WORKSHOP

DEPARTMENT OF MECHANICAL ENGINEERING

LAB MANUAL

OF

Machine Shop -1

INDIAN INSTITUTE OF TECHNOLOGY (INDIAN SCHOOL OF MINES), DHANBAD

OBJECTIVES

The objectives of machine shop-1 laboratory are

- ✓ To study the different lathe operations.
- ✓ Study of different components of lathe
- ✓ Study of tool, tool material and tool re-sharpening
- ✓ Centering of the cylindrical specimen on the lathe machine.
- ✓ To make a nut and bolt assembly.

OUTCOMES

The expected outcome of machine shop- 1 that the students should have

- ✓ A practical hand on experience of turning operation on the lathe machine.
- ✓ Understand the application of tap and die.
- ✓ Learn Different operation performed on the lathe machine.

Tutorial Assignments

- ✓ To make a bolt on the lathe machine.
- ✓ To make a thread on the external surface of the bolt using the die.
- ✓ To make an internal thread on the nut.

THE LATHE

Lathe is a machine that helps in shaping several material pieces in the desired shapes. A lathe is a machine that rotates the piece on the axis in order to perform various operations like cutting, facing, knurling, deformation and more. The main function of a lathe is to remove metal from a piece of work to give it the required shape and size by holding the work securely and rigidly on the machine and then turning it against cutting tool which will remove metal from the work in the form of chips. The most common and widely used is the center or engine lathe for preparing of various turning parts by different turning process.

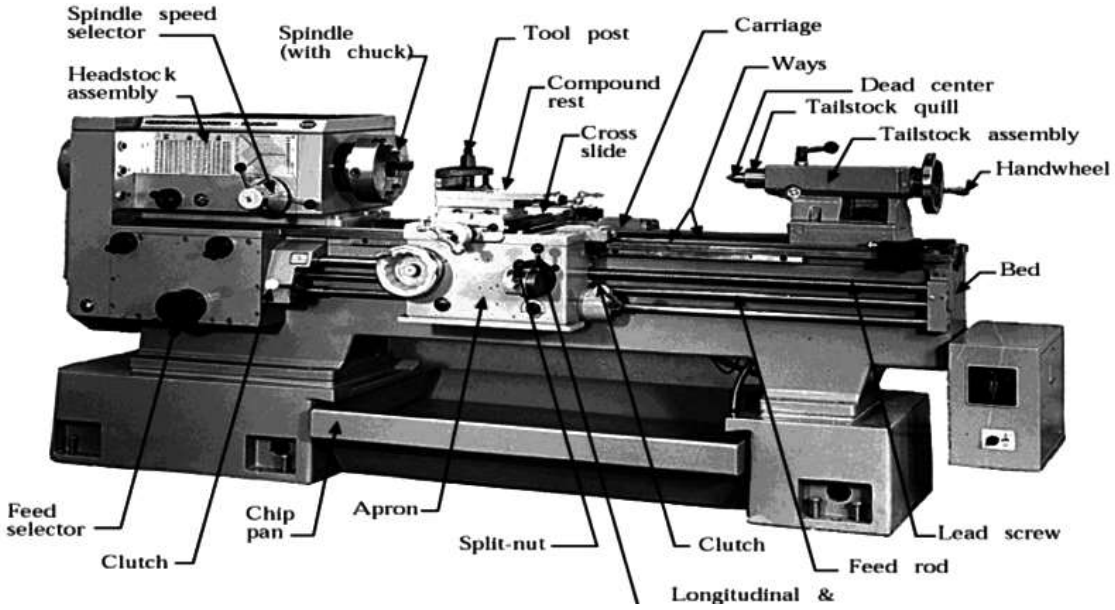


Fig. Conventional Lathe machine

In metal cutting, a wedge-shaped tool is used to remove material from the workpiece in the form of a 'chip'. Two motions are required: the 'primary motion', e.g. the rotation of the workpiece in a lathe; and the 'secondary motion', e.g. the feed of a lathe tool. Single-point tools are used for turning, shaping, planing etc. and multi-point tools are used for milling, etc.

Introduction to main parts of lathe machine

Sl. No.	Parts	Description
1.	Head stock	Head stock is one type of gear box & it is the heart of the Machine which gives various speed by means of gear Arrangement. The gear change lever is given in the head stock body to change the speed.
2.	Chuck Plate	Chuck plate is provided to mount the chuck on it.
3.	Tool Post	Tool post is mounted on the compound slide, which is used to hold the tools.
4.	Compound Slide	Compound slide is used to give angular & small longitudinal motion to the tool.
5.	Saddle & Cross Slide	Cross slide is mounted on the saddle. Cross slide give transverse motion whereas saddle gives longitudinal motion.
6.	Tail Stock	Tail stock is used to hold the job for between center turning.
7.	Lead Screw	Lead screw is used for threading operation. Which is also known as thread shaft.

8.	Apron	**:**	Apron is a gear box which gives automatic feed to the carriage.
9.	Feed Shaft	**:**	Feed shaft is used for auto feeding.
10.	Norton gear box	**:**	Norton gear box is used to obtain metric as well as BSW thread in various pitch for threading operation.
11.	Tray	**:**	Tray is provided to collect the cutting fluid & chip when machine is in running condition.
12.	Side Cover	**:**	Side cover is provided in the back side of the machine for protection of gear train & for safety purpose

Speed:

Speed is the number of circular motion of the spindle/work piece in one minute of time expressed is RPM.

Feed:

Feed is the length at which the tool travels forward for one revolution of the work piece expressed in meter/rev or mm/revolution.

Cutting speed:

The cutting speed of a tool is the speed at which the metal is removed by the tool from the work piece. It is the rate of cutting length on the main motion in meter/minute. It is denoted by a letter, v;

$$\mathbf{V} = \frac{\pi DN}{1000} \text{ (m/min)}$$

Where;

v = cutting speed.

D = diameter of the work piece.

N = number of revolutions per minute.

Depth of cut:

It is the perpendicular distance measured from the machined surface to the uncut surface of the work piece.

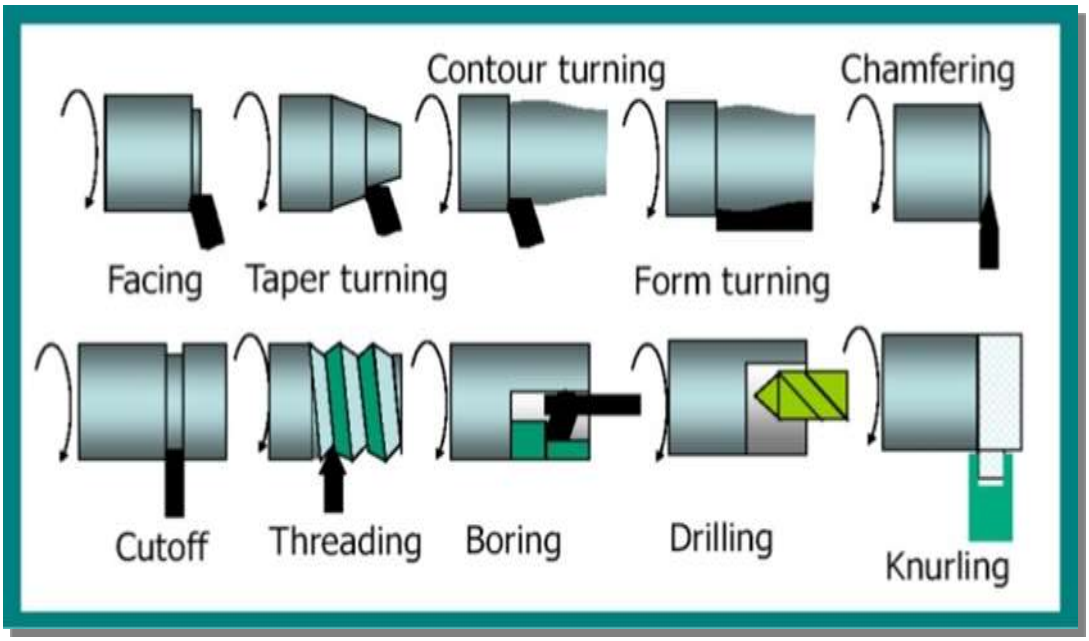
LATHE OPERATIONS

Turning: Turning is the process to remove excess material from the work piece basically to produce cylindrical or cone shaped objects, to the required shape and size. The most common center or engine lathe is used for preparing of various turning parts by different turning process.

Straight turning produces a cylindrical surface by feeding the single point cutting tool against the rotating work parallel to the work.

Facing: Facing is the operation of machining the ends of a work piece to produce flat surface square with the axis. This is also used to cut the work to the required length. The tool is fed perpendicular to the axis of rotation of the work piece.

Knurling: Knurling is the process of embossing a diamond shaped pattern on the surface of the work piece. It provides grip to the work piece.



Thread cutting: The principle of thread cutting is to produce helical groove on a cylindrical or conical surface by feeding the tool longitudinally when the job is revolving between centers or by a chuck.

Knurling: Knurling is the process of embossing a diamond shaped pattern on the surface of the work piece. It provides grip to the work piece.

Thread cutting: The principle of thread cutting is to produce helical groove on a cylindrical or conical surface by feeding the tool longitudinally when the job is revolving between centers or by a chuck.

Chamfering: It is **t**he operation of beveling the extreme end of the work piece.

Grooving: It is the process of reducing the diameter of a work piece over a very narrow surface.

Lathe specifications

1. The maximum diameter of a work that is held between centers.
2. The swing over the bed (this is the perpendicular distance from the lathe axis to top of the bed).
3. The length of the bed.
4. The length of the bed ways & type.
5. The maximum length of work that can be turned b/n centers.
6. The range of threads that can be cut.
7. The capacity of lathe (Motor).
8. Range of spindle speed.
9. Range of feed.
10. Size of the spindle nose and types of spindle nose.

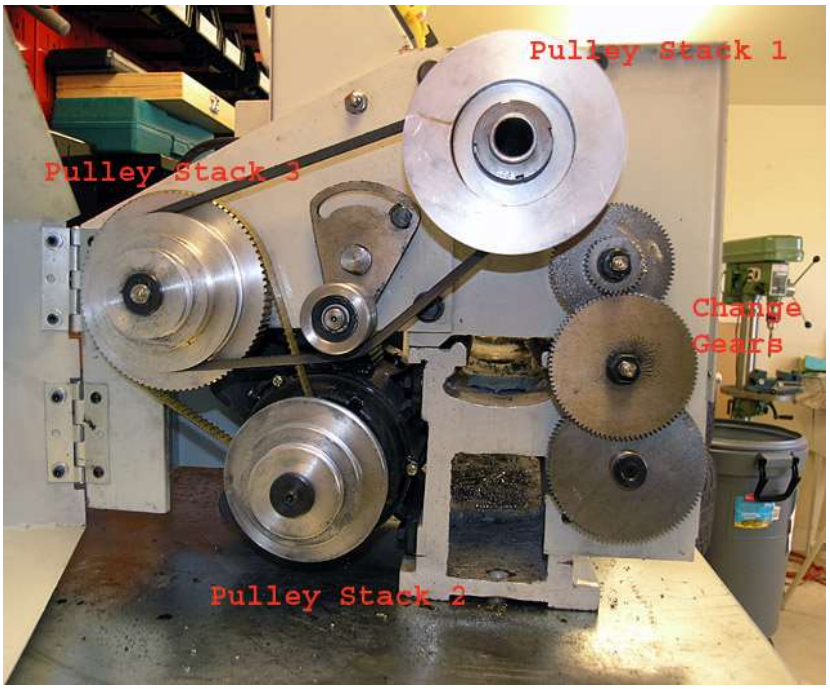


Fig. Lathe drive mechanism

Cutting tool and tool materials

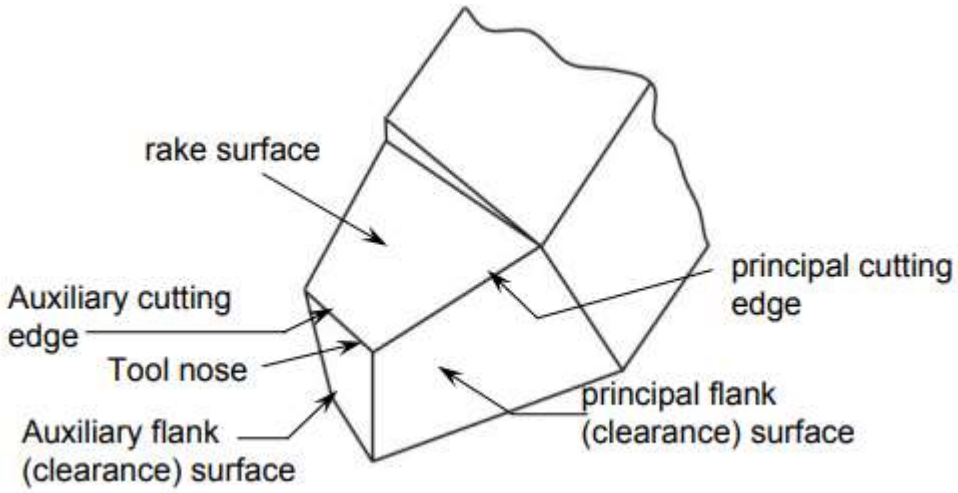


Fig. Geometry of single point cutting tool (Turning tool)

The following materials are suitable as cutting tool materials used for machining in different machine tool.

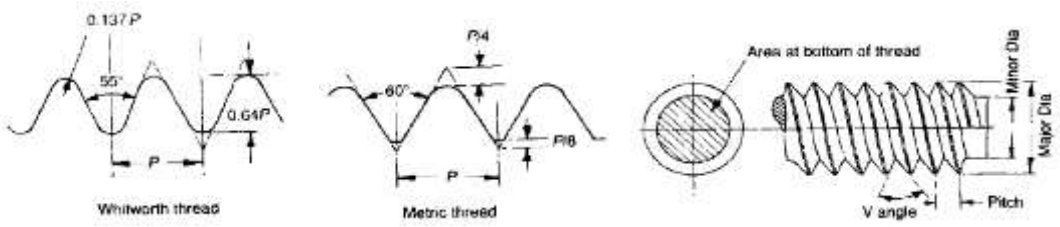
1. Carbon tool Steel
2. High speed Steel
3. Cemented carbide
4. Diamonds
5. Ceramics

Tool Re-sharpening: Tool and cutter grinding machines are used to sharpen cutting tools such as turning tools, milling cutters. The general-purpose cutter grinder is the most popular and versatile tool-grinding machine. Various attachments are available for sharpening most types of cutting tools.

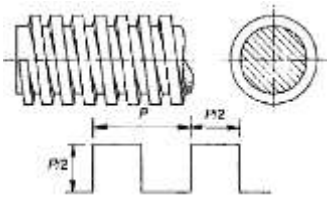
Thread specifications

Screw thread: Screw threads are used in fasteners such as bolts and screws, and also to provide a linear motion drive which may transmit power. There are several different types of screw thread used for different purposes.

Vee Thread: Vee thread is used extensively for nuts, bolts and screws. The thread may be produced by machining but rolling is much cheaper.

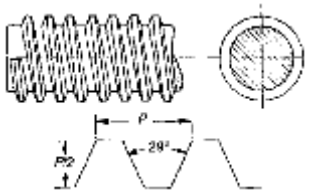


Square Thread: It is used for power transmission. The friction is low and there is no radial force on the nut.



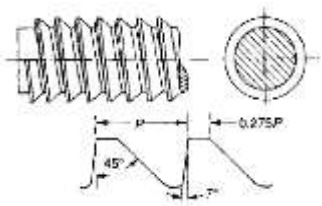
Square Thread

Acme Thread: It is used for power transmission. Has greater root strength and is easier to machine than the square thread. Used for lathe lead screw.



Acme Thread

Buttress Thread: A power screw with the advantages of both square and Acme threads. It has the greatest strength but takes a large load in one direction only (on the vertical face).



Buttress Thread

Job 1

Objective: Manufacturing of Bolt & Nut

Application: Bolts and nuts are used together for temporary fastening of a stack of parts together.

Materials used: Mild steel for both bolt and nut

Tools used: Lathe, Single point cutting tool, Vernier caliper, outside caliper, centering gauge.

Bolt

A bolt is a long metallic piece that has a round stem as its body. The body is threaded in a helical (circular) manner. The metallic piece is topped with a head on one end that allows it to be turned, either into the object or the nut. There are many types of bolts, such as hex type, square, round and flat head bolts.

Nut

A nut is a small hexagonal object made out of metal. It is shaped in a hexagon so that it is easy and firm to grip from all sides. It has a hole in its center, which has a thread running around it. It is used as a fastener to a machining bolt. The bolt and the nut are kept together by a combination of their threads' friction. Nuts come in various types, including hex, cap, coupler, wing, turnbuckle and lock.

Procedure of manufacturing a bolt:

1. Understand the drawing carefully.
2. Take a cylindrical piece of metal as given in workshop.
3. Turn it up to the major diameter. Keeping head size length apart accordingly.
4. Mark the thread length as per drawing.
5. Select the Die of M14×2 mm (2 mm is pitch).
6. Grip your work piece into the bench vice.
7. Make a thread up to the thread length.
8. Make a bolt head square/Hexagonal in milling m/c, shaping m/c, fitting shop.
9. Check the thread accuracy with the help of pitch gauge.

Procedure of manufacturing a nut:

1. Take a cylindrical mild steel work piece.
2. Turn it up to the diameter.
3. Make a center drill at center.
4. Drill it to the minor diameter i.e. dia 12.
5. Make a square from milling, shaping or fitting shop.
6. Now part off according to the size of nut.
7. Use bench vice to grip it.
8. Select the Tap M14×2 mm
9. Make an internal thread slowly with the help of threading tap.
10. Now put the nut into the bolt & check whether the job is correct or not.

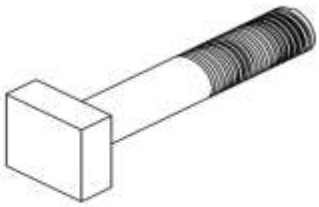
Precautions:

- Wear appropriate safety glasses. It may be necessary for others in the area to wear safety glasses too as objects will fly off the work.
- Always wear proper shoes before getting into the machine shop.
- Ensure entanglement hazards are removed (e.g. loose clothing, jewellery, etc.).
- Keep the floor free from obstructions, or slip hazards.
- Ensure that lathe has a start/stop button within easy reach of the operator.
- Follow job specifications for the speed, feed and depth of cut for materials being turned. Make sure all work runs true and centred.
- Centre-drill work deeply enough to provide support for the piece while it is turning.
- Secure and clamp the piece being worked.
- Adjust tool and tool rest so that they are slightly above the centre of the work.
- Inspect chucks for wear or damage. Flying pieces can be very dangerous..
- Use a barrier guard when operating the lathe in semi-automatic or automatic mode.
- Guard all power transmission parts.

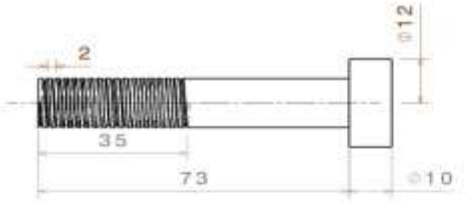
- Remove all tools, measuring instruments and other objects from saddle or lathe bed before starting machine.
- Keep all lathe cutting tools sharp.
- Ensure that the chip and coolant shields are in place.
- Shut off the power supply to the motor before mounting or removing accessories.
- Stop lathe before taking measurements of any kind.
- Use a vacuum, brush or rake to remove cuttings only after the lathe has stopped moving.
- Keep working surface clean of scraps, tools and materials.
- Keep floor around lathe clean and free of oil and grease.

Questions:

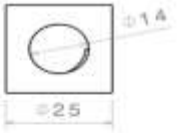
1. What is the difference between a machine and a machine tool?
2. What is a chuck? Write down the types of chucks and their use.
3. Write notes on threading tap and threading die.
4. Difference between single point and multi point cutting tool.
5. What are the types of turning operations?
6. Write the difference between turning and facing.
7. What are the operations that can be performed on Lathe?



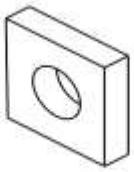
Isometric view
Scale: 1:1



Front view
Scale: 1:1

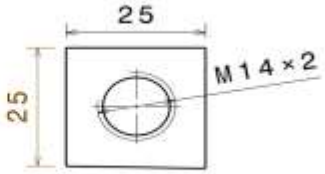


Left view
Scale: 1:1



Isometric view
Scale: 1:1

Front view
Scale: 1:1



Left view
Scale: 1:1

All dimentions are in mm

Assignment:

Look at the figure, this is the available hmt lathe machine in our workshop. Do inspection of this machine and write name of different parts on it. Make a list of key specifications of this machine.