PNS SCHOOL OF ENGINEERING & TECHNOLOGY

WORKSHOP MANUAL

DEPARTMENT OF MECHANICAL ENGINEERING

Name of subject : Mechanical Work Shop

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CARPENTARY

INTRODUCTION:

Wood work or carpentry deals with making joints for a variety of applications like doorframes, cabinet making furniture, packing etc.,

Timber:-

Timber is a name obtained from well grown plants or trees. The timber must cut in such a way that the grains run parallel to the length. The common defects in timber are knots, wet rot, dry rot etc.,

Market sizes of timber:-

Timber is sold in market in various standard shapes and sizes. They are:-

Log:-

The trunk of a tree, which is free from branches.

Balk:-

The log sawn to have roughly square cross section.

Post:-

A timber piece, round or square in cross section with more than 275 mm in width, 50 to150 mm in thickness and 2.5 to 6.5 mts length.

Board:-

A sawn timber piece, below 175 mm in width and 30 mm to 50 mm in thickness.

Reapers:-

Sawn timber pieces of assorted and nonstandard sizes, which don't conform to the aboveshapes.

WORK HOLDING TOOLS:

Carpentry vice:-

It is a work holding device. When handle vice is turned in a clockwise direction, the sliding jar forces the work against the fixed sawn. The greater the force applied to the handle, the tighter to the work held.

Bar clamp:-

It is a rectangular (or) square block with V-groove on one or both sides opposite to each other. It holds cylindrical work pieces.

C-Clamp:-

This is used to hold work against an angle plate or V-block.

MARKING AND MEASURING TOOLS:

Try square:-

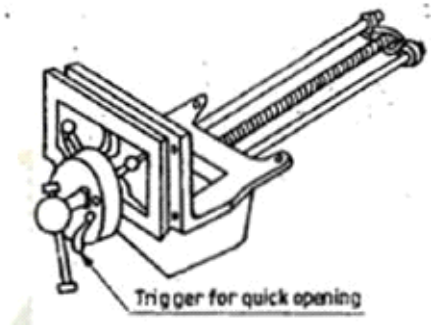
It is used for marking and testing the square ness of planed surfaces. It consists of a steel blade, fitted in a cast iron stock. It is also used for flatness. The size of a try square usedfor varies from 150 mm to 300 mm, according to the length of the blade. It is less accurate when compared to the try square used in fitting shop.

Fig : 1 steel rule

fig: 2 marking Gauge

Fig: 3 steel tape

fig: 4 Try square



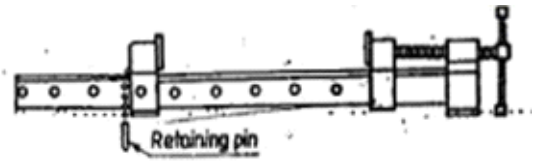


Fig: 5 corpenter vice

Fig: 6 Bar clamp

Fig: 7 metal jack plane

Fig: 8 compass and divider

Marking gauge:-

It is a tool used to mark lines parallel to the edges of wooden pieces. It consists of a square wooden stem with a riding wooden stock on it. A marking pin, made of steel is fitted on the stem. A mortise gauge consists of two pins. In these it is possible to adjust the distance between the pins, to draw two parallel lines on the stock.

Compass and dividers:-

This is used for marking circles, arcs, laying out perpendicular lines on the planed surfaceof the wood.

CUTTING TOOLS:

Hack saw:-

It is used to cross cut the grains of the stock. The teeth are so set that the saw kerfs will be wider than the blade thickness. Hard blades are used to cut hard metals. Flexible blades are having the teeth of hardened and rest of the blade is soft and flexible.

Chisels:-

These are used for removing surplus wood. Chisels are annealed, hardened and temperedto produce a tough shank and a hard cutting edge.

Rip saw:-

It is used for cutting the stock along the grains. The cutting edge of this saw makes a sleeperangle about 60o whereas that saw makes an angle of 45o with the

surface of the stock.

Tenon saw:-

It is used for cutting tenons and in fine cabinet works. The blade of this saw is very thin and so it is used stiffed with back strip. Hence, this is sometimes called back saw. The teeth shapes similar to cross cut saw.

DRILLING AND BORING TOOLS:

Auger bit:-

It is the most common tool used for boring holes with hard pressure.

Gimlet:-

This is a hand tool used for boring holes with hand pressure.

Hand drill:-

Carpenters brace is used to make relatively large size holes, whereas hand drill is used for drilling small holes. A straight shank drill is used with these tools. It is small light in weight and may be conveniently used than the brace. The drill is clamped in the chuck.

Fig: 9 cross cut saw Fig: 10 Tenon saw Fig: 11 compass saw

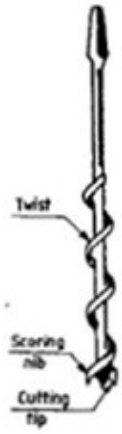


Fig: 12 Chisels Fig: 13 Carpenter's brace Fig: 14 Auger bit

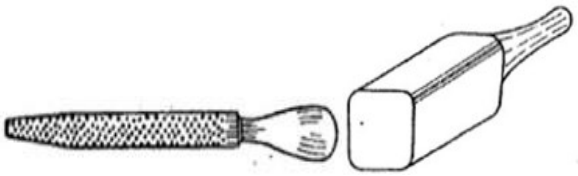


Fig: 15 Gimlet Fig: 16 wood rasp file Fig:17 Mallet

Fig: 18 Hand drill Fig: 19 Trammel Fig: 20 Claw hammer

MISCELLANEOUS TOOLS:

Ball peen hammer:-
It has a flat face, which is used for general work and a ball end is used for riveting.
Mallet:-
It is used to drive the chisel, when considerable force is to be applied, steel hammer should not be used for these purpose, as it may damage the chisel handle. Further, for better to apply a series of light taps with the mallet rather than a heavy single blow.
Claw hammer:-
It is a striking flat at one end and the claw at the others. The face issued to drive nails into wood and for other striking purpose and the claw for extracting nails out of wood.
Pinches:-
It is made of steel with a hinged and is used for pulling out small nails from wood.
Wood rasp file:-
It is a finishing tool used to make the wood smooth, remove sharp edge finishing fillets and other interior surfaces. Sharp cutting teeth are provided on its surface for the purpose.This file is exclusively used in wood work.

CARPENTRY SECTION

T-LAP JOINT

EXPERIMENT NO: 1 **DATE:**

Aim: - To make a T- lap joint

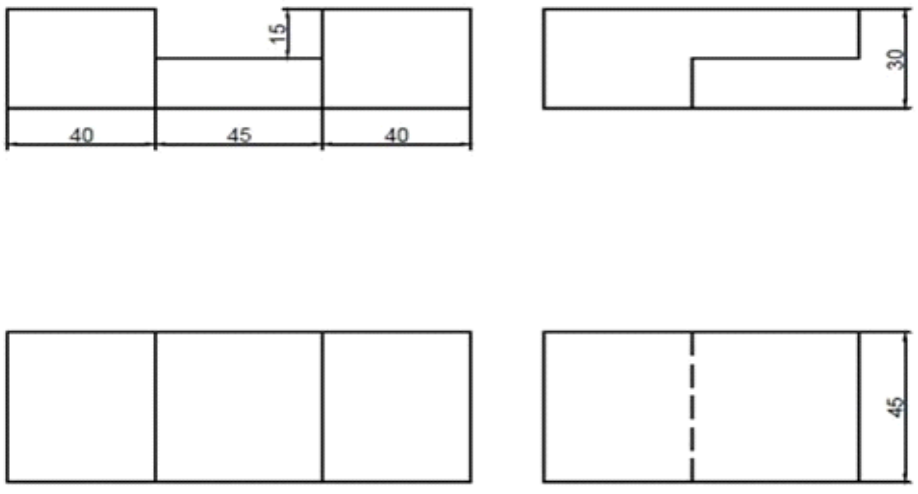
Tools required: -

- Carpenter's vice
- Steel Rule
- Try square
- Jack plane
- Scriber
- Cross cut saw
- Marking gauge
- Firmer chisel
- Mallet
- Wood rasp file and smooth file

Material required: - Wooden pieces of size 50 x 35 x 250 mm–2 Nos.

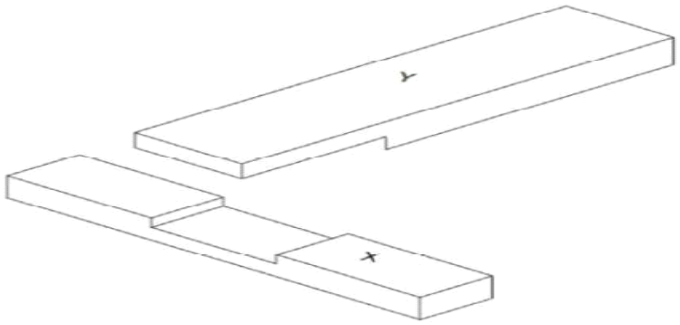
Sequence of operations: -

- Measuring and Marking
- Planning
- Check for squareness
- Removal of extra material
- Sawing
- Chiseling
- Finishing



T-LAP JOINT

ALL DIMENTIONS ARE IN MM



T-LAP JOINT

Procedure: -

- The given reaper is checked for dimensions.
- They are planed with jack plane and checked for straightness.
- The two surfaces are checked for squareness with a try square.
- Marking gauge is set and lines are marked at 30 and 45 mm to mark thethickness and width of the model respectively.
- The excess material is first chiseled with firmer and then planned to correctsize.
- The mating dimensions of the parts X and Y are then marked using steel ruleand marking gauge.
- Using the crosscut saw, the portions to be removed are cut in both the pieces,followed by chiseling.
- The ends of both the parts are chiseled to the exact lengths.
- The fine finishing is given to the parts, if required so that, proper fitting isobtained.
- The parts are fitted to obtain a slightly tight joint.

Safety precautions: -

- Loose cloths are to be avoided.
- Tools to be placed at their proper placed.
- Hands should not be placed in front of sharp edged tools.
- Use only sharp tools.
- Care should be taken, when thumb is used as a guide in cross

cutting andripping.

- Handle while chiseling, sawing and

planning with care.7.

Result: - T- lap joint is made as per the required dimensions.

CARPENTRY SECTION

DOVETAIL LAP JOINT

EXPERIMENT NO: **DATE:**

Aim: - To make a Dovetail lap joint from the given reaper of size 50 x35 x250 mm.

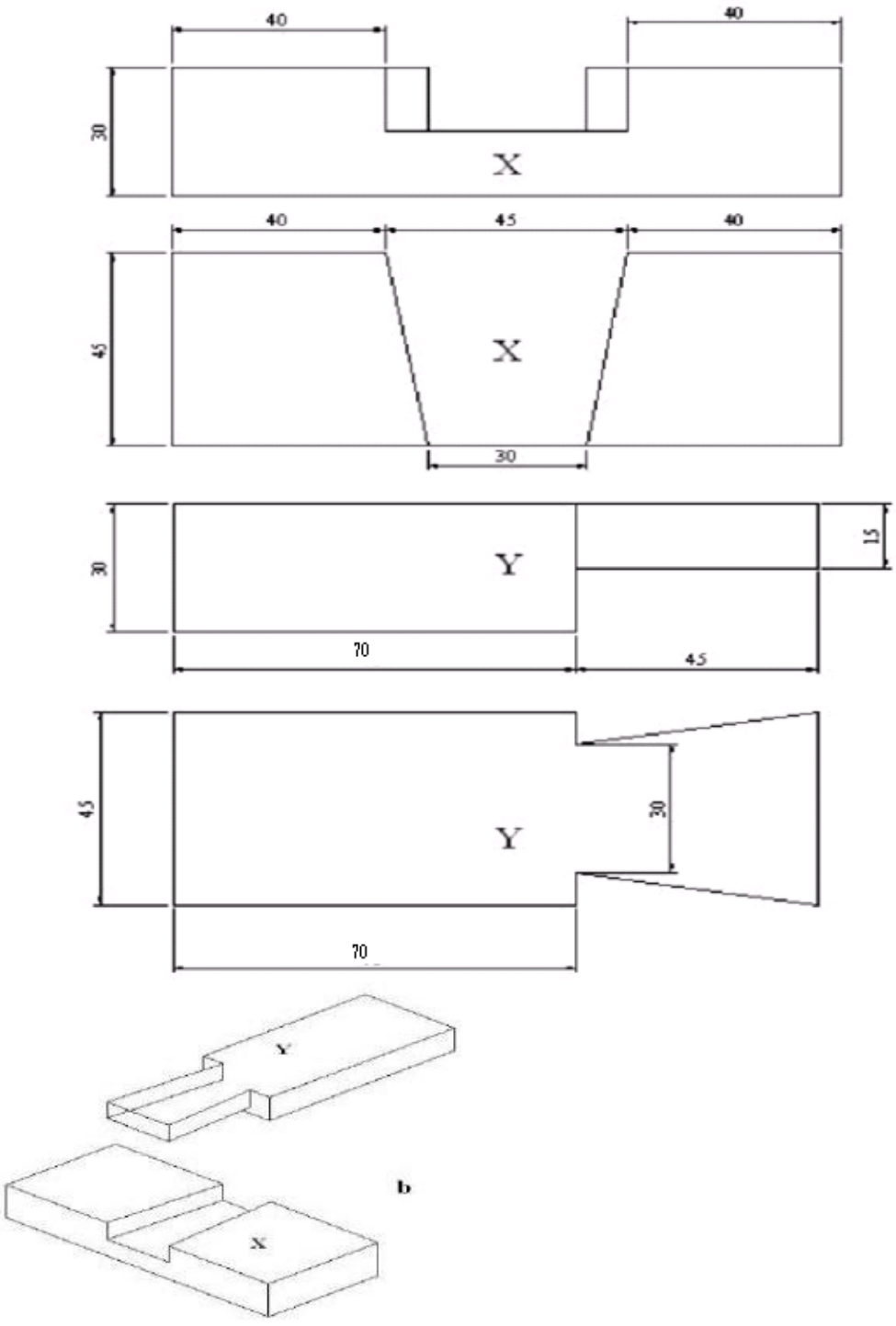
Tools required: -

- Carpenter's vice
- Steel Rule
- Try square
- Jack plane
- Scriber
- Cross cut saw
- Marking gauge
- Firmer chisel
- Mortise chisel
- Mallet
- Wood rasp file and smooth file

Material required: - Wooden pieces of size 50 x 35 x 250 mm–2 Nos.

Sequence of operations: -

- Measuring and Marking
- Planning
- Check for square ness
- Removal of extra material
- Sawing
- Chiseling
- Finishing



DOVETAIL LAP JOINT

Procedure: -

- The given reaper is checked for dimensions.

- They are planed with jack plane and checked for straightness.
- The two surfaces are checked for square ness with a try square.
- Marking gauge is set and lines are marked at 30 and 45 mm to mark thethickness and width of the model respectively.
- The excess material is first chiseled with firmer chisel and then planned tocorrect size.
- The mating dimensions of the parts X and Y are then marked using steel ruleand marking gauge.
- Using the crosscut saw, the portions to be removed are cut in both the pieces,followed by chiseling.
- The ends of both the parts are chiseled to the exact lengths.
- The fine finishing is given to the parts, if required so that, proper fitting isobtained.
- The parts are fitted to obtain a slightly tight joint.

Safety precautions: -

- Loose cloths are to be avoided.
- Tools to be placed at their proper placed.
- Hands should not be placed in front of sharp edged tools.
- Use only sharp tools.
- Care should be taken, when thumb is used as a guide in cross cutting andripping.
- Handle while chiseling, sawing and planning with care.

Result: - Dovetail lap joint is made as per the required dimensions.

MACHINE SHOP

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, mountedon 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, whenviewed from the tail stock end.

principal parts of a Lathe

Figure 4.1 shows a center lathe, indicating the main parts. The name is due to the fact that work pieces are held by the centers.

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.

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.

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

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 lengthof the bed and perpendicular to the axis of the spindle. This movement is used for facing and to providethe necessary depth of cut while turning. The apron, which is bolted to the saddle, is on the front of thelathe and contains the longitudinal and cross slide controls.

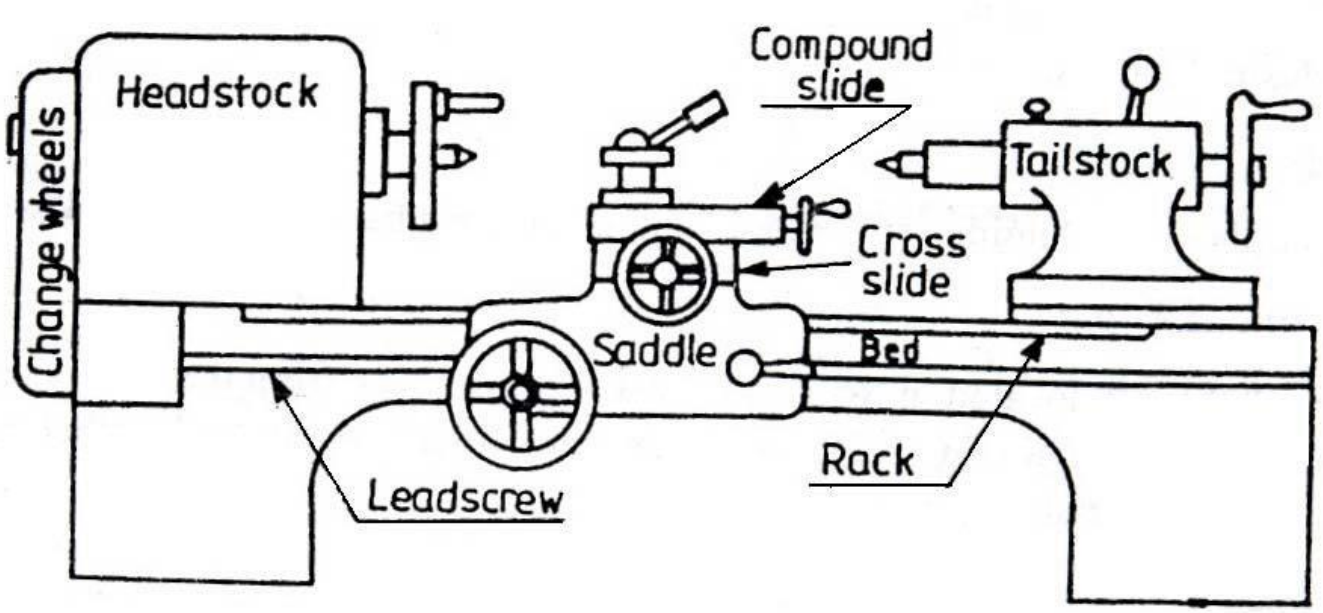


Fig :1Parts of a center Lathe

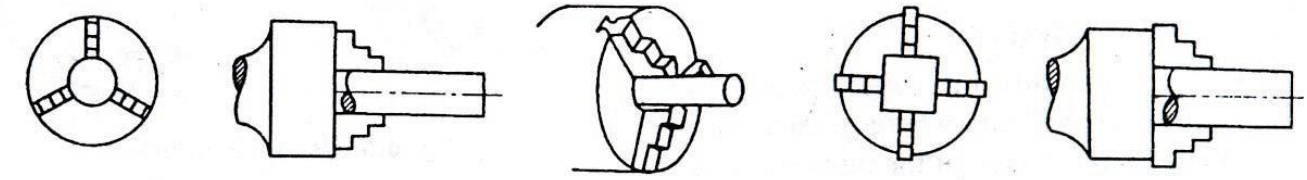


Fig :2 three jaw and four jaw chuck

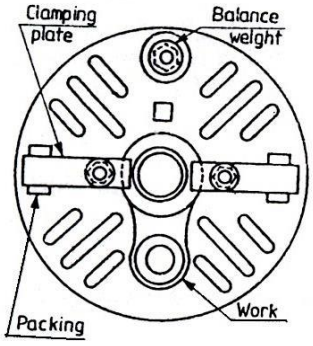


Fig:3 face plate

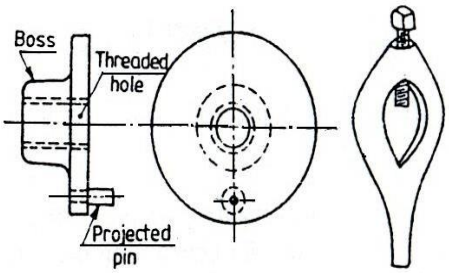


Fig :4 lathe dog and driving plate

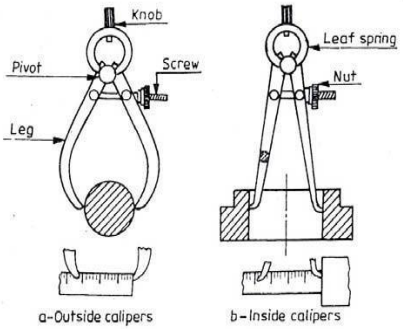


Fig: 5 calipers

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.

Tool Post

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

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 feedingor for cutting threads.

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, thedead 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.

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.

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.

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.

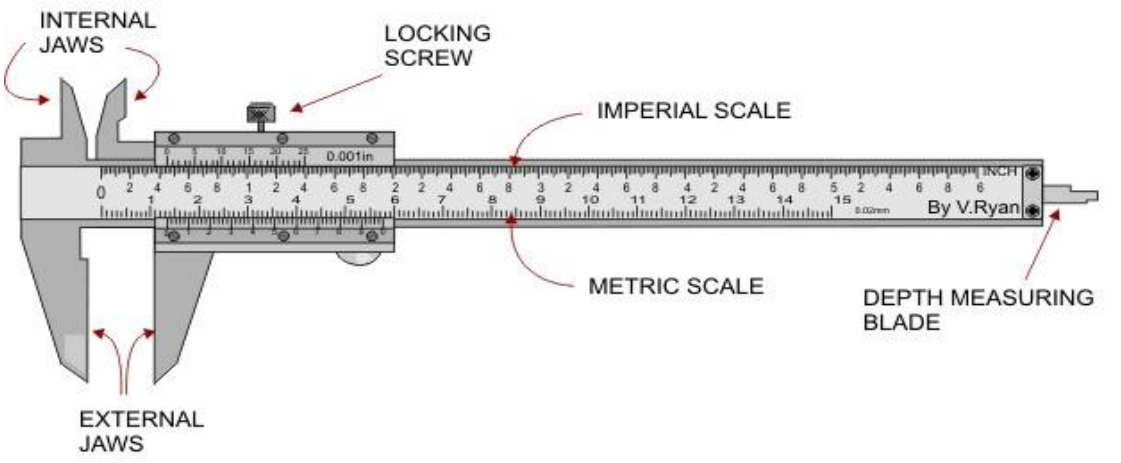


Fig: 6 varnier caliper

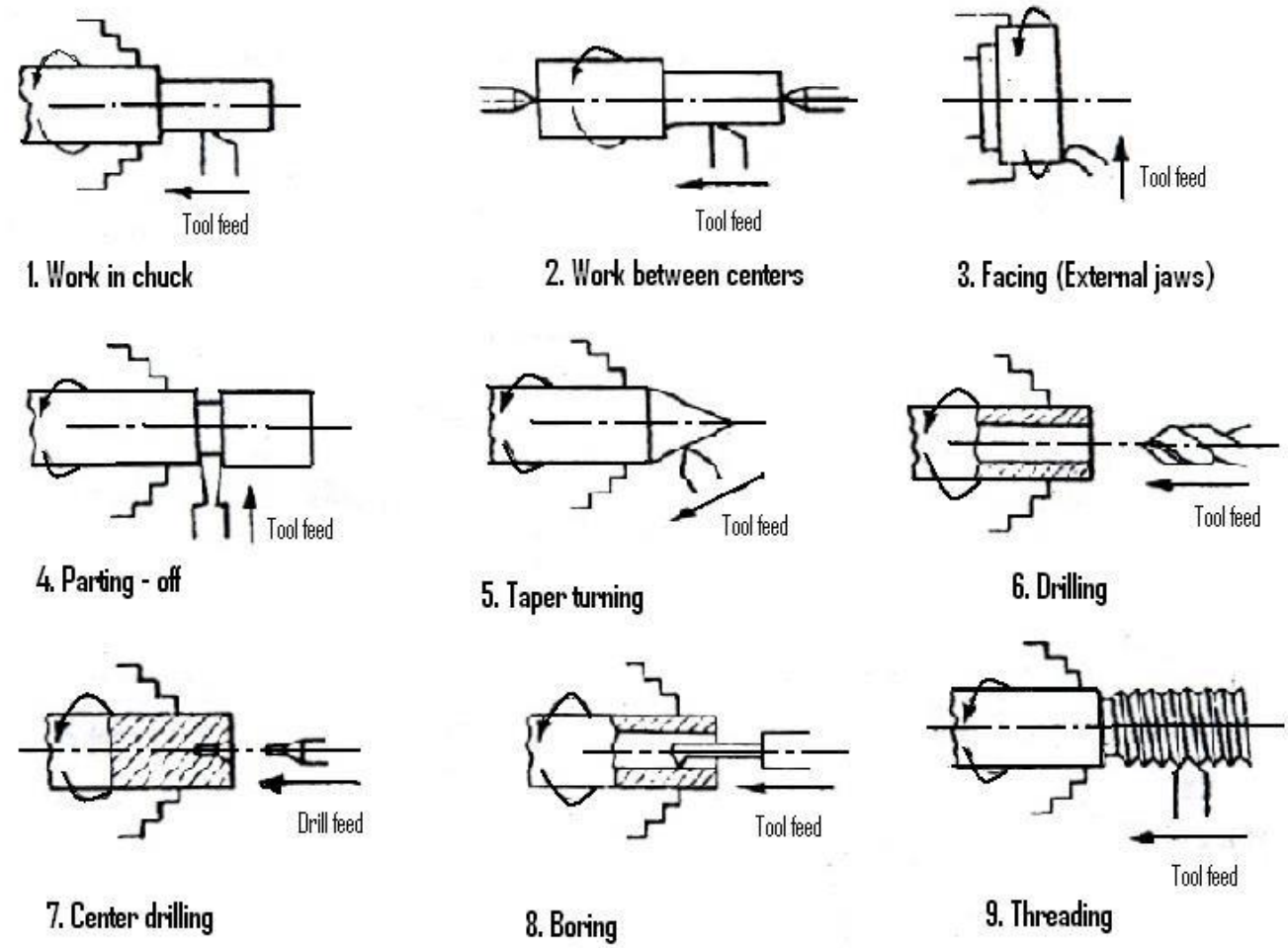


Fig: 7 operations on lathe

2. Venire Calipers

Venire 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. Ti depends upon the work piece material, feed, depth of cut, type of operation and so manyother 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 orfinish 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 HSStools are 18 percent tungsten, 4 percent chromium and 1 percent vanadium.5 to 10 percent cobalt isalso added to improve the heat resisting properties of the tool.

Carbide tipped tools fixed in tool holders, are mostly used in production shops.

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 workpiece. The operation used for machining internal surfaces is often called the boring operation in which ahole previously drilled is enlarged.For turning long work, first it should be faced and center drilled at one end and then supportedby 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 aboutthe lathe axis. A facing tool is fed perpendicular to the axis of the lathe. The tool is slightly inclinedtowards 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 chuckor 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 standardtaper. The drill bit is fitted into the tail stock spindle directly or through drill chuck. The tail stock is thenmoved over the bed and clamped on it near the work. When the job rotates, the drill bit is fed into thework 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 theteeth cut on their surface in a definite pattern. The tool is held rigidly on the tool post and the rollers arepressed against the revolving work piece to squeeze the metal against the multiple

cutting edges. Thepurpose of knurling is to provide an effective gripping surface on a work piece to prevent it from slippingwhen 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 thework 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 cuttingtool, is used for this purpose. Thread cutting in a lathe is performed by traversing the cutting tool at adefinite rate, in proportion to the rate at which the work revolves.