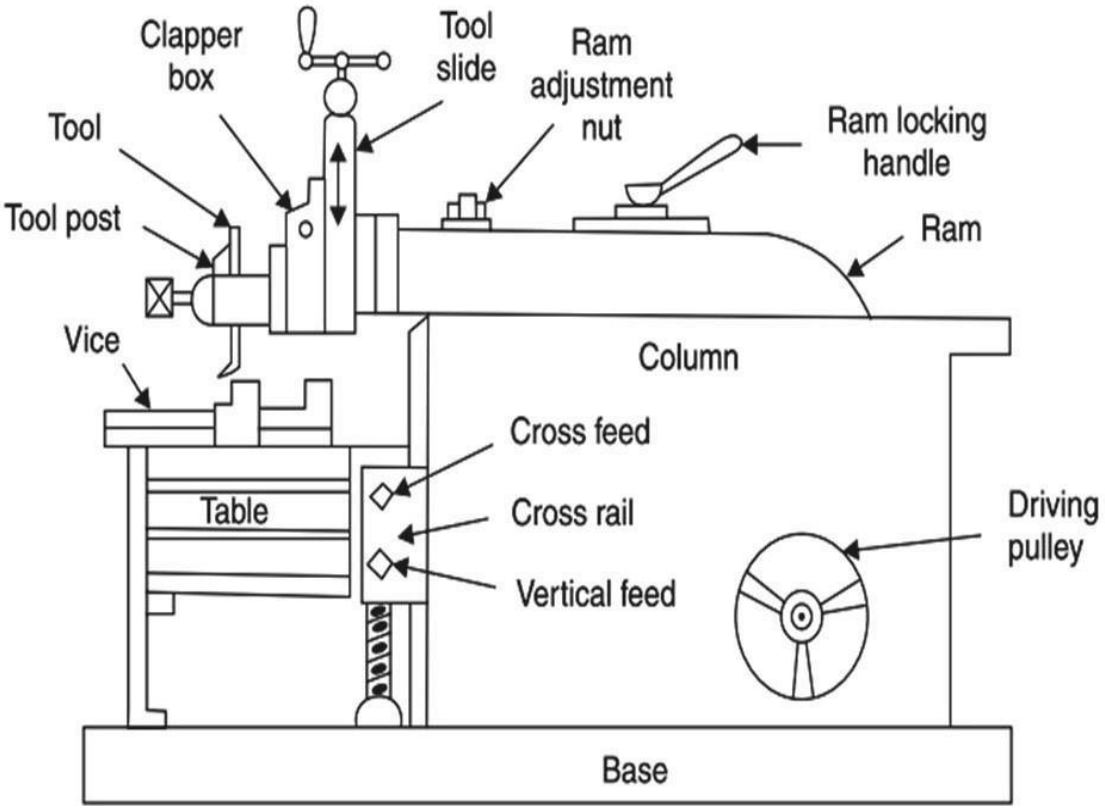
Base: It is the main body of the machine. It consists of all elements of the machine. It works as a pillar for other parts. The base is made of cast iron which can take all compressive leads.

Ram: It is the main part of the shaper machine. It holds the tool and provides the reciprocal motion to it. It is made of cast iron and moves over the ways of the column. It is attached by the rocker arm which provides its motion in a crank-driven machine.

Tool head: It is situated at the front of the ram its main function is to hold the cutting tool. The tool can be adjusted by using a clamp.

Cross Rail:

It consists of vertical and horizontal table sideways which allows the motion of the table to which it is attached with the same cross-movement mechanism.



Shaper Machine

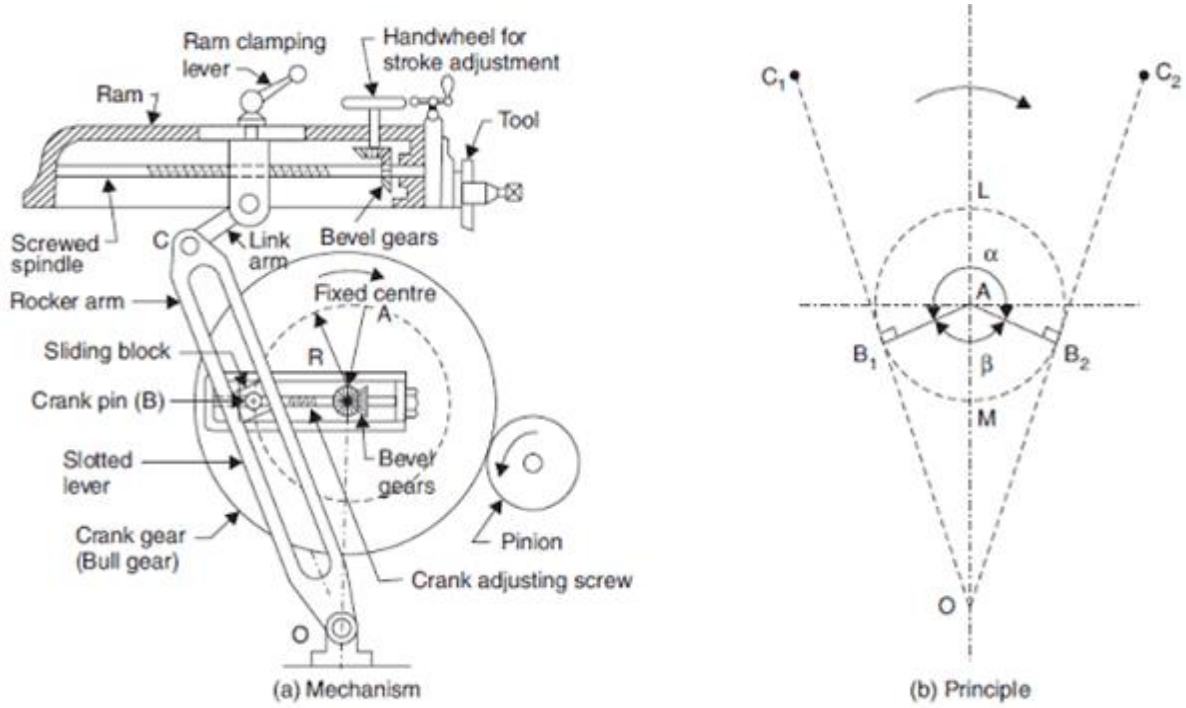
Specifications of Shaper Machine

A shaper machine can be specified on given parameters

1) Length of Ram
2) Adjustable stroke
3) Max. & Min. distance from Table to Ram
4) Max. table travel (Horizontal & Vertical)
5) Angular movement of the table
6) Max. vertical travel of tool slide
7) Max. swivel of the tool slide
8) No. of ram speeds & range of speeds
9) Range of table feed per stroke of ram
10) Overall dimensions (Length, Width, Height)
11) Net weight

Quick return mechanism of a shaper machine

A quick return mechanism is an apparatus that converts circular motion into reciprocating motion in presses and shaping machines, which are utilized to shape stocks of metal into flat surfaces. This mechanism is mostly used in shaping machines, slotting machines and in rotary internal combustion engines. The word quick return indicates that the returning stoke is faster than the forward stroke which helps the tool to retrieve back faster after doing a particular job. Quick-return mechanisms feature different input durations for their working and return strokes. The time ratio ofa Quick Return mechanism is the ratio of the change in input displacement during the working stroke to its change.

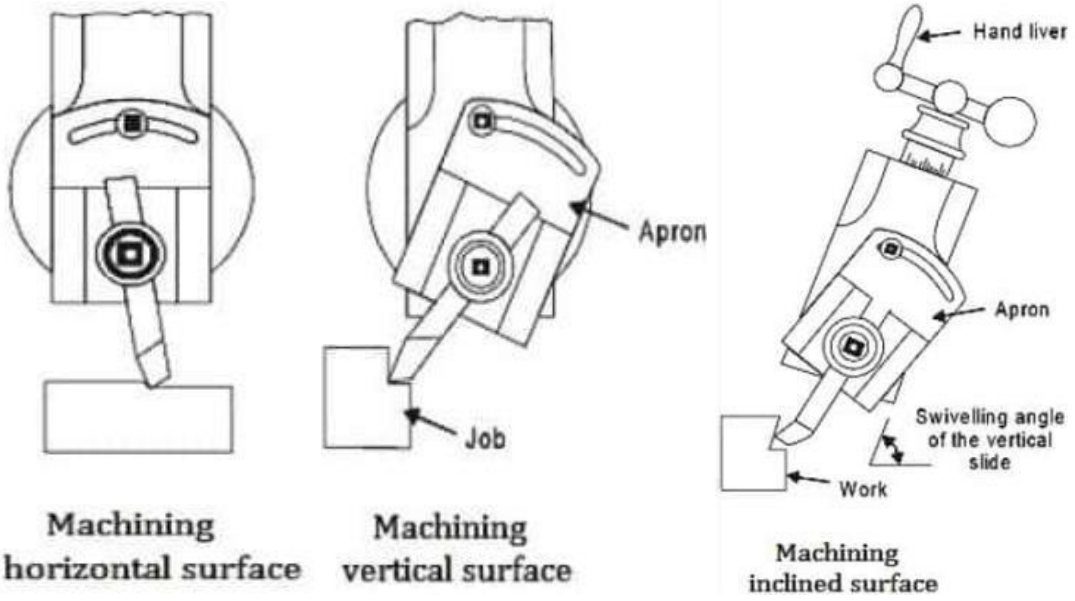


Quick return mechanism of a shaper machine

The different operations, which a shaper can perform, are as follows:

1) Machining horizontal surface.
2) Machining vertical surface.
3) Machining inclined surface.
4) Slot cutting.
5) Keyways cutting.
6) Machining irregular surfaces.

7) Machining splines and cutting gears



Machining horizontal surface

Machining vertical surface

Machining inclined surface

Machine shop Experiment No.2

Object: To study and perform various operations on a given mild steel job by a lathe machine.

Materials used: CI block

Tool used: **Shaper** machine, single-point cutting tool etc.

Procedure:

(h) Place the round bar in the chuck (three jaws self–centring chuck) of the lathe machine and tighten the chuck using the chuck key.

(i) Mount the single-point cutting tool on the tool post with the help of the tool post key.

(j) Now face both the ends of the round bar by facing operation so that the length is brought to 100 mm. Check the length by Vernier calliper.

(k) Start turning operation to obtain the different steps on the round bar, i.e. 100× ϕ 25 mm. Check the diameter and length by Vernier calliper.

(l) Set the cross slide to about 450 and give a small feed-in longitudinal direction. Move the tool using the cross slide to chamfer the ends.

(m) Mount another grooving tool on the tool post with the help of the tool post key.

(n) Start grooving operation to obtain the desired dimensions

Conclusion: Then the final job is prepared as shown in the figure.

Precaution:

g) Loose clothes should not be worn.

h) The job must be fixed tightly in the chuck using the chuck key.

i) The chuck key must be removed from the chuck before starting the machine.

j) The machine should not be left in the running position when the operation is not being done.

k) Use a brush for removing chips instead of using hand.

l) The last cut for facing and turning should be done with the smallest feed to ensure a smooth finish.

Drill Machine

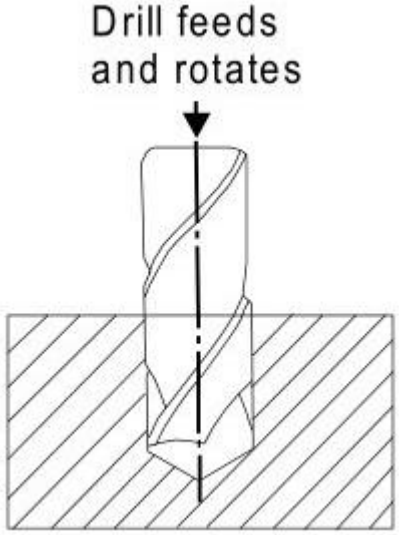
Drilling is an operation of making/producing a circular hole by removing a volume of metal from the job with a cutting tool called a twist drill. A drill is a rotary end-cutting tool with lips and clusters for the passage of cutting fluids. A drilling machine tool is designed for drilling holes in metal.

List of operations that can be performed on the drill machine:

1) Drilling operation.
2) Reaming operation.
3) Boring operation.
4) Counter boring operation.
5) Countersinking operation.
6) Spot-facing operation.
7) Tapping operation.
8) Lapping operation.

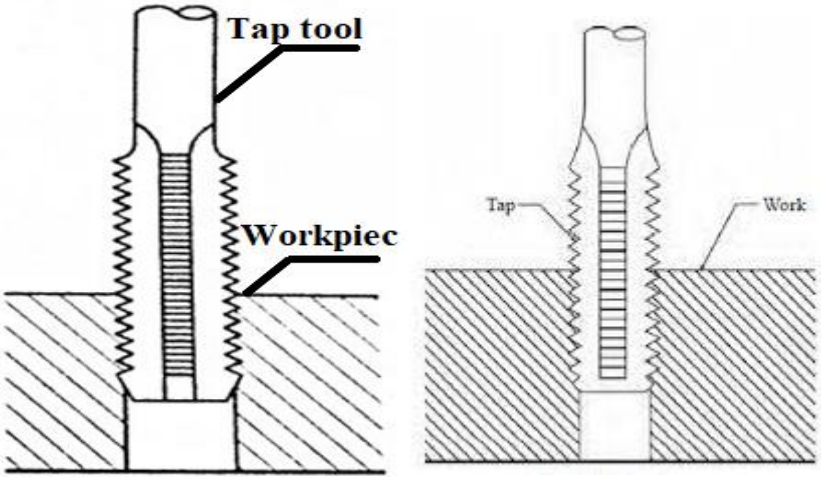
Drilling:

Drilling is the most important and common drilling machine operation. In the drilling, usually, a cylindrical hole inside the workpiece produces and removes the material inside it. Here, the material is removed by the rotating edge of the cutting tool. And that rotating edge is called a drill.



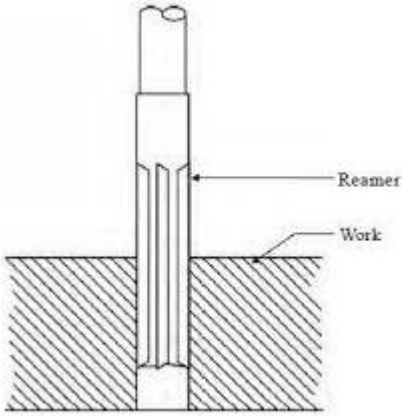
Tapping operation:

In tapping, a tap is used for generating internal threads. That means tap works as a cutting tool inside the tapping. Tapping in a drilling machine can be performed by hand. Or you can also use any external power for doing this. The metal is removed, when the tap is inserted into the hole. Tap also produces internal threads which can be fit into the external threads of the identical size.



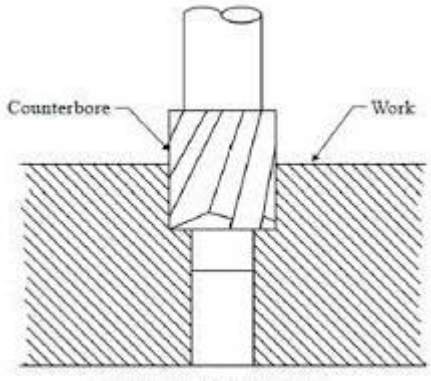
Reaming:

The size of the hole after the drilling process may not be perfect. Most of the time, its internal surface may not be finished properly. Reaming is performed to obtain the desired size of the hole. Also, the internal surface of the hole gets appropriately finished with this process. A reamer is used for reaming. Reamer is a multi-point cutting tool. The important benefit of the reaming is that it can remove an extremely small amount of metal approximately 0.375 mm



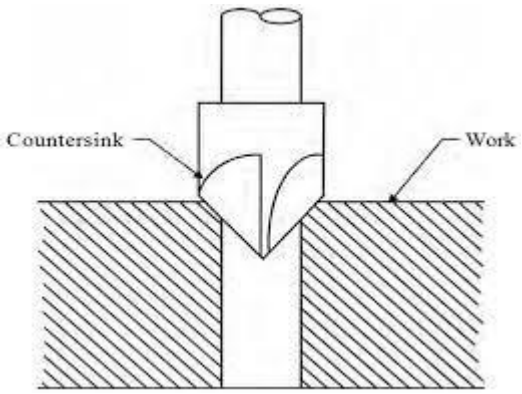
Counter boring

In the counter boring, the end of the hole is enlarged cylindrically. A counter-bore works as a tool in the counter boring. The counter bore consists of cutting edges. These cutting edges may be straight or spiral. The cutting speed in the counter-boring process is usually slow. Typically, this cutting speed is 25% smaller than that of the speed in the drilling



Counter sinking

Have you ever tried making a coned-shaped hole? It is tough to make such types of holes. Countersinking is usually done to make a cone-shaped enlargement at the end of the hole. The included angle of the conical surface may be 60º to 90º. A countersink has multiple cutting edges on its conical surface.



Types of drill machines

Drill machines are usually following types

1) Portable drilling machine
2) Sensitive drilling machine
3) Upright drilling machine
4) Radial drilling machine
5) Gang drilling machine
6) Multiple spindle drilling machine
7) Automatic drilling machine
8) Deep hole drilling machine

Working principle of a drill machine:

The rotating edge of the drills exerts a large force on the workpiece and the holes are generated. The removal of metal in a drilling operation is by shearing and extrusion.

Main parts of a Drill Machine:

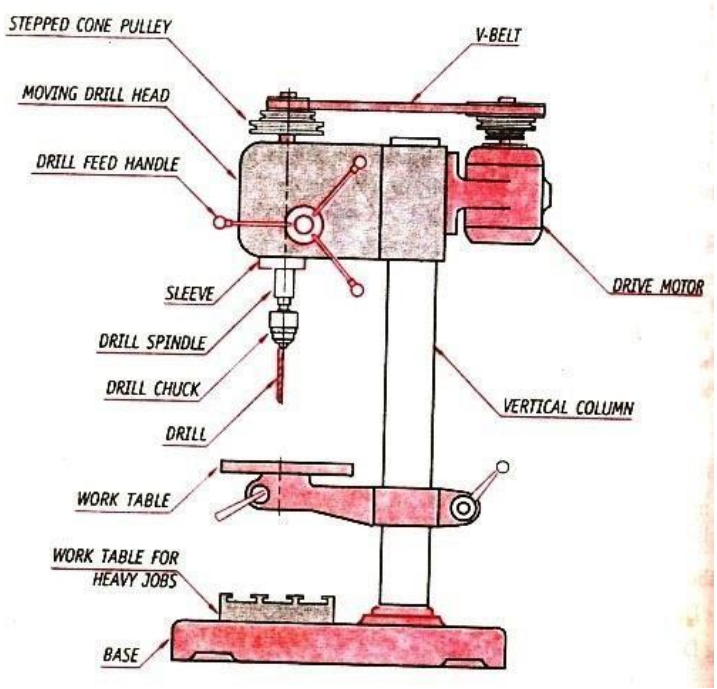
- Base
- Table
- Spindle
- Drill head

(1) Base: The base is used to support and stabilize the column or pillar drill.

(2) Table: The table supports the working material object and can be adjusted to the size of the workpiece. The table is adjusted by rotating around the pillar.

(3) Spindle: The spindle holds and rotates the drill bit. Its speed is adjusted to control the depth and diameter of the hole being bored.

(4) Drill Head: The drill head houses the spindle and moves it upward or downward.



Drill Machine

Machine shop Experiment No.3

Object: To study and perform various operations on a given mild steel job by a lathe machine.

Materials used: Mild steel rod of Ø 25 mm X 100 mm

Tool used: Lathe machine, single-point cutting tool etc.

Procedure:

(o) Place the round bar in the chuck (three jaws self–centring chuck) of the lathe machine and tighten the chuck using the chuck key.

(p) Mount the single-point cutting tool on the tool post with the help of the tool post key.

(q) Now face both the ends of the round bar by facing operation so that the length is brought to 100 mm. Check the length by Vernier calliper.

(r) Start turning operation to obtain the different steps on the round bar, i.e. 100× ϕ 25 mm. Check the diameter and length by Vernier calliper.

(s) Set the cross slide to about 450 and give a small feed-in longitudinal direction. Move the tool using the cross slide to chamfer the ends.

(t) Mount another grooving tool on the tool post with the help of the tool post key.

(u) Start grooving operation to obtain the desired dimensions

Conclusion: Then the final job is prepared as shown in the figure.

Precaution:

m) Loose clothes should not be worn.

n) The job must be fixed tightly in the chuck using the chuck key.

o) The chuck key must be removed from the chuck before starting the machine.

p) The machine should not be left in the running position when the operation is not being done.

q) Use a brush for removing chips instead of using hand.

r) The last cut for facing and turning should be done with the smallest feed to ensure a smooth finish.

Milling Machine

A milling machine is a machine tool in which cutting operation removes metal by feeding the work against a rotating cutter having single or multiple cutting edges flat or curved surfaces of many shapes can be machined by milling with well-finished accuracy. A milling machine may also be used for drilling, slotting, making a circular profile and gear cutting by having suitable attachments.

Working principle: The workpiece is held on the work table of the machine. The table movement controls the feed of the workpiece against the rotating cutter. The cutter is mounted on a spindle or rotating a bar at high speed. Except that the rotating cutter has no other motion. As the workpiece advances the cutter teeth remove the metal from the surface of workpiece and the desired shape is produced

Main parts of a milling machine: A milling machine has the following parts-

Base: It gives support and rigidity to the machine and also acts as a reservoir for the cutting fluids.

Column: The column is a main supporting frame mounted vertically on the base. The column is box-shaped, heavily ribbed inside and houses all the driving mechanisms for the spindle and the table feed.

Knee: The knee is a rigid casting mounted on the face of the column. The knee moves vertically along the guideways and this movement enables to adjustment of the distance between the cutter and the job mounted on the table.

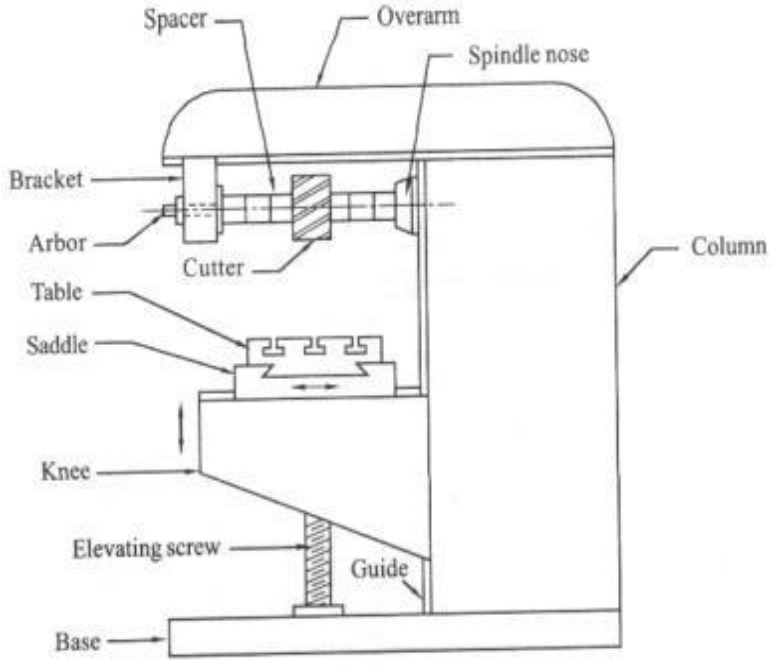
Saddle: The saddle rests on the knee and constitutes the intermediate parts between the knee and the table. The saddle moves transversely.

Table: The table rests on guideways in the saddle and provides support to the work. The table is made of cast iron. Its top surface is accurately matched and carries slots which accommodate the clamping bolt for fixing the works. The job fitted on it is given motion in three directions.

Overarm: The overarm is mounted at the top of the column and is guided in perfect alignment by the machined surface. The overarm is the support for the arbor.

Arbor support: The arbor support is fitted to the overarm and can be clamped at any location on the overarm.

Elevating screw: The upward and downward movement to the knee and the table is given by the elevation screw that is operated by hand or an automatic feed.



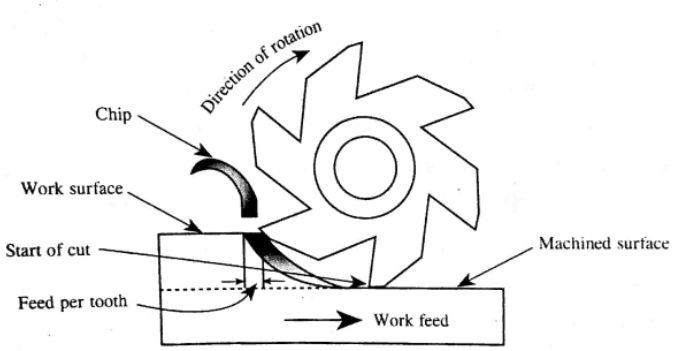
Horizontal milling machine

Types of Milling Machine:

1) Horizontal milling machine.
2) Vertical milling machine.
3) Column and Knee Type Milling Machine
4) Simplex milling machine.
5) Duplex milling machine
6) Triplex milling machine.
7) Fixed Bed Type milling machine.
8) Universal Milling Machine

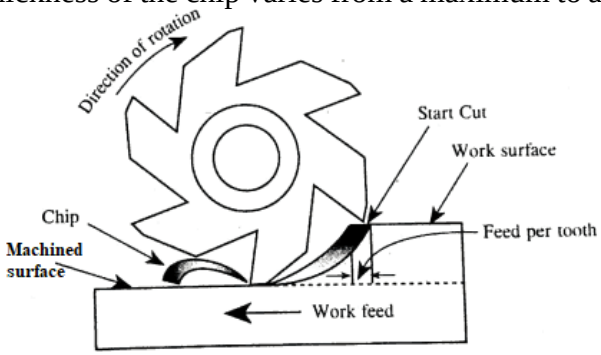
Up milling:

The up-milling is also called as conventional milling or Climb-up milling in which the cutter and feed move in opposite directions i.e. the rotary cutter moves against the feed. With reference to the adjacent figure, you can see that the cutter rotates in an anti-clockwise direction while the direction of the feed is from right to left. So, due to this opposite motion, the width of the cutting chips gradually increases from minimum to maximum.



Down milling:

This is also called a Climb-down milling. In the case of down milling, the cutter rotates in the same direction as that of the feed. There is less friction involved between the cutter and the workpiece. Therefore, the cutter and feed are moving in the same direction—this small amount of friction results in the generation of minimum heat. Here, the thickness of the chip varies from a maximum to a minimum during the process.



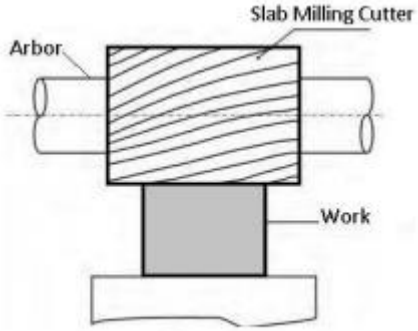
Milling Machine Operations

Various machining operations can be performed and they are mentioned below:

1) Face Milling Operation
2) Slot or Slab Milling Operation
3) End Milling Operation
4) Angular Milling Operation
5) Side and Face Milling Operation
6) Form Milling Operation
7) Slitting Operation
8) Keyway Milling Operation
9) Gear Cutting Operation
10) Profile Milling Operation
11) Helical Milling Operation

Plain Milling:

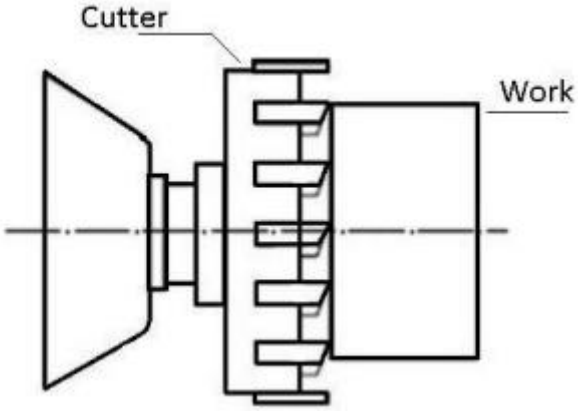
- The plain milling is the most common type of milling machine operation.
- Plain milling is performed to produce a plain, flat, horizontal surface parallel to the axis of rotation of a plain milling cutter.
- operation is also known as slab milling.
- To perform the operation, the work and the cutter are secured properly on the machine
- The depth of cut is set by rotating the vertical feed screw of the table. The machine is started after selecting the right speed and feed.



Plain Milling Operation

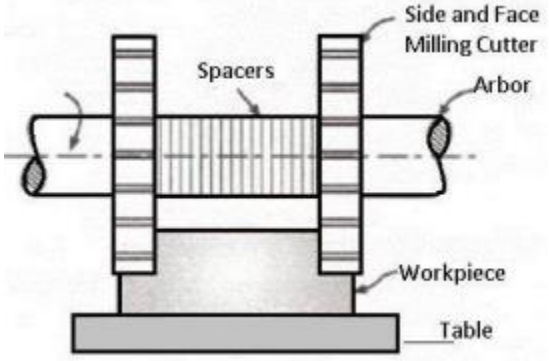
Face milling:

- The face milling is the simplest milling machine operation.
- This operation is performed by a face milling cutter rotated about an axis perpendicular to the work surface.
- The operation is carried out in plain milling, and the cutter is mounted on a stub arbor to design a flat surface.
- The depth of cut is adjusted by rotating the cross-feed screw of the table.



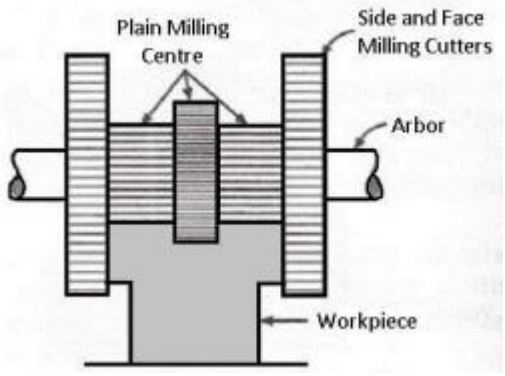
Straddle milling:

- The straddle milling is the operation of producing a flat vertical surface on both sides of a workpiece by using two side milling cutters mounted on the same arbor.
- Distance between the two cutters is adjusted by using suitable spacing collars.
- The straddle milling is commonly used to design a square or hexagonal surfaces.



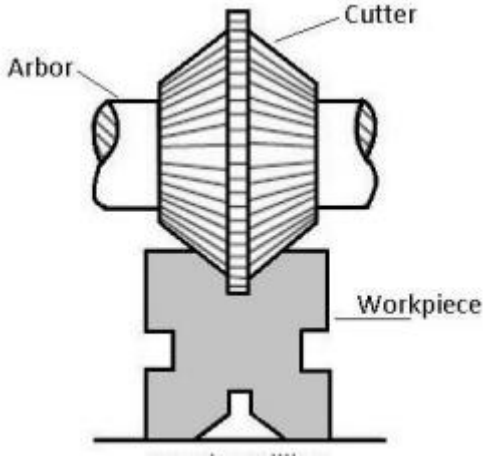
Gang milling:

- The gang milling is the operation of machining several surfaces of a workpiece simultaneously by feeding the table against several cutters having the same or different diameters mounted on the arbor of the machine.
- The method saves much of machining time and is widely used in repetitive work.
- The cutting speed of a gang of cutters is calculated from the cutter of the largest diameter.



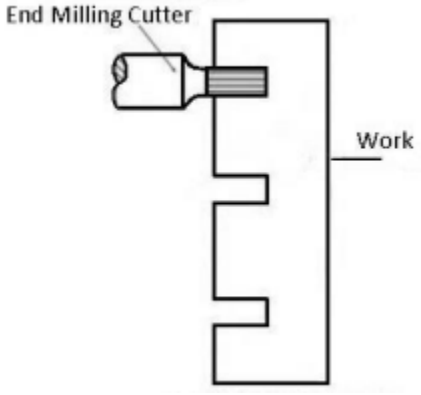
Angular milling:

- The angular milling is the operation of producing an angular surface on a workpiece other than at right angles of the axis of the milling machine spindle.
- The angular groove may be single or double angle and may be of varying included angles according to the type and contour of the angular cutter used
- One simple example of angular milling is the production of V-blocks.



End milling:

- The end milling is the operation of producing a flat surface which may be vertical, horizontal or at an angle about the table surface.
- The cutter used is an end mill. The end milling cutters are also used for the production of slots, grooves or keyways.
- A vertical milling machine is more suitable for end milling operation



Machine shop Experiment No.4

Object: To study and perform various operations on a given CI block job by a Milling machine.

Materials used: Cast Iron block of 25 mm X 100 mm

Tool used/machine used: **Milling** machine, milling cutter, machine vice etc.

Procedure:

(v) Place the round bar in the chuck (three jaws self–centring chuck) of the lathe machine and tighten the chuck using the chuck key.

(w) Mount the single-point cutting tool on the tool post with the help of the tool post key.

(x) Now face both the ends of the round bar by facing operation so that the length is brought to 100 mm. Check the length by Vernier calliper.

(y) Start turning operation to obtain the different steps on the round bar, i.e. 100× ϕ 25 mm. Check the diameter and length by Vernier calliper.

(z) Set the cross slide to about 450 and give a small feed-in longitudinal direction. Move the tool using the cross slide to chamfer the ends.

(aa) Mount another grooving tool on the tool post with the help of the tool post key.

(bb) Start grooving operation to obtain the desired dimensions

Conclusion: Then the final job is prepared as shown in the figure.

Precaution:

s) Loose clothes should not be worn.

t) The job must be fixed tightly in the chuck using the chuck key.

u) The chuck key must be removed from the chuck before starting the machine.

v) The machine should not be left in the running position when the operation is not being done.

w) Use a brush for removing chips instead of using hand.

x) The last cut for facing and turning should be done with the smallest feed to ensure a smooth finish.