Lab Manual
On
Workshop Practice-I
(ES-ME 191/291)

DEPARTMENT OF MECHANICAL ENGINEERING
HALDIA INSTITUNTE OF TECHNOLOGY

COURSE INFORMATION

Workshop Practice Lab
Code: ES-ME191/291
Contacts:
Contact Hours Per week: 3P
Credits: 1.5

Syllabus

A. THEORETICAL PART

1. INTRODUCTION TO MANUFACTURING; Socio-economic role, Definition, Major grouping and Examples. - 1L

2. ENGINEERING MATERIALS; Classification / Major grouping, Physical, Chemical and Mechanical properties, Applications - 1L

3. DIFFERENT CONVENTIONAL MANUFACTURING PROCESSES MAINLY COVERING BASIC PRINCIPLES, DIFFERENT METHODS AND GENERAL APPLICATIONS; Manufacturing by forming /shaping from solid (input) to solid (product); Forging, Rolling, Drawing, Extrusion; Press tool work- Bending, Shearing, Drawing and Coining. - 3L

4. FORMING / SHAPING FROM LIQUID TO SOLID- CASTING; General principles, General classification or Types of casting; Sand mould casting- procedural steps and requirements; Pattern, Mould, Melting, Pouring, Solidification, Extracting and Fettling. Other casting processes (for larger volume and quality); Centrifugal casting, Investment casting, Die casting. -3L

5. JOINING PROCESSES; Welding (Permanent Joining)- General classification and basis; Gas welding, Arc welding, Friction welding and Resistance welding, w.r.t. Principle, Requirements, Relative Advantages and Applications; Brazing and soldering.- 2L

6. REMOVAL (MACHINING) PROCESS; Principle and purpose of machining, Machining requirements, Machine tools- Definition, General classification w.r.t, functional principles and applications; Major machining parameters (and responses)- Speed, Feed and Depth of cut; Tool geometry (Rake, Clearance and Cutting angles), Cutting fluid application; Elementary machining operations- Facing, Centering, Turning, Threading, Drilling, Boring, Shaping and Milling. .- 2L

SCHEDULE OF PRACTICAL CLASSES
Suggested apportionment / weigtage:
• Machining (and fitting)- 50% (6 days) 18 hrs
• Casting (including pattern making molding and preparation) - 25% (3 days 9hrs)
• Welding (gas, arc and resistance) (2 days 6hrs) and Sheet Metal Working (1 day 3hr)- 25% (3 days 9hrs)

FEASIBLE TYPES / MODELS OF ASSIGNMENTS

WP1) **PATTERN MAKING, SAND MOULDING AND CASTING** (in 3 classes or 9 hours); To make a wooden pattern and a sand mould with that pattern for casting a cast iron block

WP2) **WELDING (ARC WELDING)** (in 1 day or 3 hours); To join two thick (6mm) MS plate

WP3) **WELDING (GAS WELDING**) (in 1 class or 3 hours); To join two thin mild steel plates or sheets (1 to 3 mm thick

WP4) **FITTING** (in 2 days or 6 hours); Making a gauge from MS plate

Operations required:
Squaring and finishing of the blank by filing
Making the Vee-portion by sawing and filing
Drilling (in machine) and tapping (hand)

WP5) **MACHINING** (in 3 days or 9 hours); To make a pin as shown in Fig.2 from a 20mm mild steel rod in a lathe.

WP6) **MACHINING** (in 1 day or 3 hours); To make a MS prism as shown in Fig.3 from a 20mm mild steel rod in a shaping and / or milling machine.

WP7) **SHEET METAL WORK** (in 1 day or 3 hours); Forming a cone, for example.

Department of Mechanical Engineering
Workshop Practice Laboratory
Experiment No. : ES-ME 191/291--01

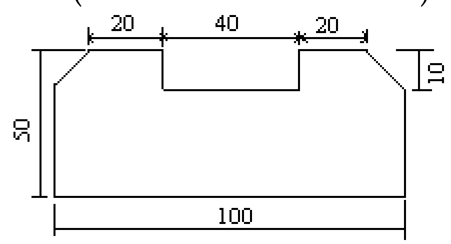
Title of Experiment: Manufacturing of a wooden pattern for casting of a given final product.

Objective of Experiment: To be familiar with the process of pattern making including pattern materials, pattern allowances, etc.

Theory:
The pattern is the principal tool during the casting process. It is the replica of the object to be made by the casting process, with some modifications. The main modifications are the addition of pattern allowances, and the provision of core prints. If the casting is to be hollow, additional patterns called cores are used to create these cavities in the finished product. The quality of the casting produced depends upon the material of the pattern, its design, and construction. The costs of the pattern and the related equipment are reflected in the cost of the casting. The use of an expensive pattern is justified when the quantity of castings required is substantial. The most commonly used patterns in foundry are as follows
1) Single Piece Pattern
2) Split Pattern or Two Piece Pattern

Tools for wood working
The principle hand tools used in a carpentry workshop can be classified into
i) Marking and measuring tool
ii) Cutting tool
iii) Planning tool
iv) Boring tool
v) Striking tool
vi) Holding tool

MATERIALS REQUIRED: Teak wood (50mm x150mm x 50mm)



TOOLS AND EQUIPMENT USED:

1. Steel rule
2. Try square
3. Marking guage
4. Rip saw
5. Tenon saw
6. Mortise chisel
7. Mallet
8. Jack plane
9. Wood rasp file

OPERATIONS TO BE CARRIED OUT:

1. Planning 2. Marking 3. Sawing 4. Chiseling 5. Finishing

PROCEDURE:

1. The wooden pieces are planned with jack plane and for strraightness..
2. An adajacent side is planned and checked for squareness with a try square
3. Marking guage is set and lines are marked at 50 mm to make the thickness and width according to given figure.
4. Using tenon saw, the portions to be removed are cut in both the pieces
5. The excess material in X is chiseled with beveled edge firmer chisel
6. The end of both the pieces is chiseled to exact lengths.

PRECAUTIONS:

1. Wood should be free from moisture
2. Marking is done with out parallax error
3. Care shoukd be taken while chiseling
4. Matching of X and Y pieces should be tight.

Conclusion:

F.A.Q:

1. What is the difference between marking gauge and mortise gauge?
2. Which tool is used to draw a line perpendicular to a reference edge?
3. Why the Saw teeth are alternately bent?
4. Which chisel is useful to produce mortise and tenon joint?
5. What is the use of oilstone?

Department of Mechanical Engineering
Workshop Practice laboratory
Experiment No. ES-ME 191/291--02

Title of the Experiment: To make a Butt joint using the given two M.S pieces by arc welding.

Objective of the Experiment: To study the welding procedure & also familiarize with MMAW tools & equipments.

Theory:

Manual metal arc welding (MMAW), also known as Shielded metal arc welding (SMAW) or informally as stick welding, is a manual arc welding process that uses a consumable electrode coated in flux to lay the weld. An electric current, in the form of either alternating current or direct current from a welding power supply, is used to form an electric arc between the electrode and the metals to be joined. As the weld is laid, the flux coating of the electrode disintegrates, giving off vapors that serve as a shielding gas and providing a layer of slag, both of which protect the weld area from atmospheric contamination.

Most of the metals and alloys can be welded by one type of welding process or the other. However, some are easier to weld than others. To compare this ease in welding term 'weldability' is often used. The weldability may be defined as property of a metal which indicates the ease with which it can be welded with other similar or dissimilar metals.
Elements of welding process used with common welding joints such as base metal, fusion zone, weld face, root face, root opening toe and root are depicted in Figure.

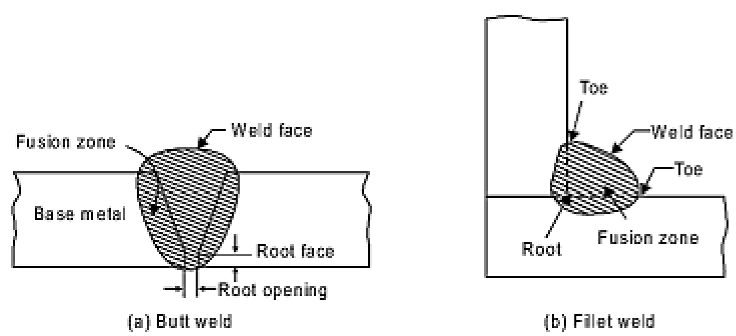


Fig. Terminological elements of welding process

List of Equipments:

1) Switch box. 2) Secondary terminals 3) Welding machine. 4) Current reading scale. 5) Current regulating hand wheel. 6) Leather apron. 7) Asbestos hand gloves. 8) Protective glasses strap 9) Electrode holder. 10) Hand shield 11) Channel for cable protection. 12) Welding cable. 13) Chipping hammer. 14) Wire brush. 15) Earth clamp. 16) Welding table (metallic)..

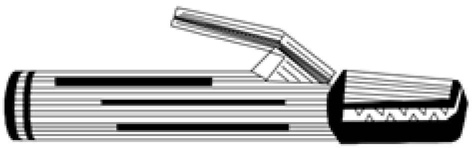


Fig. Electrode holder

v

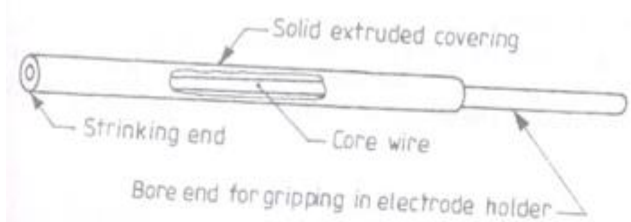


Fig. Parts of an electrode

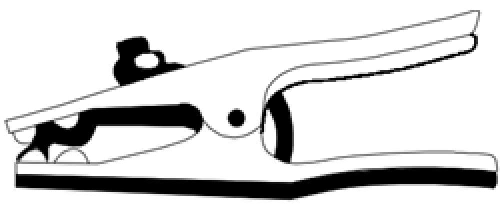


Fig. Earth clamp

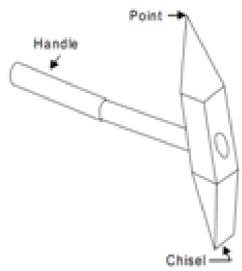


Fig. Chipping and hammer

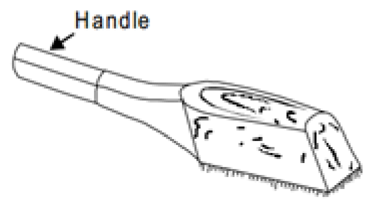


Fig. Wire brush

Safety Recommendations for ARC Welding

The beginner in the field of arc welding must go through and become familiar with these general safety recommendations which are given as under.

1. The body or the frame of the welding machine shall be efficiently earthed. Pipe lines containing gases or inflammable liquids or conduits carrying electrical conductors shall not be used for a ground return circuit All earth connections shall be mechanically strong and electrically adequate for the required current.
2. Welding arc in addition to being very is a source of infra-red and ultra-violet light also; consequently the operator must use either helmet or a hand-shield fitted with a special filter glass to protect eyes
3. Excess ultra-violet light can cause an effect similar to sunburn on the skin of the welder
4. The welder's body and clothing are protected from radiation and burns caused by sparks and flying globules of molten metal with the help of the following:
5. Gloves protect the hands of a welder.
6. Leather or asbestos apron is very useful to protect welder's clothes and his trunk and thighs while seated he is doing welding.
7. For overhead welding, some form of protection for the head is required
8. Leather skull cap or peaked cap will do the needful.

Welding joints

Some common welding joints are shown in Figure. Welding joints are of generally of two major kinds namely lap joint and butt joint. The main types are described as under.

1. **Lap weld joint 2. Butt weld joint 3. Tee Fillet Weld 4. Edge joint 5. Corner joint**

Material Required:
Mild steel plate of size 50X30X5 mm – 2 No's

Welding Electrodes: M.S electrodes 3.15 mm X450 mm

Welding Equipment: Air cooled transformer Voltage-80 to 600 V 3 phase supply, amps upto 400.

Tools and Accessories required:

1. Rough and smooth files. 2. Protractor 3. Arc welding machine (transformer type)
4. Mild steel electrode and electrode holder 5. Ground clamp 6. Tongs
7. Face shield 8. Apron 9. Chipping hammer.

Sequence of operations:
1. Tacking 2. Welding 3. Cooling 4. Chipping 5. Cleaning

Procedure:
1. The given M.S pieces are thoroughly cleaned of rust and scale.
2. The two pieces are positioned on the welding table such that, they are separated slightly for better penetration of the weld.
3. The electrode is fitted in the electrode holder and the welding current is ser to be a proper value.
4. The ground clamp is fastened to the welding table.
5. Wearing the apron and using the face shield, the arc is struck and holding the two pieces together; first run of the weld is done to fill the root gap.

Conclusion:
The single V-butt joint is thus made, using the tools and equipment as mentioned above.

F.A.Q :

1. Which tool is used to clean the surface of the workpiece ?
2. What is the source of deposition of metal?
3. What is the criteria of two metals to be welded?
4. What is the role of shielding gas formed around the weld zone?
5. What power source has to be used in case of non consumable electrode?
6. Why chipping hammer is used?

Department of Mechanical Engineering
Workshop Practice laboratory
Experiment No. ES-ME 191/291--03

Title of the Experiment: Making a permanent joint between Two Plates using gas welding process.

Objective of the Experiment: To study the welding procedure & also familiars with gas welding tools & equipments.

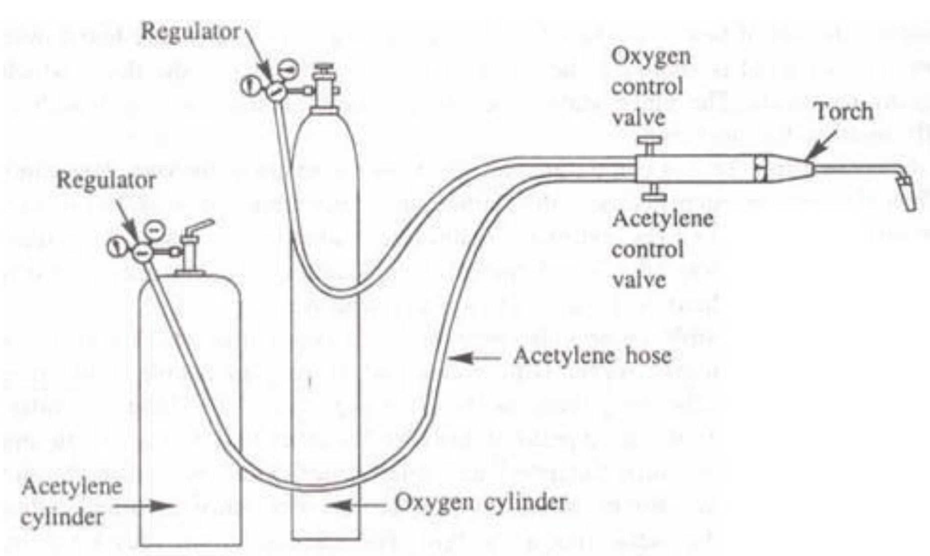
Theory:

Oxy-fuel welding is a procses that use fuel gases and oxygen to weld and cut metals, respectively. French engineers Edmond Fouché and Charles Picard became the first to develop oxygen-acetylene welding in 1903.Pure oxygen, instead of air (20% oxygen/80% nitrogen), is used to increase the flame temperature to allow localized melting of the workpiece material (e.g. steel) in a room environment. A common propane/air flame burns at about 3,630 °F (2,000 °C), a propane/oxygen flame burns at about 4,530 °F (2,500 °C), and an acetylene/oxygen flame burns at about 6,330 °F (3,500 °C).

In oxy-fuel welding, a welding torch is used to weld metals. Welding metal results when two pieces are heated to a temperature that produces a shared pool of molten metal. The molten pool is generally supplied with additional metal called filler. Filler material depends upon the metals to be welded.

Apparatus:

The apparatus used in gas welding consists basically of an oxygen source and a fuel gas source (usually cylinders), two pressure regulators and two flexible hoses (one of each for each cylinder), and a torch. This sort of torch can also be used for soldering and brazing. The cylinders are often carried in a special wheeled trolley.



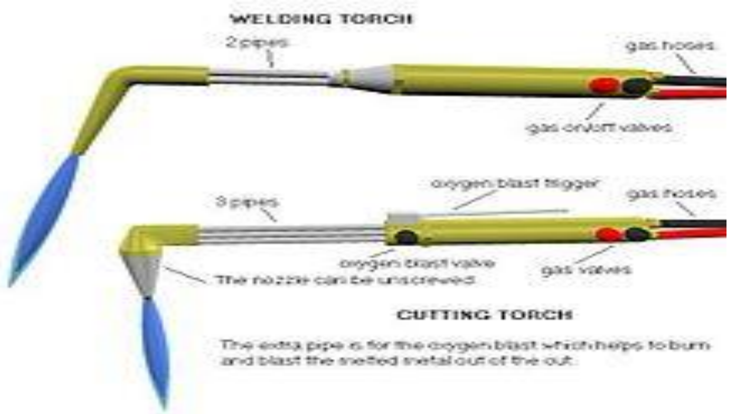


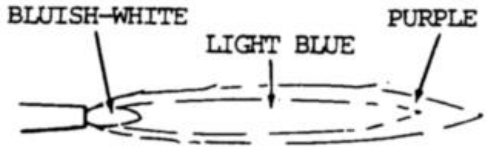
Figure. The top torch is a welding torch and the bottom is a cutting torch.

The role of Oxygen:

Oxygen is not the fuel. It is what chemically combines with the fuel to produce the heat for welding. This is called 'oxidation', but the more specific and more commonly used term in this context is 'combustion'. In the case of hydrogen, the product of combustion is simply water. For the other hydrocarbon fuels, water and carbon dioxide are produced. The heat is released because the molecules of the products of combustion have a lower energy state than the molecules of the fuel and oxygen. In oxy-fuel cutting, oxidation of the metal being cut (typically iron) produces nearly all of the heat required to "burn" through the workpiece.

Types of Flames:
1. Neutral Flame (Acetylene oxygen in equal proportions)
2. Oxidising Flame (Excess of oxygen)
3. Reducing Flame (Excess of acetylene)

Neutral Flame:
A neutral flame is produced when approximately equal volumes of oxygen and acetylene are mixed in the welding torch and burnt at the torch tip. (More accurately the oxygen-to-acetylene ratio is 1.1 to 1). The temperature of the neutral flame is of the order of about 5900ºF(3260ºC).
The flame has a nicely defined inner cone* which is light blue in colour. It is surrounded by an outer flame envelope, produced by the combination of oxygen in the air and superheated carbon monoxide and hydrogen gases from the inner cone.
The neutral flame is commonly used for the welding of:
(i) Mild steel (ii) Stainless steel (iii) Cast Iron(iv) Copper(v) Aluminium



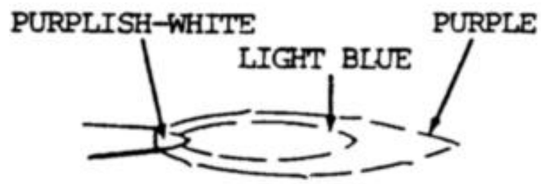
NEUTRAL FLAME
5850 °F

Oxidising Flame:

If, after the neutral flame has been established, the supply of oxygen is further increased, the result will be an oxidising flame. An oxidising flame can be recognized by the small white cone which is shorter, much bluer in colour and more pointed than that of the neutralflame. A slightly oxidising flame is helpful when welding most

(i) Copper base metals

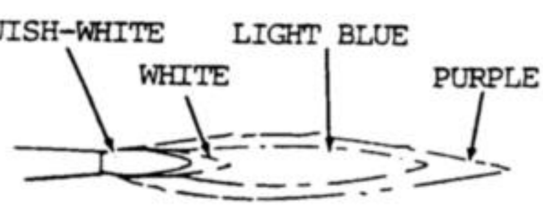
(ii) Zinc base metals



OXIDIZING FLAME
6300 °F

Reducing Flame

If the volume of oxygen supplied to the neutral flame is reduced, the resulting flame will be a carburising or reducing flame, i.e. rich in acetylene. A reducing flame can be recognized by acetylene feather which exists between the inner cone and the outer envelope. The outer flame envelope is longer than that of the neutral flame and is usually much bright in colour.



REDUCING FLAME
5700 °F

Welding: The flame is applied to the base metal and held until a small puddle of molten metal is formed. The puddle is moved along the path where the weld bead is desired. Usually, more metal is added to the puddle as it is moved along by means of dipping metal from a welding rod or filler rod into the molten metal puddle. The metal puddle will travel towards where the metal is the hottest. This is accomplished through torch manipulation by the welder.

Precautions:

Oxyacetylene welding/cutting is not difficult, but there are a good number of subtle safety points that should be learned such as:

More than 1/7 the capacity of the cylinder should not be used per hour. This causes the acetone inside the acetylene cylinder to come out of the cylinder and contaminate the hose and possibly the torch.

Acetylene is dangerous above 15 psi pressure. It is unstable and explosively decomposes.

Proper ventilation when welding will help to avoid large chemical exposure.

Conclusion:

F.A.Q :

1. Which valve is used to change the type of flame?
2. What is the role of regulator?
3. Which type of flame produces maximum heat ?
4. Why oxidising flame is shorter than neutral flame?
5. Why acetylene gas is also called D.A gas?

Department of Mechanical Engineering
Workshop Practice laboratory
Experiment No. ES-ME 191/291--04

Title of the Experiment: To make a V-Fit from the given mid steel pieces.

Objective of the Experiment: To study the Fitting procedure & also familiarise with Fitting tools & equipments.

Theory:

The term fitting, is related to assembly of parts, after bringing the dimension or shape to the required size or form, in order to secure the necessary fit. The operations required for the same are usually carried out on a work bench, hence the term bench work is also added with the name fitting.

The bench work and fitting plays an important role in engineering. Although in today's industries most of the work is done by automatic machines which produces the jobs with good accuracy but still it (job) requires some hand operations called fitting operations. The person working in the fitting shop is called fitter.

FITTING TOOLS:

Fitting shop tools are classified as below:

- Work Holding Devices/ Clamping Tools.
- Measuring and Marking Tools.
- Cutting Tools.
- Striking Tools.
- Drilling Tools.
- Threading Tools.

IV. CUTTING TOOLS:

1. Hacksaw

Hacksaw is used for cutting of rods, bars, pipes, flats etc. It consists of a frame, which is made from mild steel. The blade is placed inside the frame and is tightened with the help of a flange nut. The blade is made up of high carbon steel or high speed steel.

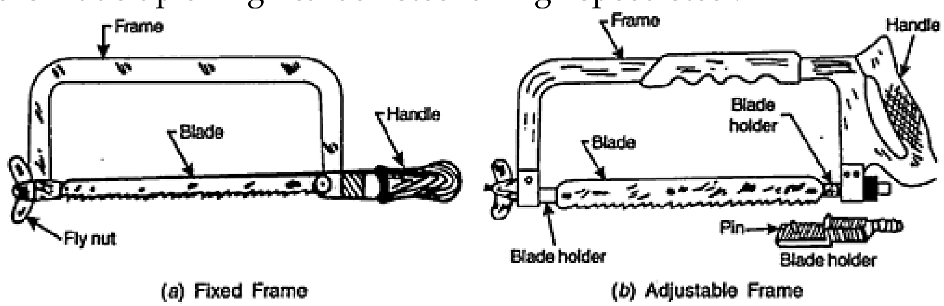


Fig. *Hand Hacksaws.*

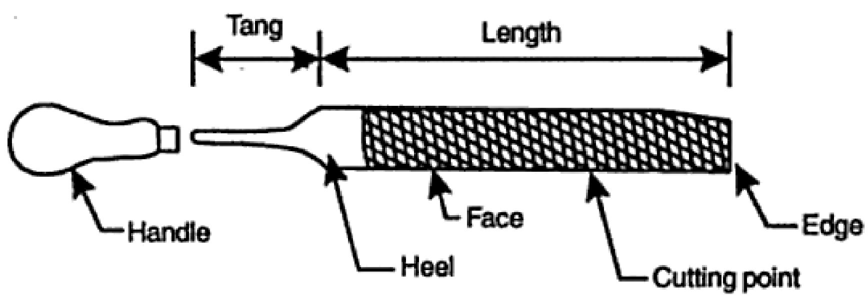
The points of the teeth are bent in a zig-zag fashion, to cut a wide groove and prevent the body of the blade from rubbing or jamming in the saw cut. The teeth of the blades are generally forward cut so in the case, pressure is applied in the forward direction only.

Depending upon the direction of cut, blades are classified as:
o Forward cut
o Backward cut.

Depending upon the pitch of the teeth (Distance between the two consecutive teeth) blades is classified as:
 Coarse (8-14 teeth per Inch)
 Medium (16-20 teeth per inch)
 Fine (24-32 teeth per inch)

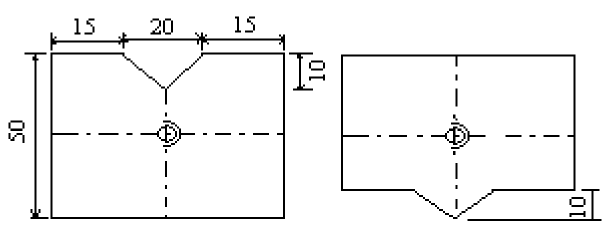
2. Files

Files are multi points cutting tools. It is used to remove the material by rubbing it on the metals. Files are available in a number of sizes, shapes and degree of coarseness.



Nomenclature of a File

MATERIALS REQUIRED: Mild steel flat (50 mm x 50 mm x 3mm).



TOO LS AND EQUIPMENT REQUIRED:
1.6"try square
2. 6"scriber
3. Odd leg caliper
4.12"hack saw Frame
6. Blades (12 TPI)
7.10"rough file
8.10"smooth file
9.10"triangle file
10. Knife Edge file
11. Dot punch
12. Ball peen hammer (0.5 Ib)

13. Steel Rule

Sequence of Operations:

1. Filling
2. Marking
3. Punching
4. Sawing
5. Filling
6. Drilling
7. Tapping
8. Finishing

PROCEDURE:

1. The given mild steel flat piece is checked for given dimensions.
2. One edge of given is filled with rough and smooth files and checked with try square for straightness.
3. An adjacent edge is also filled such that it is square to first edge and checked with try square.
4. Wet chalk is applied on one side of the flat and dried for marking.
5. Lines are marked according to given figure, using odd leg caliper and steel rule.
6. Using the dot punch, punches are made along the marked lines.
7. The excess materials removed from the remaining two edges with try square level up to half of the marked dots.
8. Finally buts are removed by the filling on the surface of the fitted job.

PRECAUTIONS:

1. The perpendicularity of face ends edges is checked perfectly by using try square.
2. Finishing is given by using only with smooth files.
3. Marking is done without parallax error.

Conclusion:

F.A.Q:

1. What are the different parts of a bench vice?
2. What type of vice is used to hold a cylindrical object?
3. How would you measure inside diameter of a jobpiece?
4. Which marking tool is helpful in drawing a line parallel to a reference edge?
5. What is the difference between dot punch and a center punch?
6. What is the difference between single cut file and double cut file?
7. How would you specify a file?
8. What is the difference between Flat file and Hand file?
9. How would you check straightness of an edge?
10. Why taps are available in a set of three

Department of Mechanical Engineering
Workshop Practice laboratory
Experiment No. ES-ME 191/291--05

Title of the Experiment: Making a cylindrical job contain external & internal threads by step turning & threading operations.

Objective of the Experiment: To study the different component & operation performed in lathe machine & drill machine.

Theory:
Lathe is a machine, which removes the metal from a piece of work to the required shape and size

Common types of lathes:

a) Engine Lathe
b) Bench Lathe:
c) Tracer Lathe:
d) Automatic Lathe:
e) Turret Lathe:
f) Computer Controlled Lathe:

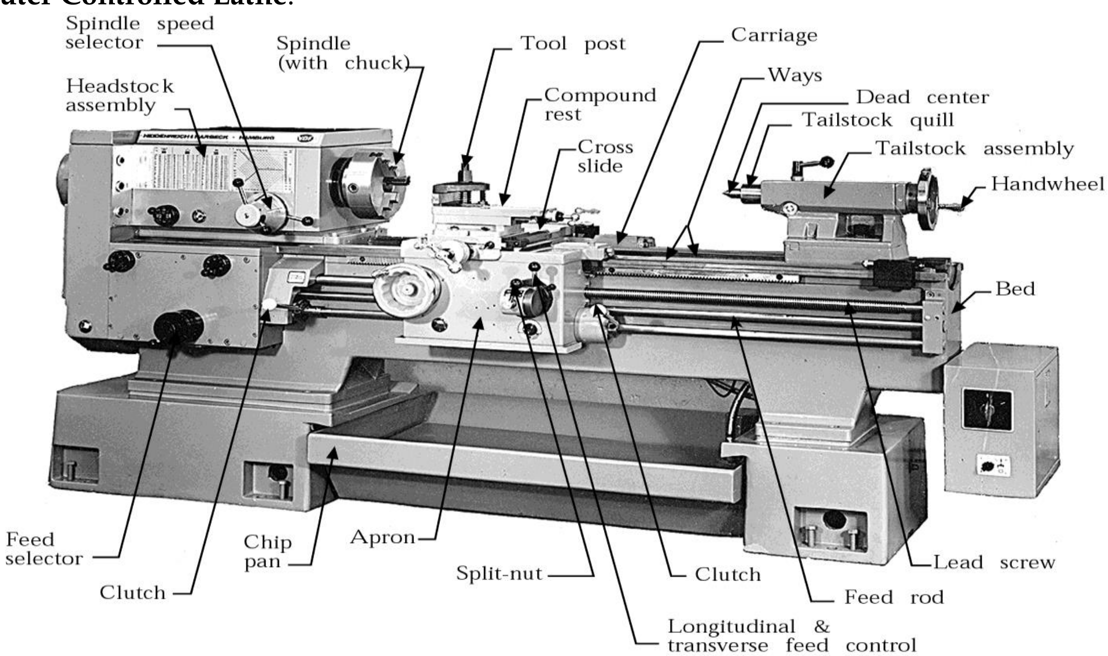


Figure1. Engine Lathe

Centre lathe – constructional features:

Lathe specifications:

- Distance between centers
- Swing over the bed
- Swing over the cross slide
- Horse power of the motor
- Number of speeds
- Number of feeds

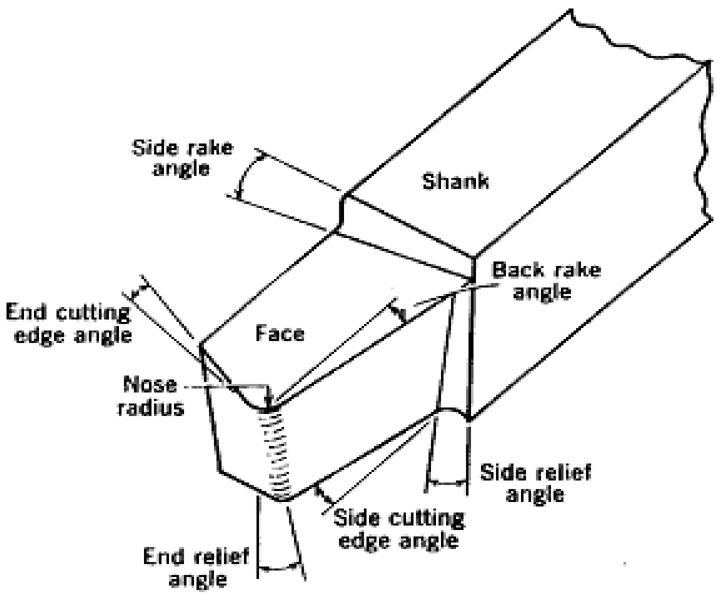


Figure 2. Shows single point cutting tool

Various lathe operations:

- Turning – produces straight, conical, curved, or grooved work pieces
- Facing – produces a flat surface at the end of the part
- Boring – to enlarge a hole
- Drilling - to produce a hole
- Cutting off – to cut off a work piece
- Threading – to produce threads
- Knurling – produces a regularly shaped roughness

Work pieces can be held by various methods:

- Work piece mounted between centers
- Work piece mounted within a single chuck
- Work piece mounted within a collet.
- Work piece mounted on a faceplate

Three Jaw chuck: It usually has three jaws, the jaws are moved simultaneously within the chuck (fig.4).

Four Jaw chuck: This is independent chuck generally has four jaws, which are adjusted individually on the chuck face by means of adjusting screws (fig.5).

Magnetic chuck: Thin jobs can be held by means of magnetic chucks.

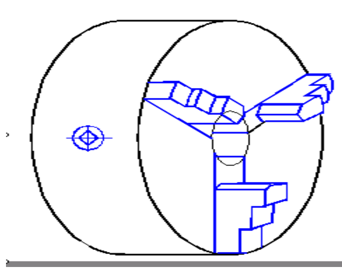


Figure 4. Three jaw chuck.

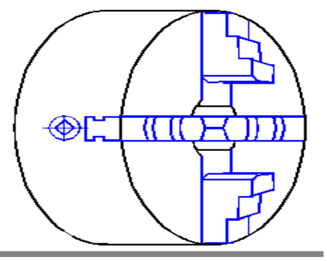
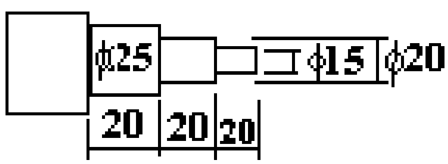


Figure 5. Four jaw chuck.

Material: 35mm dia x 150 mm long cylindrical bar.
Tools and equipments: Steel rule, surface gauge, outside caliper, adjustable wrench(8”), chuck key.



OPERATIONS TO BE CARRIED OUT:
1. Straight turning
2. Step turning
3. Filing
4. Polishing

Conclusion:

F.A.Q:
1. Define machine tool.
2. Define cutting speed and feed.
3. What are the functions of Saddle and Crossslide?
4. Why centering is necessary and which tool is used for centering of the job?
5. What is the function of tailstock?

Department of Mechanical Engineering
Workshop Practice laboratory
Experiment No. ES-ME 191/291--06

Title of the Experiment: Making a horizontal flat surface by shaping & finishing operations.

Objective of the Experiment: To study the different component & operation performed in shaper machine & grinding machine.

Theory:
Shaper Machine:
Shaper is a reciprocating type of machine tool in which the ram moves the cutting tool backwards and forwards in a straight line. It is intended primarily to produce flat surfaces. These surfaces may be horizontal, vertical, or inclined. In general, the shaper can produce any surface composed of straight-line elements. A shaper is used to generate flat (plane) surfaces by means of a single point cutting tool similar to a lathe tool.

Working principal of Shaper:
A single point cutting tool is held in the tool holder, which is mounted on the ram. The work piece is rigidly held in a vice or clamped directly on the table. The table may be supported at the outer end. The ram reciprocates and thus cutting tool held in tool holder moves forward and backward over the work piece. In a standard shaper, cutting of material takes place during the forward stroke of the ram. The backward stroke remains idle and no cutting takes place during this stroke. The feed is given to the work piece and depth of cut is adjusted by moving the tool downward towards the work piece. The time taken during the idle stroke is less as compared to forward cutting stroke and this is obtained by quick return mechanism.

Types of Shaper:
Shapers are classified under the following headings:
(1) According to the type of mechanism used for giving reciprocating motion to the ram
- (a) Crank type
- (b) Geared type
- (c) Hydraulic type

(2) According to the type of design of the table:
- (*a*) Standard shaper
- (*b*) Universal shaper

(3) According to the position and travel of ram:
- (a) Horizontal type
- (b) Vertical type
- (c) Traveling head type

(4) According to the type of cutting stroke:
- (a) Push type
- (b) Draw type.

Principal parts of Shaper:
Below figure shows the parts of a standard shaper. The main parts are given as under.

1. Base
2. Column
3. Cross-rail
4. Saddle
5. Table
6. Ram
7. Tool head
8. Clapper box
9. Apron clamping bolt
10. Down feed hand wheel
11. Swivel base degree graduations
12. Position of stroke adjustment hand wheel
13. Ram block locking handle
14. Driving pulley
15. Feed disc
16. Pawl mechanism
17. Elevating screw

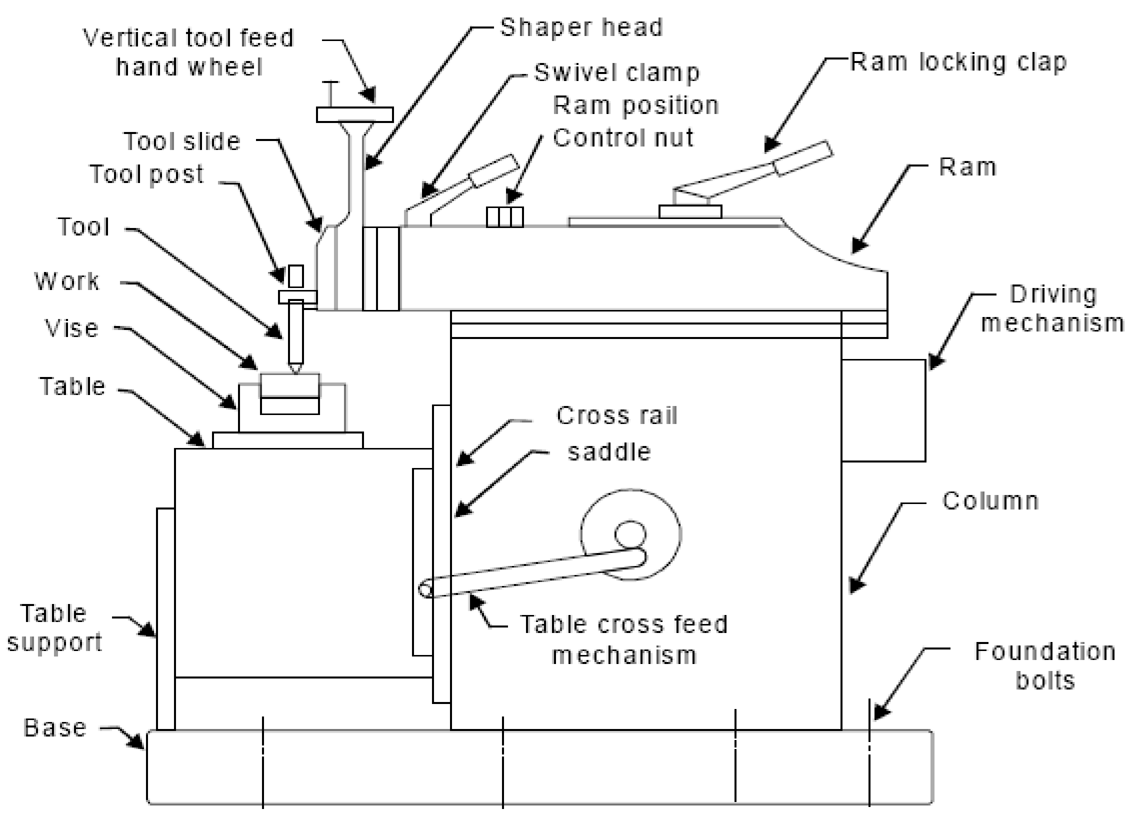


Figure 1. Parts of standard Shaper.

Specification of Shaper:
The size of a shaper is specified by the maximum length of stroke or cut it can make. Usually the size of shaper ranges from 175 to 900 mm. Besides the length of stroke, other particulars, such as the type of drive (belt drive or individual motor drive), floor space required, weight of the machine, cutting to

return stroke ratio, number and amount of feed, power input etc. are also sometimes required for complete specification of a shaper.

Shaper Mechanism:
In a shaper, rotary motion of the drive is converted into reciprocating motion of the ram by the mechanism housed within the column or the machine. In a standard shaper metal is removed in the forward cutting stroke, while the return stroke goes idle and no metal is removed during this period. The shaper mechanism is so designed that it moves the ram holding the tool at a comparatively slower speed during forward cutting stroke, whereas during the return stroke it allow the ram to move at a faster speed to reduce the idle return time. This mechanism is known as quick return mechanism. The reciprocating movement of the ram and the quick return mechanism of the machine are generally obtained by anyone of the following methods:

(1) Crank and slotted link mechanism
(2) Whitworth quick return mechanism, and
(2) Hydraulic shaper mechanism

Shaper Operations:
A shaper is a machine tool primarily designed to generate a flat surface by a single point cutting tool. Besides this, it may also be used to perform many other operations. The different operations, which a shaper can perform, are as follows:

1. Machining horizontal surface (Fig. 3)
2. Machining vertical surface (Fig. 3)
3. Machining angular surface (Fig. 3)
4. Slot cutting (Fig. 4)
5. Key ways cutting (Fig. 4)
6. Machining irregular surface (Fig. 4)
7. Machining splines and cutting gears (Fig. 23.13)

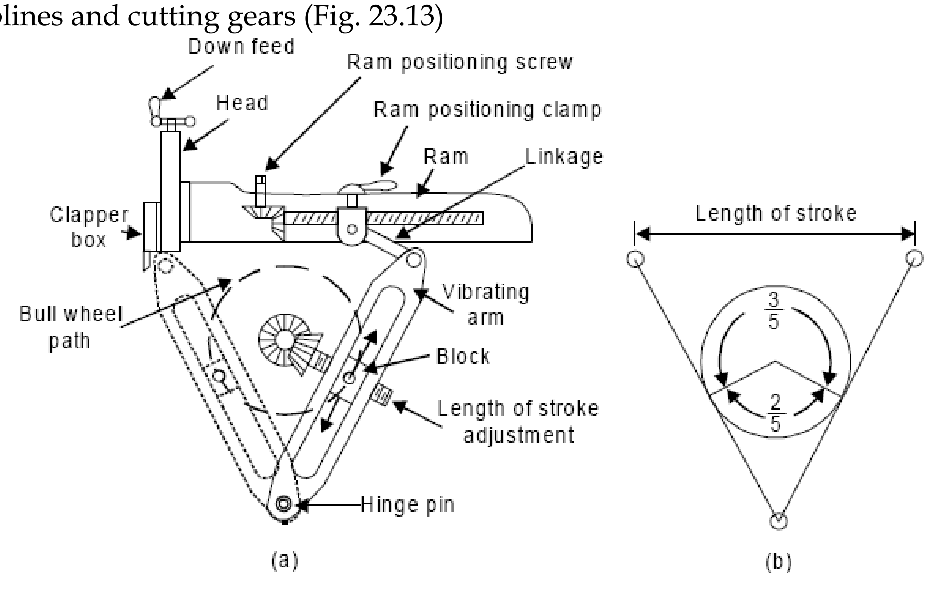


Figure 2. Crank and Slotted link Mechanism.

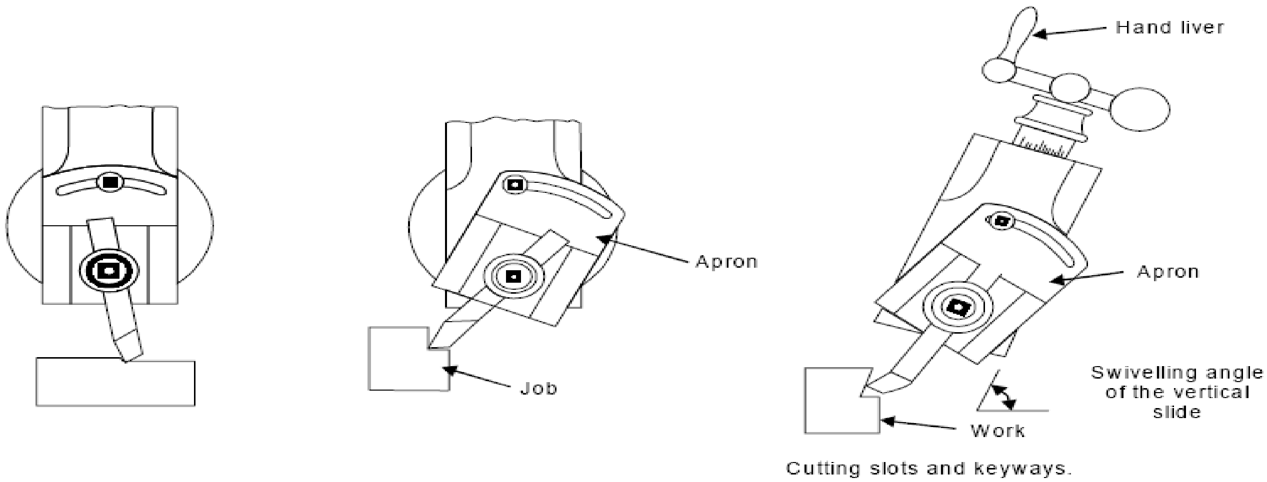
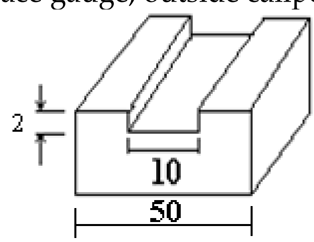


Figure 3. Machining horizontal, vertical & Angular surface on Shaper machine.

Material: 50mm x 50 mm x 50mm square bar.
Tools and equipments: Steel rule, surface gauge, outside caliper, adjustable wrench(8”), spirit level.



OPERATIONS TO BE CARRIED OUT:
1. Plain shaping
2. Slot shaping
3. Filing

Conclusion:

F.A.Q:
1. Define quick return mechanism.
2. What is the function of Ram?
3. Distinguish between turning and shaping.
4. Why return stroke is quicker than forward stroke?
5. What is the function of crossrail?

Department of Mechanical Engineering
Workshop Practice laboratory
Experiment No. ES-ME 191/291--07

Title of the Experiment: Joining of sheet metal by soldering.

Objective of the Experiment: To study the joining operation of G.I sheet metals by soldering.

Theory:

Sheet metal work has its own significance in the engineering work. Many products, which fulfill the household needs, decoration work and various engineering articles, are produced fromsheet metals. Common examples of sheet metal work are hoopers, canisters, guards, covers, pipes, hoods, funnels, bends, boxes etc. Such articles are found less expensive, lighter in weight and in some cases sheet metal products replace the use of castings or forgings.

A metal plate of thickness less than 4 mm is considered as sheet. In British system, the thickness of sheet is specified by a number called Standard Wire Gauge (SWG). The commonly used gauge numbers and the equivalent thickness in mm are given below

SWG (No.)	16	17	18	19	20	22	24	27	30
Thickness (mm)	1.62	1.42	1.22	1.02	0.91	0.71	0.56	0.42	0.37

3. HAND TOOLS:
For measuring, marking cutting and forming, various types of hand tools are used in sheet metal work. A list of them is given below:
I. Measuring tools
II. Marking tools
III. Cutting tools
IV. Forming tools
V. Joining tools

MEASURING TOOLS
The following types of tools are commonly used in sheet metal shops to measure the dimensions of work pieces:
1. Steel rule
2. Vernier caliper
3. Micrometer
4. Sheet Metal gauge
The above tools are already explained in the fitting section.

SHEET METAL GAUGE
It is a disc shaped piece of metal, having a number of slots on the outside edge as shown in figure. The slots are of various widths and each corresponds to a certain standard wire gauge (SWG) number. The gauge is placed over the edge of the sheet to be measured and a slot is found that will slip over the metal with a light fit pressure. Standard tables are referred to for conversion of SWG numbers to mm sizes.

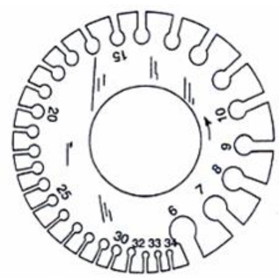


Fig. Standard wire gauge

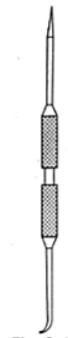


Fig. Scriber.

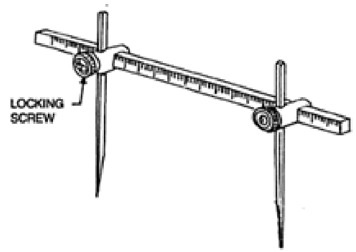


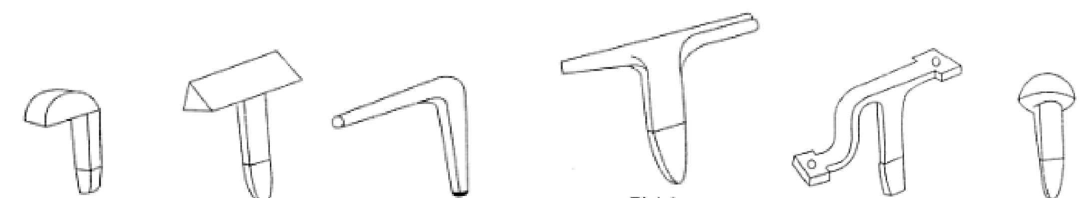
Fig. Trammel points.

FORMING TOOLS:

Shaping of the sheet metal such as folding, bending, curling, etc., are done by using the following types of forming tools.

1. Stakes:

Stakes are the sheet metal anvils used for bending, seaming and forming by using a hammer or mallet. They work as the supporting tool as well as the forming tools. They are made in different sizes and shapes depending upon the job requirement. Commonly used stakes are



Half-moon stake Hatchet stake Pipe stake Bick iron Horse-band stake Convex stake

2. Stake Holder

The stake holder used in sheet metal shop is a rectangular bench plate as shown in Figure.

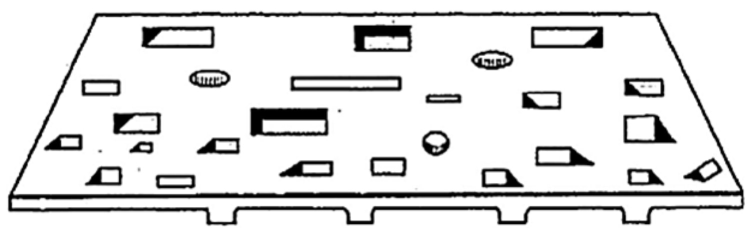


Fig. Stake Holder.

SOLDERING IRON:

A soldering iron consists of a copper block, fixed on an iron rod with a wooden handle. It is made in various shapes and sizes to suit the use as shown in figure. The purpose of the copper block is to act as a heat source for melting and spreading the solder (filler metal) at the joining area. The soldering iron (copper) is heated using furnace, blower or by electrical resistance.

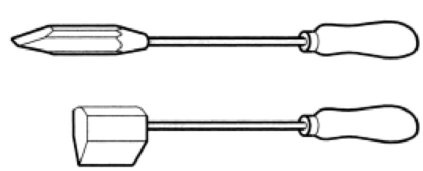
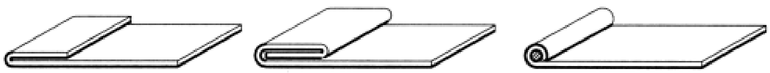


Fig. Soldering Iron

SHEET METAL JOINTS:

Edge Forming
For sheet metal objects strength is given to the edge and the sharpness is eliminated by folding the edge. The common types of folding used in sheet metal work are as follows:
1. Single hem 2. Double hem 3. Wired edge
Figure shows the three types of edge folding. A wired edge consists of an edge wrapped around a steel wire for better strength.



Material: 50mm x 50 mm galvanized iron sheet - 2 nos.

Tools and equipments: Steel rule, Try square, scriber, straight snip, mallet and stakes.

OPERATIONS TO BE CARRIED OUT:
1. Marking
2. Cutting
3. Grinding
4. Soldering

PROCEDURE:
1. The size of the given sheet is checked with steel rule.
2. The sheet is cut into pieces as per given dimension.
2. Grind the pieces of sheet metal at their edges.
3. The soldering iron is heated.
4. The edges are made to overlap each other and mallet hammer is used to straighten the faces.
5. The joint is soldered.

PRECAUTIONS:
1. Care should be taken while cutting with snip.
2. Care should be taken while bending and jumping.
Conclusion:

F.A.Q:
1. Define sheet metal. How are they measured?
2. What are the applications of G.I sheet and stainless steel sheet?
3. What is the use of stake?
4. Distinguish between soft soldering and hard soldering.
5. Why the edges of sheet are given the form of hem?