LABORATORY MANUAL

SEMESTER - FIRST

B.TECH

WORKSHOP PRACTICE LAB

Name of the Student ____

Registration No. _______Batch No. __________ Branch __________________

School of Aeronautics (Neemrana)

I-04, RIICO Industrial Area, Neemrana, Dist. Alwar, Rajasthan

(Approved by Director General of Civil Aviation, Govt. of India , All India Council for Technical Education, Ministry of HRD, Govt of India & Affiliated to Rajasthan Technical University. Kota, Rajasthan)

School of Aeronautics (Neemrana)

CERTIFICATE

This is to certify that Mr./ Ms.______________________________

Registration Number ____________________________________

of B.Tech (   ) has satisfactorily completed the term of the subject, Workshop Practice Lab, prescribed by Rajasthan Technical University, Kota.

Dated: ____________ **Signature of Faculty**

INDEX

INDEX

INDEX

SCHOOL OF AERONAUTICS

_____________________________NEEMRANA, ALWAR (RAJ.)_________________________________

WORKSHOP PRACTICE LAB MANUAL

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SOA (NEEMRANA)

Experiment No. 1

AIM:
Care and maintenance of tools and materials.

APPARATUS:
Vice, hammer, chisel, files, hacksaw, taps, dies, spanner, reamers, pliers, scrappers, screw driver, workshop forging shop tool.

INTRODUCTION:
Tools are designed to make a job easier and enable you to work more efficiently. If they are not properly used and cared for, their advantages are lost to you. Regardless of the type of work to be done, you must have, choose, and use the correct tools in order to do your work quickly, accurately, and safely. Without the proper tools and the knowledge of how to use them, you waste time, reduce your efficiency, and may even injure yourself.

PRINCIPLE:

PRECAUTIONS:
Care of vices:
1. Vices must be properly secured with bolts on work bench. In case of use of vice, the bolts must be checked and if found loose should be tightened with wrench or spanner.
2. Vice should be cleaned with cotton before and after use.
3. After six months of use, the main screw should be dismantled and lubricant properly.
4. The handle of vice should be such that while using it, It should not come out. Case should be taken that it does not bend by hammering it for properly, Securing the work piece between jaws and vice.
5. Work piece must be secured in the centre of vice between the jaws.

Care of Hammers:
1. The face of hammer must be checked to be uniform and not bulged out due to prolonged use. Normally, it doesn't happen but sometimes manufactures used poor quality of material causing this defect.
2. The hammer should be properly cleaned and wiped out by cotton before and after use.
3. The shaft or handle of hammer must be secured properly with the hammer block and normally no additional wedge should be put into, to make it from. In case the handle is loosened, it should be replaced with fresh one.
4. Hammer must be placed either in C tool box or wooden shelf.

Care of Chisel:
1. It must be kept clean and free from any oil or greasy material.
2. It should be properly cleaned and wiped out before and after use.
3. Once the cutting edge gets blunt it must be properly grounded and checking the cutting edge with a checking gauge.
4. After long use, the length of chisel gets shortened then 150mm, however in case of fine chisel this is not applicable.
5. Chisel should be kept in a wooden shelf, when not in use and should not be kept in bundles or with cutting tools.

Care of files:

1. The files should not be used without handle or loose fitting handle.
2. A file should never be used on hardened steel , hard surface scale or allowed to strike against the hardened vice jaws.
3. The new file should be used first on copper, brass and then on wrought iron and mild steel.
4. File should be cleaned with thin hard wire brush or file card. After cleaning the file, chalk should be rubbed in to the file teeth to prevent the clogging of pins.
5. The file should not be allowed to rust and to prevent it, the file is coated with machine oil. The oil should be removed before the file is put to use by carbon tetra chloride (CCl_4) or caustic soda (NaOH).
6. The worn out files may be re-used by dipping it in hydrochloric acid (HCl). The worn out files are best suited for making scrapper, punches, chisel etc.

Care of Hacksaw:

1. These may be two different types of hacksaws frame, one of fixed size and other is adjustable. In case of adjustable type, the frame is firmly made of steel pipe with loading holes of telescopic arrangement.
2. In this after long use, the frame cannot be held firmly and therefore it is not generally used However if the frame is adjustable, then it should be carefully used, so that it doesn't get loosened.
4. The blade with the hacksaw frame must be properly held and the wing nut must be replaced after long use, when it becomes too loose with screw.
4. The hacksaw blade and the frame must be kept separately when not in use.
5. The blade and frame must be clean and free from greasy material.

Care of Taps:

1. Taps must be kept clean before and after use.
2. It must be kept separately according to making or identification in sequence of operations so that when used it gives a right thread.
3. Handle of tap must be of sufficient length and square slot made at the centre of the handle should be maintained so that it properly fits into the tap wrench handle.
4. Handle should be kept clean and free from any greasy material and it should be kept separately free from tap.

Care of Dies:

1. Dies and handle should be kept clean before and after use.
2. The use of dies must be in sequence number or could be seen by visual observation so that dies could be prevented from damage.
3. Dies should be kept in a wooden box in sequence or as it is marked. Handle also should be kept separately in wooden shelf.
4. After certain intervals dies handle must be cleaned and wiped out by applying same lubricant to avoid atmospheric action. The handle should be repainted with red colour or any specified colours, specified by organisation after every three years.

Care of Spanner or Wrenches:

1. These are the tools available in different sizes ranging from 5mm to 75mm bolt or nut head size.
2. The spanner should be kept clean before and after use and free from greasy in particular.
3. If the face of spanner is widened or damaged do not reworks on it by biting or marking it correct. Use of such spanners may be case of fatal accident.

4. It should be used by holding the bolt at proper position and application of face must be at the extreme end of spanner or wrench and it should be turned at right angle to the length of the bolt. Always use the right size of spanner to avoid any damage to bolt head or screw. The spanner must be kept in a cloth jacket with flaps.

Care of Reamers:
1. They must be kept clean before and after use and must be kept on a wooden performed pack and kept in vertical positions.
2. After certain use, cutting edges must be checked and if found blunt must be grounded properly and checked with appropriate gauge and in cause of reamer its diameter.

Care of Pliers:
1. Pliers are used to hold work piece, while normally cannot be hold by another devices, therefore more case is required in maintenance of pliers.
2. It should be kept clean and free from greasy material and it must be wiped out with same cloth or cotton waste to prevent rusting of faces.
3. For the purpose cutting wires, it should not be used for hard steel materials; some other cutting tools or process must be used for that purpose.

Care of scrapper:
Since the scrapper has a very sharp cutting edge, therefore when these are not in use it is advisable to keep them lightly oiled and individually wrapped in a piece of cloth or felt or similar material, to protect the extremely hard cutting edge.

Care of Screw driver:
1. They must be kept clean and kept in cotton case to size and length.
2. All the screw driver holders either fixed or detachable must be used in such a manner that it does not get damaged.
3. The screw driver handle should be made of either wood or plastic and should not be hammered or used, otherwise except opening or cleaning or screw of specified size and shape.

Forging shop tools (Hand Tools):
(a). Anvil.
(b). Swage block.
(c). Hammers.
(d). Tongs.
(e). Chisels.
(f). Swages.
(g). Fullers.
(h). Flatters.
(i). Set hammer.
(j). Punches.
(k). Drift.

Care and Maintenance of workshop materials:
Workshop materials may be grouped in the following categories:
(a). Raw materials.
(b). Components.
(c). Fasteners.

(d). Work in process.
(e). Consumable.
(f). Lubricants.
(g). Paints.

1. All materials should be kept in proper position and are marked and displayed by writing or colouring.
2. Different types of raw materials should be stock separately.
3. Small components should be kept in container, rake or seals separately with labels.
4. Shop floor must be kept clean and dry.

Care and Maintenance of forging tools:
1. All tools must be kept clean and free from greasy material, and placed in proper position.
2.In the case of anvil and swage block, it must be installed on a wooden foundation properly set in a horizontal position with the help of spirit level and it should be checked after three or six months.
3. The surface and the edges of anvils and swage block should not be heat with hammer. This will damage the face which will not produce the desire shop.
4. The hammer shaft should be properly fixed and check the length and after use to avoid any accident.
5. The hammer shaft should be properly secured with the help of metallic or wooden wedge or nails.
6. All the tools such as tongs, dies, swage blocks, set hammers, fullers, must be kept clean and put in a wooden self properly, make for specific purpose.
7. Tongs used to hold such tools should be proper and of reasonable length.

DIAGRAM:

Fig 1.2 Bench vice

Fig 1.2 Hammer

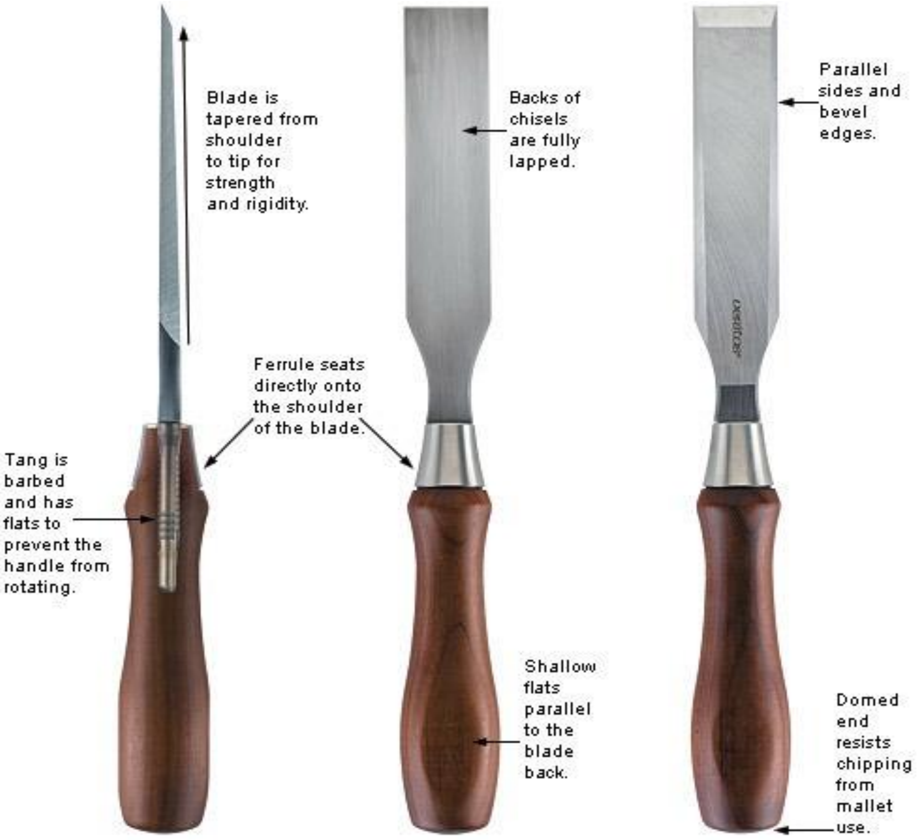

Fig 1.3 Chisel

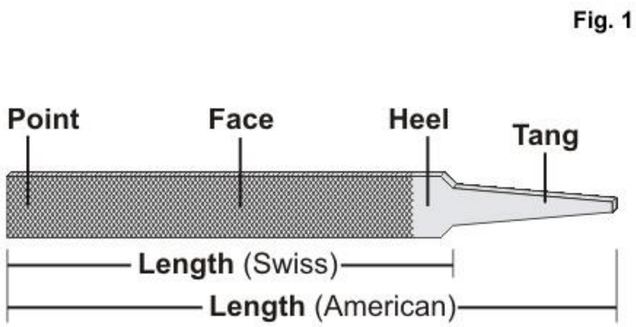

Fig 1.4 File

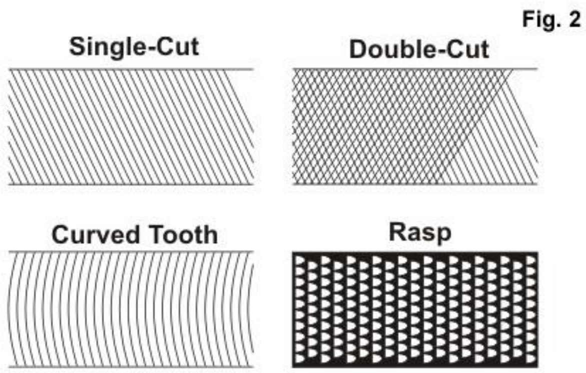

Fig 1.5 Different Styles

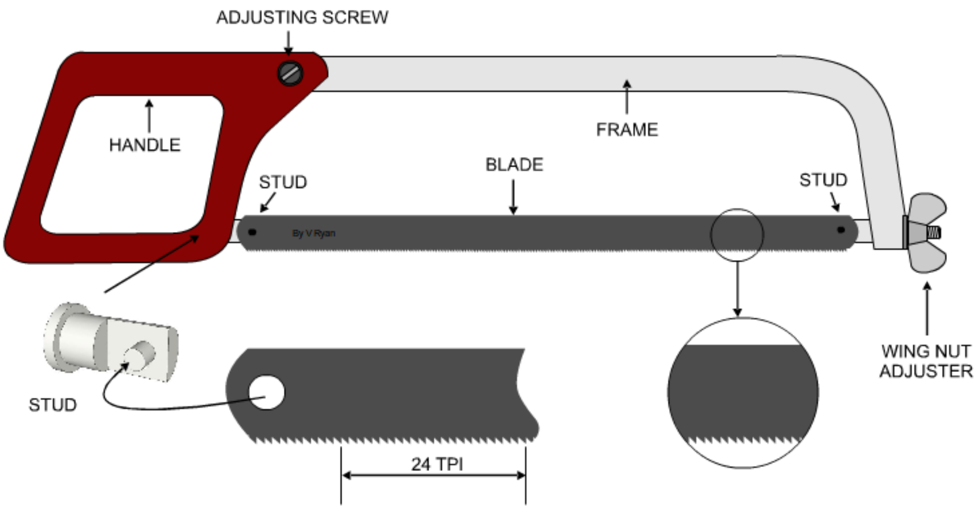

Fig 1.6 Hack saw

Fig 1.7 Different Taps

Fig 1.8 Dies

Combination Spanners

Double Open Ended Spanners

Ring Spanners

Other Special Spanners

Fig 1.9 Different Spanners

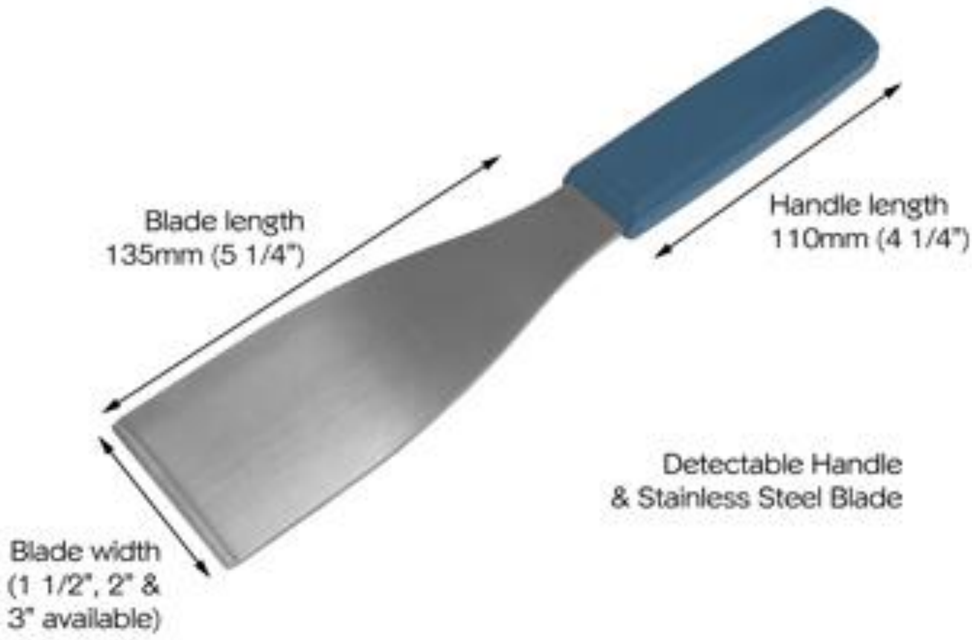

Fig 1.10 Scrapper

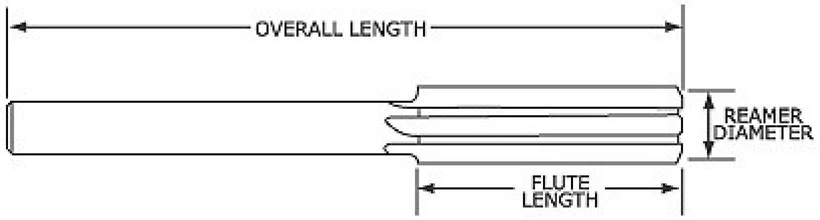

Fig 1.11 Reamer

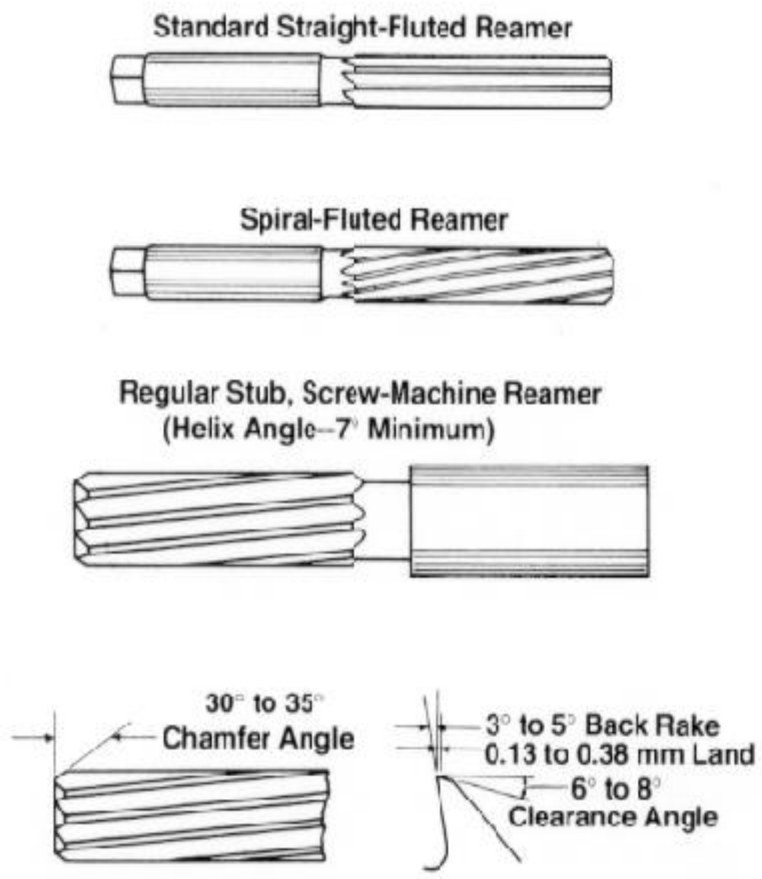

Fig 1.12 Different Reamers

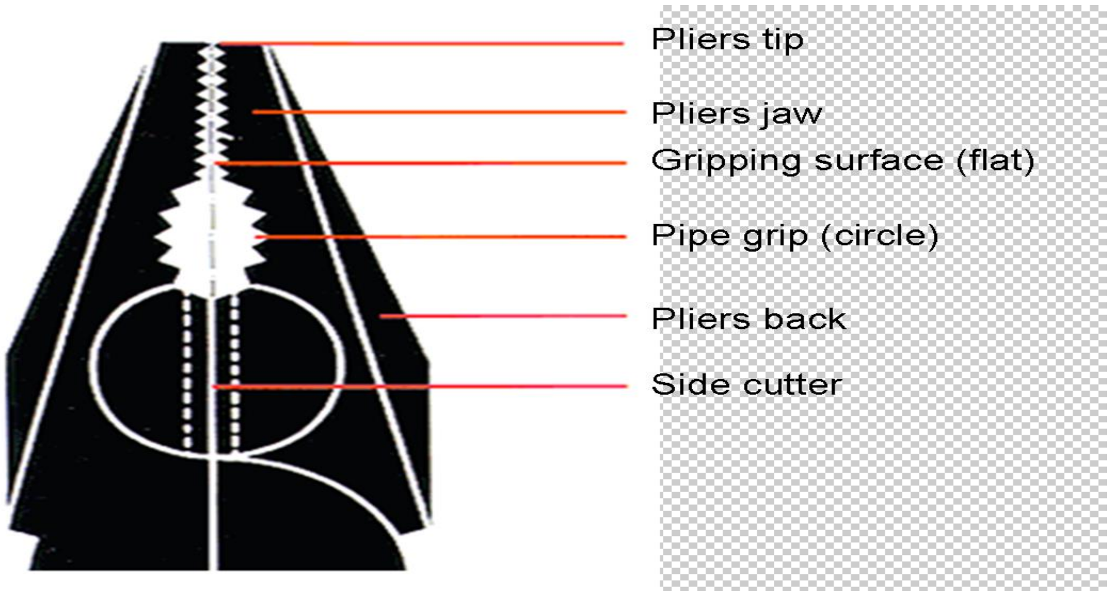

Fig 1.13 Pliers

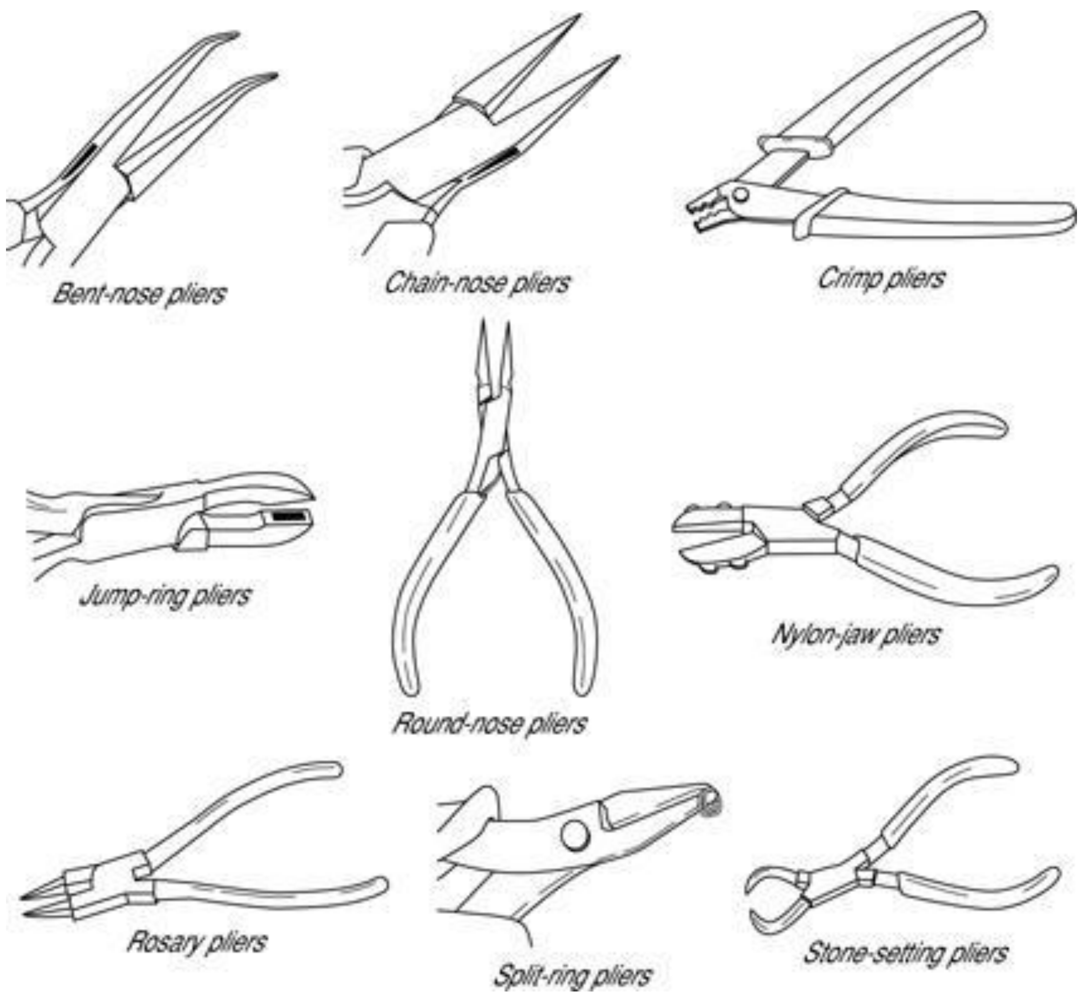

Fig 1.14 Different Pliers

Fig 1.15 Screw Driver & Screw heads

Questions:

1. Why the care of tools is important?

2. How to take care of vices?

3. How to take care of hammers?

4. How to take care of chisels?

5. Explain, how to take care of files?

6. Explain, how to take care of hacksaw?

7. How to take care of taps explain?

8. What points we should kept in mind while working with
   (a) Dies.
   (b) Reamers.

9. How to take care of spanners?

10. Explain the points to take care of spanners?

11. How to points to take care of screw driver?

12. What do you understand by workshop material?

13. Give some points to explain, how to take care of workshop materials?

14. What is forging, what are the different forging tools?

15. Explain how to take care of forging tools?

Sig. of C.I. / Principal **Sig. of Teacher**

EXPERIMENT NO. 2

AIM:

To measure the diameter of given circular hollow iron bar with the help of steel rule and caliper(inside & outside).

APPARATUS:

Iron circular bar, outside calliper, inside caliper, steel rule.

INTRODUCTION:

Caliper, measuring instrument that consist of two adjustable legs or jaws for measuring dimension of material parts. There are two types of caliper inside caliper and outside caliper. Outside caliper measure thickness and outside diameter of objects and inside caliper measure the inner diameter of a hollow bar.

PRINCIPLE:

Reading of outside& inside caliper can be read with the help of steel rule which works on the basic measuring technique of comparing an unknown length to the one previously calibrated.

PROCEDURE: Outside caliper

1. Properly clean the given bar with the help of sand paper.

2. Hold the given bar in the measuring legs of outside caliper.

3. Properly adjust the legs of caliper with adjusting screw, so that it will properly hold work piece.

4. Now, slowly remove the work piece without moving the legs of caliper.

5. Transfer this reading or measurement, on a steel rule placed on a surface plate surface.

6. Take the reading from the steel rule.

7. Repeat the procedure for second and third readings.

OBSERVATION TABLE:

Reading	Average Reading = (R1+R2+R3) / 3
1.	
2.	
3.	

DIAGRAM: Outside caliper

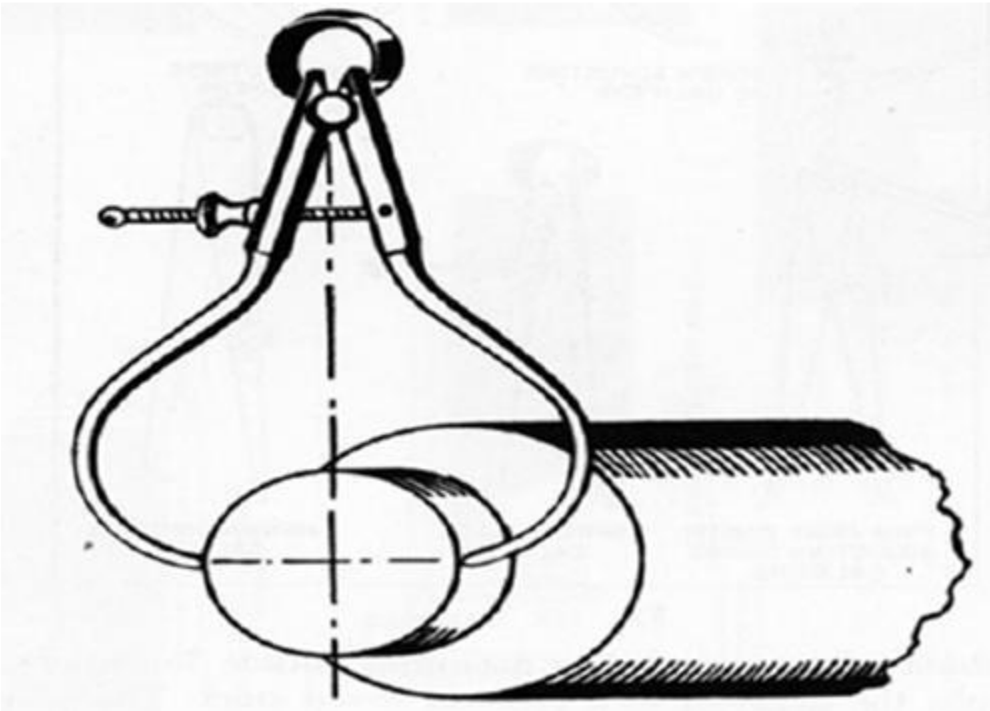

Fig.2.1: Measurement of circular bar

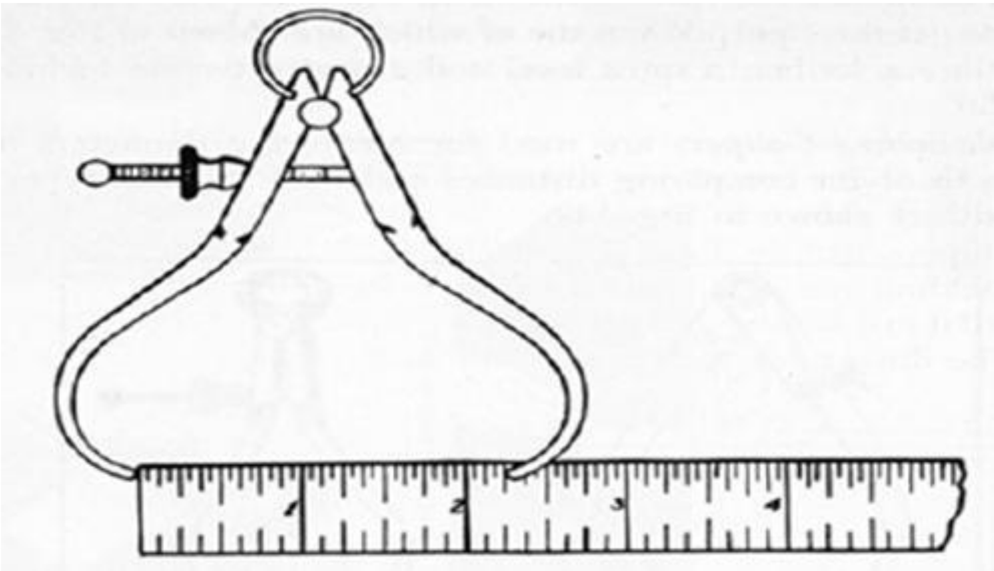

Fig.2.2: Readings help of steel rule

PROCEDURE: Inside calipe r

1. Properly clean the given bar with the help of sand paper.

2. Hold the given hollow bar in the measuring legs of inside caliper.

3. Properly adjust the legs of caliper with adjusting screw, so that it will properly hold work piece.

4. Now, slowly remove the work piece without moving the legs of caliper.

5. Transfer this reading or measurement, on a steel rule placed on a surface plate surface.

6. Take the reading from the steel rule.

7. Repeat the procedure for second and third readings.

OBSERVATION TABLE: Inside caliper

Reading	Average Reading = (R1+R2+R3) / 3
1.	
2.	
3.	

DIAGRAM: Inside caliper

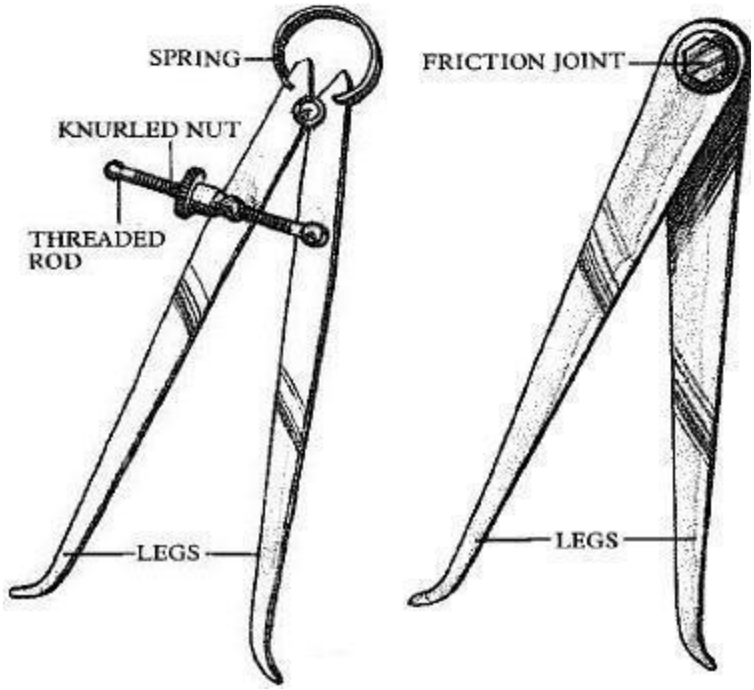

Fig 2.3: Inside Caliper

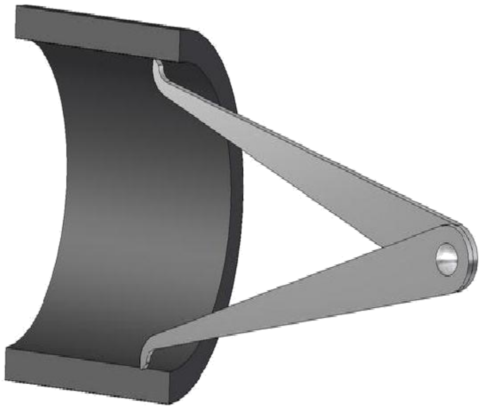

Fig 2.4: Measurement of hollow bar

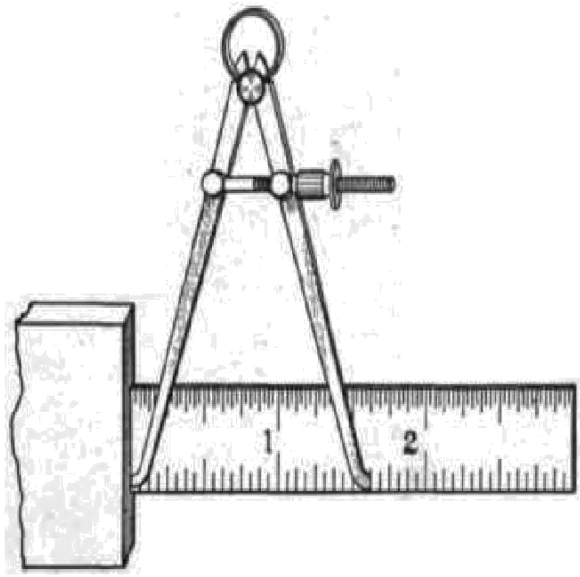

Fig 2.5: Readings help of steel rule

CONCLUSION:

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____

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____

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PRECAUTIONS:

1. Surface of work piece should be clean.
2. Properly hold the bar during measurement.
3. Readings must be taken very carefully without moving the caliper legs.
4. Scale should be placed on surface plate during measurement.
5. Take safety precaution during lab experiments.

QUESTIONS:

1. What are the Two Types of calipers?

____

____

____

____

____

2. What is the Purpose of outside Caliper?

3. How the average reading is calculated?

4. On what principle steel rule works?

5. What are the tools required for measuring the diameter of circular steel bar?

6. What are the precautions to be followed during the practical?

7. What is the procedure for measuring the diameter of circular bar?

SIG. of C.I. / Principal **SIG. of Teacher**

EXPERIMENT NO. 3

AIM:
To learn and practice the use of precision tools & measuring instruments.

APPARATUS:
1. Micrometers,
    a. inside and outside micrometer
    b. depth micrometer
    c. screw thread micrometer
2. Bevel protector

INTRODUCTION:

1. Micrometers: Micrometers are used to make precise measurement of small objects. It has a thimble and barrel. The thimble is rotated till the spindle touches the work piece. Then the final adjustment is made by using Ratchet. The lock nut is then tightened and the dimension is measured on main scale and thimble scale.

Least count of micrometer
Least count of measuring instrument is the ratio of smallest division on main scale and total number of divisions on thimble scale.

Calculation of least count
Least Count (L. C) = Pitch/no. Of divisions on micrometer barrel(thimble)
where,
Pitch = distance travelled by thimble on linear scale in one rotation.

Calculation of final reading
Total reading of micrometer = main scale reading + least count x thimble scale reading.

a. INSIDE & OUTSIDE MICROMETER:

PRINCIPLE:

It works on the principle of screw and nut. We know that when a screw is rotated through one revolution it advances by one pitch distance i.e. one rotation of screw corresponding to a linear movement of a distance equal to pitch of the screw thread.

If the circumference of the screw is divided into number of equal parts say n its rotation through one division will cause the screw to advance through (pitch/n) length.

PROCEDURE:
1. Clean the workpiece and instrument.

2. Check the micrometer for errors like play in the jaw, zero error if any.

3. Calculate the least count of the instrument.

4. Hold the workpiece in the measuring anvils.

5. Note down the reading on main scale and thimble scale.

6. Take the measurement by micrometer for at least 3 components.

7. Calculate the total reading of micrometer.

OBSERVATION TABLE:

S.NO.	Main scale reading	Thimble scale coincidence	Thimble scale reading	Zero error	Total length
a.1					
a.2					
a.3					
b.1					
b.2					
b.3					

DIAGRAM:

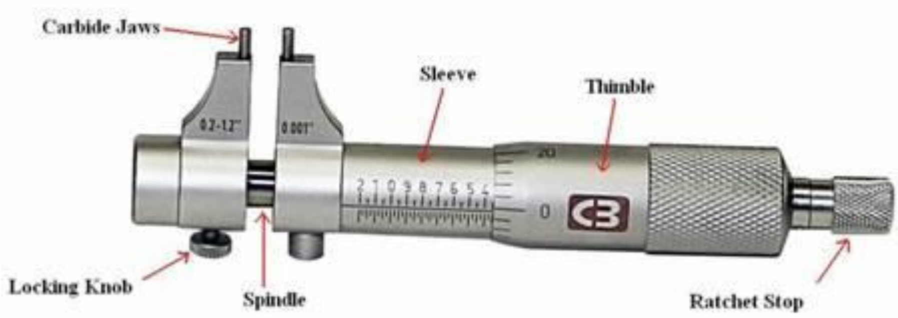


FIG.3.1 Inside Micrometer

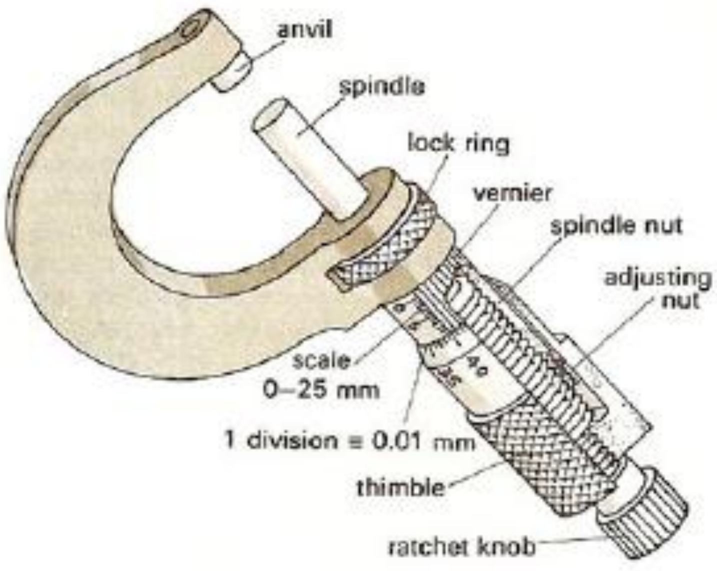


FIG. 3.2 Outside Micrometer

b. DEPTH MICROMETER:

PRINCIPLE:

Depth micrometer as the name indicates is used for measuring the depth of holes, slots and recesses. It has a shoulder, which acts as a reference surface. The shoulder is held firmly and perpendicular to the centre li8ne of hole. Extension rods are in steps of 25mm used for longer range of measurement. The extension rod can easily be inserted by removing the spindle cap. When the cap is replaced, the rod is held firmly against the reference surface. The extension rods are marked with their respective capacity and are square with the base in any position. The measuring faces of the base and rods are hardened.

PROCEDURE:

1. First choose the measurement rod suitable for the depth to be measured.

2. Clean the mounting surfaces of the measurement rod and the rod-receiving shaft using sand paper.

3. Insert and rotate the measurement rod into the rod-receiving shaft to seat it completely.

4. Turn the thimble counter clockwise so that when the base is flush on the top (reference) surface, the measurement rod does not touch the surface to be measured.

5. Holding the base firmly on the reference surface, rotate the thimble ratchet clockwise until it "clicks" three times (as the measurement rod stops on the measurement surface).

6. Read the depth measurement.

OBSERVATION TABLE:

S.No.	Main scale reading A	No. of circular section division B	Circular scale readings division X least count C	Extension rod selected	Total reading A+B+C

DIAGRAM:

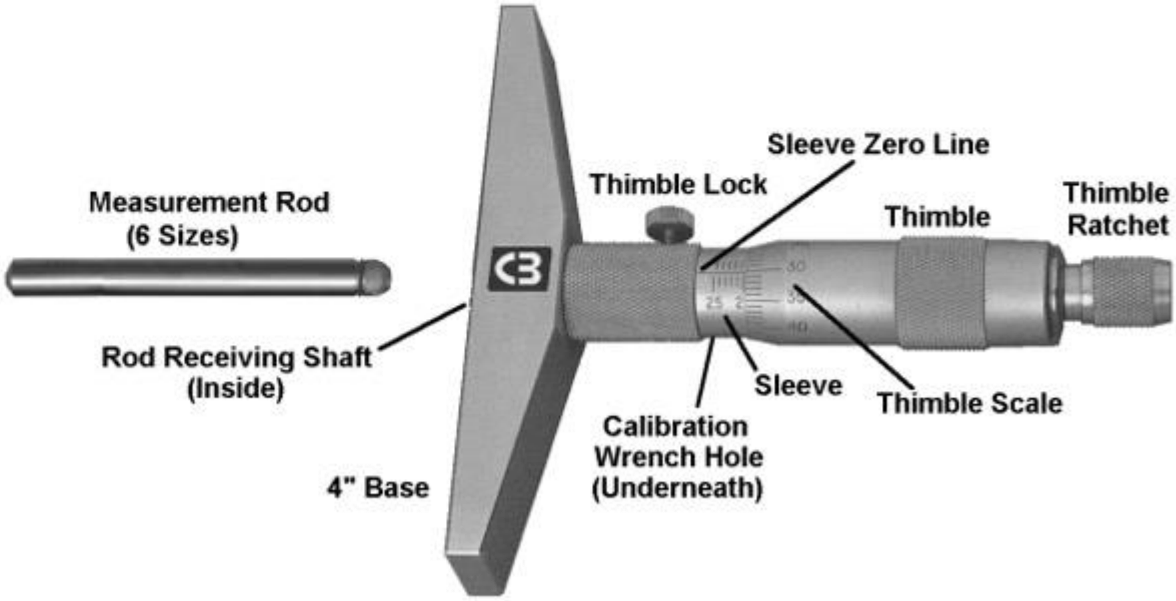


FIG. 3.3 Depth Micrometer

c. SCREW THREAD MICROMETER:

INTRODUCTION:

It is designed to measure the pitch diameter of screw threads to an accuracy of 0.01mm in construction the screw thread micrometer is similar to outside micrometer with the following differences.

1. The movable spindle is pointed, and
2. The end of the anvil is of the same form of the screw thread to be measured the different pairs of interchangeable vee-envil and spindle points are used with this micrometer. In order to measure the pitch diameter the pointed end of the spindle and the sides of the vee-anvil should contact the surfaces of the thread. The reading on the micrometer is read in the similar way as in outside micrometer.

PRINCIPLE:
The principle of the thread micrometer same as outside micrometer.

PROCEDURE:
1. Clean the work piece and instrument.
2. Check the error of the thread micrometer by the use of given test piece with micrometer.
3. Calculate the least count of the instrument.
4. Measure the screw thread pitch diameter the pointed end of the spindle and the sides of the vee-envil should contact the surface of the thread.
5. Note down the reading on the sleeve scale and the thimble scale.
6. Calculate the total reading of thread micrometer.
7. Complete the observation table.

OBSERVATION TABLE:

S.No.	Sleeve reading (A)	Thimble reading (B)	Total reading(A+B)

DIAGRAM:

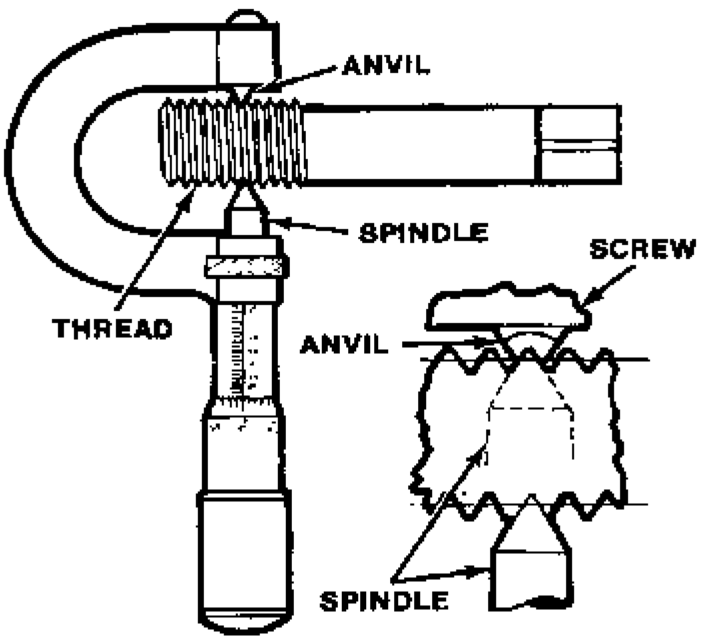


FIG.3.4 Screw Thread Micrometer

CONCLUSION/RESULT:

PRECAUTIONS:
1. it’s essential to ensure the anvil is clean before you try to measure anything.
2. Hold the item you want to measure so that it's squarely between anvil and spindle -- if it's at an angle, you will not make an accurate measurement.
3. Use the ratchet to tighten the micrometer and cease turning the screw once the appropriate torque has been reached
4. If you are right-handed, it's best to hold the micrometer in your right hand and the part you want to measure in your left; if you are left-handed, reverse this orientation.

2. BEVEL PROTECTOR:

INTRODUCTION:
It is used to lay out, measure, or check angles. The universal bevel protractor is capable of measuring obtuse angles as well as acute angles when accompanied with the correct attachments.

LEAST COUNT:-
Each space on the vernier scale is, therefore, one-twelfth of a degree. One-twelfth of a degree is equal to 5 minutes.

PRINCIPLE:
The micrometer works on the principle of screw and nut, when a screw is rotated through a nut by one revolution, it will move forward equal to a distance of one pitch.

MAIN COMPONENTS:-
The main component of the bevel protractor is the main scale The main scale is graduated into four 90-degree components. The main scale is numbered to read from 0 to 0 degrees and then back from 90 degrees to 0.As with other vernier measuring devices, the vernier scale of the bevel protractor allows the tool to divide each degree into smaller increments. The vernier scale is divided into 24 spaces, 12 spaces on either side of the zero.

TYPES OF BEVEL PROTRACTOR:-

- A
- B
- C
- D

In types A, B the Vernier is graduated to read 5min arcs whereas in case C the scale is graduated to read in degrees and the bevel protractor is without vernier or fine adjustment. the difference between type A and B is that a is provided with fine adjustment devices or acute angle attachment whereas type is not the scale of all types are graduated either as a full circle marked 0-90-0-90 with one vernier as semi-circle marked 0-90-0 with two vernier 180 apart .Type D is graduated in degrees and is not provided with either vernier or fine adjustment devices or acute angle attachment.

OBSERVATION TABLE:

S.No.	Angle of Plate	Angle Measured

DIAGRAM:

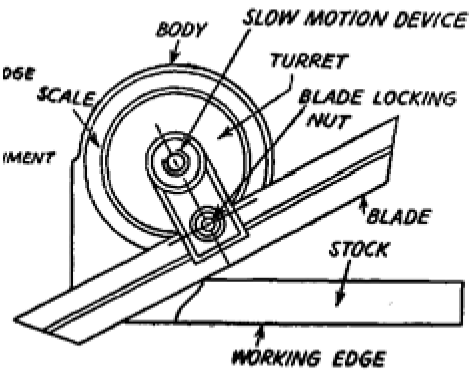


FIG. 3.5 Bevel Protector

CONCLUSION:

PRECAUTIONS:

1. The sine bar should not be used for angle greater than 60^0 because any possible error in construction is accentuated at this limit.

2. A compound angle should not be formed by mis-aligning of work piece with the sine bar. This can be avoided by attaching the sine bar and work against an angle plate.

3. As far as possible longer sine bar should be used since using longer sine bars reduces many errors.

QUESTIONS:

1. What is Pitch?

2. What is Least Count?

3. What is the principle of a Micrometer?

4. How to calculate the least count of given micrometer?

5. How to calculate the final reading from main scale reading and thimble scale reading?

6. What are the varrious precations to be observed during measurement?

7. What is zero error?

SIGN of Principal/HOD SIGN of Faculty

Experiment No. 4

AIM: To acquaint with the different types of Drill.

APPRATUS: twist bit, screwdriver bit,
masonry, spur point, bullet pilot, countersink tile, flat wood, hole saw, Forstner, wood aug er.

INTRODUCTION:

To drill a satisfactory hole in any material, the correct type of **drill bit** must be used; it must be used correctly and be sharpened as appropriate. Many jobs around the house require a hole of some kind to be drilled - whether it is putting up a shelf, building a cabinet or hanging a light fitting.

For basic requirements, a set of high-speed steel twist drills and some masonry bits will probably be sufficient for the average handyman. But for more sophisticated jobs/material, others bits will be required - perhaps larger, or designed for a specific material/purpose. Good quality drill bits can be expensive, so take care of them, keep them in a case or box if possible, rather than allowing them to roll around loose in a toolbox where the cutting edges may be damaged.

Learning how to sharpen drill bits is cost effective, it better to keep a bit sharp by occasional sharpening rather than waiting until it becomes really blunt. A sharp bit cuts better with less effort whether used in a power or hand drill. A sharp bit will also give a cleaner hole.

Types of Drill Bits:

1.TWIST BITS

Usually preferred to as twist drills, twist bits are probably the most common drilling tools used by the handyman with either a hand or electric drill. The front edges cut the material and the spirals along the length remove the debris from the hole and tend to keep the bit straight.

They can be used on timber, metal, plastics and similar materials. Most twist bits are made from either:

- **'high speed steel'** (HSS), these are suitable for drilling most types of material, when drilling metal the HSS stands up to the high temperatures.
- **'carbon steel'**, these bits are specially ground for drilling wood and should not be used for drilling metals, they tend to be more brittle, less flexible than HSS bits.

Twist bits are also available coated with Titanium nitride (TiN), these are easily identified by the gold like color. This coating increases the hardness of the bit and adds a self-lubricating property. The coating is only really effective when metal is being drilled, it has little effect when working with other materials.

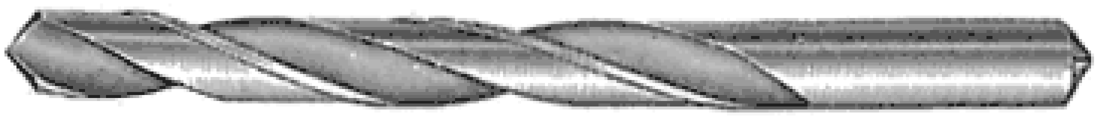
Twist drills are usually available in sizes 0.8-12 mm plus. They are designed for drilling relatively small holes, they sometimes tend to clog quickly especially when the wood is 'green' so when drilling deep holes (especially in hardwood) the bits should be withdrawn regularly to remove the waste.

Special care is required when using the smallest sizes since these bits are thin and brittle. Always hold the drill square to the work and apply only light pressure when drilling.

Sharpening - use a drill sharpener, a grindstone jig or an oilstone.

Titanium nitride bits cannot be sharpened without destroying the coating (although if the drill needs sharpening, the coating will probably have already been destroyed). Forming the correct angle at the tip is important for efficient cutting.

DIAGRAM:



2. SCREWDRIVER BIT DRILLS

Designed to fit in rechargeable screwdriver these bits have a hexagonal shank. They are ideal for drilling pilot holes but are limited by the low power of these type of screwdrivers and the limited size of small bits available.

Sharpening - as for twist drills.

DIAGRAM:

3. MASONRY BIT:

As the name suggests, these are designed for drilling into brick, block, stone, quarry tiles or concrete. The cutting tip is often made from tungsten carbide bonded to a spiralled steel shaft. Some masonry drills are described as 'durium tipped', this term refers to a highly durable silicon bronze alloy used instead of tungsten as the cutting point.

Masonry drills are usually used in a power drill; although they can be used with a lot of effort in a hand brace. Most masonry bits can be used with a hammer action power drill, but always check as the action is quite punishing on the bit and cheaper bits have been known to shatter when subjected to the pounding. Always use a slow rotational speed for drilling into harder materials to avoid overheating the tip, and frequently withdraw the bit to remove dust.

Long Masonry bits (300 to 400mm) are available for drilling through masonry walls.

Bit sizes range from 4 to 16mm.

Sharpening - use a drill sharpener or grindstone to sharpen the tungsten carbide tip.

DIAGRAM:

4. SPUR POINT BIT

Also known as a wood or dowel bit, they have a central point and two raised spurs that help keep the bit drilling straight. The bit cuts timber very fast when used in a power drill and leaves a clean sided hole. They are ideal for drilling holes for dowels as the sides of the holes are clean and parallel. Sizes range from 3 to 10mm. Spur point bits should only be used for drilling wood or some plastics.

Sharpening - a bit fiddly as it has to be done by hand. Sharpen the point and spurs with a fine file or edge of a fine grindstone; the angle between the point and spurs should be 90°.

DIAGRAM:

5. BULLET PILOT POINT:

With their central point and two spurs, Bullet drills resemble spur point bits, but can be used in metal, wood and plastics. Unlike normal twist drills, the twisted flutes are ground away; making a truer, more accurate bit than normal twist bits. They cut a clean hole and cause little damage when they break through the back of the workpiece.

Bit sizes range from 1.5 to 13 mm.

Sharpening - cannot be carried out satisfactorily.

DIAGRAM:

6. COUNTERSINK:

Although not a true 'drill', it is used in a power or hand drill to form the conical recess for the heads of countersunk screws. These bits tend to be designed for use on soft materials such as timber and plastics, not metals. When used with a power drill to counter sink an existing hole, the bit tends to 'chatter', leaving a rough surface. Better results be will obtained if the countersink bit is used before the hole is drilled, then take care to ensure that the hole is in the centre of the countersunk depression.

Countersinks are available with fitted handles so that they can be used by hand twisting, often easier than changing the bit in the drill when only a relatively few holes need countersinking.

Sharpening: difficult, but can be done with a fine triangular file.

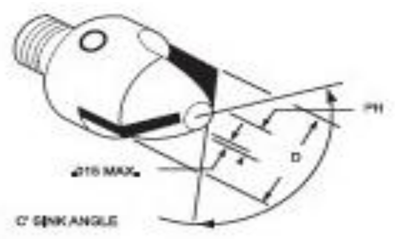
DIAGRAM:

7. COUNTERSINK WITH CLEARANCE DRILL:

These combination bits are quite clever, they drill the clearance hole and countersinks it all in one stroke. Can be used in a power drill or some routers. Different bits are required for different size of clearance holes and they are probably not cost effective unless a large number of a given hole size need to be drilled and countersunk.

Sharpening - difficult, due to shape of spur points.

DIAGRAM:

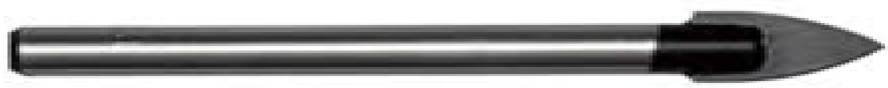
8. TILE BIT:

A bit for drilling ceramic tiles and glass, it has a ground tungsten carbide tip. They can be used with a hand drill, but are best used in a variable speed power drill on a slow speed. When drilling glass, some form of lubricant (i.e. turpentine or white spirit) should be used to keep the tip cool.

Ceramic tiles can also be drilled using a masonry bit if it is used at slow speed and without hammer action.

Sharpening - difficult because of the hard tungsten carbide and curved cutting edge. With care and patience, a blunt edge can be made good using an oilstone.

DIAGRAM:



9. FLAT WOOD BIT:

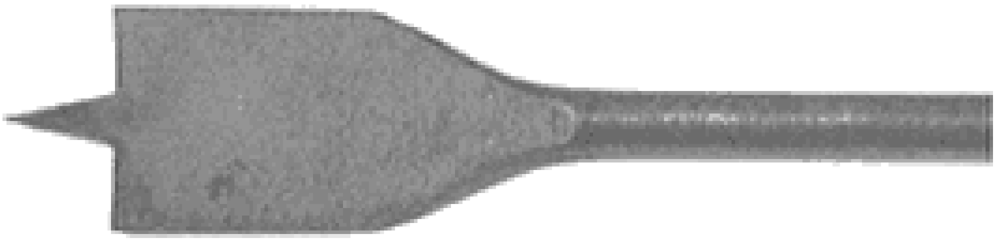
Intended for power drill use only, the centre point locates the bit and the flat steel on either side cuts away the timber. These bits are used to drill fairly large holes and they give a flat bottomed hole (with a central point) so are ideal where the head of a screw/bolt needs to be recessed into the timber - always use this bit before drilling the clearance hole for the bolt.

The larger bits require a fairly powerful drill to bore deep holes. The bits cause a lot of splintering as they break out the back of the workpiece - using a sacrificial backing board will reduce this. Flat wood bits are not really suitable for enlarging an existing hole.

Sizes range between 8 and 32mm.

Sharpening - use a fine file, oilstone or grindstone.

DIAGRAM:



10. HOLE SAW:

Used for cutting large, fixed, diameter holes in wood or plastic. They will usually cut up to a depth of 18mm - deeper versions are available. Best used in a power drill at low speed as the blade saws it's way through the material.

Sharpening - could be done with a fine triangular file - as for an ordinary saw.

DIAGRAM:

11. COMBINATION HOLE SAW:

Like the Hole Saw above, these combination saws can cut large holes but they consist of a number of different sized round saw blades, usually ranging from about 25 to 62mm in diameter. Normally the blade are secures by a radial screw in the 'head', all blades other than the desired sized being removed before the screw is inserted to secure the required diameter blade. Best used in a power drill at low speed as the blade saws it's way through the material.

Sharpening - could be done with a fine triangular file and 'setter' as for an ordinary saw.

DIAGRAM:

12. FORSTNER BIT:

Used to form holes with a flat bottom, such as for kitchen cupboard hinges. Best used in a power drill held in a drill stand as there's little in the way of a central point. If used freehand, the positioning is difficult to control as there is no central pilot bit.

Sharpening - on an oilstone or with a fine file.

DIAGRAM:

13. WOOD AUGER BIT

This is ideal when drilling large-diameter, deep holes in wood or thick man-made boards. Generally an Auger bit should only be used in a hand brace. The bit will cut a clean and deep, flat bottomed holes. The single spur cuts and defines the edge of the hole while the chisel-like cutting edge removes the waste within the previously cut circle. The threaded centre bites into the wood and pulls the bit into the timber. This 'pulling' action means that the bit is really unsuitable for use in a power drill.

Sharpening - use a fine file or oilstone to keep the spur and main cutting edges sharp.

DIAGRAM:

CONCLUSION:

PRECAUTIONS:

1. Wear Safety Goggles.
2. Wear protective clothing.
3. Turn off the drill during changing drill bit.
4. Ensure that the Chuck is Tight before Using the Drill.
5. Use the Correct Drill Bit for Every Job.
6. Avoid Clogging or Binding of the Drill Bit.

DIAGRAM:

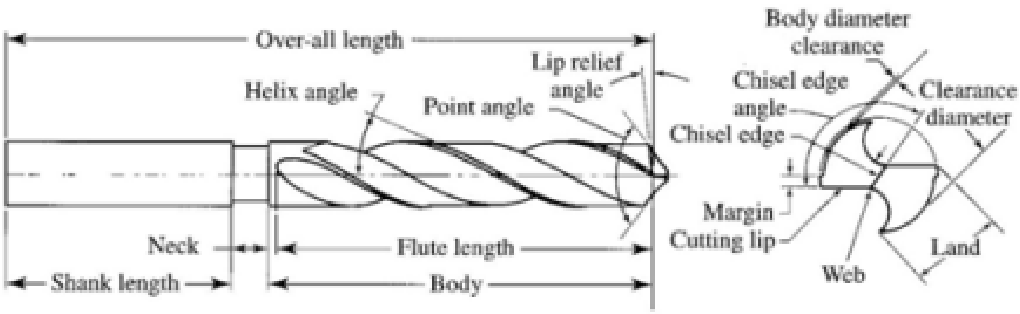


FIG. Nomenclature of Drill Bit

FIG. Different types of Drill Bits

QUESTIONS:

1.what is the use of drill bit?

2. which materials use to make Twist drill ?

3. use of screw driver drill bit?

4. Which Drill bits use for making hole in wood?

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5. how to sharpen the drill bits?

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SIGN of TEACHER **SIGN of PRINCIPAL**

EXPERIMENT – 5

OBJECTIVE: To learn and practice the use of drills and reamers.

APPARATUS USED: Drilling M/C, Twist Drill, Reamer, Work Piece.

Twist Drill:

Twist drills are the most common cutting tools used with drilling machines. Twist drills are designed to make round holes quickly and accurately in all materials. They are called twist drills mainly because of the helical flutes or grooves that wind around the body from the point to the neck of the drill and appear to be twisted. Twist drills are simply constructed but designed very tough to withstand the high torque of turning, the downward pressure on the drill, and the high heat generated by friction. There are two common types of twist drills, high-speed steel drills, and carbide tipped drills. The most common type used for field and maintenance shop work is the high-speed steel twist drill because of its low cost. Carbide-tipped metal drills are used in production work where the drill must remain sharp for extended periods, such as in a numerically controlled drilling machine.

INTRODUCTION:

Drilling: It is a cutting process that uses a **drill** bit to cut or enlarge a hole of circular cross-section in solid materials. The **drill** bit is a rotary cutting tool, often multipoint. The bit is pressed against the workpiece and rotated at rates from hundreds to thousands of revolutions per minute.

Reaming: A **reamer** is a type of rotary cutting tool used in metalworking. Precision **reamers** are designed to enlarge the size of a previously formed hole by a small amount but with a high degree of accuracy to leave smooth sides.

PRINCIPLE:

Drilling machines use a drilling tool that has cutting edges at its point. This cutting tool is held in the drill press by a chuck or Morse taper and is rotated and fed into the work at variable speeds. The removal of metal in a drilling operation is by shearing and extrusion.

PROCEDURE:

i) Run the machine at low speed and observe the motions, which control the shapes of the surfaces produced.

ji) Learn the names of the major units and the components of each machine. Record these details (Table 1).

(Please ensure that the main isolator switch is off and check that the machine cannot be inadvertently Started. Do not remove guards). Use the manufacture's handbook for details that cannot be inspected.

iii) Record the obtainable speed and feed values (Table 2).

iv) Note down the special features of the speed and feed control on each machine,

v) Pay attention to the following:

a, Size specification of various machine tools,

b, Machine tool structures and guide ways I slide ways.

c. Drive mechanism for primary (cutting) motion,

d. Drive mechanism for secondary (feed) motion.

e. Drill geometry - check for angles

OBSERVATION:

Table1: Machine Tool Specification

Machine	**Types & Make**	**Size**	**Speed Given To**		**Feed Given To**		**Types of surface produced**
			Tool	**Work**	**Tool**	**Work**	
Drilling M/C							

Table2: Speed and Feed data

S.No.	**Drilling Machine**	
	Speed	**Feed**

1		
2		
3		
4		

GENERAL DRILLING OPERATIONS:

DRILLING DEEP HOLES:

If the depth of the hole being drilled is greater than four times the diameter of the drill, remove the drill from the workpiece at frequent intervals to clean the chips from the flutes of the drill and the hole being drilled. A slight increasing speed and decrease in feed is often used to give the chips a greater freedom of movement. In deep hole drilling, the flutes of the smaller drills will clog up very quickly and cause the drill to drag in the hole, causing the diameter of the hole to become larger than the drill diameter. The larger drills have larger flutes which carry away chips easier. The depth of the hole being drilled is four times the diameter of the drill itself, remove the drill at frequent intervals and clean the chips from the flutes of the drill and from the hole being drilled.

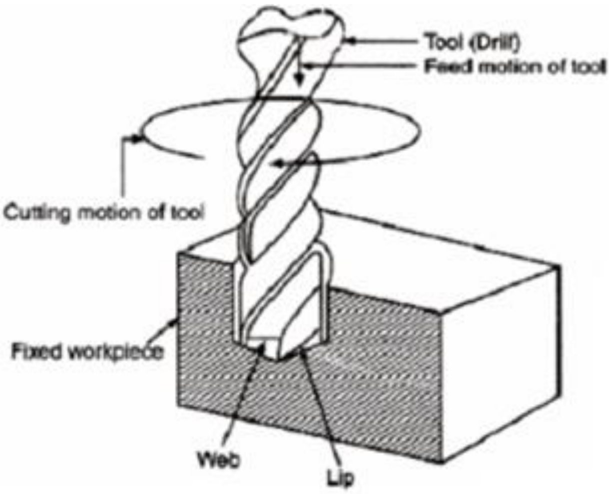

FIG.1 Drilling Deep Hole

SPECIAL OPERATIONS ON DRILLING MACHINES

COUNTERSINKING:

Countersinking is the tapering or beveling of the end of a hole with a conical cutter called a machine countersink. Often a hole is slightly countersunk to guide pins which are to be driven into the workpiece; but more commonly, countersinking is used to form recesses for flathead screws and is similar to counterboring.

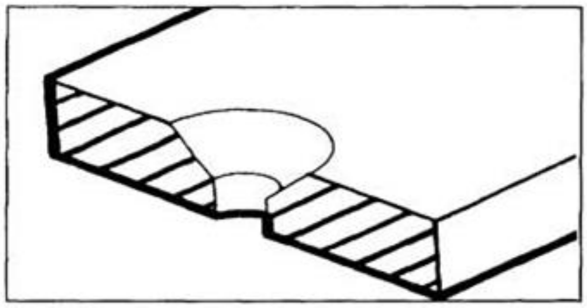

FIG.2 Counter sinking

COUNTERBORING AND SPOT FACING:

Counterboring is the process of using a counterbore to enlarge the upper end of a hole to a predetermined depth and machine a square shoulder at that depth. Spot facing is the smoothing off and squaring of a rough or curved surface around a hole to permit level seating of washers, nuts, or bolt heads. Counterbored holes are primarily used to recess socket head cap screws and similar bolt heads slightly below the surface. Both counterboring and spot facing can be accomplished with standard counterbore cutters. Counterbore cutters have a pilot to guide the counterbore accurately into the hole to be enlarged. If a counterbore is used without a pilot, then the counterbore flutes will not stay in one spot, but will wander away from the desired hole. The shank of counterbores can be straight or tapered. The pilots of counterbores can be interchangeable with one another so that many hole combinations can be accomplished.

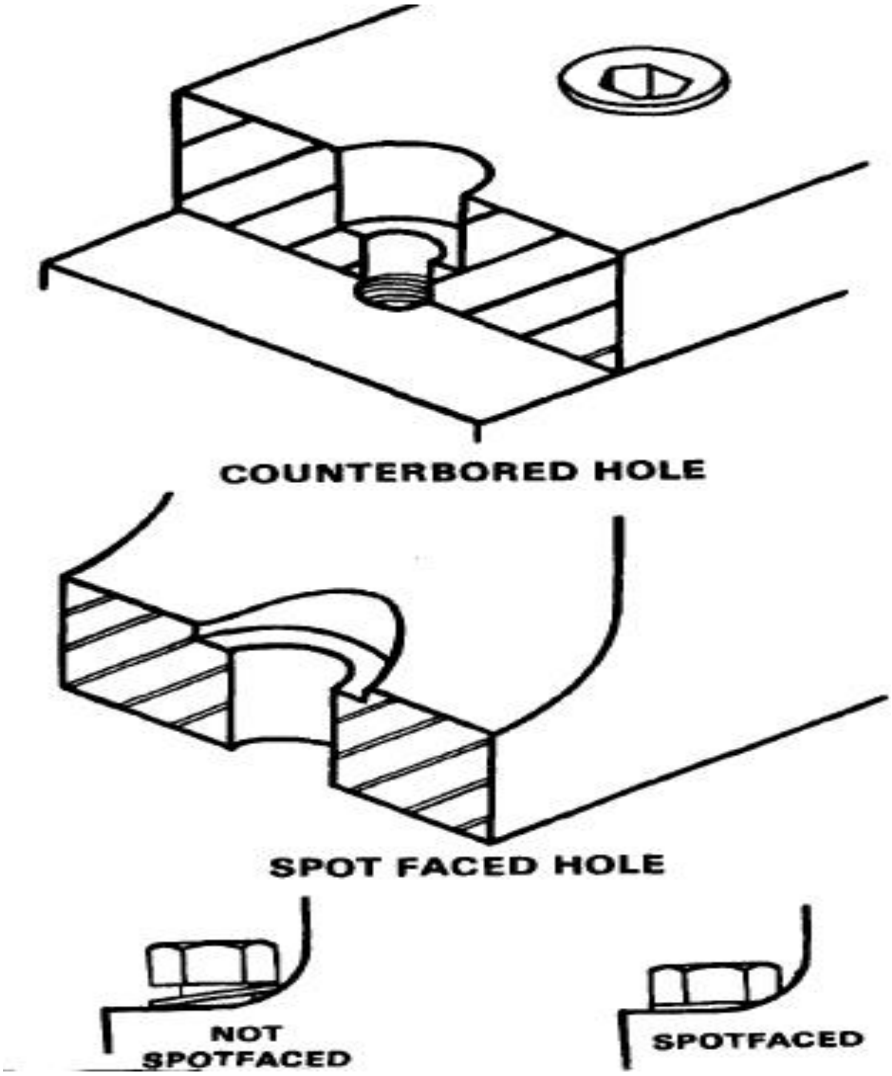

FIG. 3 Counter Boring and Spot Facing

TAPPING:

Tapping is cutting a thread in a drilled hole. Tapping is accomplished on the drilling machine by selecting and drilling the tap drill size, then using the drilling machine chuck to hold and align the tap while it is turned by hand. The drilling machine is not a tapping machine, so it should not be used to power tap. To avoid breaking taps, ensure the tap aligns with the center axis of the hole, keep tap flutes clean to avoid jamming, and clean chips out of the bottom of the hole before attempting to tap.

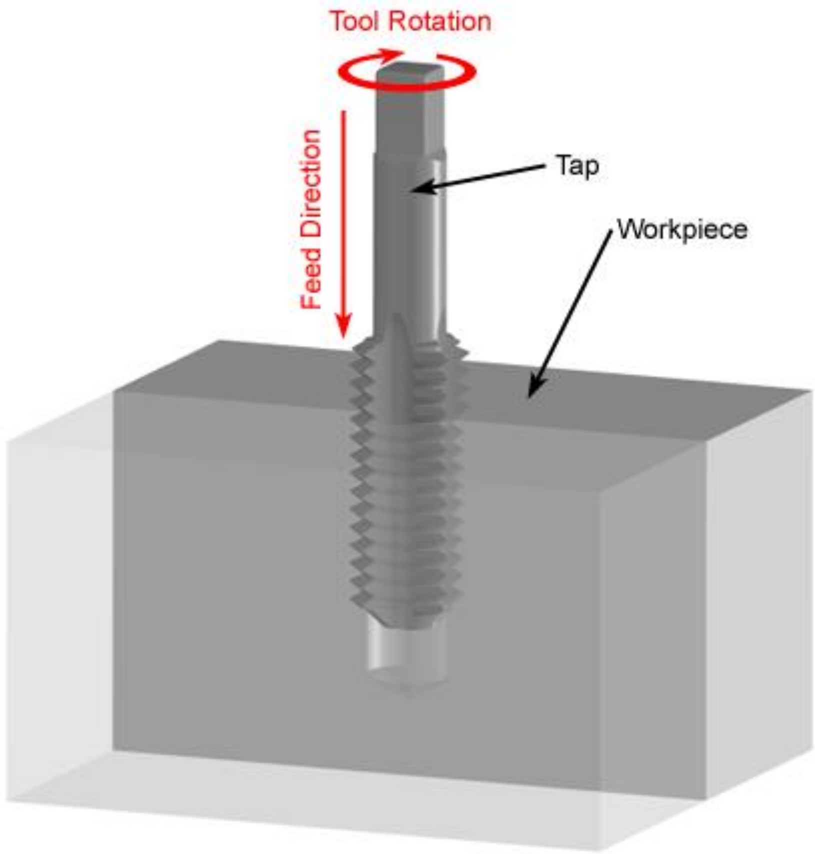

FIG. 4 Tapping Operation

REAMING:

When great accuracy is required, the holes are first drilled slightly undersized and then reamed to size. Reaming can be done on a drilling machine by using a hand reamer or using a machine reamer. When you must drill and ream a hole, it is best if the setup is not changed. For example, drill the hole (slightly undersized) and then ream the hole before moving to another hole. This method will ensure that the reamer is accurately aligned over the hole. If a previously drilled hole must be reamed, it must be accurately realigned under the machine spindle. Most hand and machine reamers have a slight chamfer at the tip to aid in alignment and starting.

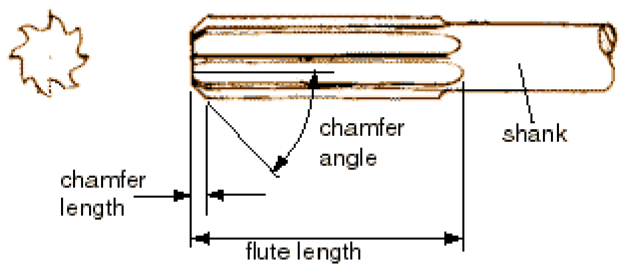

FIG. 5 Reamer

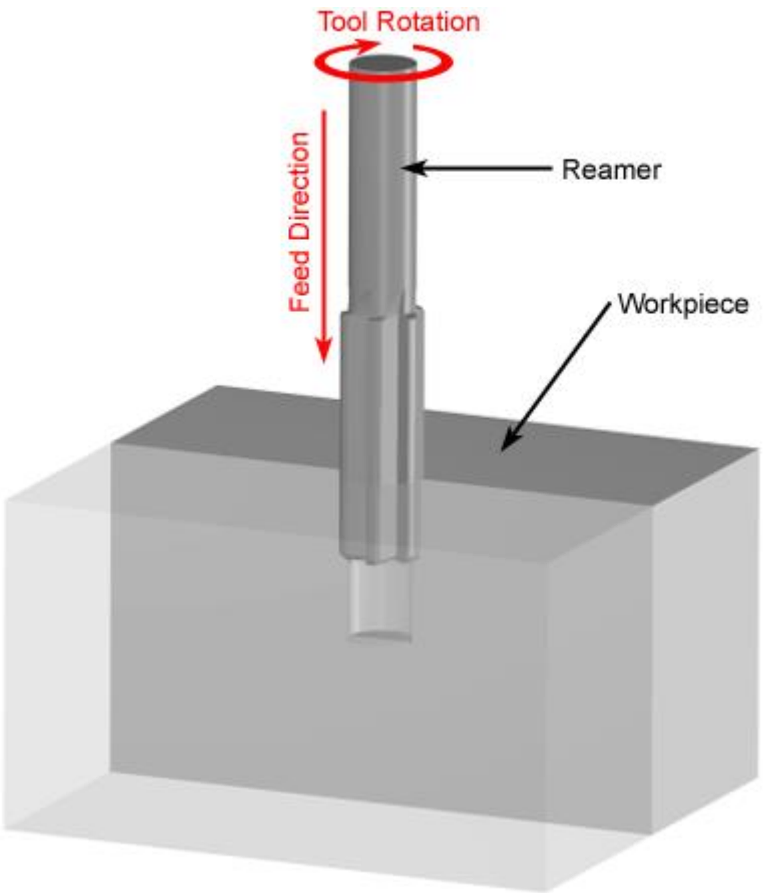

FIG. 6 Reaming Operation

DIAGRAMS:

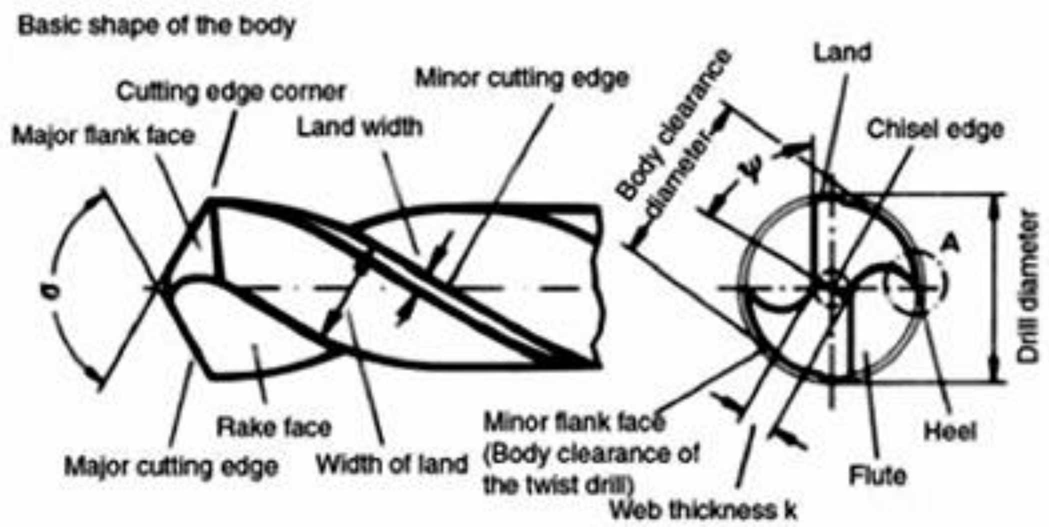

FIG. 7 Twist Drill

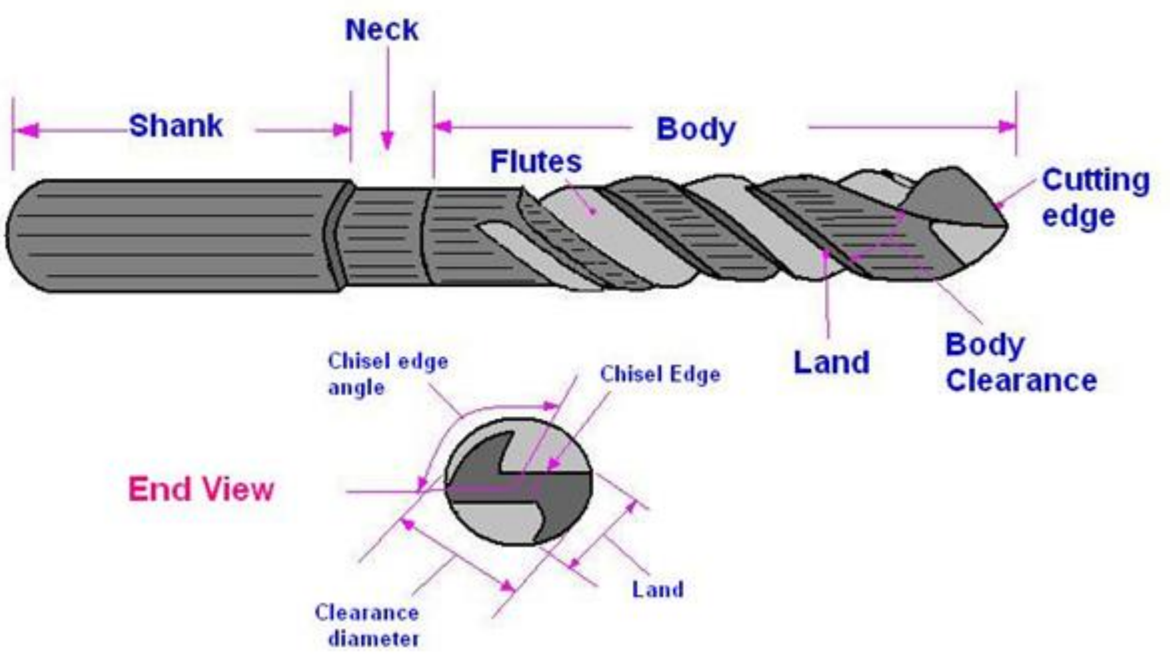

FIG. 8 Parts of Twist Drill

PRECAUTIONS:

- Never make any adjustments while the machine is operating.
- Never clean away chips with your hand. Use a brush.
- Keep all loose clothing away from turning tools.
- Make sure that the cutting tools are running straight before starting the operation.
- Never place tools or equipment on the drilling tables.
- Keep all guards in place while operating.
- Ease up on the feed as the drill breaks through the work to avoid damaged tools or workplaces.
- Remove all chuck keys and wrenches before operating.
- Always wear eye protection while operating any drilling machines.

QUESTIONS:

1.Why are drilled holes generally slightly larger than drill diameter?

2. What are the functions of flutes on a twist drill?

3. What will happen when the drilling is done with dull drill?

4. How is the diameter of a drilled hole measured?

5. What operation other than hole drilling can be performed on drilling machine?

6. How is the drill held in spindle?

SIGN of Principal/HOD

SIGN of Faculty

Experiment 6

AIM: To mark the centre and to check the taper angle of given circular workpiece by the use of marking and measuring tool, combination set.

APPARATUS: Circular bar, combination set, sand paper.

INTRODUCTION:
The combination set consist of scale, squaring-head, protractor and centre-head. It consists of a heavy scale, which is grooved all along its length. It is on this groove that sliding squaring head is fitted. One surface of the squaring head is always perpendicular to the scale and it can be adjusted at any place by a locking blot and nut. The squaring head also contains a spirit level which is used to test the surface for parallelism. For laying out dovetails an included angle is also mounted on the scale. It can also slide to any position and be locked there.

PRINCIPLE:
The principle behind steel rule is of comparing an unknown length to the one previously calibrated. The principle of protractor is of comparing an unknown angle to the one previously calibrated.

PROCEDURE:

1. Take the circular bar and clean it with the sand paper thoroughly.

2. Now first to locate the centre of circular bar , adjust the centre head on slotted steel rule with the help of locking nut.

3. Place the circular bar in the centre head (V-shape) such that steel sale will be on its circumferential face.

4. Make the line on its surface with the help of a chalk or sharp pencil.

5. Place the circular bar similarly at 90° to first position.

6. We get a point in the centre point at which both lines are intersecting each other. This is the centre of given circular bar.

7. Now, to check the angle b/w the two edges of circular bar, adjust square head with the slotted steel scale.

8. Check the piece as it is shown in figure for 90°.

9. Hold the work piece b/w sq. head & steel if it is perfect 90° there will be no gap b/w given job piece and the steel scale & square head.

10. Now for checking the angle of longer edge (length) of workpiece, make the adjustment in combination set, adjust the protractor head over slotted steel scale. Now, place the protractor head on face of circular bar & adjust steel rule along its length, now lock the tool in this position

11. Check the angle and protector head against the arrow position.

OBSERVATION TABLE:

S.NO.	**Angle of Edge**	**Avg. Reading**

CONCLUSION:

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____
____
____
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PRECAUTIONS:

1. The workpiece should be clean.

2. Reading must be taken appropriately

3. when not in use kept in the cases.

4. Every care should be taken.

DIAGRAMS:

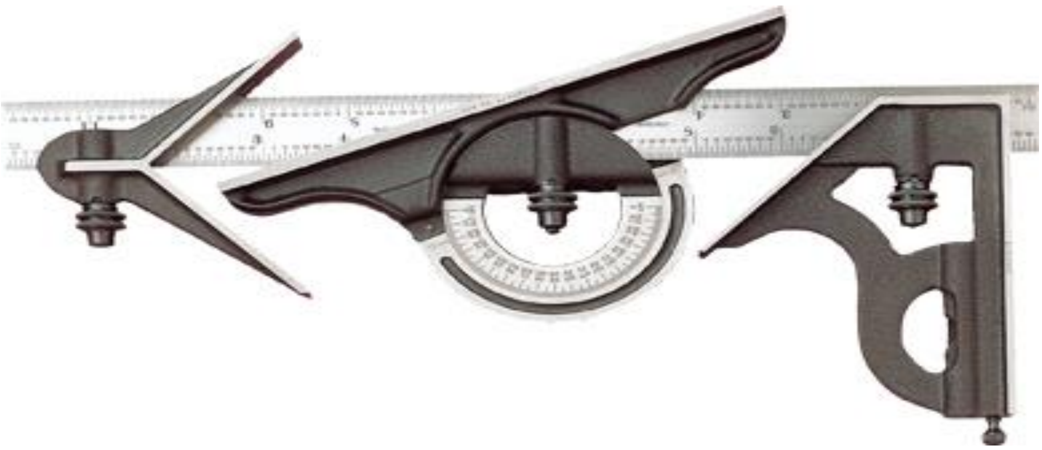


Fig. 6.1 Combination set

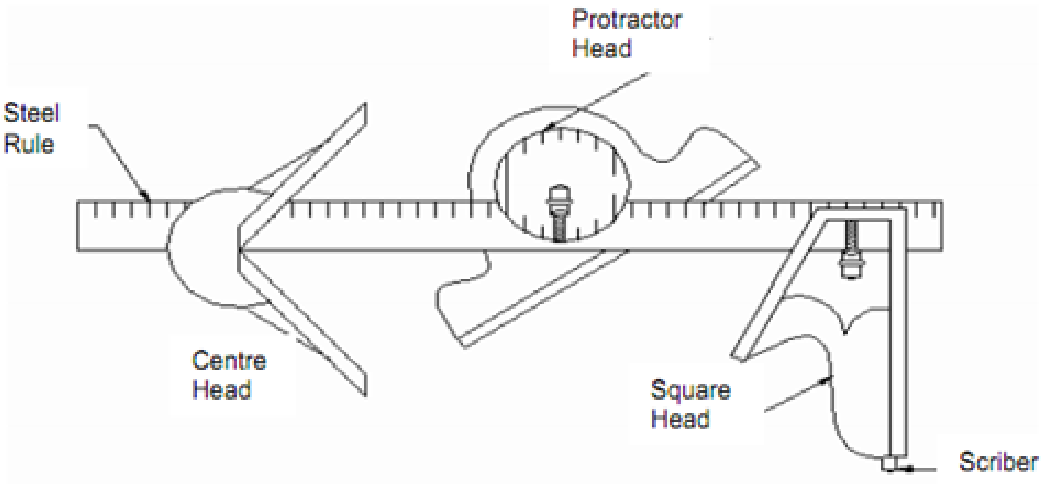


Fig 6.2 Combination set diagram

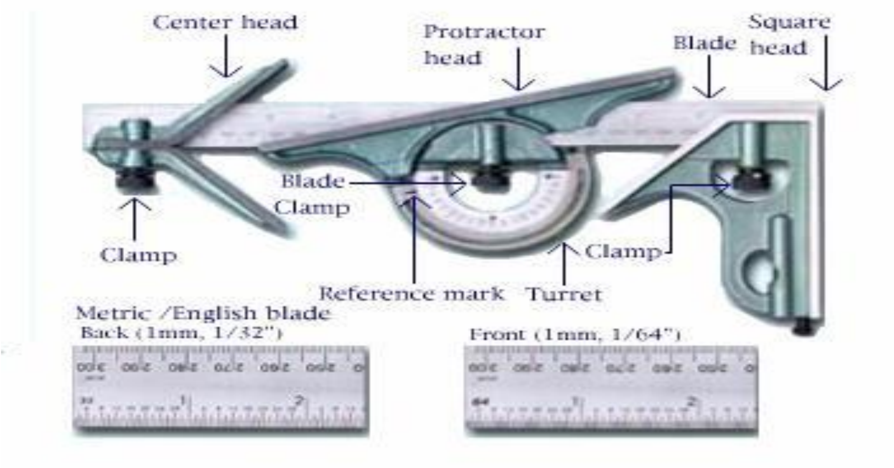
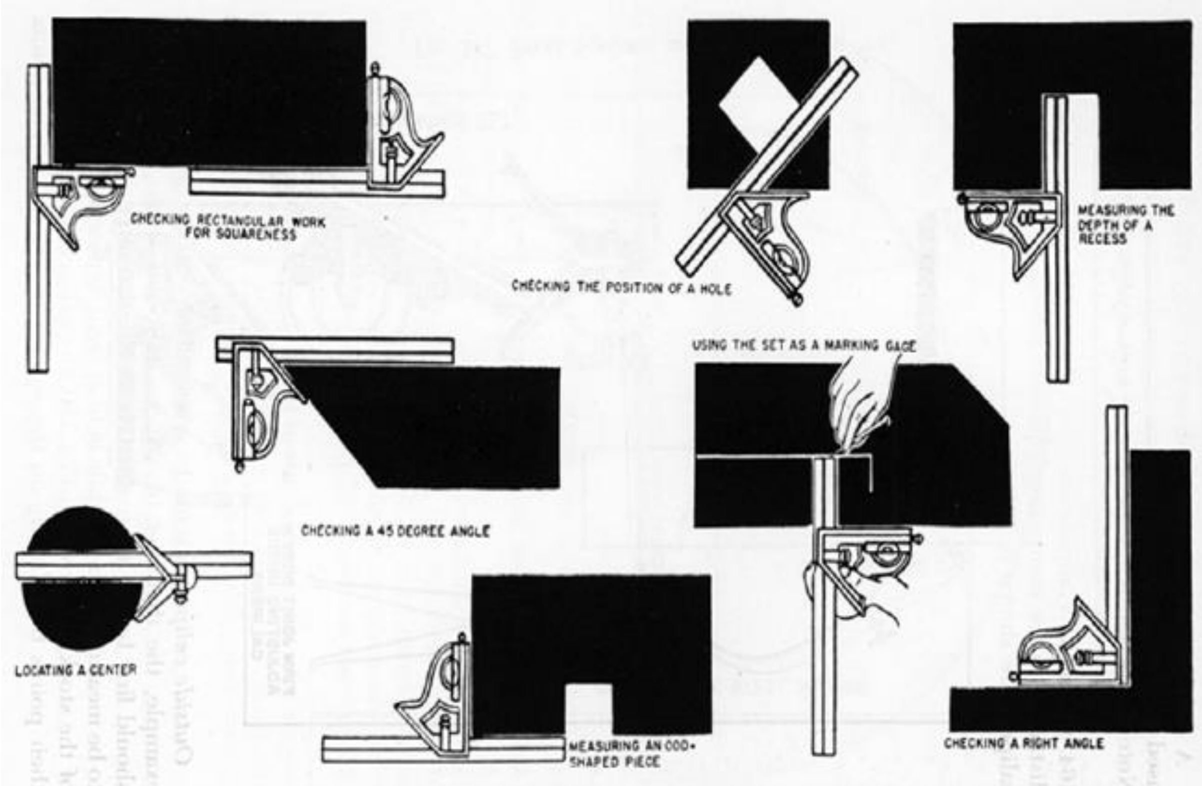


Fig 6.3 Different parts of Combination set



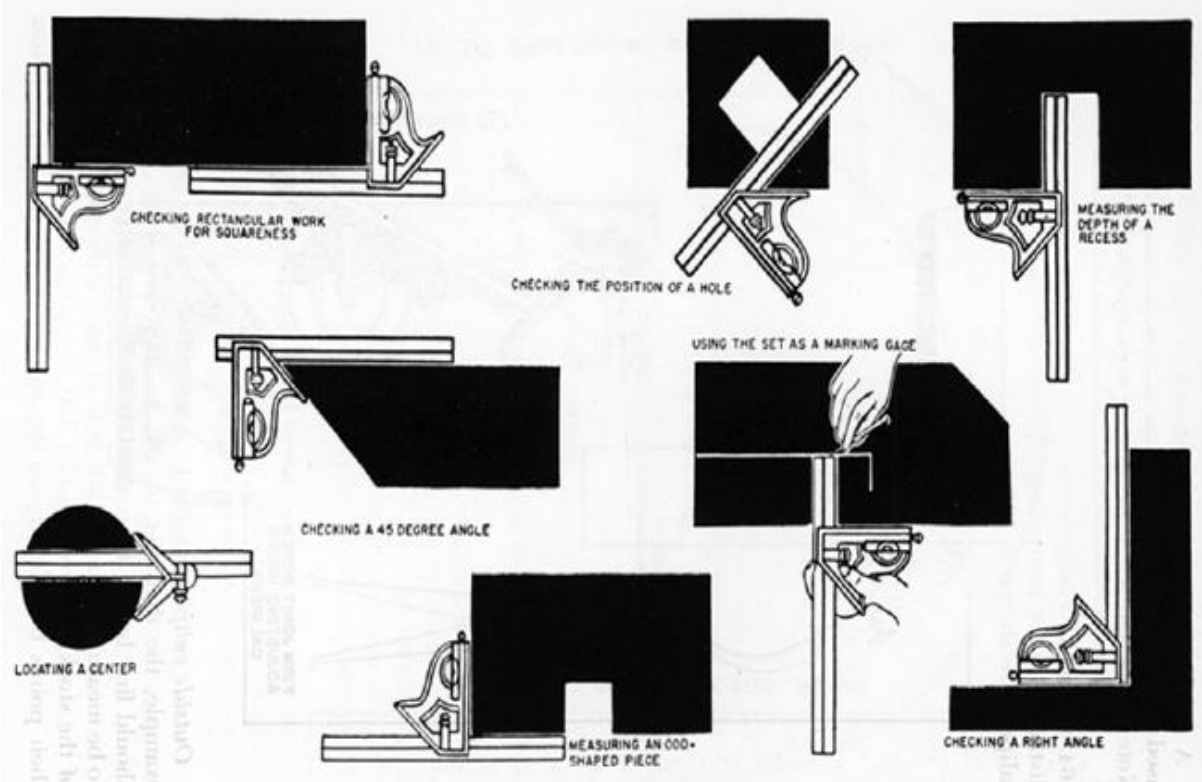


Fig.6.4 Using Combination set.

QUESTIONS:

Q.1.Why combination set is called by this name?

Q.2.What is the different tools in combination set and For What purpose they are used?

Q.3.Explain the procedure of checking a job piece with the help of combination set for it squareness.

Q.4.The protractor head in combination set can measure minimum degree of ?

Q.5.Why the spirit level is given in particular head of combination set?

Q.6.What is the purpose of sequence head in combination set?

7. What is the purpose of centre head?

SIGN. of Principal/HOD SIGN. of Teacher

Experiment no. 7

AIM: To learn and practice the use of marking and measuring, cutting and fitting tools.

APPARATUS:

- **Marking and Measuring tools:**
  i. Scribers
  ii. Divider
  iii. Punches
  iv. Try square
- **Cutting and Fitting tools:**
  i. Saws
  ii. Chisel
  iii. Files
  iv. Hammers
  v. Taps

INTRODUCTION:

Machine tools are capable of producing work at a faster rate, but, there are occasions when components are processed at the bench. Sometimes, it becomes necessary to replace or repair component which must be fit accurately with another component on reassembly. This involves a certain amount of hand fitting. The assembly of machine tools, jigs, gauges, etc, involves certain amount of bench work. The accuracy of work done depends upon the experience and skill of the fitter. The term ‘bench work’ refers to the production of components by hand on the bench, whereas fitting deals which the assembly of mating parts, through removal of metal, to obtain the required fit. Both the bench work and fitting requires the use of number of simple hand tools and considerable manual efforts. The operations in the above works consist of filing, chipping, scraping, sawing drilling, and tapping.

Marking and measuring tools:

Scribers: A Scriber is a slender steel tool, used to scribe or mark lines on metal work pieces. It is made of hardened and tempered High Carbon Steel. The Tip of the scriber is generally ground at 12oto 15o. It is generally available in lengths, ranging from 125mm to 250mm .It has two pointed ends the bent end is used for marking lines where the straight end cannot reach.

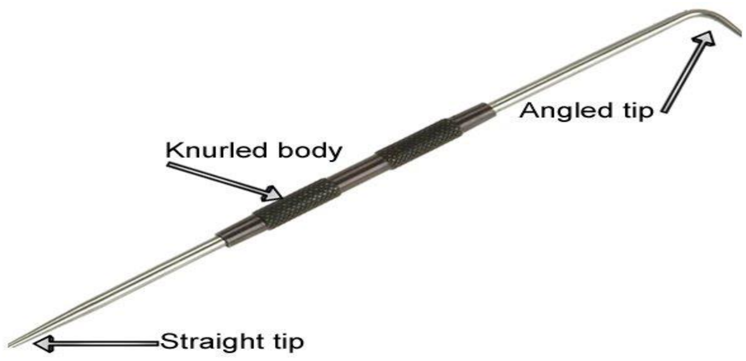


Fig. 7.1 Scriber

Divider: It is basically similar to the calipers except that its legs are kept straight and pointed at the measuring edge. This is used for marking circles, arcs laying out perpendicular lines, by setting lines. It is made of case hardened mild steel or hardened and tempered low carbon steel. Its size is specified by the length of the leg.

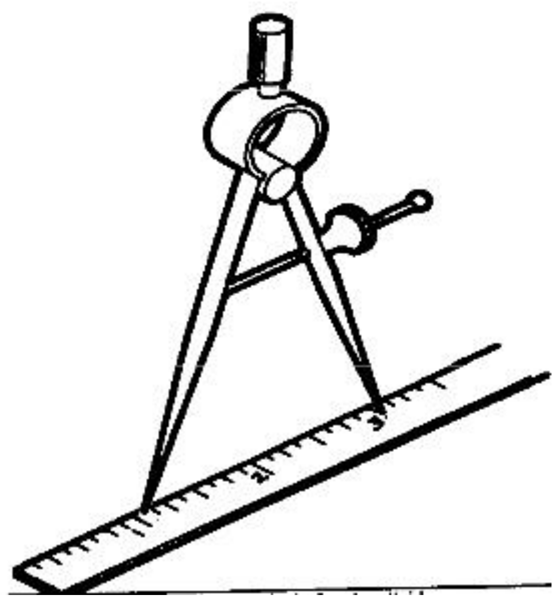


Fig.7.2 Divider

Punches: These are used for making indentations on the scribed lines, to make them visible clearly. These are made of high carbon steel. A punch is specified by its length and diameter (say as 150’ 12.5mm). It consists of a cylindrical knurled body, which is plain for some length at the top of it. At the other end, it is ground to a point. The tapered point of the punch is hardened over a length of 20 to 30mm. Dot punch is used to lightly indent along the layout lines, to locate center of holes and to provide a small center mark for divider point, etc. for this purpose, the punch is ground to a conical point having 60° included angle. Center punch is similar to the dot punch, except that it is ground to a conical point having 90° included angle. It is used to mark the location of the holes to be drilled.

Fig. 7.3 Punches

Try Square: It is measuring and marking tool for 90 angle .In practice, it is used for checking the squareness of many types of small works when extreme accuracy is not required .The blade of the Try square is made of hardened steel and the stock of cast Iron or steel. The size of the Try square is specified by the length of the blade.

Fig.7.4 try square

Cutting and Fitting tools:

Saws: The Hack Saw is used for cutting metal by hand. It consists of a frame, which holds a thin blade, firmly in position. Hacksaw blade is specified by the number of teeth for centimeter. Hacksaw blades have a number of teeth ranging from 5 to 15 per centimeter (cm). Blades having lesser number of teeth per cm are used for cutting soft materials like aluminum, brass and bronze. Blades having larger number of teeth per centimeter are used for cutting hard materials like steel and cast Iron. Hacksaw blades are classified as **(i) All hard**

and **(ii) flexible type**. The all hard blades are made of H.S.S, hardened and tempered throughout to retain their cutting edges longer. These are used to cut hard metals. These blades are hard and brittle and can break easily by twisting and forcing them into the work while sawing. Flexible blades are made of H.S.S or low alloy steel but only the teeth are hardened and the rest of the blade is soft and flexible. These are suitable for use by un-skilled or semi-skilled persons.

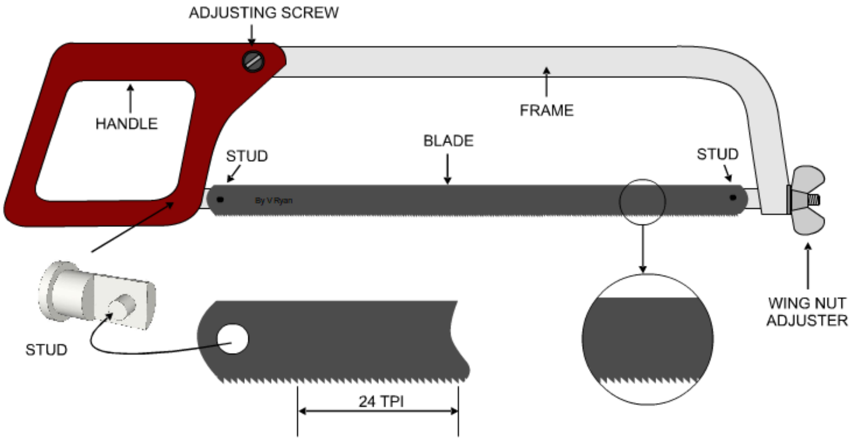


Fig.7.5 Saw

Fig.7.6 Tenon Saw

Chisels: Chisels are used for removing surplus metal or for cutting thin sheets. These tools are made from 0.9% to 1.0% carbon steel of octagonal or hexagonal section. Chisels are annealed, hardened and tempered to produce a tough shank and hard cutting edge. Annealing relieves the internal stresses in a metal. The cutting angle of the chisel for general purpose is about 60°.

Fig.7.7 Chisel

Files: Filing is one of the methods of removing small amounts of material from the surface of a metal part. A file is hardened steel too, having small parallel rows of cutting edges or teeth on its surfaces. On the faces, the teeth are usually diagonal to the edge. One end of the file is shaped to fit into a wooden handle. The figure shows various parts of a hand file. The hand file is parallel in width and tapering slightly in thickness, towards the tip. It is provided with double cut teeth. On the faces, single cut on one edge and no teeth on the other edge, this is known as a safe edge.

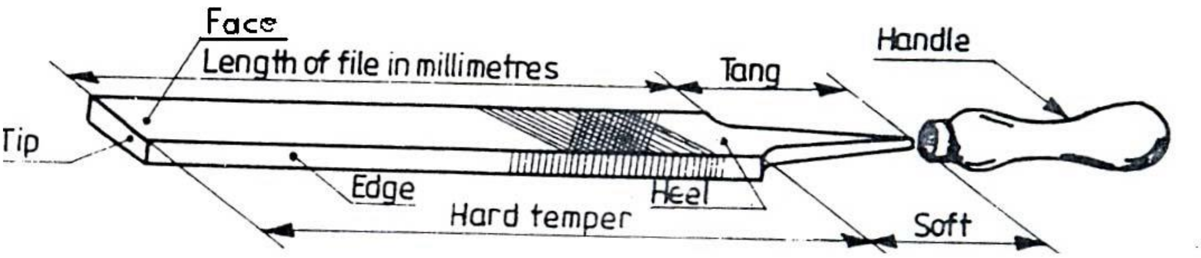


Fig.7.8 File

Hammers:

Ball Peen Hammer: Ball- Peen Hammers are named, depending upon their shape and material and specified by their weight. A ball peen hammer has a flat face which is used for general work and a ball end, particularly used for riveting.

Fig.7.9 Ball-Peen hammer

Cross-Peen Hammer: It is similar to ball peen hammer, except the shape of the peen. This is used for chipping, riveting, bending and stretching metals and hammering inside the curves and shoulders.

Fig.7.10 Cross-Peen Hammer

Straight-Peen Hammer: This is similar to cross peen hammer, but its peen is in-line with the hammer handle. It is used for swaging, riveting in restricted places and stretching metals.

Fig.7.11 Straight Peen Hammer

Taps and Tap wrenches

A tap is a hardened and steel tool, used for cutting internal thread in a drill hole. Hand Taps are usually supplied in sets of three in each diameter and thread size. Each set consists of a tapper tap, intermediate tap and plug or bottoming tap. Taps are made of high carbon steel or high speed steel.

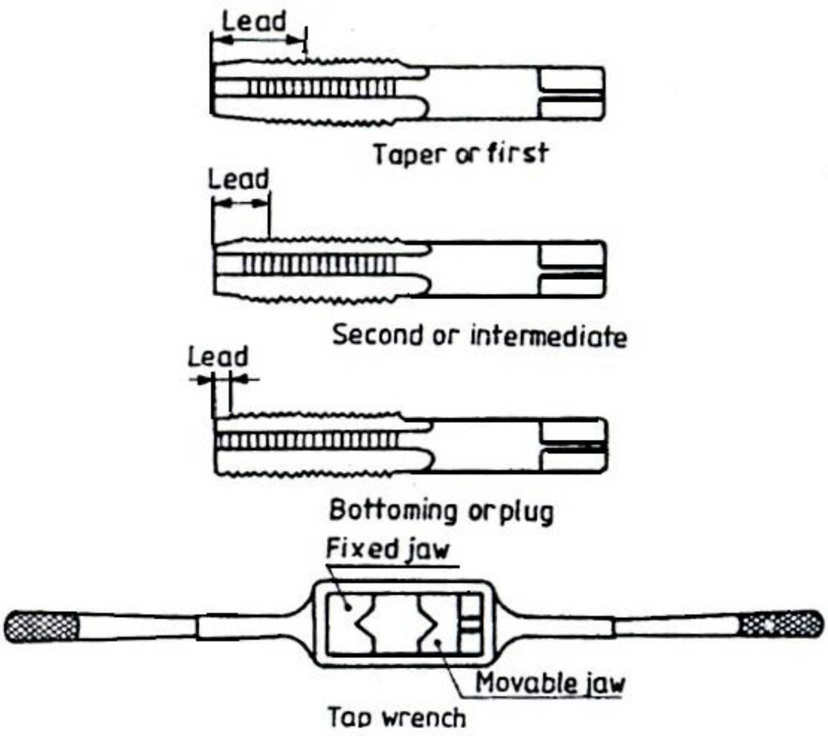


Fig.7.12 Taps and tap wrenches

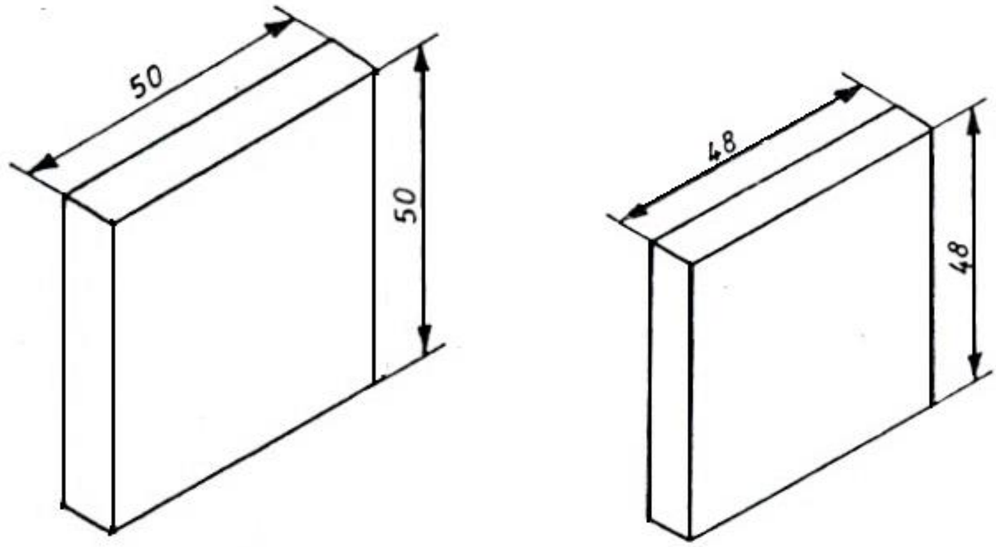
Practices:

1. Square filing: To file the given two Mild Steel pieces in to a square shape of 48 mm side as shown in Figure.

Tools required:
Bench vice, set of Files, Steel rule, Try-square, Vernier caliper, Vernier height gauge, Ball-peen hammer,
Scriber, Dot punch, Surface plate, Angle plate and Anvil.

Sequence of operations:
1. The dimensions of the given piece are checked with the steel rule.
2. The job is fixed rigidly in a bench vice and the two adjacent sides are filed, using the rough flat file first and then the smooth flat file such that, the two sides are at right angle.
3. The right angle of the two adjacent sides is checked with the try-square.
4. Chalk is then applied on the surface of the work piece.
5. The given dimensions are marked by scribing two lines, with reference to the above two datum sides by using Vernier height gauge, Angle plate and Surface plate.
6. Using the dot punch, dots are punched along the above scribed lines.

7. The two sides are then filed, by fitting the job in the bench vice; followed by checking the flatness of the surfaces. As the material removal through filing is relatively less, filing is done instead of sawing.



(a) Raw Material (b) Finished Job

Fig7.13 Filing Operation

Conclusion:

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2. V-Fitting: To make V- fit from the given two MS plates and drilling and Tapping as shown in Figure.

Tools required:
Bench vice, set of Files, Try-square, Scriber, Steel rule, Ball-peen hammer, Dot punch, Hacksaw, Vernier caliper, Surface plate, Angle plate, Vernier height gauge, 5mm drill bit, 3mm drill bit, M6 tap set with wrench, Anvil and Drilling machine.

Sequence of operations:
1. The burrs in the pieces are removed and the dimensions are checked with steel rule.
2. Make both pieces surface levels and right angles by fixing in the Vice, use Files for removing material to get level.
3. With the help of Try square check the right angles and surface levels.
4. Using Surface plate and Angle plate mark the given two metal pieces as per drawing with Vernier height gauge.

5. Punch the scribed lines with dot punch and hammer keeping on the Anvil. Punch to punch give 5 mm gap.
6. Cut excess material wherever necessary with Hacksaw frame with blade, Drill bits and Taps.
7. The corners and flat surfaces are filed by using square/flat and triangular file to get the sharp corners.
8. Dimensions are checked by vernier caliper and match the two pieces. Any defect noticed, are rectified by filing with a smooth file.
9. Care is taken to see that the punched dots are not crossed, which is indicated by the half of the punch dots left on the pieces.

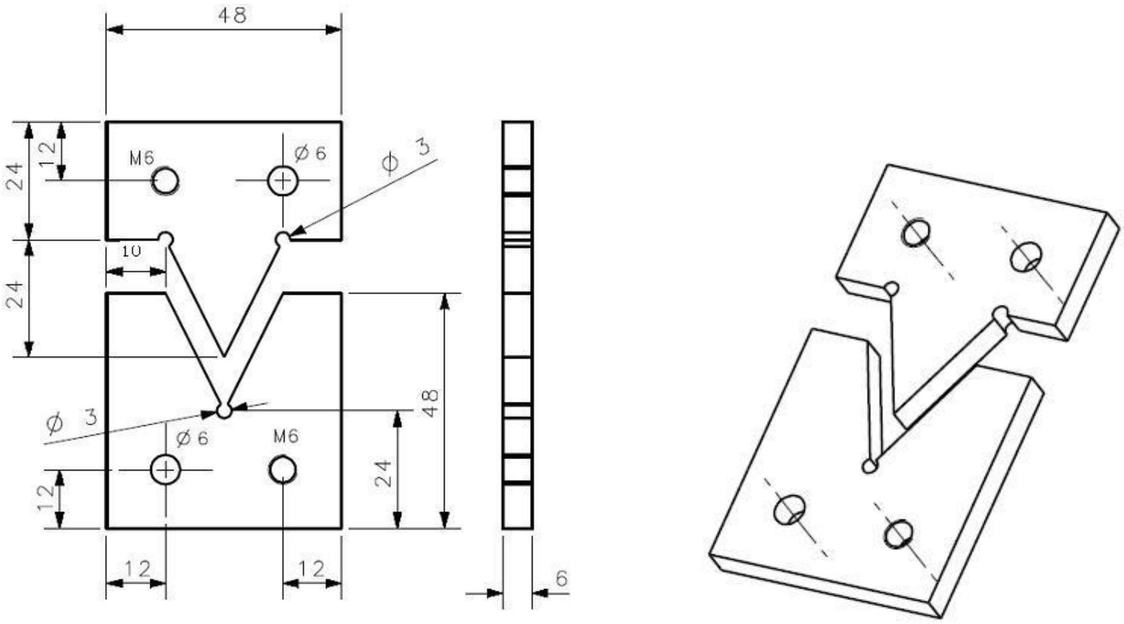

Fig.7.14 V-Fitting

Conclusion:

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3. T-Lap Joint: To make a T-lap joint as shown in Figure from the given reaper of size 50 x 35 x 250 mm.

Tools required:
vice, steel rule, jack plane, try-square, marking gauge, 25 mm firmer chisel, cross-cut saw, tenon saw, scriber and mallet.

Sequence of operations:
1. The given reaper is checked to ensure its correct size.

2. The reaper is firmly clamped in the carpenter's vice and any two adjacent faces are planed by the jack plane and the two faces are checked for squareness with the try square.
3. Marking gauge is set and lines are drawn at 30 and 45 mm, to mark the thickness and width of the model respectively.
4. The excess material is first chiseled out with firmer chisel and then planed to correct size.
5. The mating dimensions of the parts X and Yare then marked using scale and marking gauge
6. Using the cross-cut saw, the portions to be removed are cut in both the pieces, followed by chiseling and also the parts X and Y are separated by cross-cutting, using the tenon saw
7. The ends of both the parts are chiseled to the exact lengths.
8. A fine finishing is given to the parts, if required so that, proper fitting is obtained.
9. The parts are fitted to obtain a slightly tight joint.

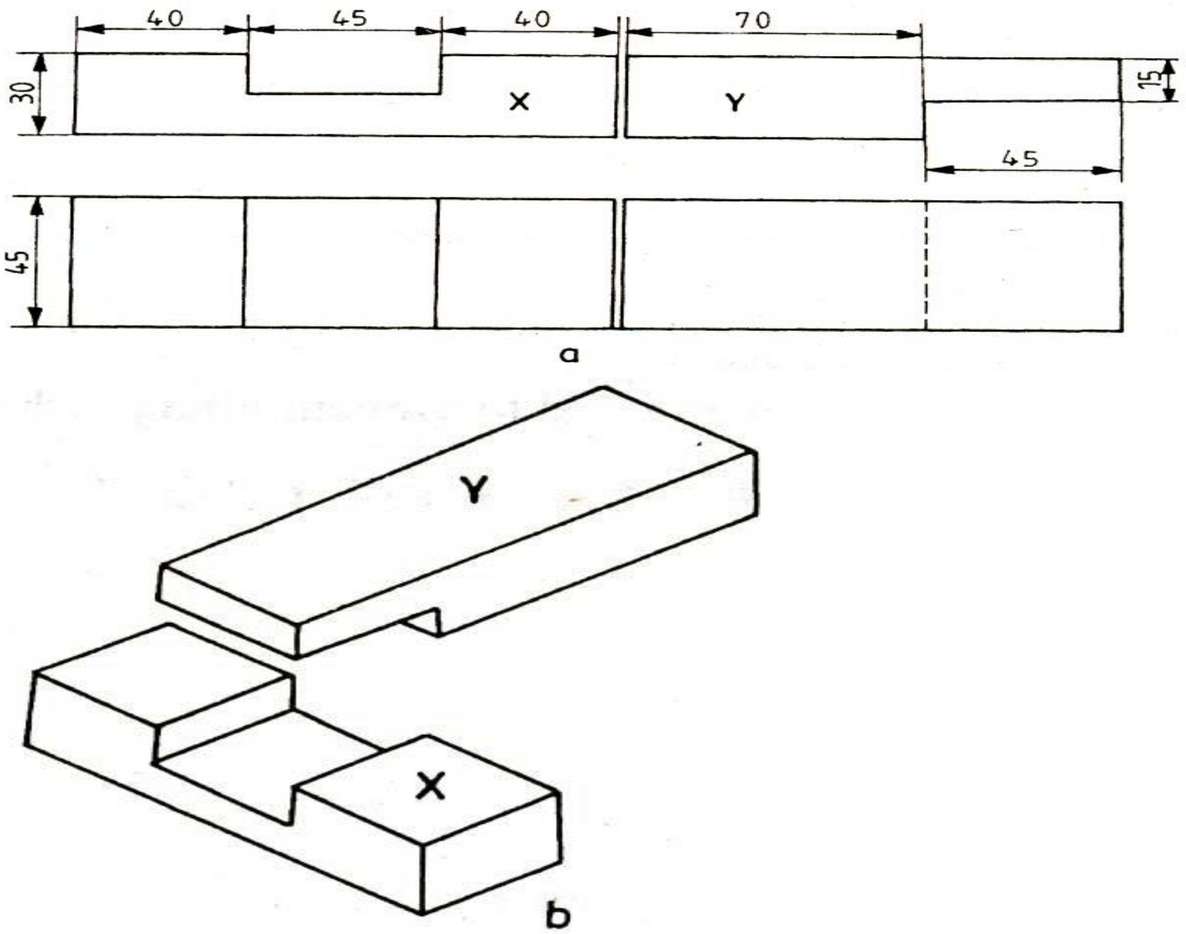

FIG.7.15 T-Lap Joint

Conclusion:

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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.

QUESTIONS:

Q.1 What do you understand by marking and measuring tools?

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Q.2.what do you understand by Cutting and fitting tools?

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Q.3.What is the use of Try square?

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Q.4. How to use the divider show by making suitable diagram?

Diagram:

Q.5. What do you understand by carpentry?

Q.6. Write the name of Different types of Hammers and Their uses?

SIGN of Principal/HOD SIGN of Faculty

Experiment – 8

AIM: to learn and practice the use of angle plate.

APPARATUS: Angle plate

INTRODUCTION: An angle plate is simply a piece of cast iron or steel that has two flat surfaces at right angles to each other. The two ends of the angle plate are also flat and at right angles to both of the two other surfaces. On some angle plates there can be webbing between the two surfaces to add to the rigidity of the surfaces. In this case inside surfaces are often just the rough surface of the original casting. Most angle plates have on the two main surfaces slots so either face can have a workpiece, other device or the milling table attached to it.

Some angle plates are made thicker so they are rigid enough without any stiffening and do not need webs at the ends. This means the internal surfaces can be machined accurately and flat. It will be seen that this is a very useful facility especially where space is limited.

If the angle plate does not have holes in it where they are needed then they can often be drilled in it. This is not a good idea to do this too often. But it is worth doing it to achieve a common set-up like fitting a rotary table to it. In this case it can be convenient to drill and tap these holes so that studs can be fitted into them. This is can be easier than trying to clamp the rotary table using loose bolts and nuts.

PRINCIPLE: An **angle plate** is a work holding device used as a fixture in metalworking. The angle plate is made from high quality material (generally spheroidal cast iron) that has been stabilized to prevent further movement or distortion. Slotted holes or *T* bolt slots are machined into the surfaces to enable the secure attachment or clamping of work pieces to the plate, and also of the plate to the worktable.

USE OF ANGLE PLATE:

1.To rotate surfaces:

The main purpose of the angle plate is that it effectively rotates one surface, for example, a milling table, into another surface at right angles to the first.

If a workpiece is clamped to an angle plate, it effectively rotates it through 90º. When a flattish workpiece is clamped to the milling table it is usually with the large surface horizontal. In this position it is not always easy to machine the sides of the workpiece as might be required. But if we use an angle plate to turn it through 90º we can easily machine the sides.

Similarly it is possible to hold a long thin workpiece on end on an angle plate. It is then possible to machine the end of the workpiece.

Fig8.1 holding a workpiece on an angle plate to machine its sides

2. Use of angle plate on end:

Though it would be usual to use the two large surfaces on an angle plate the ends of the two sides are always flat and at right angles to the two sides. This end surface could be mounted on the milling table. It would have to be clamped to the table. The possible advantage of this is that very often the length of an angle plate is longer than the height of either of its sides.

Examples of the use of an **angle plate** on **end**

Ex.1 matching two V-blocks

It might seem that two V-blocks of apparently the same size from the same manufacturer would form a pair even if not matched. In practice they can differ so much as not to be useable as a pair. If they are going to be machined to make them match then it is easiest to match the two V surfaces and then machine the others to match. One way of doing this is to mount the V-blocks on the angle of an angle plate and then clamp them together. This might necessitate drilling holes in the webs so they can be bolted together. Then the other surfaces on the V-blocks can easily be machined to match each other.

3. Increasing the effective size of an angle plate:

An angle plate can be made larger by bolting a flat plate or rectangular tube onto the front of it. If some rectangular tube is used allowance has to be made for the tube bending slightly under pressure. One solution to this is the nut the bolt inside the tube on the side where something is being clamped to the tube.

Fig8.2 Rotary table mounted on angle plate using rectangular tube 404

4. Use of an angle plate for aligning

An angle plate can be seen as being equivalent to a square but of much greater thickness. Because of this it can be used to align two edges at right angles but where one is at a different height to the other. This can be used for aligning vices.

Fig8.3 aligning a vice using a parallel, angle plate and square

5. Use of an angle plate as a stop

An angle plate bolted to the milling table to one side of a vice can be used as a stop when holding a workpiece in the vice. There is more on this under “Vices”

(a.)Angle plate used to mill accurate angles

One advantage of mounting a workpiece on an angle plate compared to using a tilting vice is that it can be used to mill one surface at an angle to another.

The workpiece can be mounted using clamps on the angle plate using a precision protractor. All of this can be done while the surface being used is horizontal.

Fig8.4 Machining an edge at an angle

Any method that could be used to align a workpiece clamped on the milling table, such a fences, could be used here.

(b.)Machining flutes on connecting and coupling rods

On many engines the connecting rods and coupling rods are fluted. It might seem that they could be clamped to the milling table and then milled out with an end mill.

This is not the best way to do this. Firstly the bottom of the flute has rounded corners. This can be done by grinding the required radius on the slot drill that is going to be used to mill the flutes. The ends of the flutes are not round such that the axis of the round corner is in the plane of the rod. It is "swept out", i.e., the axis of the round part is in the plane of the rod.

This means that most of the flute can be machined with the rod flat on the milling table. But the end of the flute has to be machined with the rod held vertically. The machining can be done with a fly cutter or a T-slot cutter modified for this job.

The connecting rod has to be held near the top of an angle plate since the length of the tool is limited. The workpiece is clamped to the angle plate.

Fig8.5 Machining a connecting rod with a Woodruff cutter

If a connecting rod is fluted at all then it is fluted on both sides.

6. Use of an angle plate with cylindrical squares:

If the angle plate has two cylindrical squares mounted on it this can provide a horizontal surface at right angles to a vertical one. This is really useful for clamping flat thin workpieces in the vertical position with the bottom of the workpiece parallel to the table. Many parts are of this sort, one example is a parallel.

The squares can be set to the same height using a height gauge. The workpiece rests on the cylindrical squares and is clamped to the angle plate. It would also be possible to make two or even more parts at the same time like this. This is a situation where only one clamp might seem to be enough for light machining. It would be with a thick workpiece but it would not be enough to stop a thin workpiece vibrating. The top of the workpieces is machined with whatever will give the best finish. The part is removed and any burr removed from it. It is returned the other way up and milled to the width required.

This would be more accurate than trying to make parallels in a vice because the parallels being made are resting on two, accurate points that could be wide apart compared to resting on a narrow, hopefully flat surface at the bottom of the vice.

The great advantage that the angle plate has over the cylindrical squares is that it is possible to mount a workpiece on it whilst it is in a convenient position, that is, the surface is horizontal when the angle plate is held in a bench vice. The plate can then be mounted so this face is now vertical with the workpiece still on it.

7. Use of angle plates – head horizontal – vertical mode

(a)Extending the area for vertical milling:

But if the angle plate is the other way round, the distance in the y direction is much smaller but the space from the cutter downwards is greater.

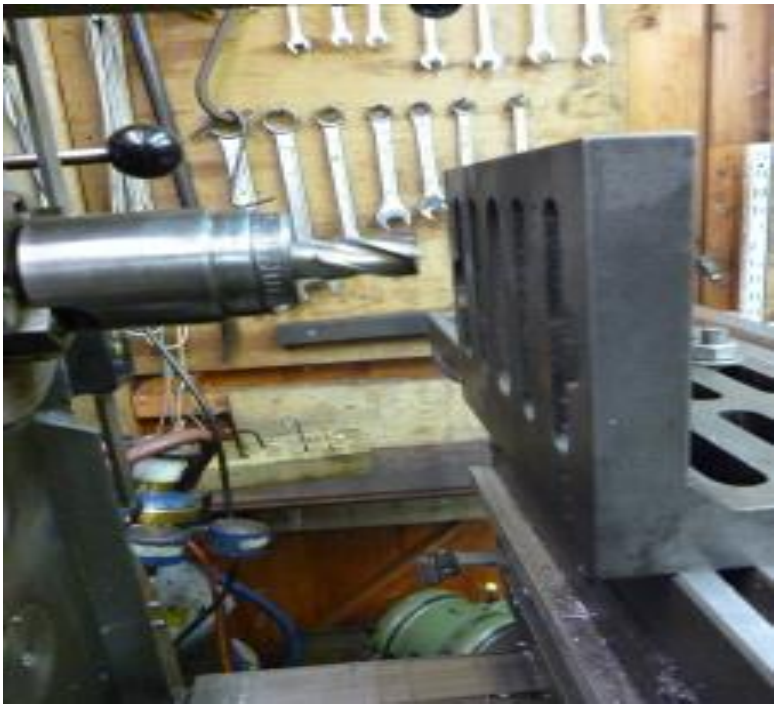

Fig8.6 Extending the milling area.

This configuration allows, in principle, for the user to use a horizontal milling machine as a vertical milling machine. But it is easy to see that it is very difficult for the user to see what is going on. It is also difficult to set up the workpiece, not only because it is inaccessible but because the surface is vertical. The only way to do this is to take the angle plate off the machine, fit it in a vice and mounted the workpiece with the surface horizontal.

This setup not only increases in the new "y" direction but since the angle could be turned round the depth in the "z" direction is also increased. But this does require an angle plate with flat internal surfaces.

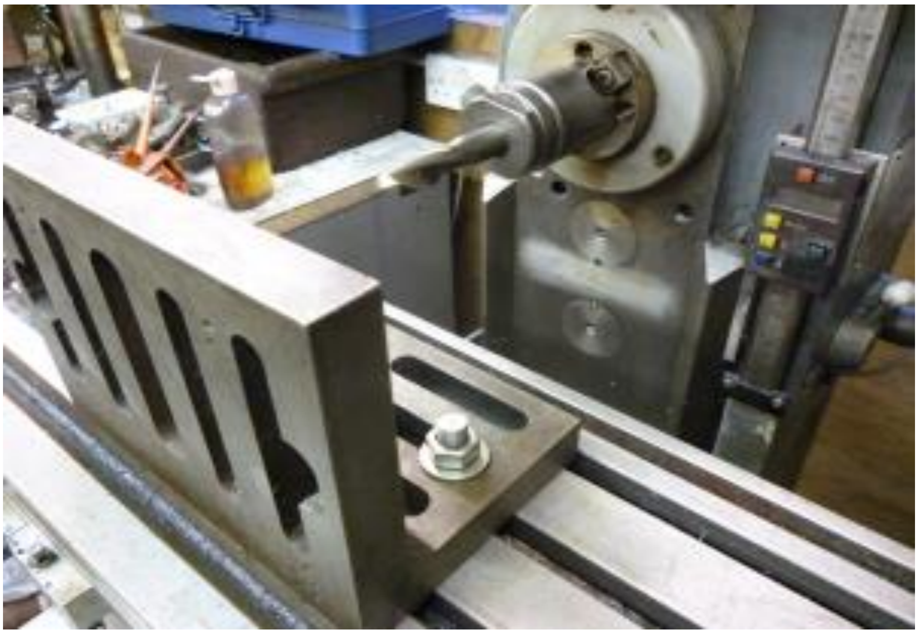

Fig8.7 Increasing the depth in the "z" direction.

PRECAUTIONS:

1. Care must be taken for the internal and external stresses develop during machining.

2. While using bolts, stops and clamps ensure that these have a firm seat on both the work and the clamping block.

3. The clamps and stops should be placed as near the work as possible.

4. Ensure that the clamping device does not hinder free movement of the work table.

DIAGRAMS:

FIG.8.8 Webbed Angle Plate

FIG8.9 Precise Giant Angle Plates

QUESTIONS:

Q.1. what do you understand by Angle plate?

Q.2. What is the principle of Angle Plate?

Q.3. How we use angle plate for Aligning?

Q.4. How to increase the effective size of angle plate?

Q.5. Write precautions using Angle plate

Sign of Teacher. **Sign of Principal**

EXPERIMENT – 9

AIM: to learn and practice the use of scrapers.

APPARATUS: Scrapers.

INTRODUCTION:

a tool or device used for scraping, especially for removing dirt, paint, or other unwanted matter from a surface. A hand **scraper** is a single-edged **tool** used to scrape metal from a surface. This may be required where a surface needs to be trued, corrected for fit to a mating part, needs to retain oil (usually on a freshly ground surface), or even to give a decorative finish. Surface plates were traditionally made by scraping.

PRINCIPLE:

Metal scraping is a technique for removing, progressively and in a controlled way, very thin layers of metal from the high areas of a surface, making it increasingly even until it reaches a very high degree of flatness. Think of a metal surface as having high and low areas, like miniature hills and valleys of a terrain. With each scraping pass you remove some material from the peaks, and so make them lower. After a sufficient number of passes, you will have brought the peaks down to the level of the valleys, and the surface will have become flat.

IMPORTANCE OF SCRAPERS:

- Scraping can be done inexpensively. If you need to watch your finances, and have already a bench grinder with a cool grinding wheel, you can buy or make the essentials you will need to do a wide range of scraping

- Recondition many worn out or even damaged measuring and layout tools

- You will also be able to make your own precision tools, as well as attachments, jigs, and accessories to extend the capabilities of your equipment, which could not be made satisfactorily without scraping some of the critical surfaces

- you will be able to conceive new projects with a greater degree of freedom, and enhance their design accordingly,

- Scraping is also essential to bring lathes, milling machines, and machine tools in general to their best performance.

- With careful scraping and some TLC in other areas, even a very inexpensively built or worn out machine usually can be turned into a precision and high performance tool.

- A well scraped machine will have the smoothness and "velvet feel" that makes it a pleasure to use, and will give many years of accurate and trouble free service. And when it eventually wears out, you can scrape it again, and again make it work like new.

CARE OF SCRAPERS:

Since the scrapper has a very sharp cutting edge, therefore when these are not in use it is advisable to keep them lightly oiled and individually wrapped in a piece of cloth or felt or similar material, to protect the extremely hard cutting edge.

PRECAUTIONS:

1. Work in a Clear, Well Lit Area.
2. Keep Scraper Away from Moisture.
3. Wear Adequate Protection.
4. Store the Scraper when it is Not in Use.
5. Perform Required Maintenance.
6. Never Touch the scraper Immediately after Finishing a Job.
7. Carry the Tool Carefully.

DIAGRAMS:

FIG.1 Scraper

FIG. 2 Different types of Scrapers

Experiment no. 10

AIM: To learn and practice the use of Snipes.

APPARATUS: SNIPES.

INTRODUCTION:

Snips, also known as **shears**, are hand tools used to cut sheet metal and other tough webs. If the handles are in line with the blades is known as a straight snips; if the handles are at an angle then it is known as an offset configuration. This design allows for the material to flow away from the blades when making long cuts, which is easier and safer than straight cutting snips.

There are two broad categories: tinner's snips, which are similar to common scissors, and compound-action snips, which use a compound leverage handle system to increase the mechanical advantage.

Tinner snips:

Tinner's snips, also known as tin snips, are one of the most popular type of snips. They are defined by their long handles and short blades. They usually have extra wide jaws and are made of drop forged carbon steel. Depending on the size of the blade, tin snips can cut between 24 and 16 gauge cold rolled low-carbon tin. They can be ranged in length from 7 to 14 in (180 to 360 mm) long. There are two main types: straight-pattern and duckbill-pattern. Straight-pattern are best for straight cuts, but can handle gentle curves. Duckbill-pattern snips, also known as Trojan-pattern snips, have blades that taper down from the pivot to the tip of the blades. The blade edges are also bevelled to more easily cut curves and circles or shapes. They are a lighter duty snip that can only cut up to 25 gauge mild steel. Other common blade patterns include the circle pattern or curved pattern and the hawk's-bill pattern. Circle pattern snips have a curved blade and are used to cut circles. Hawk's-bill snips are used to cut small radii on the inside and outside of a circle. The shape of the blades allow for sharp turns without buckling the sheet metal. A common use is cutting holes in pipes.

Compound-action snips:

Compound-action snips are also known as aviation snips because they were developed to cut aluminum in the construction of aircraft. They can handle aluminium up to 18 gauges, mild steel up to 24 gauges or stainless steel up to 26 gauge. These types of snips have become the most popular because of the linkage that increases the mechanical advantage without increasing the length of the snips. There are three cutting styles: straight cutting, left cutting, and right cutting. Straight cutting snips (generally have yellow colored soft grips) cut in a straight line and wide curves; left cutting snips (usually red) will cut straight and in a tight curve to the left; right cutting snips (usually green) will cut straight and in a tight curve to the right. These different cutting styles are necessary because metal is stiff and heavy and does not move out of the way readily when cutting around a curve. The respective styles move the material out of the way when cutting in the direction they are designed for. The blades are usually serrated to prevent material slippage.

In addition to the configurations outlined below, there are also upright and long cut configurations. The upright snip has the blades rotated 90° from the handles. This configuration is more ergonomic and commonly used in tight spaces. The long cut snip has long blades that make it easier to make long straight cuts. These snips are commonly used on vinyl or aluminum siding

Standard compound-action snips are designed for cutting steel or softer materials, although the occasional use on stainless steel is not detrimental. For cutting through tougher materials, such as Inconel and titanium, special hard snips are available. They are similar in design to standard or offset aviation snips but have specially heat treated blades. These snips will have a different color handle to differentiate them from the other standard types.

Pipe and duct snips

Pipe and duct snips, also known as double cut snips, are a subtype of compound-action snip used to cut stove pipe and ducting lengthwise. The snips have a three-piece jaw that has two side blades that slide against a central blade. This creates in (4.4 mm) wide strip that curls up along the cut. A compound lever system is used to increase the mechanical advantage.

CARE OF SNIPES:

1. It should be kept clean and free from greasy material and it must be wiped out with same cloth or cotton waste to prevent rusting of faces.

2. When these are not in use it is advisable to keep them lightly oiled and individually wrapped in a piece of cloth or felt or similar material, to protect the edges.

3. after certain use, cutting edges must be checked and if found blunt must be grounded properly

CONCLUSION:

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DIAGRAMS:

Fig.10.1 Tinner Snipe tool

Fig.10.2 Compound action Snipe tool

Fig.10.3 Pipe and Duct Snipe

Fig.10.4 Nose Plier Snipe

Fig.10.5 Bent nose side cutting plier snipe.

Fig.10.6 jewelry snipe.

Experiment No. 11

AIM:
To check and tight all the mounting bolts, screw, and moving parts of aircraft F-27 with the help of different types of screw drivers and spanners / wrenches.

APPARATUS:
Screw drivers, wrenches.

INTRODUCTION:
Screw drivers:
A screw driver is a hand tool that is designed to turn screws. The shank is made of steel set in to a wooden or plastic handle. The blade is shaped or flattened to fit recesses in the heads of screws or bolts. Screw drivers are made in many sizes. A stubby screw driver helps to start screws where space is limited.

SPANNERS/WRENCHES:
A wrench is a tool for turning nuts or bolts. It is usually made of steel. There are many kinds of wrenches. They may consists of a slot, socket, pins or movable jaws for grasping the nut, with the rest of the tool serving as a handle for applying pressure.

PRINCIPLE:
To turn nuts and bolts and screws for assembling and disassembling them from fittings.

PROCEDURE:
1. All the screw drivers and wrenches should be cleaned with cotton before and after use.
2. It should be used by holding the bolt at proper position and application of face must be at the extreme and of spanner or wrench and it should be turned at right angle to the length of the bolts.
3. Always use the right size of screw driver and wrench to avoid any damage to bolt head or screw.
4. The spanner or wrench must be kept in a cloth jacket with flaps.

OBSERVATION TABLE:

S.No.	Physical check	Observation

PRECAUTIONS:

1. Always match the screwdriver to the screw head, both in terms of size and type.

2. Choose contoured handles that fit the shank tightly, with a flange to keep the hand from slipping off the tool.

3. Use a slot screwdriver with a blade tip width that is the same as the width of slotted screw head.

4. For cross head screws, use the correct size and type of screwdriver: a Phillips screwdriver may slip out of a screw head designed for use with the slightly, flatter-tipped Pozidrive screwdriver.

5. Use a vise or clamp to hold the stock if the piece is small or moves easily.

6. Wear safety glasses or a face shield (with safety glasses or goggles) that is appropriate for the hazards of the work you are doing.

7. Keep the screwdriver handle clean. A greasy handle could cause an injury or damage from unexpected slippage.

DIAGRAMS:

FIG 11.1 Screw Driver

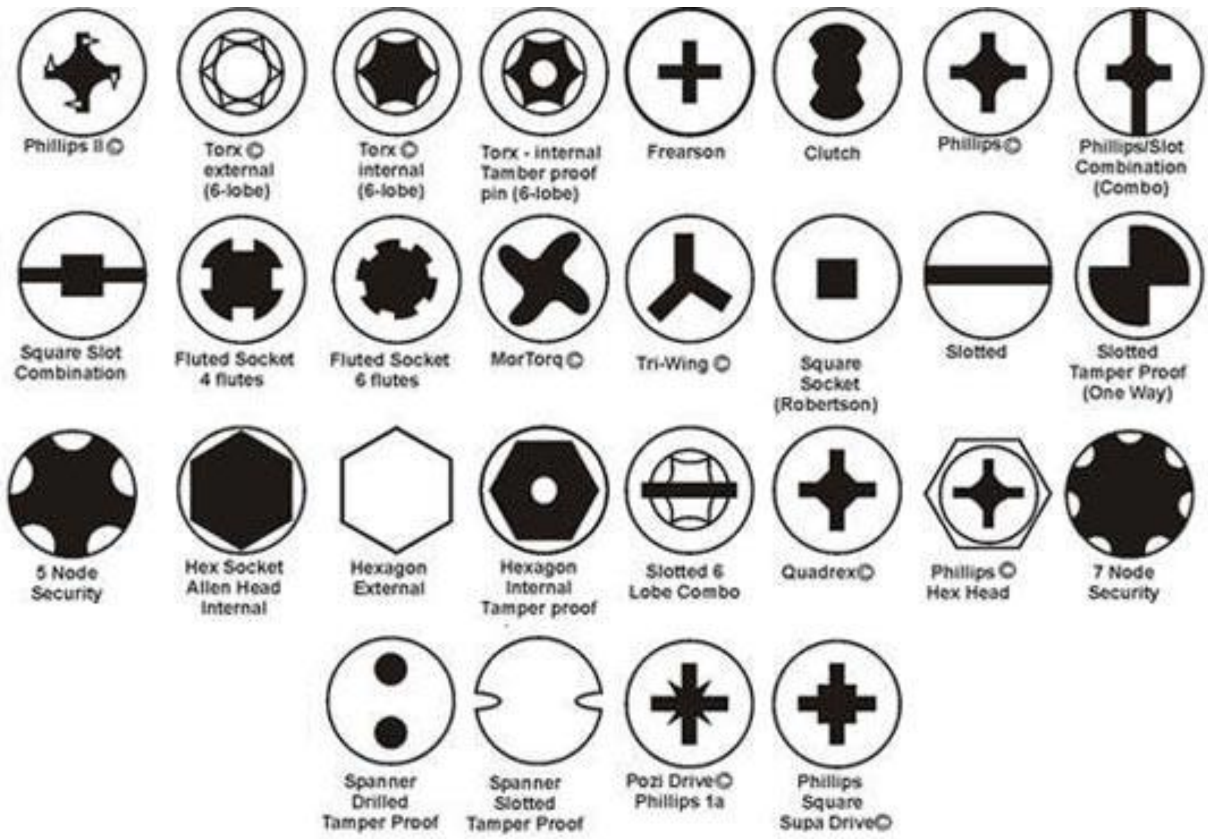

FIG 11.2 Different Screw Head

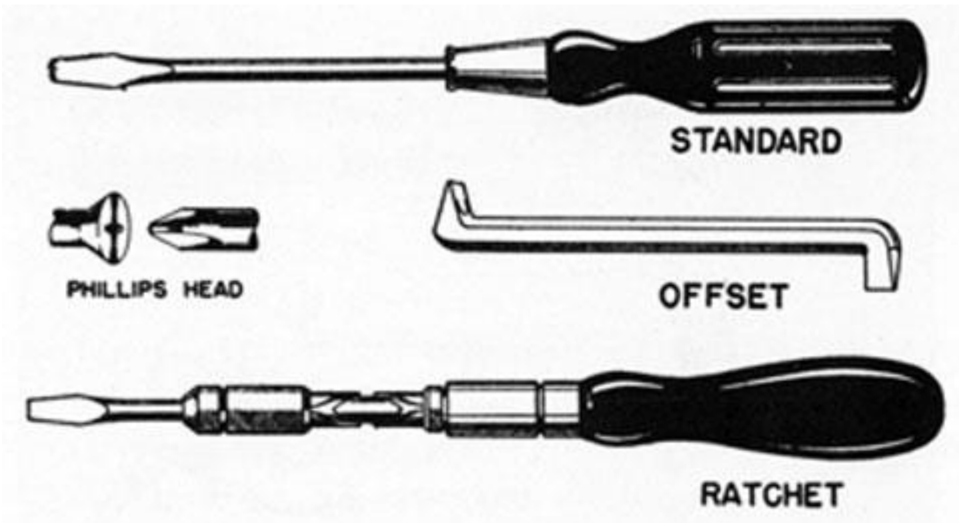

FIG. 11.3 Standard & Ratchet Screw Driver

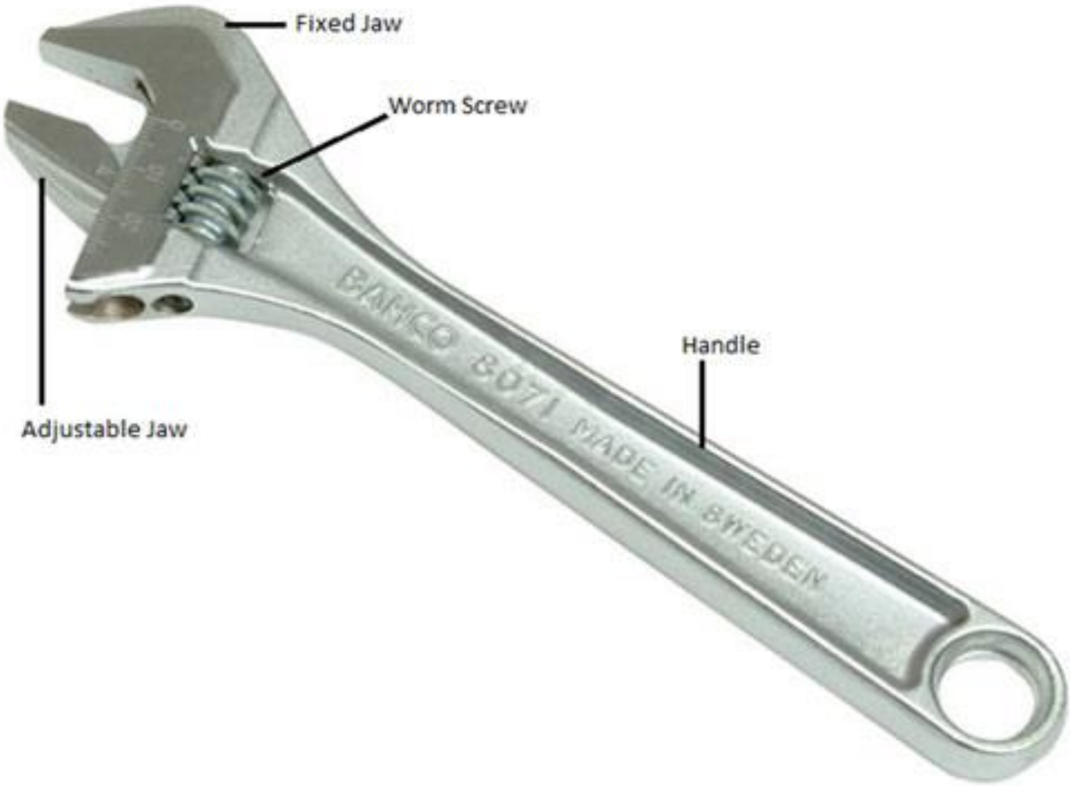

FIG. 11.4 Spanner


Combination Spanners


Double Open Ended Spanners


Ring Spanners


Other Special Spanners

FIG. 11.5 Different Types Of sppaners

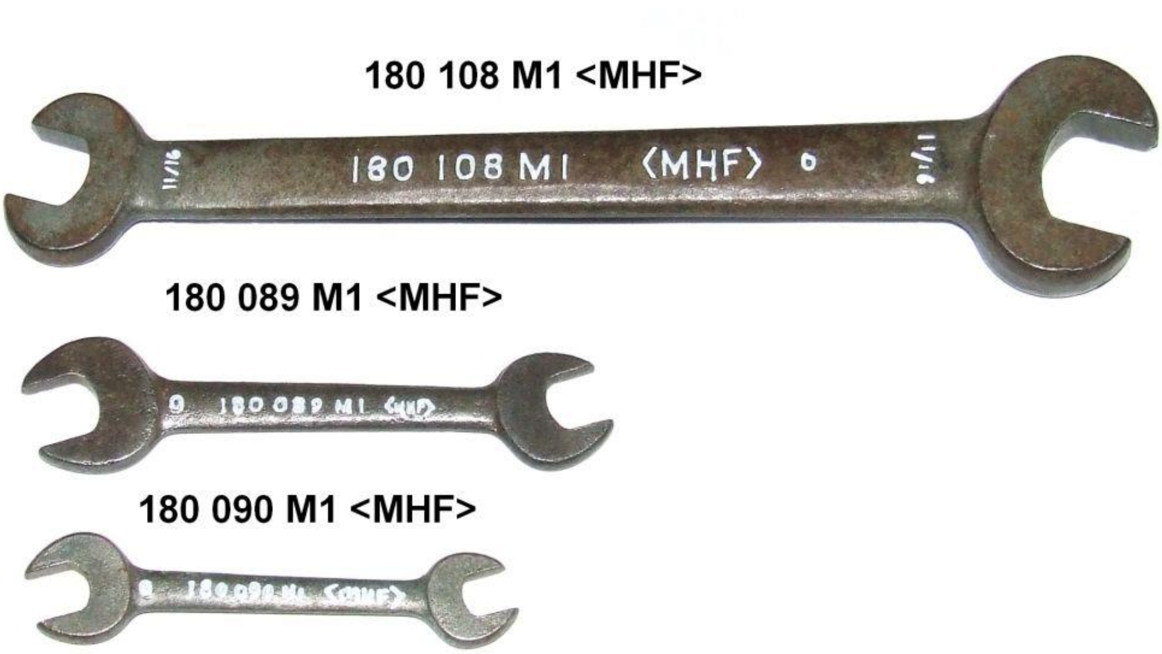

FIG. 11.6 Spanners Notation

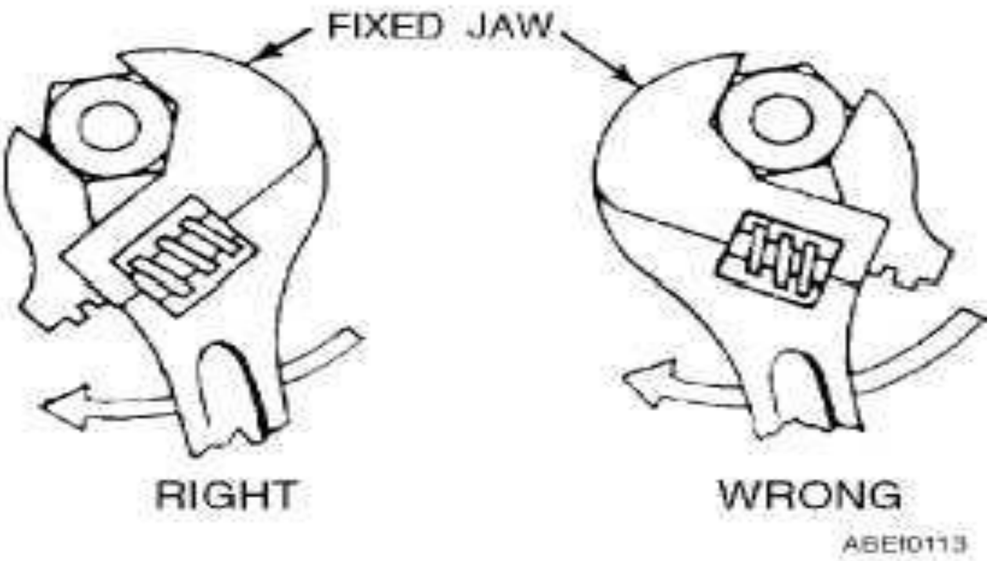

FIG. 11.7 Spanners using method

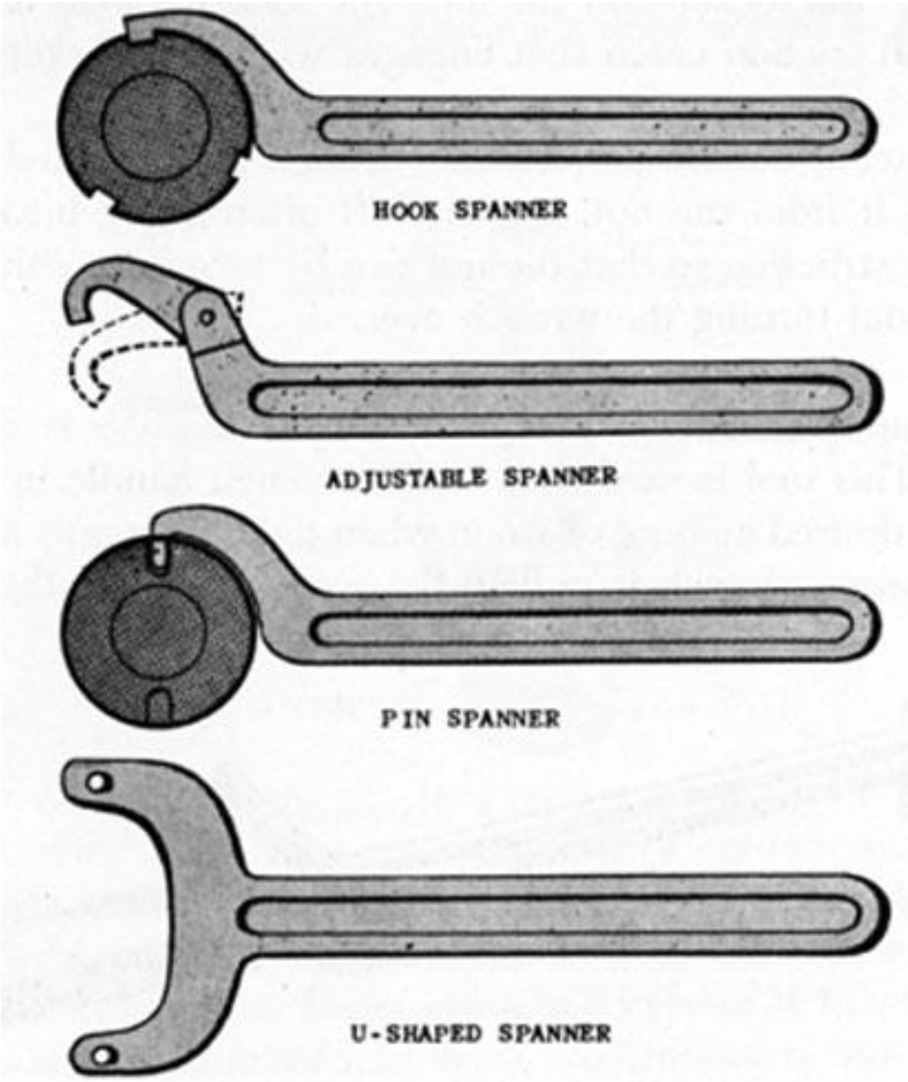

FIG. 11.8 Different Styles Of spanners

FIG. 11.9 Pipe Wrench

Questions:

1. What is a screwdriver?

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2. What is a heavy-duty screw driver?

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3. What is a phillips screwdriver?

4. What is the purpose of a double-ended offset screwdriver?

5. What is a wrench?

6. What is an adjustment wrench?

7. What is a T-handle top wrench?

8. What is a socket wrench and how it is used with a ratchet?

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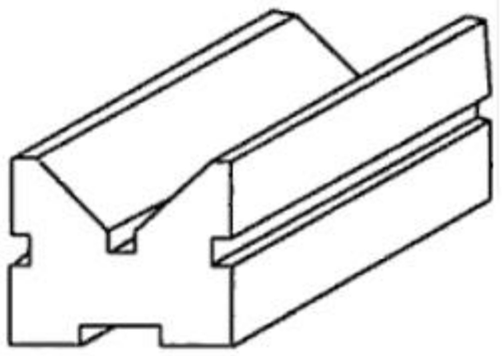
Experiment no. 12

AIM: to learn and practice the use of work holding tools.

APPARATUS: V- Blocks, 'C' Clamps, Workpiece.

INTRODUCTION:

V Block: V-Blocks are precision metalworking jigs typically used to hold round metal rods or pipes for performing drilling or milling operations. They consist of a rectangular steel or cast iron block with a 90-degree channel rotated 45-degrees from the sides, forming a V-shaped channel in the top. A small groove is cut in the bottom of the "V". They often come with screw clamps to hold the work. There are also versions with internal magnets for magnetic work holding. When the handle is rotated there is movement in the screw.



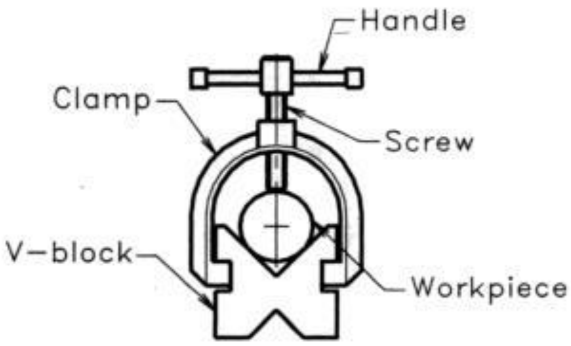


FIG.12.1 V Block

Fig.12.2 V Block Parts

C Clamp: A C-clamp or **G-clamp** is a type of clamp device typically used to hold a wood or metal workpiece, and often used in, but are not limited to, carpentry and welding. These clamps are called "C" clamps because of their C shaped frame, but are otherwise often called G-clamps or G-cramps because including the screw part they are shaped like an uppercase letter G. These clamps are available is sizes varying from 70 mm to 800 mm. it is used for holding the planks after gluing.

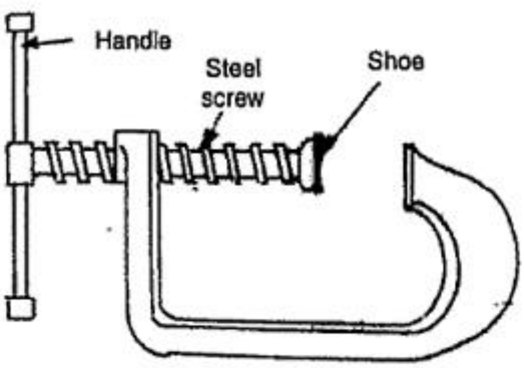


Fig.12.3 C-Clamp

CARE and MAINTENANCE:

1. Keep screw lubricated with small quantity of preventive lubricating oil.
2. Keep metal surface free of rust or corrosion
3. If you remove the clamp knob, clean the threads with a wire brush and place a small amount of silicone grease on the threads and the washer.
4. Coat surfaces with preservative lubricating oil.
5. Replace all part broken or damaged beyond repair.

CONCLUSION:

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DIAGRAMS:

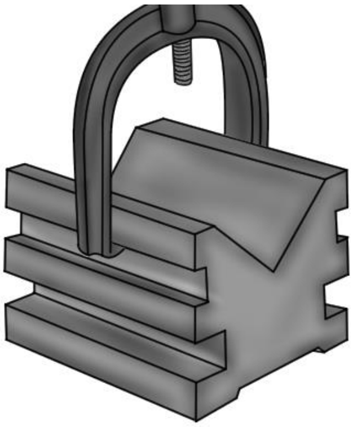

Fig.12.4 V- Block

Fig.12.5 C- Clamp

QUESTIONS:

Q.1. what is the use of v- block or v clamp?

Q.2. how to use c- clamp to hold a workpiece?

Q.3. write precautions of using clamps?

Q.4. which materials are used in making of clamps?

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Experiment No. 13

AIM:
To measure the diameter and length of given machined circular work piece by using vernier caliper with British system.

APPARATUS:
Vernier caliper, circular work piece.

INTRODUCTION:
It is precision instrument which is used for measuring external as well as internal diameters of shafts, thickness of parts etc. to an accuracy of 0.001 inch and to an accuracy of 0.02mm. It can also be used to measure the depth of slots and holes.

PRINCIPLE:
The principle of vernier is that when two scales or divisions slightly different in size are used the difference between them can be utilised to determine the accuracy of measurement.

PROCEDURE:
Steps:
1. Note the no. of full inches marks crossed.
2. Note the no. of main divs. crossed.
3. Note the full sub divisions crossed by vernier zero beyond the 2nd reading.
4. Note the no. of divisions on vernier scale coinciding with any divisions on main scale.

Example:

First reading	=	1.000 inch.
Second reading(6 min divs.)	=	0.600
Third reading (3 sub divs.)	=	0.075
Fourth reading (10 V. divs.)	=	0.010
Final readings	=	1.685

OBSERVATION TABLE:

S.No.	Range	Smallest Division Value on main Scale	No. of Division of Vernier	Least Count

DIAGRAM:

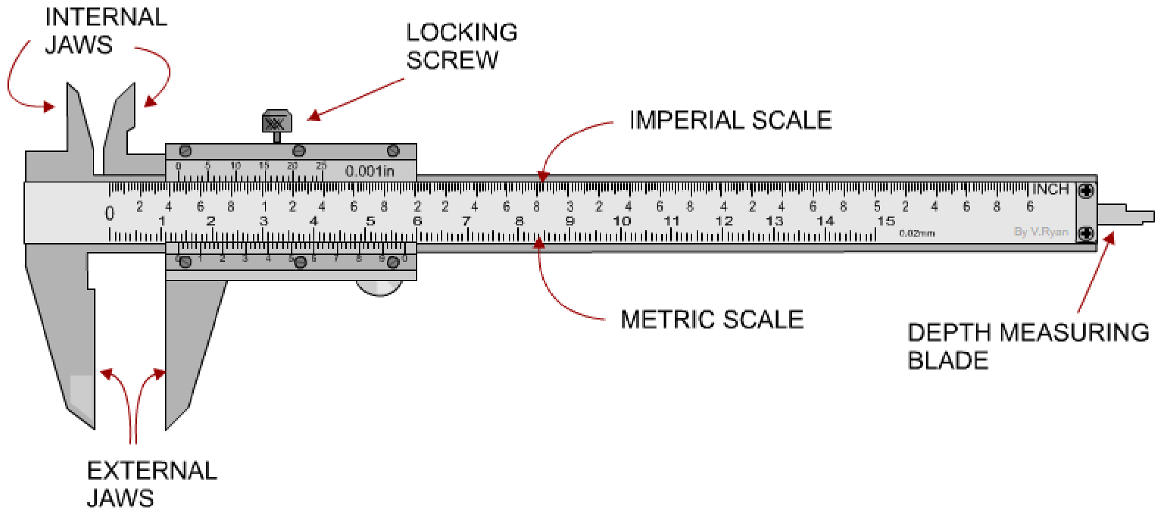

FIG. 13.1 Vernier Caliper

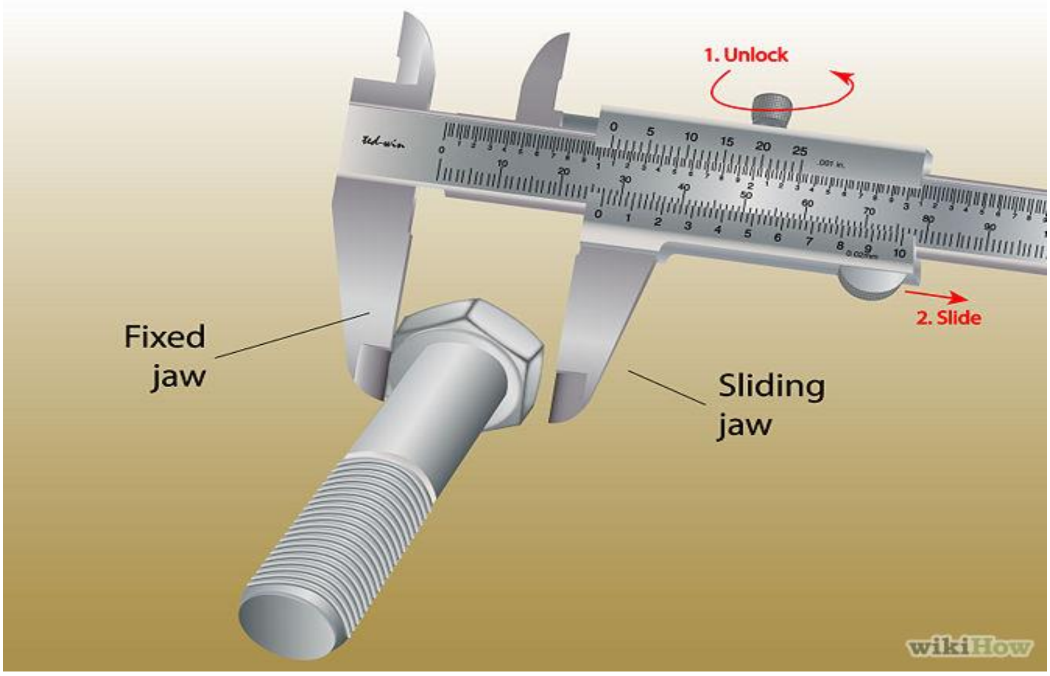

FIG. 13.2 Using in measuring Dia of Bolt Head

CONCLUSION:

PRECAUTIONS:

1. Line of measurement must coincide with line of scale i.e. following Abbe's principle correctly.

2. While measuring outside diameters with Vernier caliper, caliper should not be tilted or twisted.
3. Do not apply unnecessary extra pressure while taking measurements.
4. Handle and grip the instrument near or opposite to the jaws while taking the measurement.
5. Accuracy of measurement primarily depends on two senses – sense of sight (eyes) and sense of touch (feel). Imperfect vision and improper eyesight can cause error so use of proper magnifying glass should be done.

QUESTIONS:

1. What is vernier caliper?

2. Which material is used for making vernier caliper?

3. How the least count of vernier caliper can be determined?

4. What are the uses of vernier caliper?

5. What do you understand by 25/49 vernier caliper?

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Experiment No. 14

AIM:
To measure the height and scribe the lines on the desired dimension of given work piece by using vernier height gauge.

APPARATUS:
Vernier height gauge, work pieces.

INTRODUCTION:
It is mainly used for measuring heights of parts to an accuracy of 0.02 mm, and 0.001 inch also. It is also used for scribing lines in layout work.

PRINCIPLE:
The principle of vernier height gauge is that when two scales or divisions slightly different in size are used the difference between them can be utilised to determine the accuracy of measurement. The vernier height gauge commonly used, have the measuring range from 0 to 300mm.

PROCEDURE:
1. Before using this instrument, it should be checked for zero error.
2. For this, the vernier height gauge is placed on a surface plate and the vernier head is brought down till the measuring jaw touches the surface plate.
3. In this position, the zero on the main scale should coincide with the zero on the vernier scale.
4. In order to measure the height the work is placed between the surface plate and the measuring face.
5. The final adjustment depending upon the sense of correct feel is made by the fine adjustment screw.
6. The measurement is read in the similar way as in the vernier caliper.
7. For scribing lines, the scriber is set at a specified height and moved along the work piece to be marked.

Observation Table:

S.No.	Full Inches	Main Div.	Sub Div.	V. Div.	Total Reading

Conclusion:

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PRECAUTIONS:

1. The height gauges are generally kept in their cases when not in use.
2. Every care should be taken, particularly in case of long height gauges, to avoid its heating by warmth from the hands.
3. The springing of the measuring jaw should be always avoided.

DIAGRAM:

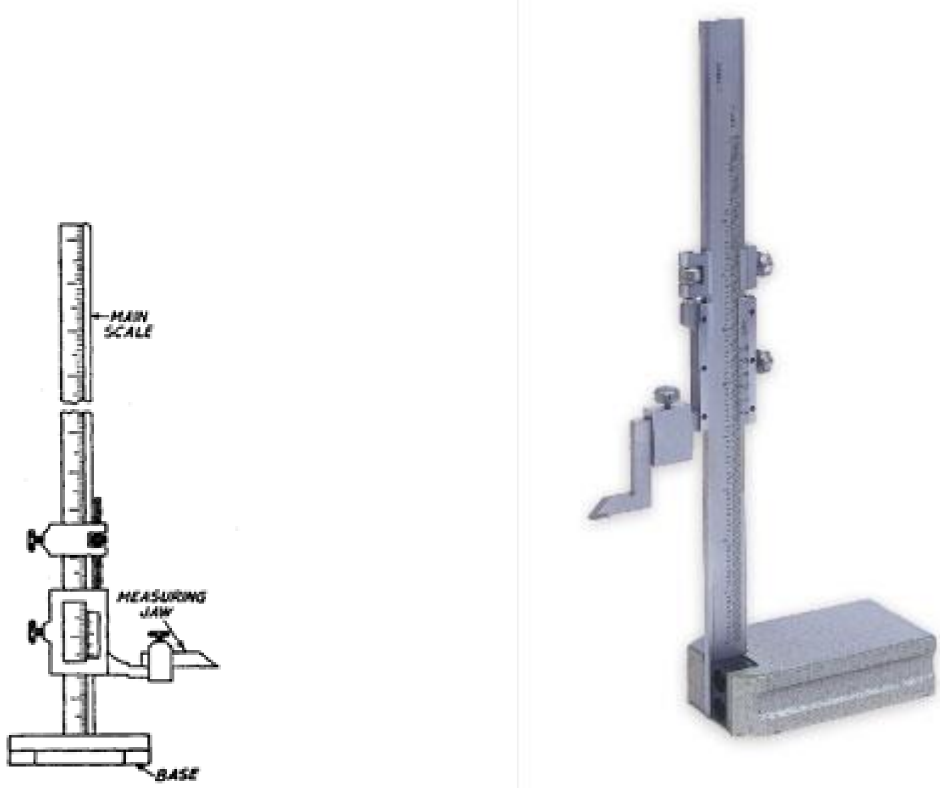

FIG. 14.1 Vernier Height Gauge

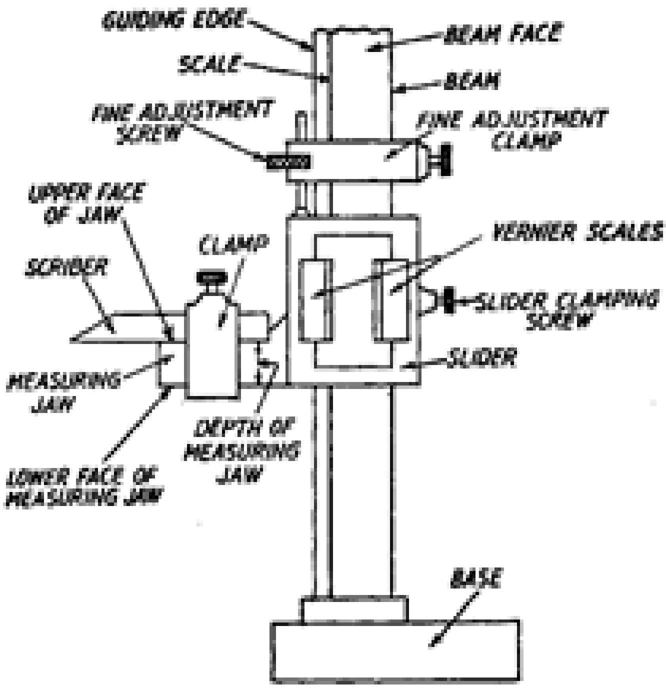

FIG. 14.2 Different Parts

QUESTIONS:

1. What is a vernier height gauge?

2. Which material is used for making vernier height gauge?

3. How the least count of vernier height gauge can be determined?

4. What are the uses of vernier height gauge?

5. What do you understand by 50/49 method vernier height gauge?

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Experiment No. 15

AIM: to learn and practice the use of vernier depth gauge.

APPARATUS: Vernier Depth Gauge, Specimen.

INTRODUCTION: Vernier depth gauge is used to measure the depth of holes, slots and recesses, to locate center distances etc. It consists of (i) A sliding head having flat and true base free from curves and waviness.

(ii) A graduated beam known as main scale. The sliding head slides over the graduated beam.

(iii) An auxiliary head with a fine adjustment and a clamping screw. The beam is perpendicular to the base in both directions and its end square and flat. The end of the sliding head can be set at any point with fine adjustment screw depending upon the sense of correct feel. The clamping screw is then tightened and the instrument is removed from the hole and readings are taken in the same way as taken by vernier caliper. While using the instrument it should be ensured that the reference surface on which the depth gauge base is rested, is satisfactorily true, flat and square.

PRINCIPLE: The principle of vernier depth gauge is that when two scales or divisions slightly different in size are used the difference between them can be utilized to determine the accuracy of measurement. The vernier height gauge commonly used, have the measuring range from 0 to 300mm.

PROCEDURE:
1. Before using this instrument, it should be checked for zero error.
2. For this, the vernier depth gauge is placed on a surface plate and the vernier head is brought down till the measuring jaw touches the surface plate.
3. In this position, the zero on the main scale should coincide with the zero on the vernier scale.
4. In order to measure the depth of the work is placed between the surface plate and the measuring face.
5. The final adjustment depending upon the sense of correct feel is made by the fine adjustment screw.
6. The measurement is read in the similar way as in the vernier caliper.
7. For scribing lines, the scriber is set at a specified height and moved along the work piece to be marked.

OBSERVATION TABLE:

Sr. No.	Main scale reading (A) mm	No. of vernier scale division	Vernier scale readings div X L.C. (B)	Total reading A + B

CONCLUSION:

PRECAUTIONS:

1. The depth gauges are generally kept in their cases when not in use.
2. Every care should be taken, particularly in case of long height gauges, to avoid its heating by warmth from the hands.
3. The springing of the measuring jaw should be always avoided.

DIAGRAM:

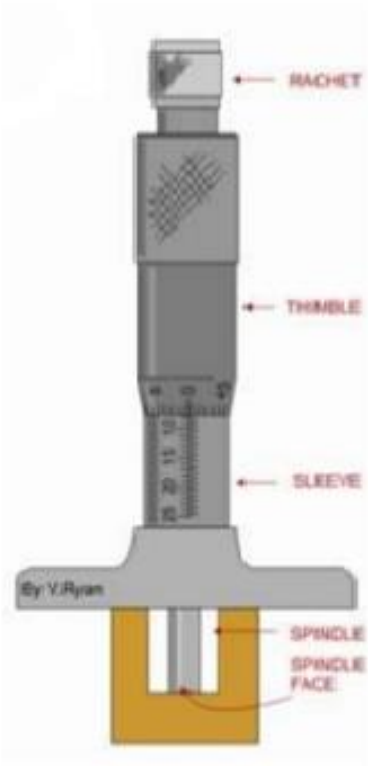

FIG.15.1 Depth Gauge.

QUESTIONS:

Q.1. what is the use of Depth Gauge?

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Q.2. Write the principle of depth gauge**.**

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Q.3. Write Precaution in using Depth Gauge.

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Experiment No. 16

AIM:
To measure the taper angle of given machined job piece, by using sine bar with surface plate and gauge blocks.

APPARATUS:
Sine bar, surface plate and gauge block.

INTRODUCTION:

(a). **Sine bar:**
It is used either to measure angles more precisely than a bevel protector or for locating any work to a given angle Q with in very close limits. It is generally used with conjunction with slip gauges and surface plate. A sine bar consists handened and ground steel bar which is staped at the ends. A roller is fastened in each step with a screw. A sine bar is specified by the distance between the centres of two roles some holes are drilled in the body of the sine bar in order to reduce the weight and to facilitate handling.

(b). **Surface plate:**
It is made of grey cast iron in various sizes. It is usually square or rectangular and has the top and the adjacent four edges very accurately machined and scraped to form a true flat surface and are brought in square. It is placed horizontally on a firm support whose working height is about 800 mm from the floor.
It is used to check the trueness of flat surfaces and to copy the master surface on a work. A thin coating of red lead mixed with oil is spread evenly over the surface plate. The work to be tested is cleaned, placed on the plate and gently moved along it. The parts which come in contact with red lead are marked and show where more metal has to be removed. The surface plate are made in two grades of accuracy i.e. A & B, depending upon scraping of within 0.005 mm and 0.02mm respectively. It should be oiled and covered with a wooden cover to protect from dust when not in use.

(c). **Gauge block:**
The slip gauges are used for checking the accuracy of measuring instruments such as micrometers, calipers, snap gauges, dial indicators etc. These are also used for setting the sine bars for angular measurement, for accurate measurements in die manufacture and in various precision measuring machines like tool room microscopes etc.
The slip gauge consist of alloy steel or tool steel block of section about 30mm by 10mm. These are hardened before being finished to size. The slip gauges are made in the following four grades.

1. Workshop or production grade.
2. Inspection grade.
3. Calibration grade.
4. Reference grade.

PRINCIPLE
The work having tapered top and flat base is placed on the surface plate and adjust the sine bar, with the help of gauge blocks on the top of work piece. In this way we can determine the taper angle with sine formula.

PROCEDURE

1. Clean the given work piece with sine paper.
2. Place the work piece over the surface plate.
3. Then adjust the sine bar with the gauge blocks to coincides the top surface of the work piece with the sine bar.
4. Then determine the H1 & H2 measurement.
5. Now apply the formula sin □ = P/H and determine the angle.
6. In this way we check the taper angle.

Observation Table:

S.No.	**Perpendicular distance P= H1-H2**	**Hypotenus (H)**	**Angles Sin θ = P/H**

CONCLUSION:

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PRECAUTION:

1. The sine bar should not be used for angle greater than 60° because any possible error in construction is accentuated at this limit.

2. A compound angle should not be formed by mis-aligning of workpiece with the sine bar. This can be avoided by attaching the sine bar and work against an angle plate.

3. Accuracy of sine bar should be ensured.

4. As far as possible longer sine bar should be used since many errors are reduced by using longer sine bars.

DIAGRAM:

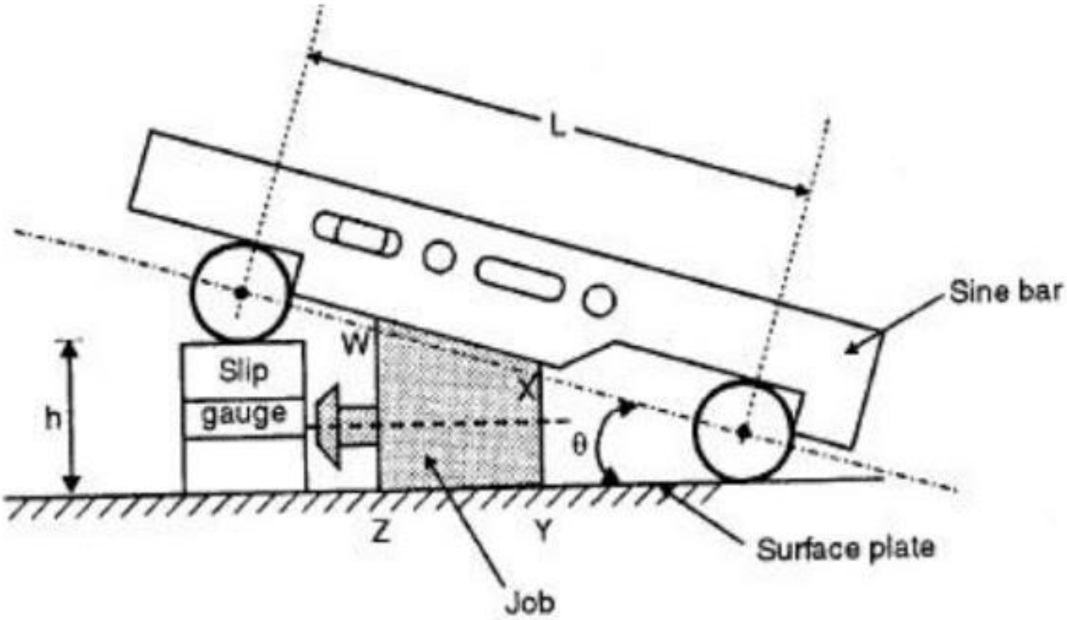

FIG. 16.1 Surface plate, Slip gauge And Sine Bar

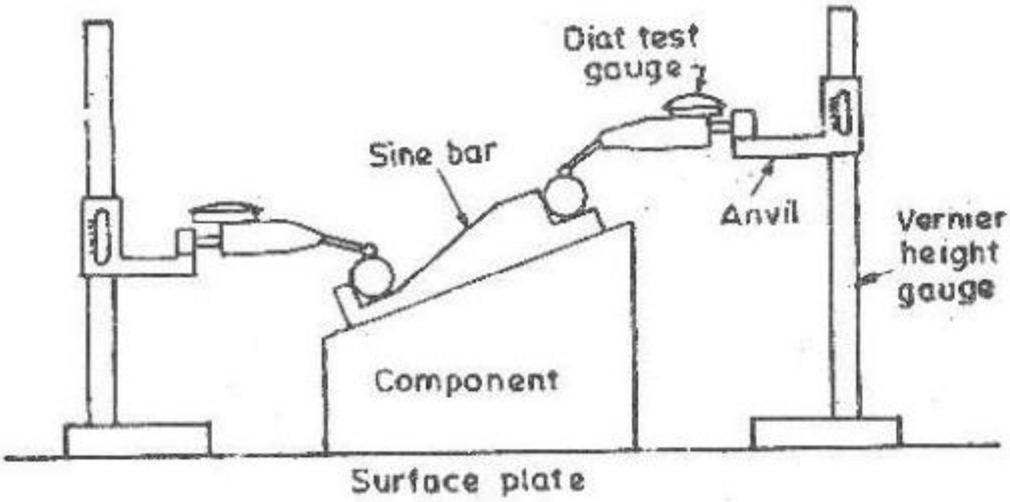

FIG. 16.2 Angle Measurement using Sine Bar

QUESTIONS:

1. What is sine bar?

2. Which material is used for making sine bar?

3. How the size of sine bar can be determined?

4. What are the uses of sine bar?

5. What do you understand by H1 & H2?

6. What is surface plate?

7. Which material is used for making surface plate?

8. What do you understand by high spots?

9. What is working height for surface plate?

10. What is the purpose of surface plate?

11. What are the gauge blocks?

12. What is the purpose of gauge blocks?

13. In what grades slip gauge are made?

14. What is the principle for checking the taper angle of given work piece with sine bar?

15. What precaution must be followed while working with sine bar?

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Experiment 17

AIM: to learn and practice the use of different gauges.

APPARATUS: Plug Gauge, Filler gauge, Radius Gauge, Wire Gauge, Screw Pitch gauge, Ring Gauge, Snap Gauge, Work Pieces.

INTRODUCTION:

1. Plug Gauge: A Go-No gauge (or Go/no go) refers to an inspection tool used to check a workpiece against its allowed tolerances. Its name derives from its use: the gauge has two tests; the check involves the workpiece having to pass one test (Go) and fail the other (No Go). It is an integral part of the quality process that is used in the manufacturing industry to ensure interchangeability of parts between processes, or even between different manufacturers.

A Go NoGo gauge is a measuring tool that does not return a size in the conventional sense, but instead returns a state. The state is either acceptable (the part is within tolerance and may be used) or it is unacceptable (and must be rejected).

They are well suited for use in the production area of the factory as they require little skill or interpretation to use effectively and have few, if any, moving parts to be damaged in the often hostile production environment.

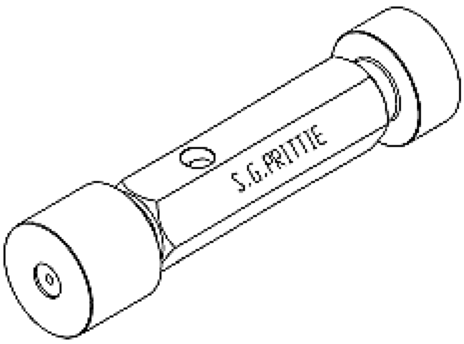


Fig.17.1 Plug gauge

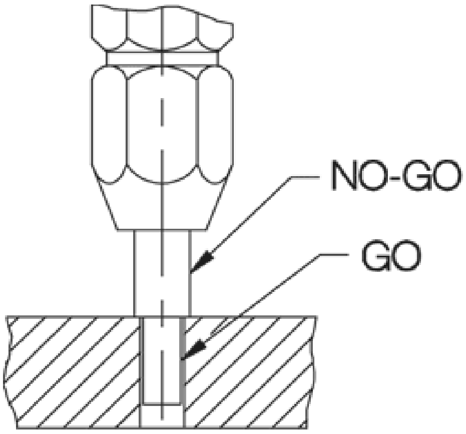


Fig.17.2 Go, No-Go condition

2. Feeler gauge: A feeler gauge is a tool used to measure gap widths. Feeler gauges are mostly used in engineering to measure the clearance between two parts. They consist of a number of small lengths of steel of different thicknesses with measurements marked on each piece. They are flexible enough that, even if they are all on the same hinge, several can be stacked together to gauge intermediate values. It is common to have two sets for imperial units (typically measured in thousandths of an inch) and metric (typically measured in hundredths of a millimeter) measurements.

A similar device with wires of specific diameter instead of flat blades is used to set the gap in spark plugs to the correct size; this is done by increasing or decreasing the gap until the gauge of the correct size just fits inside the gap.

The lengths of steel are sometimes called leaves or blades, although they have no sharp edge.

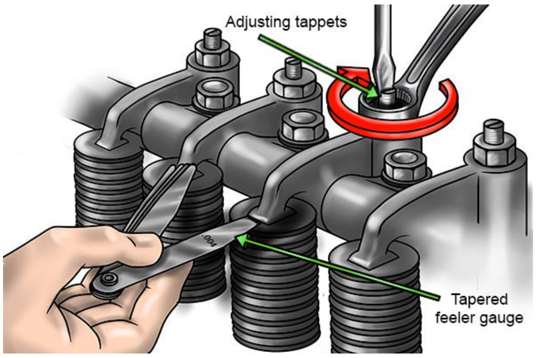


Fig.17.3 Feeler gauge

Fig.17.4 Measuring Clearance

3. Radius Gauge: radius gauge, also known as a fillet gauge, is a tool used to measure the radius of an object.

Radius gauges require a bright light behind the object to be measured. The gauge is placed against the edge to be checked and any light leakage between the blade and edge indicates a mismatch that requires correction.

A good set of gauges will offer both convex and concave sections, and allow for their application in awkward locations. Every leave has different radius. The material of the leaves is stainless steel.

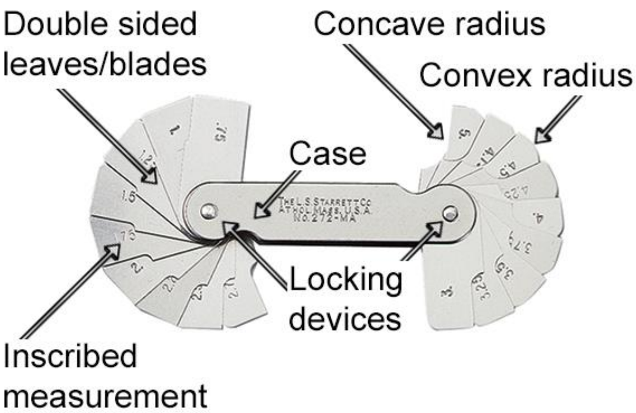
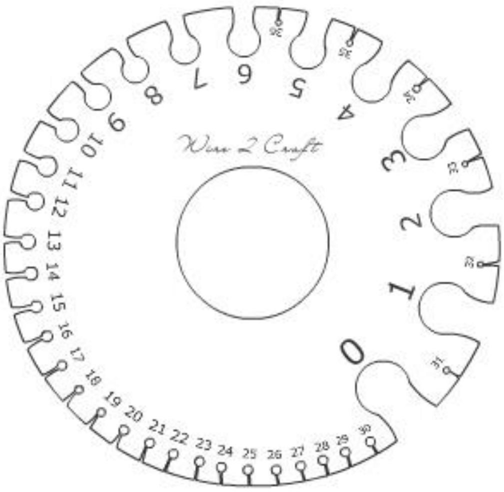


Fig.17.5 Radius gauge

Fig.17.6 Different parts of radius gauge

4. WIRE Gauge: Wire gauge is a measurement of how large a wire is, either in diameter or cross sectional area. This determines the amount of electric current a wire can safely carry, as well as its electrical resistance and weight per unit of length. Wire gauge is applicable to both electrical and non-electrical wires, being important to electrical wiring and to structural cable.



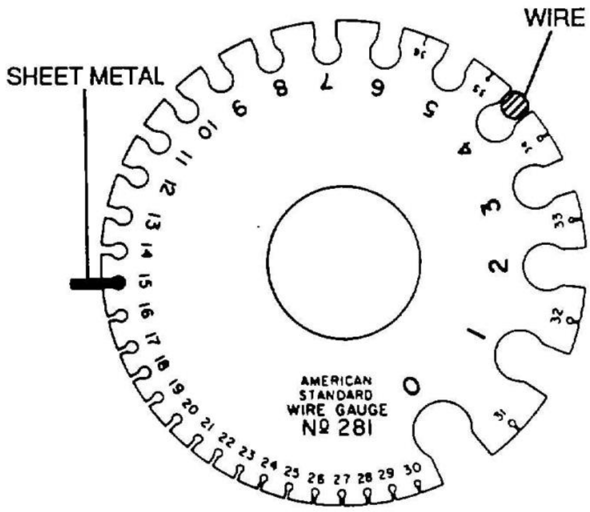


Fig.17.7 Wire gauge

Fig.17.8 Measurement of wire dia.

5. Screw pitch gauge: A screw pitch gauge, also known as a thread pitch gauge or pitch gauge, is used to measure the pitch or lead of a screw thread. The uppermost gauge in the image is an ISO metric pitch gauge, the larger gauge in the center is for measuring the Acme thread form, and the lower gauge is for Whitworth screws.

Thread pitch gauges are used as a reference tool in determining the pitch of a thread that is on a screw or in a tapped hole. This tool is not used as a precision measuring instrument. This device allows the user to determine the profile of the given thread and quickly categorize the thread by shape and pitch. This device also saves time, in that it removes the need for the user to measure and calculate the thread pitch of the threaded item.

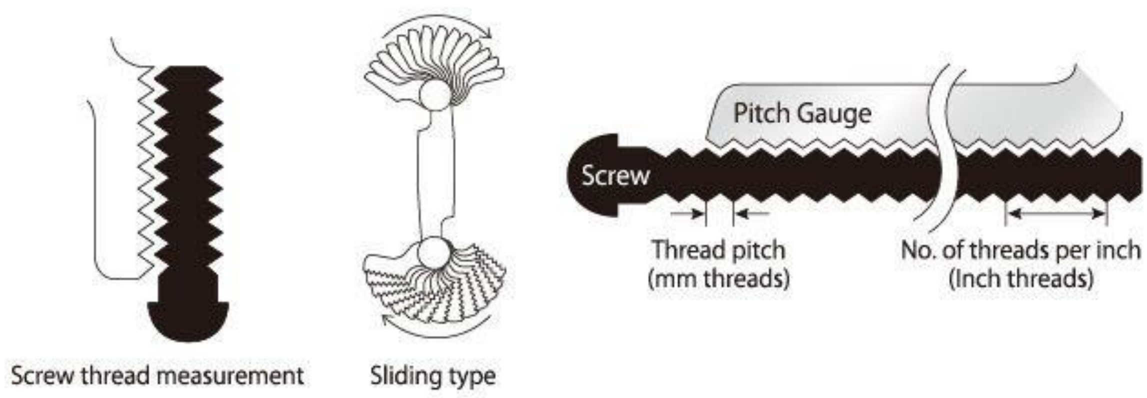


Fig.17.9 Screw thread gauge and Thread measurement.

6. Ring Gauge: A ring gauge, is a cylindrical ring of a thermally stable material, often steel, whose inside diameter is finished to gauge tolerance and is used for checking the external diameter of a cylindrical object.

Ring gauges are used for comparative gauging as well as for checking, calibrating, or setting of gauges or other standards. Individual ring gauges or ring gauge sets are made to variety of tolerance grades in metric and English dimensions for master, setting, or working applications.

There are three main types of ring gauges: go, no go, and master or setting ring gauges.

Go gauges consist of a fixed limit gauge with a gauging limit based on the plus or minus tolerances of the inspected part. A go ring gauge's dimensions are based on the maximum OD tolerance of the round bar or part being gauged. The go ring (OD) gauge should be specified to a minus gauge makers' tolerance from the maximum part tolerance.

No-go gauges consist of a fixed limit gauge with a gauging limit based on the minimum or maximum tolerances of the inspected part. The no go ring (OD) gauge should be specified to a plus gauge makers' tolerance from the minimum part tolerance.

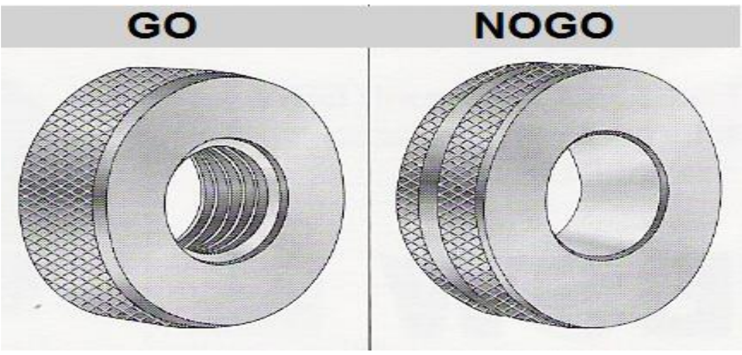


Fig.17.10 Ring gauge (Go & No-Go)

7. Snap Gauge: A snap gage is a form of Go/no go gauge. It is a limit gage with permanently or temporarily fixed measurement aperture (gaps) which is used to quickly verify whether an outside dimension of a part matches a preset dimension or falls within predefined tolerances. The surfaces which define the edges of the aperture are the anvils, which may be made of separate pieces of hard material such as tungsten carbide for wear resistance. Two apertures are frequently used to provide Go/No-Go testing and are often arranged such that a part being measured can pass through the two apertures in sequence; a part that is within tolerance will pass through the first maximum size limit aperture but will not be able to pass through the minimum size limit aperture. A snap gauge usually has a "C" shaped frame with the aperture(s) at the opening of the "C". Snap gages may be machined and ground out of a single block of metal or adjustable snap gages, which have movable anvils that may be adjusted over a limited range of sizes, may be used. They may also be of built up construction in which one or more gage blocks or feeler gauges are sandwiched between two anvils.

Adjustable snap gages may be reset to compensate for wear or re-tasked for measuring a different dimension and can be purchased off the shelf and set rather than needing to be fabricated from scratch when a new gage is needed. Gauge blocks would typically be used to initially set the width of the measuring aperture(s).

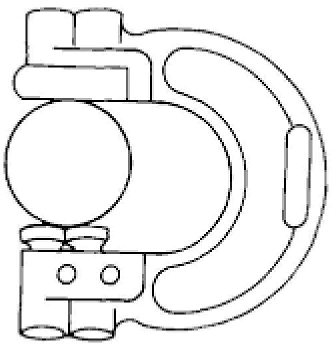


Fig.17.11 Snap gauge

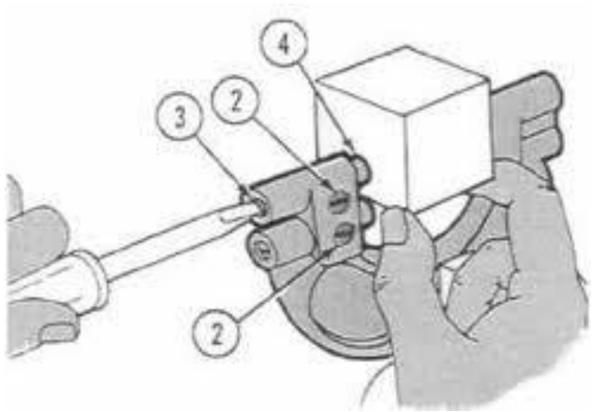


Fig.17.12 Measurement using snap gauge

CONCLUSION:

SAFETY PRECAUTIONS:

- Do not use gauges for any other purpose than inspection. For example, never substitute a thread gauge for a nut or bolt, and also never use a gauge instead of tools (hammer, tap, die)etc.
- As a gauge has a sharp portion to satisfy requirements for its function, concern about avoiding injury.
- Be sure to check that the gauge and handle are not loose before use.
- While a gauge or product is moving, never conduct inspection with the gauge
- Before using a gauge, thoroughly wash the gauge and product with gas oil or kerosene, or wipe them with a clean cloth to remove dust and dirt.
- Before using a gauge, check the gauge for any rust, flaw, burr, etc. If rust, flaw or burr is found, remove it carefully with an Arkansas grinding stone of good quality
- When inspecting a threaded product with a taper thread gauge, do not screw in the gauge rapidly to the end. Otherwise, the gauge is suddenly inserted, so that it will not come off. So carefully screw in at the final insertion.

- Do not hit the gauge by strong force. For example, when passing GO gauge or drawing an immobilized gauge, do not hit or shock it strongly with a hammer etc.
- If the gauge is dropped by accident, check the extent of damage and remove burr with an Arkansas grinding stone of good quality, or take other proper countermeasures.
- When keeping a gauge, do not leave the gauge fitted to a product or do not leave a plug gauge fitted to a ring gauge. Otherwise, the gauges or the gauge and product may stick firmly each other, sometimes resulting in rusting.

DIAGRAMS:

Fig.17.13 Plug Gauge

Fig.17.14 Wire gauge

Fig.17.15 Ring Gauge

Fig.17.16 Snap Gauge

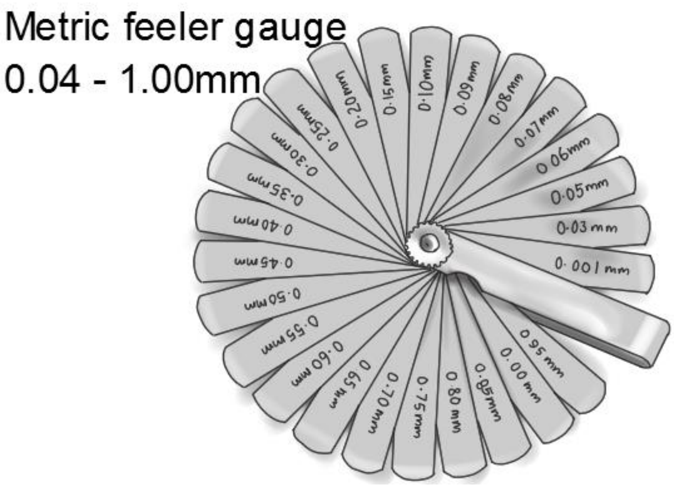


Fig.17.17 Feeler Gauge

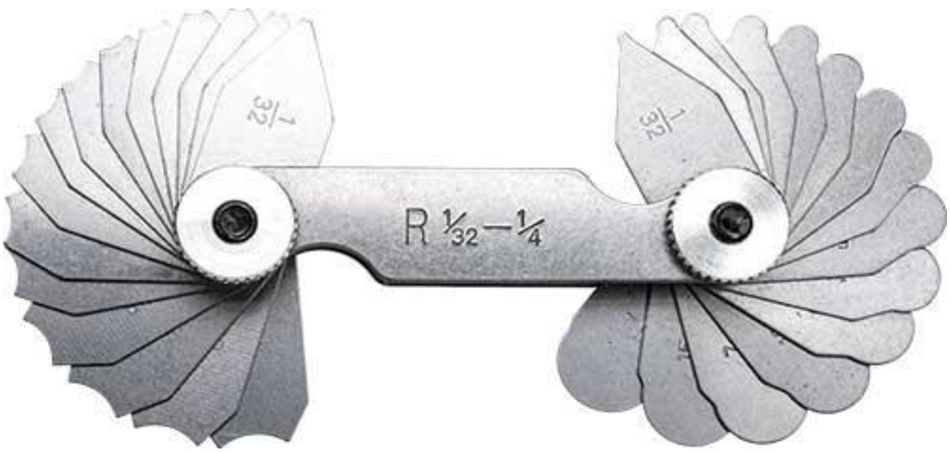


Fig.17.18 Radius Gauge

Fig.17.19 Screw Pitch Gauge

QUESTIONS:

Q.1.what is the use of Plug gauge?

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Q.2. what do you understand by Go and No-Go gauges?

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Q.3. How to use Snap gauge?

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Q.4. write the use of feeler gauge?

Q.5. how the screw thread gauge is use?

Q.6. Write safety precautions of using gauges?

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Experiment no. 18

AIM: To learn and practice the use of Dial test Indicator and to check the straightness of the straight edge.

APPARATUS:
Straight edge, surface plate to accommodate the straight edge, support blocks, dial test indicator.

INTRODUCTION:

Dial test Indicator: A dial test indicator, also known as a lever arm test indicator or finger indicator, has a smaller measuring range than a standard dial indicator. A test indicator measures the deflection of the arm; the probe does not retract but swings in an arc around its hinge point. The lever may be interchanged for length or ball diameter, and permits measurements to be taken in narrow grooves and small bores where the body of a probe type may not reach. The model shown is bidirectional; some types may have to be switched via a side lever to be able to measure in the opposite direction.

These indicators actually measure angular displacement and not linear displacement; linear distance is correlated to the angular displacement based on the correlating variables. If the cause of movement is perpendicular to the finger, the linear displacement error is acceptably small within the display range of the dial. However, this error starts to become noticeable when this cause is as much as 10° off the ideal 90°. This is called **cosine error**, because the indicator is only registering the cosine of the movement, whereas the user likely is interested in the net movement vector. Cosine error is discussed in more detail below.

Straight edges: These are used for checking the straightness and flatness of parts in conjunctions with surface plate, spirit levels and the flatness of a surface background. These may be made of steel or cast iron. Steel straight edges are available up to 2'm length and may be rectangular in section with beveled edge. Cast iron straight edges are made up to 3 inch length and widely used for testing machine tool slide ways.

The straight edges are classified as follows:
1. Tool-maker's straight edge.
2. Wide-edge straight edge
3. Angle straight edge.

PRINCIPLE:
The magnification of the small movement of the plunger or stylus is converted into a rotary motion of the pointer on a circular scale.

PROCEDURE:

1. The distance of support point is calculated (2/9 of total length of straight edge from each end).
2. The straight edge is divided into convenient equal number parts (measuring using accuracy increase with max number of parts), which contain the support point also.
3. The surface plate, straight edge and support block are cleaned.
4. The straight edge is supported over the blocks at the calculated distance.
5. Dial gauge is set below the straight edges so that the plunger is in its middle portion and the reading was taken at each point.
6. The management was made throughout out the length of the straight edge.
7. The difference b/w the nominal and measured difference in heights at various points

OBSERVATION TABLE:

Position	Nominal Slip (mm)	Actual Slip (mm)	Error

CONCLUSION:

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PRECAUTIONS:

(1) Check before using

- Confirm whether operation is smooth.
- Confirm whether quiescent point of indicator (pointer / short hand) is stable.
- Dial Indicator: Confirm whether contact point and lug back (back lid) are not loose.
- Dial Test Indicator: Please confirm whether contact point and stem are not loose. Torque for fastening screws of contact point is to be in the range 1.5～2.0kg・cm. If it is fastened too strong, screw part will be damaged.

(2) Installation method

- Dial Indicator should be installed with only stem or lug back. (Dial Test Indicator should be with stem or dovetail)
- Holding tool should be sufficiently stiff.
- Whether installation is right or wrong can be confirmed by that the pointer will return to the set position even after contact point of Dial indicator (Test Lever) is touched to measured substance and inner frame (case) is pushed from up and down by finger.
- Angle of Dial Test Indicator contact point Please set contact point to be perpendicular to measuring direction. In case of measuring large angle, please correct it. Otherwise, angle error will occur.

(3) Suppose dial is read from oblique direction of outer dial, error will happen. Please read from front face.

(4) In case of using it where temperature changes, please frequently confirm the setting point of pointer with master gauge etc.

(5) In case of dropping it down or making impact with it, please use it after inspection.

DIAGRAMS:

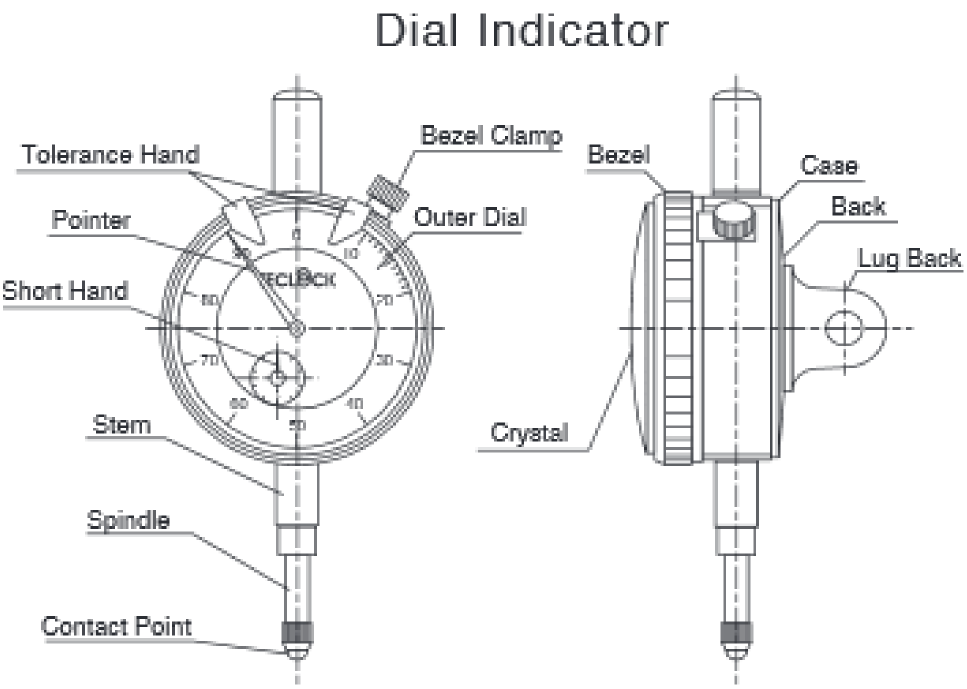

Fig.18.1 Dial Test indicator and its part.

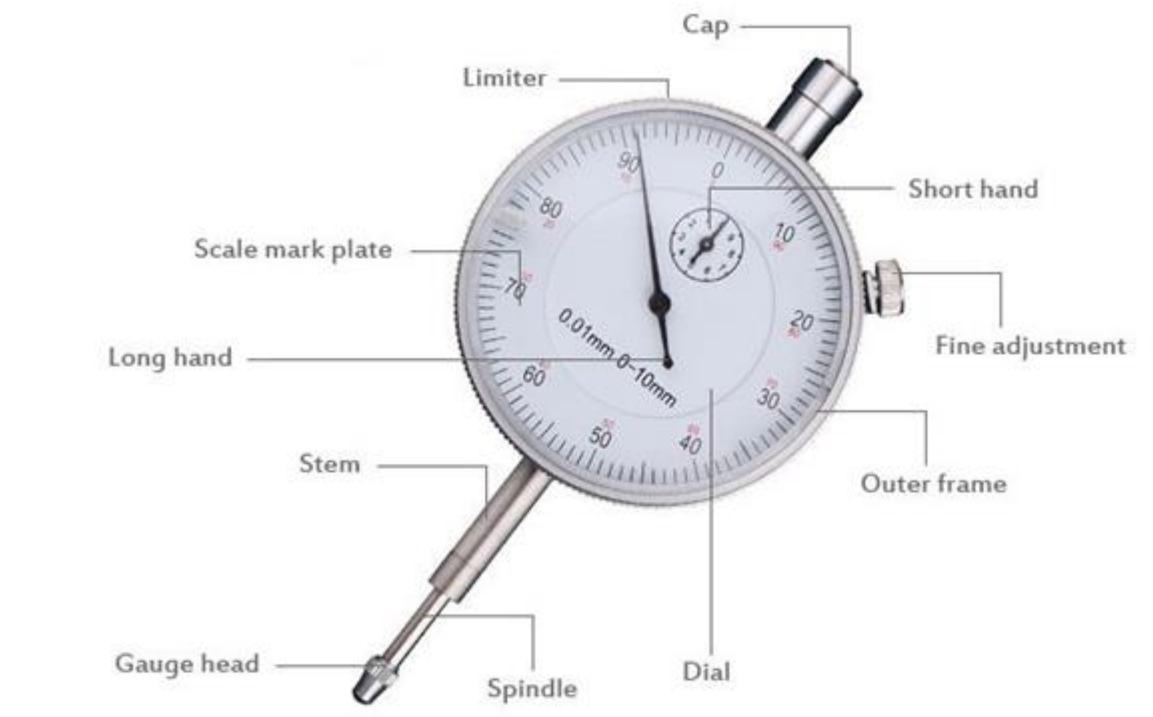

Fig. 18.2 Structure of Dial test indicator

QUESTIONS:

1. What is the purpose of dial test indicator?

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2. What are the different types of straight edge?

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3. What is the procedure of checking a Straight edge?

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4. How the error is calculated while checking the straightness of straight edge?

5. Which material is used for making straight edge?

6. Give the specification of steel straight edge & cast iron straight edge.

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Experiment no. 19

AIM: to learn and practice the use of thread cutting tool.

APPARATUS: Dies, Workpiece.

INTRODUCTION: External threads are made with the help of a threading die or die−stock.

Die−stock:
It consists of a handle−equipped holder in which two threading dies are placed. One of them is fixed, the other one can be moved by means of a pressure piece via a locking screw. Three to five pairs of exchangeable threading dies for various sizes of threads belong to a die−stock.

Application of the tools

- Threading dies cut the thread in one operation; they are used with bolt diameters up to 12mm. Bolt diameters between 12 mm and 30 mm can be cut by threading die or die−stock as well.
- Die−stocks are mainly used with bolt diameters over 30 mm; they are drawn over the bolt in several operations. Readjustment before every new operation is necessary. In the course of the last operation, the thread is accurately cut to size by a threading die,

Thread cutting operation

- The threading die is set in exactly horizontal position on the bevel of the bolt and turned clockwise slowly and with slight pressure from above (with right−hand thread). Only when the starting end of the thread is cut and the threading die guides itself, the breaking of chips can begin.
- The die−stock is opened as much as is necessary to shove it over the bolt − a small piece of the bolt must project above. The die−stock is adjusted to horizontal position and the movable threading die is tightened. Then, the die−stock is turned up to the bevel so that it is still guided. The movable threading die is further tightened. Then, the thread can be cut by turning the die−stock up and down adjusting the threading die simultaneously.

CARE AND MAINTENANCE:
Lubricating and cooling agents are chosen according to the kind of material.

- **Cleaning:** After thread cutting, the chips and rests of oil are removed from the thread flanks by compressed air or brush.

- **Checking:** The length of the thread is checked by vernier caliper, the accuracy of fit of the thread by the thread ring gauge according to the nominal diameter. The surface of the thread flanks can be assessed by the eye.

- Use appropriate safety guards or machine encapsulations to securely collect particles such as chips or cutting elements, which may spin off.

CONCLUSIONS:

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DIAGRAMS:

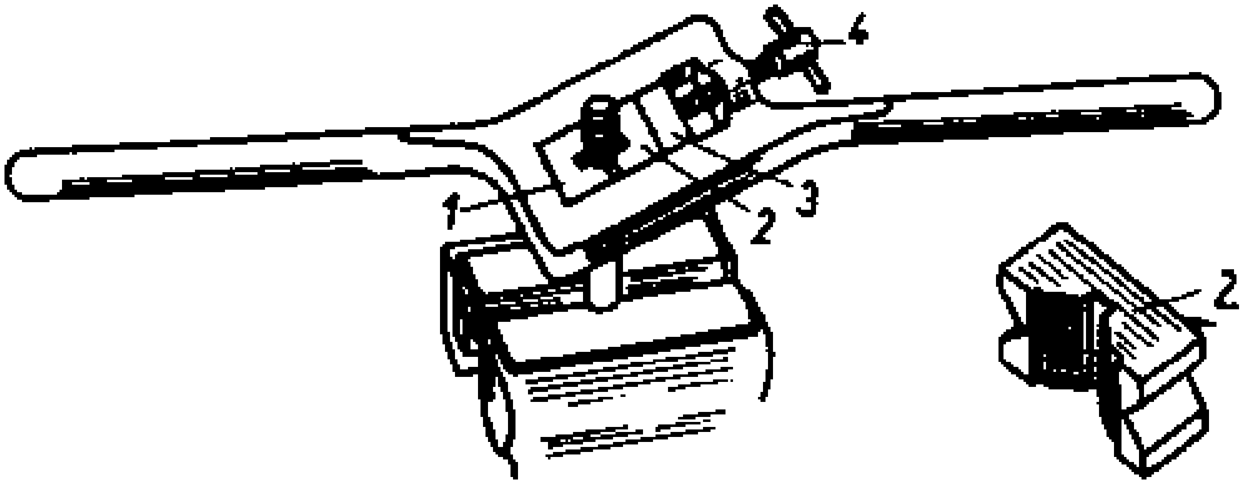

Fig.19.1 Die-Stock

Fig.19.2 Die Stock

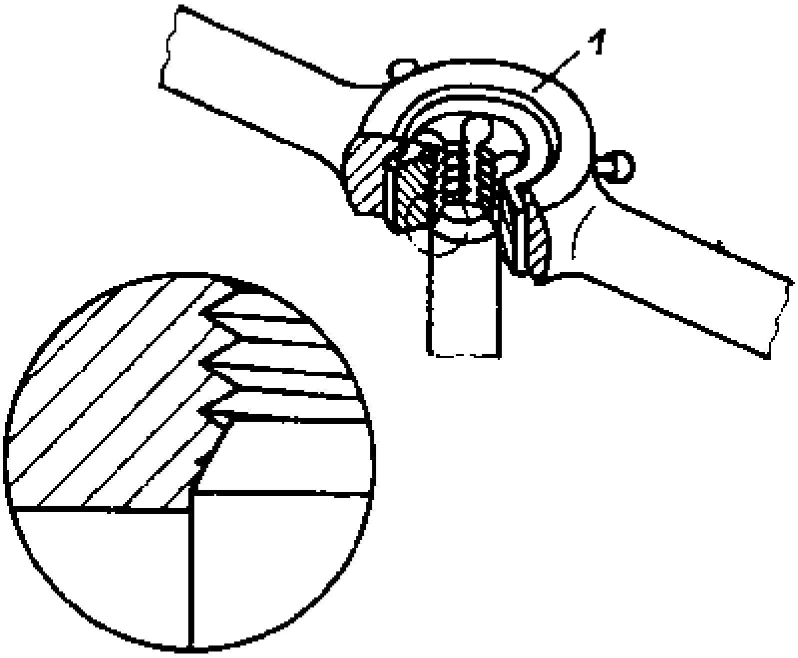

Fig.19.3 Thread cutting.

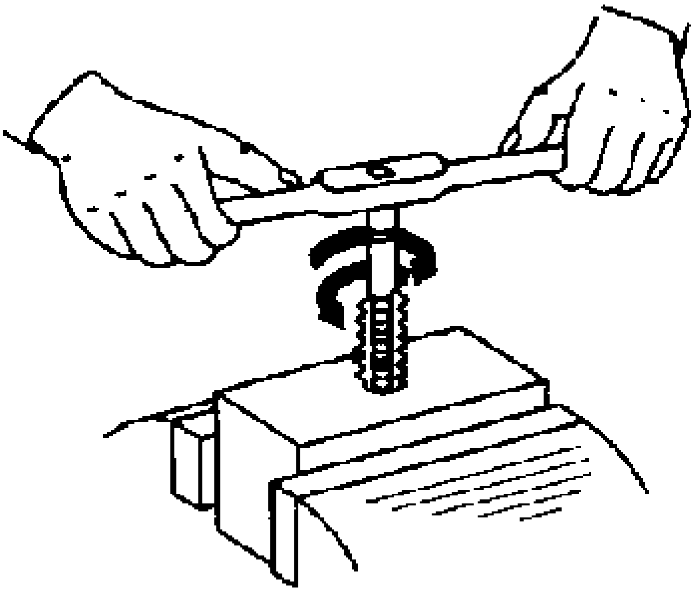

Fig.19.4 Thread Cutting Operation

QUESTIONS:

Q.1.What are the distinguishing features in the use of threading dies and die–stocks?

Q.2.Why must lubricating and cooling agents be used?

Q.3.Why is it necessary to move the thread tap or threading die or die–stock, respectively, backwards at regular intervals?

Q.4. Write safety Precautions in thread cutting operation?

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Experiment no. 20

OBJECTIVE: Analyze the various types of tolerances and applications, and to know the fundamental of the systems of fits.

INTRODUCTION:
In the early days, majority of the components were actually matted together, their dimensions being adjusted until the required type of fit was obtained. But with the passage of time, engineers and workers realized that the variations in the sizes of the parts had always present and that such variations could be restricted but not avoided. It has also been realized that exact size components are difficult to produce. Any attempt towards very closed dimensions of a product will increase cost of the production. The functional aspects of the component may be achieved even without going for its exact dimensions using limits, fit and tolerances. This reduces the unit cost of production and increases the rate of production.

For **example**, a shaft of exact 10.00 mm diameter is difficult to produce by machining process. But if you provide tolerance, i.e. the amount of variation permitted in the size, then such parts can be easily produced. A dimension 10 ± 0.05 means a shaft may be produced between 10.05 and 9.95. These two figures represent limit and the difference, (10.05 – 9.95) = 0.10 is called tolerance.

FITS AND THEIR CLASSIFICATIONS
When two parts are to be assembled, the relation resulting from the difference between their sizes before assembly is called a fit. A fit may be defined as the degree of tightness and looseness between two mating parts.

The important terms related to the fit are given below:

(i)Clearance
In a fit, this is the difference between the sizes of the hole and the shaft, before assembly, when this difference is positive. The clearance may be maximum clearance and minimum clearance. Minimum clearance in the fit is the difference between the maximum size of the hole and the minimum size of the shaft.

(ii)Interference
It is the difference between the sizes of the hole and the shaft before assembly, when the difference is negative. The interference may be maximum or minimum. Maximum interference is arithmetical difference between the minimum size of the hole and the maximum size of the shaft before assembly. Minimum interference is the difference between the maximum size of the hole and the minimum size of the shaft.

(iii)Transition
It is between clearance and interference, where the tolerance zones of the holes and shaft overlap.
So, you can see that fits depend upon the actual limits of the hole and or shaft and can be divided into three general classes:

(i) Clearance Fit.

(ii) Interference Fit.

(iii) Transition Fit.

Clearance Fit

In clearance fit, an air space or clearance exists between the shaft and hole as shown in Figure 20.1 Such fits give loose joint. A clearance fit has positive allowance, i.e. there is minimum positive clearance between high limit of the shaft and low limit of the hole.

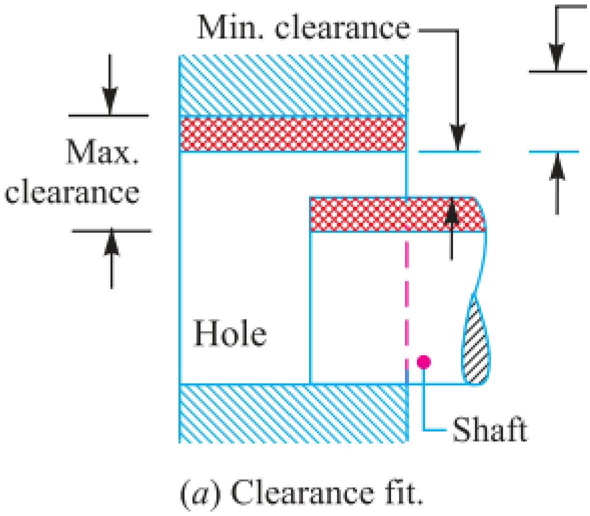


Figure 20.1: Clearance Fit

Clearance fit can be sub-classified as follows:

(a)Loose Fit

It is used between those mating parts where no precision is required. It provides minimum allowance and is used on loose pulleys, agricultural machineries etc.

(b)Running Fit

For a running fit, the dimension of shaft should be smaller enough to maintain a film of oil for lubrication. It is used in bearing pair etc. An allowance 0.025 mm per 25 mm of diameter of boring may be used.

(c)Side fit or Medium Fit: It is used on those mating parts where great precision is required. It provides medium allowance and is used in tool slides, slide valve, automobile parts, etc.

Example 20.1

A spindle slides freely in a bush. The basic size of the fit is 50×10^{-3} mm. If the tolerances quoted are $^{+62}_{0}$ for the holes and $^{-80}_{-180}$ for the shaft, find the upper limit and lower limit of the shaft and the minimum clearance.

Solution:

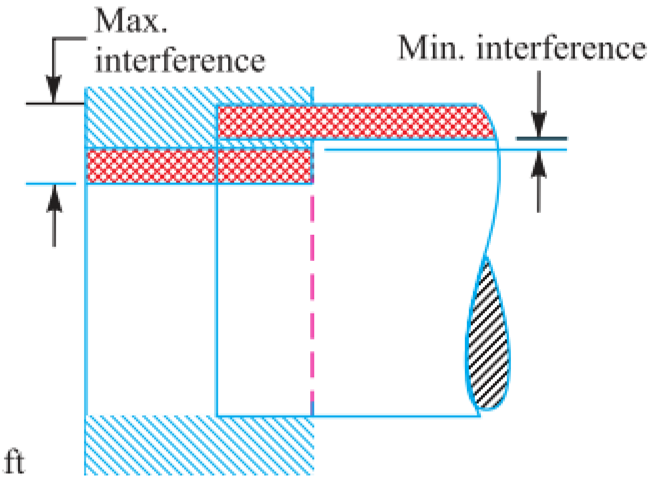
Tolerances are given in units of one thousandth of millimeter, so the upper limit of the hole will be 50.062 mm and lower limit for the hole is the same as the basic size of 50.000 mm.

The shaft upper limit will be $(50.000 - 0.080) \times 10^{-3} = 49.92 \times 10^{-3}$ m The shaft lower limit will be $(50.000 - 0.180) \times 10^{-3} = 49.82 \times 10^{-3}$ m

The minimum clearance or allowance is $(50.000 - 49.920) \times 10^{-3} = 8 \times 10^{-5}$ mm.

Interference Fit:

A negative difference between diameter of the hole and the shaft is called interference. In such cases, the diameter of the shaft is always larger than the hole diameter. In Figure 20.2. Interference fit has a negative allowance, i.e. interference exists between the high limit of hole and low limit of the shaft.



(*b*) Interference fit.

Figure 20.2: Interference Fit

In such a fit, the tolerance zone of the hole is always below that of the shaft. The shaft is assembled by pressure or heat expansion.

The interference fit can be sub-classified as follows :

(a)Shrink Fit or Heavy Force Fit

It refers to maximum negative allowance. In assembly of the hole and the shaft, the hole is expanded by heating and then rapidly cooled in its position. It is used in fitting of rims etc.

(b)Medium Force Fit

These fits have medium negative allowance. Considerable pressure is required to assemble the hole and the shaft. It is used in car wheels, armature of dynamos etc.

(c)Tight Fit or Press Fit

One part can be assembled into the other with a hand hammer or by light pressure. A slight negative allowance exists between two mating parts (more than wringing fit). It gives a semi-permanent fit and is used on a keyed pulley and shaft, rocker arm, etc.

Example 20.2

A dowel pin is required to be inserted in a base. For this application H 7 fit for hole and a p 6 fit for the shaft are chosen. The tolerance quoted are $^{+\,25}_{\ 0}$ for the

hole and $^{+\ \ 42}_{\ 26}$ for the shaft. Find the upper and lower limits of the hole and also dowel pin, and the maximum interference between dowel pin and the hole. The basic size of the fit is 50×10^{-3} m.

Solution

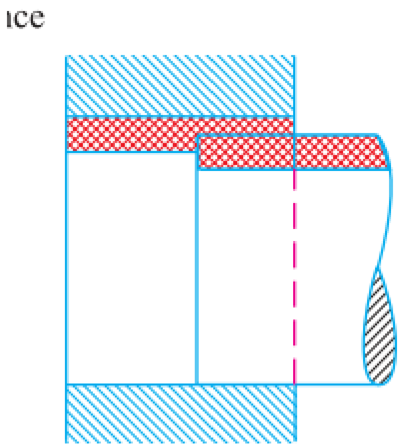
The upper limit for the hole will be $(50.000 + 0.025) \times 10^{-3} = 50.025 \times 10^{-3}$ m The lower limit for the hole will be $(50.000 + 0)$ $50.000 \times 10^{-3} = 50 \times 10^{-3}$ m The upper limit for dowel pin will be $(50.000 + 0.042) \times 10^{-3} = 50.042 \times 10^{-3}$ m

The lower limit for dowel pin will be $(50.000 + 0.026) \times 10^{-3} = 50.026 \times 10^{-3}$ mm

The maximum interference between dowel pin and the hole is $(50.042 - 50.000) \times 10^{-3} = 0.042 \times 10^{-3}$ m $= 42 \times 10^{-6}$ m.

Transition Fit:

It may result in either clearance fit or interference fit depending on the actual value of the individual tolerances of the mating components. Transition fits are a compromise between clearance and interference fits. They are used for applications where accurate location is important but either a small amount of clearance or interference is permissible. As shown in Figure 20.3, there is overlapping of tolerance zones of the hole and shaft.



(*c*) Transition fit.

Figure 20.3 : Transition Fit

Transition fit can be sub-classified as follows :

(a)Push Fit

It refers to zero allowance and a light pressure (10 cating dowels, pins, etc.) is required in assembling the hole and the shaft. The moving parts show least vibration with this type of fit. It is also known as snug fit.

(b)Force Fit or Shrink Fit

A force fit is used when the two mating parts are to be rigidly fixed so that one cannot move without the other. It either requires high pressure to force the shaft into the hole or the hole to be expanded by heating. It is used in railway wheels, etc.

(c)Wringing Fit
A slight negative allowance exists between two mating parts in wringing fit. It requires pressure to force the shaft into the hole and gives a light assembly. It is used in fixing keys, pins, etc.

Example 20.3

For a particular application, an H 7 fit has been selected for the hole and a K 6 fit for the shaft. The tolerance quoted are $\begin{matrix}+25\\0\end{matrix}$ for the hole and $\begin{matrix}+18\\12\end{matrix}$ for the shaft.

Find the upper limit and lower limit for the hole and also for bush. The basic size of fit is 50×10^{-3} m.

Solution

The upper limit for the hole will be $(50.000 + 0.025) \times 10^{-3} = 50.025 \times 10^{-3}$ m. The lower limit for the hole will be $(50.000 + 0) \times 10^{-3} = 50.000 \times 10^{-3}$ m. The upper limit for the bush will be $(50.000 + 0.018) \times 10^{-3} = 50.018 \times 10^{-3}$ m. The lower limit for the bush will be $(50.000 + 0.002) \times 10^{-3} = 50.002 \times 10^{-3}$ m.

SYSTEMS OF FIT
A fit system is the systems of standard allowance to suit specific range of basic size. If these standard allowances are selected properly and assigned in mating parts ensures specific classes of fit.
There are two systems of fit for obtaining clearance, interference or transition fit. These are :

(i) Hole basis system

(ii) Shaft basis system

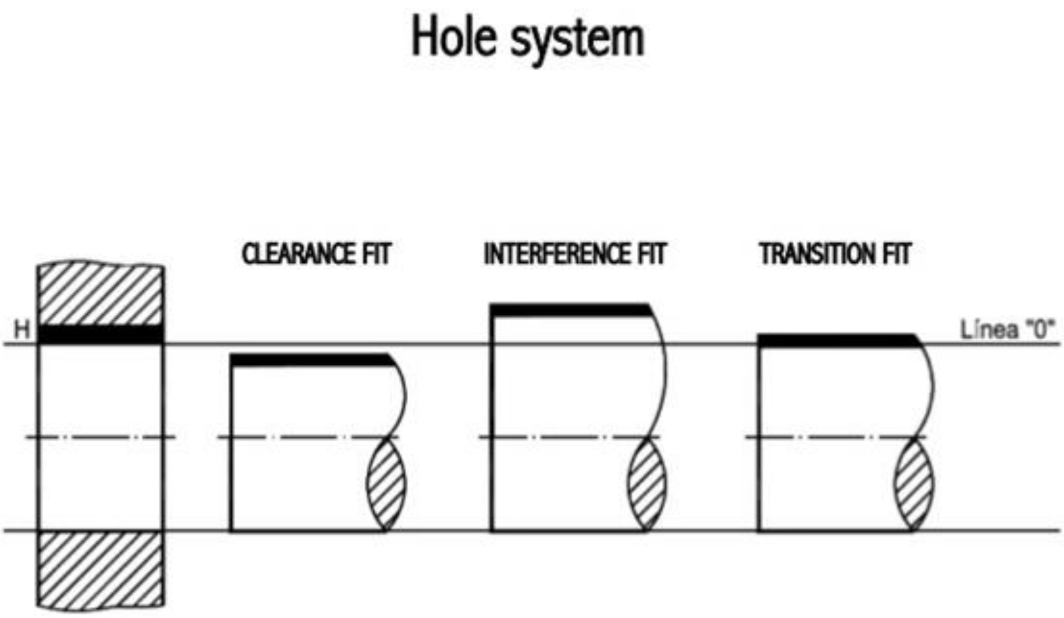


Figure 20.4 : Hole Basis System

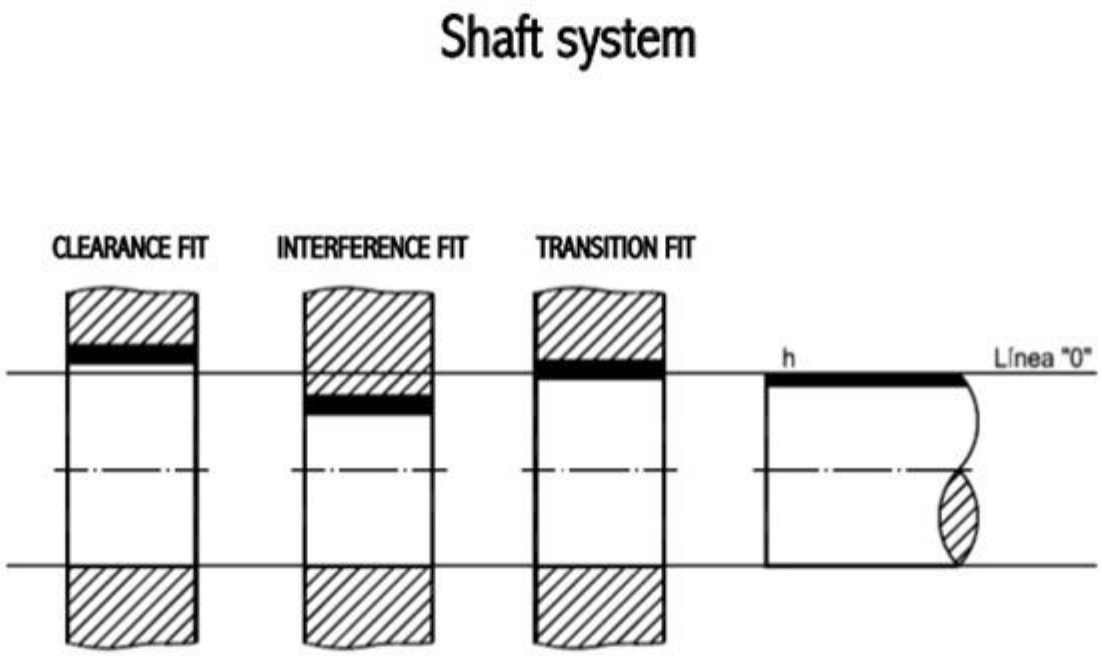


Figure 20.5 : Shaft Basis System

<u>Hole basis system</u>:
In the hole basis system, the size of the hole is kept constant and shaft sizes are varied to obtain various types of fits.
In this system, lower deviation of hole is zero, i.e. the low limit of hole is same as basic size. The high limit of the hole and the two limits of size for the shaft are then varied to give desired type of fit.
The hole basis system is commonly used because it is more convenient to make correct holes of fixed sizes, since the standard drills, taps, reamers and branches etc. are available for producing holes and their sizes are not adjustable. On the other hand, size of the shaft produced by turning, grinding, etc. can be very easily varied.

<u>Shaft Basis System</u>:
In the shaft basis system, the size of the shaft is kept constant and different fits are obtained by varying the size of the hole. Shaft basis system is used when the ground bars or drawn bars are readily available. These bars do not require further machining and fits are obtained by varying the sizes of the hole.
In this system, the upper deviation (fundamental deviation) of shaft is zero, i.e. the high limit of the shaft is same as basic size and the various fits are obtained by varying the low limit of shaft and both the limits of the hole.

TOLERANCE AND ITS CLASSIFICATION:
The permissible variation in size or dimension is tolerance. Thus, the word tolerance indicates that a worker is not expected to produce the part of the exact size, but definite a small size error is permitted. The difference between the upper limit (high limit) and the lower limit of a dimension represents the margin for variation to workmanship, and is called a tolerance zone (Figure 20.6).

Tolerance can also be defined as the amount by which the job is allowed to go away from accuracy and perfectness without causing any functional trouble, when assembled with its mating part and put into actual service.

Example 20.4

A shaft of 25 mm basic size is given as 25 ± 0.02 mm. Find the tolerance.

Solution

The maximum permissible size (upper limit) = 25.02 mm and the minimum permissible size (lower limit) = 24.98 mm

Then, Tolerance = Upper Limit – Lower Limit

= 25.02 – 24.98

= 0.04 mm = 4×10^{-5} m

There are two ways of writing tolerances

(a) Unilateral tolerance

(b) Bilateral tolerance.

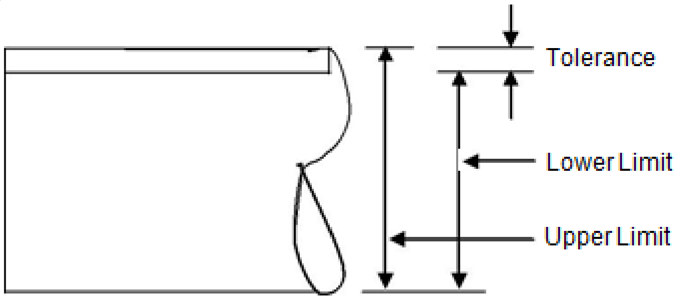


Figure 20.6 : Tolerance

Unilateral Tolerance

In this system, the dimension of a part is allowed to vary only on one side of the basic size, i.e. tolerance lies wholly on one side of the basic size either above or below it (Figure 20.7).

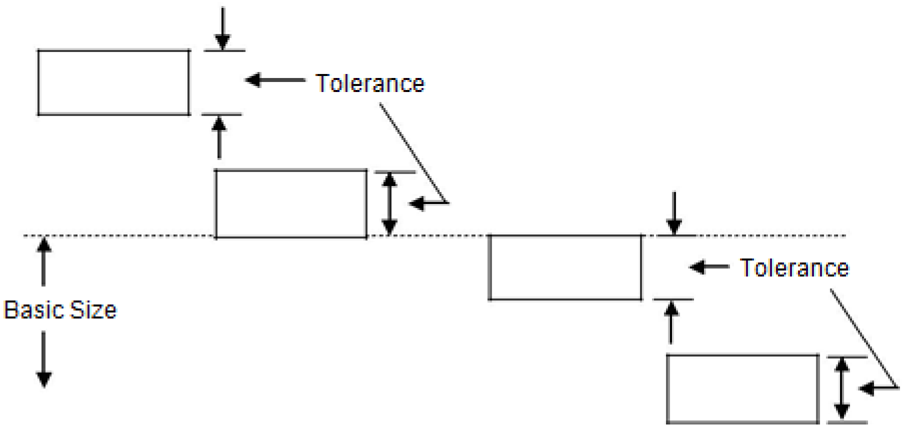


Figure 20.7 : Unilateral Tolerance

Examples of unilateral tolerance are :

$$25^{+0.02}_{+0.01},\ 25^{-0.02}_{-0.01},\ 25^{-0.01}_{-0.02},\ 25^{+0.0}_{-0.02}\ \text{etc.}$$

Unilateral system is preferred in interchangeable manufacture, especially when precision fits are required, because

(a) it is easy and simple to determine deviations,

(b) another advantage of this system is that „Go" Gauge ends can be standardized as the holes of different tolerance grades have the same lower limit and all the shafts have same upper limit, and

(c) this form of tolerance greatly assists the operator, when machining of mating parts. The operator machines to the upper limit of shaft (lower limit for hole) knowing fully well that he still has some margin left for machining before the parts are rejected.

<u>BiLateral Tolerance</u>:

In this system, the dimension of the part is allowed to vary on both the sides of the basic size, i.e. the limits of tolerance lie on either side of the basic size, but may not be necessarily equally dispose about it (Figure 20.8).

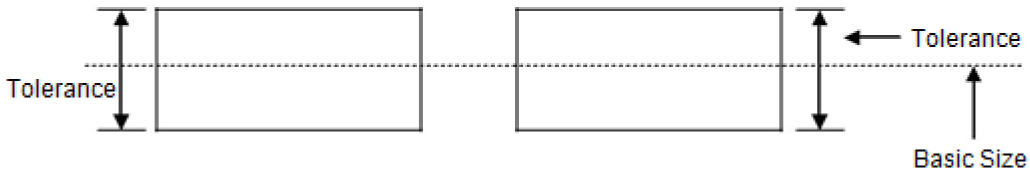


Figure 20.8 : Bilateral Tolerance

Examples of bilateral tolerance are :

$$25^{\pm 0.02},\ 25^{+0.02}_{-0.01}\ \text{etc.}$$

In this system, it is not possible to retain the same fit when tolerance is varied and the basic size of one or both of the mating parts are to be varied. This system is used in mass production when machine setting is done for the basic size.

Example 20.5

A 50 mm diameter shaft is made to rotate in the bush. The tolerances for both shaft and bush are 0.050 mm. determine the dimension of the shaft and bush to give a maximum clearance of 0.075 mm with the hole basis system.

Solution

In the hole basis system, lower deviation of hole is zero, therefore low limit of hole = 50 mm.

High limit of hole = Low limit + Tolerance

= 50.00 + 0.050

= 50.050 mm = 50.050×10^{-3} m

High limit of shaft = Low limit of hole – Allowance

= 50.00 – 0.075

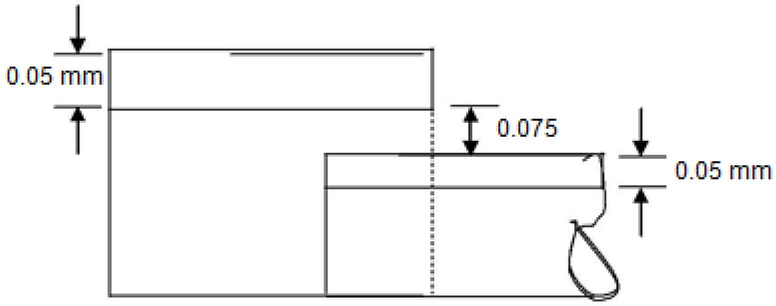
= 49.925 mm = 49.925 × 10^{-3} m

Low limit of the shaft = High limit – Tolerance

= 49.925 – 0.050

= 49.875 mm = 49.875 × 10^{-3} m

The dimension of the system is shown in Figure 3.8.



Example 20.6

For each of the following hole and shaft assembly, find shaft-tolerance, hole tolerance and state whether the type of fit is

(a) clearance,

(b) transition, and

(c) interference:

(i) Hole : $50^{+0.25}_{+0.00}$ mm, Shaft : $50^{+0.05}_{+0.005}$ mm

(ii) Hole : $30^{+0.05}_{+0.00}$ mm, Shaft : $30^{-0.02}_{+0.05}$ mm

(iii) Hole : $25^{+0.04}_{+0.00}$ mm, Shaft : $25^{+0.06}_{+0.04}$ mm

Solution

(a) Hole : High limit of hole = 50.025 mm

Low limit of hole = 50.00 mm Hole tolerance = 50.025 – 50.00

= 0.025 mm = 25 × 10^{-6} m Shaft : High limit of shaft = 50.05 mm

Low limit of shaft = 50.005 mm Shaft tolerance = 50.05 – 50.005

= 0.045 mm 45 × 10^{-6} m

If we choose high limit of hole with high limit of shaft then Allowance = 50.025 – 50.05

= – 0.025 (Interference)

Similarly, if we choose low limit of hole and either high limit or low limit of shaft, it is clear that there will be interference.

Thus, we conclude that the type of fit is **Transition fit**.

(b) Hole : High limit = 30.05 mm

Low limit = 30.00 mm

Tolerance = 0.05 mm = 5×10^{-5} m

Shaft : High limit = 30 – 0.02 = 29.98 mm

Low limit = 30 – 0.05 = 29.95 mm

Tolerance = 29.98 – 29.95 = 0.0 3 mm = 3×10^{-5} m

If we select high limit of hole and high limit of shaft then

Allowance = 30.05 – 29.98 = 0.07 mm

If we choose low limit of hole and high limit of shaft then

Allowance = 30.00 – 29.98 = 0.02 mm

Thus, we conclude that the type of fit is **Clearance fit.**

(c) Hole : High limit = 25.04 mm

Low limit = 25.00 mm Tolerance = 25.04 – 25.00

= 0.04 mm = 4×10^{-5} m

Shaft : High limit = 5.06 mm

Low limit = 25.04 mm

Tolerance = 25.06 – 25.04

= 0.02 mm = 2×10^{-5} m

If we select high limit of shaft and low limit of hole, then

Allowance = 25.00 – 25.06

= – 0.06 mm = -6×10^{-5} m

It is clear that for any combination of hole and shaft the allowance will be negative. Thus, we conclude that the type of fit is **Interference fit**.

QUESTIONS:

Q.1. what is a fit?

Q.2. What is the difference between clearance and interference?

Q.3. Mention the applications of clearance, interference and transitions fits.

Q.4.Which of the following are clearance, transition and interference fits?

(i) Push fit,

(ii) Wringing fit,

(iii) Force fit, and

(iv) Slide fit.

Q.5. Differentiate between „Hole basis system" and „Shaft basis system".

Q.6. A clearance fit is required between the mating parts with hole, specified as $25^{+0.04}_{-0.00}$ mm and shaft $25^{-0.02}_{-0.04}$ mm.

Find maximum and minimum permissible size of the hole and also for the shaft.

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EXPERIMENT NO. 21
PREPARE A T-LAP JOINT

AIM
To prepare a T-Lap Joint as per given dimensions in the carpentry shop

MATERIALS USED
Shorea wood 115mm X 45mm X 45mm.

APPARATUS USED
1. Steel rule.
2. Handsaw.
3. Wooden jack plane.
4. Try square.
5. Marking gauge.
6. Carpenter's vice.
7. Tenon saw.
8. Scriber.
9. Claw hammer.
10. Firmer chisel.

INTRODUCTION
Carpentry
It is the process of making wooden components. It deals with the building work, furniture, cabinet making etc. Preparation of joints is one of the important operations in all wood works called a joinery process. It deals with making joints for a variety of applications like door frames, window frames, wardrobes, cupboards etc.

Steel Rule
It is strip of steel with graduations on its edges which used for measuring and setting out dimensions.

Try Square
Try squares are used for marking and testing of right angles and for testing flatness of surface.

Marking Gauge
It is a tool which has one projected marking pin which is used to mark accurate lines parallel to the true edge of a wooden piece.

Wooden Jack Plane
It consists of wooden body in which blade is set at an angle of 45 degrees to the body or sole. The cutting blade used is made of high carbon steel and is very similar to a chisel. Jack Plane is a general purpose plane and is used to produce flat and smooth surfaces on wood.

Hand Saw
It is used to cut across the grains of the stock or thick wood. The teeth are set alternately to the right and left of the blade, and its purpose is to make the cut wider than the thickness of the blade. This allows the blade to move freely in the cut, without sticking. Its teeth are set at 2.5 mm apart.

Tenon Saw or Back Saw

This saw is mostly used for cross cutting when a finer and more accurate finish is required. The teeth are shaped in the form of an equilateral triangle and generally have 13 teeth for 25 mm length.

Firmer Chisel

It is a general-purpose chisel and is used for cutting and shaping wood accurately. The width of the blade varies from 1.5 to 50 mm.

Sequence of Operations

1. Marking.
2. Planning.
3. Cutting.
4. Setting.

PROCEDURE

1. The given wooden piece is checked to ensure its correct size.

2. The piece is firmly clamped in the carpenter's vice and any two adjacent faces are planned by the jack plane and the two faces are checked for squareness with the try square.

3. Marking gauge is set and lines are drawn at 15mm and 10mm, to mark the thickness and width of the model respectively.

4. The excess material is first chiselled out with firmer chisel and then planed to correct size.

5. The mating dimensions of the parts X and Y are then marked using scale and marking gauge.

6. Using the cross cut saw, the portions to be removed are cut in both the pieces, followed by chiselling and also the parts X and Y are separated by cross cutting, using the tenon saw.

7. A fine finishing is given to the parts, if required so that, proper fitting is obtained.

8. The two work pieces are fitted to make a slightly tight T-Lap Joint as per drawing.

SAFETY PRECAUTION

1. Start the sawing out side marking lines.

2. Tools which are not being used should always be kept in their respective places. They should not be allowed to scatter on the work place or bench.

3. While using chisels, lake care that cutting is performed in the direction away from your body.

4. The tools should always be kept well sharpened since a blunt or dull tool is apt to slip and cause injury.
5. Boards and other wooden pieces carrying nails should never be allowed to remain on the floor, other wise any body may unknowingly step on to them and the foot may be injured.
6. No machine should operated without the permission of the shop incharge.
7. While working on a circular saw, always avoid standing in a line with the plane of the rotating blade and always keep your hands at a distance from the blade.
8. Before starting cutting, allow the saw to attain the full speed.
9. The shop floor should always be kept well sharpened since a blunt or dull tool is apt to slip and cause injury.

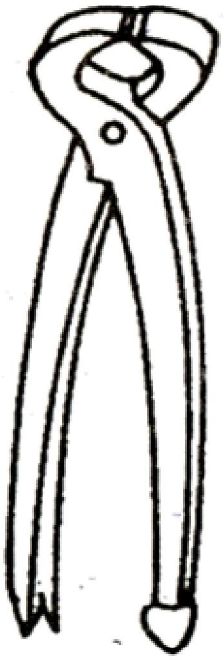
CONCLUSION

TOOLS / EQUIPMENTS DIAGRAM

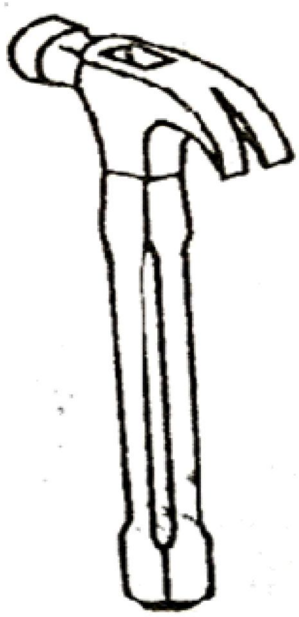
Steel Rule

Try Square

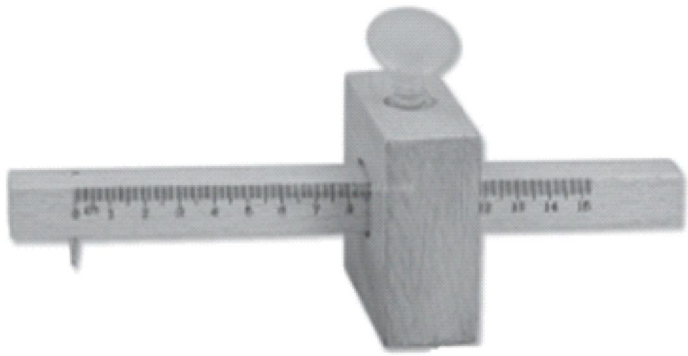
Firmer Chisel



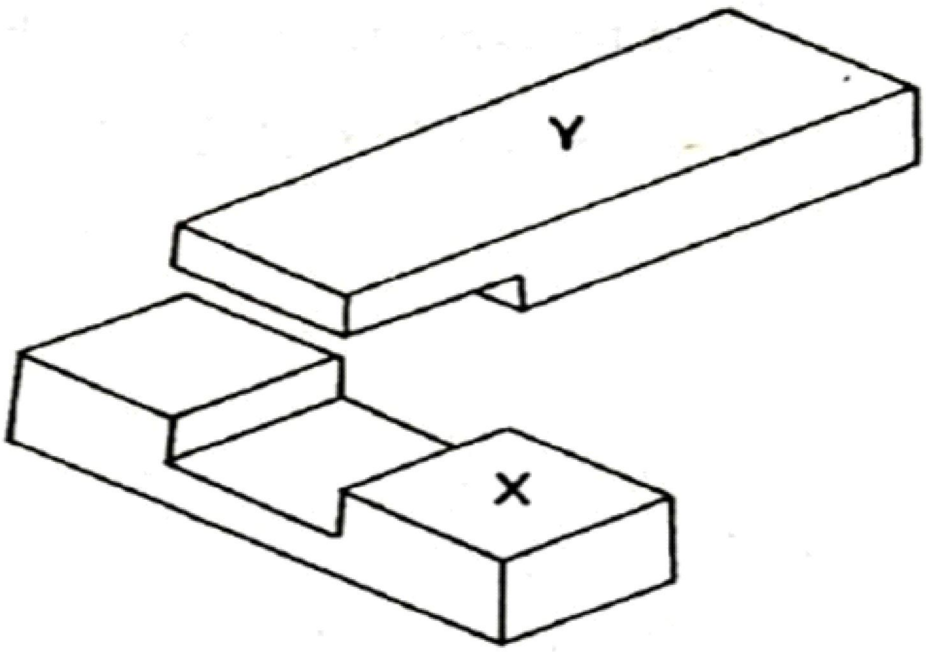
Pincer



Claw Hammer



Marking Gauge



T-lap Joint

QUESTIONS

1. What is the sequence of operations in carpentry shop?

2. Name some measuring tools?

3. What is the use of marking gauge?

4. What is the use of the Anvil?

5. What is the use of try square?

6. What are the various types of joints?

7. What is the difference between marking gauge and mortise gauge?

8. What is the use of claw hammer?

9. Which safety precautions should be taken in carpentry shop?

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EXPERIMENT NO. 22

T- BRIDLE JOINT

AIM

To prepare a T- bridle Joint as per given dimensions.

MATERIALS USED

Shorea wood 115mm X 45mm X 45mm.

APPARATUS USED

1. Steel rule
2. Mortise Chisel
3. Wooden jack plane
4. Try square
5. Marking gauge
6. Carpenter's vice
7. Tenon saw
8. Claw hammer.

INTRODUCTION

Bridle Joint:

This joint is the reverse of mortise and tenon joint in form and often called as the open mortise tenon joint. These joints are used where the members are of square or near square section and thus unsuitable for making a mortise and tenon joint of good proportions.

Try Square: Try squares are used for marking and testing of right angles and for testing flatness of surface.

Marking Gauge:

It is a tool which has one projected marking pin which is used to mark accurate lines parallel to the true edge of a wooden piece.

Mortise Chisel:

It is used for cutting mortises and chipping inside holes, etc. The cross section of the mortise chisel is proportioned to withstand heavy blows during mortising. Further, the cross section is made stronger near the shank.

Sequence of Operations:

1. Marking
2. Planning
3. Cutting
4. Mortising and Tenoning
5. Setting

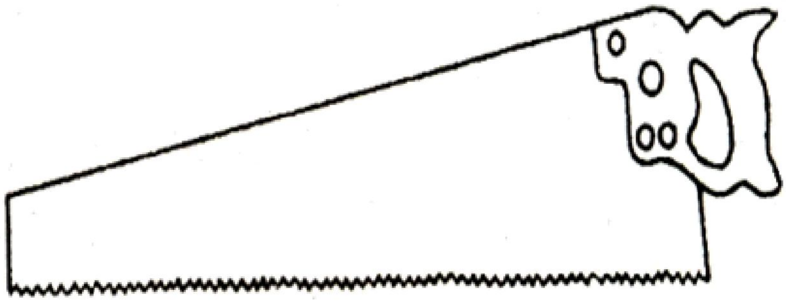
PROCEDURE

1. The given wooden piece is checked to ensure its correct size.
2. The piece is firmly clamped in the carpenter's vice and any two adjacent faces are planned by the jack plane and the two faces are checked for squareness with the try square.
3. Marking gauge is set and lines are drawn at 15 and 30 mm, to mark the thickness and width of the model respectively.
4. The excess material is first chiselled out with firmer chisel and then planed to correct size.
5. The mating dimensions of the parts X and Y are then marked using scale and marking gauge.
6. Using the cross cut saw, the portions to be removed are cut in both the pieces, followed by chiselling and also the parts X and Y are separated by cross cutting, using the tenon saw.
7. The material to be removed in part X (Open mortise) is carried out by using the mortise and firmer chisels.
8. The two work pieces are fitted to make a slightly tight T-Bridle Joint as per drawing.

SAFETY PRECAUTION

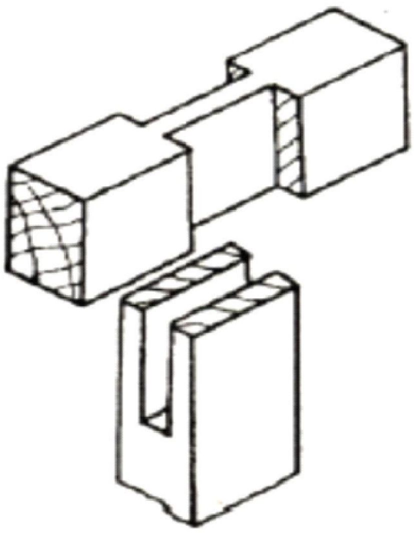
1. Start the sawing out side marking lines.
2. Tools which are not being used should always be kept in their respective places. They should not be allowed to scatter on the work place or bench.
3. While using chisels, lake care that cutting is performed in the direction away from your body.
4. The tools should always be kept well sharpened since a blunt or dull tool is apt to slip and cause injury.
5. Boards and other wooden pieces carrying nails should never be allowed to remain on the floor, other wise any body may unknowingly step on to them and the foot may be injured.
6. No machine should operated without the permission of the shop incharge.
7. While working on a circular saw, always avoid standing in a line with the plane of the rotating blade and always keep your hands at a distance from the blade.
8. Before starting cutting, allow the saw to attain the full speed.
9. The shop floor should always be kept well sharpened since a blunt or dull tool is apt to slip and cause injury.

DIAGRAM



Cross Cut Saw

Mortise Chisel



Try Square

T- Bridle Joint

CONCLUSION

QUESTIONS

1. Name some Marking tools.

2. What is the use of Mortise Chisel?

3. Why Bridle joint is also called as Open Mortise joint?

4. What is the use of Pincer?

5. What is the use of Divider?

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6. Out of Lap Joint or Bridle Joint which joint is stronger?

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EXPERIMENT NO. 23
CONSTRUCT A MOULD CAVITY

AIM
To construct a mould cavity by using the given pattern.

MATERIALS USED
Pattern of the object, silica sand, binders, water etc.

APPARATUS USED
1. Moulding Flask
2. Shovel
3. Hand Riddle
4. Trowel
5. Reamers
6. Strike-off bar
7. Vent wire
8. Slick
9. Lifter
10. Bellow
11. Draw Screws
12. Mallet

INTRODUCTION

Flask
It is a metallic or wooden frame, without fixed top or bottom, in which the mould is formed. Depending upon the position of the flask in the moulding structure, it is referred to by various names such as drag – lower moulding flask, cope – upper moulding flask, cheek – intermediate moulding flask used in three piece moulding.

Pattern
It is the replica of the final object to be made. The mould cavity is made with the help of pattern.

Parting line
This is the dividing line between the two moulding flasks that makes up the mould.

Moulding sand
Sand, which binds strongly without losing its permeability to air or gases. It is a mixture of silica sand, clay, and moisture in appropriate proportions.

Facing sand
The small amount of carbonaceous material sprinkled on the inner surface of the mould cavity to give a better surface finish to the castings.

Core
A separate part of the mould, made of sand and generally baked, which is used to create openings and various shaped cavities in the castings.

Pouring basin
A small funnel shaped cavity at the top of the mould into which the molten metal is poured.

Sprue
It is the passage through which the molten metal, from the pouring basin, reaches the mould cavity. In many cases it controls the flow of melted metal into the mould.

Runner
It is the channel through which the molten metal is carried from the sprue to the gate.

Gate
It is a channel through which the molten metal enters the mould cavity.

Chaplets
Chaplets are used to support the cores inside the mould cavity to take care of its own weight.

Riser
A column of molten metal placed in the mould to feed the castings as it shrinks and solidifies.

Vent
It is a small opening in the mould to facilitate escape of air and gases.

PROCEDURE

1. The first step in making a mould is to place the pattern on the moulding board.

2. The drag is placed on the board.

3. Dry facing sand is sprinkled over the board and pattern to provide a non sticky layer.

4. Moulding sand is then riddled in to cover the pattern with the fingers; then the drag is completely filled.

5. The sand is then firmly packed in the drag by means of hand reamer. The ramming must be proper i.e. it must neither be too hard or soft.

6. After the ramming is over, the excess sand is levelled off with a straight bar known as a strike off bar.

7. With the help of vent wire, vent holes are made in the drag to the full depth of the flask as well as to the pattern to facilitate the removal of gases during pouring and solidification.

8. The finished drag flask is now rolled over to the bottom board exposing the pattern.

9. Cope half of the pattern is then placed over the drag pattern with the help of locating pins. The cope flask on the drag is located aligning again with the help of pins.

10. The dry parting sand is sprinkled all over the drag and on the pattern.

11. A sprue pin for making the sprue passage is located at a small distance from the pattern.

12. The operation of filling, ramming and venting of the cope proceed in the same manner as performed in the drag.

13. The sprue and riser pins are removed first and a pouring basin is scooped out at the top to pour the liquid metal.

14. Then pattern from the cope and drag is removed and facing sand in the form of paste is applied all over the mould cavity and runners which would give the casting a good surface finish.

15. The mould is now assembled. Which is ready for pouring.

SAFETY PRECAUTION

1. Moulding flask should be kept in neat & Dry place.

2. The pattern should be uniformly pressed.

3. The moulding sand should be riddled before using.

4. The facing sand should be uniformly spreaded over the surface of mould cavity.

5. Always use particular instruments for the experiment.

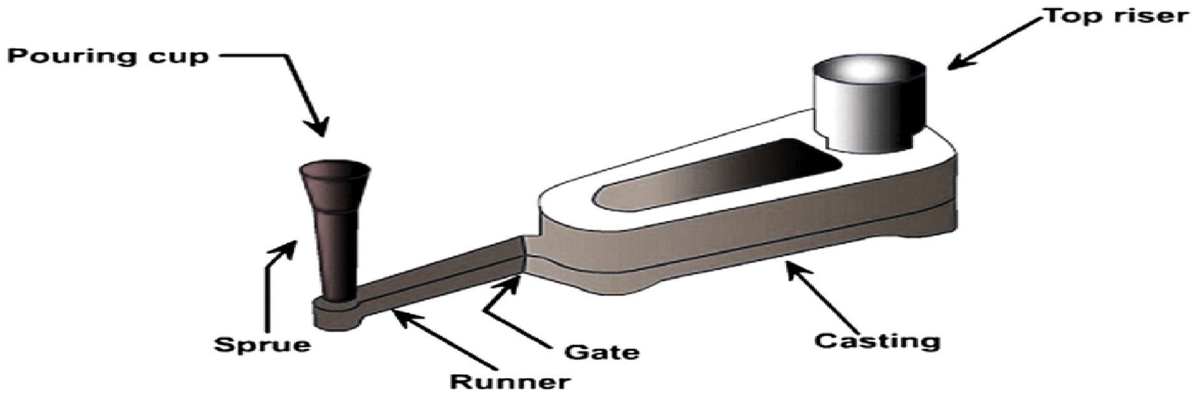
6. The instrument should be checked before use.

7. The using pattern must be handle by which it is to be lifted.

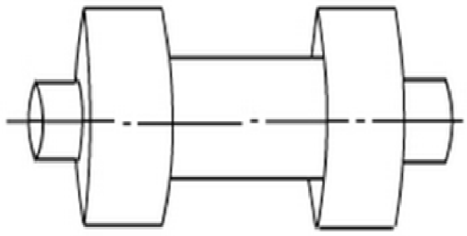
8. Make sure that water is placed at a distance from the mould and cavity.

9. Always put off your tie, ring, watches, bangles while doing any experiment.

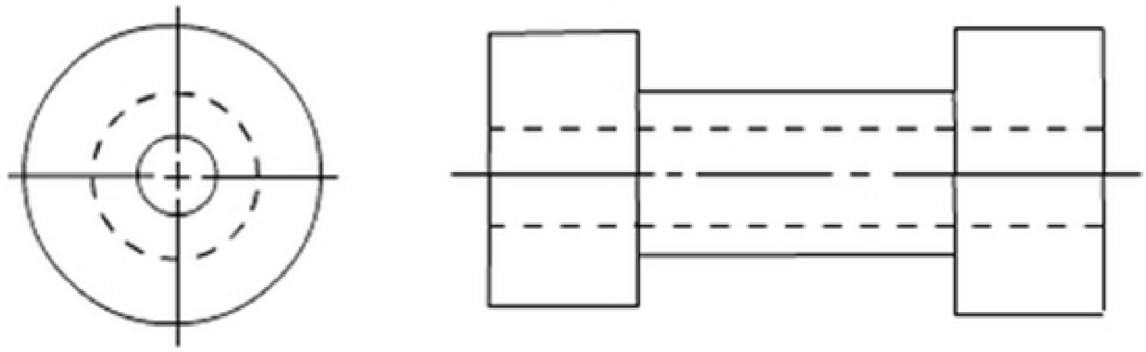
DIAGRAM



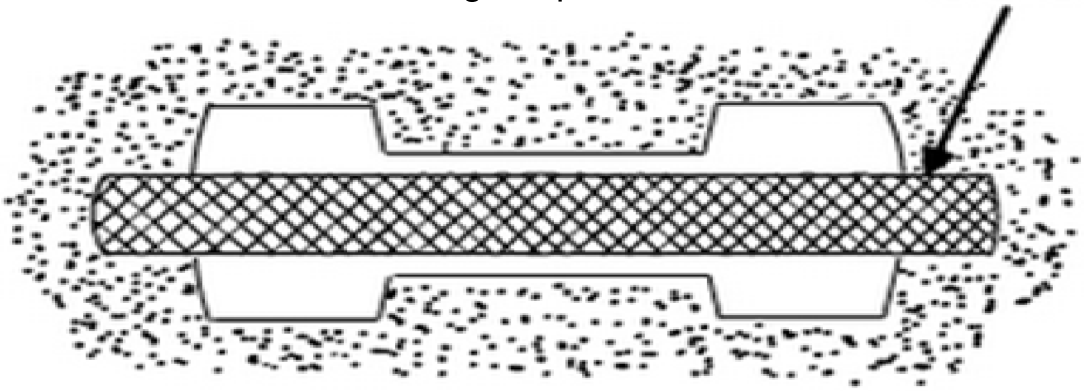
Basic parts of a Mould Cavity



Pattern



Moulding Preparation



Mould

CONCLUSION

QUESTIONS

1. Define the term “Foundry”?

2. What is the use of the vent wire?

3. What is the difference between casting and moulding?

4. Why cores are used in the foundry shop?

5. Define the term “Pattern”?

6. Name any six tools used in the foundry shop?

7. Name the three parts of any moulding flask?

8. Why sprue is made in the cavity?

9. What do you mean by the term “gate”?

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EXPERIMENT NO. 24
CASTING OF A SIMPLE PATTERN

AIM
To prepare a casting of a simple pattern by using Aluminium

MATERIALS USED
Plaster of Paris, Pattern of the object, silica sand, binders, water etc.

APPARATUS USED
1. Moulding Flask
2. Shovel
3. Hand Riddle
4. Trowel
5. Hammer
6. Strike-off bar
7. Vent wire
8. Slick
9. Lifter
10. Bellow
11. Draw Screws
12. Mallet
13. Crucible
14. Bull Ladle

INTRODUCTION
Casting Process
Casting means pouring molten metal into a mould with a cavity of the shape to be made, and allowing it to solidify. When solidified, the desired metal object is taken out from the mould either by breaking the mould or taking the mould apart. The solidified object is called the casting.

Casting Defects

Cut and washes
These appear as rough spots and areas of excess metal which are caused by erosion of moulding sand by the flowing metal. This is caused by the moulding sand not having enough strength and the molten metal flowing at high velocity.

Metal penetration
When molten metal enters into the gaps between sand grains, the result is a rough casting surface. This occurs because the sand is coarse or no mould wash was applied on the surface of the mould. The coarser the sand grains more the metal penetration.

Fusion
This is caused by the fusion of the sand grains with the molten metal, giving a brittle, glassy appearance on the casting surface.

Swell

Under the influence of forces, the mould wall may move back causing a swell in the dimension of the casting. A proper ramming of the mould will correct this defect.

Mis-runs

A mis-run is caused when the metal is unable to fill the mould cavity completely and thus leaves unfilled cavities. A mis-run results when the metal is too cold to flow to the extremities of the mould cavity before freezing. Long, thin sections are subject to this defect and should be avoided in casting design.

Cold Shut

A cold shut is caused when two streams while meeting in the mould cavity, do not fuse together properly thus forming a discontinuity in the casting. The mis-run and cold shut defects are caused either by a lower fluidity of the mould or when the section thickness of the casting is very small.

Mould Shift

The mould shift defect occurs when cope and drag or moulding boxes have not been properly aligned.

PROCEDURE

1. The first step in making mould is to place the pattern on the moulding board.

2. Moulding sand is then riddled in to cover the pattern with the fingers; then the drag is completely filled.

3. The sand is then firmly packed in the drag by means of hand reamers. The ramming must be proper i.e. it must neither be too hard or soft.

4. After the ramming is over, the excess sand is levelled off with a straight bar known as a strike off bar.

5. With the help of vent wire, vent holes are made in the drag to the full depth of the flask as well as to the pattern to facilitate the removal of gases during pouring and solidification.

6. Cope half of the pattern is then placed over the drag pattern with the help of locating pins. The cope flask on the drag is located aligning again with the help of pins.

7. A sprue pin for making the sprue passage is located at a small distance from the pattern.

8. The operation of filling, ramming and venting of the cope proceed in the same manner as performed in the drag.

9. The sprue and riser pins are removed first and a pouring basin is scooped out at the top to pour the liquid metal.

10. Then pattern from the cope and drag is removed and facing sand in the form of paste is applied all over the mould cavity and runners which would give the finished casting a good surface finish.

11. Then all material 's with in appropriate amount with aluminium is put in the crucible and then heated upto 660.3^{0}C.

12. Afterwards the mixture formed is poured slowly in the mould cavity with the help of bull ladle.

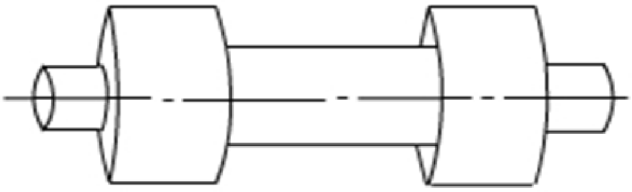
13. The pouring process should be continuous and No time lapse should be there.

SAFETY PRECAUTION

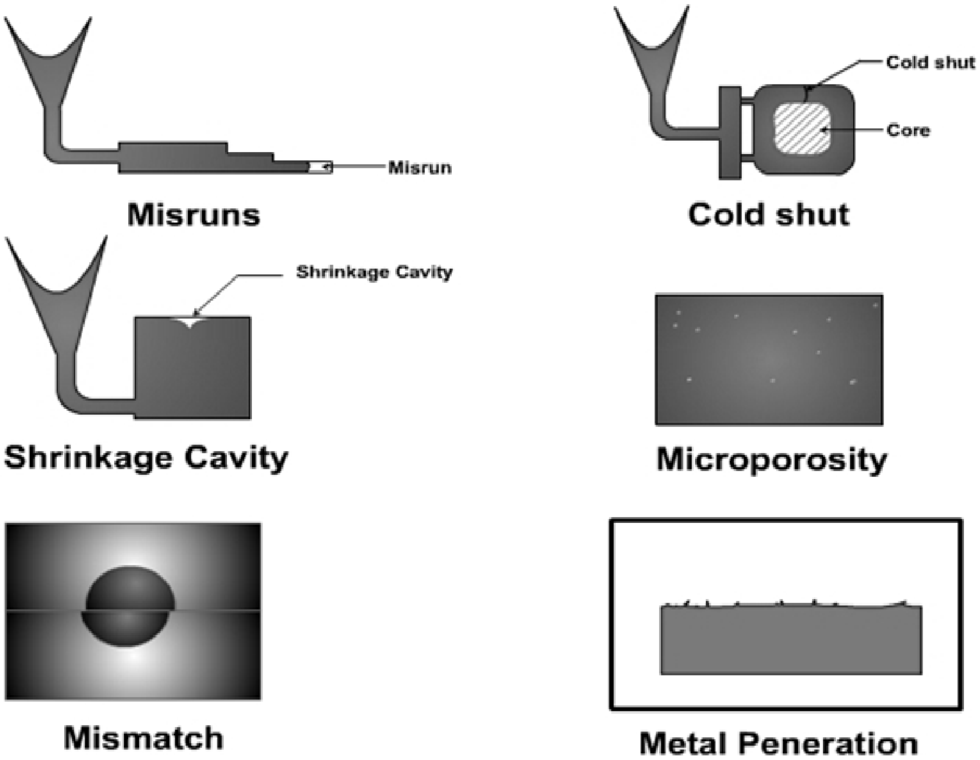
1. The surrounding should be neat and clean.
2. Crucible must be dried before the process.
3. No water should be present while performing the experiment.
4. We should wear leather shoes and leather gloves while performing the experiment.
5. Thus like rings, waters and ties must be removed before performing the experiment.
6. Heat up-the ladles before use.
7. Pouring should be continuous without any break.
8. Practical should be performed away from public place.

CONCLUSION

DIAGRAM



Casting of the given Pattern



Casting Defects

QUESTIONS

1. Define the term “Casting”?

2. What is the use of the Crucible?

3. Define the term “Mismatch”?

4. Why Riser is made in the cavity?

5. State the difference between gate and runner?

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EXPERIMENT NO. 25
BUTT JOINT USING MILD STEEL

AIM
To prepare a Butt Joint using mild steel pieces as per given dimensions by using Electric Arc Welding.

MATERIALS USED
Mild Steel plates: 50mm X 40mm X 5mm, 2 nos.
Mild Steel electrode Diameter = 3.15mm

APPARATUS USED
1. Arc welding machine
2. Mild steel electrodes
3. Electrode holder
4. Ground clamp
5. Flat nose Tong
6. Face shield
7. Apron
8. Hand gloves
9. Metallic work Table
10. Try square
11. Steel rule
12. Wire brush
13. Chipping hammer
14. Grinding machine

INTRODUCTION
Arc Welding
In arc welding, the heat required for joining the metals is obtained from an electric arc. Transformers or motor generator sets are used as arc welding machines. These machines supply high electric currents at low voltages and an electrode is used to produce the necessary arc. The coated electrode serves as the filler rod and arc melts the surfaces so that the metals to be joined are actually fused together. In addition to the welding machine, the various accessories and tools which are needed for carrying out the welding work are given above. The diagram on front page shows the principle of Arc Welding using a transformer.

The Butt Joint
It is used to join the ends or edges of two plates or surfaces located approximately in the same plane with each other.

Electrode Holder
The electrode holder is connected to the end of the welding cable and holds the electrode. It should be light, strong, easy to handle and should not become hot while in operation. The jaws of the holder are insulated, offering protection from electric shock.

Wire Brush
A wire brush is used for cleaning and preparing the work piece before and after the welding.

Welding Table
It is made of steel plate and pipes. It is used for positioning the parts to be welded properly.

Face Shield
A face shield is used to protect the eyes and face from the rays of the arc and from spatter or flying particles of hot metal. It is available in hand or helmet type. The hand type is preferred to use and they are made of light weight, non reflecting fibre fitted with dark glass.

Hand Gloves
Hand gloves are used for protecting the arms while welding form sparks and from current.

Flat Tong
A flat tong is used for holding works of rectangular shape during welding and after welding.

Chipping Hammer
It is made of tool steel and is used for removing slag formation on welds. One end of the head is sharpened like a cold chisel and the other end to a blunt, round point.

PROCEDURE

1. Take the two mild steel pieces of given dimensions and clean the surfaces thoroughly from rust, dust particles, oil and grease.

2. Remove the sharp corners and burrs by filing or grinding.

3. The two pieces are positioned on the welding table such that, they are separated slightly for better penetration of the weld.

4. The electrode is fitted in to the electrode holder and the welding current is set to a proper value.

5. The ground clamp is fastened to the welding table. The machine is switched ON.

6. Wearing the apron, hand gloves, using the face shield, the arc is struck and the work pieces are tack welded at the ends and holding the two pieces together; first run of the weld is done to fill the root gap.

7. Second run of the welding is done with uniform movement. During the process of welding, the electrode is kept at angle of 15° to 25° from vertical and in the direction of welding.

8. The slag formation on the weld is removed by chipping hammer.

9. Filing is done to remove spatters around the weld.

SAFETY PRECAUTION

1. Always use goggles when welding or cutting.

2. Use aprons and gloves.

3. Do not point the flame towards the regulators and another person.

4. When finished welding shut off the main valves, bleed the lines and loosen the regulator adjusting screws.

5. Wind up the hoses when finished shutting everything off.

6. Do not turn acetylene valve more than 1.5 turns.

7. Never use oil near oxygen equipment.

8. Threads used for acetylene are LEFT-HANDED.

9. Threads used for acetylene are RIGHT-HANDED.

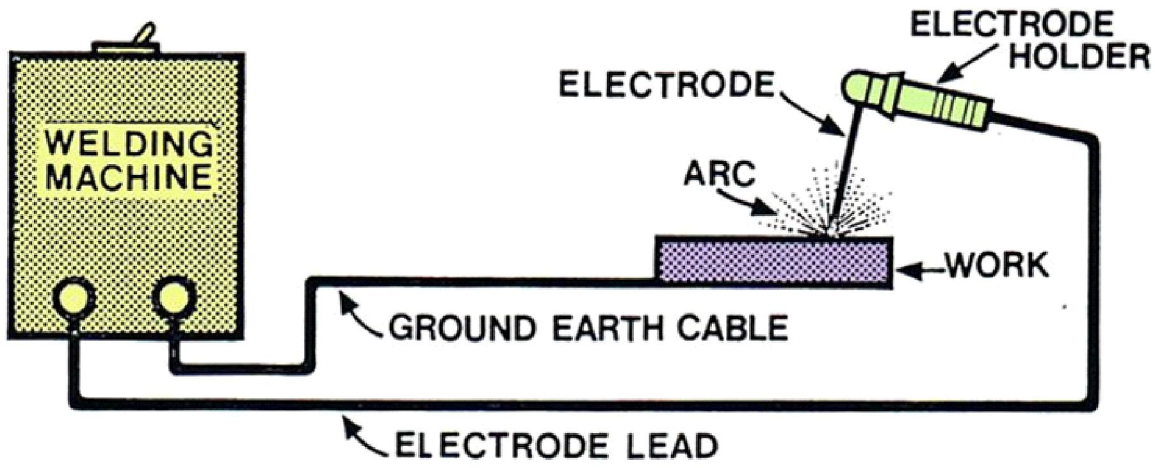
10. There will be horseplay.

CONCLUSION

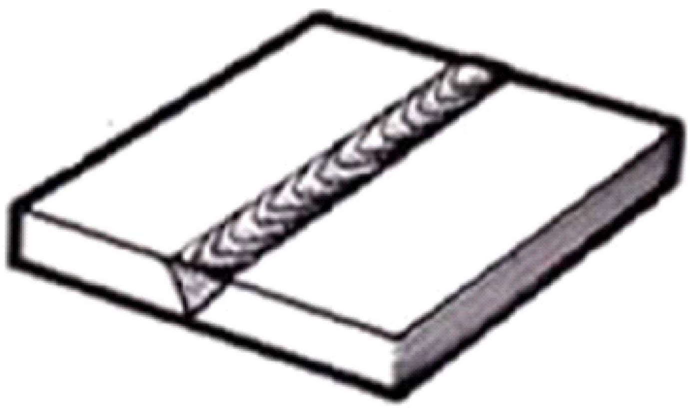
RESULT

In this way we get the required welding joint.

DIAGRAM



ARC WELDING SETUP



BUTT JOINT

QUESTIONS

1. Define the term “flux”?

2. What is the use of “chipping hammer”?

3. Distinguish between the terms “lap joint and butt joint”?

4. What is the use of the Anvil?

5. State the difference between face shield and hand shield?

6. What is the difference between AC and DC welding transformer?

7. Name any six tools/equipments used in the welding shop?

8. Which flux material was present on the welding electrode?

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EXPERIMENT NO. 26
DOUBLE LAP JOINT

AIM

To make a double lap joint, using the given mild steel pieces by Electric arc welding.

MATERIALS USED

Mild Steel plates: 50mm X 40mm X 5mm, 2 nos.
Mild Steel electrode Diameter = 3.15mm

APPARATUS USED

1. Arc welding machine
2. Electrode holder
3. Face shield
4. Apron
5. Hand gloves
6. Metallic work Table
7. Steel rule
8. Wire brush
9. Chipping hammer
10. Grinding machine.

INTRODUCTION

Sequence of Operations

1. Cleaning the work pieces
2. Marking
3. Tack welding
4. Full welding
5. Cooling
6. Chipping
7. Finishing

Arc Welding

In arc welding, the heat required for joining the metals is obtained from an electric arc. Transformers or motor generator sets are used as arc welding machines. These machines supply high electric currents at low voltages and an electrode is used to produce the necessary arc. The coated electrode serves as the filler rod and arc melts the surfaces so that the metals to be joined are actually fused together.

Flat position welding

In this position, the welding is performed from the upper side of the joint, and the face of the weld is approximately horizontal. Flat welding is the preferred term; however, the same position is sometimes called down hand welding.

Horizontal position welding

In this position, welding is performed on the upper side of an approximately horizontal surface and against an approximately vertical surface.

Vertical position welding
In this position, the axis of the weld is approximately vertical as shown in diagram.

Overhead position welding
In this welding position, the welding is performed from the underside of a joint.

PROCEDURE
1. Take the two mild steel pieces of given dimensions and clean the surfaces thoroughly from rust, dust particles, oil and grease.
2. Remove the sharp corners and burrs by filing or grinding and prepare the work pieces.
3. The work pieces are positioned on the welding table, to form a lap joint with the required over lapping.
4. The electrode is fitted in to the electrode holder and the welding current is set to a proper value.
5. The ground clamp is fastened to the welding table.
6. Wearing the apron, hand gloves, using the face shield and holding the over lapped pieces the arc is struck and the work pieces are tack welded at the ends of both the sides.
7. The alignment of the lap joint is checked and the tack welded pieces are reset, if required.
8. Welding is then carried out throughout the length of the lap joint, on both the sides.
9. Remove the slag, spatters and clean the joint.

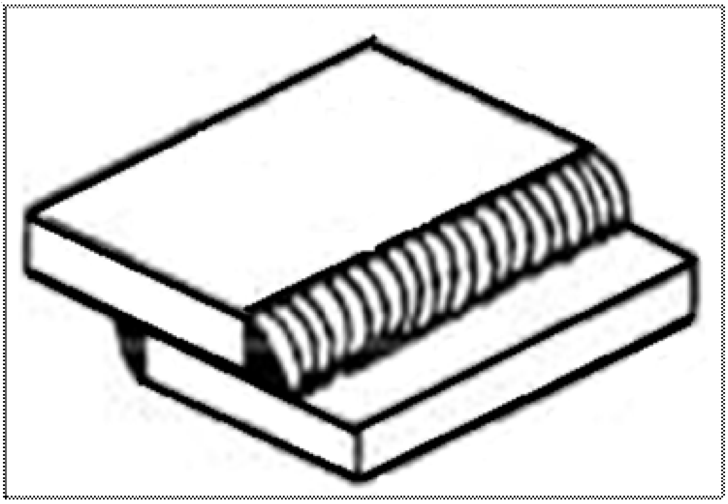
SAFETY PRECAUTION
1. Always use goggles when welding or cutting.
2. Use aprons and gloves.
3. Do not point the flame towards the regulators and another person.
4. When finished welding shut off the main valves, bleed the lines and loosen the regulator adjusting screws.
5. Wind up the hoses when finished shutting everything off.
6. Do not turn acetylene valve more than 1.5 turns.
7. Never use oil near oxygen equipment.
8. Threads used for acetylene are LEFT-HANDED.
9. Threads used for acetylene are RIGHT-HANDED.
10. There will be horseplay.

CONCLUSION

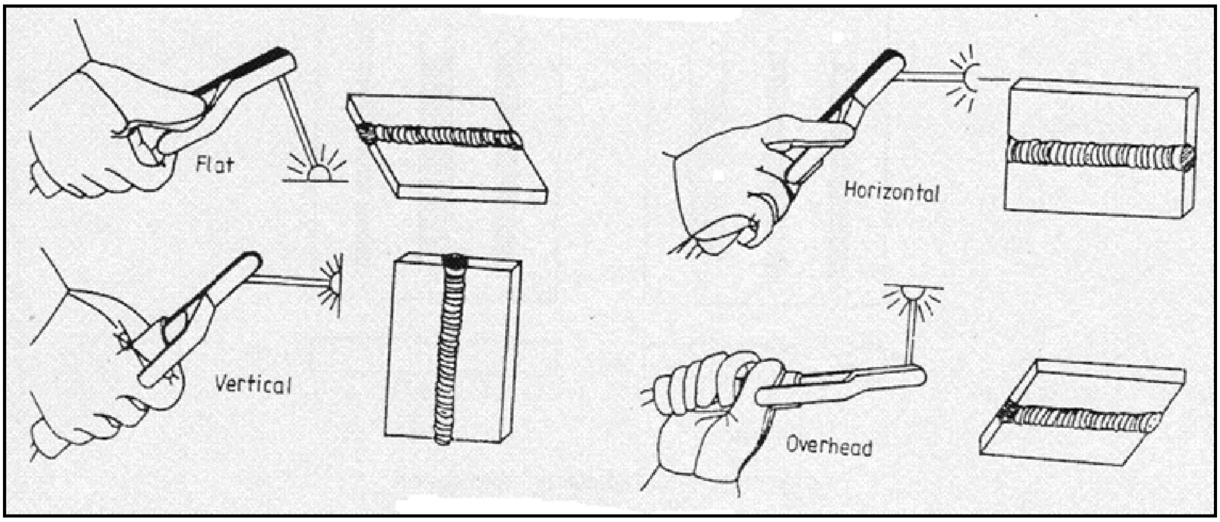
RESULT

In this way we get the required welding joint.

DIAGRAM



Double Lap joint



Welding Positions

QUESTIONS

1. What is the main aim to use the electrode?

2. While performing electric arc welding which safety device is used in order to protect your eyes from sparks?

3. Write down the sequence of operations in welding?

4. How slag is removed?

5. What is the difference between butt joint and lap joint?

6. Which material is coated on electrode?

7. What type of electricity is used in arc welding?

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EXPERIMENT NO. 27
LAP JOINT

AIM
To make a lap joint, using the given mild steel pieces by using Oxy-Acetylene welding

MATERIALS USED
Mild Steel plates: 50mm X 40mm X 5mm, 2 nos.

APPARATUS USED
1. Oxy-Acetylene welding
2. Welding Torch
3. Face shield
4. Apron
5. Hand gloves
6. Steel rule
7. Wire brush
8. Chipping hammer
9. Grinding machine

SEQUENCE OF OPERATIONS
1. Cleaning the work pieces
2. Marking
3. Gas Welding
4. Cooling
5. Chipping
6. Finishing

INTRODUCTION
Oxy-Acetylene Welding
The oxyacetylene welding process uses a combination of oxygen and acetylene gas at extremely high pressure to provide a high temperature flame. Acetylene cylinders should always be stored in the upright position to prevent the acetone form escaping thus causing the acetylene to become unstable.

Neutral Flame
The neutral flame is produced when the ratio of oxygen to acetylene, in the mixture leaving the torch, is almost exactly one-to-one. It’s termed neutral” because it will usually have no chemical effect on the metal being welded. It will not oxidize the weld metal; it will not cause an increase in the carbon content of the weld metal.

Carburizing Flame
The excess acetylene flame as its name implies, is created when the proportion of acetylene in the mixture is higher than that required to produce the neutral flame. Used on steel, it will cause an increase in the carbon content of the weld metal.

Oxidizing Flame

The oxidizing flame results from burning a mixture which contains more oxygen than required for a neutral flame. It will oxidize or”burn” some of the metal being welded.

PROCEDURE

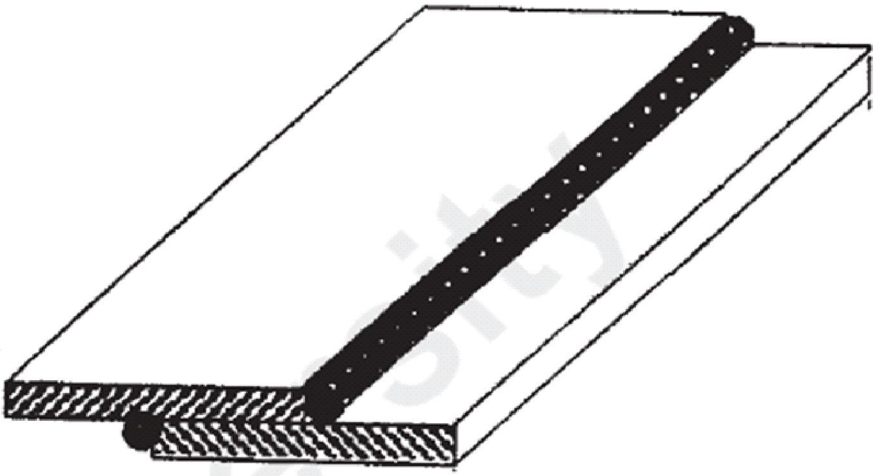
1. Take the two mild steel pieces of given dimensions and clean the surfaces thoroughly from rust, dust particles, oil and grease.
2. Remove the sharp corners and burrs by filing or grinding and prepare the work pieces.
3. The work pieces are positioned on the welding table, to form a lap joint with the required over lapping.
4. Remove the slag, spatters and clean the joint.

SAFETY PRECAUTION

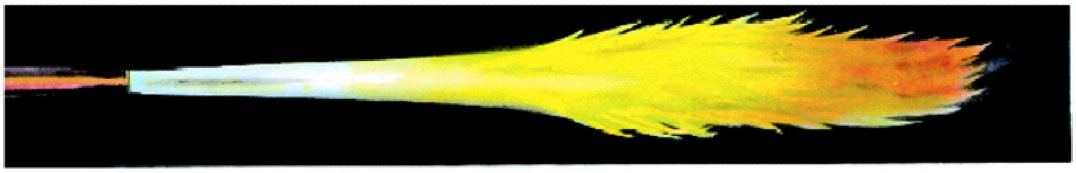
1. Never use a match box for lighting a torch in gas welding.
2. Acetylene cylinder must always be kept upright.
3. Cylinder should not be exposed to welding flame, direct sunlight, water etc.
4. Cylinders should be stored in a well protected, well ventilated and well away from highly combustible materials.
5. Smokers should not smoke at the place where gas cylinders have been stored.
6. An acetylene cylinder valve shall not be opened more than 1.5 turns of the spindle.
7. Gas holes must be clean, smooth and correct size.
8. Use the correct color hose for oxygen (Green/Black) and acetylene (Red).

CONCLUSION

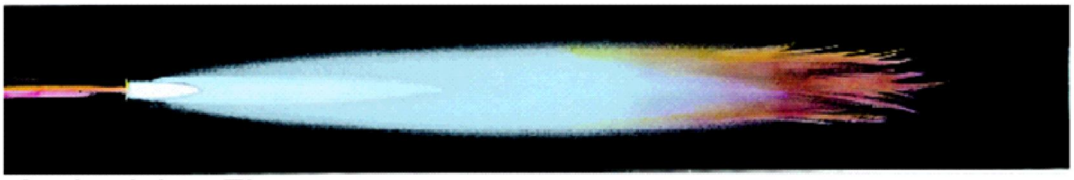
DIAGRAM



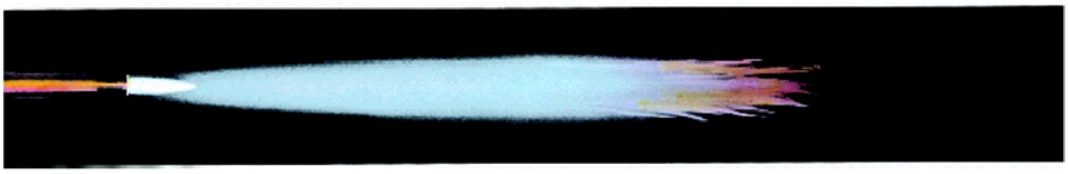
Lap joint



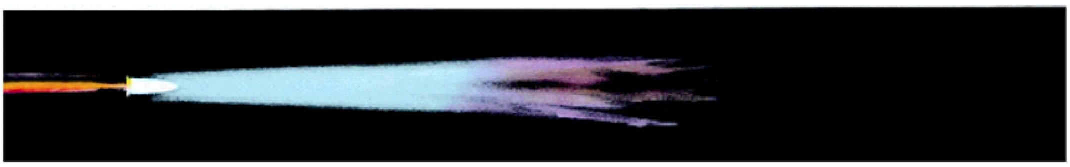
Acetylene Burning in Atmosphere
Open fuel gas valve until smoke clears from flame.



Carburizing Flame
(Excess acetylene with oxygen.) Used for hard-facing and welding white metal.



Neutral Flame
(Acetylene and oxygen.) Temperature 5589°F (3087°C). For fusion welding of steel and cast iron.



Oxidizing Flame
(Acetylene and excess oxygen.) For braze welding with bronze rod.

QUESTIONS

1. Define the term "Flux".

2. What do you mean by Oxy-Acetylene welding?

3. State the difference between oxidizing and carburizing flame.

4. What are the various parts of a flame?

5. What is the average temperature of the cone of the flame?

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EXPERIMENT NO. 28
LATHE MACHINE

AIM
To make a job with specified dimensions on Lathe machine with step turning and chamfering operations.

MATERIALS USED
Mild steel round bar, length = 105 mm, Diameter = 30 mm.

APPARATUS USED
1. Lathe machine
2. Cutting tool
3. Chuck key
4. Steel rule
5. Vernier calliper

SEQUENCE OF OPERATIONS
1. Facing
2. Turning
3. Step Turning
4. Chamfering

INTRODUCTION
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 gearing 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 taper to receive the dead centre that supports the work. Drills, reamers, taps may also be fitted into the spindle, for performing operations such 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 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.

Compound Rest
It supports the tool post. By swivelling 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 feeding or for cutting threads.

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

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

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

SEQUENCE OF OPERATIONS
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.

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. For turning long work, first it should be faced and centre drilled at one end and then supported by means of the tail stock centre.

Step Turning
Step turning is the operation of creating various cylindrical cross sections on a metal piece.

Chamfering
It is the operation of bevelling 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.

PROCEDURE
1. The given work piece is held in the 3 jaw chuck of the lathe machine and tightened firmly with chuck key.
2. Right hand single point cutting tool is taken tightened firmly with the help of box key in the tool post.

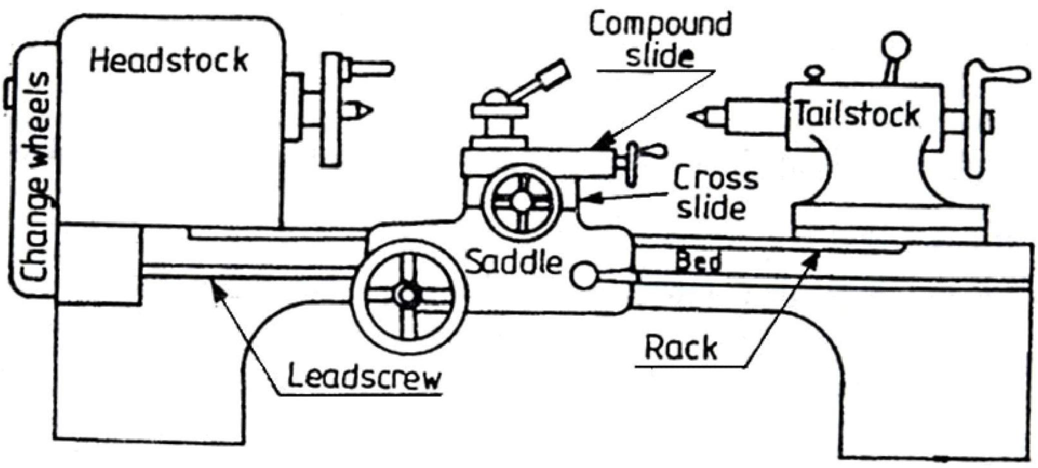
3. Machine is switched on and the tool post is swivelled and the cutting point is adjusted such that it positioned approximately for facing operation then the tool is fed into the work piece and the tool post is given the transverse movement by rotating the hand wheel of the cross slide.
4. With this facing is completed and the tool post is swivelled and cutting point is made parallel to the axis of work piece.
5. Depth of cut is given by cross slide to the tool post and the side hand wheel is rotated to give the longitudinal movement for the tool post and job is turned to the required length and diameters according to the sketch shown in figure.
6. After completion of the job it is inspected for the dimensions obtained with the help of steel rule and outside calliper or vernier calliper.

SAFETY PRECAUTION

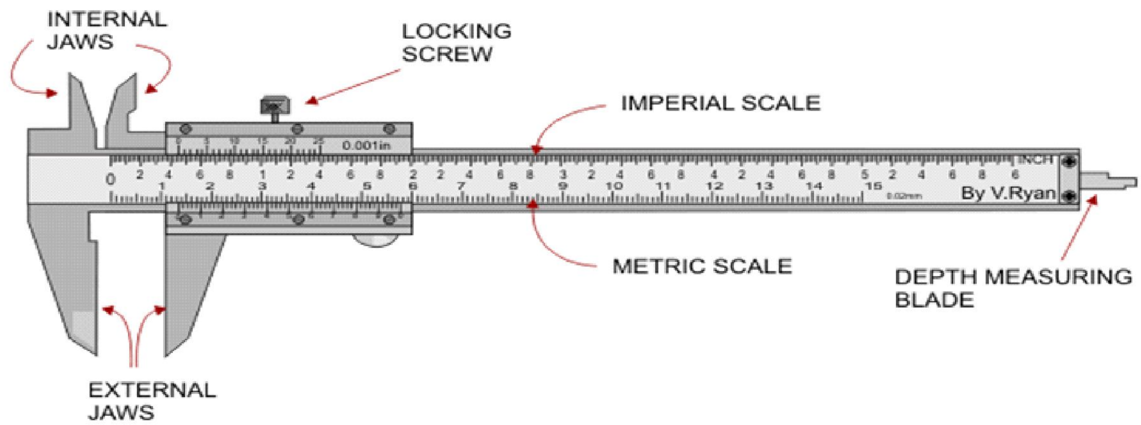
1. Chuck key is not lift in the chuck after tightening the job firmly.
2. Fold your shirt sleeves before starting the job.
3. Job tool and tool post should be tight firmly before starting any operation.
4. Don't stop the chuck by hand.
5. Always switch off the machine before leaving the machine.

CONCLUSION

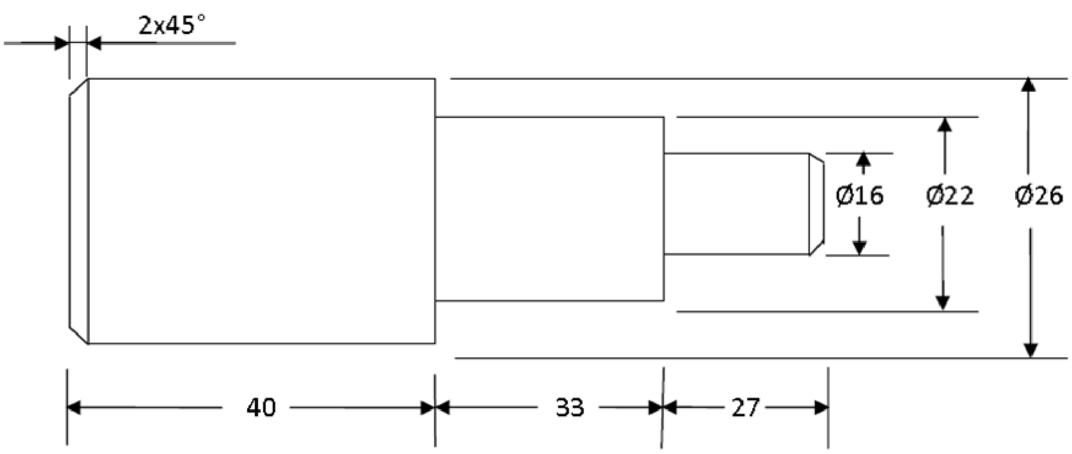
DIAGRAM



Parts of Lathe Machine



Vernier Calliper



Step Turning and Chamfering

QUESTIONS

1. Define the term “Machining”.

2. Why we use Vernier Calliper?

3. Write down all the parts of a Lathe Machine.

4. Define the term “Turning”.

5. What do you mean by Step Turning operation?

6. What is the difference between three-jaw chuck and four-jaw chuck?

7. Define the term “Chamfering”.

8. State the difference between live centre and dead centre.

9. What do you mean by “Head Stock”?

10. Define Tail Stock.

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EXPERIMENT NO. 29
FILING OPERATION

AIM
To finish the two sides of a square piece by filing operation.

MATERIALS USED
Mild steel plate 50mm *50mm * 5mm.

APPARATUS USED
1. Bench vice
2. Set of Files
3. Steel rule
4. Try square
5. Scriber
6. Surface plate
7. Anvil

INTRODUCTION
Filing
Filing is one of the methods of removing small amounts of material from the surface of a metal part by using a tool known as file.

File
A file is hardened steel having small parallel rows of cutting edges or teeth on its surfaces. On the faces, the teeth are usually diagonal to the edge. One end of the file is shaped to fit into a wooden handle.

PROCEDURE
1. The dimensions of the given piece are checked with the steel rule.
2. The job is fixed rigidly in a bench vice and the two adjacent sides are filed, using the rough flat file first and then the smooth flat file such that the two sides are at right angle.
3. The right angle of the two adjacent sides is checked with the try square.
4. The two sides are then filed by fitting the job in the bench vice followed by checking the flatness of the surfaces.

SAFETY PRECAUTION
1. Apply Pressure for filing in forward stroke only.
2. Do not keep file in the kit without cleaning after using it.
3. Do not use those files on brass which have been used on iron and steel.
4. While filing for the first time with a new file apply an even and light pressure otherwise the teeth may be broken during the operation.
5. Preferably in order to makes the teeth used to work use a new file on metals like gunmetal, bronze and brass etc.
6. Do not use new files for cleaning welds.
7. File the chilled surface of casting with an old file first before using a new file.

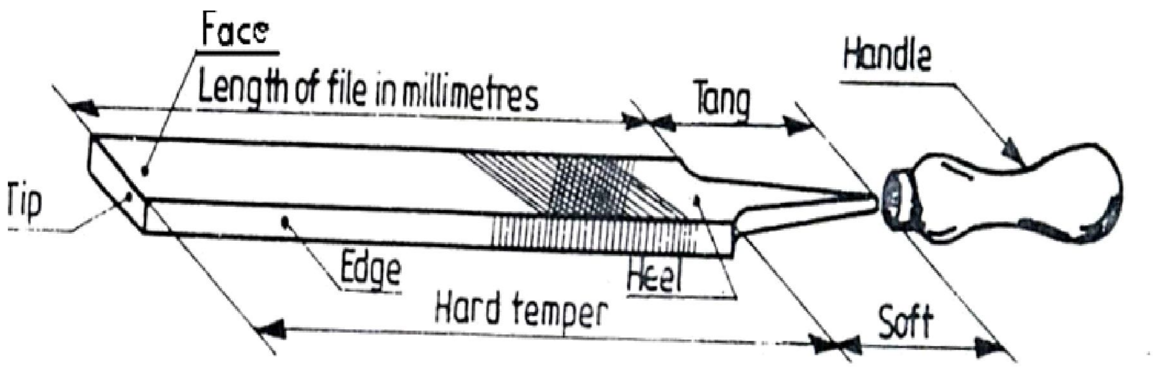
8. A second cut file gives better results in filing steel.
9. Use bastard file for heavy removal of metal and follow it with a 2nd cut or smooth file.
10. For general work in filing always use a second cut file.
11. Always use a 'safe edge' file for filing a work which has square corners.

NOTE

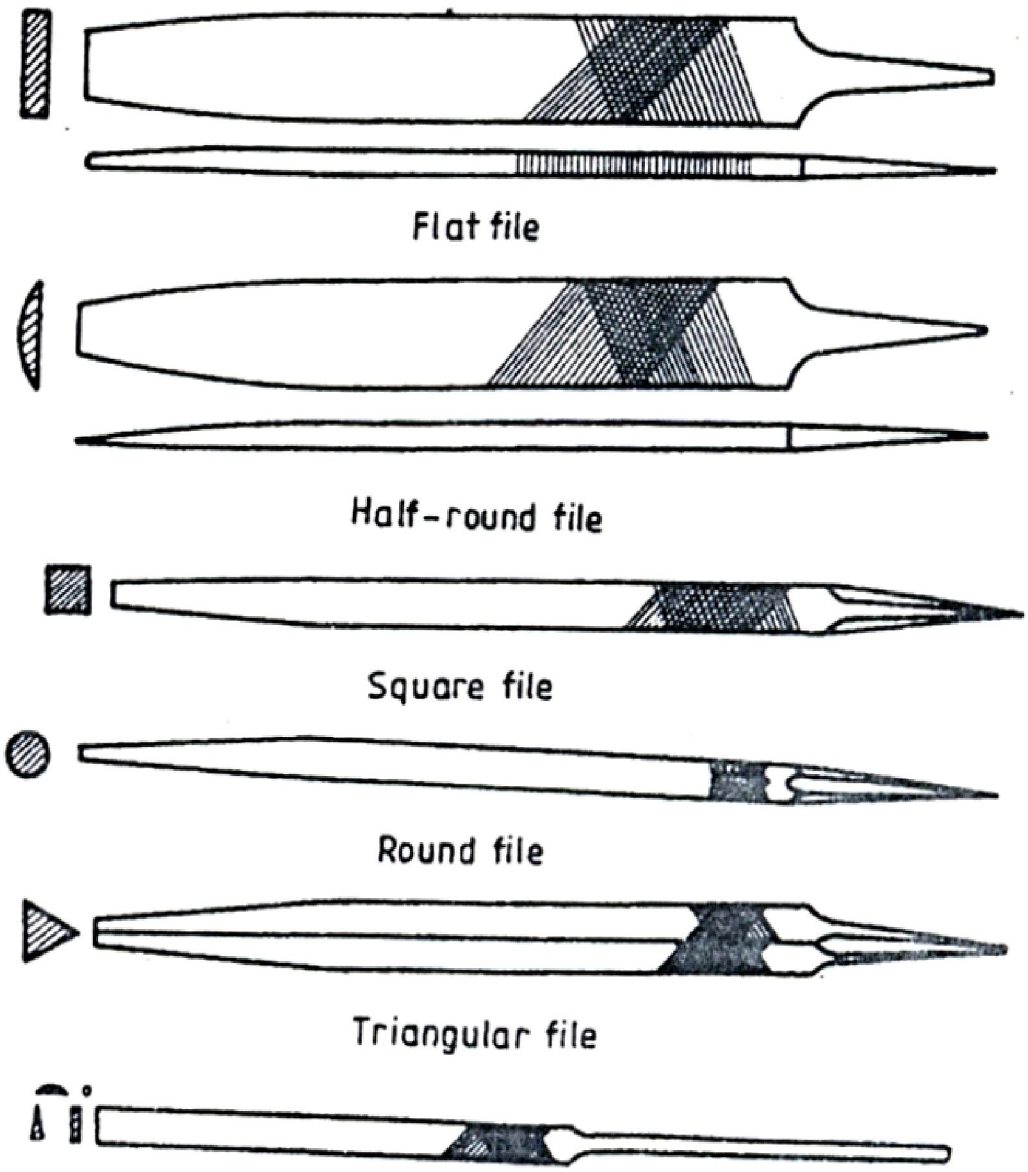
As the material removal through filing is relatively less, filing is done instead of sawing.

CONCLUSION

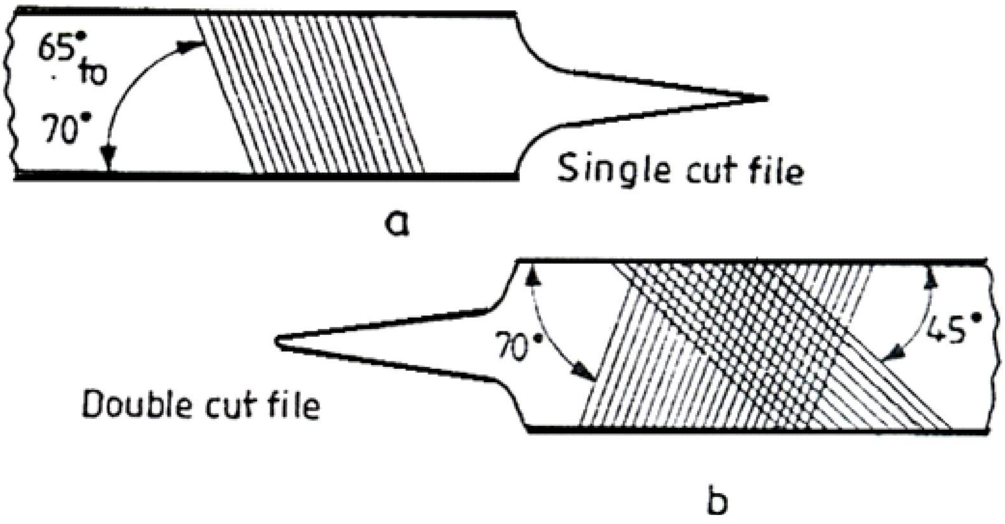
DIAGRAM



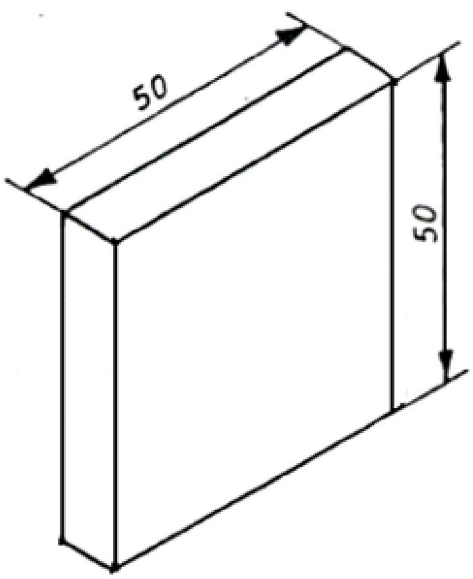
Parts of a hand file



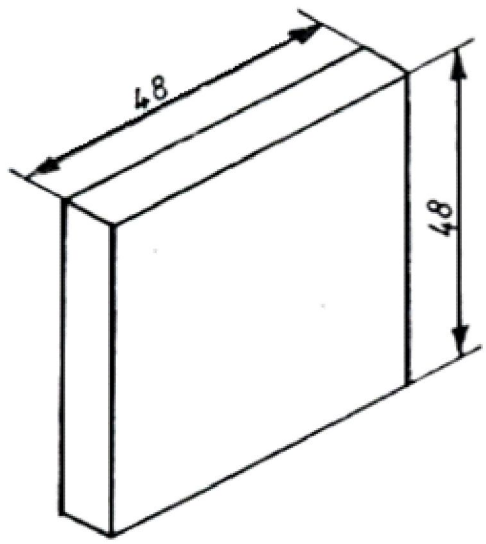
Types of Files



Single cut and double cut file



Raw Material



Finished Job

QUESTIONS

1. What is the use of surface plate?

2. What do you mean by filing operation?

3. State the difference between file and saw.

4. What are the various parts of a flat file?

5. Define the term “anvil”.

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EXPERIMENT NO. 30

SQUARE AND TRIANGULAR NOTCH USING HACKSAW

AIM

To cut a square and triangular notch using hacksaw and to drill three holes as per given PCD (Piitch circular dia) on given material.

MATERIALS USED

Mild steel round bar, length = 105 mm, Diameter = 30 mm.

APPARATUS USED

Mild steel plate 48mm *48mm * 5mm

SEQUENCE OF OPERATIONS

1. Bench vice
2. Set of Files
3. Try square
4. Scriber
5. Steel rule
6. Dot punch
7. Hacksaw
8. Surface plate
9. 5mm drill bit
10. M6 tap set with wrench
11. Anvil
12. Drilling machine

INTRODUCTION

Surface plate

The surface plate is machined to fine limits and is used for testing the flatness of the work piece. It is also used for marking out small box and is more precious than the marking table. The degree of the finished depends upon whether it is designed for bench work in a fitting shop or for using in an inspection room; the surface plate is made of Cast Iron, hardened Steel or Granite stone. It is specified by length, width, height and grade. Handles are provided on two opposite sides, to carry it while shifting from one place to another.

Punches

These are used for making indentations on the scribed lines, to make them visible clearly. These are made of high carbon steel. A punch is specified by its length and diameter (say as 150’ 12.5mm). It consists of a cylindrical knurled body, which is plain for some length at the top of it. At the other end, it is ground to a point. The tapered point of the punch is hardened over a length of 20 to 30mm.

Dot punch is used to lightly indent along the layout lines, to locate centre of holes and to provide a small centre mark for divider point, etc. for this purpose, the punch is ground to a conical point having 60° included angle.

Centre punch is similar to the dot punch, except that it is ground to a conical point having 90° included angle. It is used to mark the location of the holes to be drilled.

Taps and Tap wrenches

A tap is a hardened and steel tool, used for cutting internal thread in a drill hole. Hand Taps are usually supplied in sets of three in each diameter and thread size. Each set consists of a tapper tap, intermediate tap and plug or bottoming tap. Taps are made of high carbon steel or high speed steel.

PROCEDURE

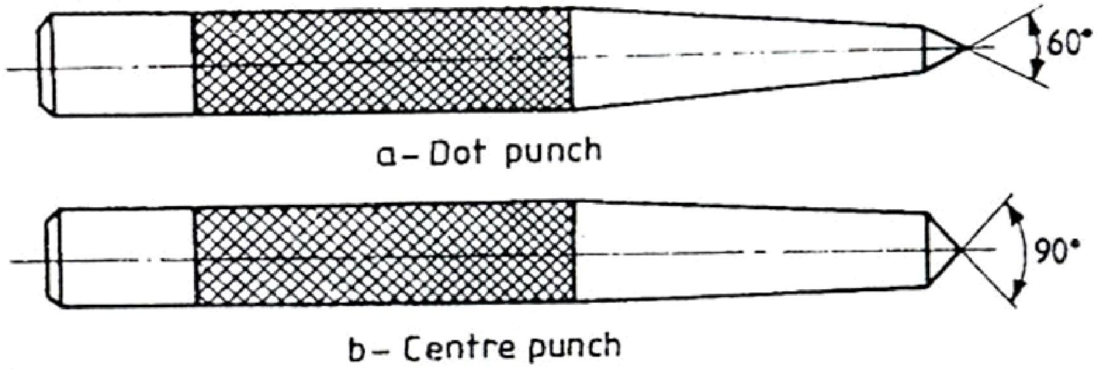
1. The burrs in the pieces are removed and the dimensions are checked with steel rule.
2. Make both pieces surface levels and right angles by fixing in the Vice, use Files for removing material to get level.
3. With the help of Try square check the right angles and surface levels.
5. Punch the scribed lines with dot punch and hammer keeping on the Anvil.
6. Cut excess material wherever necessary with Hacksaw frame with blade, Drill bits and Taps.
7. The corners and flat surfaces are filed by using square/flat and triangular file to get the sharp corners.
8. Dimensions are checked by vernier calliper and match the two pieces. Any defect noticed, are rectified by filing with a smooth file.
9. Care is taken to see that the punched dots are not crossed, which is indicated by the half of the punch dots left on the pieces.

SAFETY PRECAUTION

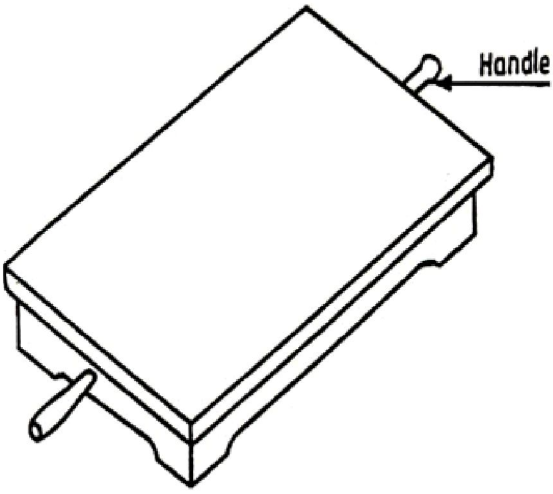
1. Always secure the material being drilled.
2. When lowering the press, keep your hands out of the way of the bit.
3. Clean chips from the work with a brush not by your hands.
4. Always remove the key from the chuck before turning on the power.
5. Wipe up all the cutting fluids that spills on the floor right away after right away.
6. After using a drill, wipe it clean of chips and cutting fluids. Replace the tool to proper storage .
7. Wash your hands after using cutting or oils, some cause skin rash which can develop serious skin disorder.
8. Newly cut threads are very sharp always use brush or cloth to clean them.

CONCLUSION

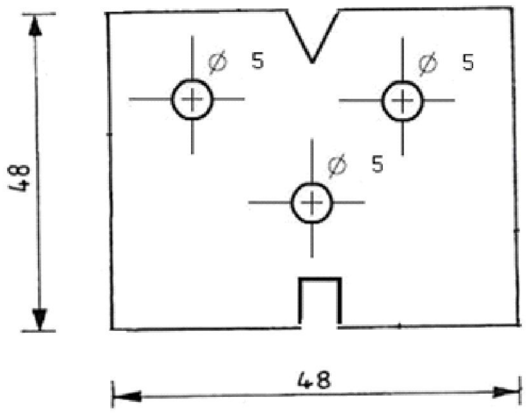
DIAGRAM



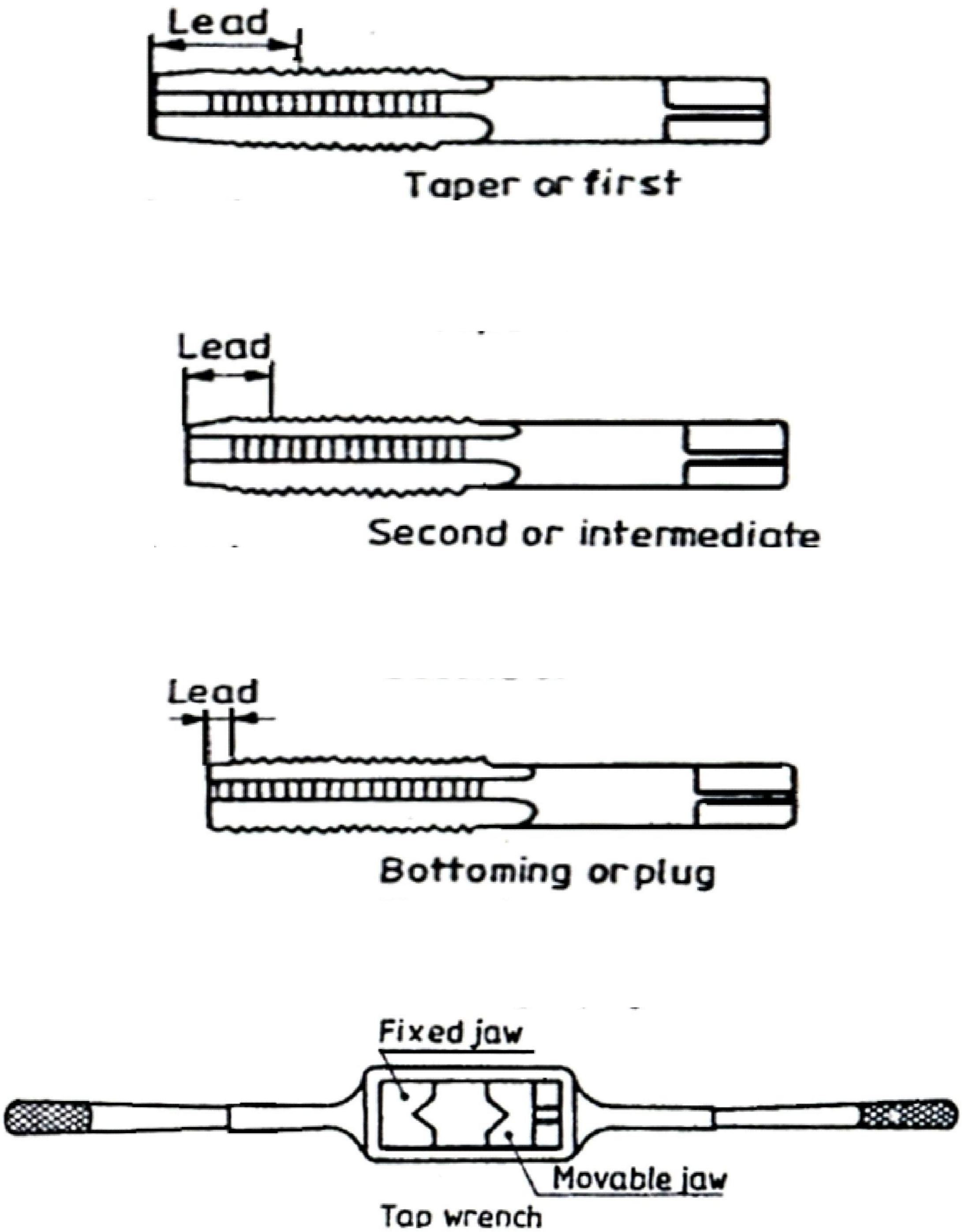
Type of Punches



Surface Plate



Drilling and Tapping



Tap and Tap Wrench

QUESTIONS

1. What is the use of divider?

2. What is the use of Bench vice?

3. What is the use of Flat File?

4. What is the use of Dot Punch?

5. What is the use of Hacksaw?

6. What is the use of Surface plate?

7. What is the use of Drill bit?

8. What is the use of Tap wrench?

9. What is the use of Triangular file?

10. What is the use of round file?

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EXPERIMENT NO. 31

FINISH THE TWO SIDES OF A CUBIC STRUCTURE ON SHAPER MACHINE

AIM

To finish the two sides of a cubic structure on shaper machine.

MATERIALS USED

Mild steel cubic structure 48 X 48 MM.

APPARATUS USED

SHAPER MACHINE, STEEL RULE, VERNIER CALIPER.

INTRODUCTION

Shaper

The shaper is a machine tool used primarily for:

1. Producing a flat or plane surface which may be in a horizontal, a vertical or an angular plane.
2. Making slots, grooves and keyways
3. Producing contour of concave/convex or a combination of these.

PRINCIPLE

The job is rigidly fixed on the machine table. The single point cutting tool held properly in the tool post is mounted on a reciprocating ram. The reciprocating motion of the ram is obtained by a quick return motion mechanism. As the ram reciprocates, the tool cuts the material during its forward stroke. During return, there is no cutting action and this stroke is called the idle stroke. The forward and return strokes constitute one operating cycle of the shaper.

CONSTRUCTION

The main parts of the Shaper machine is Base, Body (Pillar, Frame, Column), Cross rail, Ram and tool head (Tool Post, Tool Slide, Clamper Box Block).

Base

The base is a heavy cast iron casting which is fixed to the shop floor. It supports the body frame and the entire load of the machine. The base absorbs and withstands vibrations and other forces which are likely to be induced during the shaping operations.

Column

It is mounted on the base and houses the drive mechanism compressing the main drives, the gear box and the quick return mechanism for the ram movement. The top of the body provides guide ways for the ram and its front provides the guide ways for the cross rail.

Cross Rail

The cross rail is mounted on the front of the body frame and can be moved up and down. The vertical movement of the cross rail permits jobs of different heights to be accommodated below the tool. Sliding along the cross rail is a saddle which carries the work table.

Ram and tool head

The ram is driven back and forth in its slides by the slotted link mechanism. The back and forth movement of ram is called stroke and it can be adjusted according to the length of the work piece to be-machined.

PROCEDURE

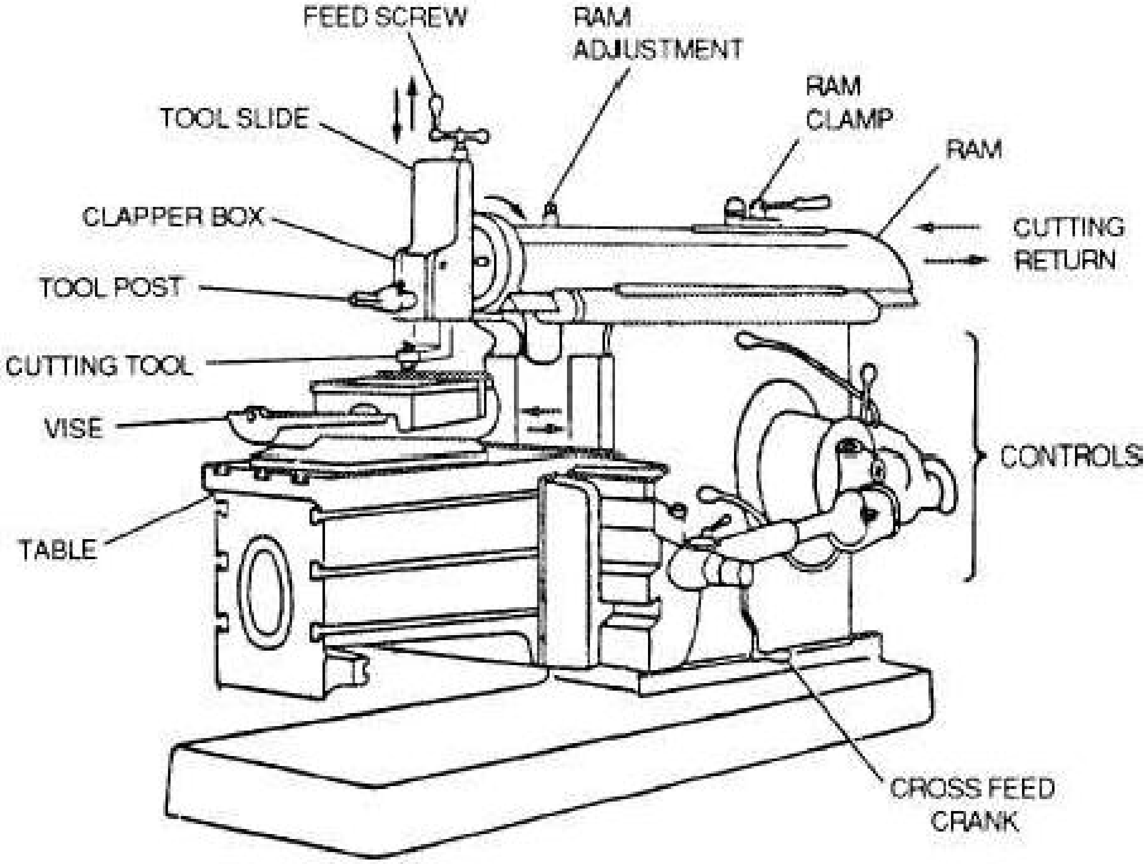
1. Select suitable no. of stroke of ram formula cutting speed.
2. Select suitable depth of cut.
3. Hold the work piece in machine vice; set the length of stroke and position of stroke shaper's ram.
4. Rectangular packing use for work piece setting.
5. Start plain face and change direction of work piece with help of try square maintained square.
6. Inspect the work piece as per drawing.

SAFETY PRECAUTION

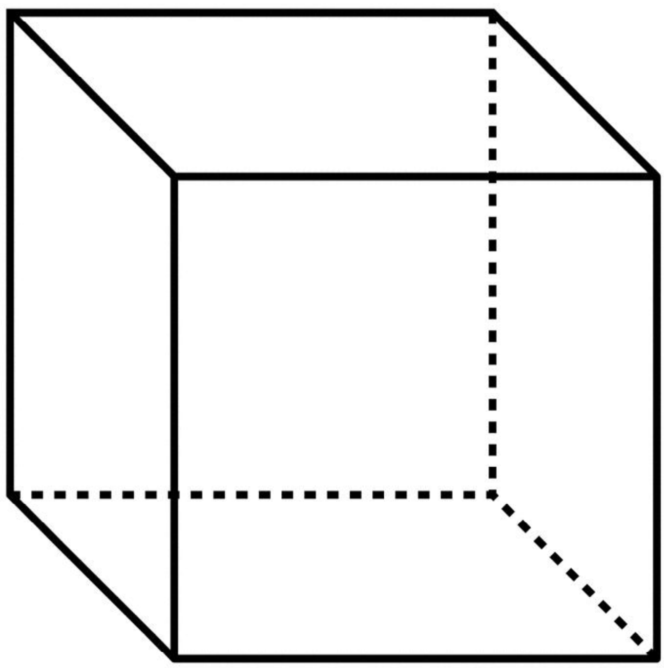
1. You have not to stand in front of the ram.
2. Set the stroke length before starting the machine.
3. After stopping the machine take the, measurement.
4. Always use sharp tools.
5. Length of stroke should 10 mm longer than the length of work - piece.

CONCLUSION

DIAGRAM



Parts of Shaper Machine



Finished surfaces of a cubic structure

QUESTIONS

1. What are various operations performed on shaper?

2. How is shaping machine specified?

3. Describe with help of neat sketch, principal parts of shaper?

4. Differentiate between planer, slotter and shaper?

6. What are the basic parts of shaper machine?

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EXPERIMENT NO. 32

PREPARE A CHISEL FROM A 25 MM OCTAGONAL BAR

AIM

To prepare a chisel from a 25 mm octagonal bar of high carbon steel as per given drawing .

MATERIAL

25 mm octagonal bare of high carbon steel (All dimension are in mm)

TOOLS

1. Anvil
2. Tong closed mouth, open mouth tong, round hollow tong square hollow tong.
3. Sledge hammer
4. Flatter
5. Scale
6. Cold chisel
7. Bottom chisel
8. 300mm steel rule

INTRODUCTION

The smithying and forging is a process of heating the metal to a plastic state and then shaping it with a hand hammer or the smithying is an oldest from of forging and is largely used where small parts are shaped by heating them in an open fire or hearth. It is also called hand forging or smith forging and is done by the black smith.

PROCEDURE

1. Heat up the one end of octagonal rod in hearth
2. Chamfer one end of the rod
3. Heat other end of octagonal bar in the hearth bup 95°c

ADVANTAGE AND DISADVANTAGES OF FORGING

Advantages

1. If refines the structure of the metal.
2. If renders the metal stronger by setting the directions of grains.
3. If results in considerable saving in time material as compared to the production of a similar item by cutting a solid and the shaping it.
4. The reasonable degree of accuracy may be obtained.
5. The forging may be welded.
6. It increases the ductility and resistance to imp [act loading.

Disadvantages

1. The cost of initial set up is heavy.
2. The close tolerances under forging operations is difficult. to maintain.
3. The metal gets cracked distorted if worked below a specified temperature limit.
4. Forge the heated portion of bar to flat taper and finish if with flatter.
5. Cut off the excess material with hot set chisel.
6. Temper and grind the cutting edge.

SAFETY PRECAUTIONS

1. Put on the leather gloves and apron staring the experiment.
2. Use the proper tools.
3. Heat up the job to the required temperature.
4. Use square hollow tong for holding the octagonal box.
5. Use goggles while working in front of the hearth.
6. Hold the heated octagonal rod firmly in the tong.

QUESTIONS

1. What is forging?

2. What is the difference smithing and forging?

3. Write down the main forging operations used in smithy shop?

4. What are the main tools used in forging shop?

5. What do you mean by cold set and hot set chisels.

6. What are the uses of drifts and punches?

7. Write down the main parts of anvil.

8. Name the different types of tongs used in smithy shop.

9. Sketch and describe the steam and board drop hammers?

10. Described in detail the process of hand welding?

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EXPERIMENT NO. 33

DRILLING OPERATION

AIM

To perform the drilling operation (holes of 5 mm and 12 mm) and grinding operation (to grind a corner) on old job as per drawing.

MATERIAL USED

Old job piece (All dimension are in mm)

TOOL USED

1. Try square
2. Twist drills 5mm and 12mm
3. Centre punch
4. 100gm hammer
5. Scriber
6. Spring divider
7. Steel rule 300 mm
8. Drilling machine and grinding machine

INTRODUCTION

Grinding is the finishing operation because it removes comparatively little metal 0.25 to 0.50 mm in most operations and the accuracy in dimensions is in the order of 0.000025mm. Grinding is also done to machine material which are too hard for other machining methods that use cutting tools. Many different types of grinding machines have now been developed for handling various kinds of work to which the grinding process applicable.

PROCEDURE

1. Receive the job piece and tools by the lab assistance.
2. Mark the job piece as per drawing and punch the marked lines.
3. Mark also the 15mm radius as per drawing.
4. Drill holes of 5mm diameter 12mm diameter by drilling machine.
5. Grind the corner as per given radius in the drawing by grinding machine.
6. Finish and remove the burns on the job.

SAFETY PRECAUTIONS

1. Marking should be done properly as per drawing.
2. Drill holes of correct size.
3. Don’t use blunt drills.
4. While grinding wear goggles for protecting the face and eyes.
5. While drilling use the cutting oil for smooth services.
6. Hold the job in the machine vice firmly while drilling.
7. Wear leather apron while grinding the corner of the job.

QUESTIONS

1. What is the function of shaper machine?

2. Name the main parts of shaper machine?

3. What is the main operations of shaper machine?

4. What is mean by Grinding? Explain

5. What different types of internal grinder?

6. What is a 'Centre less' internal grinder? Describe the principle of grinding on this type of grinder?

7. What are roll grinder and where are they used?

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