Lathe Machine: Definition, Introduction, Parts, Operation, Specification, PDF

learnmechanical.com/lathe-machine

July 23, 2018

Today we will study the **Definition, Introduction, Diagram, Parts, Operation, and Specification** of a **lathe machine tool**. Also, you can download the whole document in a PDF format, I will add the PDF download link at the bottom of this article. So let me give you the **introduction of the lathe machine tool**.

Lathe machine introduction

The ***Lathe*** was invented by **Jacques de Vaucanson around 175**1.

The **Lathe Machine** is an ancient tool. At the very early stage this machine was developed around 1300 BC at that time there was not developed so many parts expect headstock and Tailstock. But during the industrial revolution Metalworking lathe evolved into heavier machines with thicker, more rigid parts.

Between 19 and 20 century the electric motor is replaced line shafting as a power source.

Then in 1950, the servomechanism is applied to control lathe and other machine tools by numeric, Direct numerical control machine.

The **Lathe is the most versatile machine tool** among all standard of the machine tool.

Nowadays the manually controlled machine exists like a CNC machine and even do with the help of feed mechanism the lathe machine operates manually.

Lathe Machine Definition:

A lathe machine is a machine tool which is used to remove metals from a workpiece to give a desired shape and size.

Lathe Machines are used in **metalworking, woodturning, metal spinning, thermal spraying, glass working, and parts reclamation**.

The various other operations that you can perform with the help of Lathe Machine can include sanding, cutting, knurling, drilling, and deformation of tools that are employed in creating objects which have symmetry about the axis of rotation.

There are several **components of a lathe**, later on, I discuss the **most important Parts of Lathe with their function**. It is also known as the father of all standard machine tools.

The function of Lathe is to **remove the metal in the form of chips from a piece of work by mounting the same rigidly on a machine spindle and revolving at the required speed and the cutting tool is fed against the work either longitudinally or crosswise to make the work to the required shape and size**.

Parts of the Lathe machine tool and their functions:

A ***lathe machine tool consists of several parts*** like:

1. **Headstock**
2. **Bed**
3. **Tailstock**
4. **Carriage**
5. **Saddle**
6. **Cross-slide**
7. **Compound rest**
8. **Toolpost**
9. **Apron**
10. **Lead Screw**
11. **Feed rod**
12. **Chuck**
13. **Main spindle**
14. **Leg**

Let me explain all these parts in details.

Head Stock:

Head Stock is situated at the left side of lathe bed and it is the house of the driving mechanism and electrical mechanism of a Lathe machine tool.

- It holds the job on its spindle nose having external screw threads and internally Morse taper for holding lathe center. And it is rotating at a different speed by cone pulley or all geared drive. There is a hole throughout spindle for handling long bar work.
- Head Stock transmit power from the spindle to the feed rod, lead screw and thread cutting mechanism.

Accessories mounted on headstock spindle:

1. **Three jaw chuck**
2. **Four jaw chuck**
3. **Lathe center and lathe dog**
4. **Collect chuck**
5. **Faceplate**
6. **Magnetic chuck**

A separate speed change gearbox is placed below headstock to reduce the speed in order to have different feed rates for threading and automatic lateral movement of the carriage. The feed rod is used for most turning operation and the lead screw is used for thread cutting operation.

Bed:

It is the base of the lathe machine. It is made of single piece casting of Semi-steel (Chilled Cast Iron). The bed consists of two heavy metal slides running lengthwise, with ways or 'V' formed upon them and rigidly supported with cross girths.

- It is sufficiently rigid and good damping capacity to absorb vibration.
- It prevents the deflection produced by the cutting forces.
- It supports the headstock, tailstock, carriage and other components of lathe machine.

Tail Stock:

Tail Stock is situated at the right side above the lathe bed.

It is used for:

- Support the long end of the job for holding and minimizes its sagging.
- It holds the tool for performing different operations like drilling, reaming, tapping, etc.
- And it is also used for a small amount of taper for a long job by offsetting the tailstock.

Carriage:

The carriage is used for support, guide and feed the tool against the job when the machining is done.

- It holds moves and controls the cutting tool.
- It gives the rigid supports to the tool during operations.
- It transfers power from feed rod to cutting tool through apron mechanism for longitudinal cross-feeding.
- It simplifies the thread cutting operation with the help of lead screw and half nut mechanism.

It is consists of:

1. **Saddle**
2. **Cross-slide**
3. **Compound rest**
4. **Toolpost**
5. **Apron**

It provides three movements to the tool:

1. **Longitudinal feed-through carriage movement**
2. **Cross feed-through cross slide movement**
3. **Angular feed-through top slide movement**

Saddle:

Generally, it is made up of 'H' shaped casting and it has 'V' guide and a flat guide for mounting it on the lathe bed guideways.

Cross-slide:

It is assembled on the top of the saddle. The top surface of the cross-slide is provided with T-slot.

Compound rest:

It supports the tool post and cutting tool in its various positions. It can be swiveled at any desired position in the horizontal plane. It is necessary for turning angles and boring short tapers.

Tool post:

It is the topmost portion of the carriage and it is used to hold various cutting tools or tool holder.

There are three types of tool post commonly used and those are:

1. **Ring and rocker tool post**
2. **Squarehead tool post**
3. **Quick change tool post**

Apron:

An apron is a house of the feed mechanism. It is fastened to the saddle and hangover in front of the bed.

Lead screw:

A lead screw is also known as a power screw or translation screw. It converts rotational motion to linear motion. Lead Screw is used for **Thread Cutting operation** in a lathe machine tool.

Feed Rod:

Feed rod is used to move the carriage from left side to right side and also from the right side to left side.

Chuck:

Chuck is used to holding the workpiece securely.

There are generally 2 types of chucks:

1. **3 jaw self-centering chuck**
2. **4 jaw independent chuck**

Main Spindle:

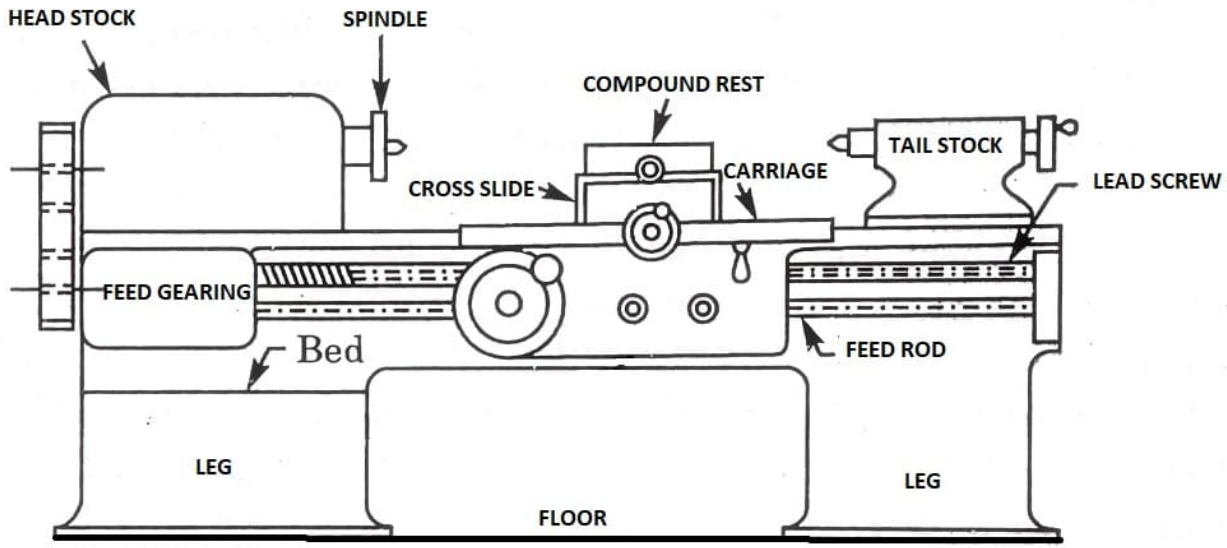
The spindle is a hollow cylindrical shaft in which long jobs can pass through it.

It is designed so well that the thrust of the cutting tool does not deflect the spindle.

Leg:

Legs are carrying an entire load of a lathe machine tool and transfer to the ground. The legs are firmly secured to the floor by the foundation bolt.

Schematic diagram of the lathe machine:



Lathe machine tool

Now discuss the operations performed in a Lathe

Here is the comprehensive list of lathe operation. Although as any operation performs in lathe machine tool but these are some of the general operation we are doing in a lathe.

- ***Centering***
- ***Facing***
- ***Turning***
- ***Chamfering***
- ***Knurling***
- ***Thread cutting***
- ***Drilling***
- ***Boring***
- ***Reaming***
- ***Spinning***
- ***Tapping***
- ***Parting off***

Before continuing any **operation in lathe** we have to load the job and center it on the head-stock spindle.

In **lathe operations**, the headstock spindle holds the job and it rotates with the same speed as the spindle. The carriage holding the tool on the tool post, also the carriage gives the tool post moves longitudinally or crosswise direction to give the desired feed on the job.

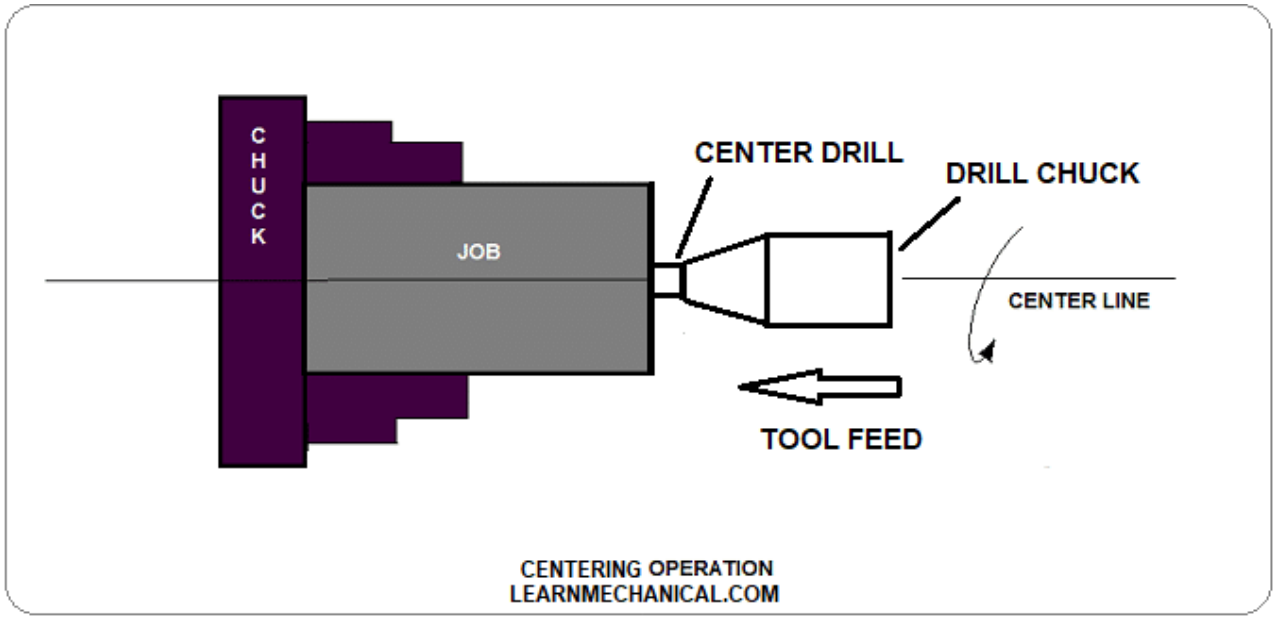
This two motions (longitudinally and crosswise) helps to remove the chips of the metal and giving the proper shape of the job.

The Lathe is such a versatile machine that it can produce another lathe.

It is tough to mentioned which operations are not performed in a lathe machine tool, though we discuss **some important lathe operations in details**.

Centering operation in the lathe:

We use this operation for producing a conical hole in the face of the job to make the bearing support of the lathe center when the job is to hold between two centers. (Head-stock and Tail-stock).



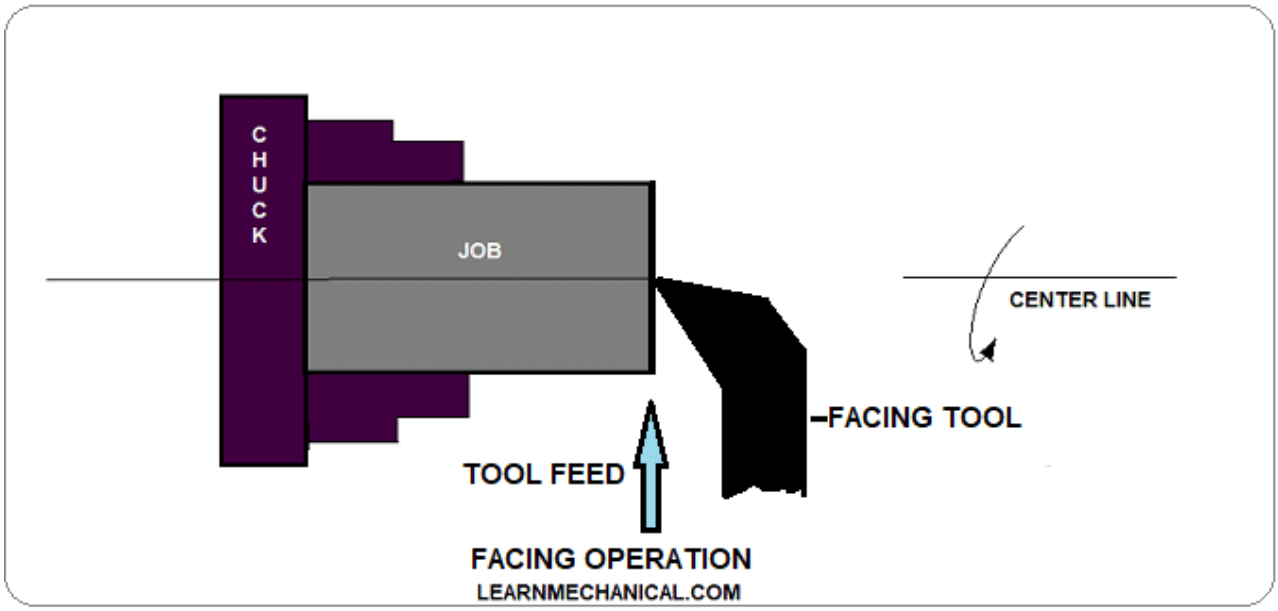
CENTERING OPERATION

Facing operation in the lathe:

Facing operation is for making the ends of the job to produce a smooth flat surface with the axis of operation or a certain length of a job.

In this operation,

1. Hold the job on Head-stock spindle using Three or four-jaw chuck.
2. Start the machine on desire RPM to rotate the job.
3. Give a desirable feed on the perpendicular direction of the axis of the job.



FACING OPERATION

Turning operation in the lathe:

The operation by which we remove the excess material from the workpiece to produce a cone-shaped or a cylindrical surface.

There are **several types of turning operations**, those are:

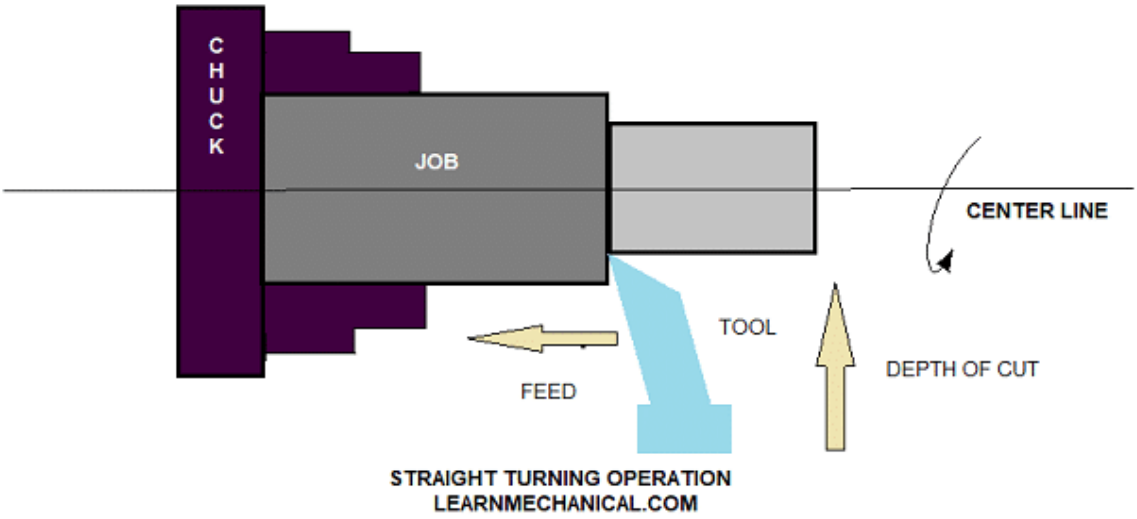
1. *Straight turning*
2. *Shoulder turning*
3. *Rough turning*
4. *Finish turning*
5. *Taper turning*
6. *Eccentric turning*

Straight turning:

This operation is done to produce a cylindrical surface by removing excess material from the workpiece.

It is done in the following ways:

1. Mount the job by suitable job holding device and check the trueness of the job axis with lathe axis.
2. Hold the cutting tool on the tool post and set the cutting edge at the job axis or slightly above it.
3. Set the spindle as per desired feed.
4. Give depth of cut as per finish or rough cut.
5. Start the machining.
6. Engage automatic feed to move the carriage with the tool to the desired length, then disengage the feed and carriage is brought back to its starting.
7. The process is repeated until the job finished.



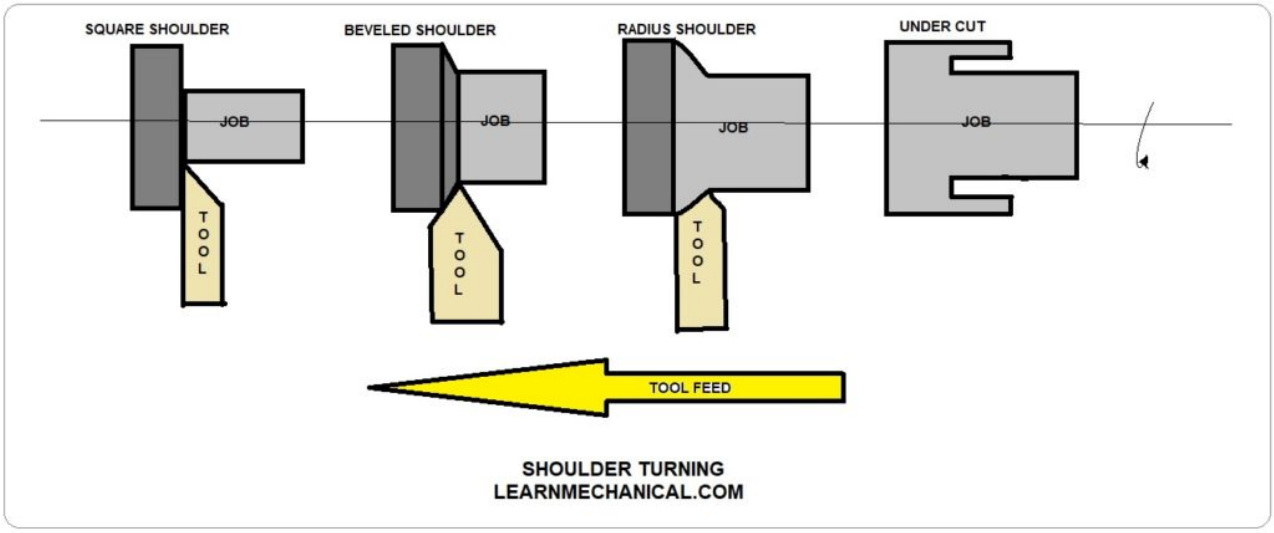
STRAIGHT TURNING OPERATION

Shoulder turning:

A **shoulder turning** is called which has a different diameter to form a step from one diameter to another.

There are four kinds of shoulder.

1. *Square*
2. *Beveled*
3. *Radius*
4. *Undercut*



SHOULDER TURNING

Rough turning:

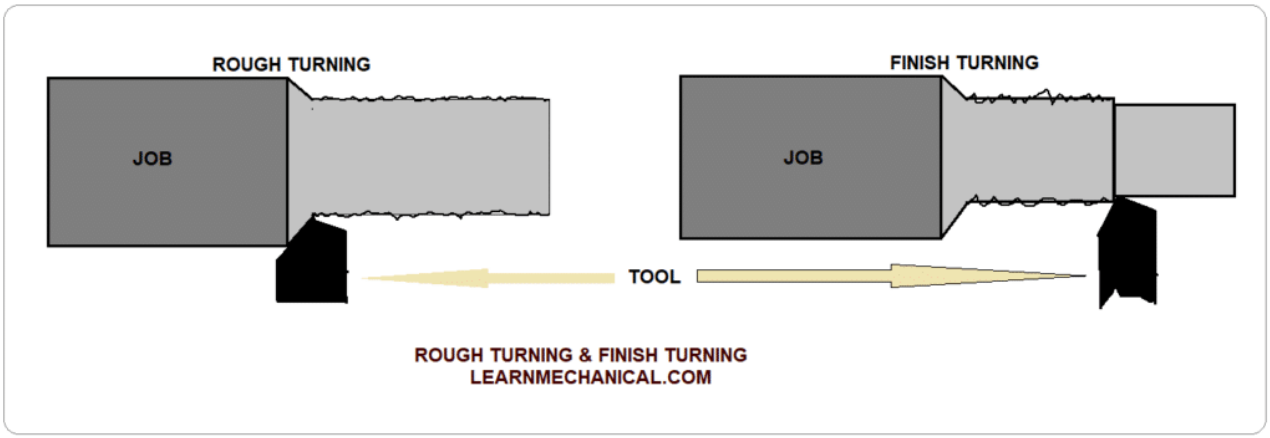
It is a process of removal of excess material from the workpiece in minimum time by applying a high rate of feed and heavy depth of cut.

Depth of cut is around 2 to 5mm and the rate of feed is 0.3 to 1.5mm/revolution.

Finish turning:

The **finish turning operation** needs high cutting speed, minimum feed and a very small depth of cut to generate the smooth surface.

In finish turning the depth of cut is around 0.5 to 1mm and the rate of feed is 0.1 to 0.3 mm/revolution.



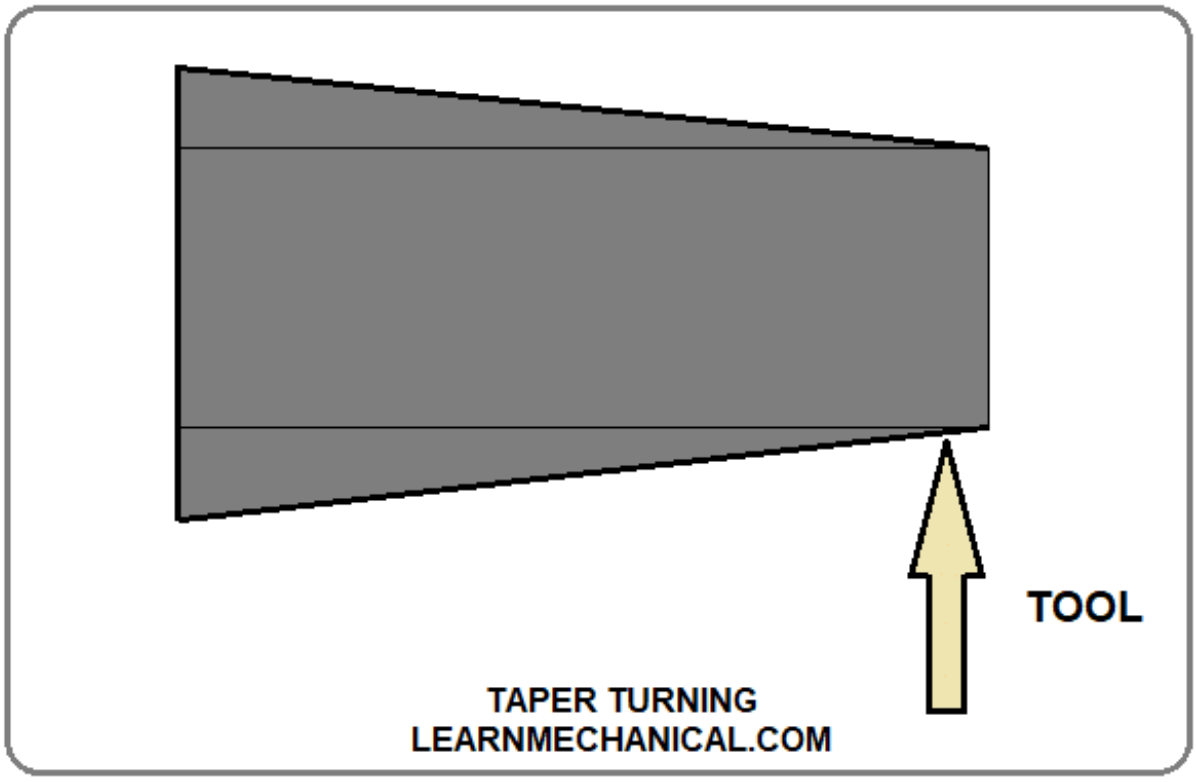
ROUGH TURNING AND FINISH TURNING

Taper turning:

First, let me give you an idea about the taper.

A **taper** is defined as a uniform decrease or increase in diameter of a workpiece along with its length.

The operation by which a conical surface of the gradual reduction in diameter from a cylindrical workpiece is produced is called **taper turning**.



TAPER TURNING

Taper turning methods:

A **tapering** form may be done by anyone of the following methods.

1. *Taper turning by form tool*
2. *By swiveling the compound rest*
3. *Tail-stock set over method*
4. *By taper turning attachment*

Let me discuss them in brief.

Taper turning by form tool:

It is used to form a short length of taper by using a form tool or broad nose tool.

Any increase in the length of taper will require the use of a wider cutting edge which may destroy the workpiece due to the vibration and spoil the workpiece.

In this operation, the tool angle must be half of the taper angle.

Taper turning by swiveling the compound rest:

This method is used for turning step and short tapers.

It is done as follows:

1. Set the compound rest by swiveling it from the centerline of lathe center through

an angle equal to half taper angle.
2. Clamp the carriage in place.
3. After adjusting and setting the tool, feed is applied by compound rest's feed handle to complete the taper.

Tail-stock set over method:

Set over of tail-stock from its center-line is done equal to half taper.

Job is held between the centers. The length of the workpiece will be long enough. An only small taper on a long job is done by this process.

It is used for external taper only.

By taper turning attachment:

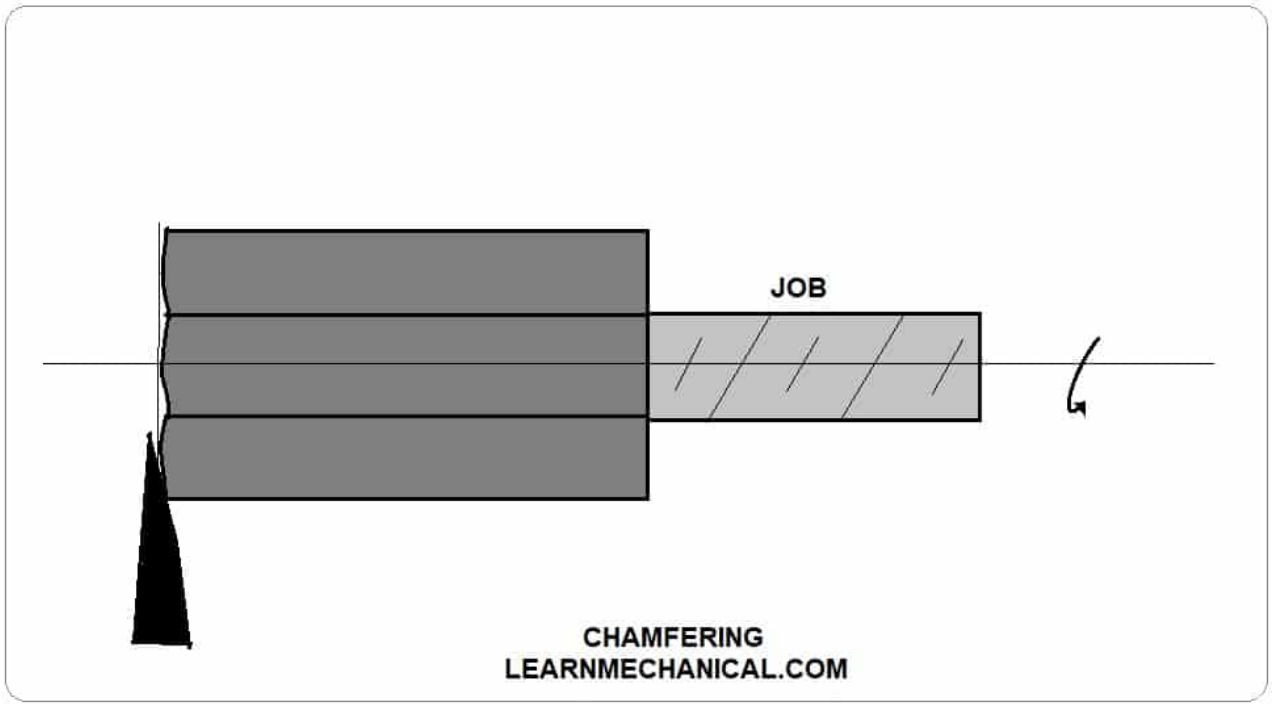
It is done in the following ways:

1. The cross slide is first made free from lead screw by hinder screw.
2. The rear end of the cross slide is then tightened with guide block by a belt.
3. Set the guide bar at an angle to the lathe axis. (Half taper angle)
4. The required depth of cut is given by the compound slide is at a right angle to the lathe axis.

Chamfering operation:

Chamfering is used for beveling the end of a job to remove burrs, to look better, to make a passage of the nut into the bolt.

This operation is done after thread cutting, knurling, rough turning.

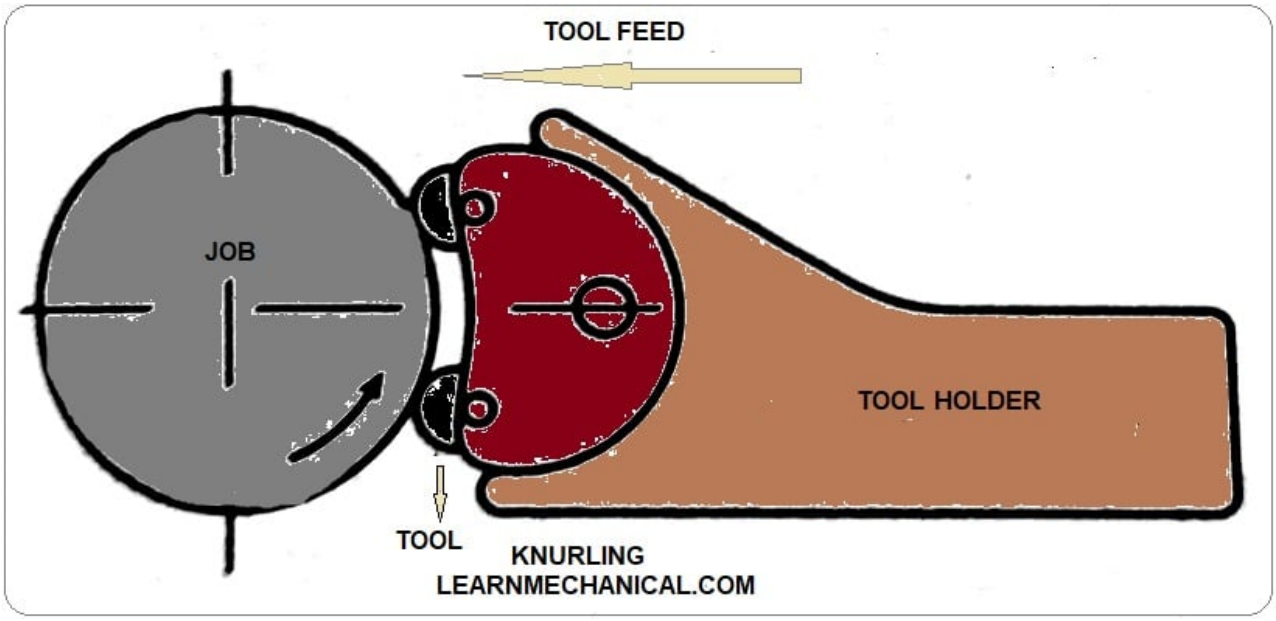


CHAMFERING

Knurling operation:

It is the process of producing a rough surface on the workpiece to provide effective gripping.

Knurling tool is held rigidly on the tool post and pressed against the rotating job so that leaving the exact facsimile of the tool on the surface of the job.



KNURLING

Thread cutting operation :

It is the operation which is used to produce a helical groove on a cylindrical or conical surface by feeding the tool longitudinally when the job revolved between the two centers.

Tool setting for thread cutting operation:

The tool should be set exactly to the height of the centerline of the job and at 90 degrees to the job.

Tool setting gauge is used for this purpose.

Feeding during thread cutting operation:

It is done in two ways.

1. The tool may be feed exactly at 90 degrees to the job axis but it does not have good cutting action because only the front end of the tool does cutting.
2. The tool may be feed at an angle from 27-30 degrees at which the compound rest may be set so that complete side of the tool is used for cutting action which gives a better polish on the threads.

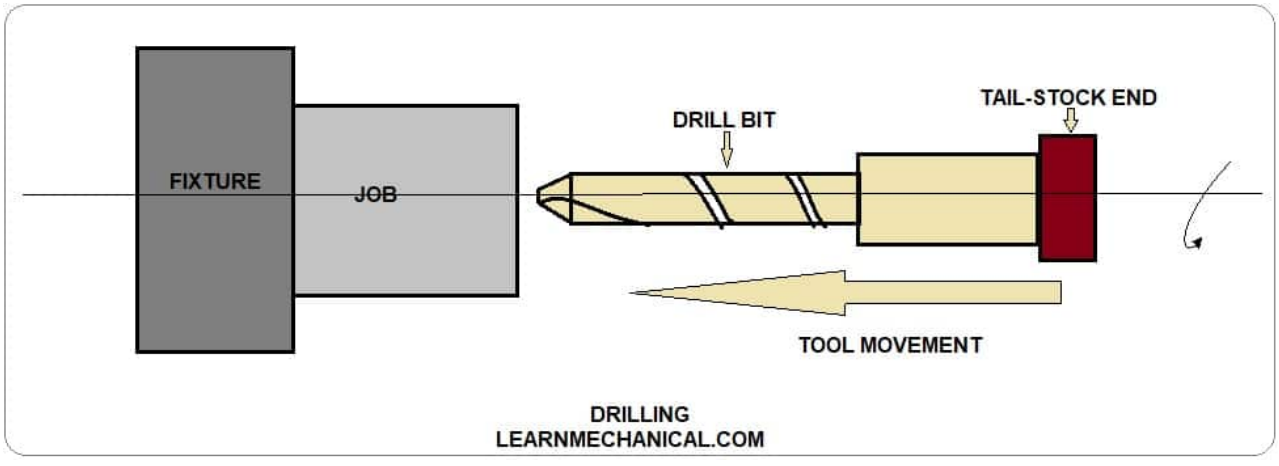
Job speed during threading:

The job speed will be 1/3 to 1/4 th of the job speed in turning operation.

Drilling operation:

Drilling is an operation by which we can make holes on a job.

In this operation, the job is rotated at the turning speed on the lathe axis and the drilling tool fitted on the tail-stock spindle. And the tail-stock is moved towards the job by hand feed.

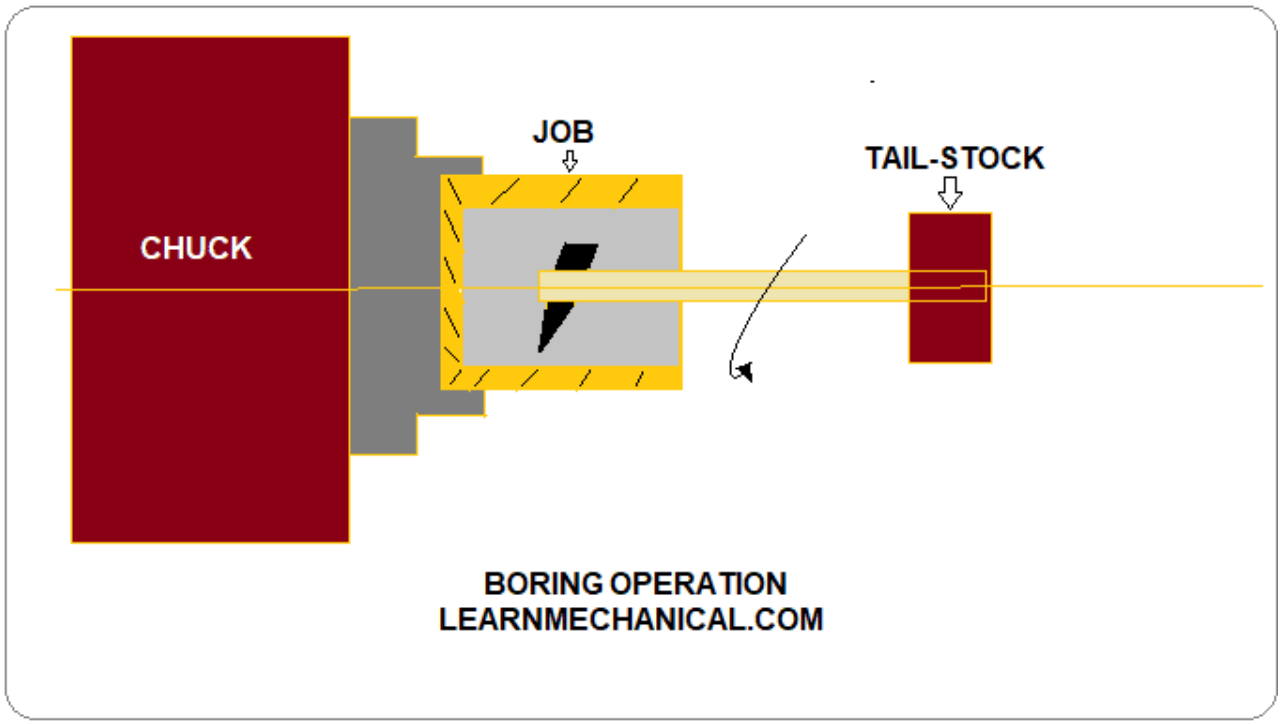


DRILLING

Boring operation:

In this operation, we can enlarge the diameter of the existing hole on a job by turning inside with some farm tool known as a boring tool.

The boring tool is also fitted on tail-stock.

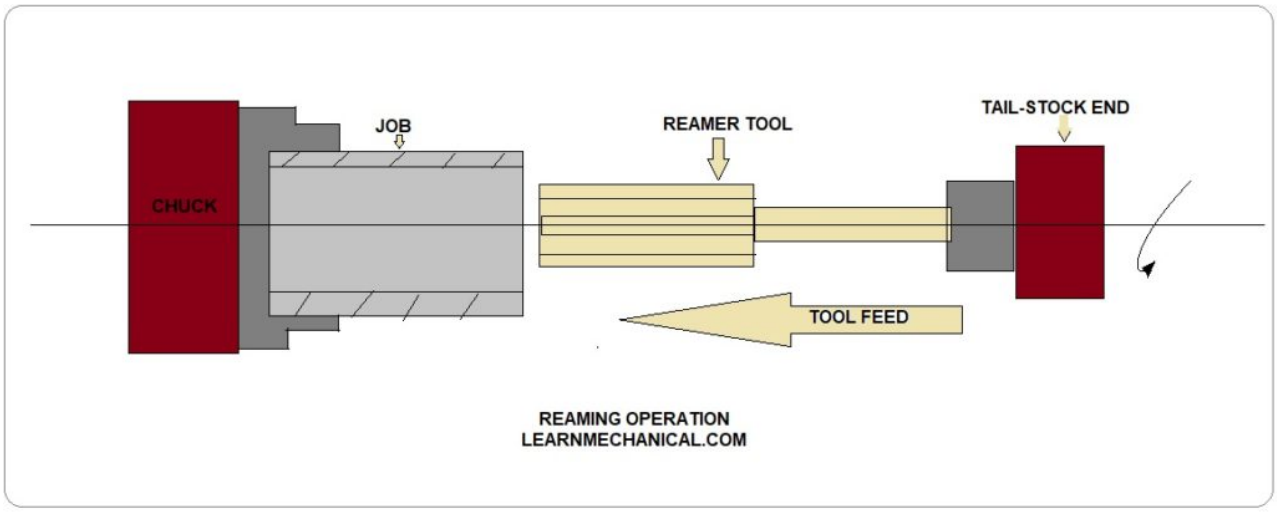


BORING OPERATION

Reaming operation:

Reaming is the operation for sizing or finishing a drilled hole to the required size by a tool called reamer.

This tool is fitted on tail-stock.



REAMING OPERATION

Spinning operation:

In this operation, the job of this sheet metal is held between the former and the tail-stock center rotates at high speed with the former.

the long round nose forming tool rigidly fixed on special tool post presses the job on the periphery of the former. So the job is taken exactly the shape of the former.

This is a chipless machining process.

Tapping operation:

We use this operation for creating internal threads within a hole by means of a tool called tap.

Three taps are generally used in an internal thread.

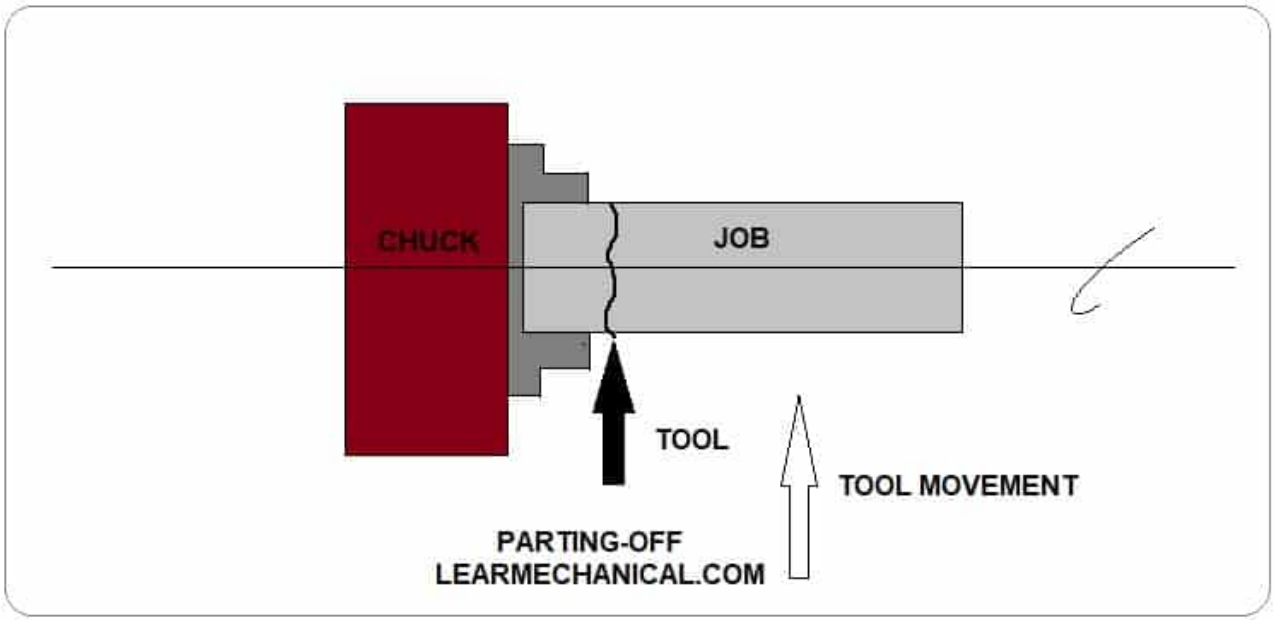
1. *Taper Tap*
2. *Second Tap*
3. *Plug Tap*

Parting-off operation:

It is the operation of cutting off a bar type job after complete the machining process.

In this operation a bar type job is held on a chuck, rotates at turning speed, a parting off tool is fed into the job slowly until the tool reaches the center of the job.

I also wrote an article on drilling machine, you may check that out.



PARTING-OFF OPERATION

Specification of a Lathe:

A **Lathe** is generally specified by:

1. Swing- the largest work diameter that can be swung for the lathe bed.
2. The distance between headstock and tailstock center
3. Length of the bed in meter
4. The pitch of the lead screw
5. Horsepower of the machine
6. Speed range and number of speeds of HS spindle
7. The weight of the machine in tonne

Video lecture on Lathe machine tool if you wish you can check this video for brief knowledge:

https://youtu.be/1AwOzDv7j6o

Source: NPTEL By: Prof. Asimava Roy Choudhury (IIT, Khargapur)

Video of different types of Lathe operations

https://youtu.be/SvlZHHDXCZs

Conclusion:

Hey, now I want to hear from you. I hope you understand the definition, parts, operations, and specification of a lathe machine.

If you have any queries or doubts about the lathe machine tool, you can ask me in the comment section, and also you can **join our facebook group here**. I will love to hear from you and glad to help you. Till then enjoy rest your day. Cheers

Subjects we have for you:

> Manufacturing Process
>
> Automobile Engineering
>
> Power Engineering
>
> Thermal Engineering
>
> Refrigeration and Air-conditioning
>
> Engineering Thermodynamics