

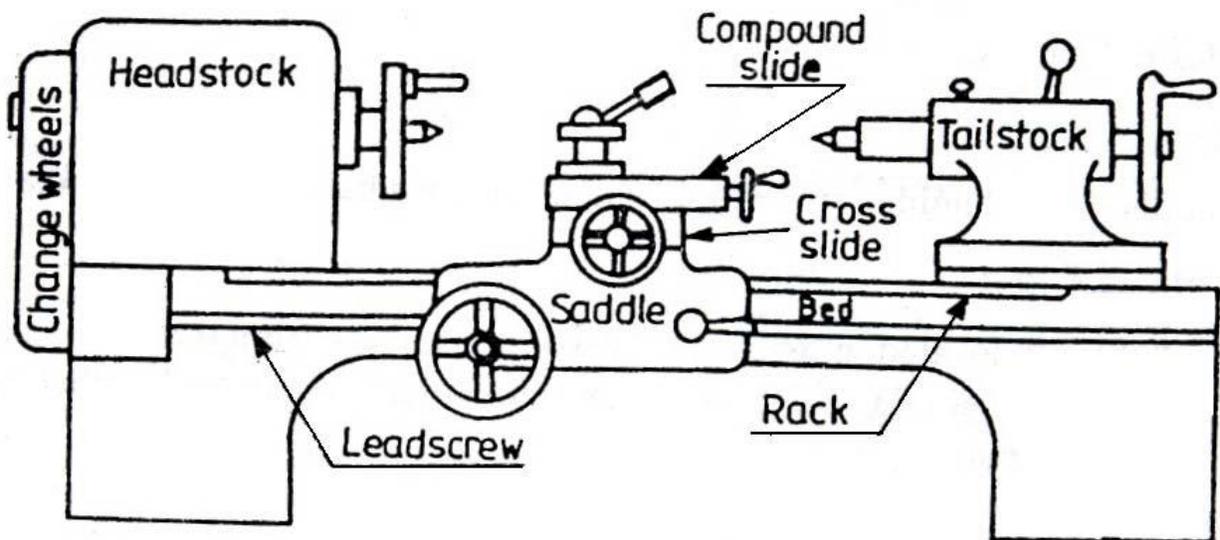
MACHINE SHOP : - TURNING

INTRODUCTION

In a machine shop, metals are cut to shape on different machine tools. A lathe is used to cut and shape the metal by revolving the work against a cutting tool. The work is clamped either in a chuck, fitted on to the lathe spindle or in-between the centers. The cutting tool is fixed in a tool post, mounted on a movable carriage that is positioned on the lathe bed. The cutting tool can be fed on to the work, either lengthwise or cross-wise. While turning, the chuck rotates in counter-clockwise direction, when viewed from the tail stock end.

PRINCIPAL PARTS OF A LATHE

Figure shows a center lathe, indicating the main parts. The name is due to the fact that work pieces are held by the centers.



1 Bed

It is an essential part of a lathe, which must be strong and rigid. It carries all parts of the machine and resists the cutting forces. The carriage and the tail stock move along the guide ways provided on the bed. It is usually made of cast iron.

2 Head stock

It contains either a cone pulley or gearings to provide the necessary range of speeds and feeds. It contains the main spindle, to which the work is held and rotated.

3 Tail stock

It is used to support the right hand end of a long work piece. It may be clamped in any position along the lathe bed. The tail stock spindle has an internal Morse taper to receive the dead center that

supports the work. Drills, reamers, taps may also be fitted into the spindle, for performing operations such as drilling, reaming and tapping.

4 Carriage or Saddle

It is used to control the movement of the cutting tool. The carriage assembly consists of the longitudinal slide, cross slide and the compound slide and apron. The cross slide moves across the length of the bed and perpendicular to the axis of the spindle. This movement is used for facing and to provide the necessary depth of cut while turning. The apron, which is bolted to the saddle, is on the front of the lathe and contains the longitudinal and cross slide controls.

5 Compound Rest

It supports the tool post. By swiveling the compound rest on the cross slide, short tapers may be turned to any desired angles. **40**

6 Tool Post

The tool post, holds the tool holder or the tool, which may be adjusted to any working position.

7 Lead Screw

It is a long threaded shaft, located in front of the carriage, running from the head-stock to the tail stock. It is geared to the spindle and controls the movement of the tool, either for automatic feeding or for cutting threads.

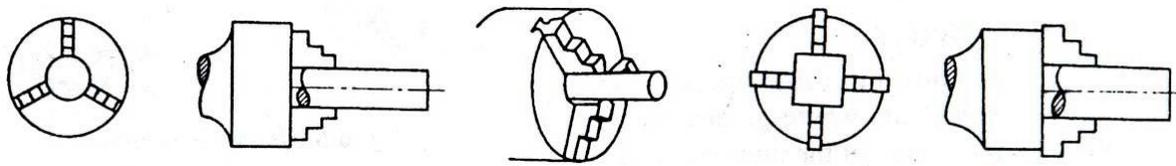
8 Centers

There are two centers known as dead center and live center. The dead center is positioned in the tail stock spindle and the live center, in the head-stock spindle. While turning between centers, the dead center does not revolve with the work while the live center revolves with the work.

WORK-HOLDING DEVICES

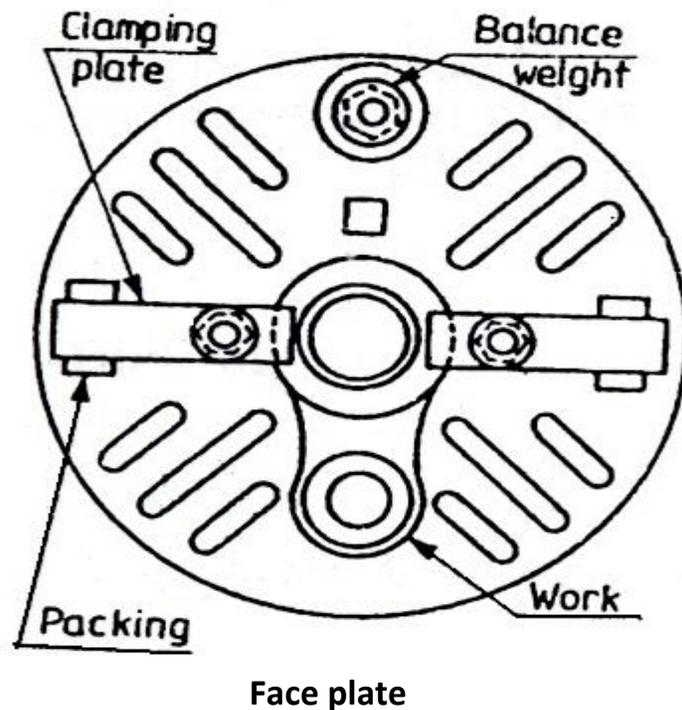
1 Three jaw chuck

It is a work holding device having three jaws (self-centering) which will close or open with respect to the chuck center or the spindle center, as shown in figure. It is used for holding regular objects like round bars, hexagonal rods, etc.



2 Face plate

It is a plate of large diameter, used for turning operations. Certain types of work that cannot be held in chucks are held on the face plate with the help of various accessories.



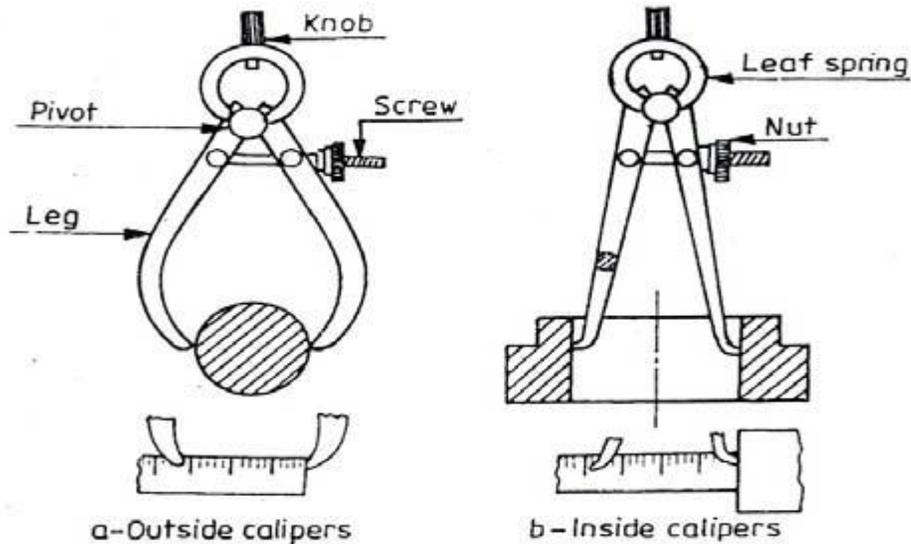
3 Lathe dogs and driving plate

These are used to drive a work piece that is held between centers. These are provided with an opening to receive and clamp the work piece and dog tail, the tail of the dog is carried by the pin provided in the driving plate for driving the work piece.

4 MEASURING INSTRUMENTS

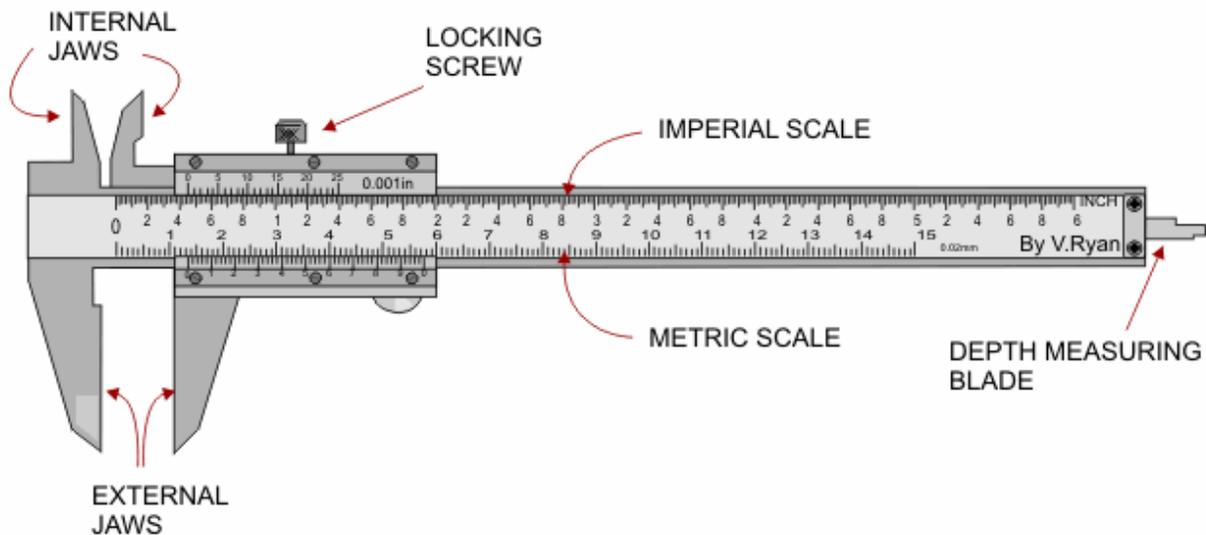
1 Outside and inside Calipers

Firm joint or spring calipers are used for transfer of dimensions with the help of a steel rule



2 Vernier Calipers

Vernier caliper is a versatile instrument with which both outside and inside measurements may be made accurately. These instruments may have provision for depth measurement also.



3 Micrometers

Outside and inside micrometers are used for measuring components where greater accuracy is required.

CUTTING PARAMETERS

1 Cutting speed

It is defined as the speed at which the material is removed and is specified in meters per minute. It depends upon the work piece 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 work piece diameter in mm.

2 Feed

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

3 Depth of Cut

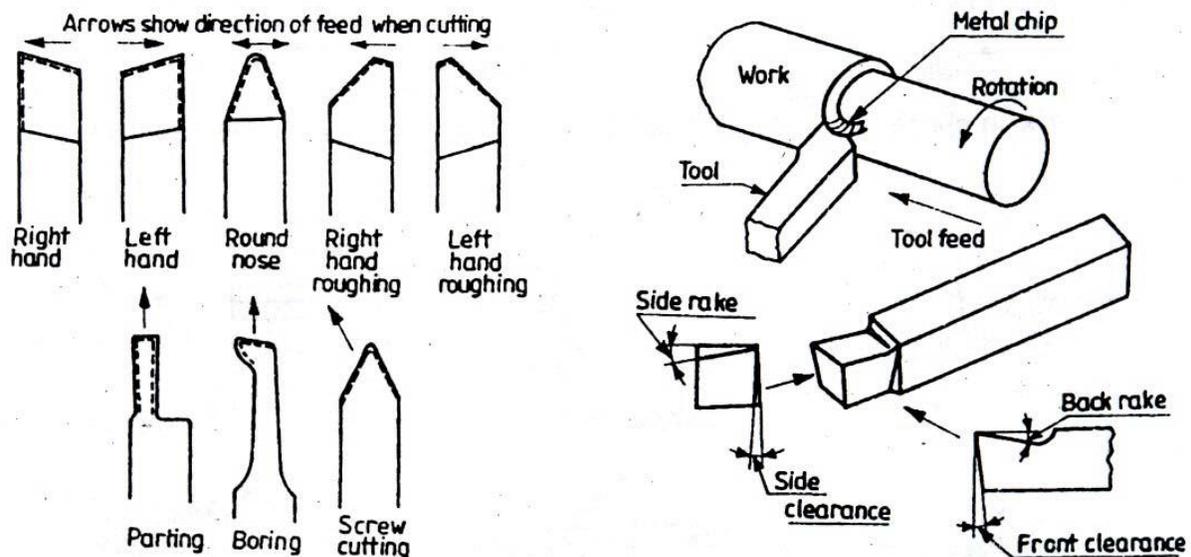
It is the movement of the tip of the cutting tool, from the surface of the work piece and perpendicular to the lathe axis. Its value depends upon the nature of operation like rough turning or finish turning.

TOOL MATERIALS

General purpose hand cutting tools are usually made from carbon steel or tool steel. The single point lathe cutting tools are made of high speed steel (HSS). the main alloying elements in 18-4-1 HSS tools are 18 percent tungsten, 4 percent chromium and 1 percent vanadium. 5 to 10 percent cobalt is also added to improve the heat resisting properties of the tool. Carbide tipped tools fixed in tool holders, are mostly used in production shops.

TOOL GEOMETRY

A single point cutting tool used on lathe may be considered as a simple wedge. Figure 4.8 shows the common turning tools used for different operations. Figure 6.9 shows the basic angles of a simple turning tool.



LATHE OPERATIONS

1 Turning

Cylindrical shapes, both external and internal, are produced by turning operation. Turning is the process in which the material is removed by a traversing cutting tool, from the surface of a rotating work piece. The operation used for machining internal surfaces is often called the boring operation in which a hole previously drilled is enlarged. For turning long work, first it should be faced and center drilled at one end and then supported by means of the tail-stock centre.

2 Boring

Boring is enlarging a hole and is used when correct size drill is not available. However, it should be noted that boring cannot make a hole.

3 Facing

Facing is a machining operation, performed to make the end surface of the work piece, flat and perpendicular to the axis of rotation. For this, the work piece may be held in a chuck and rotated about the lathe axis. A facing tool is fed perpendicular to the axis of the lathe. The tool is slightly inclined towards the end of the work piece.

4 Taper Turning

A taper is defined as the uniform change in the diameter of a work piece, measured along its length. It is expressed as a ratio of the difference in diameters to the length. It is also expressed in degrees of half the included (taper) angle. Taper turning refers to the production of a conical surface, on the work piece on a lathe. Short steep tapers may be cut on a lathe by swiveling the *compound rest* to the required angle. Here, the cutting tool is fed by means of the compound slide feed handle. The work piece is rotated in a chuck or face plate or between centers.

5 Drilling

Holes that are axially located in cylindrical parts are produced by drilling operation, using a twist drill. For this, the work piece is rotated in a chuck or face plate. The tail stock spindle has a standard taper. The drill bit is fitted into the tail stock spindle directly or through drill chuck. The tail stock is then moved over the bed and clamped on it near the work. When the job rotates, the drill bit is fed into the work by turning the tail stock hand wheel.

6 Knurling

It is the process of embossing a diamond shaped regular pattern on the surface of a work piece using a special knurling tool. This tool consists of a set of hardened steel rollers in a holder with the teeth cut on their surface in a definite pattern.

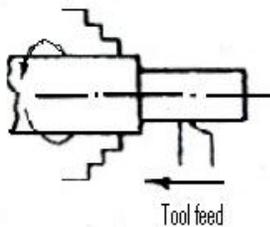
The tool is held rigidly on the tool post and the rollers are pressed against the revolving work piece to squeeze the metal against the multiple cutting edges. The purpose of knurling is to provide an effective gripping surface on a work piece to prevent it from slipping when operated by hand.

7 Chamfering

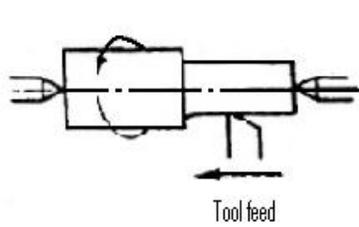
It is the operation of beveling the extreme end of a work piece. Chamfer is provided for better look, to enable nut to pass freely on threaded work piece, to remove burrs and protect the end of the work piece from being damaged.

8 Threading

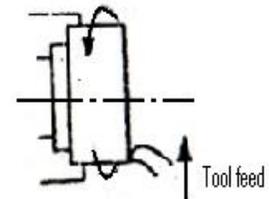
Threading is nothing but cutting helical groove on a work piece. Threads may be cut either on the internal or external cylindrical surfaces. A specially shaped cutting tool, known as thread cutting tool, is used for this purpose. Thread cutting in a lathe is performed by traversing the cutting tool at a definite rate, in proportion to the rate at which the work revolves.



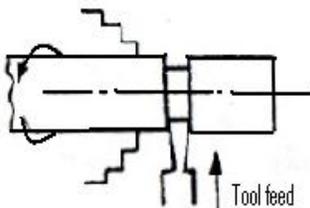
1. Work in chuck



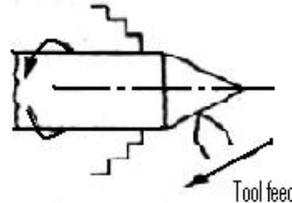
2. Work between centers



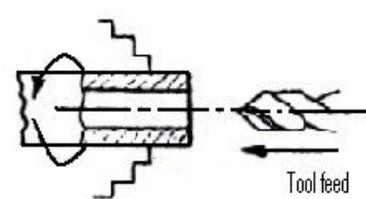
3. Facing (External jaws)



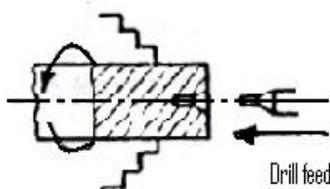
4. Parting - off



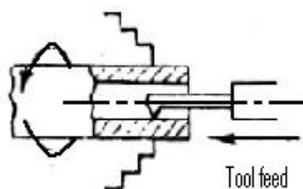
5. Taper turning



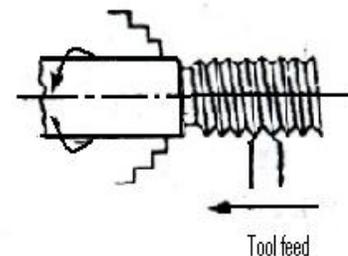
6. Drilling



7. Center drilling



8. Boring



9. Threading

Operations of Lathe

SAFETY PRECAUTIONS

- 1.** Always wear eye protection - preferably industrial quality safety glasses with side-shields. The lathe can throw off sharp, hot metal chips at considerable speed as well as spin off spirals of metal that can be quite hazardous. Don't take chances with your eyes.
- 2.** Wear short sleeve shirts, loose sleeves can catch on rotating work and quickly pull your hand or arm into harm's way.
- 3.** Wear shoes - preferably leather work shoes - to protect your feet from sharp metal chips on the shop floor and from tools and chunks of metal that may get dropped.
- 4.** Remove wrist watches, necklaces, chains and other jewelry. Tie back long hair so it can't get caught in the rotating work. Think about what happens to your face if your hair gets entangled.
- 5.** Always double check to make sure your work is securely clamped in the chuck or between centers before starting the lathe. Start the lathe at low speed and increase the speed gradually.
- 6.** Get in the habit of removing the chuck key immediately after use. Some users recommend never removing your hand from the chuck key when it is in the chuck. The chuck key can be a lethal projectile if the lathe is started with the chuck key in the chuck.
- 7.** Keep your fingers clear of the rotating work and cutting tools. This sounds obvious, but I am often tempted to break away metal spirals as they form at the cutting tool.
- 8.** Avoid reaching over the spinning chuck. For filing operations, hold the tang end of the file in your left hand so that your hand and arm are not above the spinning chuck.
- 9.** Never use a file with a bare tang - the tang could be forced back into your wrist or palm.