SVR ENGINEERING COLLEGE

NANDYAL-518501, KURNOOL (DIST.) A.P

OFFERING DIPLOMA, B.TECH, M.TECH, MBA COURSES

APPROVED BY AICTE NEW DELHI- AFFILIATED TO JNTU, ANANTAPURAM.

DEPARTMENT OF

MECHANICAL ENGINEERING

ENGINEERING WORKSHOP OBSERVATION

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Signature of faculty

<u>'Instructions to the Students'</u>

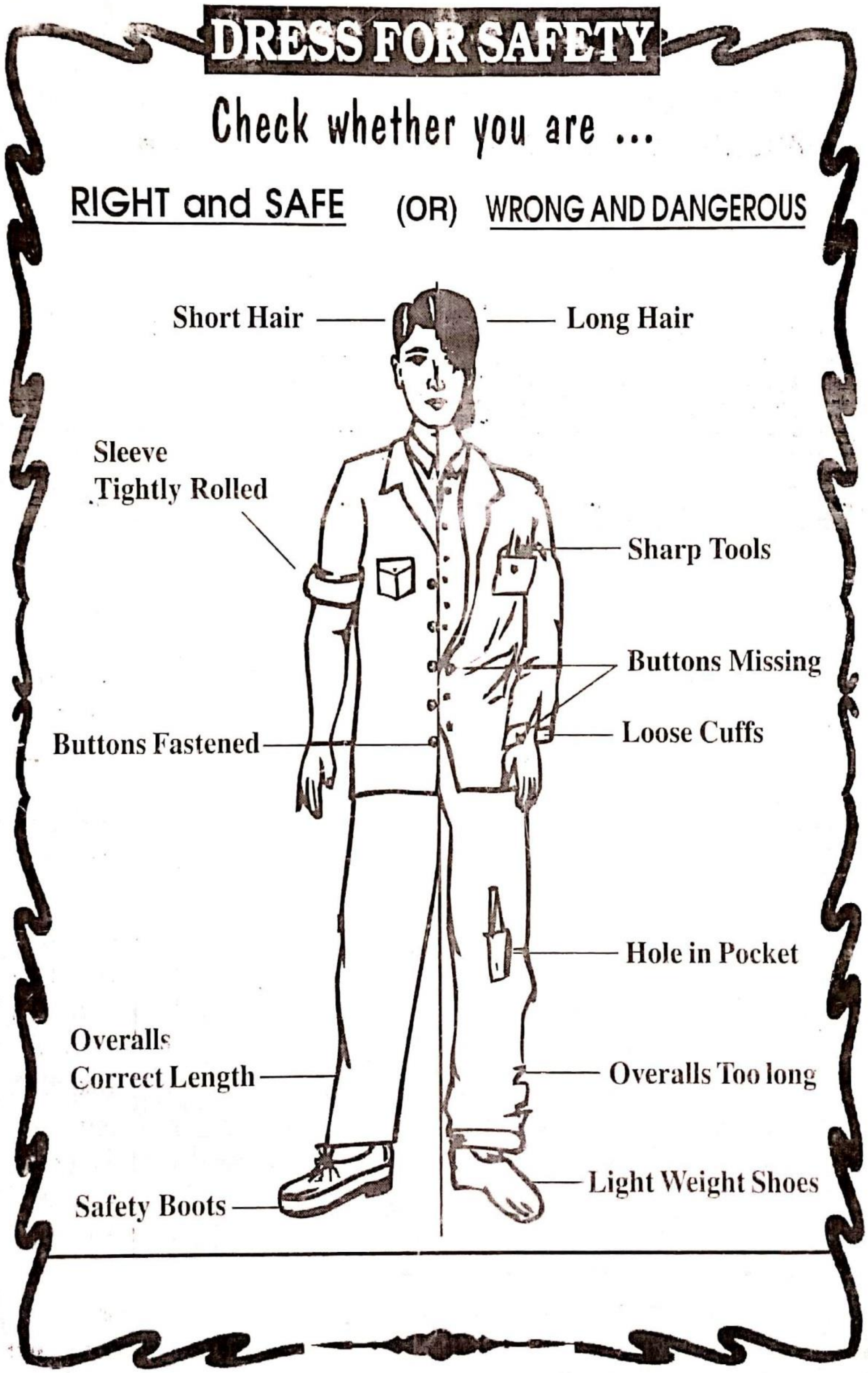
DO's

1. Students must always wear uniform and shoes before entering the lab.
2. Proper code of conduct and ethics must be followed in the lab.
3. Windows & doors to be kept open for proper ventilation and air circulation.
4. Note down the specifications of the experimental setup before performing the experiment.
5. Check for the electrical connections and inform if any discrepancy found to the attention of lecturer/lab instructor.
6. Perform the experiment under the supervision/guidance of a lecturer/lab instructor only.
7. After the observations are noted down switch off the electrical connections.
8. In case of fire use fire extinguisher/throw the sand provided in the lab.
9. In case of any physical injuries or emergencies use first aid box provided.
10. Any unsafe conditions prevailing in the lab can be brought to the notice of the lab in charge.

DONT's

1. Do not operate any experimental setup to its maximum value.
2. Do not touch/ handle the experimental setups/Test Rigs without their prior knowledge.
3. Never overcrowd the experimental setup/Test Rig, Leave sufficient space for the person to operate the equipment's.

4. Never rest your hands on the equipment or on the display board, because it has fragile measurement devices like thermometers, manometers, etc.


DRESS FOR SAFETY
Check whether you are ...
RIGHT and SAFE (OR) WRONG AND DANGEROUS
Short Hair
Long Hair
Sleeve Tightly Rolled
Sharp Tools
Buttons Missing
Loose Cuffs
Buttons Fastened
Hole in Pocket
Overalls Correct Length
Overalls Too long
Safety Boots
Light Weight Shoes

CARPENTRY

INTRODUCTION

Carpentry may be defined as the process of making wooden components. It starts from a marketable form of wood and ends with a finished product. It deals with the building work, furniture, cabinet making, etc. Joinery, i.e., preparation of joints is one of the important operations in all wood-works. It deals with the specific work of a carpenter like making different types of joints to form a finished product. In this chapter, tools and works associated with joinery are presented.

CARPENTRY TOOLS

The following are the tools that are made use of in all the wood working operations:

Marking and Measuring Tools

Accurate marking and measurement is very essential in carpentry work, to produce parts to exact size. To transfer dimensions onto the work; the following are the marking and measuring tools that are required in a carpentry shop:

Steel rule; It is an important tool for linear measurement. It can also be used as a marking tool (Fig. 1.1).

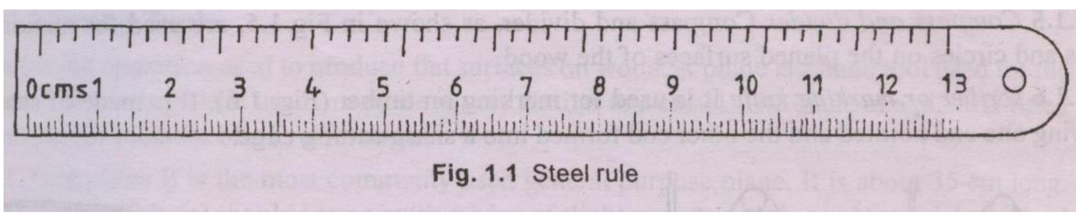


Fig. 1.1 Steel rule

Marking gauge: It is a tool used to mark lines parallel to the edge of a wooden piece. It consists of a square wooden stem with a sliding wooden stock (head) on it. On the stem is fitted a marking pin, made of steel. The stock is set at any desired distance from the marking point and fixed in position by a screw. It must be ensured that the marking pin projects through the stem, about 3 mm and the end is sharp enough to make a very fine line (Fig.

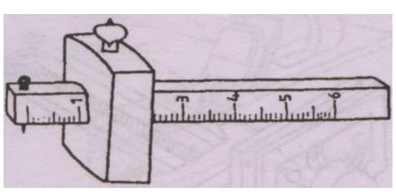
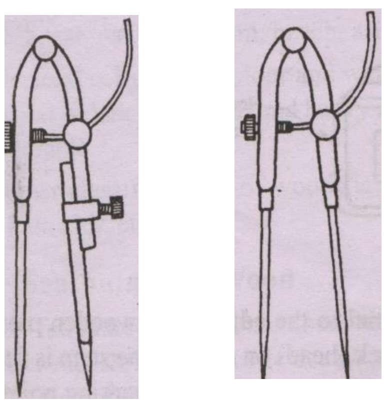


Fig. 1.3 **Marking gauge**

Try-square: It is used for marking and testing the squareness and straightness of planed surfaces. It consists of a steel blade, fitted in a cast iron stock. It is also used for checking the planed surfaces for flatness (Fig. 1.4). Its size varies from 150 to 300 mm, according to the length of the blade. It is less accurate when compared to the try-square used in the fitting shop.

Compass and divider: Compass and divider, as shown in Fig 1.5, are used for marking arcs and circles on the planed surfaces of the wood.

Scriber or marking knife: It is used for marking on timber (Fig. 1.6). It is made of steel, having one end pointed and the other end formed into a sharp cutting edge.



Compass Divider

Fig. 1.5 Compass and divider

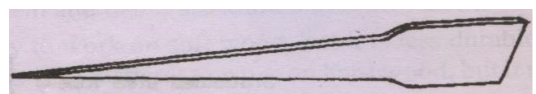
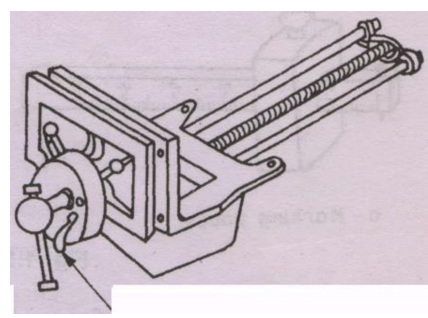


Fig. 1.6 Scriber or marking knife Blade



Trigger for quick opening

Fig. 1.8 Carpenter's vice

Holding Tools

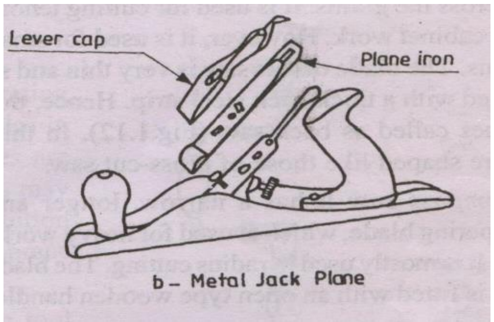
Carpenter's vice: Figure 1.8 shows the carpenter's bench vice, used as a work holding device in a carpenter shop. Its one jaw is fixed to the side of the table while the other is movable by means of a screw and a handle. The jaws are lined with hard wooden faces.

Bar cramp: Figure 1.9 shows a bar cramp. It is made of steel bar of T-section, with malleable iron fittings and a steel screw. It is used for holding wide works such as frames or tops.

Planing Tools

Planing is the operation used to produce flat surfaces on wood. A plane is a hand tool used for the purpose. The cutting blade used in a plane is very similar to a chisel. The blade of a plane is fitted in a wooden or metallic block, at an angle.

Jack plane It is the most commonly used general purpose plane. It is about 35 cm long. The cutting iron (blade) should have a cutting edge of slight curvature. It is used for quick removal of material on rough work and is also used in oblique planing.

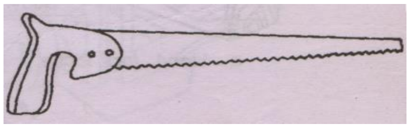


b – Metal Jack Plane

Cutting Tools

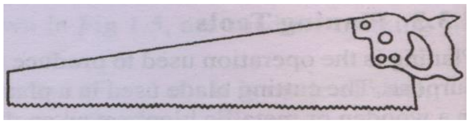
Saws: A saw is used to cut wood into pieces. There are different types of saws, designed to suit different purposes. A saw is specified by the length of its toothed edge.

Cross-cut or hand saw It is used to cut across the grains of the stock. The teeth are so set that the saw kerf will be wider than the blade thickness



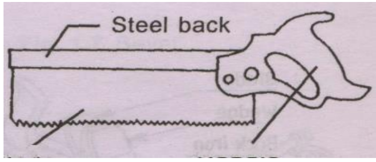
This allows the blade to move freely in the cut, without sticking.

Rip saw It is used for cutting the stock along the grains.

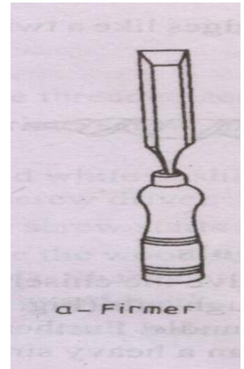


The cutting edge of this saw makes a steeper angle, i.e., about 60° Whereas that of crosscut saw makes an angle of 45° with the surface of the stock.

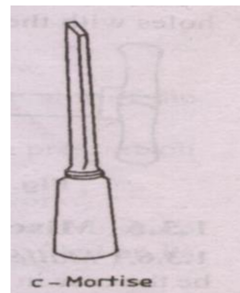
Tenon saw It is used for cutting the stock either along or across the grains. It is used for cutting tenons and in fine cabinet work. However, it is used for small and thin cuts. The blade of this saw is very thin and so it is stiffened with a thick back steel strip. Hence, this is sometimes called as back-saw .In this, the teeth are shaped like those of cross-cut saw.



Chisels: Chisels are used for cutting and shaping wood accurately. Wood chisels are made in various blade widths, ranging from 3 to 50 mm. They are also made in different blade lengths. Most of the wood chisels are made into tang type, having a steel shank which fits inside the handle. These are made of forged steel or tool steel blades.

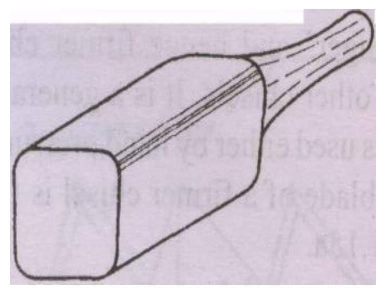


Firmer chisel: The word 'firmer' means 'stronger' and hence firmer chisel is stronger than other chisels. It is a general purpose chisel and is used either by hand pressure or by a mallet. The blade of a firmer chisel is flat.

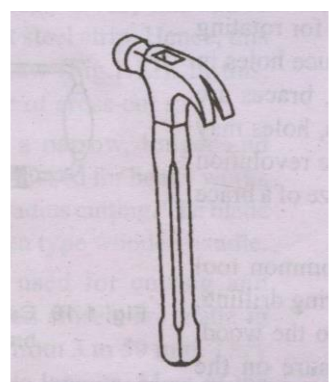


Mortise chisel: It is used for cutting mortises and chipping inside holes, etc. The cross-section of the mortise chisel is proportioned to withstand heavy blows during mortising. Further, the cross-section is made stronger near the shank.

Miscellaneous Tools



Mallet: It is used to drive the chisel, when considerable force is to be applied, which may be the case in making deep rough cuts (Fig. 1.20). Steel hammer should not be used for the purpose, as it may damage the chisel handle. Further, for better control, it is better to apply a series of light taps with the mallet rather than a heavy single blow.



Claw hammer: It has a striking flat face at one end and the claw at the other, as shown in Fig. 1.22. The face is used to drive nails into wood and for other striking purposes and the claw for extracting relatively large nails out of wood. It is made of cast steel and weighs from 0.25 kg to 0.75 kg.

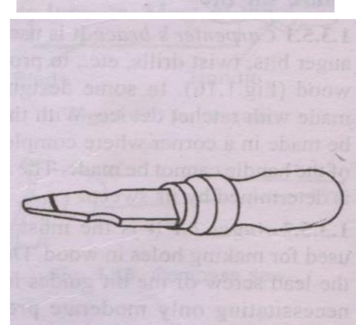


Fig. 1.23 Screw driver

Screw driver: It is used for driving wood screws into wood or unscrewing them. The screw driver of a carpenter is different form the other common types.The length of a screw driver is determined by the length of the blade. As the length of the blade increases, the width and thickness of the tip also increase

Wood rasp file It is a finishing tool used to make the wood surface smooth, remove sharp edges, finish fillets and other interior surfaces. Sharp cutting teeth are provided on its surface for the purpose. This file is exclusively used .in wood work.

Method of Using the Plane

The following may be noted while using the plane:

1. Hold the handle of the plane with the right hand and the knob with the left band.
2. Stand to the left side of the job, feet apart and with the left foot slightly ahead.
3. While pushing the plane, gradually shift weight to the left foot.
4. While planing, keep the fore-arm straight in- line behind the plane.

NOTE (i) Always plane along the grains. Planing against the grains will result in rough work.

(ii) When not in use, lay the plane on its side. This prevents the cutting edge becoming dull by contact with the bench top.

Cutting Wood with Chisels

The following are the points to be observed while chiseling:

1. Fix the work in a vice so that, both hands are free to use the chisel.
2. Push the chisel away from the body and keep both the hands behind the cutting edge.
3. Use left hand to guide the chisel and the right hand to push it forward.
4. Use the chisel with the bevel down for roughing cuts and with the bevel up for finishing cuts.

Chiseling along the grains Chiseling along the grains is often made to reduce either the width or thickness of the stock.

Chiseling across the grains This kind of work is done in making notches. The following must be observed during the work:

WOOD JOINTS

There are many kinds of joints used to connect wood stock. Each joint has a definite use and requires laying-out, cutting and putting them together. The strength of the joint depends upon the amount of contact area. If a particular joint does not have much contact area, then it must be reinforced with nails, screws or dowels

SAFE PRACTICES

1. Tools that are not being used should always be kept at their proper places.
2. Make sure that your hands are not in front of sharp edged tools while you are using them.
3. Use only sharp tools. A dull tool requires excessive pressure, causing the tool to slip.
4. Wooden pieces with nails, should never be allowed to remain on the floor.
5. Be careful when you are using your thumb as a guide in cross-cutting and ripping.
6. Test the sharpness of the cutting edge on wood or paper, but not on your hand.
7. Never chisel towards any part of the body.
8. Select the longest screw driver that is appropriate for the job intended. The longer the tool, the greater the effort applied.
9. The tip of the screw driver must fit the slot without wobbling. The width of the tip should be equal to the length of the screw slot.
10. Keep the screw driver properly pointed to prevent injury to hands.

CARE AND MAINTENANCE OF TOOLS

Chisels

1. Do not use chisels where nails are present.
2. Do not use it as a screw driver.

Saws

1. Do not use a saw with a loose handle.
2. Always use triangular file for sharpening the teeth.
3. Apply grease when not in use.
4. Do not use a saw on metallic substances.

Mallet

1. Do not use it on hard substances.
2. Do not use it on nails.

Plane

1. Do not use it at the places, where a nail is driven in the wood.
2. Keep its blade well sharpened.

TRADE: CARPENTRY SHOP	**WORKSHOP LAB**	**EXP: HALF LAP JOINT**

Aim: To make a Half Lap Joint from the given wooden piece for the desired dimensions.

Material Required: A wooden piece of size 50x35x250 mm.

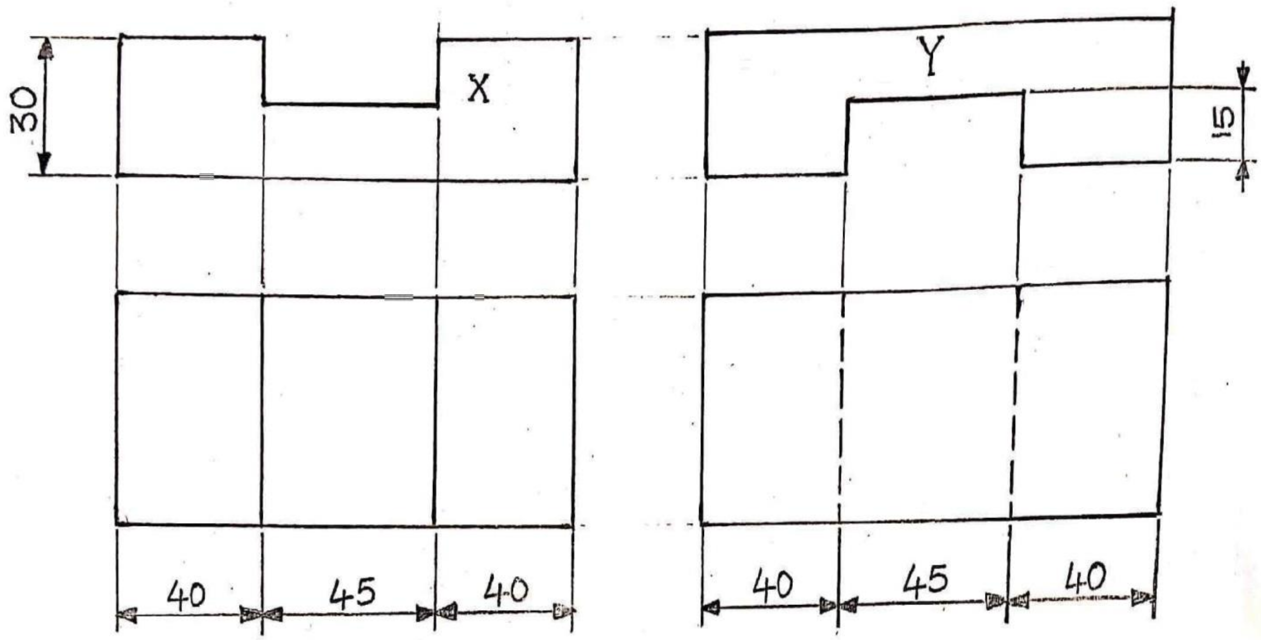
Tools required: 1. Jack plane 2.Try Square 3.Marking Gauge 4. Mallet 5. Steel Rule 6. Carpentry Vice 7. Wood Rasp File 8. Firmer Chisel 9. Mortise Chisel 10. Rip Saw 11. Tenon Saw

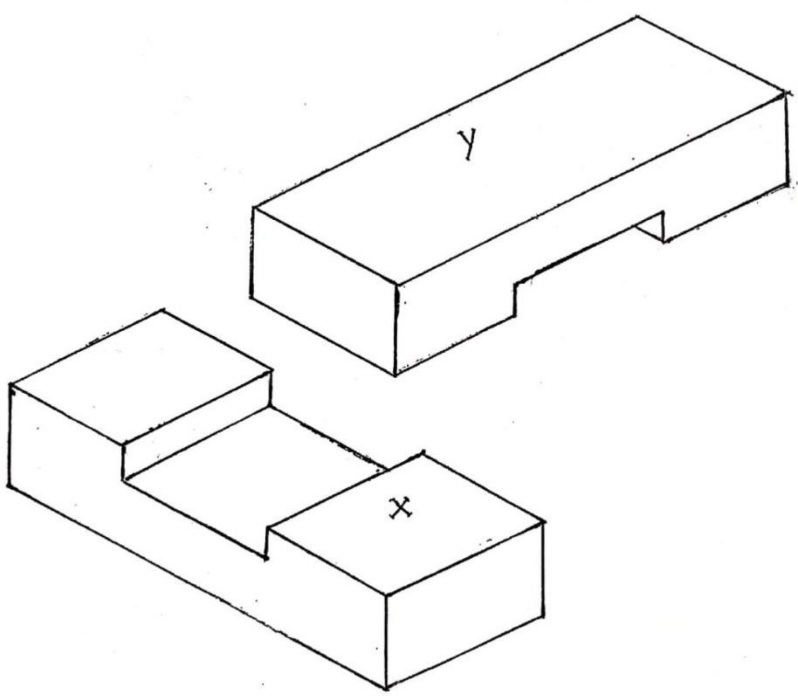
Sequence of Operations: 1. Rough planning 2. Marking 3. Cutting or Sawing 4. Chiseling 5. Finish planning

Working Steps:

- The given job is checked to ensure its correct size.
- The job is firmly clamped in the carpentry vice and any two surfaces are planed by Jack plane to get right angle.
- Using try square, the right of the work piece is checked.
- All the four sides of the wooden pieces are planed to get the smoother and finished surface.
- The job is cut into two halves using Rip saw then proper marking is done for cross joint on the two pieces using steel rule and marking gauge.
- One half is taken. Using tenon saw and firmer chisel the unwanted portions are removed as per the drawing.
- The above procedure is repeated for the other half of the work piece and Jack plane is used to plane the other two faces upto the marked portions
- Now the two pieces are assembled to check proper fitting.
- The finished job is again checked for its accurate shape and size using Try square and steel rule.

Result:





HALF LAP JOINT

ALL DIMENSIONS ARE IN mm.

TRADE: CARPENTRY SHOP	**WORKSHOP LAB**	**EXP: DOVETAIL JOINT**

Aim: To make a Dovetail Joint from the given wooden piece for the desired dimensions.

Material Required: A wooden piece of size 50x35x250 mm.

Tools required: 1. Jack plane 2.Try Square 3.Marking Gauge 4. Mallet

5. Steel Rule 6. Carpentry Vice 7. Wood Rasp File

8. Firmer Chisel 9. Mortise Chisel 10. Rip Saw 11. Tenon Saw

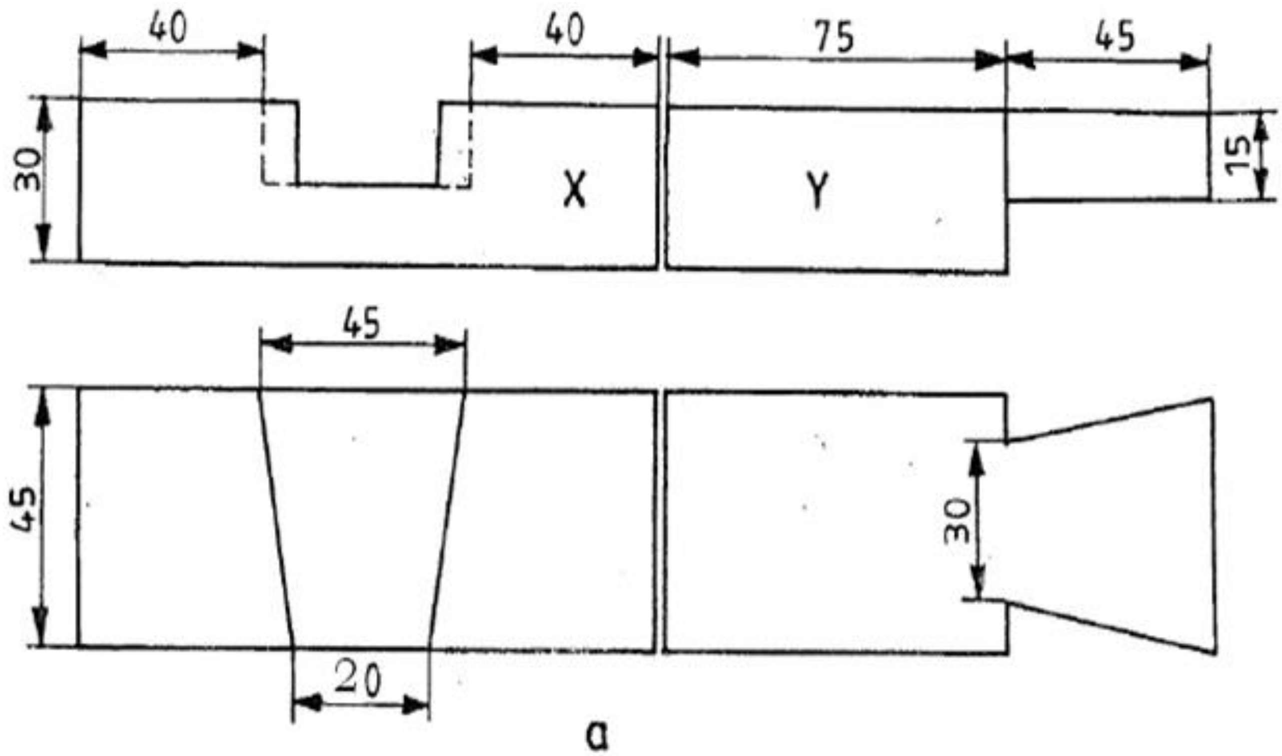
Sequence of Operations: 1. Rough planning 2. Marking 3. Cutting or Sawing

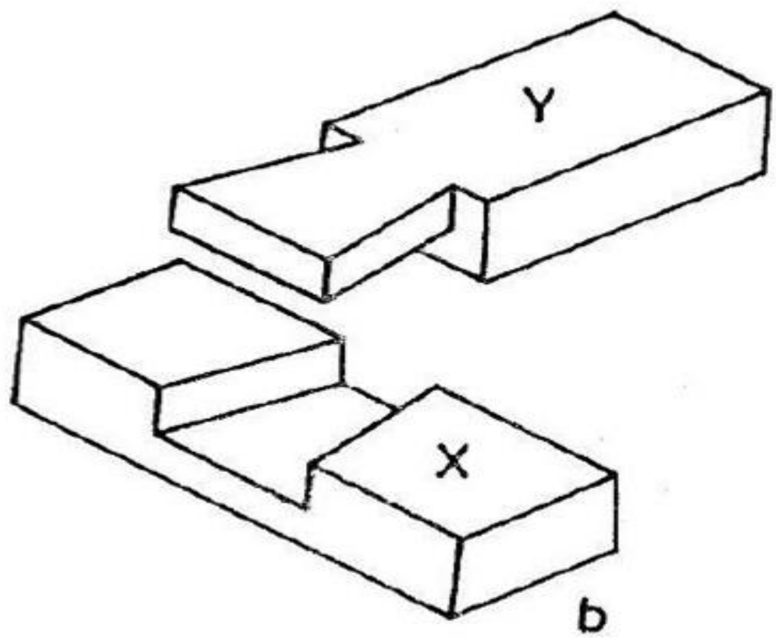
4. Chiseling 5. Finish planning

Working Steps:

- The given job is checked to ensure its correct size.
- The job is firmly clamped in the carpentry vice and any two surfaces are planed by Jack plane to get right angle.
- Using try square, the right of the work piece is checked.
- All the four sides of the wooden pieces are planned to get the smoother and finished surface.
- Now the portions for lapping portion are marked.
- After sawing remove the waste material by firmer chisel and trimming the dovetail by chisel to exact size.
- Cutting the dovetail groove on second piece and finishing the groove.
- If the material is still remained in 2 or 3 mm, remove by filing by wood rasp file.
- Now the two pieces are assembled to check proper fitting.

Result:





DOVETAIL JOINT

ALL DIMENSIONS ARE IN mm.

FITTING

2.1 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 a component which must fit accurately with another component on re-assembly. 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 with 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 effort. The operations in the above works consist of filing, chipping, scraping, sawing, drilling, tapping, etc.

FITTING TOOLS

Holding Tools

Bench vice: The bench vice is a work-holding device (Fig. 2.1). It is the most commonly used vice in a fitting shop. It is fixed to the bench with bolts and nuts. The vice body consists of two main parts, fixed jaw and a movable jaw. When the vice handle is turned in a clockwise direction, the sliding jaw forces the work against the fixed jaw. The greater the pressure applied to the handle, the tighter is the work held. Jaws are made of hardened steel. Serrations on the jaws ensure a good grip. Jaw caps made of soft material are used to protect finished surfaces, gripped in the vice. The size of the vice is specified by the length of the jaws.

The vice body is made of cast iron which is strong in compression, weak in tension and so fractures under shocks and therefore should never be hammered.

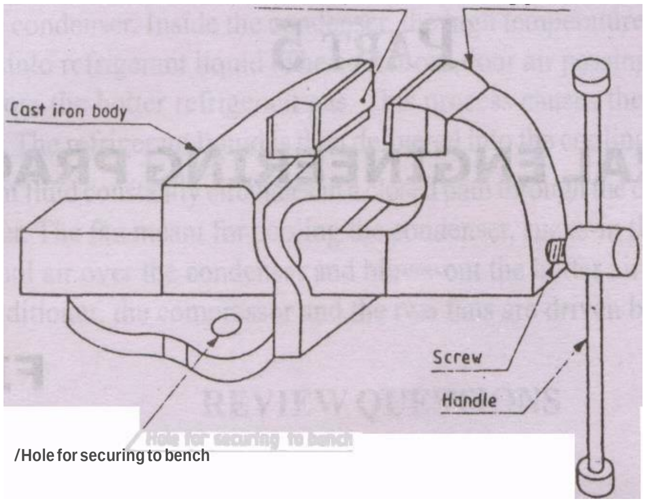


Fig. 2.1 Bench vice

Marking and Measuring Tools

2.2.2.1 Surface plate The surface plate (Fig. 2.4) is machined to fine limits and is used for testing the flatness of the work piece. It is also used for marking out small works and is more precise than the marking table. The degree of fineness of the finish 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' grade. Handles are provided on two opposite sides, to carry it while shifting from one place to another.

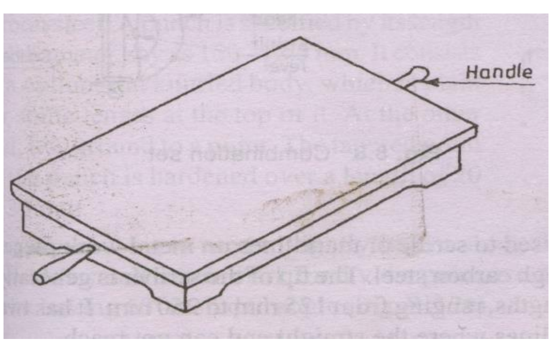


Fig. 2.4 **Surface plate**

Scriber *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 12° to 15°. It is generally available in lengths, ranging from 125 mm to 250 mm. It has two pointed ends. The bent end is used for marking lines where the straight end can not reach.

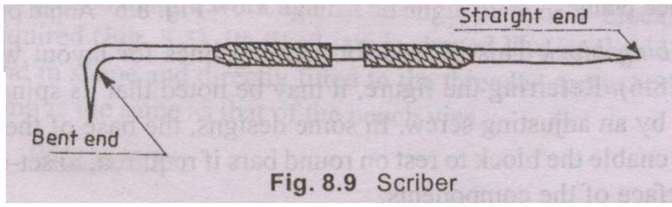


Fig. 8.9 Scriber

Try-square It is a measuring ami-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 beam, of cast iron or steel. The size of the try-square is specified by the length of the blade.

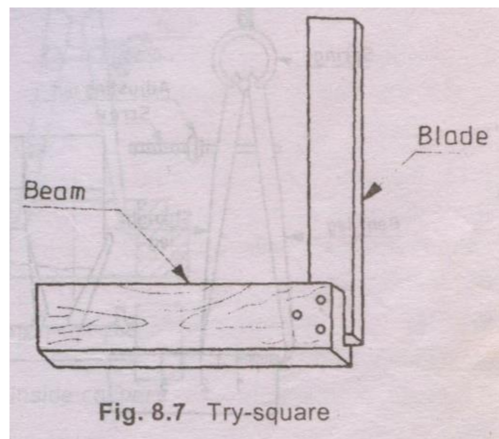
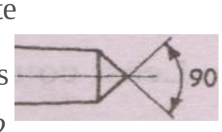


Fig. 8.7 Try-square

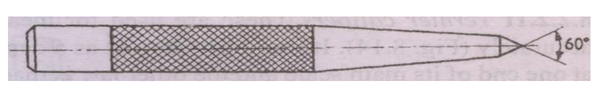
Punches These are used for making indentations on the scribed lines, to make them visible clearly. These are made of high carbon steel. A punch is specified by its length and diameter, say as 150 ' 12.5 mm. It consists of a cylindrical knurled body, which is plain for some length at the top of it. At the other end, it is ground to a point. The tapered pointof the punch is hardened over a length of 20 to30mm.

Dot punch This 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 (Fig. 2 .12a).



b-Dot punch

Centre punch This is similar to the dot punch, except that it is ground to a conical point having 90° included angle (Fig. 2.12b). It is used to mark the location of the holes to be drilled.



Cutting Tools

Hacksaw: The hacksaw 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 per 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 types. 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.

The teeth of the hacksaw blade are staggered, as shown in Fig. 2.20 and are known as a 'set of teeth'. These make slots wider than the blade thickness, preventing the blade from jamming.

2.2.3.2 Chisels Chisels are used for removing surplus metal or for cutting thin sheets (Fig. 2.21). 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 a hard cutting edge. Annealing relieves the internal stresses in the metal. The cutting angle of the chisel for general purpose is about60°.

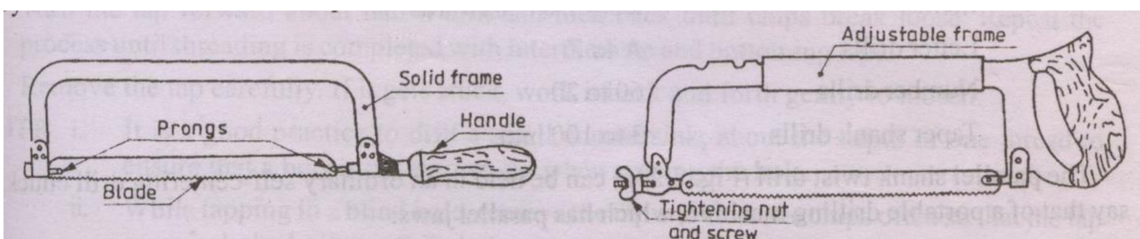


Fig. 8.19 Hacksaw frame with blade

Miscellaneous Tools

Ball-peen hammer: 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 aball end, particularly used for riveting (Fig. 2.34).

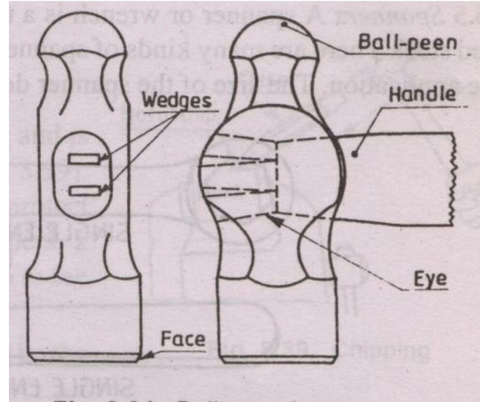


Fig. 8.34 Ball-peen hammer

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.

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.

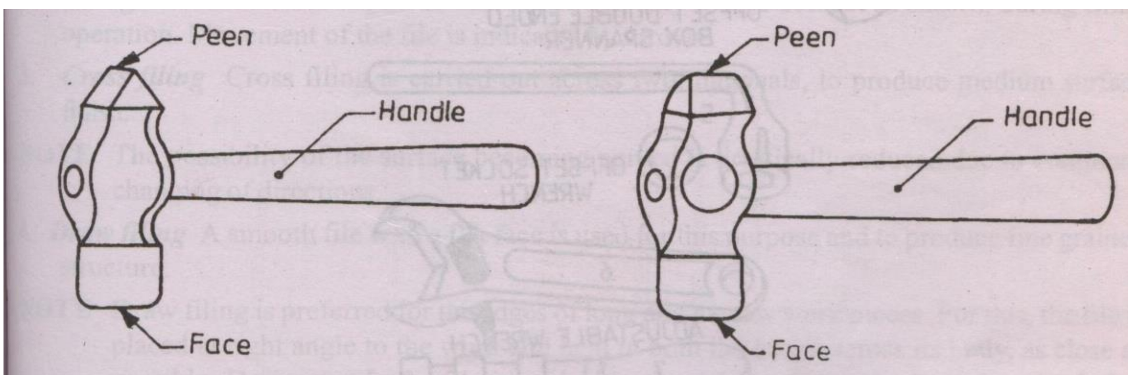


Fig. 8.35 Cross-peen hammer **Fig. 8.36** Straight-peen hammer

FITTING OPERATIONS

Chipping

Removing the metal with a chisel is called chipping and is normally used where machining is not possible.While chipping, safety goggles must be put on, to protect eyes from the flying chips. To ensure safety of others, a chip guard is placed in position. Care should be taken to see that the chisel is free from mushroom head.

NOTE For better results, the angle of chipping must be the same throughout the operation.

Filing

There are several methods of filing, each with a specific purpose. With reference to the figure, the following may be noted:

1. **Holding the file** For heavy work and to remove more metal, a higher pressure is used. For light and fine work, a light pressure is applied.
2. **Filing internal curves** *A* part of half round file only makes contact as shown, during filing operation. Movement of the file is indicated by arrows.

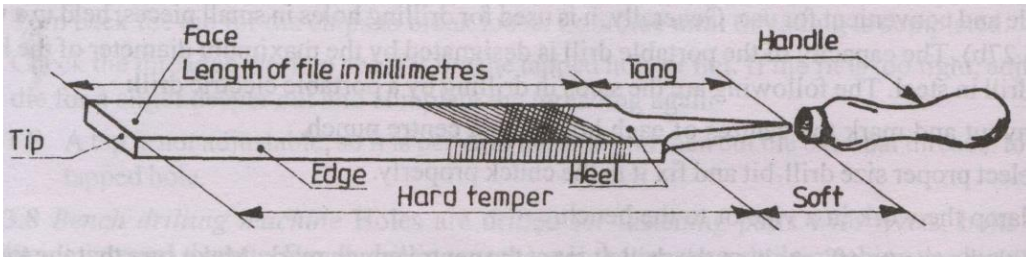


Fig. 8.29 Hand file

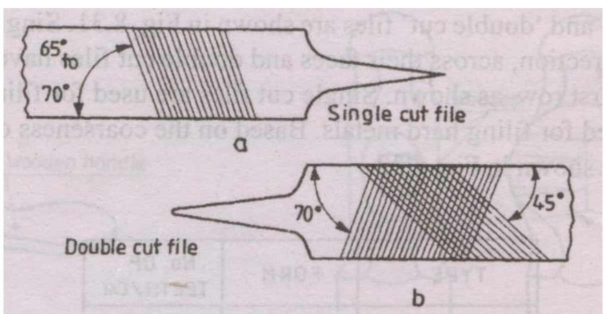


Fig. 8.31 Single and double cut files

3. **Cross filing** Cross filing is carried out across two diagonals, to produce medium surface finish.

NOTE The possibility of the surface becoming curved is drastically reduced due to continous changing of directions.

2.3.2.2 Checking flatness and squareness To check flatness, the try-square is placed as shown in Fig. 2.4 la. No light should be seen between the bottom edge of the square and the top surface of the work piece, when both are held against light. Similarly, the flatness across thickness of plate is tested as shown. The squareness of one edge with respect to another reference edge is checked as

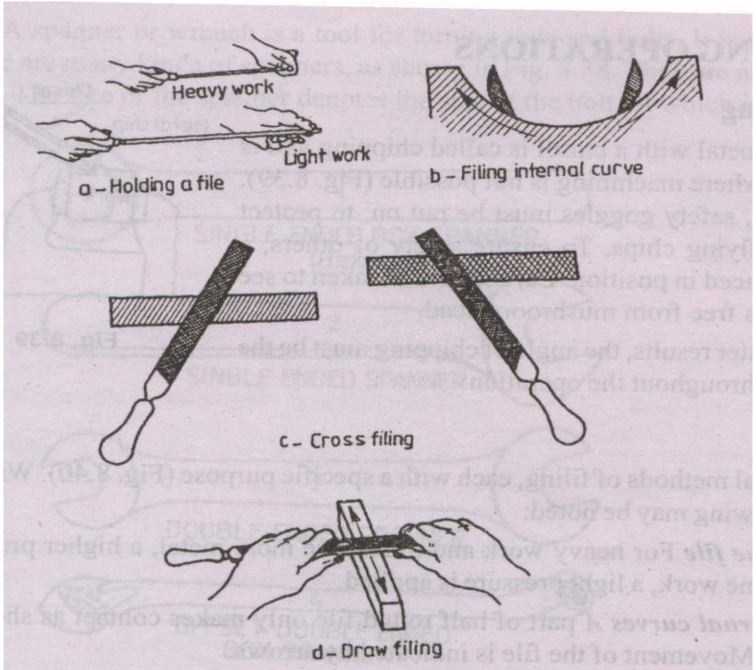


Fig. 8.40 Filling

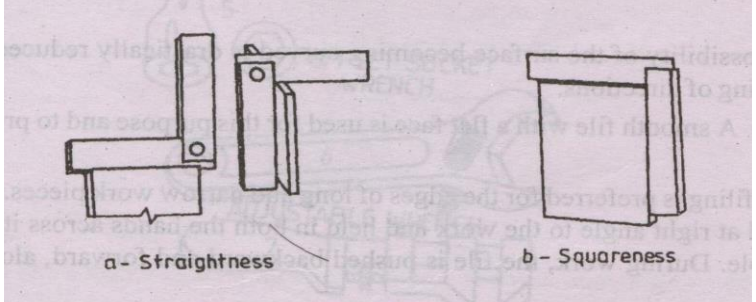


Fig. 8.41 Use of try-square

SAFE AND CORRECT PRACTICES

The following are some of the safe and correct work practices in bench work and fitting shop, with respect to the tools used:

1. Use the file with a properly fitted tight handle. Never drive a file into its handle with a hammer or other objects. It may chip or break the file or split the handle. After filing, remove the burrs from the edges of the work, to prevent cuts to the fingers.
2. Keep hands and tools wiped clean and free of dirt, oil and grease. Dry tools are safer to use than slippery tools. Do not carry sharp tools in pockets.
3. Keep tools sharp and in good adjustment. Dull or poorly adjusted tools must be forced, causing accidents.
4. Hold the pointed tool away from the body, to avoid injury, in case the tool slips.
5. Wear leather shoes and not chappals.
6. Don't wear loose clothes.

7. Remember that a slippery floor is always dangerous.
8. Do not keep working tools at the edge of the table.
9. Put the sharp tool in its proper place, immediately after completion of work with it.
10. Never work in a place where there is no sufficient light.
11. Avoid talking and unnecessary discussions during working time and concentrate only on the work.
12. Position the work piece such that the cut to be made is close to the vice. This practice prevents springing, saw breakage and personal injury.
13. Position the work in the vice such that it does not overhang into an aisle or other area where a person might accidentally brush against it.
14. When sawing in a vice, make sure that the work is held tight. A loose vice is dangerous.
15. Cut a small groove with sharp corner of a file, where a saw cut is to be started. The groove permits accurate positioning of the saw and also prevents slipping of the teeth.
16. Start with a new blade in another place, when a blade breaks during a cut. This prevents binding and blade breakage.
17. For cutting thin metal strips, clamp them between two pieces of wood. Cutting through both the wood and the metal prevents the saw teeth from digging-in and bending the metal.
18. Apply force only on the forward (cutting) stroke and relieve the force on the return stroke.
19. Take the longest possible stroke, but does not allow the blade supporting pins to touch, the job.
20. Do not hold the work piece in hand while cutting.

TRADE: FITTING SHOP	WORKSHOP LAB	EXP: V-FITTING

Aim: To make a V-Fitting on the given work pieces.

Material Required: 50x50x5 mm Mild Steel Work Pieces-2 No's

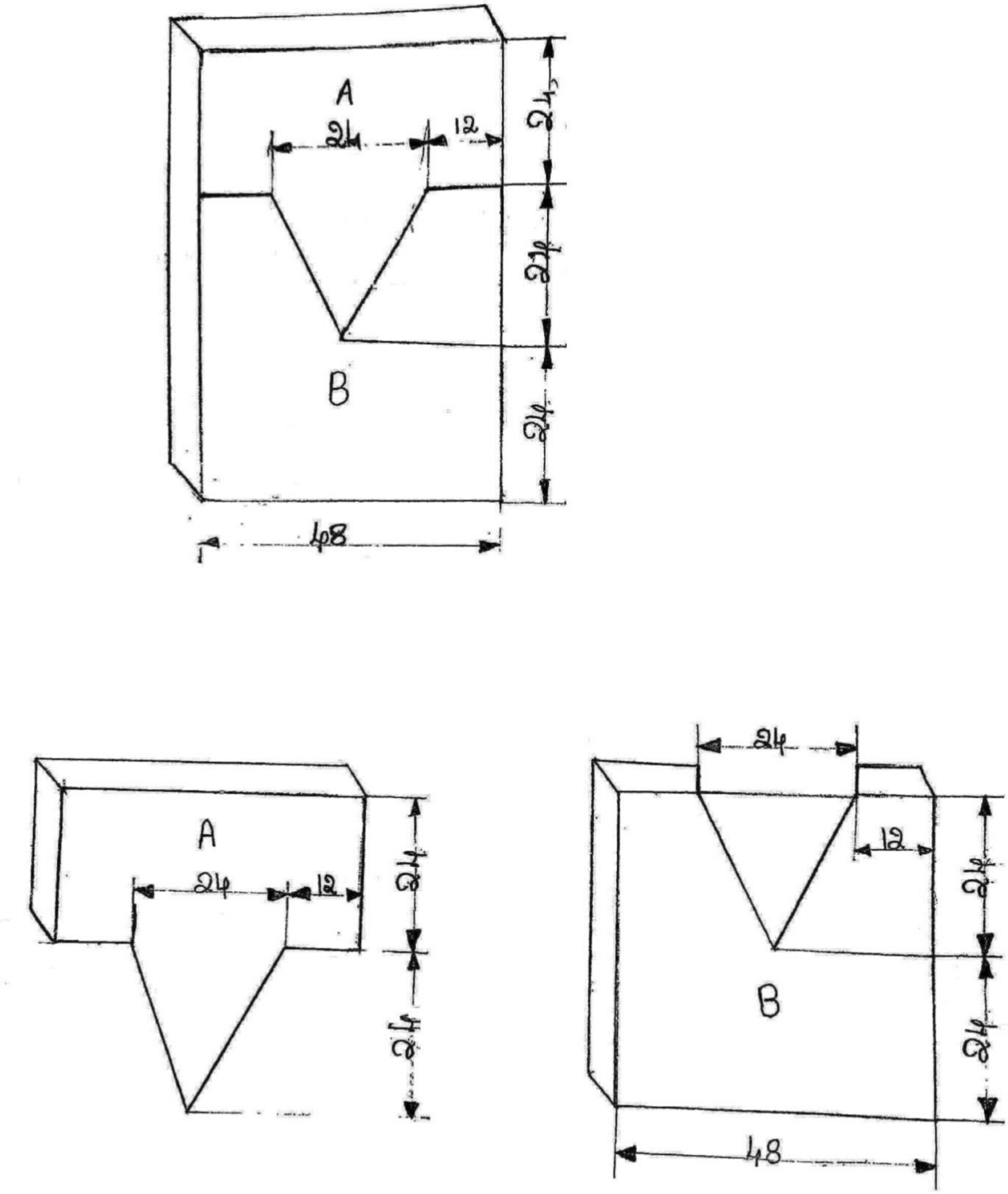
Tools required: 1. Bench vice 2.Steel Rule 3.Standard Set of Filing Tools 4. Try Square 5. Scriber 6. Vernier Height Gauge 7. Surface Plate 8. Angle Plate 9. Ball Peen Hammer 10. Hack Saw 11. Dot Punch. 12. Mild Steel pieces-2

Sequence of Operations: 1. Checking 2. Rough Filing 3. Marking 4. Punching 5. Sawing 6. Rough Filing 7. Finishing Filing.

Working Steps:

- The raw material is checked for its size 50x50x5 mm after debarring.
- The given pieces are fixed rigidly on the vice separately and all edges are filed using flat file so that they are at right angles.
- The chalk is applied uniformly on the surface of the work pieces.
- The work pieces are marked to given dimensions as per drawing with reference to the dot. Using surface plate and vernier height gauge.
- Now using dot punch, dots are punched along the marked line.
- Using Hacksaw frame the unwanted portions are removed cutting edges are filed by using flat files, triangular files finally the assembly is checked for the required class of fit.

Result:



V-

FITTING

ALL DIMENSIONS ARE IN mm.

TRADE: FITTING SHOP	**WORKSHOP LAB**	**EXP: DOVETAIL FITTING**

Aim: To make a Dovetail Fitting on the given work pieces.

Material Required: 50x50x5 mm Mild Steel Work Pieces-2 No's

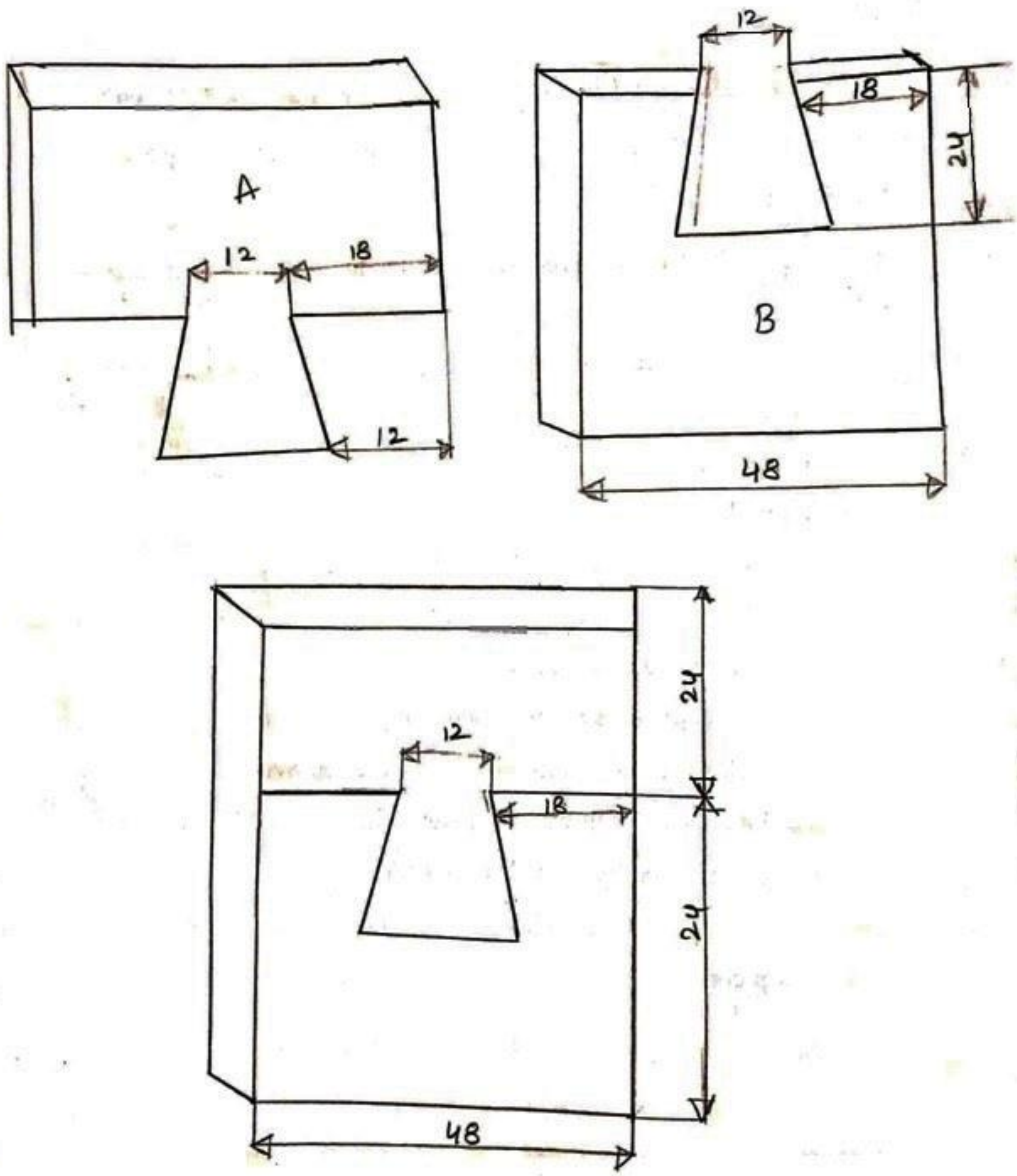
Tools required: 1. Bench vice 2.Steel Rule 3.Standard Set of Filing Tools 4. Try Square 5. Scriber 6. Vernier Height Gauge 7. Surface Plate 8. Angle Plate 9. Ball Peen Hammer 10. Hack Saw 11. Dot Punch. 12. Mild Steel pieces-2

Sequence of Operations: 1. Checking 2. Rough Filing 3. Marking 4. Punching 5. Sawing 6. Rough Filing 7. Finishing Filing.

Working Steps:

- The burrs in the pieces are removed and the dimensions are checked with the steel rule.
- The pieces are clamped one after the other and the outer mating edges are filed and checked for their flatness, with the help of the try-square.
- The side edges of the two pieces are filed such that, they are at right angle to each other and widths are exactly 48 mm.
- Chalk is then applied on the surfaces of the two pieces.
- The given dimensions of the dovetail fitting are marked, by using the Jenny caliper, steel rule and surface plate.
- Using the dot punch, dots are punched along the above scribed lines.
- Using the hack saw, the unwanted portions are removed.
- Using the flat chisel, the unwanted material in the piece Y is removed.
- The cut edges are filed by the half round file.
- The corners of the stepped surfaces are filed by using a square or triangular file to get the sharp corners.

Result:



DOVETAIL FITTING

ALL DIMENSIONS ARE IN mm.

HOUSE WIRING

INTRODUCTION

Power is supplied to domestic installations through a phase and a neutral, forming a single phase A.C 230 V, two-wire system. For industrial establishments, power is supplied through three-phase four wire system, to give 440 V. Figure 3.1 shows the power tappings for domestic and industrial purposes. The neutral is earthed at the distribution sub-station of the supply.

When supplied to domestic utilities, power is fed to a kilowatt meter and then to a distribution panel. The panel distributes power along several circuits. It also protects these circuits from overload by safety devices like fuses or circuit breakers. The panel also serves as a main switch.

As a safe practice, all single-phase devices such as switches, fuses, etc., are connected to the live conductor. All electrical conductors and cables are color coded and must be correctly connected-up. Electrical wiring is defined as a system of electric conductors, components and apparatus for conveying electric power from the source to the point of use. The wiring system must be designed to provide a constant voltage to the load.

ELEMENTS OF HOUSE WIRING

Fuses and Circuit Breakers

These are the devices designed to provide protection to a circuit against excess current. In old type of distribution panels, open link fuses, plug or cartridge fuses were used. In newer panels, circuit breakers are used. If something goes wrong with an appliance or supply, the line becomes overloaded or short- circuited. Then, either the fuse blows-out or circuit breaker trips open, isolating that circuit or appliance. In such cases, the appliance must be checked for defects or it must be ensured that there are not too many appliances in that particular circuit.

Figure 3.2 shows several forms of fuses that are in use. Open link fuses are not safe in operation, even though they are cheaper and reliable. It consists of a thin strip of metal or wire. Here, when the fuse blows-off due to heavy current in the circuit, the metal is spilled around. A modified version of it consists of a porcelain fuse link, backing the wire safely.

Plug

It is a device, carrying two or three metallic contacts in the form of pins, intended for engaging with corresponding socket contacts and arranged for attachment to appliances such as radio, T.V, table fan, etc. Figure 3.5a shows both two pin and three pin plugs.

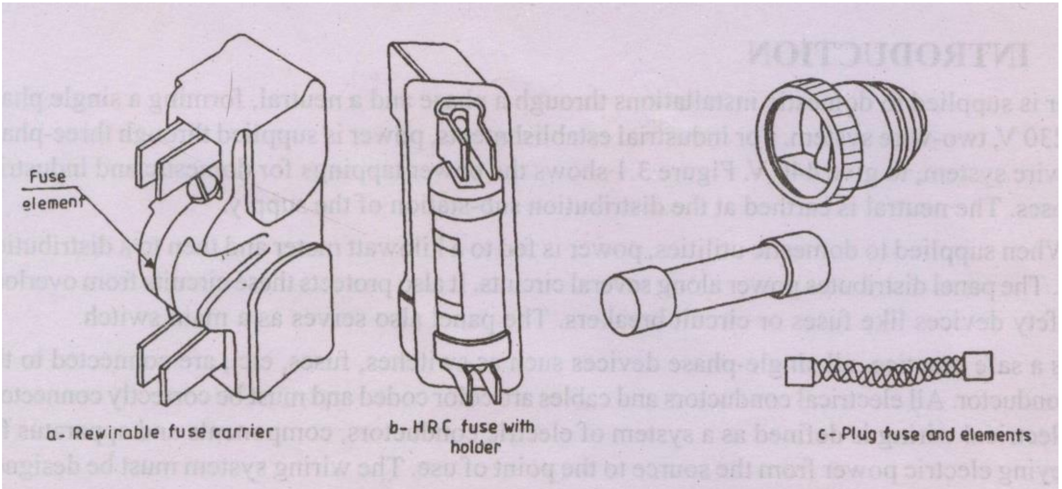


Fig. 3.2 Forms of fuses

Lamp Holder

Lamp holders are designed to hold lamps and connect them in the circuit. Both bayonet cap and screw lamp holders are available up to 200 W lamps. Figure 3.6 shows a lamp holder (pendant type).

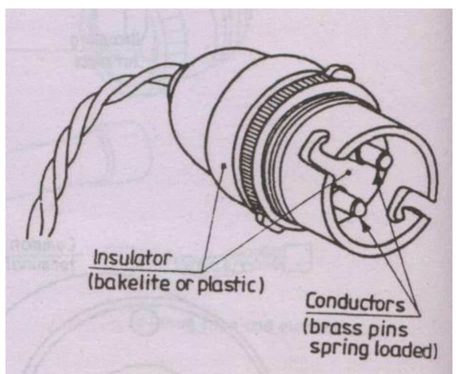


Fig. 3.6 Pendant lamp holder

INTERIOR WIRING

Wires and Wire Sizes

A wire is defined as a bare or insulated conductor consisting of one or several strands. An insulated wire consists of a conductor with insulating material made of vulcanized India Rubber (VIR) or Poly vinyl chloride (PVC). The wire may consist of one or several twisted strands. A multi-core conductor consists of several cores insulated from one another and enclosed in a common sheathing

Wire sizes are specified by the diameter of the wire, using a standard wire gauge (SWG), which also gives an idea of the current carrying capacity. The specification consists of both the number of strands and the diameter of each wire in it. For example, the specification, (i) silk wire 14/36 indicates 14 strands of 36 SWG each and (ii) 3/18 PVC indicates 3 strands of 18 gauges each.

COMMON HOUSE WIRING REPAIRS

An attempt is made here to familiarize the student with the fundamental principles of simple electrical wiring systems, as he/she is also expected to know some of the common house wiring repairs.

Replacing a Fuse

The steps to be followed while replacing a fuse are as follows:

1. Keep a flash light at hand. Also, be sure of having an extra fuse of right capacity.
2. Disconnect the defective appliance or any extra device that might have blown-out the fuse.
3. Open the fuse box and remove the blown-out fuse.
4. Position the new fuse. See that it fits properly in its place, as loose connection may cause a short circuit.

Replacing a Switch or an Outlet

Following are the stages involved in replacing a switch or an outlet:

1. Obtain the switch or outlet of the type that has to be replaced.
2. Disconnect the power supply, by putting off the main switch.
3. Remove the switch or outlet cover with a screw driver.
4. Loosen the switch or outlet and remove it from the box or wall, after noting how different colored wires are attached.
5. Position the switch or outlet in its place and connect the wires.
6. Fix the cover plate.
7. Put-on the main switch.

Repair of Household Appliances

Household appliances are of two types; those which are motor driven and those which are of heating type. Motor driven appliances include refrigerator, washing machine, sewing machine, etc. Heating appliances are iron box, frying pan, toaster, electric heater, water heater, etc.

While connecting the wires with electrical accessories; the following are the steps to be followed:

1. Open the cover of the electrical accessory, with the help of screw driver.
2. Loosen screws of the terminals.
3. Take two pieces of wires and remove nearly 25 mm of insulation from one end.
4. Bend half of the bare wire by 180°.
5. Insert one of the bent wires in the terminal of the accessory and tighten it with the screw.
6. Insert the other piece of the bent wire in the second terminal of the accessory, in the same manner as above.
7. Put the cover on the accessory.

Precautions

1. Ensure that the insulation of the wire reaches upto the terminal of the accessory.
2. Do not remove the insulation, more than what is needed.
3. Do not over-tighten the screw.
4. Bend the bent wire slightly, after placing it in the terminal.
5. Ensure that the bare wire is not touching any part of the accessory.

Rules for wiring

1. Every fitting or appliance must be controlled by a switch.
2. Every socket outlet must also be controlled by a switch.
3. The switch should be on the live conductor.
4. The incandescent lamps should be suspended atleast 2.5 m above the floor level.
5. All ceiling fans must be hanged at least 2.75 m above the floor level.
6. Power wiring should be separated from wiring for illumination.
7. Every sub-circuit must have a separate fuse.
8. The switches and starters of the motors should be easily accessible.
9. All the metal coverings, frames, etc., should be earthed.

EARTHING

The definition of the term, 'earthing' or 'grounding' as it is otherwise called, refers to the connection of the electrical equipment, to the mass of the earth by a wire of negligible resistance, for the safety of the human body from shocks.

The metallic covers of machines, the frames of the machines, sheathing of wiring, etc., are generally dead. Failure of insulation or workmanship, may make these alive. When this happens, a person touching the parts receives an electric shock. To avoid this, the relevant parts are earthed. A good earthing system should have a very low resistance and should be in a position to allow the leakage current through it.

The following are the methods of earthing:

(i) Earthing through a water main,

(ii) Plate earthing, and

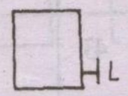
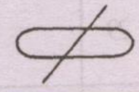
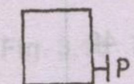
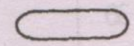
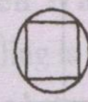
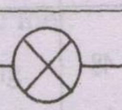
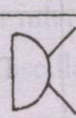
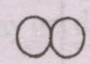
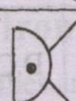
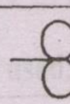
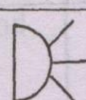
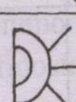
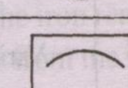
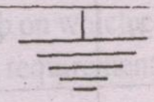
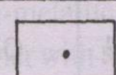
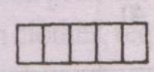
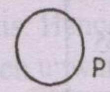
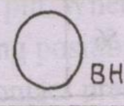
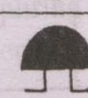
(iii) Pipe earthing. The following are some of the items that

need earthing:

Metallic coverings, containing electric supply wires, switches, distribution fuse boards, ceiling fans, generator frames, stationary and portable motors, metallic parts of transformers, refrigerators.

CIRCUIT SYMBOLS

Table 3.1 gives circuit symbols of certain electrical items.

S. No.	Description	Symbol	S. No.	Description	Symbol
1	Main switch (Light)		15	Single tube light	
2	Main switch (Power)		16	Double tube light	
3	Meter		17	Bell	
4	One way switch		18	Buzzer	
5	Two way switch		19	Horn	
6	Lamp		20	Siren	
7	Two pin socket 5 Amp.		21	Ceiling fan	
8	Two pin socket with switch 5 Amp.		22	Bracket fan	
9	Three pin socket with switch 5 Amp.		23	Exhaust fan	
10	Three pin socket 15 Amp.		24	Fan regulator	
11	Three pin socket with switch 15 Amp.		25	Earth	
12	Bell push		26	Heater	
13	Single light pendent		27	Fire alarm push	
14	Batten lamp holder		28	Fire alarm bell	

SAFE PRACTICES

1. When closing the electric switch, always grasp the switch by the insulated handle.
2. Do not run too many electrical items from one point.
3. Use fuses and circuit breakers of proper capacity, so as to interrupt the current before it becomes dangerous.
4. Disconnect the units to be repaired, free from power supply and make sure that they might not be energized while the repair work continues.
5. Do not pour water to put-on fires in electric wires and electric equipment. You will be subjected to electric shock or you will be electrocuted, Use sand to put-off fires in electric items.
6. Whenever there! is power failure, put-off the power supply to all equipment, in order to prevent spontaneous recovery.
7. Never remove a plug from an outlet by pulling the cord. Always pull by the plug.
8. Never work on electric wires when the power is on.
9. Never work with bare feet. It is better to wear rubber shoes while working.
10. While testing, always keep one hand in your pocket. If the hands are in contact with a circuit, a current will flow across your body and is more dangerous.
11. Electricity has no respect for ignorance. Do not apply voltage or turn-on any device until, it has been properly checked.
12. Check theearth connection before switching-on portable equipment.
13. Before replacing the blown fuse, always switch-off the main switch.

WORKSHOP LAB

TRADE: HOUSE WIRING SHOP

EXP: TWO LAMPS CONTROLLED BY ONE WAY SWITCH IN SERIES

Aim: To connect the two lamps to one-one way switch in Series.

Tools required:

1. Wires-4
2. Bulbs-2
3. Screws-6
4. PVC pipes
5. Wooden Board
6. Screw Driver-1
7. Cutting plier-1
8. Junction Box-3
9. One-way switch-1
10. Clamps
11. Tester
12. Lamp holders-2
13. Fuse
14. Insulation Tape

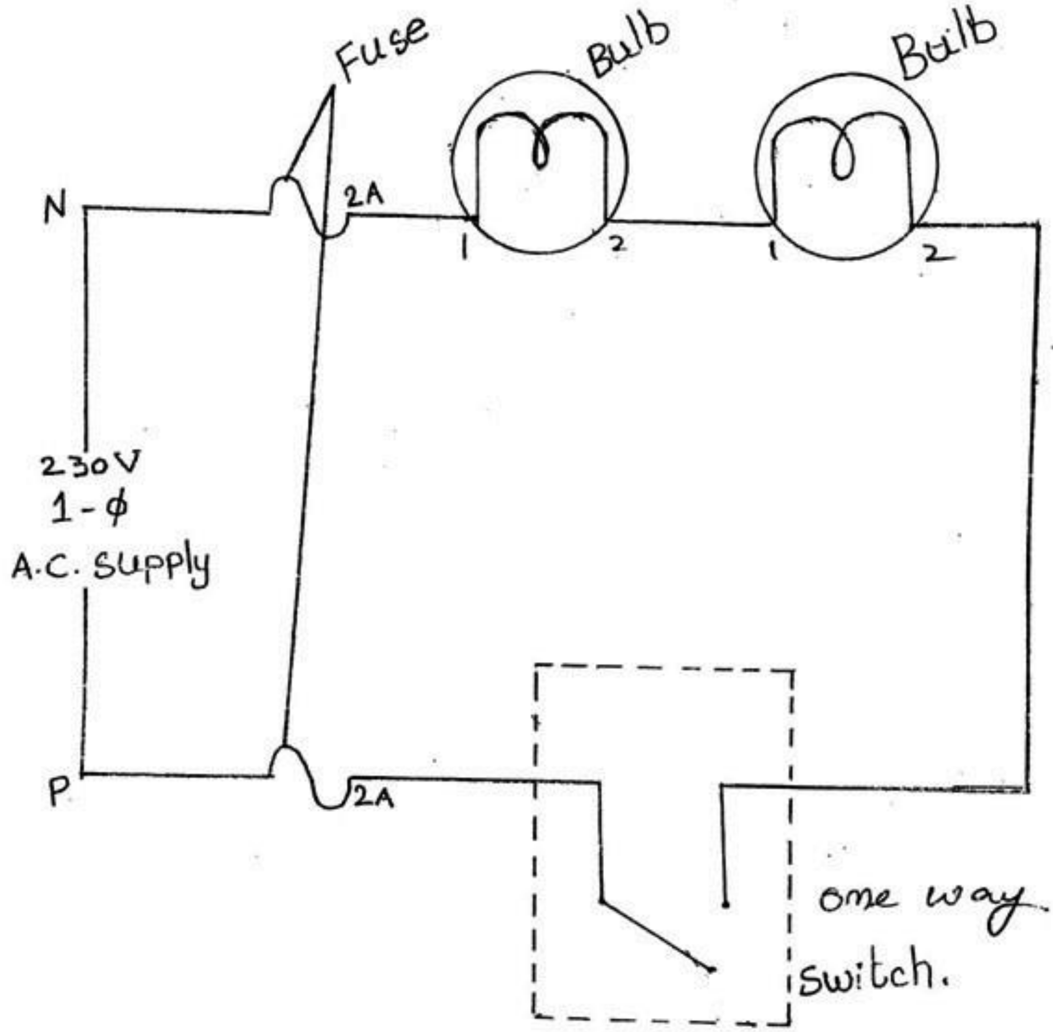
PROCEDURE:

- Connect the neutral point to the first terminal of the first bulb.
- The second terminal of the first bulb is connected to 1st terminal of second bulb.
- The 2nd terminal of second bulb is connected to second terminal of switch.
- 1st terminal of switch is connected to pole.

PRECAUTIONS:

- Check the connections whether they are connected loosely or tightly.
- Handle tools carefully.
- Whether the switch is ON position we should not touch the circuit.

Result:



CIRCUIT DIAGRAM

TWO LAMPS CONTROLLED BY ONE WAY SWITCH IN SERIES

WORKSHOP LAB

TRADE: HOUSE WIRING SHOP

EXP: TWO LAMPS CONTROLLED BY ONE WAY SWITCH IN PARALLEL

Aim: To connect the two lamps to the one-one way switch in Parallel.

Tools required:

1. Wires-4
2. Bulbs-2
3. Screws-6
4. PVC pipes
5. Wooden Board
6. Screw Driver-1
7. Cutting plier-1
8. Junction Box-3
9. One-way switch-1
10. Clamps
11. Tester
12. Lamp holders-2
13. Fuse
14. Insulation Tape

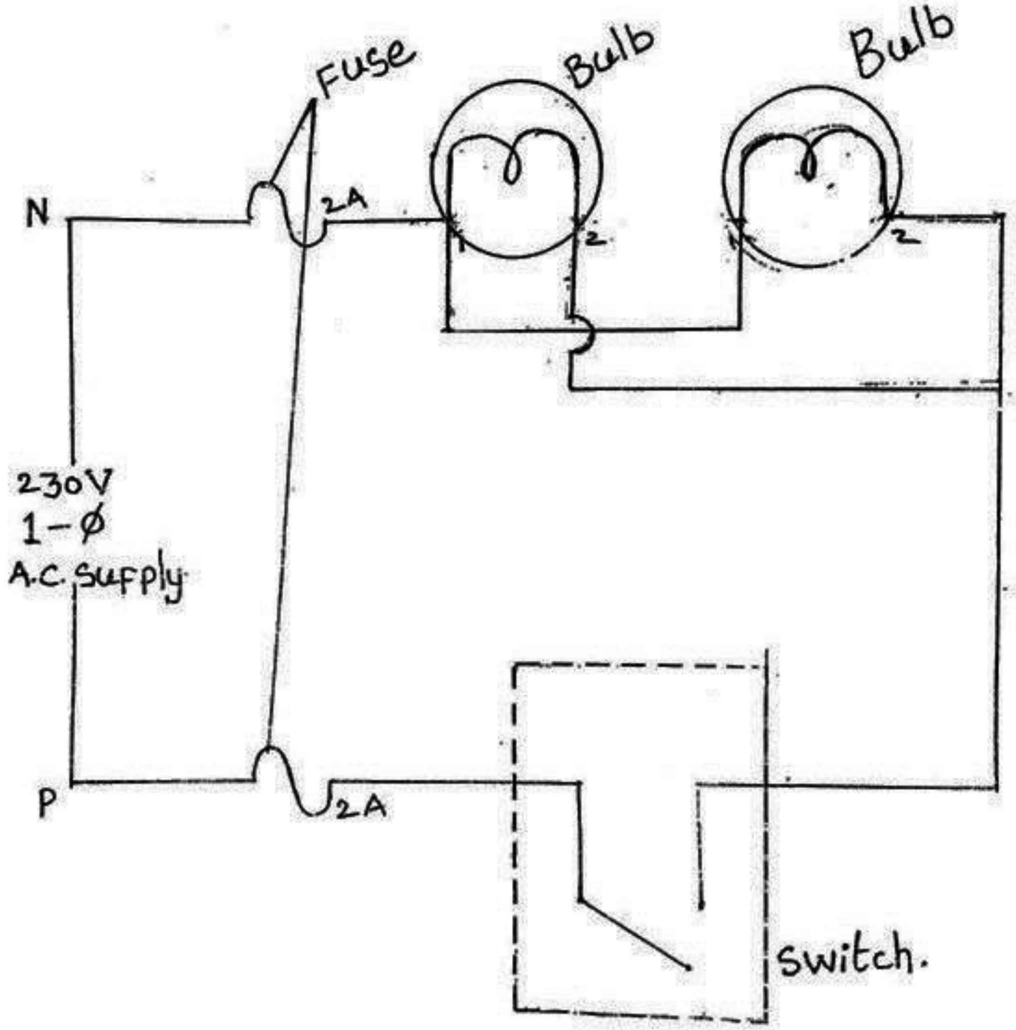
PROCEDURE:

- Connect neutral point to 1st bulb of first terminal and is connected to 2nd bulb of 1st terminal.
- First bulb of second terminal is connected to second bulb of second terminal and connected to switch of one side.
- Switch of second terminal is connected to pole.

PRECAUTIONS:

- Check the connections whether they are connected loosely or tightly.
- Handle tools carefully.
- Switch of second terminal is connected to pole.
- Whether the switch is ON position we should not touch the circuit.

Result:



CIRCUIT DIAGRAM

TWO LAMPS CONTROLLED BY ONE WAY SWITCH IN PARELLEL

WORKSHOP LAB

TRADE: HOUSE WIRING SHOP

EXP: ONE LAMP CONTROLLED BY TWO-TWO WAY SWITCHES IN (OR) WIRING FOR STAIR CASE LAMPS

Aim: To give connections for one lamp controlled by two-two way switches.

Tools required:

1. Wires-4
2. Bulbs-1
3. Screws-6
4. PVC pipes
5. Wooden Board
6. Screw Driver-1
7. Cutting plier-1
8. Junction Box
9. Two-way switches-2
10. Nails
11. Tester
12. Bulb holder-1
13. Fuse
14. Insulation Tape

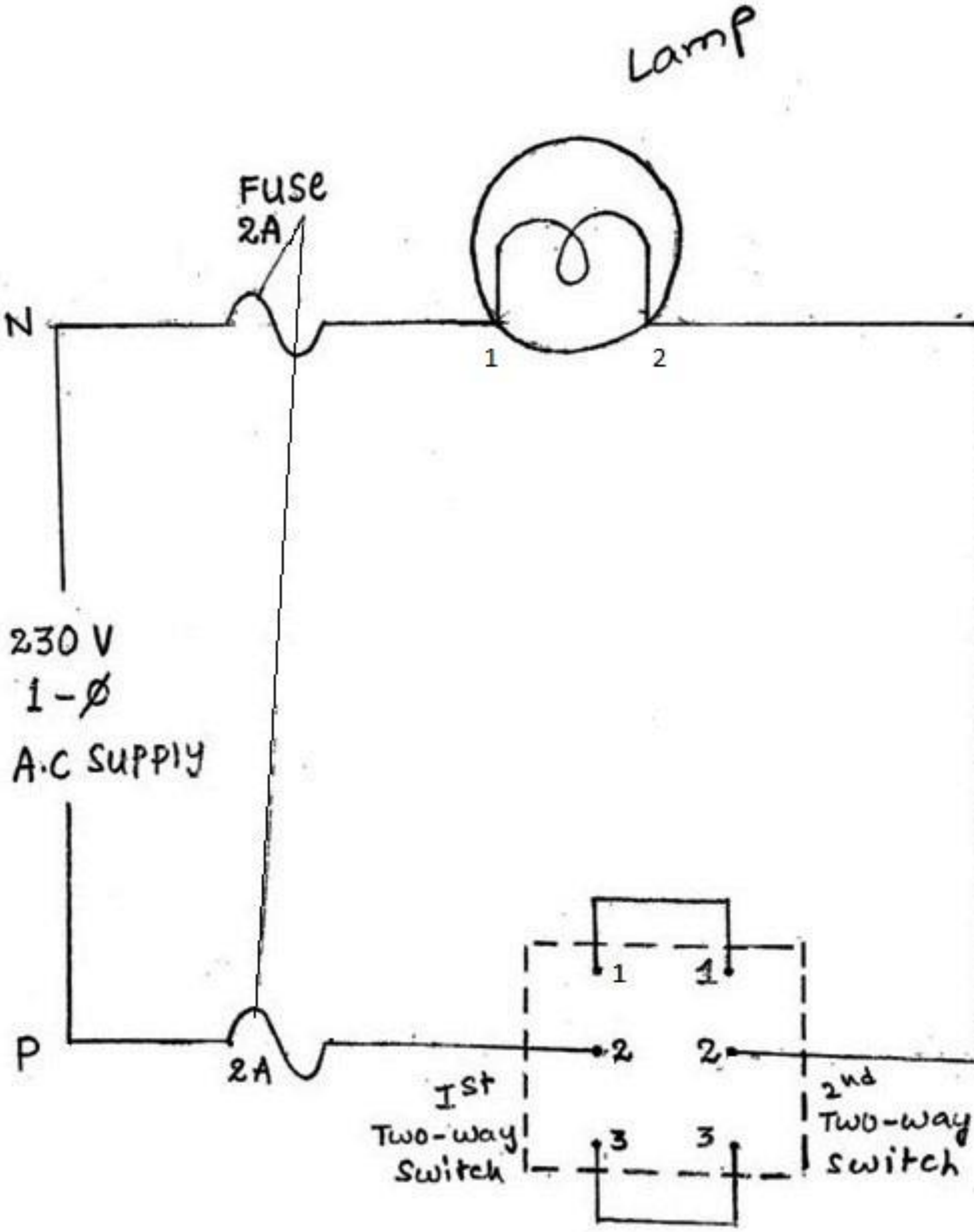
PROCEDURE:

- Connect a wire from neutral point to 1st point of bulb.
- Connect a wire 2nd point of bulb holder to the middle of point of 2nd switch.
- First switch of 1st point and 2nd switch, 3rd point is connected to first switch 3rd point.
- Phase point is connected to the first switch of middle point.
- Fix the bulb to the holder and put the fuses to the main.

PRECAUTIONS:

- Connect wires to the neutral and phase correctly.
- Wear the shoes while doing experiment.
- Connect the wires in proper position.
- Whether the switch is ON position we should not touch the circuit.

Result:



CIRCUIT DIAGRAM

ONE LAMP CONTROLLED BY TWO-TWO WAY SWITCHES

TIN SMITHY
(SHEET METAL)

INTRODUCTION

Many engineering and house hold articles such as hoppers, guards, covers, boxes, cans, funnels, ducts, etc., are made from a flat sheet of metal; the process being known as tin smithy. For this, the development of the article is first drawn on the sheet metal, then cut and folded, to form the required shape of the article. The edges of the article are then secured through welding, brazing, soldering, riveting, etc. For successful working in the trade, one should have a thorough knowledge of project! ve geometry and development of surfaces.

Allowance should be given in the drawing stage for folding and bending. This allowance depends upon the radius of the bend and thickness of the sheet metal.

SHEET METAL MATERIALS

A variety of metals are used in a sheet metal shop such as black iron, galvanized iron, copper, tin, jluminum and stainless steel.

Black iron is the cheapest metal. The name black iron is because of its black color. It is rolled o the desired thickness and then annealed. It corrodes rapidly, because it is not coated. The ipplication of this metal is limited to articles that are to be painted.

A sheet of soft steel, which is coated with molten zinc is known as galvanized iron. The zinc :oat forms a coating that resists rust, improves the appearance of the metal and permits it to be soldered with greater ease.

Copper sheets are available as cold or hot rolled sheets. Copper is highly resistant to corrosion. As it is a ductile material, copper sheets can be formed into complex shapes and the joints can be wed easily.

Iron sheets, coated with tin are known as tin sheets. Tin sheets are used for dairy equipment, cans, pans, food containers, etc. The thicknesses of tin sheets are denoted by special marks and not by gauge numbers.

Aluminum in the form of sheets can be used with the addition of small quantities of metals like copper, silicon, manganese and iron. It is widely used for processing vessels and tanks, house-hold appliances, refrigerator trays, kettles, etc. Aircraft structures are mainly made from aluminum and its alloys.

Stainless steel is an alloy of steel with 8-4% nickel, 18% chromium and traces of other metals. It has got greater resistance to corrosion and can be welded. It is used for making kitchen-ware, dairy and food processing plants, chemical plants, etc.

HAND TOOLS

The common hand tools used in sheet metal work are, steel rule, usually of 60 cm length, wire gauge, dot punch, trammel, scriber, ball-peen hammer, straight-peen hammer, cross-peen hammer, mallet, snips and soldering iron.

Wire Gauge

The thickness of sheet metal is referred in numbers known as standard wire gauge (SWG). The gaps in the circumference of the gauge are used to check the gauge number as shown in Fig. 4.2. Some of the standard wire gauge numbers with corresponding thick nesses are as follows (Table. 4.1):

Table 10.1

SWG No	Thickness, mm
10	3.20
12	2.60
14	2.30
16	1.60
20	1.00
22	0.70
24	0.65
26	0.45
30	0.30

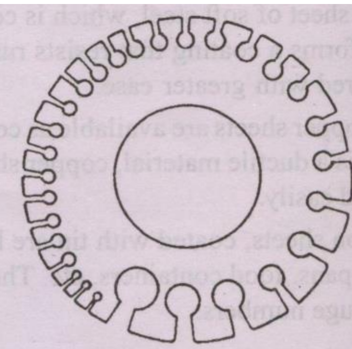


Fig. 10.2 Standard wire gauge

Snips

Snips are hand shears, varying in length from 200 mm to 600 mm, 200 mm and 250 mm being the lengths commonly used. Figure 4.4 shows straight and curved snips. The straight snip is used for cutting along outside curves and straight lines and curved snip or bent snip is for trimming along inside curves.

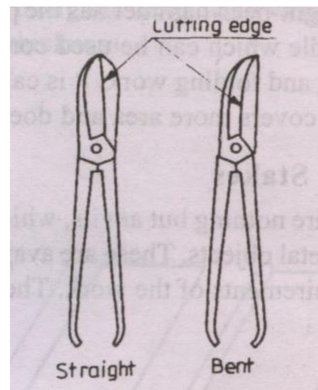


Fig. 10.4 Snips

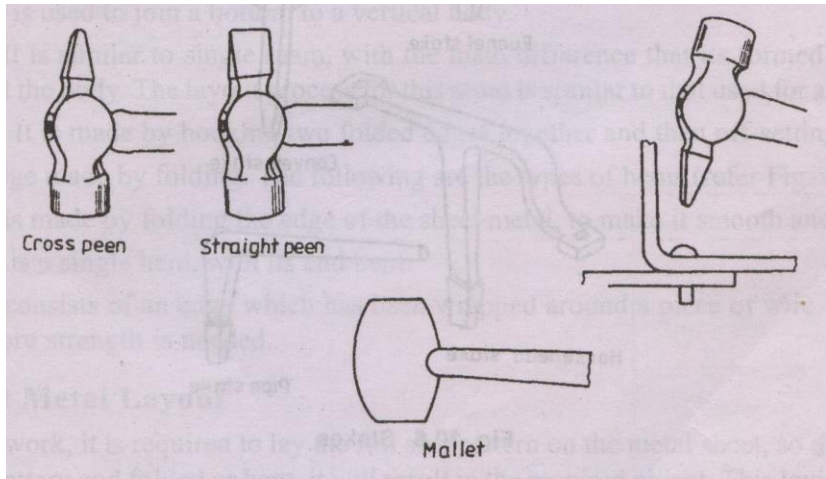


Fig. 10.5 Hammers

Hammers

Light weight hammers and mallets are used in sheet metal work.

Ball-peen hammer has a cylindrical, slightly curved face and a ball head. It is a general purpose hammer, used mostly for riveting in sheet metal work. Cross-peen hammer shown, has a tapered peen end and is perpendicular to the handle. Because of this, it can reach awkward corners as shown.

Straight-peen hammer has the peen end similar to the cross-peen, but it is positioned parallel to the handle which can be used conveniently for certain operations of folding, Mallet is used for bending and folding work. It is called as soft hammer. Generally, it is made of wood. It is light in weight, covers more area and does not dent the work.

Stakes

Stakes are nothing but anvils, which are used as supporting tools and to form, seam, bend or rivet sheet metal objects. These are available in different shapes and sizes as shown in Fig. 4.6, to suit the requirements of the work. They are made from wrought iron, faced with steel.

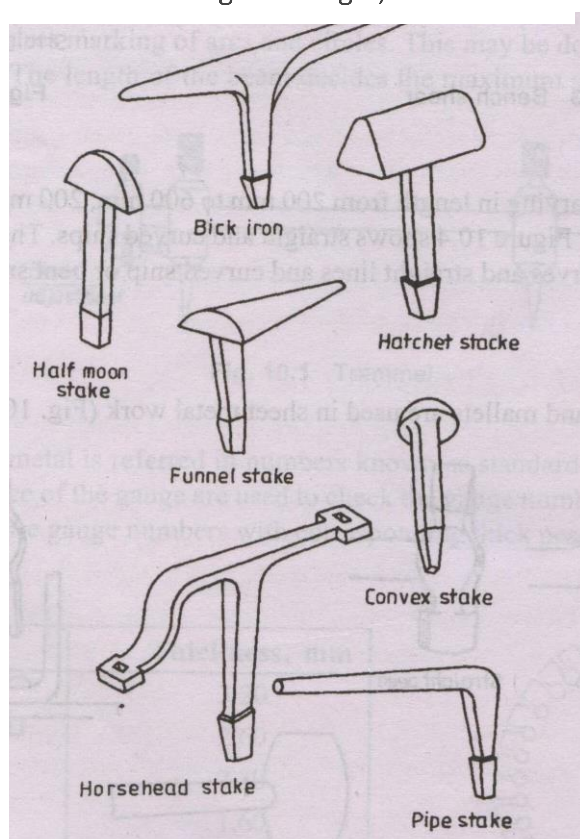


Fig. 10.6 Stakes

SHEET METAL JOINTS

Various types of joints are used in sheet metal work, to suit the varying requirements. Some commonly used sheet metal joints and folded edges are shown in Fig. 4.7. These are self secured joints, formed by joining together two pieces of sheet metal and using the metal itself to form the joint. These joints are to be used on sheets of less than 1.6 mm thickness.Various forms of seams and hems are associated with sheet metal works; as described below:

A seam is a joint made by fastening two edges together. The following are the types of seams

Single seam It is used to join a bottom to a vertical body.

Double seam It is similar to single seam, with the main difference that its formed edge is bent upward against the body. The layout process for this seam is similar to that used for a single seam.
Grooved seam It is made by hooking two folded edges together and then off-setting the seam. A hem is an edge made by folding. The following are the types of hems (refer Fig. 4.7): ***Single hem*** It is made by folding the edge of the sheet metal, to make it smooth and stiff. *Double hem* It is a single hem, with its end bent.

Wired edge It consists of an edge which has been wrapped around a piece of wire. This edge is used where more strength is needed.

Sheet Metal Layout

In sheet metal work, it is required to lay the full size pattern on the metal sheet, so that when it is cut along the pattern and folded or bent, it will result in the required object. This laying-out of the complete surface on the metal sheet is known as the development of the surface of the object.
However, while laying-out, it is necessary to provide excess material for the joints known as allowance. Figure 4.8 shows the layouts of certain objects and the shapes obtained when formed

SOLDERING

Soldering is one method of joining two or more pieces of metals by means of fusible alloy, called solder, applied in the molten state-. The melting temperature of the solder should be lower than that of the base metals being joined. For a good job, the metals to be joined must be free from dirt, grease and oxide. Solder is made of tin and lead, usually in equal proportions. It comes either in the form of wire or bar. A soldered joint cannot withstand high temperatures (more than 150° C) and pressures.

Capillary action between the solder and base metal will not take place unless the base metal is clean. A flux is used with the solder to remove oxides and thus permit good solder wetting. An acid flux is used for black iron and galvanized iron. A rosin flux is used for tin plate, copper and electric wire.

Soldering is advantageous as, similar and dis-similar metals, can be joined by this process.

NOTE When in its hot molten state, the solder, on contact with the base metal, transfer its thermal activity by convection. The solder alloy will combine with the base metal at the interface of the two. Edges of the crystal lattice structure overlap each other and join to form a solid that is mechanically and electrically continuous, i.e., in soldering, the adhesion is not mechanical but chemical.

Soldering Iron

Soldering requires a source of heat. A common method of transmitting heat to the metal surfaces is by using a soldering iron. Figure 4.11 shows the soldering iron used for the purpose. The working end of this tool is made of copper, which is a good conductor of heat. In electrical soldering; the soldering iron is heated by passing current. But, in the ordinary soldering, the bit is heated by a heating source like furnace, etc

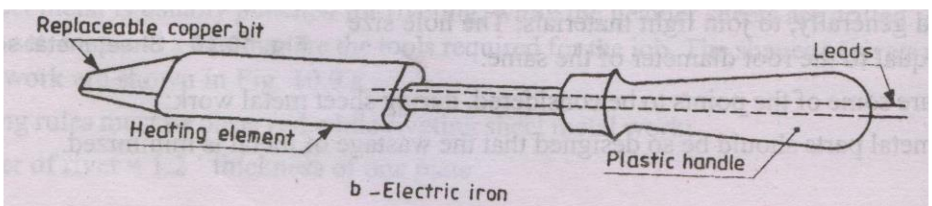


Fig. 10.11 Soldering irons

Method of Soldering

The following are the stages involved in soldering work:

1. Clean the surfaces to be soldered.
2. Keep the surfaces to be joined, close together.
3. Apply a thin layer of flux with a brush.
4. Heat the soldering copper to proper temperature.
5. Tack the seam by applying solder at several points.
6. Begin at one end and move the copper bit slowly, adding solder as needed.
7. Allow the joint to cool.
8. Clean the joint and then test the joint for strength.

NOTE i. Do not handle the soldered job, until the solder is partially cooled.

ii. Do not melt the solder on the copper bit itself. Instead, heat the metals to be joined to melt the solder.

Reasons for using Soldering Flux

The application of flux is necessary in soldering, as it assists the process of soldering, by assuring proper contact between the base metals and solder. The following are the reasons for using the soldering flux:

J. To clean the surface of the base metal during heating

2. To eliminate impurities present in metals
3. To break down the surface tension of the metal and enable the solder to flow
4. To prevent the formation of fresh oxides, by forming a protective layer on the solder

Uses of Soldering

Soldering is used to join the following:

1. Electrical components in television, radio, transistor and tape recorders
2. Electronic components like printed circuit boards
3. Automobile parts like radiators and copper pipes
4. Sheet metal works
5. Utensil repairs

SAFE PRACTICES

General

1. Use hand leather gloves while handling heavy sheets.
2. Avoid feeling the cut portion by hand while cutting with snip.
3. Do not let sheet metal slip through your hands. Most cuts from sheet metal result from allowing it to slide through the hands.

Snips

1. Use snips only for metal that can be cut by force applied by hand.
2. Hand snips should never be used to cut wire. Such practice ruins the cutting edges of the blades.

TRADE: TIN SMITHY SHOP	WORKSHOP LAB	EXP: TAPERED TRAY

Aim: To prepare a Tapered tray by using metal sheet.

Material Required: 180x180 mm G.I Sheet

Tools required:

1. Sheet Metal	2.Straight Snip	3.Bent Snip (Curved Snip)
4. Scriber	5. Mallet	6. Divider
7. Steel Rule	8. Stake	9. Compass
10. Straight Peen Hammer		11. Ball Peen Hammer.

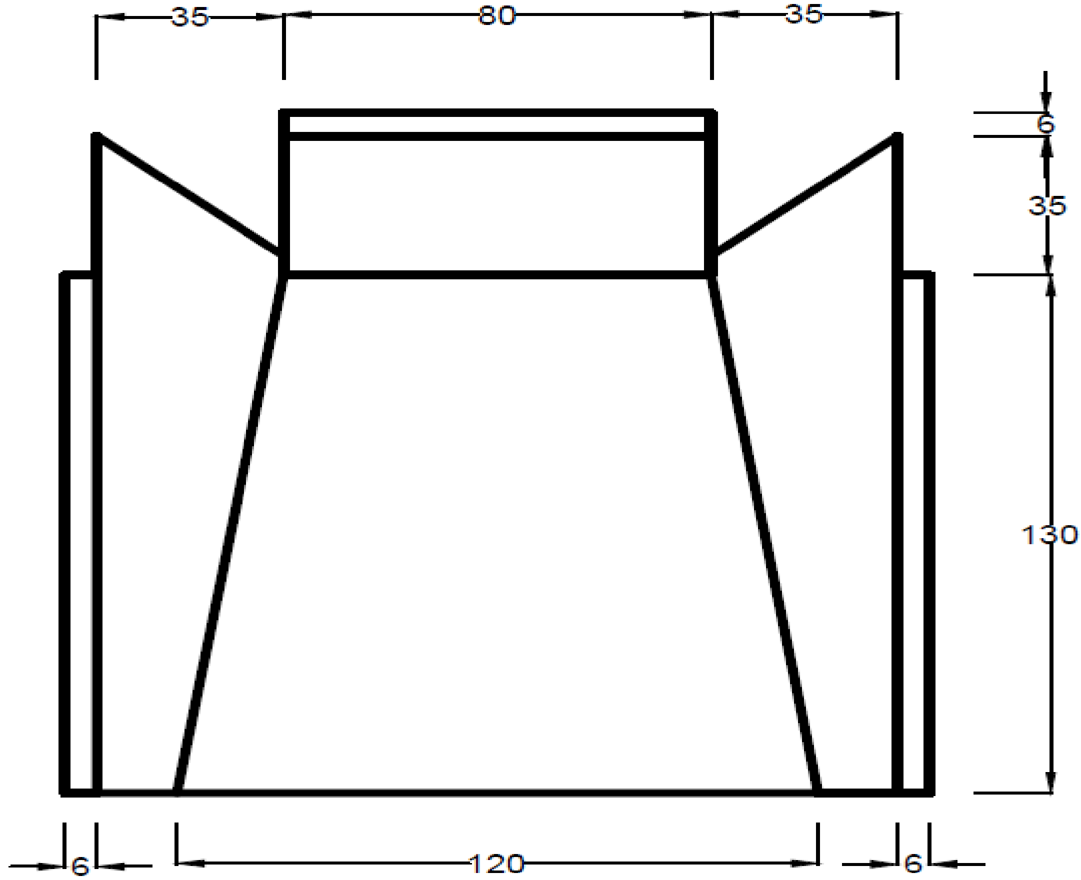
Procedure:

- A plate of sheet metal of required size is taken and the required dimensions of given rectangular tray are marked on the sheet by using scriber.
- And each edge one curved shapes are given a 5mm excess width for the purpose of folding.
- As per the dimensions the sheet is cut off by using straight snip whenever is required.
- Now the initially given 5mm excess width is folded in required directions of each edge and corners.
- Then all attachable parts are attached with use of foldable edges by using ball peen hammer, mallet and stakes.
- So that required rectangular tray is prepared by the thin sheet metal.

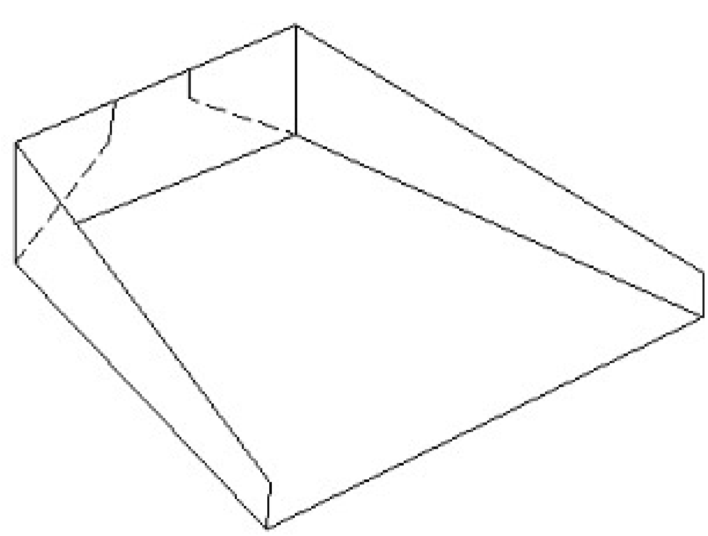
Precautions:

- The dimensions are carefully marked by giving 95mm excuse width.
- As the edges and corners are very sharp, care is taken while cutting and folding the edges. The foldable parts and edges are folded by hammered and stakes only.

Result: Thus the required Tapered tray shape has prepared by using metal sheet and different types of tools.



DEVELOPMENT OF TAPERED TRAY



TAPERED TRAY

TRADE: TIN SMITHY SHOP	WORKSHOP LAB	EXP: PIPE ELBOW

Aim:To prepare a Pipe Elbow by using metal sheet.

Material Required: 300x160 mm G.I Sheet

Tools required:

1. Sheet Metal 2.Straight Snip 3.Bent Snip (Curved Snip)
4. Scriber 5. Mallet 6. Divider
7. Steel Rule 8. Stake 9. Compass
10. Straight Peen Hammer 11. Ball Peen Hammer.

Procedure:

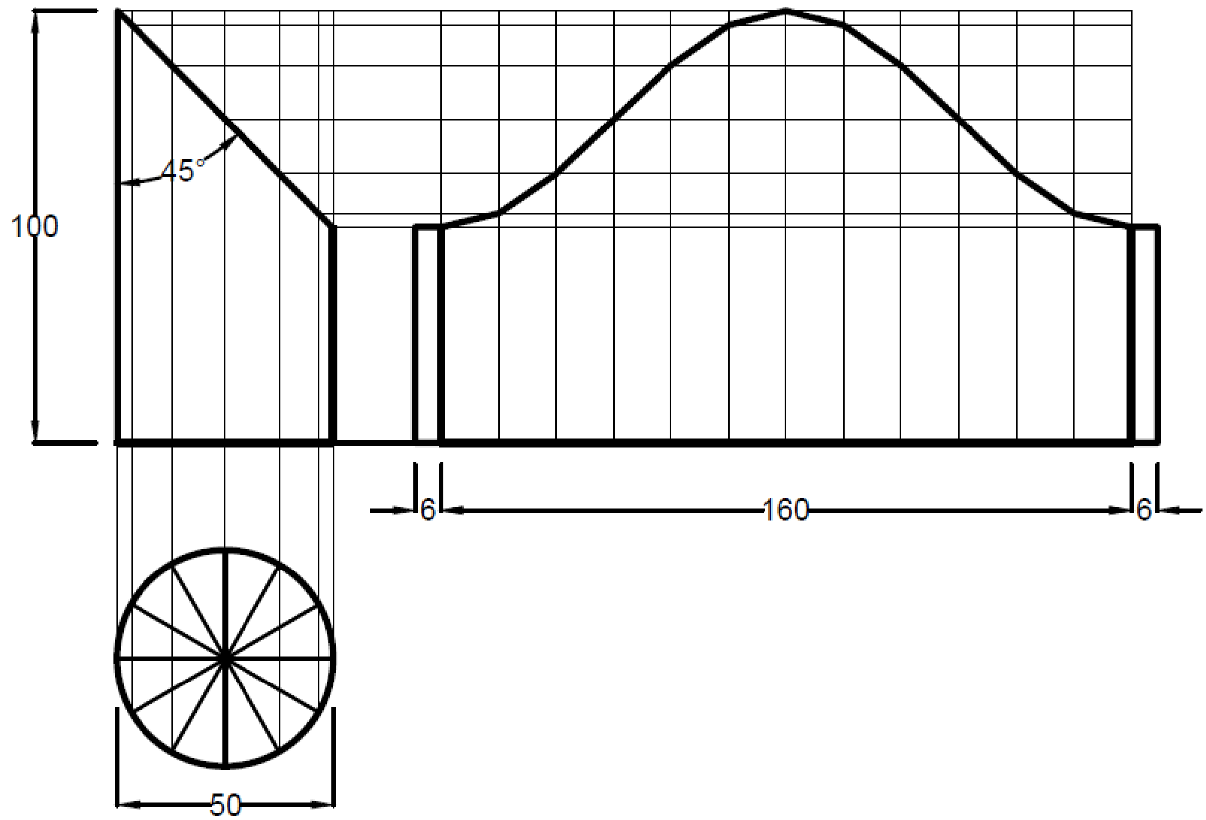
- The operation consists of making two similar cylindrical pipes truncated at an angle of 45^o on one side of each pipe seamed at beveled ends.
- Drawing the development of a cylindrical pipe truncated at an angle of 45^o on one side.
- Scribing the lines on the sheet by placing the pattern on it.
- Cutting the sheet over the marked dimensions using the curved snips.
- Hem the straight side of the sheet and flange the curved side of the sheet.
- Folding the edges of the joining sides.
- Forming the sheet into cylindrical shape by using stake.
- Seam the sides by using mallet.
- Repeating the similar operations for making second pipe for making elbow.

Precautions:

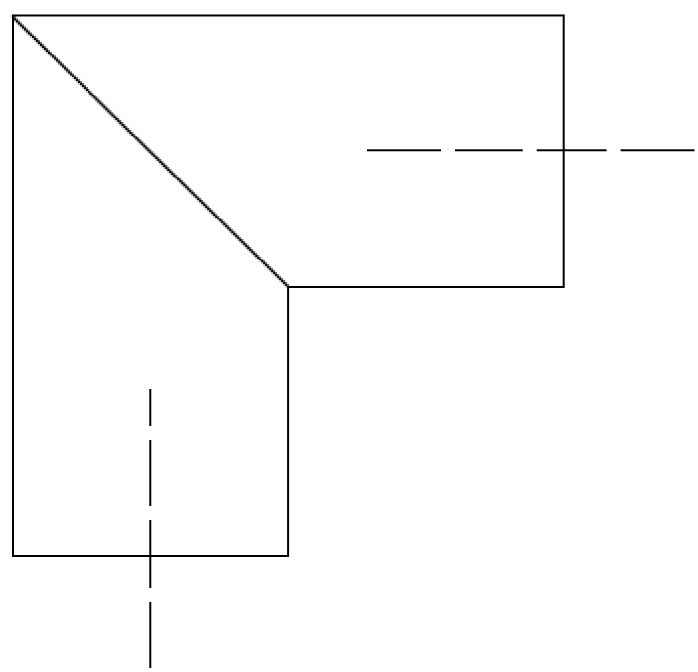
- The dimensions are carefully marked by giving 95mm excuse width.
- As the edges and corners are very sharp, care is taken while cutting and folding the edges. The foldable parts and edges are folded by hammered and stakes only.

Result:

Thus the required Pipe Elbow shape has prepared by using metal sheet and different types of tools.



DEVELOPMENT OF PIPE ELBOW



PIPE ELBOW