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MINING ENGINEERING
LAB MANUAL

WORKSHOP PRACTICE
(B.TECH)
SEMESTER II

WORKSHOP PRACTICE I

Experiment No. -1

Aim: - To study different types of measuring tools used in metrology and determine least counts of Vernier calipers, micrometers and Vernier height gauges.
Procedure: - Describe in brief the following measuring tools with neat sketch mentioning their sizes & usage.
1) Vernier caliper
2) Micrometer (inside & outside)
3) Vernier height gauge
4) Vernier depth gauge
5) Standard wire gauge
6) Combination set
7) Screw thread gauge
8) Depth micrometer
9) Radius gauge
10) Caliper
11) Try square
12) Sine bar
13) Bevel protector
14) Dial indicator
Least count: - Least count of Vernier caliper, micrometer, & Vernier height gauge to be calculated.

MEASURING INSTRUMENTS

1. outside and inside Calipers

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

2. Venire Calipers

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

3. Micrometers

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

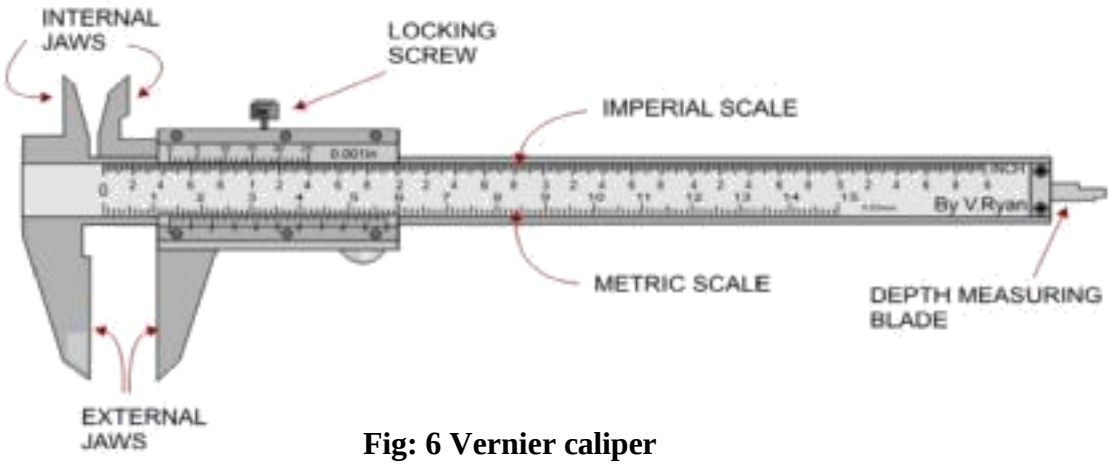


Fig: 6 Vernier caliper

Precautions:-

1) Measuring tools should not be mishandled.
2) Proper upkeep of measuring tool is necessary must be cleaned.
3) Tools before & after use kept in store
4) Tools should be calibrated after certain interval & accuracy determined.

Experiment No. -2

Aim: - To study different types of machine tools (lathe, shaper or planer or slotter, milling, drilling machines).

Procedure: -

1) Neat diagram of following machine tools to be drawn.

2) Brief description of the machine tools to be given.

3) Important parts to be labeled & marked.

4) Accessories should be indicated.

5) Different function of the machine tool can perform to be described.

Machine tools: -

1) Different types of lathes.

2) Different types of drilling machine.

3) Different types of milling machine e.g. horizontal, vertical, universal.

4) Shaper

5) Planer

6) Slotter

Principal parts of a Lathe

Figure 1 shows a center lathe, indicating the main parts. The name is due to the fact that work pieces are held by the centers.

Bed

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

Head stock

It contains either a cone pulley or gearings to provide the necessary range of speeds and feeds.

It contains the main spindle, to which the work is held and rotated.

Tail stock

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

center 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. The apron, which is bolted to the saddle, is on the front of the lathe and contains the longitudinal and cross slide controls.

Compound Rest

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

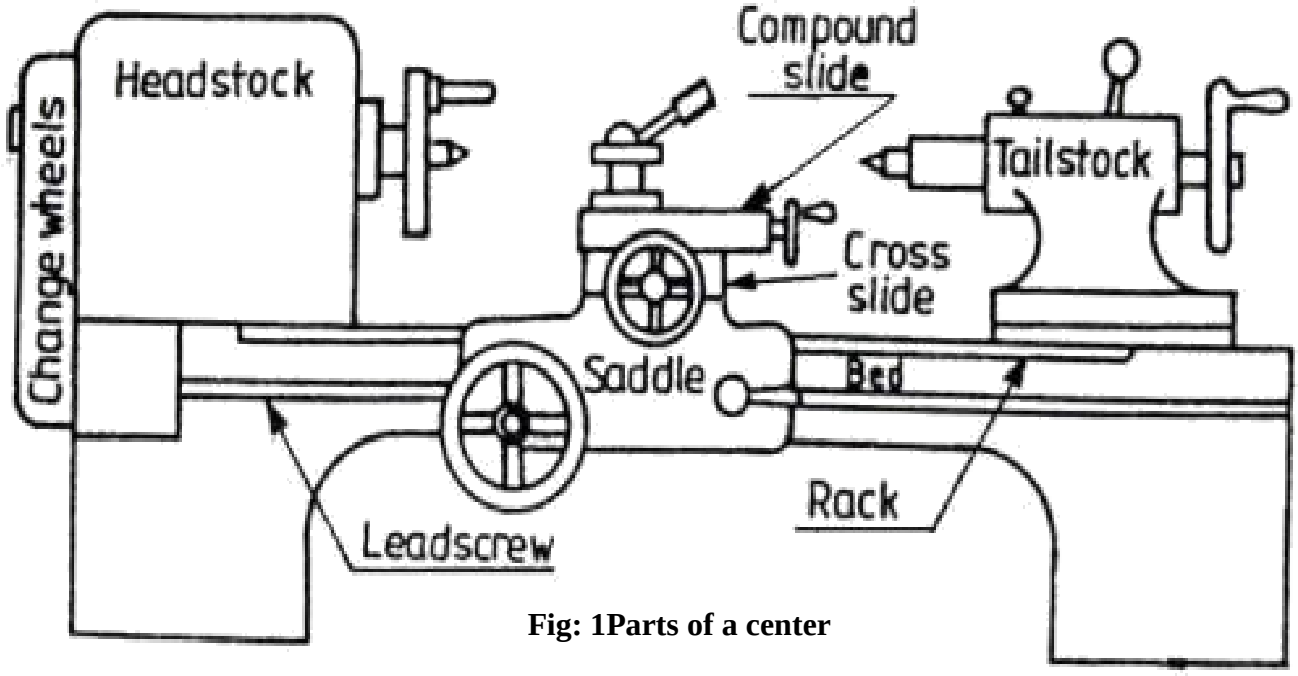
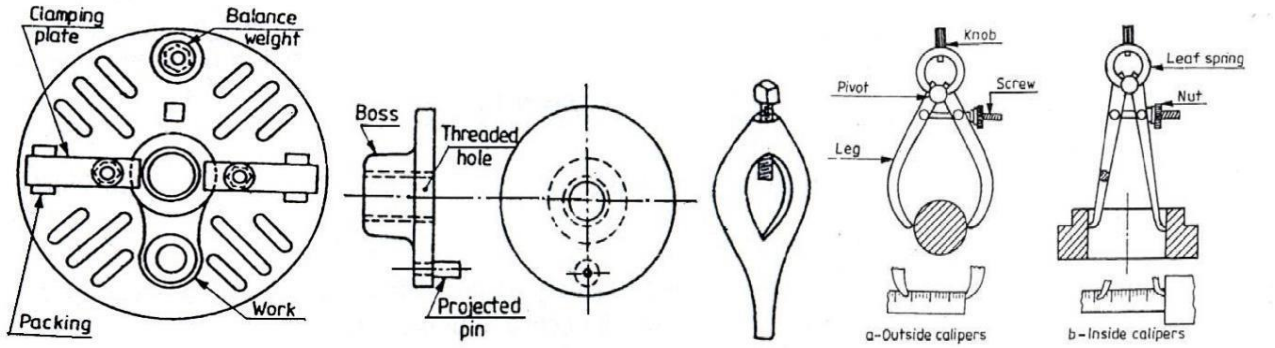


Fig: 1Parts of a center

Fig: 2 Three jaw and four jaw chuck



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.

Centers

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

Precautions:-

1. How various operations can be performed on a particular machine tool and the precautions required for that to be remembered.
2. Upkeep & usual maintenance of the machine tools must be well understood.
3. Work piece should be firmly gripped in the three jaw chuck.
4. Coolant is to be used.
5. Hand gloves and apron must be used while working.
6. Proper rpm should be selected before the operation.

Experiment No. -3

Aim: - To prepare a job on a lathe involving facing, outside turning, taper turning, step turning, radius making and parting-off.

Tool required: - Single point cutting tool, radius tool, parting tool.

Material required: - Mild steel rod.

Instruments required: - Steel rule, Vernier caliper, outside caliper, sine bar.

WORK- HOLDING DEVICES

Three jaw chuck

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

Face plate

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

Lathe dogs and driving plate

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

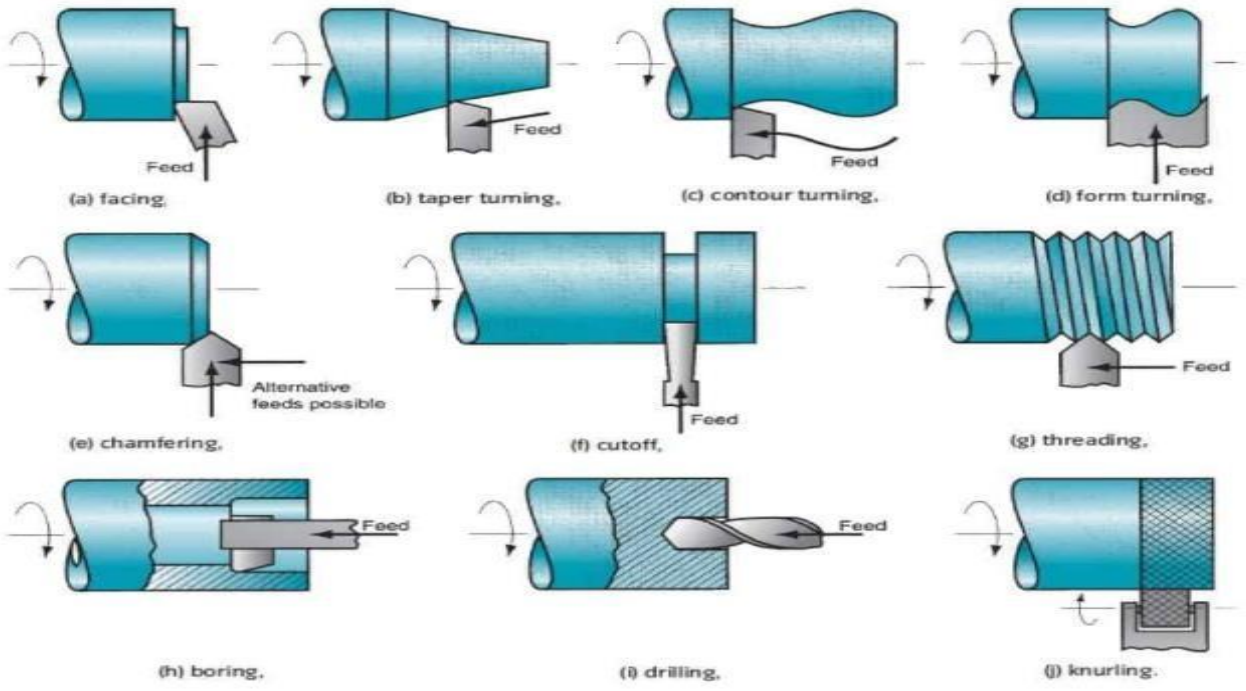


Fig: Operations on lathe

LATHE OPERATIONS

1. Turning

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

2. Boring

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

3. Facing

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

4. Taper Turning

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

5. Drilling

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

6. Knurling

It is the process of embossing a diamond shaped regular pattern on the surface of a work piece using a special knurling tool. This tool consists of a set of hardened steel rollers in a holder with the teeth cut on their surface in a definite pattern. The tool is held rigidly on the tool post and the rollers are pressed against the revolving work piece to squeeze the metal against the multiple cutting edges. The purpose of knurling is to provide an effective gripping surface on a work piece to prevent it from slipping when operated by hand.

7. Chamfering

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

8. Threading

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

Procedure: -

1. Job is fixed in three jaw chuck for proper alignment.
2. Single point cutting tool is fixed in the tool post and facing operation is completed.
3. A rough cut is used to turn the outer periphery.
4. Final turning and step turning operation are completed in sequence.
5. The compound slide is set at the taper angle as per calculation with the center line and tapering operation is completed through different cuts.
6. Radius tool is fixed in tool post for making radius and the operation is completed.
7. For maintaining the proper length of the job parting off tool is used and parting operation is completed.

Precautions: -

1. Work piece should be firmly gripped in the three jaw chuck.
2. Coolant is to be used.
3. Hand gloves and apron must be used while working.
4. Proper rpm should be selected before the operation.

Experiment No. 4

Aim: - To make M.S Plate into required model by V- fitting.

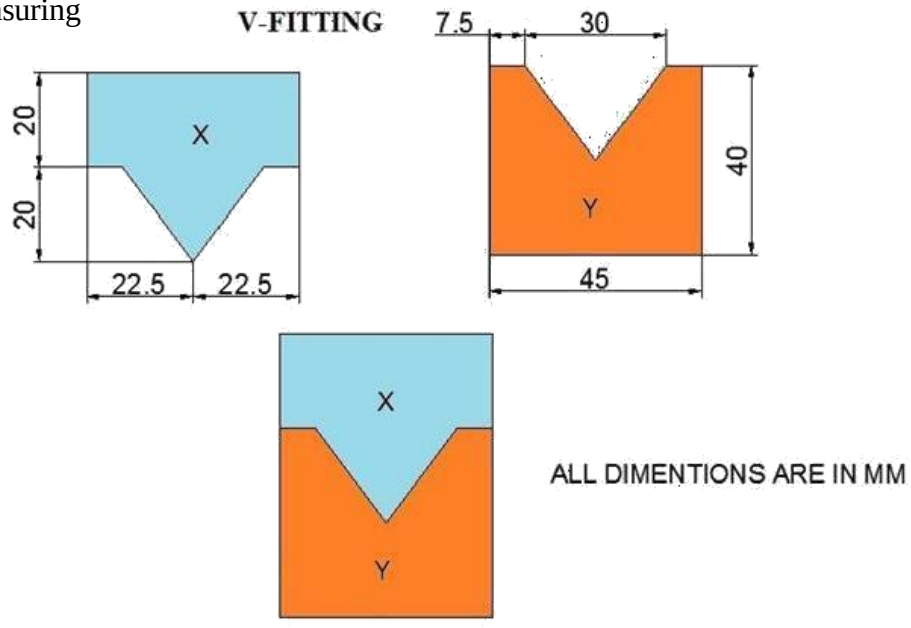
Tools required: -

1. Bench vice
2. Steel rule
3. Try square
4. Ball peen hammer
5. Scriber
6. Hack saw with blade
7. Dot punch and Centre punch
8. Surface plate
9. Vernier height gauge
10. Rough and smooth flat files
11. Flat chisel and triangular file

Material required: - Mild steel (M.S) plate of size 48 x 34–2 Nos.

Sequence of Operations: -

1. Filing
2. Checking flatness and squareness
3. Marking and measuring
4. Punching
5. Sawing
6. Chipping
7. Finishing



Procedure: -

1. The burrs in the pieces are removed and the dimensions are checked with a steel rule.
2. The pieces are clamped one after the other and the outer mating edges are filed by using rough and smooth files.
3. The flatness, straightness and squareness i.e. right angle between adjacent sides are checked with help of Try-square.
4. Chalk is then applied on the surfaces of the two pieces.
5. The given dimensions of the V-fitting are marked with help of Vernier height gauge carefully.
6. Using the dot punch, dots are punched along the above scribed lines.
7. Using the hack saw, the unwanted portions are removed.
8. Using the flat chisel, the unwanted material in the piece Y is removed.
9. The cut edges are filed by the half round file.
10. The corners of the stepped surfaces are filed by using a square or triangular file to get the sharp corners.
11. The pieces (X and Y) are fitted together and the mating is checked for the correctness of the fit.

Safety precautions: -

1. Care is taken to see that the marking dots are not crossed, which is indicated by the half of the punch dots left on the pieces.
2. Apply pressure in forward direction during hack sawing.
3. Don't rub steel rule on the job.
4. Fix blade in hack saw frame with correct tension.
5. During hack sawing the coolant like water or lubricating oil is to be used.
6. Use precision instruments like Vernier calipers and Vernier height gauge carefully.
7. Files are to be cleaned properly after using.

Result: - V- fit is made as per the required dimensions.

Experiment No: 5

Aim:-To make a double lap joint, using the given mild steel pieces and by arc welding.

Material used: Two mild steel pieces of 100 mm X 40 mm X 6 mm.

Tools and equipment 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. Bench vice,
11. Rough flat file,
12. Try square,
13. Steel rule,
14. Wire brush,
15. Ball peen hammer,
16. Chipping hammer.

Operations to be carried out

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

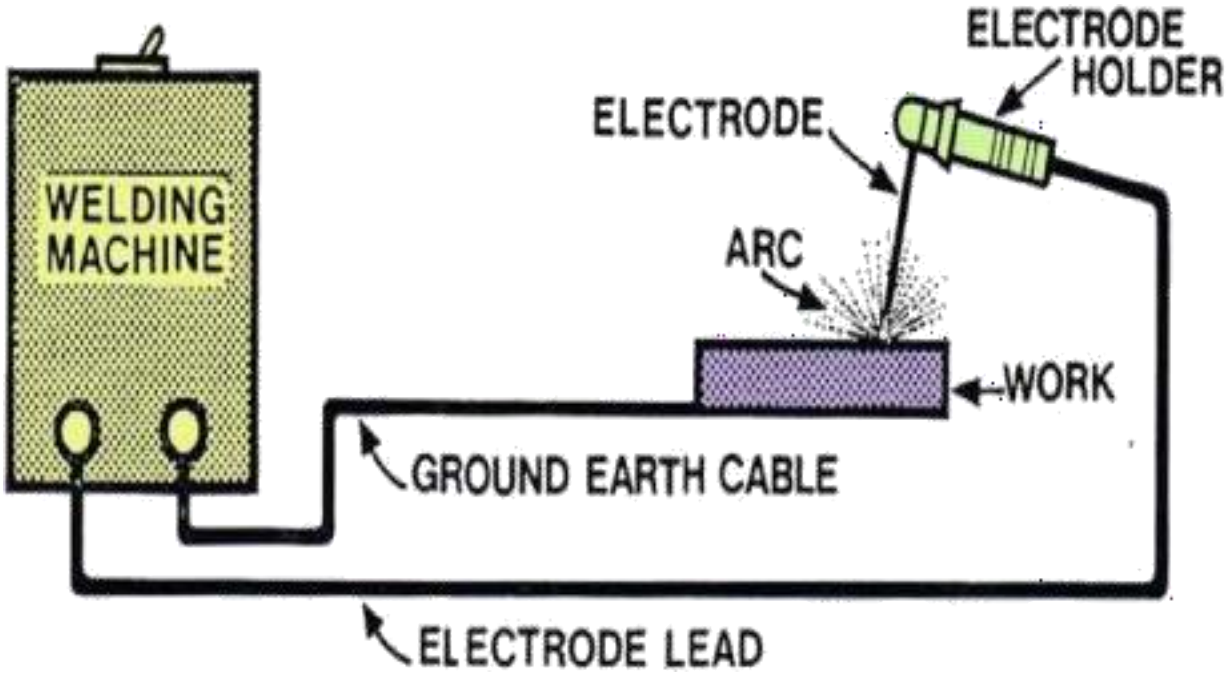


Fig: Arc welding set up

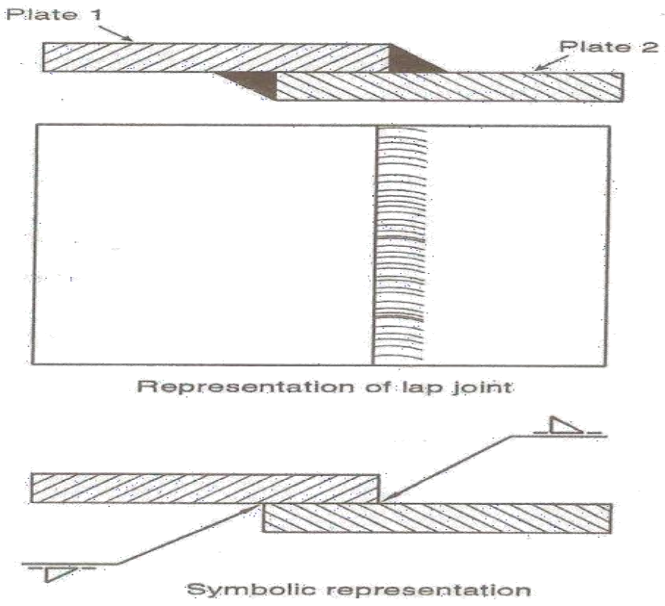


Fig: Lap joint

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.

Precautions:

1. Use goggles, gloves in order to protect the human body.
2. Maintain the constant arc length.

Result The lap joint is thus made, using the tools and equipment as mentioned above.

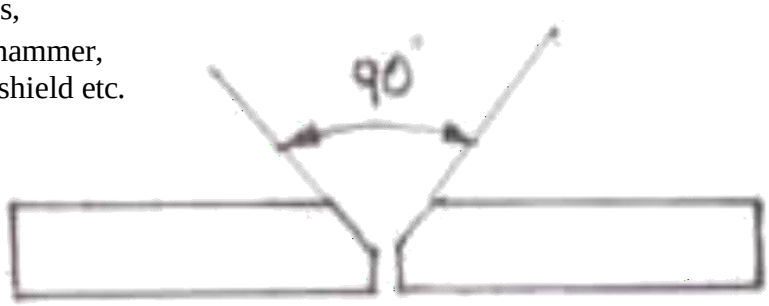
Experiment No: 6

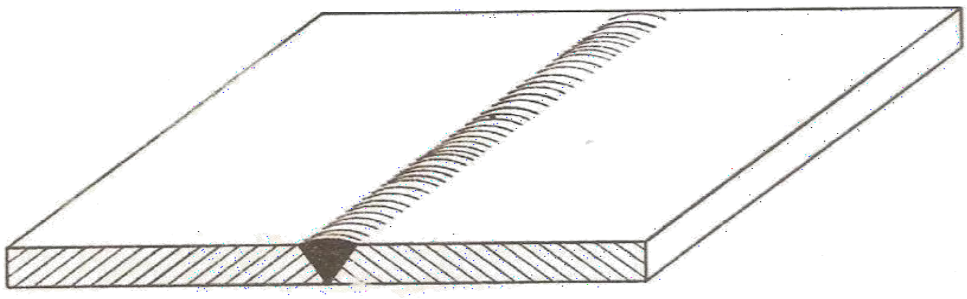
Aim: Preparation of butt joint as shown in figure using shielded metal arc welding process.

Material required: 2m.s flat pieces of given size.

Tools required:

1. Welding transformer,
2. Connecting cables,
3. Electrode holder,
4. Ground clamp,
5. Electrodes,
6. Hipping hammer,
7. Welding shield etc.





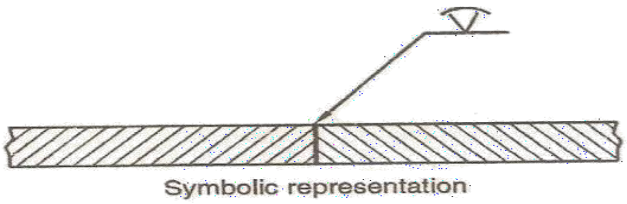


Fig. V – butt joint

Procedure:

1. The given metallic pieces filled to the desired size.
2. On both pieces beveled in order to have V groove.
3. The metallic pieces are thoroughly cleaned from rust grease, oil, etc.
4. The metallic pieces are connected to terminals of Trans former.
5. Select electrode diameter based on thickness of work piece and holds it on the electrode holder. Select suitable range of current for selected dia.
6. Switch on the power supply and initiates the arc by either striking arc method or touch and drag method.
7. Take welding to be done before full welding.
8. In full welding process after completion one part before going to second part. Slag is removed from the weld bed. With the metal wire brush or chipping hammer.
9. Then the above process will be repeated until to fill the groove with weld bed or weld Metal.

Precautions:

1. Use goggles, gloves in order to protect the human body.
2. Maintain the constant arc length.

Result: Butt joint is prepared as shown in figure by using arc-welding process.

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Experiment No: 7

RECTANGULAR TRAY

AIM: To prepare a **Rectangular tray** of given dimensions (l = 120 mm, b = 80 mm, h=24 mm) using a galvanized iron sheet.

MATERIAL REQUIRED: galvanized iron sheet of 180 mm x 140 mm

TOOLS REQUIRED: Steel rule, scriber, stake, straight snip, mallet, nose pliers.

SEQUENCE OF OPERATIONS:

1. Cleaning & marking,
2. Cutting,
3. Edge folding,
4. Bending,
5. Joining,
6. Finishing.

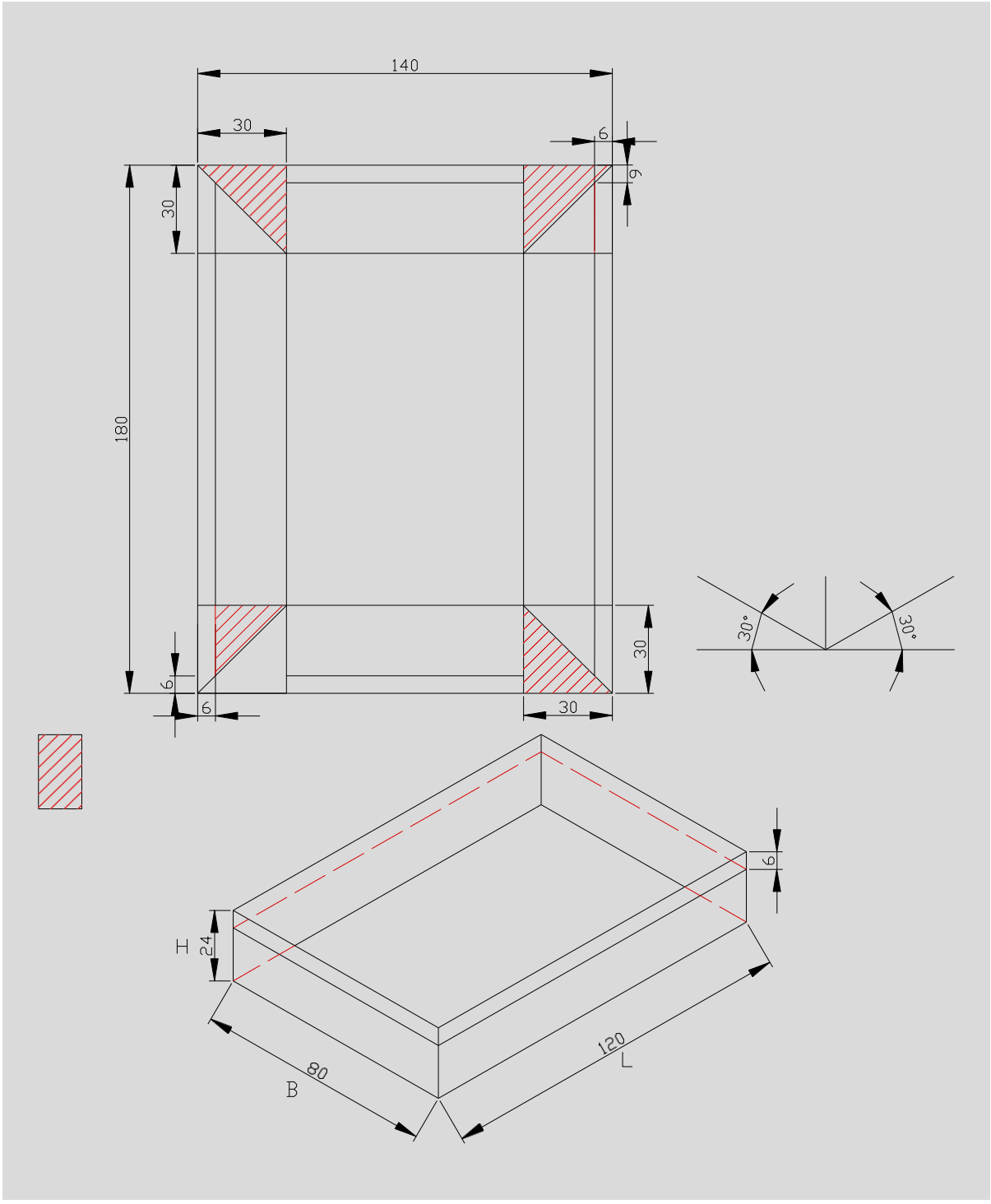
PROCEDURE:

1. Prepare the development of the rectangular tray as per the dimensions given (l = 120 mm, b = 80mm, h = 24mm).
2. Choose a G. I sheet size to accommodate the development.
3. Clean the sheet and mark the development using steel rule, scriber and divider.
4. Remove the unwanted material by using a straight snip.
5. Fold the edges on the required sides by using a suitable stake.
6. Bend the sheet at required markings to get the shape using suitable stake and mallet.
7. The **Rectangular tray** of required dimensions is obtained.

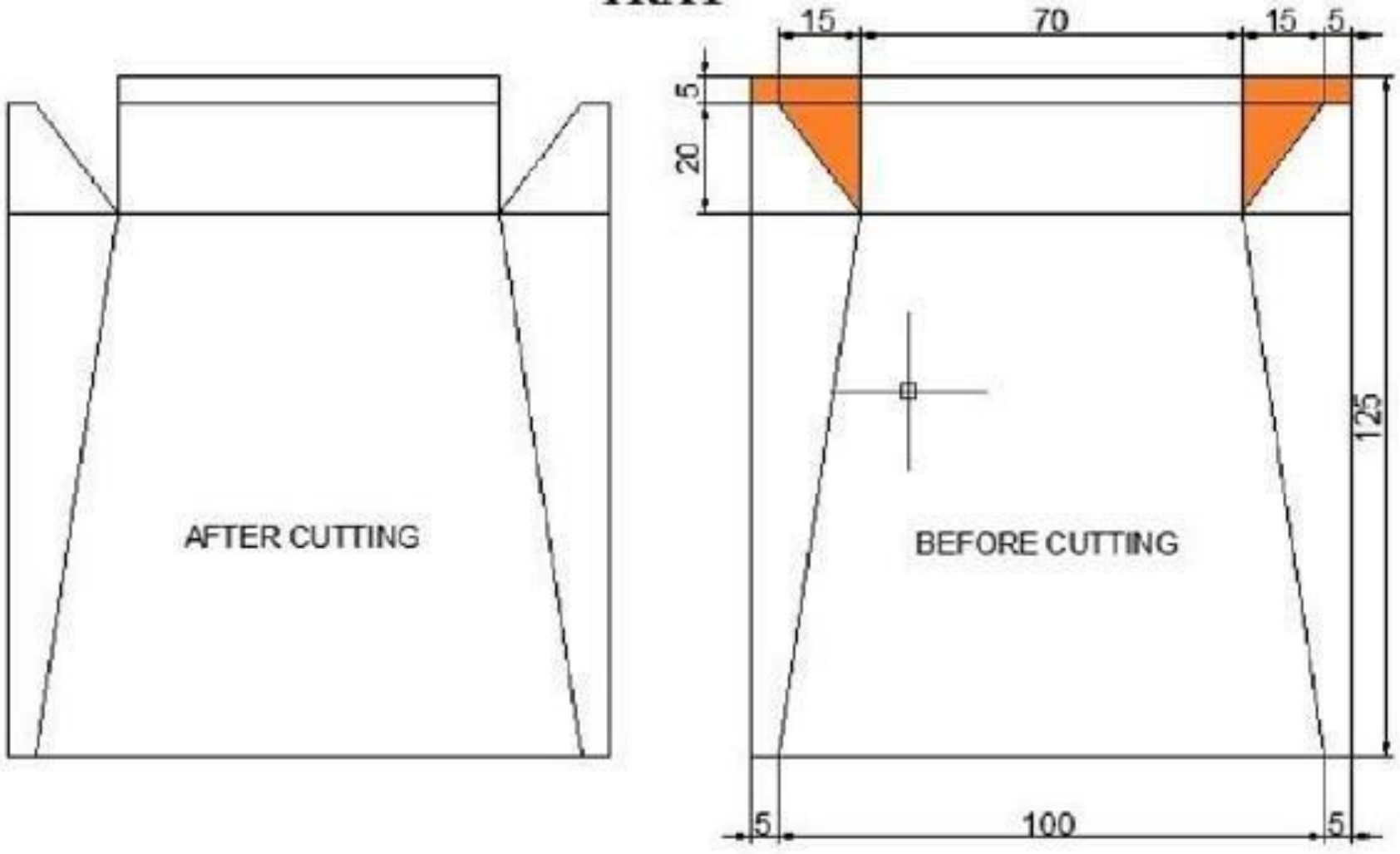
PRECAUTIONS:

1. Cutting should be done along the marked lines care fully.
2. Selection of stake is important for the required shape.
3. Excessive hammering of mallet during edge folding and finishing should be avoided.
1. Since the sheet metal has sharp edges at should be handled care fully to avoid endures.

RESULT: The **Rectangular tray** of required dimensions is obtained.


140
30
6
9
30
180
30
6
6
30
30°
30°
6
H
24
80
B
120
L

TRAY



EXPERIMENT NO: 8

DOVE TAIL HALVING JOINT

AIM

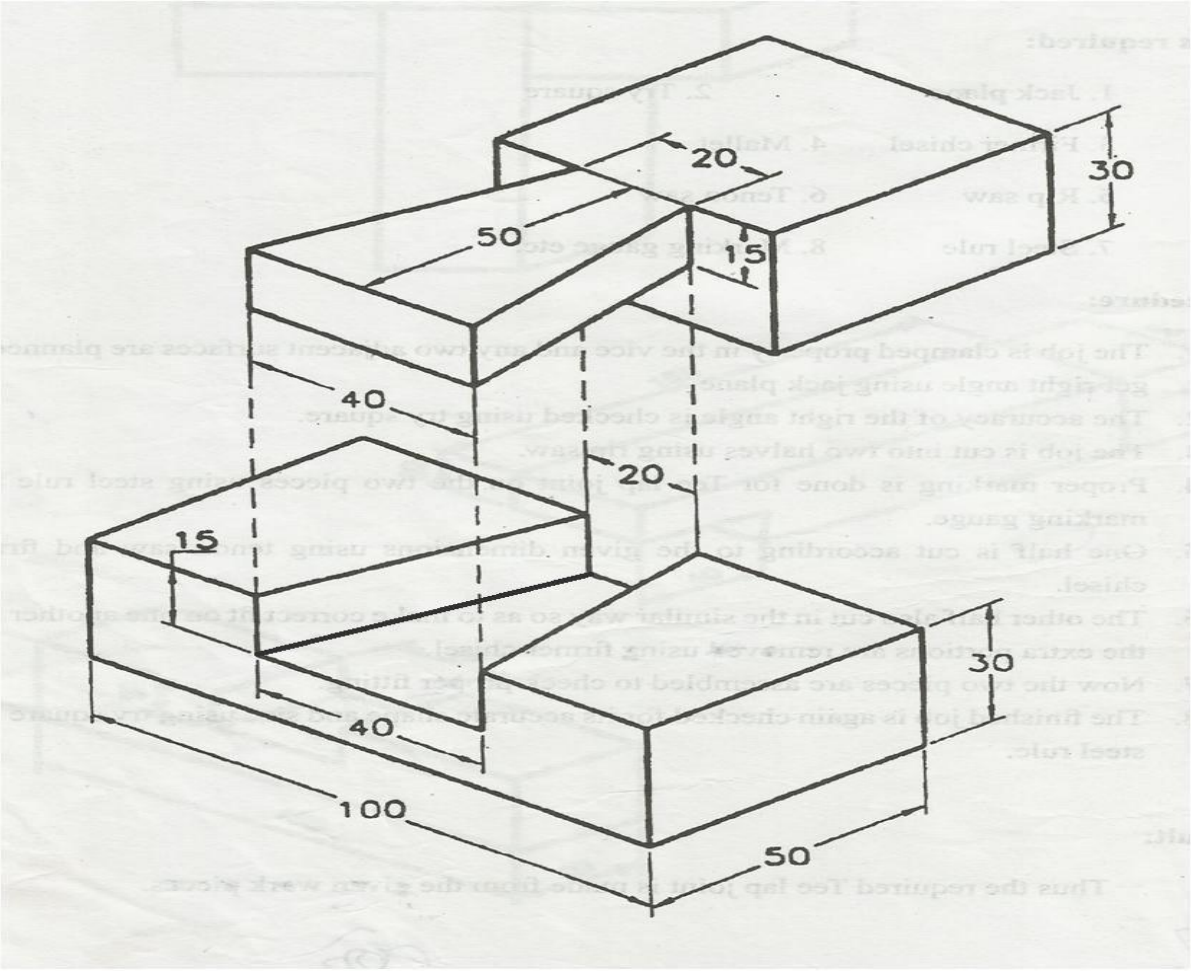
To make a dovetail halving joint from the given work piece.

MATERIAL REQUIRED

Soft wood of size 300x50x50 mm.

TOOLS REQUIRED

1. Jackplane
2. Bench vice
3. Try square
4. Mortise gauge
5. Mallet
6. Firmer chiesel



All dimensions in 'mm'

PROCEDURE

1. The given work piece is firmly clamped in the Bench vice and any two adjacent surfaces are planed to get right angles using the jack plane.
2. Using the try square, the right angles of planed faces are checked.
3. Now the other two surfaces are planed to get smooth surface.
4. The work piece is cut into two pieces by using the rip saw.
5. Mark the dimensions for the dovetail joint on the two pieces using the steel rule and marking gauge.
6. Remove the unwanted portions as per the drawing and assemble to check proper fitting.

RESULT

Thus the desired dovetail halving joint is obtained.