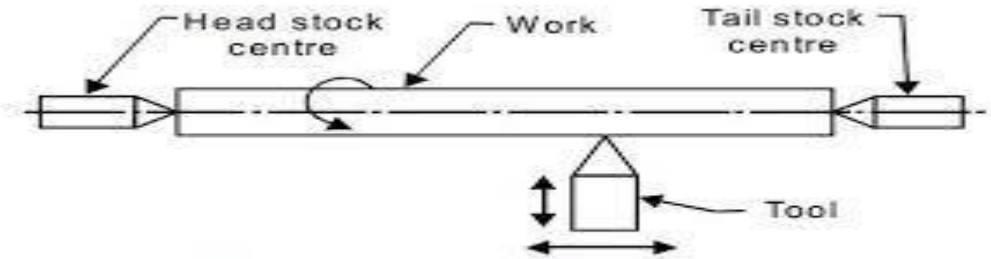
Lathe Machine

A lathe machine is a machine tool that removes the undesired material from a rotating workpiece in the form of chips with the help of a tool that is traversed across the work and can be feed deep into the work.It one of the most versatile and widely used machine tools all over the world.

Lathe Machine Definition
This is also known as the 'Mother of all Machines'. Nowadays, Lathe Machine has become a general-purpose machine tool, employed in production and repair work, because it permits a large variety of operations to be performed on it.

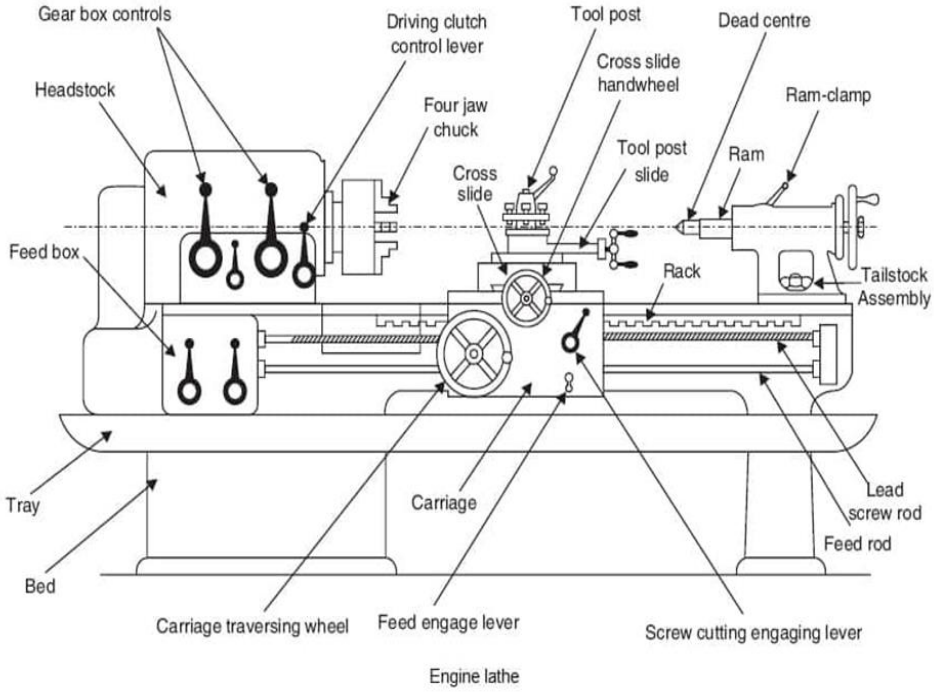
A Lathe works on the principle of rotating the workpiece and a fixed cutting tool.The workpiece is held between two rigid and strong supports called a center or in a chuck or in faceplate which revolves.Lathe removes the undesired material from a rotating workpiece in the form of chips with the help of a tool that is transverse across the work and can be fed deep in the work.The main function of the lathe is to remove the metal from a job to give it the required shape and size



Principle diagram of lathe

Lathe Machine Parts:

- Bed
- Headstock
- Tail stock
- Carriage
- Saddle
- Cross Slide
- Compound rest
- Tool Post
- Apron
- Chuck
- Feed rod
- Lead Screw
- Spindle



Engine lathe

Bed:
The bed of the lathe machine is the base on which all the other parts of the lathe are mounted. The bed is made from cast iron or nickel cast iron alloy and is supported on broad box-section columns.Its upper surface is either scraped or grounded and the guiding and the sliding surfaces are provided.The bed consists of heavy metal slides running lengthwise, with ways or v's forced upon them. It is rigidly supported by cross griths.

Headstock:
The headstock is present on the left end of the bed. The main function of the headstock is to transmit power to the different parts of the lathe.

It supports the main spindle in the bearing and aligns it properly. It also houses a necessary transmission mechanism with speed changing levers to obtain different speeds.

Tailstock:
The tailstock is a movable casting located opposite to the headstock on the way of the bed.

The basic function of the tailstock is:

1. To support the other end of the work when being machined.
2. To hold a tool for performing operations like drilling, reaming, tapping, etc.

It consists of the dead centers, the adjusting screws, and the handwheel. The body of the tailstock is adjustable on the base which is mounted on the guideways of the bed and can be moved.

Carriage:
Carriage is located between headstock and tailstock. The basic function of the carriage is to support, guide, and feed the tool against the job during operation.

It consists of 5 main parts:

- Saddle
- Cross Slide
- Compound rest
- Tool Post
- Apron

Saddle:
It is an H-shaped casting mounted on the top of the lathe ways. It provides support to cross-slide, compound rest, and tool post.

Cross Slide:
Cross slide is provided with a female dovetail on one side and assembled on the top of the saddle with its male dovetail.

The top surface of the cross slide is provided with T slots to enable fixing of rear tool post or coolant attachment. Carriage basically provides a mounted or automatic cross-movement for the cutting tool.

Compound Rest:
Compound rest is present on the top of the cross slide. It supports the tool post and cutting tool in its various positions. Compound rest is necessary for turning angles and boring short tapers and forms on forming tools.

Tool Post:
The tool post is mounted on the compound rest. It is used to hold various cutting tool holders. The holders rest on a wedge which is shaped on the bottom to fit into a concave-shaped ring (segmental type)Which permits the height of the cutting edge to be adjusted by tilting the tool. It is fixed on the top slide. It gets its movement by the movement of the saddle, cross slide, and top slide.

Apron:
The Apron is fastened to the saddle and hangs over the front of the bed. Apron consists of the gears and clutches for transmitting motion from the feed rod to the carriage, and the split nut which engages with the lead screw during cutting threads.

Chuck:
Chuck is basically used to hold the workpiece, particularly of short length and large diameter or of irregular shape which can't be conveniently mounted between centers. It can be attached to the lathe by screwing on the spindle nose.

Independent or four-jaw chuck:
It is used for irregular shapes, rough castings of square or octagonal in such jobs, where a hole is to be positioned off the center. It consists of four jaws and each jaw is independently actuated and adjusted by a key for holding the job.

Three jaw or universal chuck:
It consists of three jaws that move simultaneously by turning a key and the workpiece automatically remains in the center of the chuck opening. It is used for holding a round, hexagonal bar or other symmetric work.

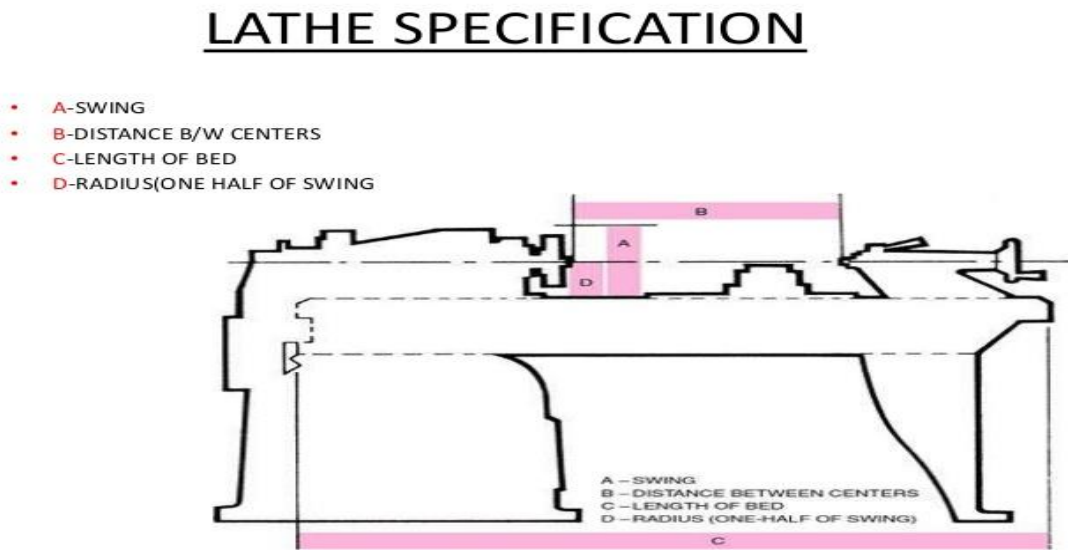
Collet chuck:
It is mostly used in the places where production work is required such as in Capstan Lathe or automats. It is used for holding the bars of small sizes (below 63mm).

Magnetic chuck:
They are of permanent magnet type or electrically operated. In Lathe, it does not have widespread use.

Feed Rod:
Feed rod is a power transmission mechanism used for precise linear movement of the carriage along the longitudinal axis of the lathe. In some lathe machines instead of feed rod lead screws are used.

Lead screw:
The lead screw is used mostly in the case when the threading operation is to be performed on a lathe. As we know for threading operation requires rotational movement of the job (workpiece) and the linear movement of the tool (tool post).

So rotation of the job is obtained by the chuck and the desired linear motion of the tool-post (as the lead screw drives the saddle when it is engaged) is provided with the help of a lead screw.



Lathe Machine Specification
a) The length between the two centers:It is the measure of the maximum length of the workpiece that can be fixed between the lathe center.

b) Height of the center:The distance between the lathe axis and the lathe bed is called the height of the center.

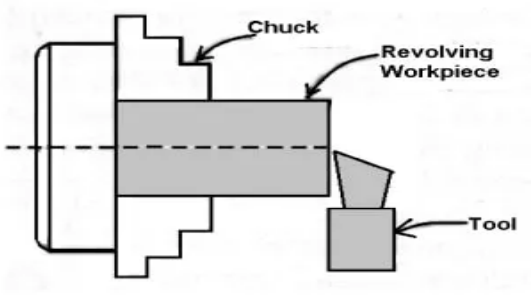
c) Swing Diameter over the bed:It is the maximum diameter of the workpiece that can we turned on a lathe without hitting the lathe bed.

d) Maximum bar diameter:It is the maximum diameter of the workpiece that can be passed through the hole in the headstock.

Lathe Machine Operations

FACING

It is an operation of reducing the length of the workpiece by feeding the perpendicular to the lathe axis. This operation of reducing 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.

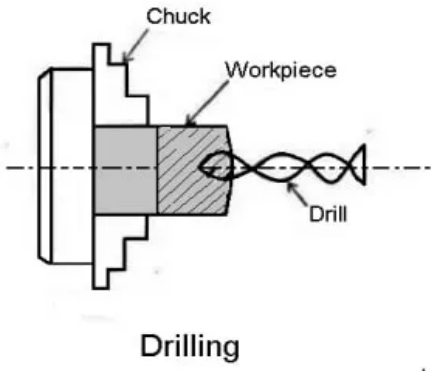


Facing Operation

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.

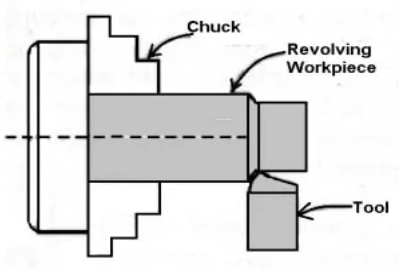
The feeding is adopted is affected by the movement of the tailstock spindle. This method is adopted for the drilling of regular-shaped workpiece.



Drilling

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.

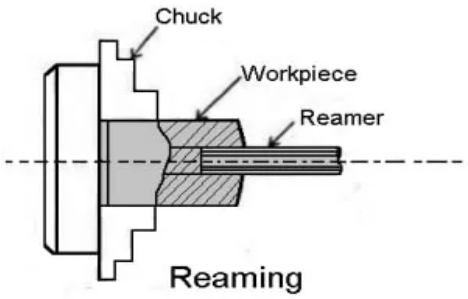


Turning Operation

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.

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.

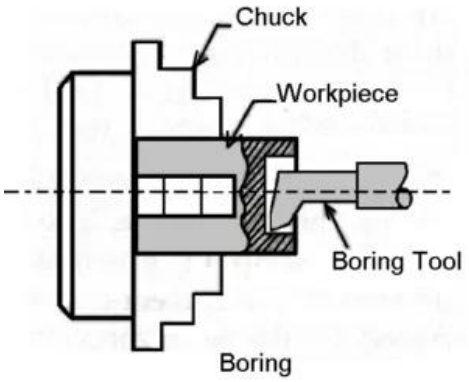


Reaming

Boring:

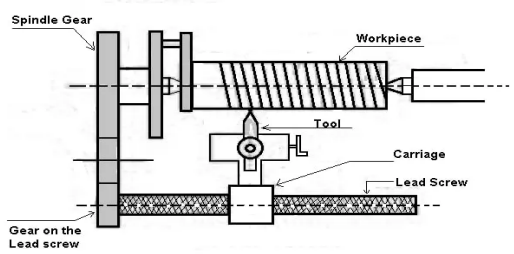
Boring is the operation of enlarging the hole which is already drilled, punched or forged. It cannot produce a hole. Boring is similar to the external turning operation and can be performed in a lathe. In this operation, the workpiece is revolved in a chuck or a faceplate and the tools which are fitted 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 adopted for boring small-sized works only. The speed of this process is slow.



Thread cutting:

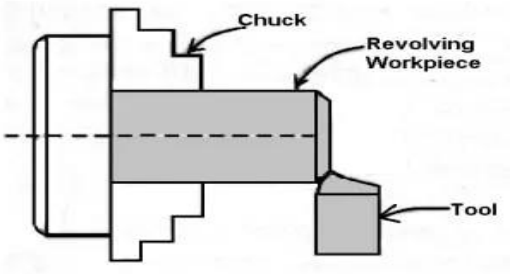
It is the important operation in the lathe to obtain the continuous ”helical grooves” or ” threads’‘.When the threads or helical grooves are formed on the out surface of the workpiece is called external thread cutting. When the threads or helical grooves are formed on the inner surface of the workpiece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



Thread Cutting

Chamfering operation

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



Chamfering

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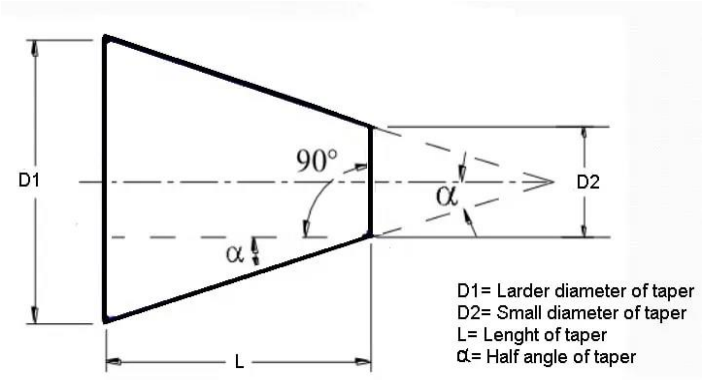
Taper Turning:

- 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.



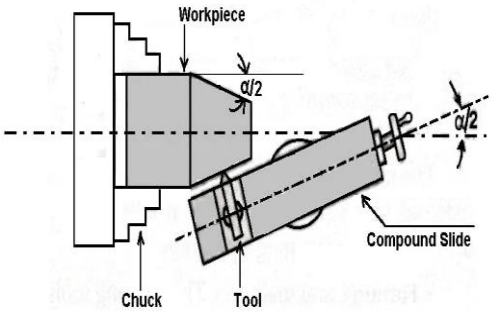
The amount of taper in the workpiece is usually specified on the basis of the difference in diameter of the taper to its length. It is known as a cone and it is indicated by the letter K.

It has the formula K = D-d / 1 to produce the taper on the workpiece.

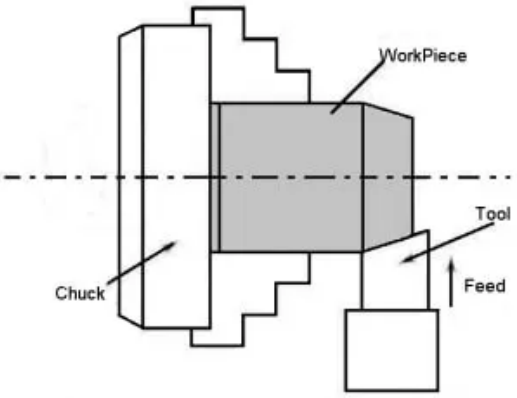
- D = Larger diameter of taper.
- d = Small diameter of taper.

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.

- Methods of taper turning,
  - Form tool method
  - Combined feeds method
  - Compound rest method or swivelling compound rest method
  - Tailstock set over method
  - Taper turning attachment method



Taper Turning



Taper Turning Using Form Tools.

- Taper: $\tan\alpha = \frac{D_1 - D_2}{2L}$

1. Form tool method

Here the taper length obtain is equal to the width of the form tool. To obtain the required size of the taper the form tool is fed slowly straight into the workpiece by operating the cross slide perpendicular to the lathe axis.

2. Combined feeds method

The combined feed is made with the movement of a tool in longitudinal and lateral direction simultaneously while moving the workpiece.

3. Compound rest swivel method

Here the workpiece rotates and the cutting tool is fed at an angle by swivelled compound rest. The base of the compound rest is graduated in degrees.

4.Taper turning attachment method

- This method is similar to the compound rest method.
- Here the job or workpiece rotates and the tool is fed at the taper angle α.
- In this, arrangement, which has guide block graduated in degrees, with the help of this the block can be required taper angle to the lathe axis.
- The taper angle is calculated similarly to the compound rest method using the formula: tanα = D-d / 21.