LAB RECORD

BASIC WORKSHOP (AME102)

(AUTONOMOUS)

I B.TECH (Freshman Engineering)

Prepared By

Mr. VVSH Prasad, Professor, MECH

Mr. USP Rao, Professor, MECH

Ms. G. Karunya, Assistant Professor, MECH

FRESHMAN ENGINEERING

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

Vision

To bring forth professionally competent and socially sensitive engineers, capable of working across cultures meeting the global standards ethically.

Mission

To provide students with an extensive and exceptional education that prepares them to excel in their profession, guided by dynamic intellectual community and be able to face the technically complex world with creative leadership qualities.

Further, be instrumental in emanating new knowledge through innovative research that emboldens entrepreneurship and academic development for the benefit of wide spread community.

Quality Policy

Our policy is to nurture and build diligent and dedicated community of engineers providing a professional and unprejudiced environment, thus justifying the purpose of teaching and satisfying the stakeholders.

A team of well qualified and experienced professionals ensure quality education with its practical application in all areas of the institute.

Philosophy

The essence of learning lies in pursuing the truth that liberates one from the darkness of ignorance and institute of aeronautical engineering firmly believes that education is for liberation.

Contained therein is the notion that engineering education includes all fields of science that plays a pivotal role in the development of world-wide community contributing to the progress of civilization. This institute, adhering to the above understanding, is committed to the development of science and technology in congruence with the natural environs. It lays great emphasis on intensive research and education that blends professional skills and high moral standards with a sense of individuality and humanity. We thus promote ties with local communities and encourage transnational interactions in order to be socially accountable. This accelerates the process of transfiguring the students into complete human beings making the learning process relevant to life, instilling in them a sense of courtesy and responsibility.

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

Program Outcomes-(common for all branches)

PO1	**Engineering knowledge:** apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis:** identify, formulate, review research in literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PO3	**Design and development of solutions;** design solutions for complex engineering problems and design system components or processors that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal and environmental considerations.
PO4	**Conduct investigations of complex problems:** use research based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage:** create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	**The engineer and society:** apply reasoning informed by the contextual knowledge to access societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and Sustainability:** understand the impact of the professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of , and need for sustainable development
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and Teamwork:** Function effectively as an individual and as a member or leader in diverse teams and in multi-disciplinary settings.
PO10	**Communication:** communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions.
PO11	**Project Management and Finance:** Demonstrate knowledge and understanding of the Engineering and Management principles and apply these to once own work, as a member and leader in a team, to manage projects and in multi disciplinary environments.
PO12	**Lifelong Learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes- Aeronautical Engineering	
PSO1	**Professional skills:** Able to utilize the knowledge of aeronautical/aerospace engineering in innovative, dynamic and challenging environment for design and development of new products
PSO2	**Problem solving skills:** imparted through simulation language skills and general purpose CAE packages to solve practical, design and analysis problems of components to complete the challenge of airworthiness for flight vehicles.
PSO3	**Practical implementation and testing skills:** Providing different types of in house and training and industry practice to fabricate and test and develop the products with more innovative technologies
PSO4	**Successful career and entrepreneurship:** To prepare the students with broad aerospace knowledge to design and develop systems and subsystems of aerospace and allied systems and become technocrats.
Program Specific Outcomes- Computer Science and Engineering	
PSO1	**Professional Skills:** The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, multimedia, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity.
PSO2	**Problem-Solving Skills:** The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality product for business success.
PSO3	**Successful Career and Entrepreneurship:** The ability to employ modern computer languages, environments, and platforms in creating innovative career paths to be an entrepreneur, and a zest for higher studies
Program Specific Outcomes- Information Technology	
PSO1	**Professional Skills:** The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, multimedia, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity.
PSO2	Software Engineering practices: The ability to apply standard practices and strategies in software service management using open-ended programming environments with agility to deliver a quality product for business success.
PSO3	**Successful Career and Entrepreneurship:** The ability to employ modern computer languages, environments, and platforms in creating innovative career paths to be an entrepreneur, and a zest for higher studies.
Program Specific Outcomes- Electronics and Communication Engineering	
PSO1	**Professional Skills:** An ability to understand the basic concepts in Electronics & Communication Engineering and to apply them to various areas, like Electronics, Communications, Signal processing, VLSI, Embedded systems etc., in the design and implementation of complex systems.

PSO2	**Problem-Solving Skills:** An ability to solve complex Electronics and communication Engineering problems, using latest hardware and software tools, along with analytical skills to arrive cost effective and appropriate solutions.
PSO3	**Successful Career and Entrepreneurship:** An understanding of social-awareness & environmental-wisdom along with ethical responsibility to have a successful career and to sustain passion and zeal for real-world applications using optimal resources as an Entrepreneur.

Program Specific Outcomes- Electrical and Electronics Engineering

PSO1	**Professional Skills:** Able to utilize the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based teamwork.
PSO2	**Problem-Solving Skills:** Can explore the scientific theories, ideas, methodologies and the new cutting edge Technologies in renewable energy engineering, and use this erudition in their professional envelopment and gain sufficient competence to solve the current and future energy problems Universally.
PSO3	**Successful Career and Entrepreneurship:** The understanding of technologies like PLC, PMC, process controllers, transducers and HMI one can analyze, design electrical and electronics principles to install, test , maintain power system and applications.

Program Specific Outcomes- Mechanical Engineering

PSO1	To produce engineering professional capable of synthesizing and analyzing mechanical systems including allied engineering streams.
PSO2	An ability to adopt and integrate current technologies in the design and manufacturing domain to enhance the employability.
PSO3	To build the nation, by imparting technological inputs and managerial skills to become Technocrats.

Program Specific Outcomes- Civil Engineering

PSO1	**Understanding:** Graduates will have an ability to describe, analyze, and solve problems using mathematics and systematic problem-solving techniques.
PSO2	**Analytical Skills:** Graduates will have an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
PSO3	**Broadness:** Graduates will have a broad education necessary to understand the impact of engineering solutions in a global, economic, and societal context.

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

Certificate

This is to certify that it is a bonafied record of practical work done by sri/kum.____ bearing the Roll No.________________of class ____________Branch in the ____laboratory during the Academic under our supervision.

Head of the Department **Lecture In-charge**

External Examiner **Internal Examiner**

ENGINEERING WORKSHOP SYLLABUS

ATTAINMENT OF PROGRAM OUTCOMES
&
PROGRAM SPECIFIC OUTCOMES

Exp. No	Experiment	Program Outcomes Attained	Program Specific Outcomes Attained
1	Carpentry- Half lap Joint	PO5,PO6,PO9, PO11,PO12	PSO1, PSO2, PSO3
2	Carpentry- Dove Tail Joint	PO5,PO6,PO9, PO11,PO12	PSO1, PSO2, PSO3
3	Fitting- Square Fit	PO5,PO6,PO9 PO11,PO12	PSO1, PSO2, PSO3
4	Fitting- Straight Fit	PO5,PO6,PO9, PO11,PO12	PSO1, PSO2, PSO3
5	Tin Smithy- Round Tin	PO5,PO6,PO9, PO11,PO12	PSO1, PSO2, PSO3
6	Tin Smithy- Round Tin	PO5,PO6,PO9, PO11,PO12	PSO1, PSO2, PSO3
7	House wiring- Series Connection	PO5,PO6,PO9 PO11,PO12	PSO1, PSO2, PSO3
8	House wiring- Parallel Connection	PO5,PO6,PO9, PO11,PO12	PSO1, PSO2, PSO3
9	House wiring- 2 Way Switch	PO5,PO6,PO9, PO11,PO12	PSO1, PSO2, PSO3
10	Moulding- Wheel Flange	PO5,PO6,PO9, PO11,PO12	PSO1, PSO2, PSO3
11	Moulding- Bearing Housing	PO5,PO6,PO9, PO11,PO12	PSO1, PSO2, PSO3
12	Blacksmithy- ‘S’ Shape	PO5,PO6,PO9, PO11,PO12	PSO1, PSO2, PSO3
13	Blacksmithy- ‘J’ Shape	PO5,PO6,PO9, PO11,PO12	PSO1, PSO2, PSO3
14	Welding- Arc Welding	PO5,PO6,PO9, PO11,PO12	PSO1, PSO2, PSO3
15	Welding- Gas Welding	PO5,PO6,PO9, PO11,PO12	PSO1, PSO2, PSO3
16	Plumbing Familiarization	PO5,PO6,PO9, PO11,PO12	PSO1, PSO2, PSO3
17	Machine Shop- Familiarization	PO5,PO6,PO9, PO11,PO12	PSO1, PSO2, PSO3

ENGINEERING WORKSHOP LABORATORY

OBJECTIVE:

The objective of this lab is to teach students various trades of mechanical systems and to explain them the working for performing various operations on these systems. This lab complements the engineering workshop course. Students will gain practical knowledge by performing operations in various trades of Carpentry, Fitting, Tinsmithy, House wiring, Moulding, Blacksmithy, Welding and Plumbing.

OUTCOMES:

Upon the completion of Engineering Workshop course, the student will be able to:

1. Design and model different prototypes in the carpentry trade such as cross lap joint, dove tail joint.
2. Design and model various basic prototypes in the trade of fitting such as square fir and straight fit.
3. Design and model various basic prototypes in the trade of Tinsmithy such as round tin and rectangular tray.
4. Design and model various basic house wiring techniques such as connecting one lamp with one switch, connecting two lamps with one switch and one bulb controlled by two switches.
5. Design and model various basic prototypes in the trade of moulding, blascksmithy and welding different parts.

MAPPING COURSE OUTCOMES LEADING TO ACHIEVEMENT OF THE PROGRAM OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
I					H	H			S			H		S	H
II					H	H			S			H		S	H
III					H	H			S			H		S	H
IV					H	H			S			H		S	H
V					H	H			S			H		S	H

S= Supportive **H=Highly Related**

SAFETY PRECAUTIONS IN MACHINE SHOP: 7.5.1.05

1. “ Tight fitting clothes” must be worn because an loose clothing is likely to be caught in moving or rotating parts of a machine, long sleeves of shirts, long hair, neck tie and jewelry are “definite hazard” in the machine shop.
2. Wear “safety shoes”. Don’t wear canvas shoes, as they give no resistance to hard objects dropped on the feet.
3. Know your job and follow instructions.
4. A machine should not be started until it is determined that all conditions of safe operations are compiled with.
5. Suitable “fences and guards” should be in place before commencing the job, and these should be removed only for the purpose of authorized inspection and adjustment.
6. No adjustment, repair or filling should be attempted while the machine is running.
7. One should know the location of “main-switch”to switch off power in case of emergency.
8. Adjust and secure the tool properly before commencing the job.
9. Wear “safety Goggles” when working in areas, where sparks or metal chips are flying.
10. The use of “Cooling Mixture” is very essential as it preserves the cutting edges of the tool, and prevents distortion of the work.
11. Check up the “Serviceability” of a tool, measuring instrument or Tester before putting it for use.
12. Accidents occur unexpectedly without prior warning, causing damage to men and Machine; these can be avoided if proper “ Safety Rules” are followed.
13. Proper insulation of electric wires and earthing of electrical appliances and machines must be ensured.
14. Maintenance of “Serviceable” fire extinguishers and water points in shop floor, for preventing “fire hazards” is most essential.
15. Maintaining of cleanliness of “shop-floor” is most important.

DO NOT:

1. Operate a machine unless you are authorized to do so.
2. Walk away from a running machine
3. Distract or interfere with any one operating machine.
4. Start a machine unless you know how to stop it.
5. Be over confident.

Goal:

To allow the student to gain an appreciation of the principles of operations in a mechanical workshop and to get a feel for industrial application, and to provide the student with progressive hands-on structured experience of industrial environment. To develop an understanding of the basics of maintenance of machinery and equipment.

Corse objective:

1. To give ‘hands on experience’ of crafts-man ship, machining, and assembly.
2. To make students familiar with different work trades
3. To develop quality and safety consciousness amongst the students.
4. To develop respect towards labour work amongst the student.

Corse objective:

1. Know how to function and operate in a workshop environment and grasp the principles underlying the work being done.
2. Effectively use various measuring tools and instruments commonly used in Mechanical workshops.
3. Make simple parts using common workshop machinery
4. Carry out first-line maintenance of common workshop machines using the technical manuals.
5. Understand the basics of planned / Scheduled and unscheduled maintenance.

The student should be able to:

1. Operate /use all common tools and basic machines
2. Read, understand and interpret engineering drawings.
3. Make three dimensional sketches.
4. Handle marking-out and precision measuring instruments.
5. Carry out basic metal cutting tasks.
6. Perform first-line maintenance of workshop machines
7. Be a productive contributor to scheduled maintenance tasks.

List of Experiments

CARPENTRY INTRODUCTION

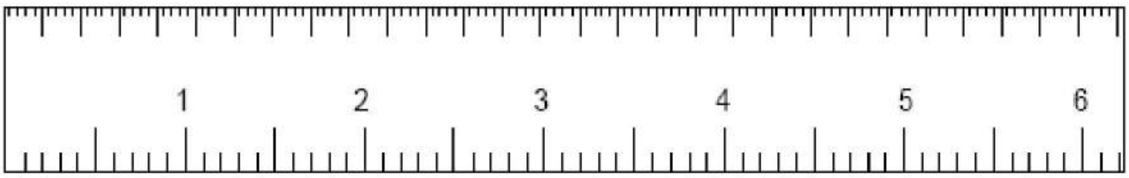
Carpentry deals with the processing of wood to obtain desired shapes and sizes. The process dealing with the technique of making wooden pattern is called pattern making. Wood obtained from tree is the chief product of forest. It has been universally acceptable as raw material for manufacturing wooden products or appliances. From the pre-historic times, wood has been utilized an important source of getting heat by firing it. It has been utilized as an major construction material for making shelter for the basic need of human being. The useful work on wood is being generally carried out in a most common shop known as carpentry shop. The work performed in carpentry shops comprises of cutting, shaping and fastening wood and other materials together to produce the products of woods. Therefore, carpentry shop deals with the timber, various types of tools and the art of joinery

The tools used in carpentry are listed below:

1.Steel Foot Rule:

It's one side has the graduations of 1/8'' and other is divided into markings of 1/16''. Metric scales are also used, having the graduation in mm and cm.

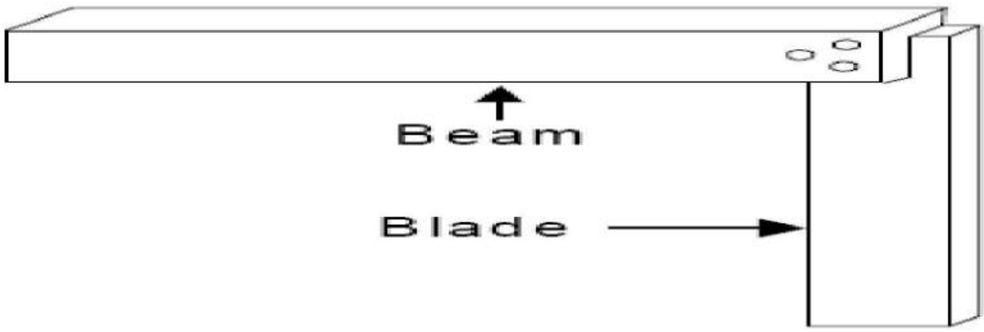
STEEL RULE: Used for making and measuring linear dimensions. It is specified by its length.



Steel rule

STEEL TAPE: The steel tape is used for measuring longer dimensions. They are available in different sizes, ranging from 0.6 to 2.5 m. It is flexible can be coiled and presses in a case

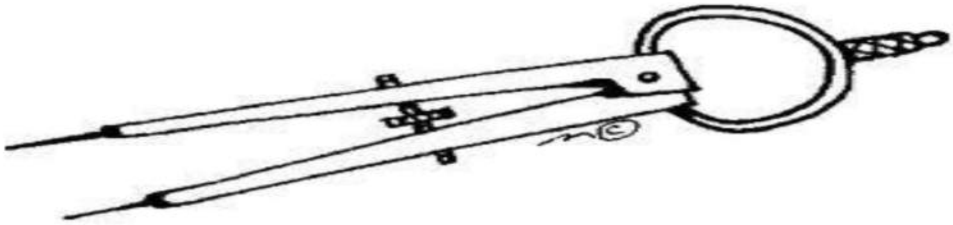
2. Try Square: It is an important tool for Squaring, testing and measuring. It is usually made of steel, but sometimes also with wood.



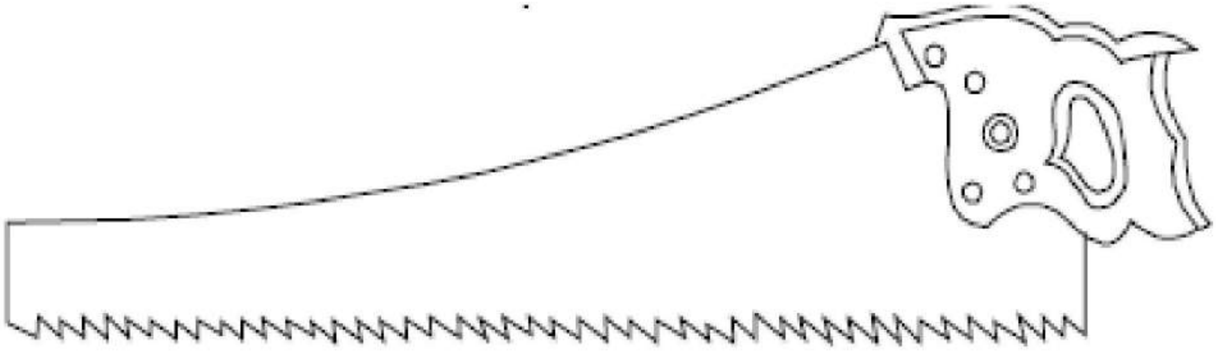
3.Marking Gauge: It is used for scoring or for folling a line parallel to a given space, edge or end. It is made of wood. There is a sharp metal spur point. Main bar of the guage has graduations printed on it similar to that of foot rule. It is always advisable to check the measurement from the spur point to movable head.

4.Bevel Square: This tool resembles the try square in appearance but has a movable blade which can be adjusted for laying out at any angle. It is also employed for testing chamfers, bevels and angles.

5.Divider: It consists of two pointed legs, the points are hardened and tempered to prevent wear. It is used for transferring the sizes and scribing curves is circles on wooden surface.

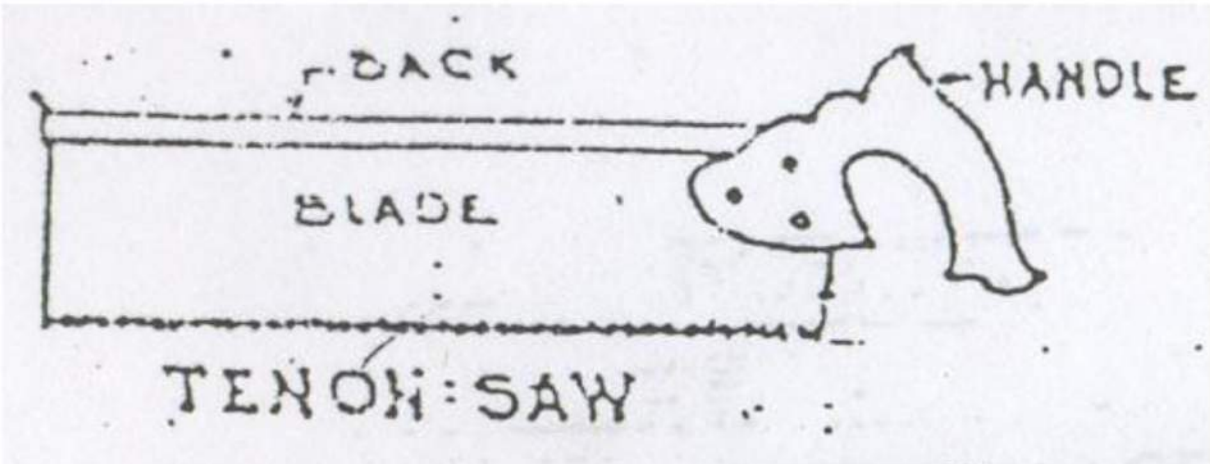


6.Cross Cut Hand Saw: It is specified by length of blade in inches. The more popular size are 24 inches. No of teeth per inch decides the blade coarseness or fineness. Coarse saw is preferable for fast operation (working) and for cutting green timber. Fine saw is desirable for smooth and accurate cutting on dry seasoned wood.



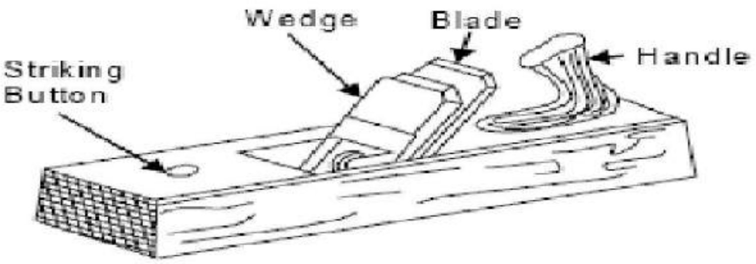
Cross cut Handsaw

7. Tennon Saw: It is a cross cut saw with fine teeth stiffened by thick back usually it is of 12'' size and consists of fourteen teeth per inch. It is used for very fine work in cabinet construction and for making joints.



10. Jack plane: This is used to smoothen the different planes of wooden black. It is universally used because of its size and utility...

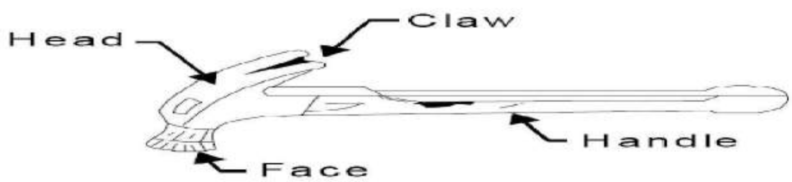
a. WOODEN JACK PLANE:



Jack plane

b. METAL JACK PLANE: Its body is made of gray cast iron, and is provided with a wooden handle at the back and a wooden knob at the front for holding with both the hands. A fine screw is used for adjusting the depth of cut i.e. the thickness of shaving removed, and a lever is used for lateral adjustment of the blade. It is very durable and gives better finish.

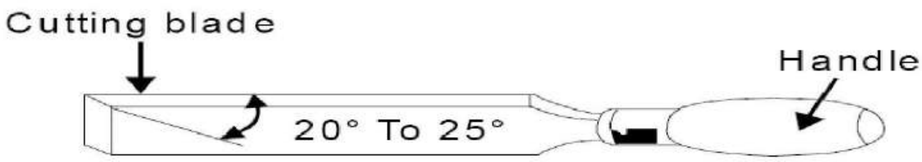
11. Claw Hammer: The most convenient tool for driving nuts is claw hammer. It is specified by weight of the head (that rangers from (7 to 20 ounces)).



Claw hammer

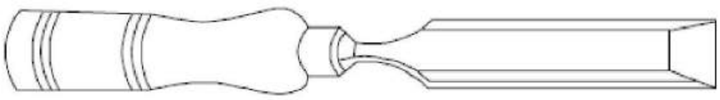
12. Chisels and Gouges: Chisels are classified as

a. FIRMER CHISEL: The firmer chisel is capable of doing heavy work and is used for joining and shaping the wood, with or without mallet. The chisel blade is made of rectangular section with beveled edge length of the blade is about 125 mm and the width of the edge varies from 3 to 50 mm.



Firmer chisel

b. Dovetail chisel: It is similar to firmer chisel but sides are beveled so that it can cut sharp corners. It is used for cutting sockets where the angles is less than a right-angle.

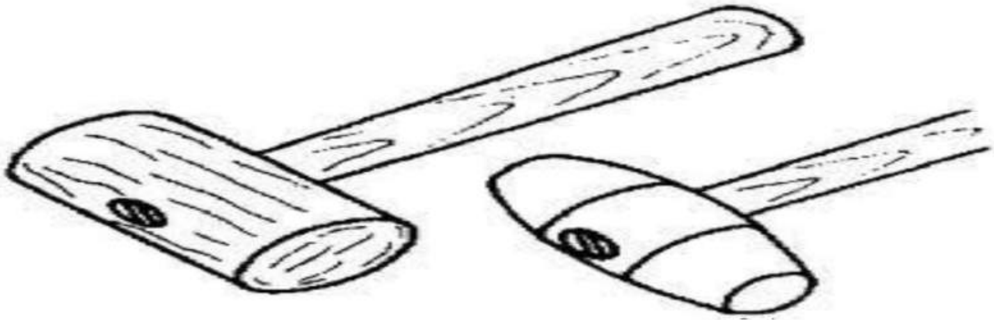


c. Mortise chisel: These chisels are robust, and can withstand heavy blows. It has a thick stock and narrow cutting edge. It is used for cutting mortises, and its width is ground to exact size of mortise to be cut.

Mortise chisel

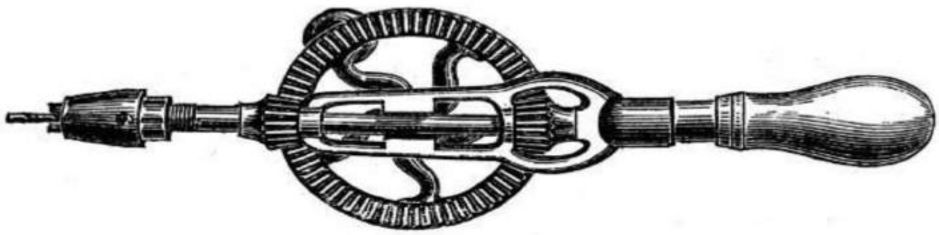
13. STRIKING TOOLS: Striking tools are used to drive in nails and to operate chisels.

a. Wooden Hammer: It is mostly used for bench work and light work. It is made of cast steel with tempered face and peen. The wooden handle fits in the eye and steel wedge is driven into from a rigid joint.



b. **Hand drill:** It is used for marking holes in wooden surfaces. A small steading handle is provided as well as handle at end. The three jaw self centering chuck holds twist drill to a size of about 10mm. It is for light work.

Drill Bits:



i) Twist Drill: This bit is used for boring holes for dowels. It bores along clean hole.

ii) Center bit: The center bit is used for boring shallow holes up to a diameter of 50mm.

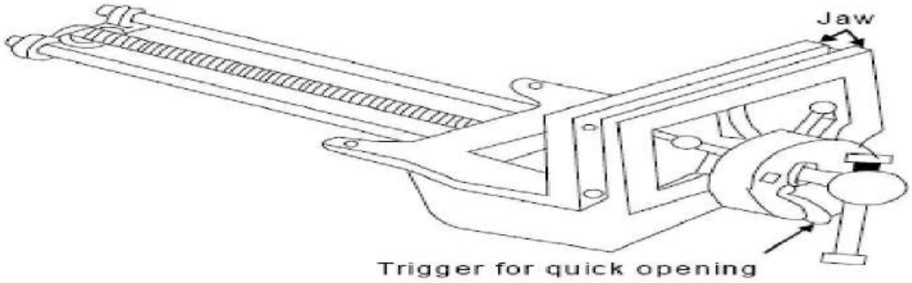
iii) Counter bit: It can be used for boring conical holes to receive the heads of the screws.

iv) Auger Bit: It is used for boring holes in logs. Auger bits size ranges from 5mm to 25mm in diameter. These bits vary in length from 17.5 cm to 25cm.

14. **WORK HOLDING TOOLS:**

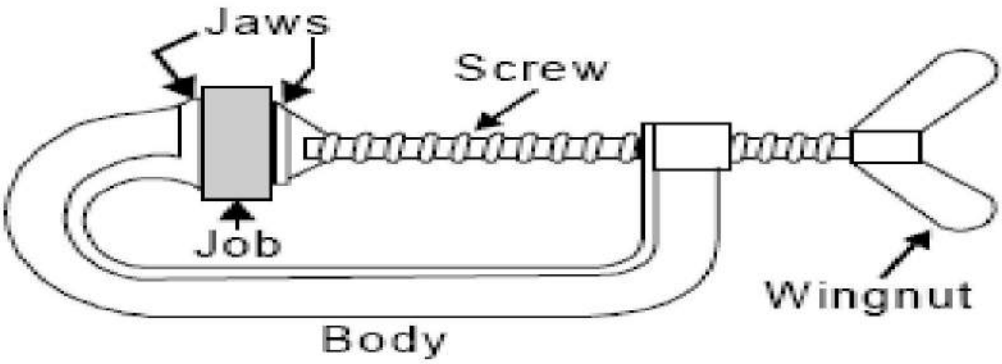
The vice and cramp are used to hold work while some operations are carried out.

a. CARPENTRY BENCH VICE: It is made of gray cast iron or steel, and it has two jaws one of which is fixed to the side of a bench and the other is movable. The faces of jaws are lined with hard wood to prevent damage of work surface. It is used for holding the work for planning sawing and chiseling on the bench.



Carpenter vice

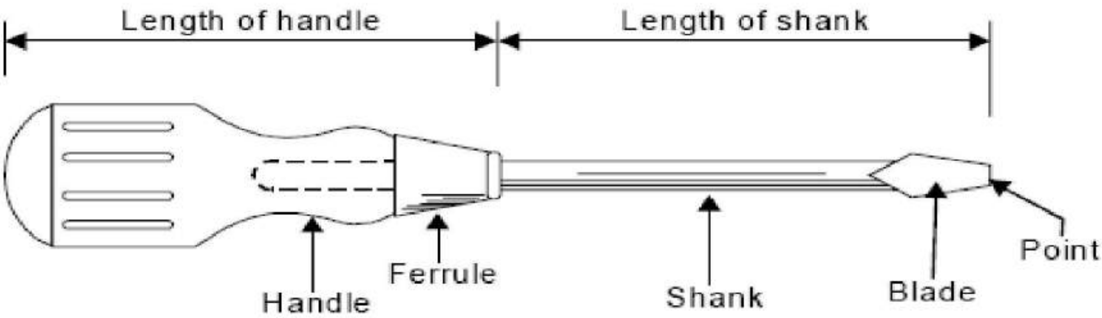
b. G or C – CLAMP: It is made of forged steel in the form of letter 'C'. A screw with metal handle is provided at one end of 'C'. It is used in joining the plywood with laminated sheets etc., with adhesives. It is also used as blades holding device sharpening and setting of saw tooth.



G or C-clamp

15. MISCELLANEOUS TOOLS:

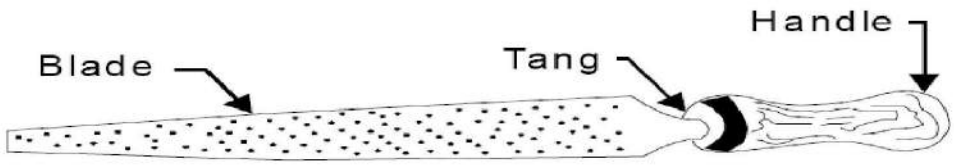
a. SCREW DRIVER: These are used for driving the screws on wood or unscrewing them from wood. The size is specified by length of the blade.



Standard screw driver with its parts

b. PINCER: It is used for pulling out the nails and is more efficient the claw hammer.

c. WOODRASP FILE Rasps files are of used for maintaining other wood working tools and equipment. They are made of hardened tool steel which is tempered and they should never be dropped as they are very brittle to break. They are of various types depending upon their size, shape, cuts and degree of their coarseness



Rasps

EXERCISE NO – 1

LAP HALVING JOINT

Aim: To prepare a lap Halving joint.

Materials Required: Teak wood piece of size 300x50x25mm.

Tools Required: Jack Plane, Try square, Tennon saw, Marking knife, 2ft rule, firmer chisel, Mallet.

Procedure:

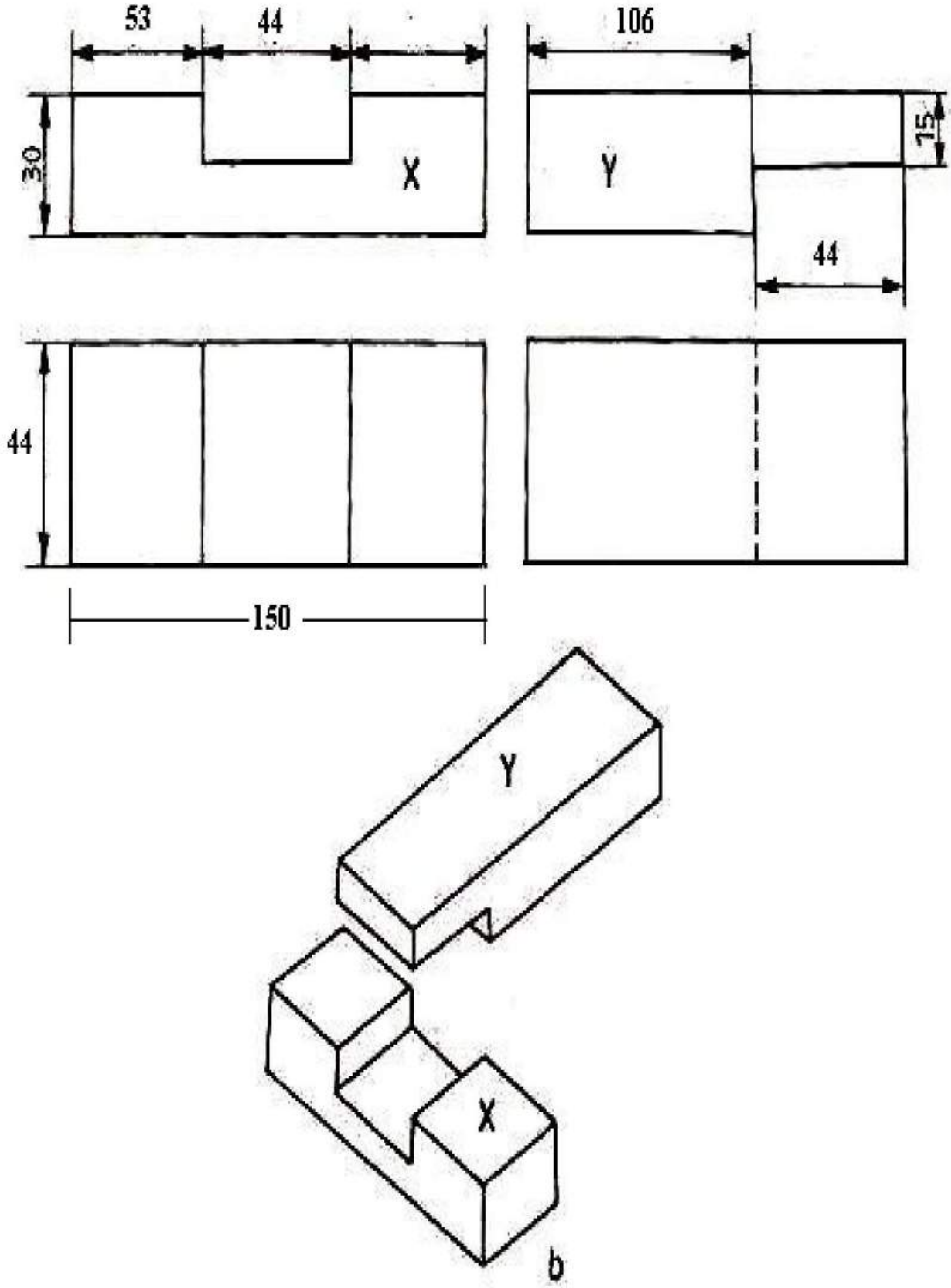
Precautions:

1. Feed the saw from head to tool.
2. Care should be taken while operating with tools.

The saw teeth should not touch the hard material.

Result :

HALF- LAP JOINT



All Dimensions are in "mm"

EXERCISE NO -2

DOVETAIL HALVING JOINT

Aim: To prepare a Dovetail halving joint.

Materials Required: Teak wood piece of size 300x50x25mm.

Tools Required: Jack plane, Try square, Tennon saw, 2ft rule, Marking Knife, Firmer Chisel, Mallet.

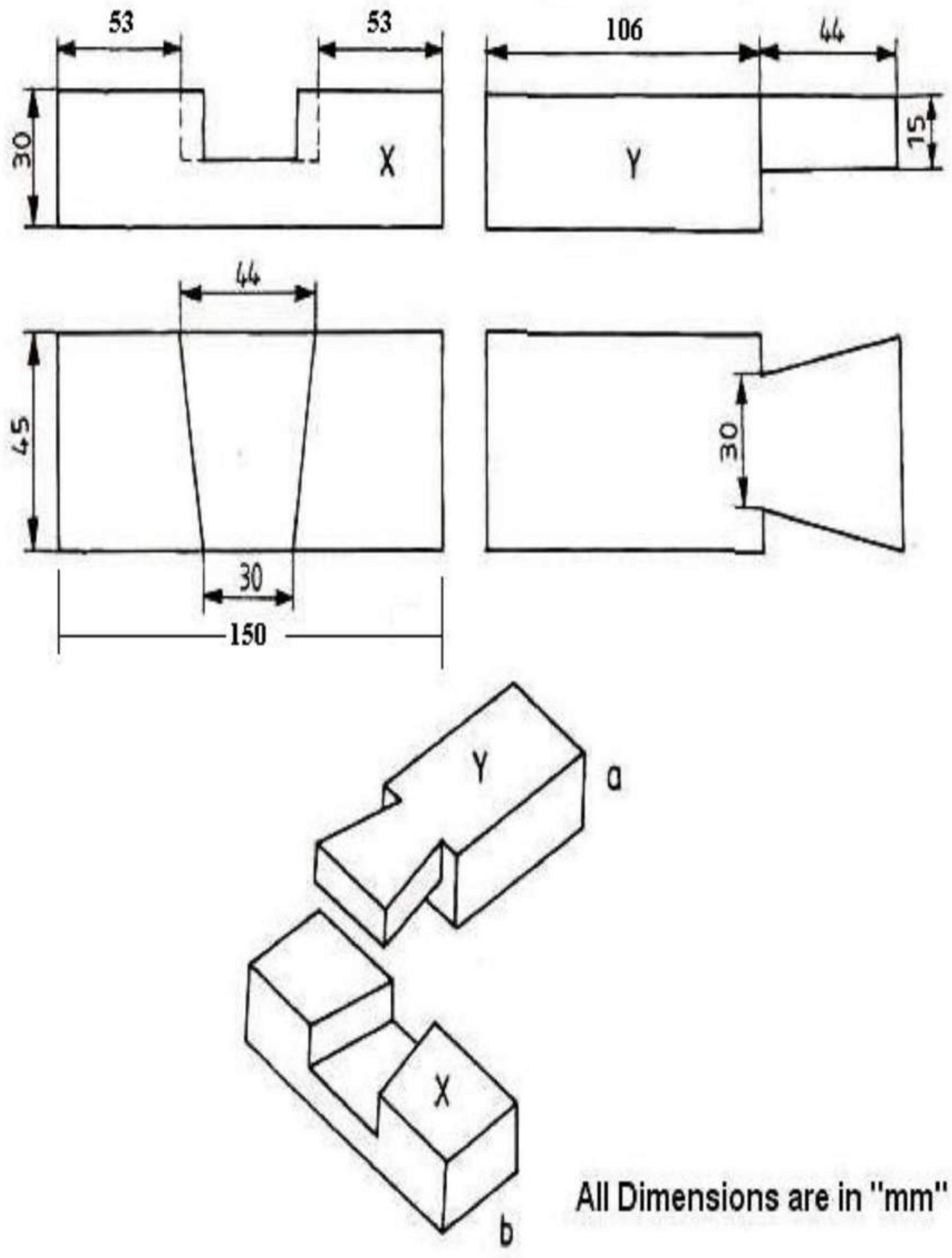
Procedure:

Precautions:

1. The saw teeth should not touch the hard material.
2. Feed the saw from head to tool.

Result

DOVETAIL JOINT



VIVA QUESTIONS

1. Plane used for larger surfaces is____________________________
2. A round hole is finished using ( )

   a)Chisel b)Gauge c) Rasp file
3. Moisture content in wood is removed by _________________ .
4. A mortise gauge is used is to draw perpendicular/parallel lines on the stock_____________________
5. _____________ is used to check squareness and straightness
6. The jaws of a carpenter's vice are lined with metallic/wooden faces ()
7. ____________ & ______________ is used for planning end grains of wood.
8. __________ Saw is used for small and thin cuts.
9. Rip saw is used for cutting the stock across/along the grains.
10. Firmer chisel is stronger/weaker than other chisels.
11. _____________ chisel is convenient for making dovetail joints.
12. The hand tool used for rotating auger bit is called _______________ ________________.
13. Hand drill is used for making( )

    (a) small holes, (b) big holes, (c) semi –circular,(d) concave grooves.
14. Mallets are made of ( )

    a) soft wood,(b) hard wood,(c) mild steel (d) cast iron.
15. The length of the screw driver is given by its total length, including that the length of its handle (True\ False).
16. _____________ & _____________ file is used in carpentry shop for finishing work.
17. In lap joints ____________ amount of wood is removed from each piece.
18. Mortise Gauge is a ( )

    a) Striking tool b) Planing tool c) Marking tool d) Boring tool
19. Right angles are drawn or tested using ( )

    a) Bevel square b)Try square c)Miter square d)Spirit level
20. Saw used for fine work is ( )

    a) Tenon saw b)Jack saw c)Rip saw d)Dovetail saw

FITTING

INTRODUCTION:

Machine tools are capable of producing work a faster rate, but there are occasions when components are processed at the bench. The term bench work refers to the production of components by hand on the bench, where as fitting deals with the assembly of matting parts, through removal of metal to obtain the required fit. Both the bench work and fitting operations consists of filling, chipping, sawing, drilling, tapping etc.

CLASSIFICATION OF TOOLS:

The tools commonly used in fitting may be classified as

Work holding tools

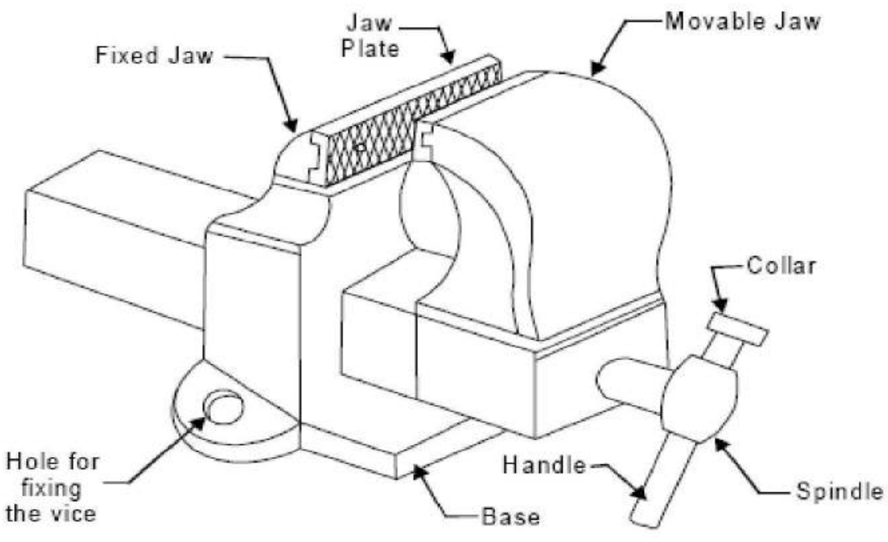
Cutting tools

Striking tools

Marking and checking tools

WORK HOLDING TOOLS:

a)Bench vice b)Hand vice c)Pipe vice d)Pin vice e)Tool makers vice f)Leg-vice g)C-clamp

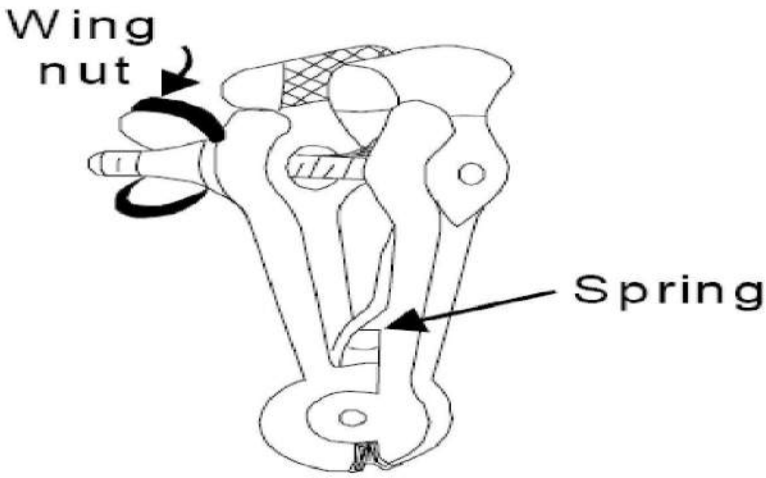


A bench vice

A. BENCH VICE:

The bench vice is a work-holding device. It has two jaws one of which is fixed to the bench and other slides with aid of square screw and a box nut arrangement. The outer end of screw carries a handle. The jaws are made with hardened steel and body is cast iron or cast steel. The working faces of jaws are serrated to give additional grip for holding.

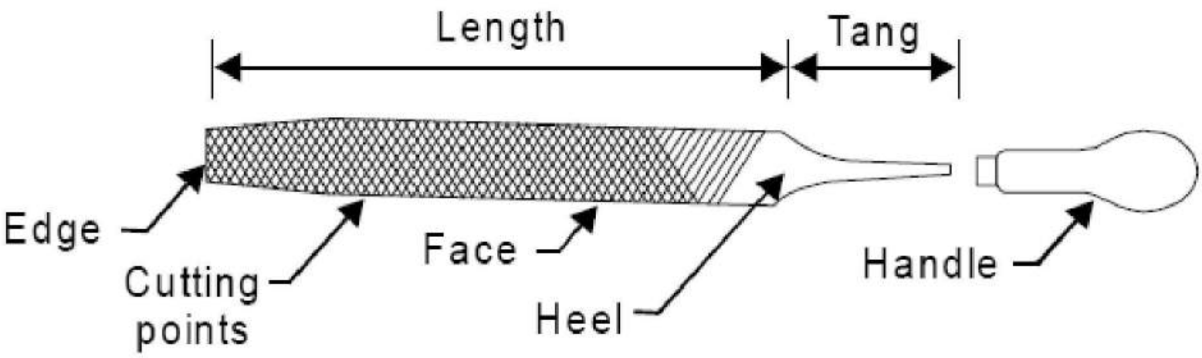
HAND WISE:



Hand vice

FILE:

File is a cutting tool. A file is hardened steel is a hardened steel tool, having slant parallel rows of cutting edges or teeth on its surface on the faces. The one end of the file is shaped to fit into wooden handle. The hand file is parallel in width double cut teeth on the faces, single cut on the one edge and no teeth on the other edge, which is known as "safe edge".

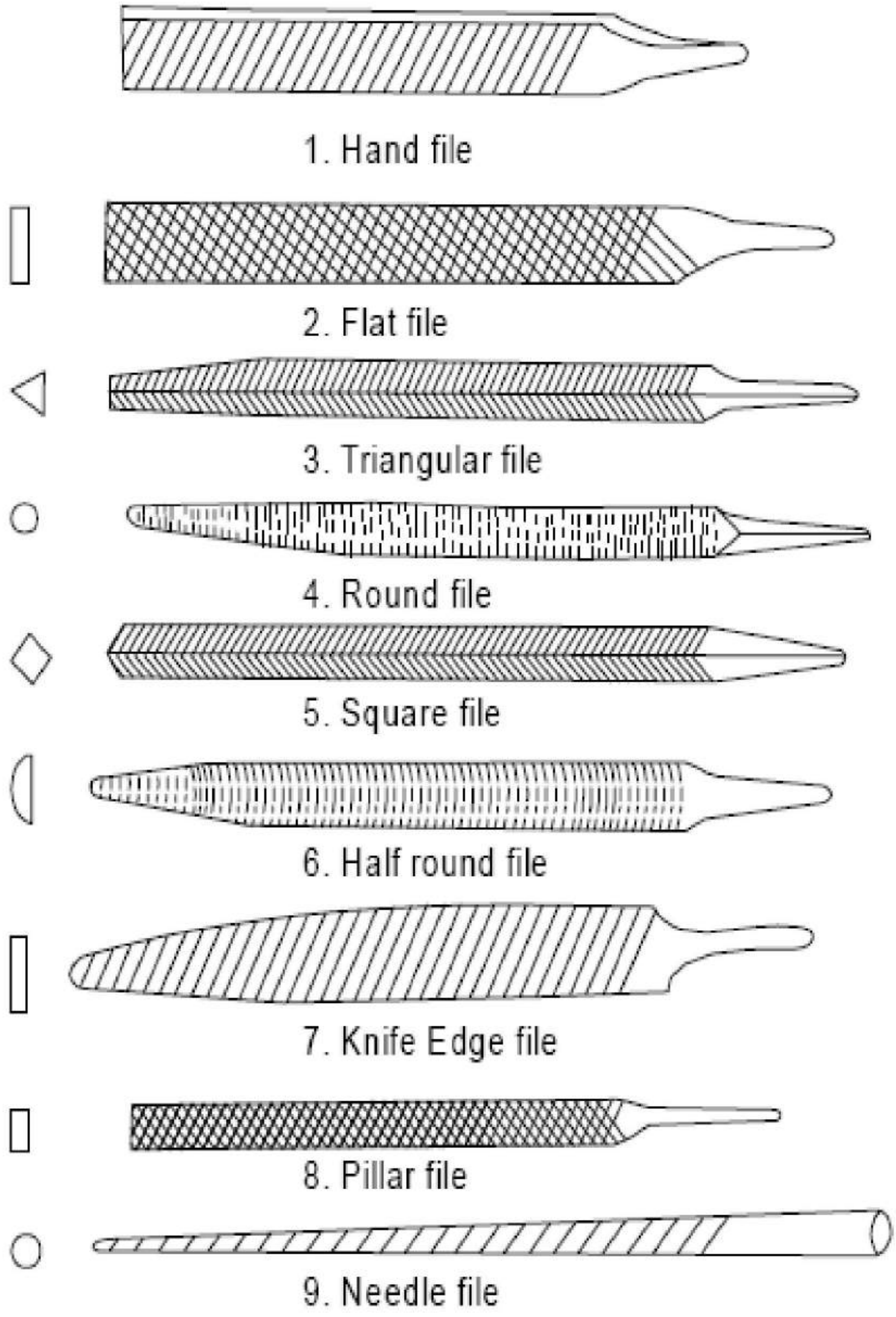


Parts of a file

TYPES OF FILES: Files are classified according to their shape, cutting teeth and pitch grades of teeth.

- Hand file ---------It is used for filing a surface, at a right angle to an already finished surface.
- Flat file-------------Used for general filing

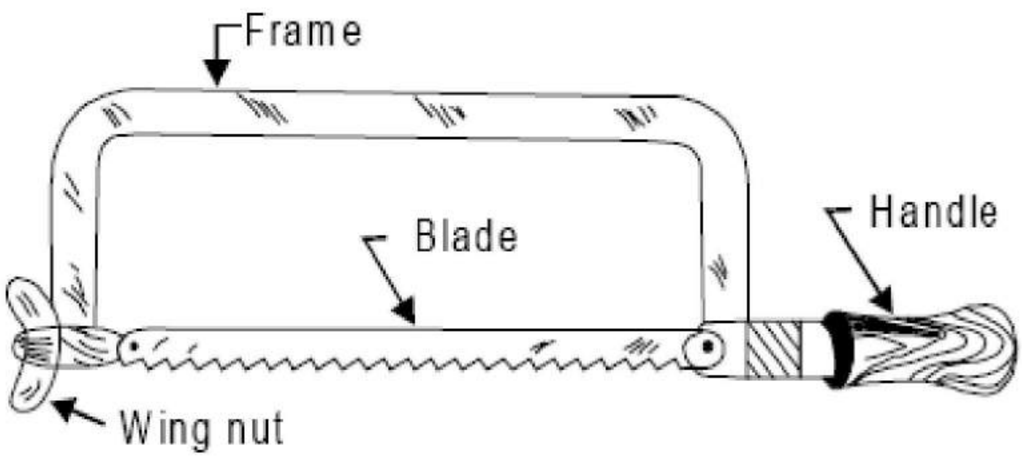
- Square file---------Used for slots and key ways.
- Triangular file-----Used for sharp corners
- Half round file-----Used for filing concave surfaces and internal corners.
- Round file---------- Used for deep hole filing



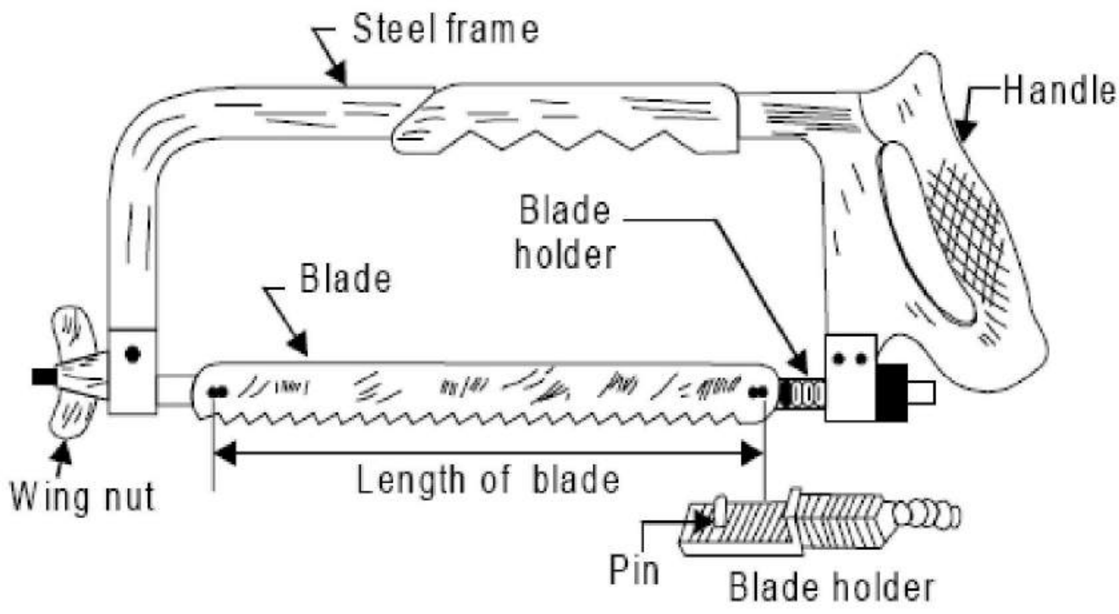
CUTTING TOOLS:

HACK SAW:

1. Solid frame



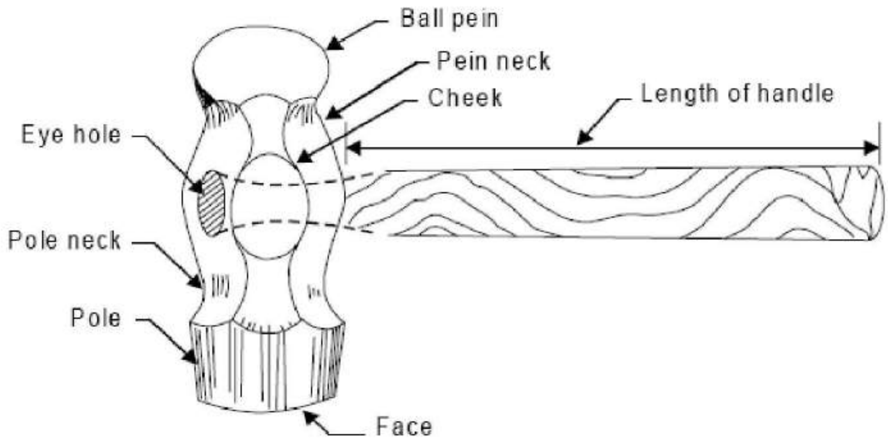
2. Adjustable frame



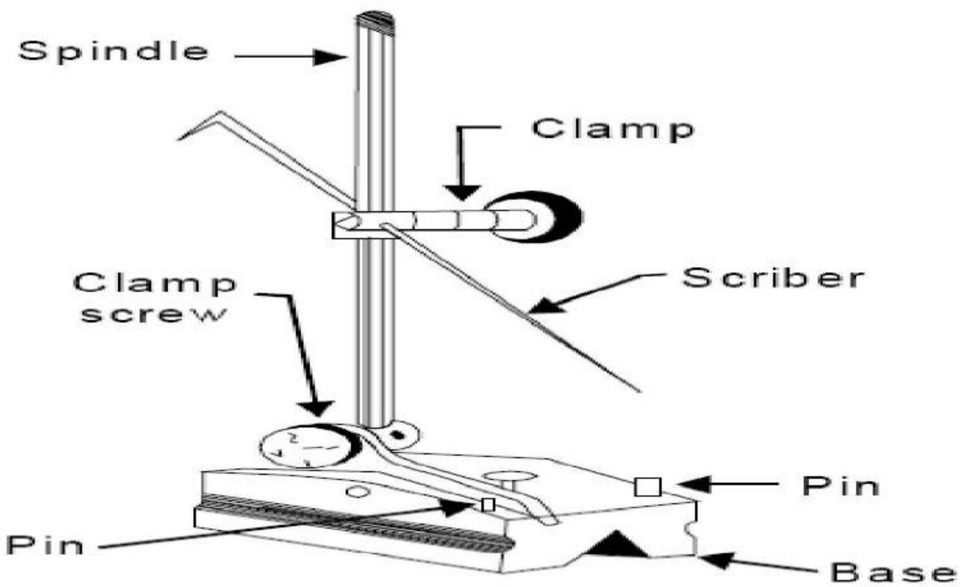
The hack saw is used for cutting metal by hand. It consists of a frame. This holds a thin blade, firmly in position. Hack saw blades have a number of teeth ranging 5 to 15 per cm.. The teeth of Hack saw blade are staggered or bended alternatively are known as a set of teeth . These make slots wider than the blade thickness, preventing the blade from jamming.

STRIKING TOOLS:

Hand hammers are striking tools. They are made of medium carbon steel. The various types of hand hammers in common use are ball peen hammer, cross peen hammer, and straight peen hammer.



MARKING TOOLS:



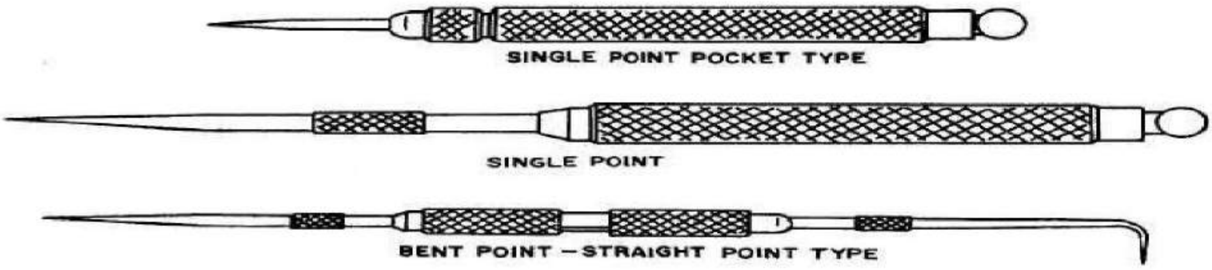
A universal surface gauge

Marking is a process of lay out of sizes on work piece. The following tools are used in marking out operations.

1. Scriber
2. Dividers
3. Jenny calipers
4. Scribing book
5. Angle plate
6. V-block
7. Punch
8. Try square
9. Surface plate

. **SCRIBERS:**

A scriber is slender tool used to scribe or marking lines on metal work piece.



PUNCH:

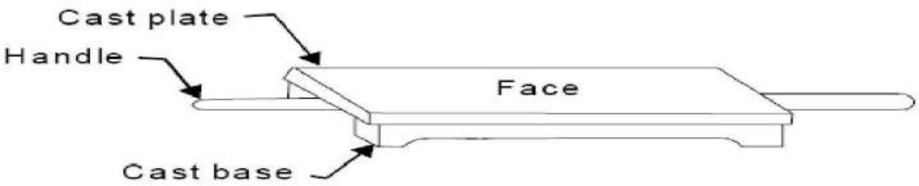
Punch is made of tool steel. The various types of punches prick punch, center punch, number punch and letter punch.

- **PRICK PUNCH:** It is also called as dot punch. Used for marking small dots along the layout lines.
- **CENTER PUNCH:** This is similar to dot punch, except that is point grounded to an angle 90^{o}. It is used for mark the location of holes to be drilled

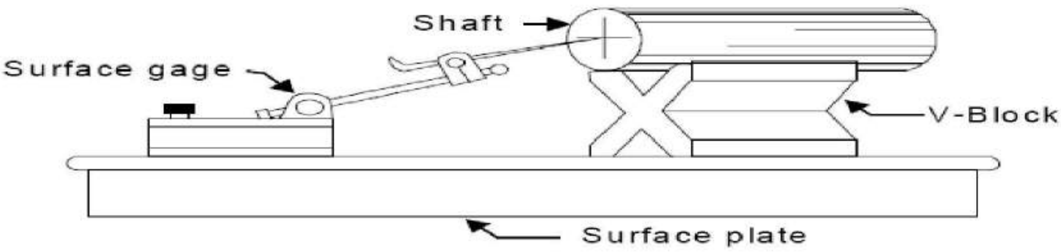
V-BLOCK: v-blocks are made of cast iron or hardened steel. They are provided with grooves on the top and bottom, and rectangle slots on two sides for location of clamps.

TRY SQUARE: It is used for checking the squareness of small works. The size of try square is specified by the length of the blade.

SURFACE PLATE: It is used for provide true surface support to the work during marking is made of cast iron, hardened steel or granite it is specified by length x width x height x grade.



A surface plate

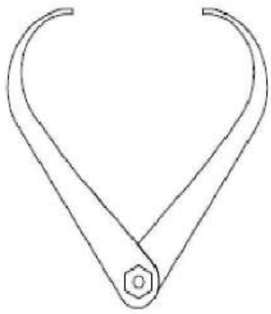


DIVIDER:

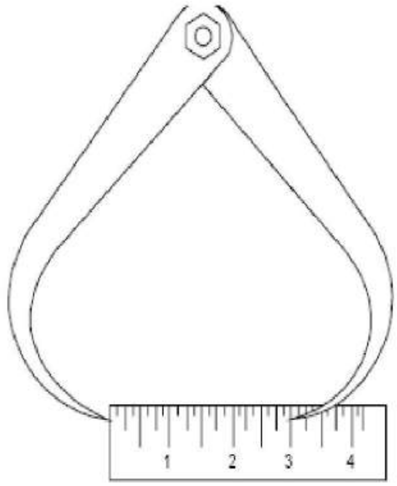
This is used for making circles, arcs, laying out perpendicular lines, bisecting lines etc

CLENNY CALIPER:

This is also called as odd leg or hermaphrodite caliper used for marking parallel lines from a finished edge and also for locating the center of round bars.



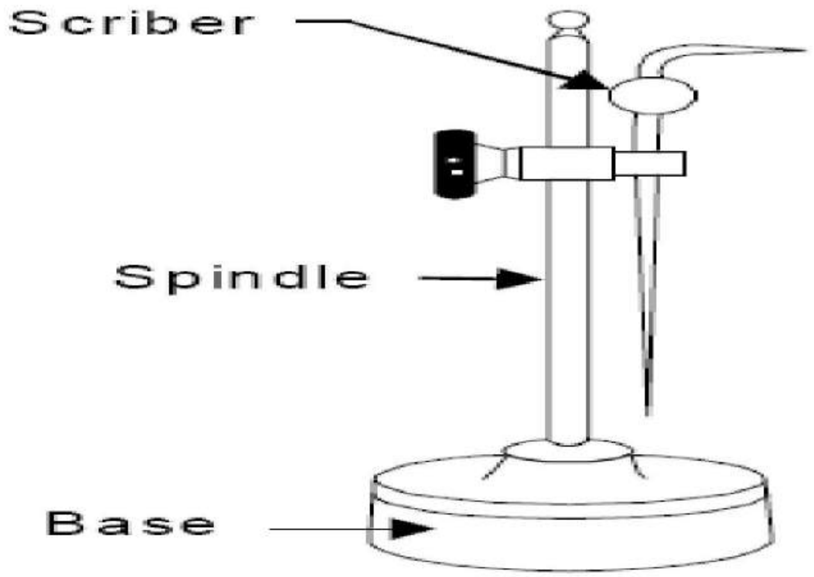
A simple outside caliper



A caliper held in rule

A standard spring joint outside caliper

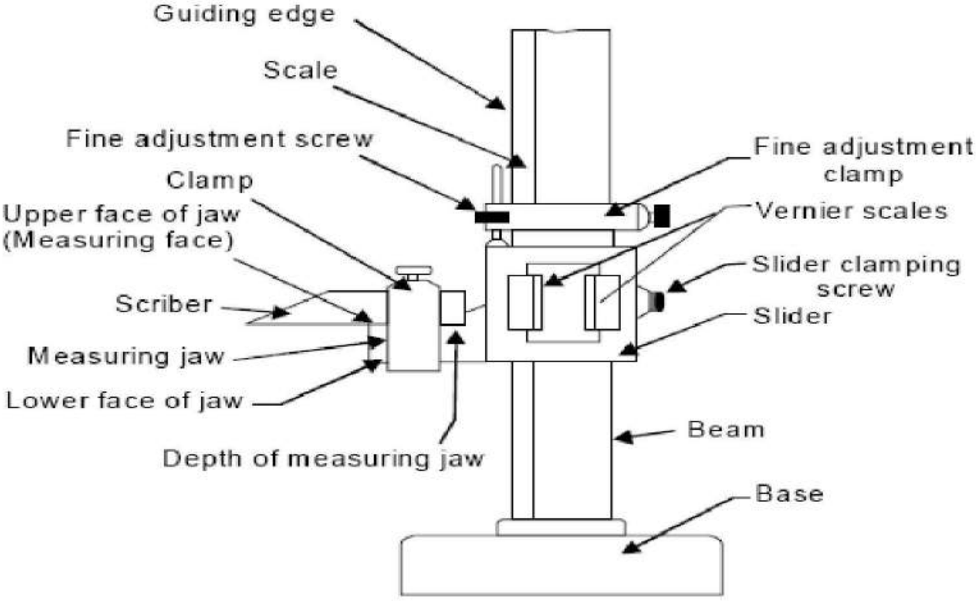
SCRIBING BLOCK: It is also known as universal scribing block. This used for scribing lines for layout work and checking parallel surfaces.



A surface gauge or scribing block

ANGLE PLANE: The angle plate is made of cast iron or hardened steel. They are provided with v-grooves on the top and bottom, and rectangle slots on two sides for location of clamps

VERNIER HEIGHT GUAGE: It is clamped with scriber it is used when it is required to take measurements from the surface on which the guage is standing. The accuracy and working principles of this guage are the same as those of the vernier caliper



A vernier height gauge

MEASURING AND CHECKING INSTRUMENT:

Measuring tools may be classified:

1. **LINEAR MEASURING INSTRUMENTS**

   (a) Steel rule (b) caliper (c) depth gauge (d) vernier caliper

   (e) Micro meter (f) gauge block (g) dial indicator or dial gauge

2. **ANGULAR MEASURING INSTRUMENTS**

   (a) Bevel protractor (b) Combination set (c) Sine bar

3. **SURFACE MEASURING INSTRUMENTS**

   (a)Spirit level (b) straight edge

STEEL RULE: It is a strip of steel with graduation on its edges

CALIPERS: Used for transferring the dimensions both external and internal. They are made either with firm joint or spring caliper.

- **OUTSIDE CALIPER:** Used for measuring outside dimensions of cylindrical shapes.
- **INSIDE CALIPER:** Used for measure the diameter of holes and width of key ways.
- **VERNIER CALIPER:** They are used for measuring outside as well as inside dimensions accurately. It may be also used as depth guage. Least count = one main scale division – one vernier scale division

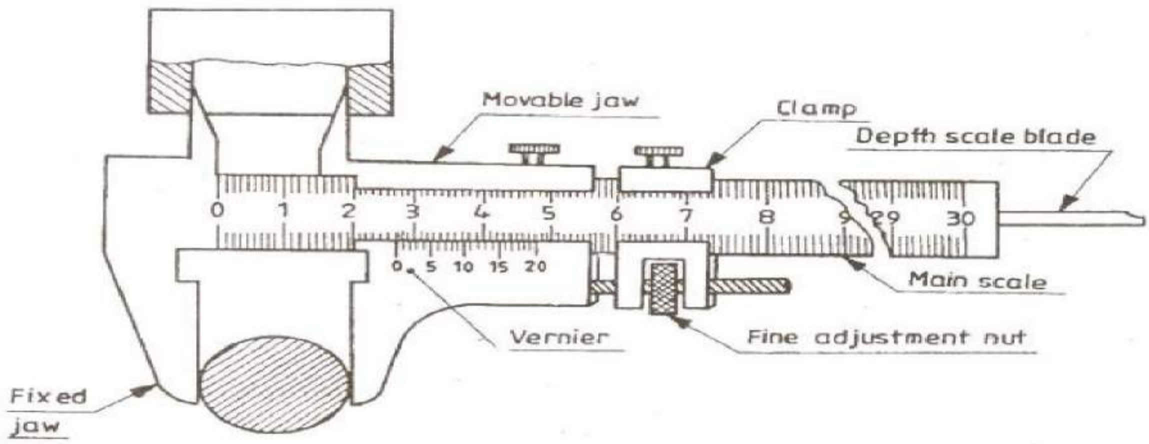


Fig. 8.14 Vernier calipers

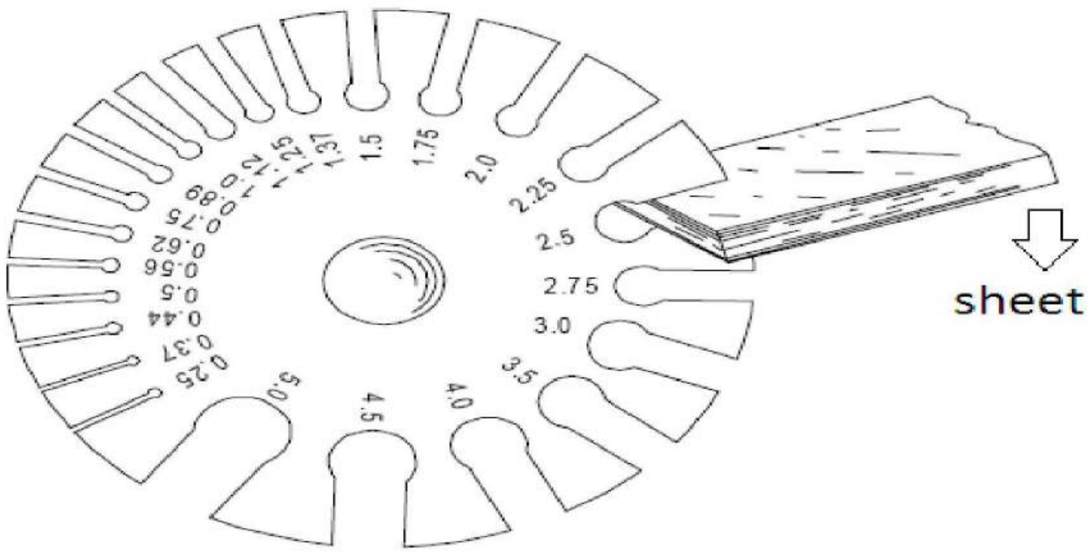
.

COMBINATION SET: It consist of a rule, square head, center head, and a protractor. This may be used for making mitres(45^0) for locating the centre on the end of the round bar.

GUAGES:

Gauges are inspection tools used in production work to control the size and shape of the components.

- **PEELER GUAGES:** These are thin steel blades hardened and grounded to various sizes. These are used to check the clearance between the two mating parts. The blade thickness varies from 0.03 to 1.0mm and the length of the blade is about 100mm.
- **SCREW PITCH GUAGE:** It is used to check the pitch of the screw. The pitch of the screw is directly on the gauge.
- **WIRE GUAGE:** The wire gauge is used to check the diameter of wire from 0.1mm to 10mm



A wire gauge

- **PLATE GUAGE:** Plate gauge (standard wire gauge) is used to measure thickness. Each slot is represented by number (SWG NUMBER), as the number increases the thickness decreases. The most common gauge used in sheet metal has 21 slots with gauge numbers ranging from 4 to 24
- **RADIUS AND FILLET GUAGE:** These are used to check the radii of curvature of convex and concave surfaces.

SAFETY PRECAUTIONS:

- Never wear loose clothes, wear the prescribed dresses while in work shop.
- Never enter the shop without shoes.
- Don't run or play on the shop floor.
- Keep the floor clear of metals chips, curls and waste pieces.
- Concentrate on the work and don't talk unnecessarily while operating machine.
- Do not operate any machine without getting conversant with its mechanism.
- Do not wear rings, watches etc. That could be caught in moving machinery.
- Do not attempt to oil, clean (or) adjust (or) repair any machine, when it is running.
- When you switch off the machine, do not leave before it has completely stopped running.
- Keep your body behind the cutting edge of an edged cutting tool.
- Never use a hammer with a loose head.
- Wear the goggles whenever there is a danger of flying matter/threat of exposure of harmful light rays.
- Do not clean chips without hands
- Do not try to stop the machine with your hands (or) body.
- Keep all the hand tools in working condition.
- Slippery floors, poor ventilation, poor lighting, and inadequate space are the potential causes of accidents.
- Install fire extinguishers at places prone to fire accidents.
- Ensure availability of first aid box with contents in workshop.

SQUARE FIT

Expt No:

Date:

Aim: To make a square fitting of dimensions 48x48x6mm with the given MS flat material piece.

Tools required: Steel rule, Try square, 12inch Rough file, 8 inch Smooth file with safe edge, Scriber, Dot punch, Hack saw frame with blade, Ball peen hammer, Odd leg caliper, Surface gauge and V-Block.

Sequence of operations:

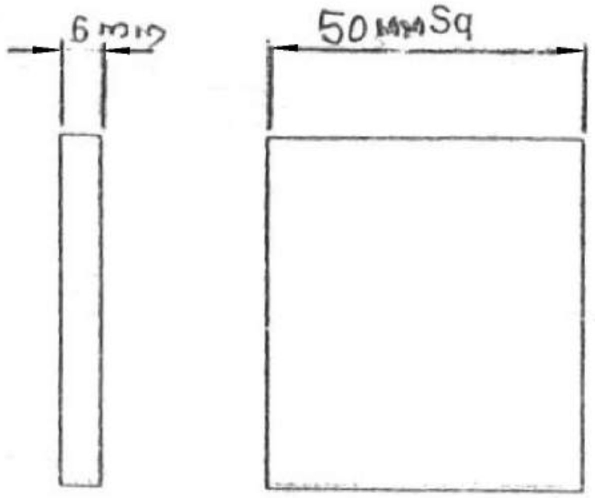
1. Filing
2. Marking
3. Punching
4. Cutting
5. Filing
6. Finishing

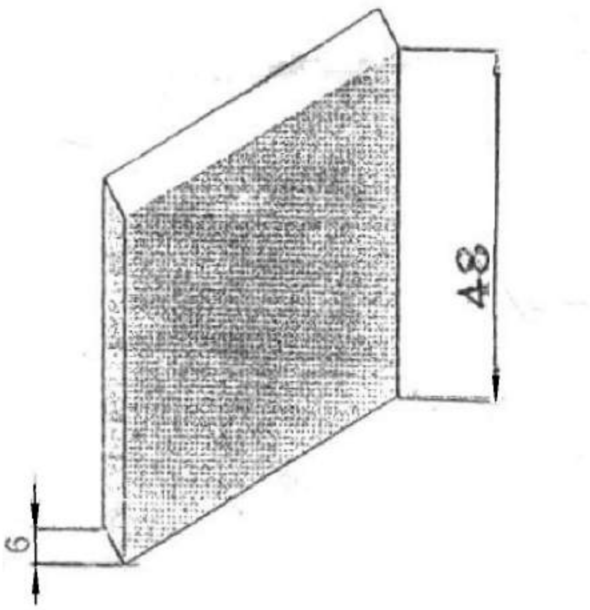
Procedure:

Result:

Precautions:

1. Wear tight overauls & safety shoes.
2. Position the job very close to the vice jaw to prevent springing, saw breakage and personnel injury.
3. Apply force only on the forward stroke while cutting.
4. See that the handle of the hammer is tightly wedged.
5. Remove sharp projecting edges and burrs, which produce inaccuracies in layouts, measurement errors & improper fits.


6 mm
50 mm Sq


48
6

STRAIGHT FIT

Expt No:

Date:

Aim: To make a straight fitting of dimensions as per the sketch with the given MS flat material pieces.

Tools required: Steel rule, Try square, 12inch Rough file, 8 inch Smooth file with safe edge, Scriber, Dot punch, Hack saw frame with blade, Ball peen hammer, Odd leg caliper, Surface gauge and V-Block.

Sequence of operations:

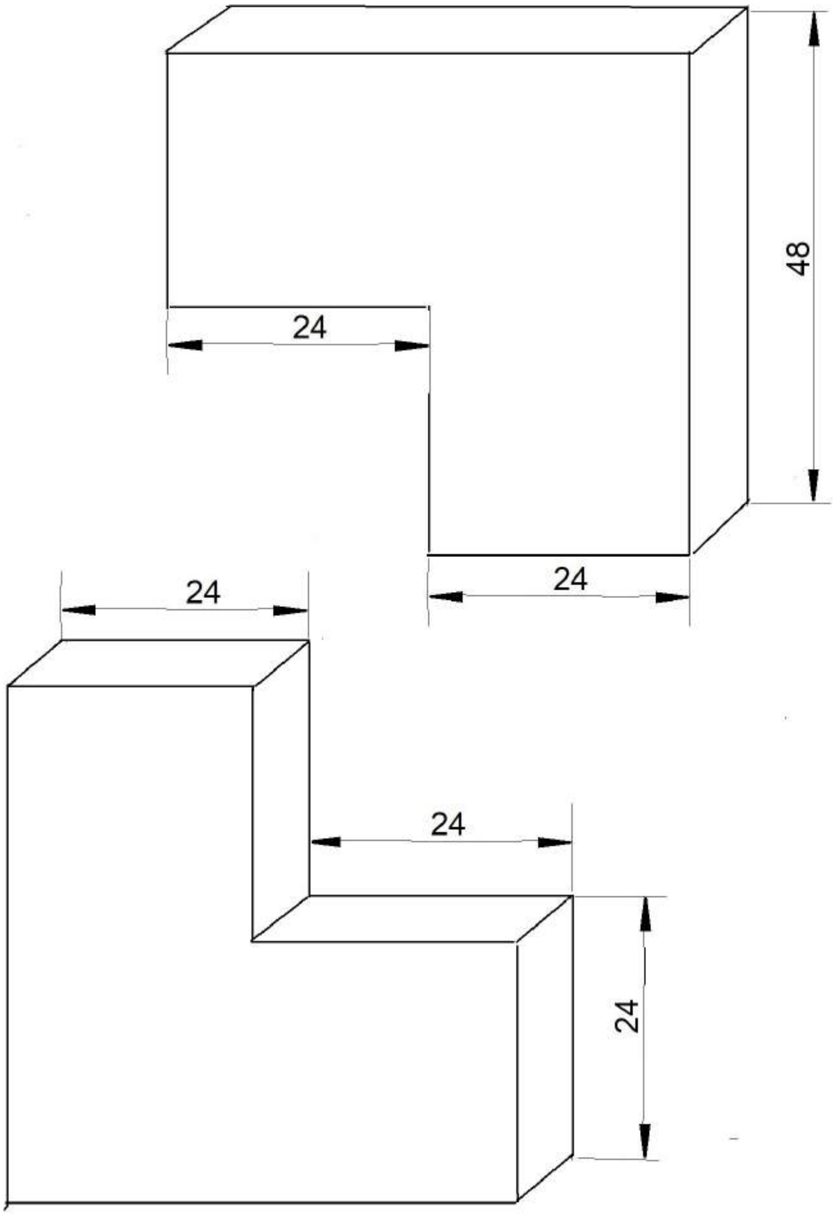
1. Filing
2. Marking
3. Punching
4. Cutting
5. Filing
6. Finishing.

Procedure:

Result:

Precautions:

1. Wear tight overauls & safety shoes.
2. Position the job close to the vice jaw to prevent springing, saw Breakage & personnel injury.
3. Apply force only on the forward stroke while cutting.
4. See that the handle of the hammer is tightly wedged.
5. Remove sharp projecting edges and burrs, which produce inaccuracies in layouts, measurement errors & improper fits.


48
24
24
24
24
24

VIVA QUESTIONS

1. The size of vice is specified by the length of the ____________
2. ___________ are provided on the jaws of the bench vice, to ensure good grip.
3. Cast iron is strong in _____________ and weak in ___________.
4. __________ & ___________ & __________ is used to support round stock for layout and inspection.
5. The angle of Vin V-block is usually , (a)45°,(b) 60° ,(c)90°, (d)120°
6. Try-square may be used as a measuring and marking tool for 90° angle.
7. ____________ is used to mark or scribe lines on metal work pieces.
8. Odd leg caliper is also called as _________ or _________
9. The dot punch has a sharper point than a centre punch.
10. Calipers are direct/indirect measuring tools.
11. Vernier calliper s can be used for measuring inside dimension accurately. (True/False)
12. A hacksaw blades is so fitted in its frame , that it cuts on the _________ stroke.
13. Hacksaw blades having lesser number of teeth per centimetre are used for cutting ___________ materials.
14. The _________ of the teeth keeps the hack-saw blade from binding in the cut .
15. Combination piler is used for ________ __________ _________ material.
16. A tap is used for cutting external threads. (True/False)
17. The finishing tap is known as __________ tap.
18. Dies are used for making external threads. (True/False)
19. The edge of a file that does not have a teeth on it is called a ________ __________.
20. The shape of the file to be used on a job depends upon the amount of material to be removed (True/False)

TIN SMITHY

INTRODUCTION:

The metal plank having less than 2 mm thickness is called sheet metal. Sheet metal work deals with the production of components in wide variety of shapes and sizes from sheet metal, with aid of tools or machines metals used in sheet metal work variety of metal shop. The characteristics and uses of some of the important metals used in sheet metal work are described below:

Galvanized iron: It is a sheet of soft steel, which is coated with zinc. Zinc resists corrosion and improves the appearance of metal. Galvanized iron is one of the least expensive metals and is used for making pans, buckets, ducts, gutters, tanks, boxes, etc.

Black iron: It is uncoated sheet of metal with bluish-black appearance. It corrodes rapidly and is not used extensively due to difficulties of soldering. The black iron sheets are used for the parts that are to be painted.

Tin plate: Tin plate is an iron or steel coated with pure tin. It has very bright silver appearance and is used for food containers, cans and pans.

Stainless steel: It is an alloy steel possessing corrosion resistance. General type stainless steel contains 18 percent chromium and 8 percent nickel. This steel is commonly known as 18-8 stainless steel. These are available in various sizes and thickness. It is widely used for food containers and dairy equipment.

Copper: It has reddish color and possesses good malleability, ductility and resistance to atmospheric corrosion.

Aluminium: Sheet aluminium is never pure aluminium and it is always allowed with small quantities of copper silicon, magnesium and iron.

CO RELATION BETWEEN TINSMITY AND ENGINEERING DRAWING:

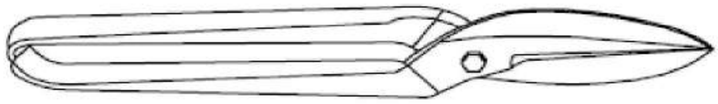
In Tin Smity we make different surface models using metal sheets. Here we use the techniques of engineer drawing (development of surfaces) to cut the metal sheet. Using development of surfaces technique in engineering we can obtain the size and shape to the sheet required to produce that object which results in reduction of scrap.

TOOLS AND EQUIPMENT:

Some of the tools used in fitting are also used in sheet metal work. Certain additional tools used by sheet metal worker are described below:

Snips: Hand shears or snips are used to cut sheet metal. Although there are many types, the sheet metal workers generally use straight snips and curved snips.

Bench shears: Bench shear is used for cutting thicker sheets. It is the lower fixed blade firmly secured by bracket at the bottom. The movable blade is pivoted at the rear end; the hand operating lever is attached to the front end of movable blade in a link mechanism.



Straight hand shear

Universal shear

Curved hand shear

Stakes: Stakes are made of steel and forged in a variety of shapes and sizes. Its working face is machined and polished to facilitate various operations such as bending, seaming or forming.

The following types of stakes are most generally used:

Double seaming: These stakes has two horns and it is used to make double seam for vessels.

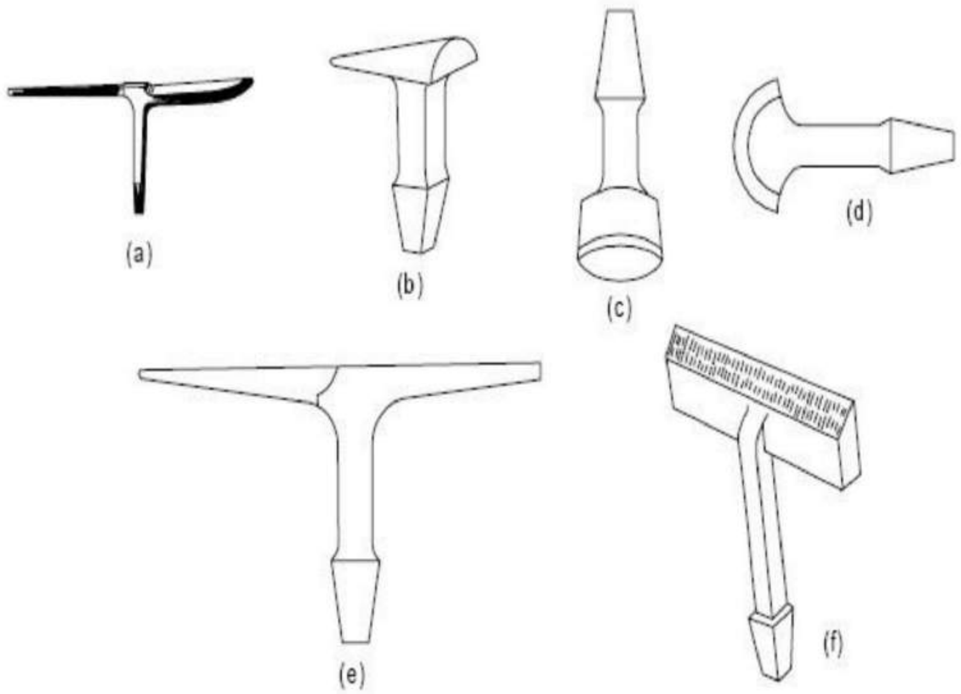
Blow horn: These stakes has two horn tapering horns and it is used to form or seam funnels.

Break horn: These stakes has a square tapered horn on one side and a round tapered horn on opposite side. It is used for shaping round and square surfaces, bending edges and making corners.

Conductor stake: These stakes has two cylindrical horns having different diameters. It is used for forming pipes and cylindrical pieces.

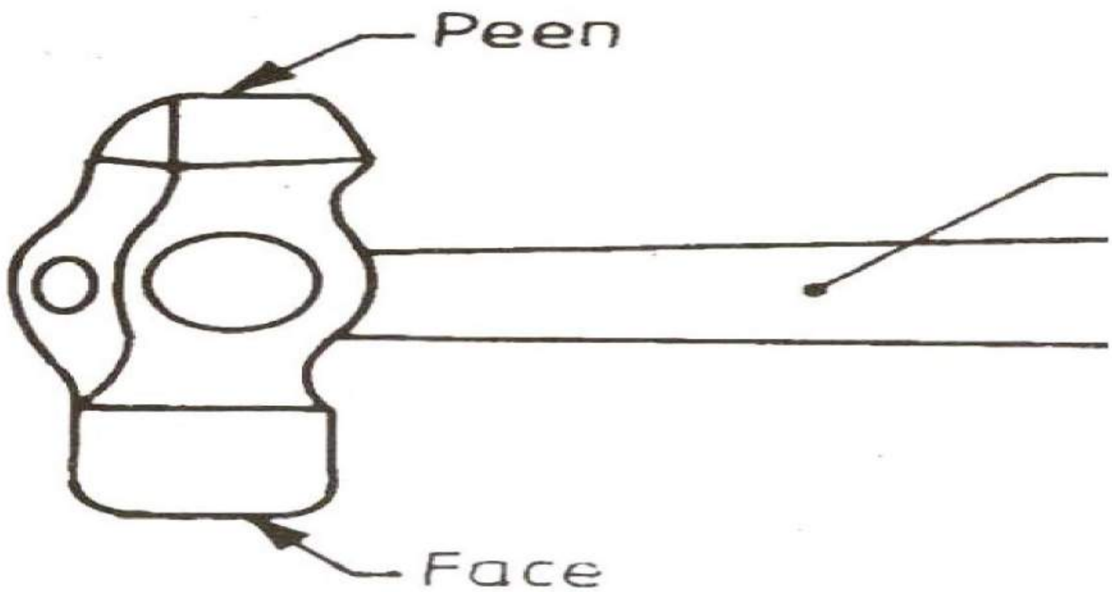
Funnel stake: It is used for forming conical shapes and for making wire rings.

Hatchet stake: It has a horizontal sharp straight edge and can be used for making straight, sharp bends and for folding and bending edges.

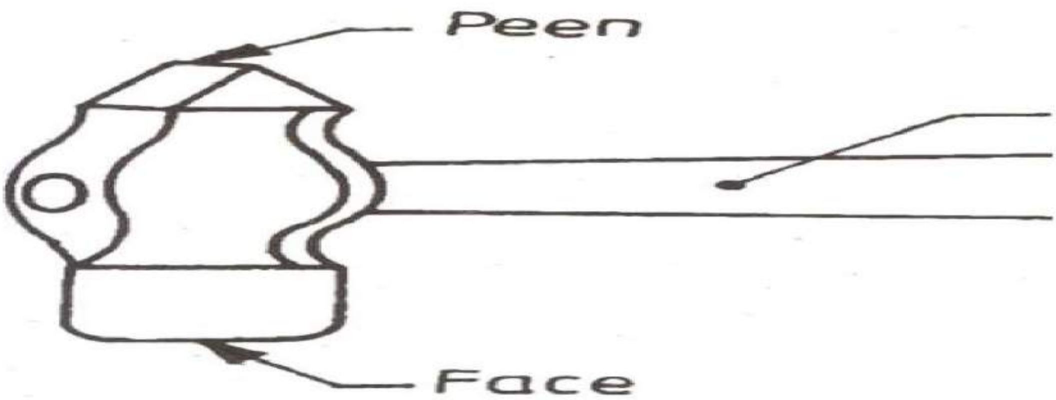


Hand hammers and mallets: The sheet metal worker uses a wide variety of hammers and mallets for forming shapes by different operation. The most commonly used hammers are as follows:

Straight-peen hammer: It has a peen end similar to its bottom size round shape and its top side is straight point. Square, slightly curved face and its peen is tapered. It is used for riveting.



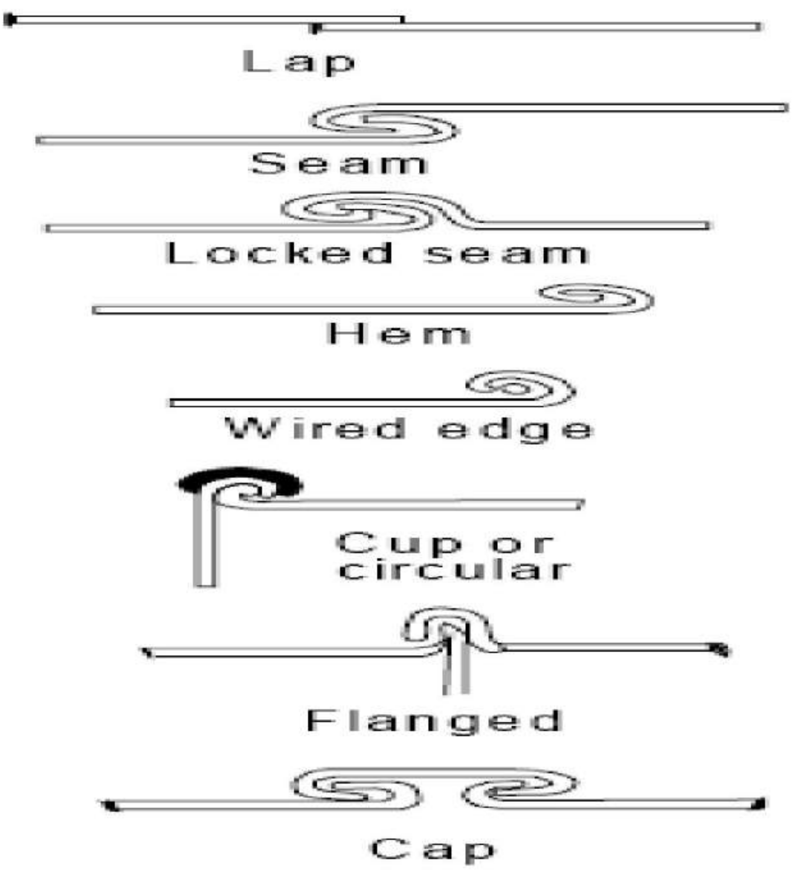
Cross-peen hammer: It has a square, flat face and it is tapered on one side. It is used for setting down the edges for making a double seam.



Mallet: Mallet is generally made of wood or plastic. It is used whenever slight blows are required. Wooden mallets do not damage the surface.

Wire Gauge: The thickness of sheet metal is preferred in numbers known as the standard wire gauge (SWG). The gaps in the circumference of the gauge are used to check the gauge number as shown below.

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 below. These are self secured joints, formed by joining together two pieces of sheet metal and using the metal itself to form the joint.



Various sheet metal joints

SAFETY PRECAUTIONS:

- Never carry tools in pockets.
- Do not try to hold the sheets with bare hands.
- Do not remove any guards on squaring shear.
- Care should be exercised when working on squaring shears. Be sure that the fingers are away from the shearing blade.
- Never use a soldering iron with a loose handle.
- Never touch a soldering iron to see its hotness. The safest method is to touch the iron to solder. The melting of solder indicates the correct temperature
- Be careful when cutting out a pattern. Remove scrap metal to avoid injuries.

ROUND TIN

Expt No:

Date:

Aim: To make a Round tin of dimensions as per the given sketch with the given G I Sheet.

Tools required: Steel rule, Vernier caliper, scriber, divider, Punch, Chisel, Hammer, Mallet, Shears/snips, Pliers, Stakes, Soldering iron, Shearing machine.

Sequence of operations:

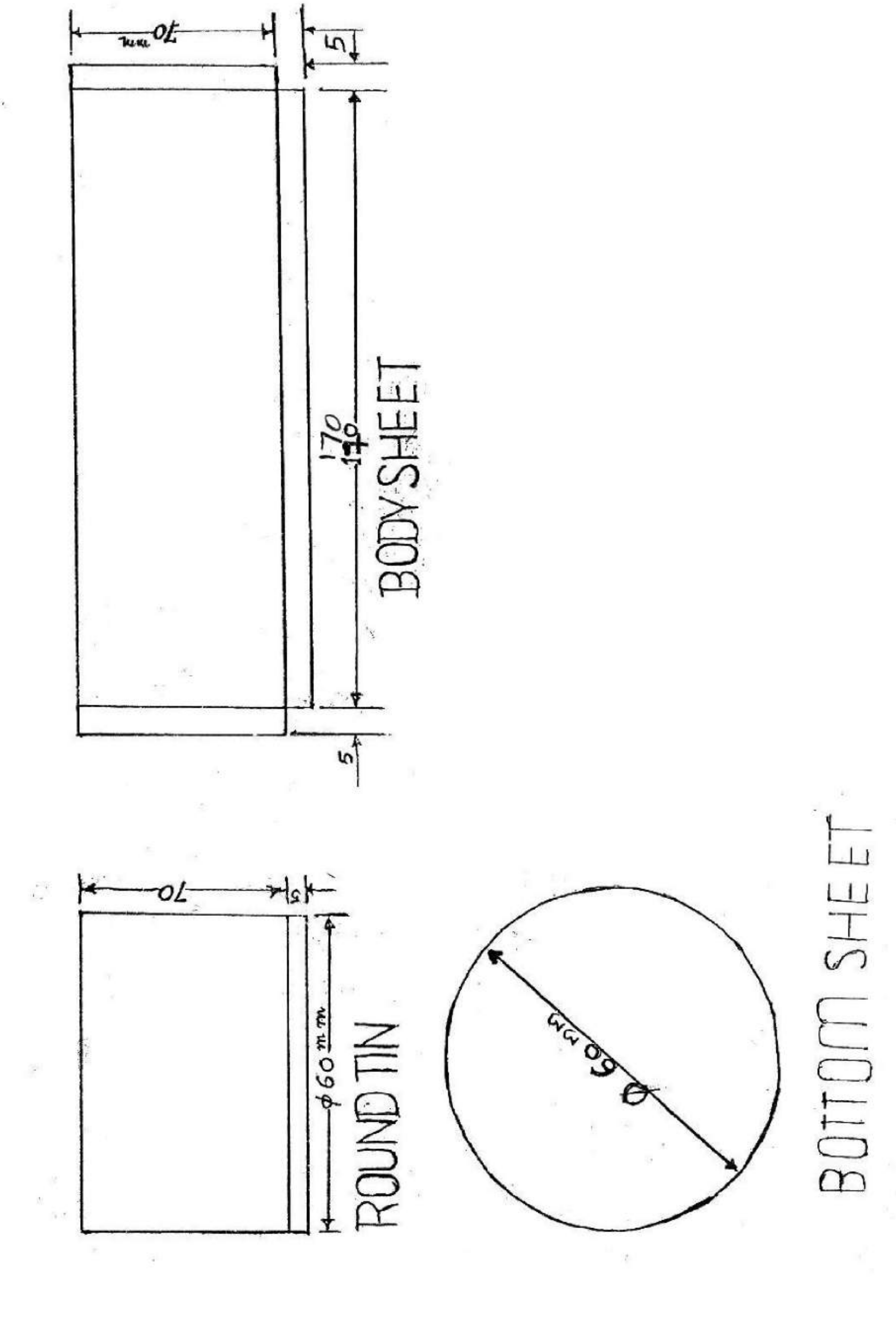
1. Marking
2. Shearing
3. Bending
4. Folding
5. Squeezing & pressing
6. Soldering

Procedure:

Result:

Precautions:

1. Wear tight overauls & safety shoes.
2. See that the handle of the hammer is tightly wedged.
3. Draw the pattern of correct dimensions giving due allowances for making joints.
4. Take care while using shear/snip or shearing machine to avoid personnel injury.


70 mm
5
170
5
BODY SHEET
70
5
ϕ60 mm
ROUND TIN
ϕ 60 mm
BOTTOM SHEET

RECTANGULAR TRAY

Expt No:

Date:

Aim: To make a rectangular tray of dimensions as per the given sketch With the given G I Sheet.

Tools required: Steel rule, Vernier caliper, scriber, divider, punch, Chisel, Hammer, Mallet, Shears/Snips, Pliers, Stakes, Soldering iron ,Shearing machine.

Sequence of operations:

1.Marking	4.Folding
2.shearing	5.Squeezing & Pressing
3.Bending	6.Soldering

Procedure:

Result:

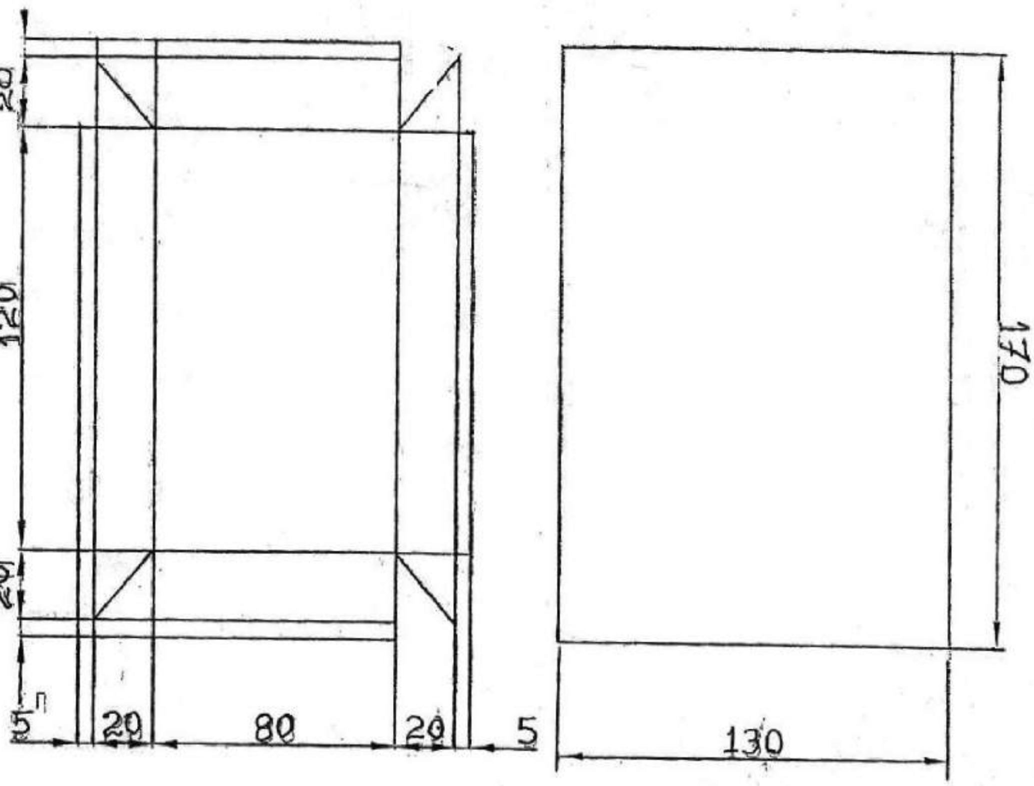
Precautions:

1.Wear tight overauls & safety shoes.

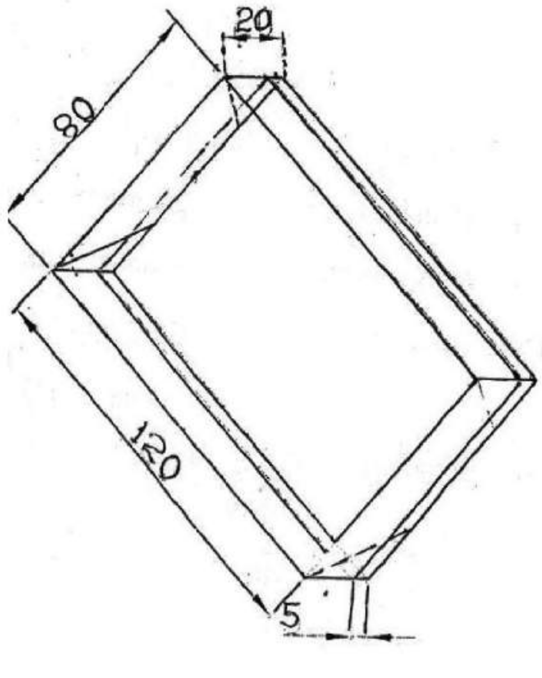
2.See that the handle of the hammer is tightly wedged.

3.Draw the pattern of correct dimensions giving due allowance for making joints.

4.take care while using shear/snip or shearing machine to avoid personal injury



DEVELPOMENT



RECTANGULAR TRAY

HOUSE WIRING

INTRODUCTION:

Electrical wiring is defined as a system of electrical conductor, components and apparatus for conveying electric power from the source to the point of use. Power is supplied domestic installation through a phase and a neutral forming a single phase AC 230 V two wire system. For industrial establishment, power is supplied through three-phase wire system to give 440 V. The neutral is earthed at the distribution substation of the supply. When supplied to domestic utilities, phase is fed to a kilowatt meter and then to a distribution panel. The panel distribution passes along with circuits.

ELEMENTS OF HOUSE WIRING:

1. Fuses and circuit breakers:

These are devices designed to provide protection to a circuit against excess current.

2. Electric Switch:

This is a device that makes and breaks or changes the course of electric circuit.

3. 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., Fan etc.

4. Socket out let:

It is a device carrying two or three contact designed for engagement with corresponding plug pins and arranged for connection to fixed wiring.

5. Lamp Holder:

Lamp Holder is designed to hold lamps and connect there in the circuit.

6. Main Switch:

This is a switch intended to connect or cut off the supply of the electricity to the whole of insulation. It contains one or more fuses.

COMMON HOUSE WIRING CONNECTIONS:

- One lamp controlled by a one-way switch:

Figures show the wiring diagram for a lamp controlled by a one-way switch. This is the normal connection one comes across in house wiring.

- Two lamps connected in series or parallel by a one-way switch:

- Two lamps may be connected by one-way switch in parallel for bright glow or in series for dull glow.
- One lamp controlled by 2 two-way switches:

It is sometimes desirable to control a lamp from two different places. One may come across this situation with staircase, long corridors or hall containing two entrances etc.

Combination Piler: It is made of steel and its size is given according to fix length. It has a cutter for cutting the wires.

Electrician knife: It is the tool used for removing the insulation from the wires. It has two folding blades, one for removing the insulation and the other for clearing the wires.

Test Lamp: A test holder with a lamp is called a test lamp. It is used for testing the supply.

Pocker: It is long sharp tool used for making pilot holes in wood before fixing and tightening of wood screws.

Rawl plug tool and bit: It has two parts namely the tool bit and tool holder. The tool bit is made of carbon steel and the tool holder is made of mild steel. It is used for making holes in brick and concrete walls or ceilings. Its size depends upon the number, as the number increases; the thickness of the bit as well as the plug also increases.

Ball peen Hammer: There are different types of hammers used for different purposes. The purpose of ball peen hammer is generally used in electrical trades. The size of hammer is usually indicated by its weight.

Electric soldering Iron: It is used for soldering wires to commutator segments and small joints with solder. It consists of pointed oval copper bit fixed to an iron rod which is heated by an electric element only.

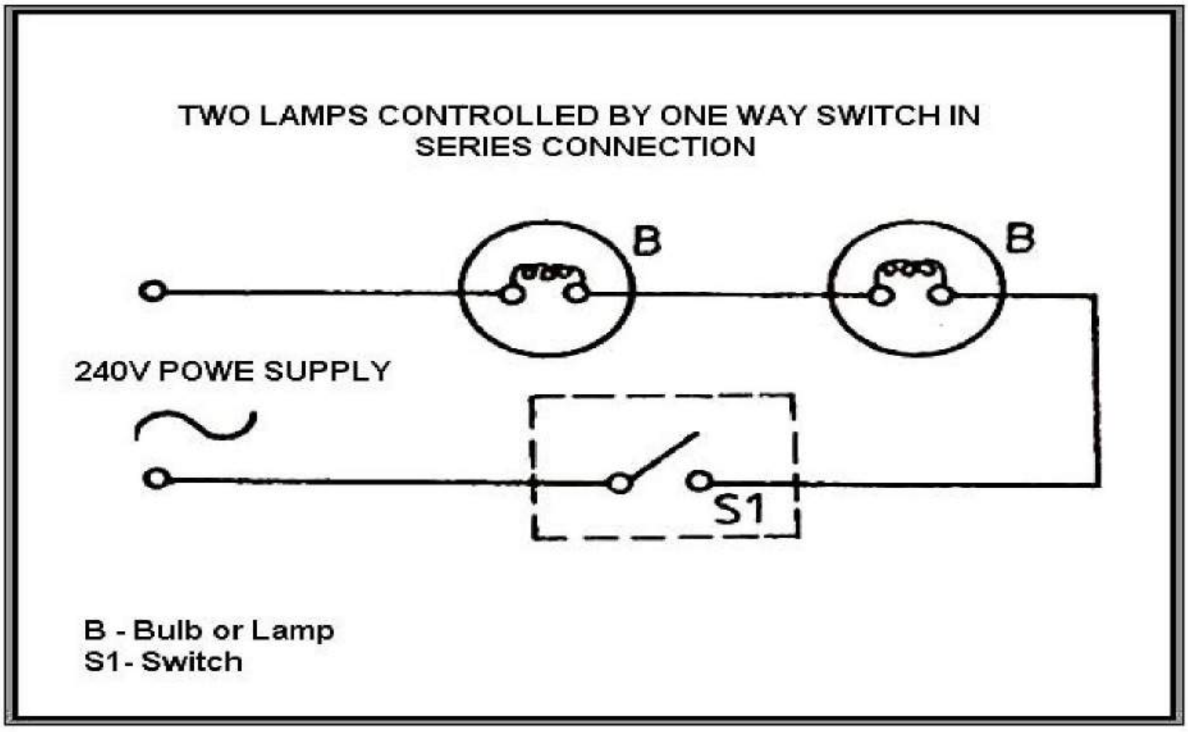
EXPERIMENT – 01:

AIM: To prepare a wiring to control two lamps connected in series by one switch. (SERIES CONNECTION)

TOOLS REQUIRED:

1. Screw driver,
2. Connector,
3. Tester,
4. Lamp holders,
5. One way switch, wires,
6. Wire clips,
7. Nails, Pocker,
8. Bulbs,
9. Wire cutter,
10. Nose plier,
11. Cutting plier,
12. Ball peen hammer.

CIRCUIT DIAGRAM:



SEQUENCE OF OPERATIONS:

PRECAUTIONS:

1. Never remove a plug from an outlet by pulling the cord. Always pull by the plug.
2. Whenever there is power failure, put off the power supply to all equipment in order to prevent spontaneous recovery.
3. Put on mains only ascertaining completion of correct wiring.

RESULT:

EXPERIMENT-02:

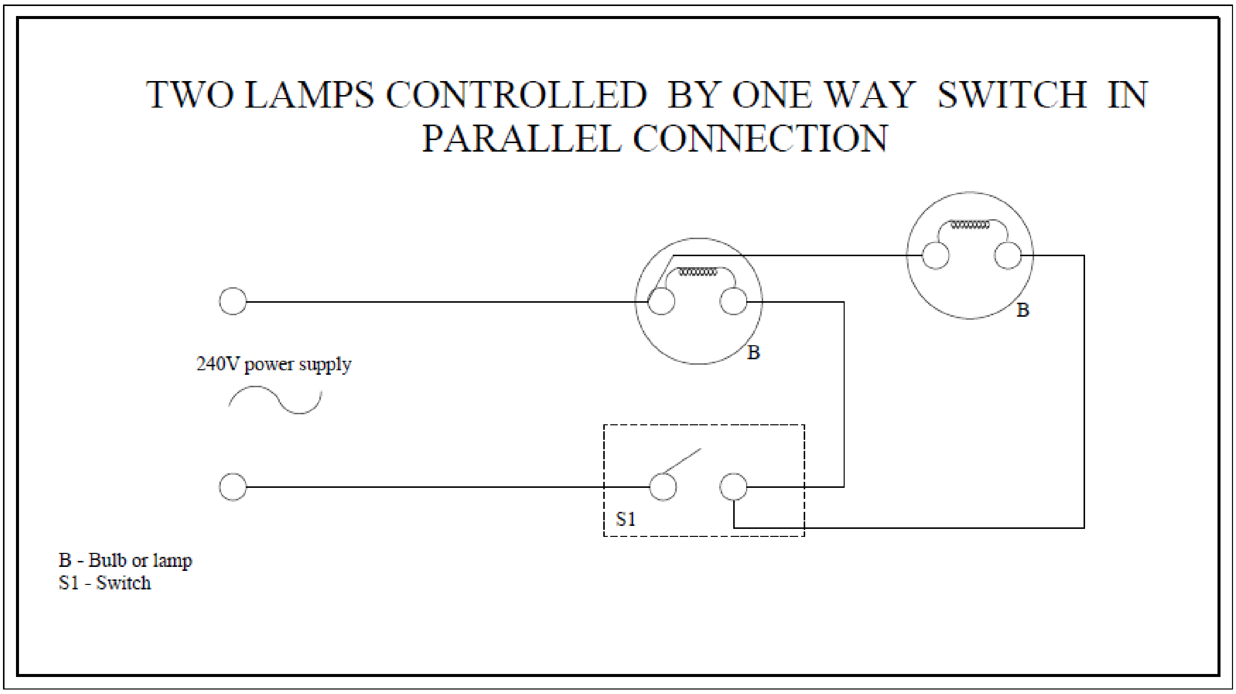
AIM: To prepare a wiring to control two lamps connected in parallel by one switch.

(PARALLEL CONNECTION)

TOOLS REQUIRED:

1. Screw driver
2. Connector
3. Tester
4. Lamp holders
5. One way switch
6. Wires
7. Wire clips
8. Nails
9. Pocker
10. Bulbs
11. Wire cutter
12. Nose pliers
13. Cutting pliers
14. Ball peen hammer

CIRCUIT DIAGRAM:



SEQUENCE OF OPERATIONS:

SAFETY PRECAUTIONS:

1. Never remove a plug from an outlet by pulling the cord. Always pull the plug.
2. Whenever there is power failure, put off power supply to all equipment in order to prevent spontaneous recovery.
3. Put on mains only after ascertaining completion of correct wiring.

RESULTS:

EXPERIMENT-02:

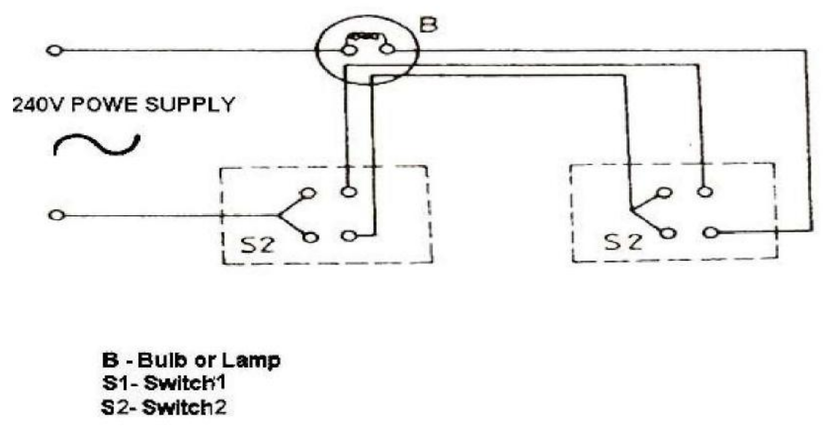
AIM: To prepare a wiring to control one lamp controlled by two way switch.

TOOLS REQUIRED:

1. Screw driver
2. Connector
3. Tester
4. Lamp holders
5. One way switch
6. Wires, wire clips
7. Nails
8. Pocker
9. Bulbs
10. Wire cutter
11. Nose pliers
12. Cutting pliers
13. Ball peen hammer

CIRCUIT DIAGRAM:

ONE LAMP CONTROLLED BY TWO WAY SWITCH



SEQUENCE OF OPERATIONS:

PRECAUTIONS:

1. Never remove a plug from an outlet by pulling the cord. Always pull the plug.
2. Whenever there is power failure, put off power supply to all equipment in order to prevent spontaneous recovery.
3. Put on mains only after ascertaining completion of correct wiring.

RESULTS:

VIVA QUESTIONS (HOUSE WIRING)

1. For domestic use,power is supplied through a ____________ and a ___________, forming a single phase A.C, two wire system.
2. For industrial establishments power is supplied through _______phase,______wire system.
3. Electric switch __________ and___________ the electric circuit.
4. A plug engages with corresponding ____________ contacts.
5. Main switch is used only to cut –off the supply of electricity.
6. A lamp filament is made of____________.
7. A multicore conductor consists of several cores _____________ from each other.
8. Wire sizes are specified by the diameter/length of the wire.
9. The wire specification 14/36 indicates __________ strands of _________ SWG.
10. In series circuit, when one device breaks down; the remaining devices operate (True/False)
11. In parallel circuit, if one device breaks down; the remaining devices operate. (True/False)
12. Regulator is used for controlling the __________ of a fan.
13. Universal fans operate both on A.C and D.C (True /False)
14. While using a table fan, always use two/three core flexible wire for connection.
15. If the bulb on the handle of an automatic electric iron glows, it means that the iron is cool/hot.
16. The intensity of the glow of an indicator lamp is a measure of a voltage/current level.

FOUNDRY

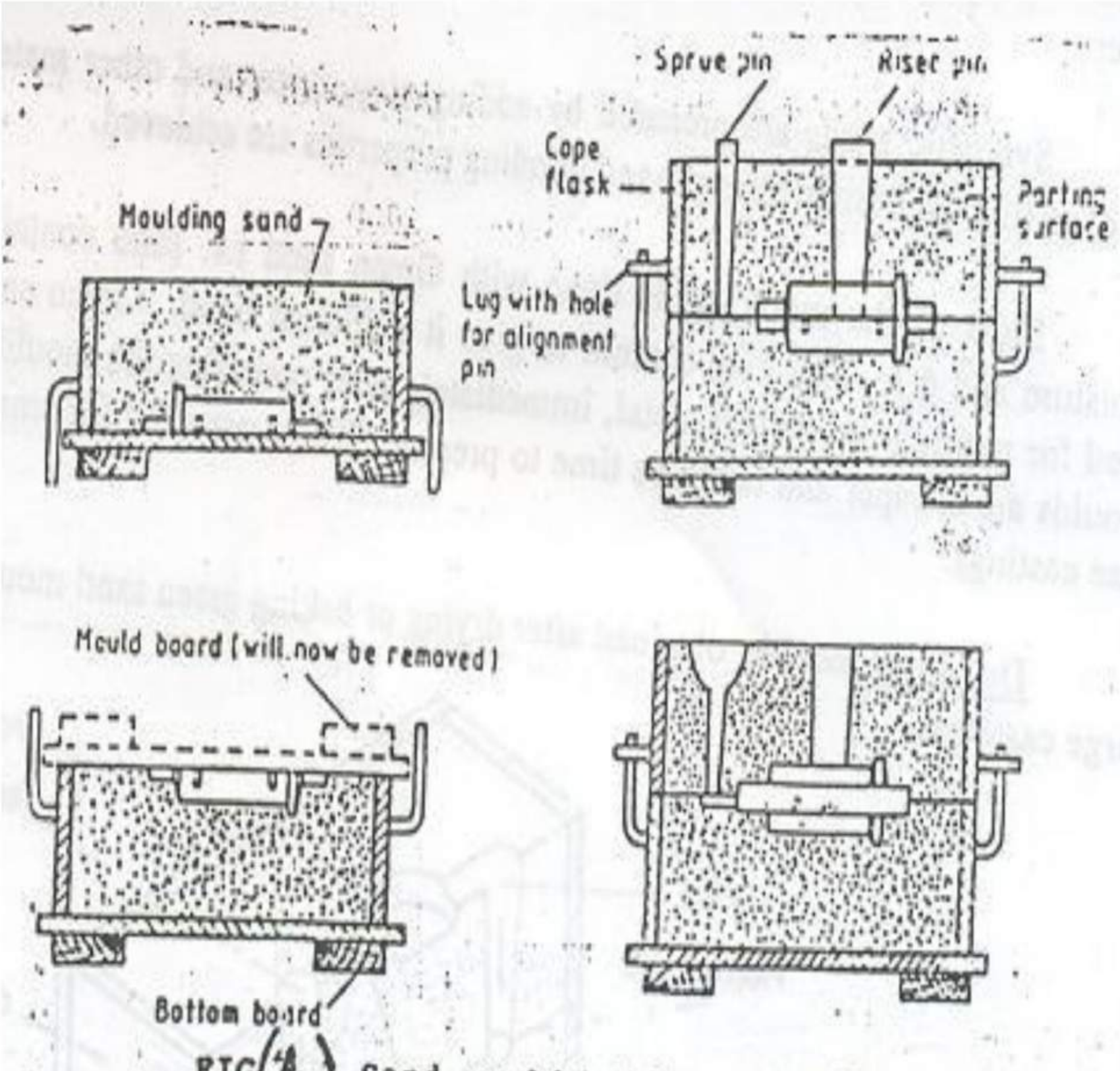
INTRODUCTION:

Metal casting is the process of forming metallic objects by melting metal, pouring it into the shaped cavity of a MOULD and allowing it to solidity. The process of casting involves the basic operations of pattern making, sand preparation, MOULDING, melting of metal, pouring in moulds, cooling, shake-out, felting, heat treatment, finishing and Inspection.The casting process involving the use of sand as moulding medium can be classified as sand moulding processes. The stages involved in the sand moulding processes are: Sand preparation, pattern making, core making (if required), moulding and closing.

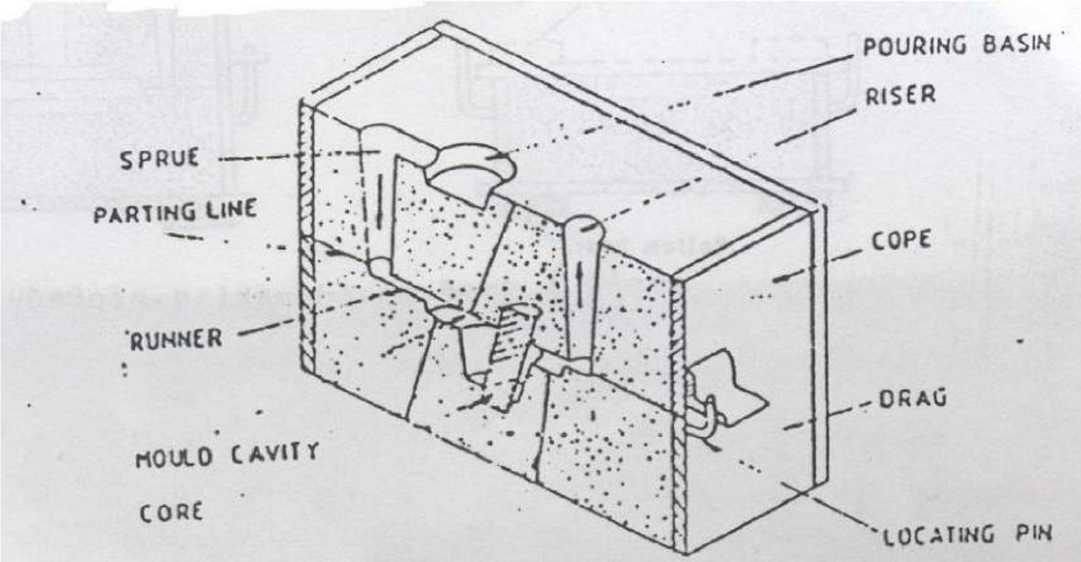
PREPARATION OF A MOULD (fig 1)

1. The following are the steps used in making a simple mould using a hollow split pattern with core prints on both sides:
2. Place the bottom half of the pattern on the moulding board, with its flat side on the board.
3. Place the drag over the board.
4. Sprinkle the pattern and the moulding board with parting sand.
5. Allow facing sand, over the pattern, until it is covered to a depth of 2 to 3 cm.
6. Pack the moulding sand around the pattern into the corners of the flask with fingers.
7. Place backing sand in the flask and ram the sand in the moulding box with a rammer.
8. Use first the peen end and then the butt end of the rammer.
9. Strike off the excess sand from the top surface of the drag with strike off bar.
10. Turn the drag upside down.
11. Blow-off the loose sand particles with the bellows and smoothen the upper surface.
12. Align top half of the pattern with the bottom half by means of dowel pins.
13. Place the cope on the top of the drag in position, Locate riser on the highest point of the pattern.
14. Place the sprue pin 5 to 6cm away from the pattern on the other side of the riser pin.
15. Sprinkle the upper surface, over and around the pattern with the parting sand.
16. Repeat steps 4 to 7, appropriately.
17. Make holes with the vent rod to about 1cm from the pattern.
18. Remove the sprue and riser pins by carefully drawing them out. Make a funnel shaped hole at the top of the sprue hole, called the pouring basin.
19. Lift the cope and place it aside on its edge.

20. Insert the draw pin into the pattern. Wet the edges around the pattern, loosen the pattern by
21. rapping. Then draw the pattern straight up.
22. Repeat the above step for withdrawing pattern straight up.
23. Repair the mould by adding bits of sand, if necessary.
24. Cut gate in the drag from the sprue to the mould; blow-off any loose sand particles in the mould.
25. Set the core carefully in the locations provided by the core prints.
26. Close the mould by placing cope over the drag.
27. The mould is ready for pouring the molten metal.



FIG(1) Sand mould making procedure



MOULING SAND:

Sand is the principal material used in a foundry. The principal ingredients of moulding sands are (i) Silica Sand (ii) Clay and (iii) Moisture, clay imparts the necessary bonding strength to the moulding sand. Moisture when added in correct proportion provides the capacity to clay for binding the silica sand. Special additives are also added to develop certain properties to the moulding sands.

- Natural moulding sand is either available in river beds or dug from pits. They posses an appreciable amount of clay and are received, with the addition of water.
- Synthetic sands are prepared by adding clay, water and other materials to silica sand, so that the desires strength and bonding properties are achieved.
- Most of the moulding is done with Green sand i.e. sand containing 6 to 8% moisture and 6 to 10% clay content to give it sufficient bond. Green sand moulds are used for pouring the molten metal, immediately after preparing the moulds Green sand moulds are cheaper and take less time to prepare. These are used for small and medium size castings.
- Dry sand moulds, obtained after drying or baking green sand moulds are used for large castings.
- Parting sand which is clay free, fine grained silica sand, is used to keep the green sand from sticking to the pattern and also to prevent the cope and drags from clinging.
- Core sand is used for making cores. This is silica sand mixed with core oil and other additives. Core is a shape made in core sand placed in a mould to produce an accurate hollow shape or cavity in a casting when liquid material is poured in the

mould, it occupies all the empty spaces restricted on outside by mould and internally by core, finally forming the casting.

PATTERN: A pattern is the replica of the desired casting, which when packed in a suitable material, produces a cavity called the mould. This cavity when filled with molten metal, produces the desired casting after solidification.

Types of patterns: (fig 2) Wood or metal patterns are used in foundry practice. Single piece, split, loose piece, multipiece and cored patterns are some of the common types.

Single piece, solid pattern: It is the simplest of all the patterns. This has a flat surface on the cope side. This makes possible a straight line parting on the joint between the cope and the drag of the mould.

- **Split pattern:** Split patterns are adopted for intricate castings, where removal of the pattern from the mould is difficult. The two halves of the patterns are put together by dowel pins. If the two pieces are similar in size and shape, it is called a split pattern, otherwise, it is known as a two-piece pattern.
- **Loose piece pattern:** When a pattern cannot be withdrawn from the mould due to its complexity, loose pieces are provided to facilitate this. However, only two moulding boxes are required for making a mould in this case.
- **Multi-piece pattern:** This type of pattern is made in three or more parts. The parts that make-up the pattern are held together with dowel pins. The number of moulding boxes required will be equal to the number of pieces on the pattern.
- **Cored pattern:** When a casting with holes or recesses is to be made, a cored pattern is needed. This type of pattern is made with core prints added to the surface. After moulding, the core prints leave impressions in the sand for positioning a dry sand core. A sand core is prepared separately, dried and then positioning a dry sand core. A sand core is prepared separately dried and then positioned in the mould before it is closed. When molten metal is poured into the mould, a cavity or recess is formed in the casting, the shape of which is determined by that of the core.
- **Core Print:** An impression in the form of a recess is made in the mould, to support a core in the mould. This is obtained with the help of a projection, suitably added to the pattern.This projection on the pattern is known as the core print. Depending upon the casting shape, core print may be horizontal or vertical.

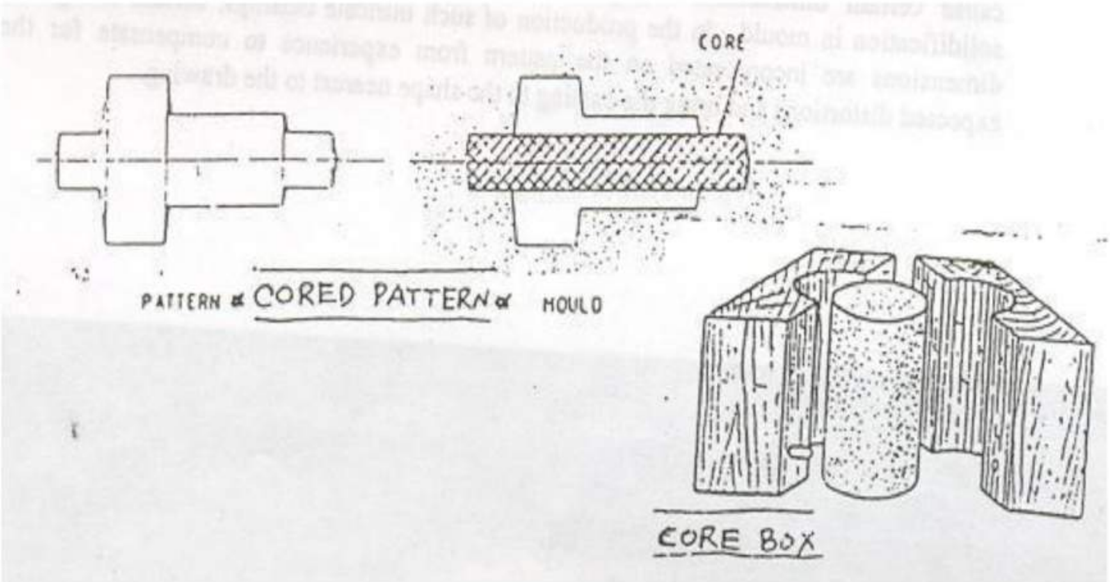


Fig : 2

Core box: A core box is made of either wood or metal, into which sand is packed to form the core. Wood is commonly used for making a core box; but metal boxes are used when cores are to be made in large number. Specially prepared core sand is used in making cores.

PATTERN DESIGN: While designing a pattern, the following must be considered.

1. Avoid abrupt changes in cross section. This is to avoid certain defects in the casting.
2. Avoid sharp corners and edges to enable smooth flow of molten metal in the mould cavity.
3. Provide the following pattern allowances.

- Shrinkage (Contraction) Allowance: Liquid metal which fills the mould-cavity entirey when poured, normally shrinks or contracts in solid stste from solidus temperature to liquidus reducing dimensions. To compensate for this, pattern should be made correspondingly lager than the final casting dimensions. Tis additional allowance which is upto 2% over the casting dimensions depending on the metal poured is incorporated in the pattern layout in all dimensions.For making patterns special scales called contraction scales are used. There will be a special scale for each type of metal to be poured.
- Machining Allowance: The final casting needs to be machined on many external/internal faces for better dimensional accuracy and finish. Accordingly, additional material has to be provided on all such faces requiring later, on the rough casting and so on the pattern. The amount of machining allowance depends on the size of the casting, the quality requirements and the nature of the casting metal.
- Draft (taper) Allowance: To facilitate easy withdrawl of pattern from the rammed mould, normally the vertical contact on the pattern are given a small taper or draft.

The amount of draft depends upon the depth of the pattern the material and finish of pattern, and should be minimum to keep the casting dimensions closer to the final drawing sizes, deeper patterns (500 mm) may have drafts even up to 8 mm. Draft is sometimes given as inclination in degrees (1 to 2) from the vertical faces. For deeper faces, it may be given for half height positive and other half, negative.

- Distortion Allowance: In long, thin and curved castings, the contraction stresses may cause certain dimensional changes which distort the overall configuration, during solidification in mould. In the production of such intricate castings, certain changes in dimensions are incorporated on the pattern from experience to compensate for the expected distortions and bring the casting to the shape nearest to the drawing.

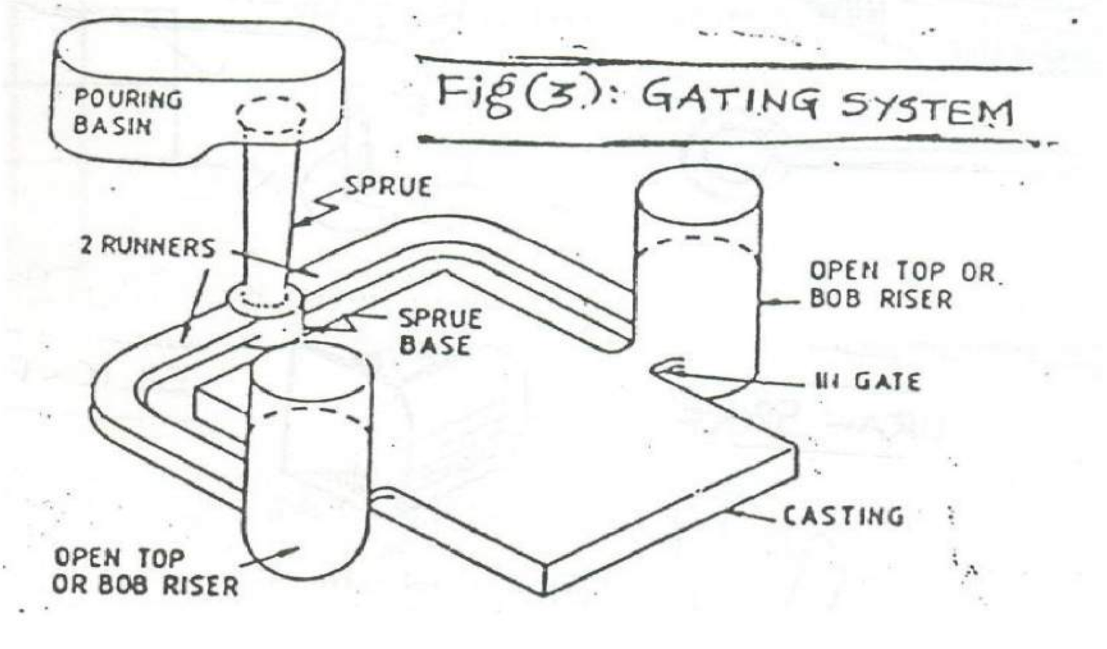
GATING SYSTEM: (fig 3) The elements of a gating system includes pouring basin, sprue, runner and in-gates and finally, the riser as shown in fig. and the function of each is as described below.

Pouring basin: It is a cup shaped reservoir on the top of a cope in which the molten metal is poured. The purpose of which is to minimize splash and turbulence and promote the entry of clean metal only into the sprue.

Sprue: This is a tapered passage in the cope through which molten metal from pouring basin reaches the sprue from which it in turn enters the runner.

Runner & in-gates: This is a channel in the drag which is always full of molten metal feeds the required amount of metal into the mould cavity through in-gates

Riser: This is also a tapered passage in the cope into which molten metal rises and the same is fed to the casting to compensate the shrinkage

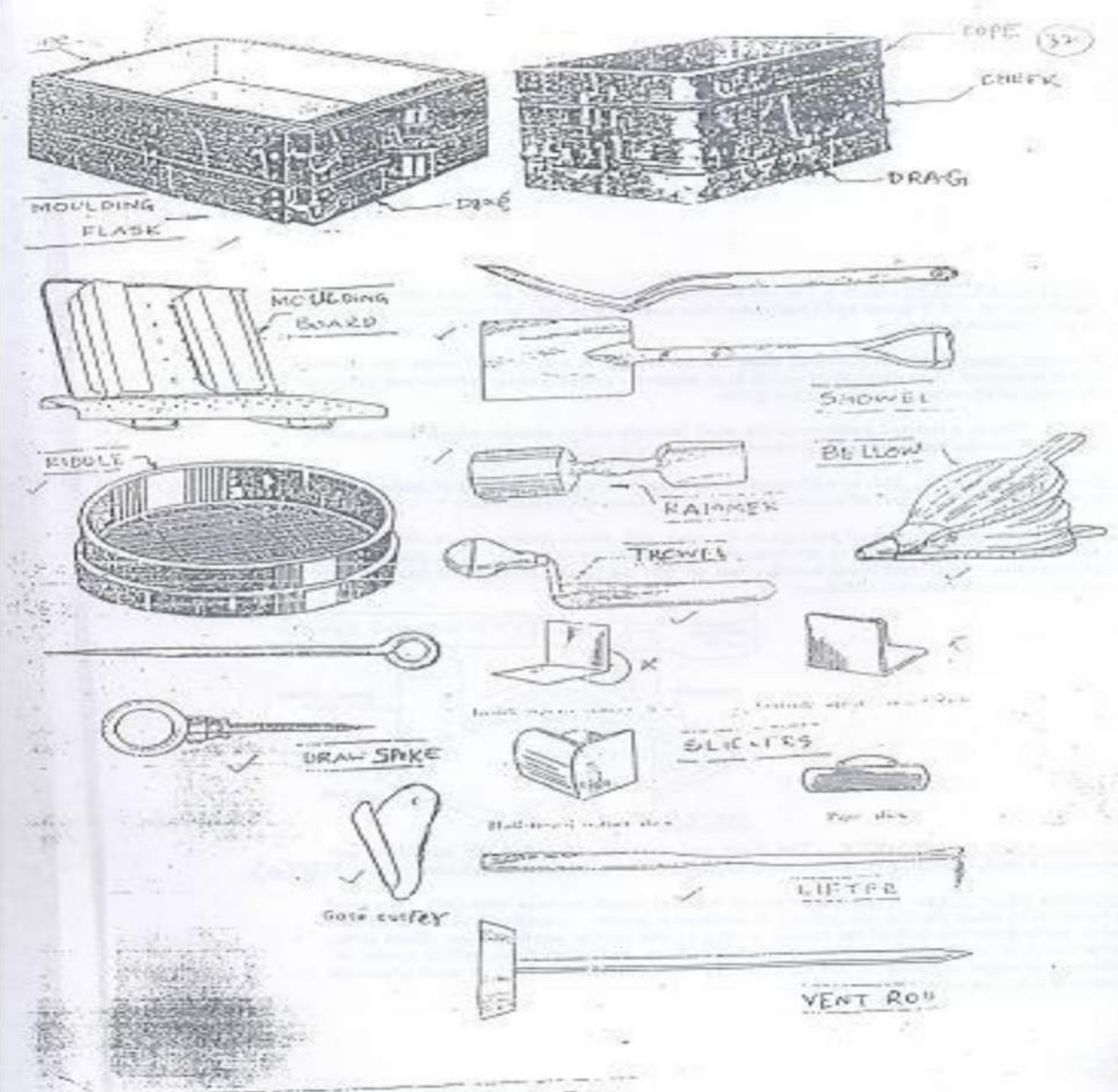


Fig(3): GATING SYSTEM

TOOLS AND EQUIPMENT: The tools and equipment needed for moulding are: moulding board, moulding flasks (boxes), bellows, showel, riddle, and moulder's tools (fig 4)

- **Moulding Flask(Box):** It is a box made of wood or metal, open at both ends. The sand is rammed in after placing the pattern to produce a mould. Usually,it is made of two parts. Cope is the top half of the mould having guides for the aligning pins. Draft is the bottom half of the flask, having aligning pins. Cheek, is another flask, which comes in between the cope and drag in the case of a three box mould. Check is used when the pattern consists of more than two parts.
- **Moulding Board:** It is a wooden board with smooth surface. It supports the cope and drag boxes and the pattern, while the mould is being made.
- **Shovel:** It is used for mixing and tempering moulding sand and for transferring the sand into the flask. It is made of steel blade with a wooden handle.
- **Riddle:** Hand riddle consist of a wooden frame fitted with a screen of standard wire mesh at its bottom. It is used for hand riddling (sieving) of sand to remove coarse sand particles and other foreign material of bigger size from the foundry sand.
- Rammer: It is used for packing or ramming the sand around the pattern.One of its ends,called the open end, is wedge shaped and is used for packing sand in spaces, pockets and corners in the early stages of ramming. The other end, called the butt end, has a flat surface and is used for compacting the towards the end of moulding.
- **Striking edge or strike-off bar:**It is a piece of metal or wood with straight edge.It is used to remove the excess sand from the mould after ramming to provide a level surface.
- **Trowel:** It consists of a metal blade fitted into a wooden handle. It is used to smoothen the surface of the mould. It may also be used for repairing the damaged portion of the mould. Trowels are made in many diffrnt styles and sizes, each one suitable for a particular job.
- **Spike or draw pin:** It is a pointed steel rod with a loop at the other end.It is used to remove the pattern from the mould. A draw screw, with a threaded end, may also be used for the purpose.
- **Slick:** It is a small ended tool having a flat on one end and a spoon on the other. It is used for mending and finishing small surfaces of the mould.

- Lifters: Lifters are made of thin sections of various widths and lengths, with one end bent at right angles. These are used for cleaning and finishing the bottom and sides of the deep and narrow pockets of the mould.
- **Gate Cutter:** It is a semi-circular piece of tin sheet, used to cut gates in the mould. Gates are meant for providing necessary passages for flow of molten metal into the mould cavity.
- **Bellows:** It is a hand tool, used to blow air, to remove the loose sand particles from the mould cavity.
- **Vent Rod:** It is a thin rod used for making vents or holes in the sand mould to allow the escape of mould gases generated during the pouring of molten metal.



Fig(4) TOOLS AND EQUIPMENTS

WHEEL FLANGE

Expt No:

Date:

Aim: To make a mould from the pattern of Wheel flange

Tools required: Moulding board, moulding flask (cope & drag), shovel, rammer, strike off edge, sprue pin, riser pin, trowel, draw pin, slik, gate cutter, vent rod, Moulding sand, chalk/talc powder, molasis.

Sequence of operations:

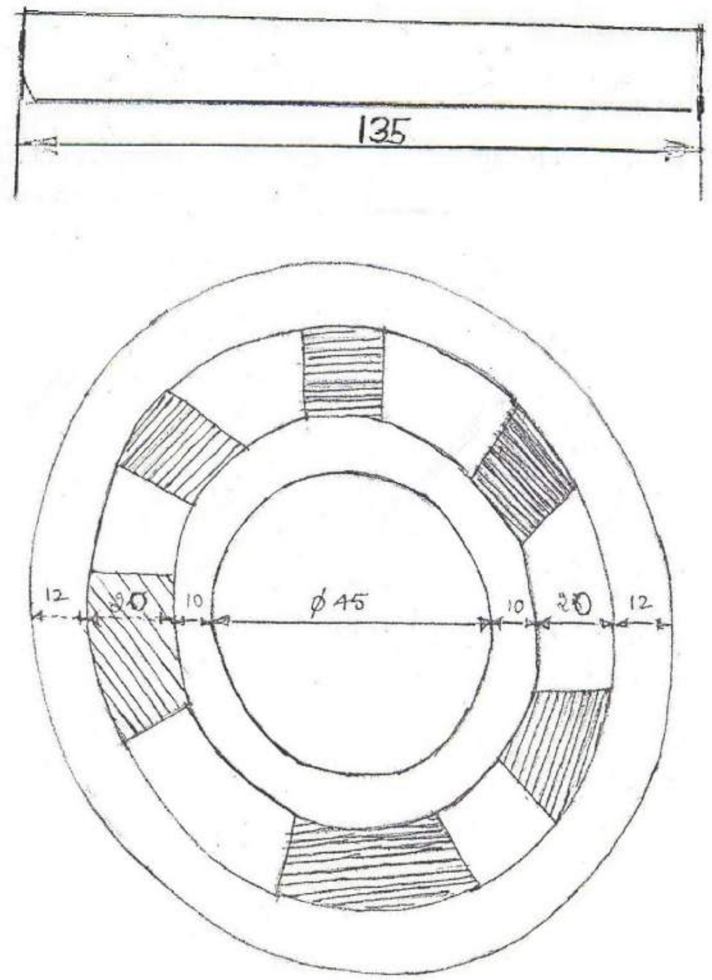
1.Sand preparation
2.ramming
3.Gate cutting
4.Finishing.

Procedure:

Result:

Precautions:

1.The sand prepared should not be too dry or too wet.
2.Molasis/clay should be applied on inner walls of moulding flask properly.
3.Ramming should be done with care when wooden patterns are used.
4.No loose sand should be present



WHEEL FLANGE

BEARING HOUSING

Expt No:

Date:

Aim: To make a mould from the pattern of bearing housing.

Tools required: Moulding board, moulding flask (cope & drag), shovel, rammer, strike off edge, sprue pin, riser pin, trowel, draw pin, slik, gate cutter, vent rod, Moulding sand, chalk/talc powder, molasis.

Sequence of operations:

1.Sand preparation
2.ramming
3.Gate cutting
4.Finishing.

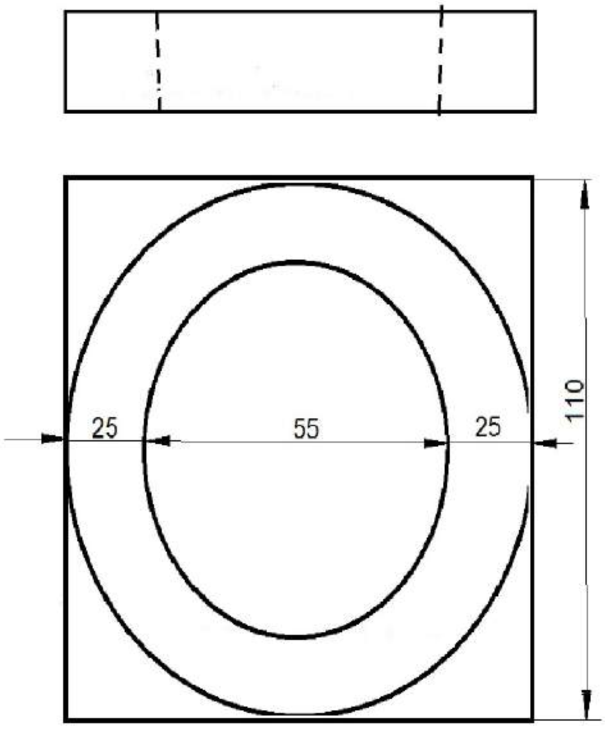
Procedure:

Result:

Precautions:

1.The sand prepared should not be too dry or too wet.
2.Molasis/clay should be applied on inner walls of moulding flask properly.
3.Ramming should be done with care when wooden patterns are used.
4.No loose sand should be present inside the mould cavity.

BEARING HOUSING



BLACKSMITY

Forging or Blacksmithy in general refers to the process for the heating of metal in order to manipulate it into desired forms and shapes based on particular concepts or designs. As such, hand forging is still the process of forging metal, only this time the process is manually guided by a forger with the aid of specially designed equipment that are specifically made for such a purpose. Even though hand forging is labor intensive, the process is still favored over machine-produced metals in certain instances due to the perception that it offers some advantages over the other type. The process for hand forging is different from that of machines, and the tools utilized are also different from those used in the mechanized process.

HAND FORGING

The process of hand forging is an ancient one that has been utilized for many centuries by professionals who are generally referred to as blacksmiths. Basically, they shape the metal by heating and applying blows of varying pressure to the metal in order to manipulate it into a desired contour that is keeping with the design the blacksmith is trying to achieve. Apart from the fact that this method of forging metal requires a lot of labor and strength, it also has some benefits over the metals that are forged in other ways. One of the benefits of hand forging is the fact the metal produced through this method is usually stronger than metal produced by other techniques, such as casting or welding. The main reason is that the repeated blows from the blacksmith and the careful monitoring of the process results in a less porous material that is better refined than most tactics.

MACHINE FORGING

A forging machine is also called a press or punch press; the machine presses down on a metal blank and creates a specific shape. Operated in one of three common temperatures — cold, warm and hot —, the designation is keyed to the temperature of the metal being shaped. Using enough pressure to stamp a basic shape from a solid piece of metal in a single strike, the forging machine often operates from a flywheel mechanism that powers a stamping die downward and into the second component piece of the total die, continually pressing due to the inertia of the spinning flywheel. It is a common design trait for a forging machine to drop or press the die or stamp straight down on the work piece, hence the name drop forge.

Tools

Anvil: An anvil is a basic tool, a block with a hard surface on which another object is struck. The block is as massive as is practical, because the higher the inertia of the anvil, the more efficiently it causes the energy of the striking tool to be transferred to the work piece.

Sledge Hammer: A sledgehammer is a tool with a large, flat, often metal head, attached to a lever (or handle). The size of its head allows a sledgehammer to apply more force than other hammers of similar size. Along with the mallet, it shares the ability to distribute force over a wide area. This is in contrast to other types of hammers, which concentrate force in a relatively small area.

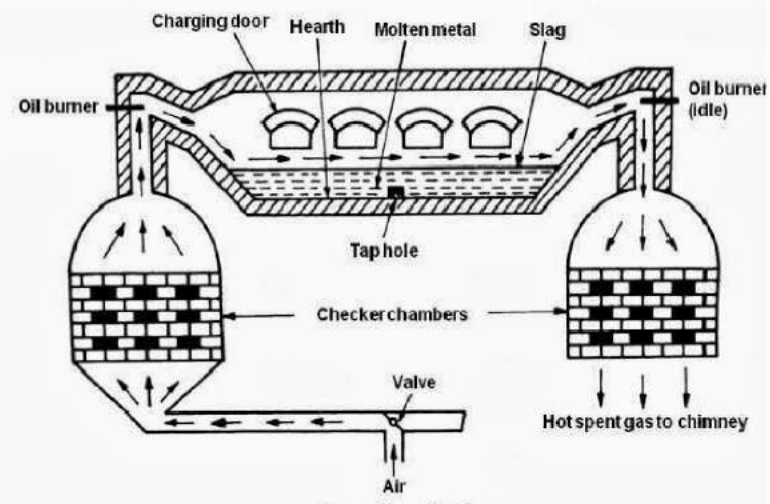
Tongs:

Tongs are a tool used to grip and lift objects, of which there are many forms adapted to their specific use. Some are merely large pincers or nippers, but most fall into three classes:

1. Tongs which have long arms terminating in small flat circular ends of tongs and are pivoted close to the handle, as in the common fire-tongs, used for picking up pieces of coal and placing them on a fire.
2. Tongs consisting of a single band of metal bent round one or two bands joined at the head by a spring, as in sugar-tongs (a pair of usually silver tongs with claw-shaped or spoon-shaped ends for serving lump sugar), asparagus-tongs and the like.

3. Tongs in which the pivot or joint is placed close to the gripping ends, such as a driller's round tongs, blacksmith's tongs or crucible-tongs.

Open Hearth Furnace:



Open Hearth Furnace

Open hearth furnaces are one of a number of kinds of furnace where excess carbon and other impurities are burnt out of pig iron to produce steel. Since steel is difficult to manufacture due to its high melting point, normal fuels and furnaces were insufficient and the open hearth furnace was developed to overcome this difficulty. Compared to Bessemer steel, which it displaced, its main advantages were that it did not expose the steel to excessive nitrogen (which would cause the steel to become brittle), was easier to control, and it permitted the melting and refining of large amounts of scrap iron and steel.

The open hearth process is a batch process and a batch is called a "heat". The furnace is first inspected for possible damage. Once it is ready or repaired, it is charged with light scrap, such as sheet metal, shredded vehicles or waste metal. The furnace is heated using burning gas. Once it has melted, heavy scrap, such as building, construction or steel milling scrap is added, together with pig iron from blast furnaces. Once all the steel has melted, slag forming agents, such as limestone, are added. The oxygen in iron oxide and other impurities decarburize the pig iron by burning excess carbon away, forming steel. To increase the oxygen contents of the heat, iron ore can be added to the heat. The process is far slower than that of Bessemer converter and thus easier to control and sample for quality assessment. Preparing a heat usually takes 8 h to 8 h 30 min to complete into steel. As the process is slow, it is not necessary to burn all the carbon away as in Bessemer process, but the process can be terminated at given point when desired carbon contents has been achieved.

SHAPE – S

Expt No:

Date:

Aim: To make the shape S as per the given sketch with the given MS round rod.

Tools required: Smith forge/hearth, anvil, swage block, ball/straight/cross peen hammer, sledge hammer, tongs, chisels, flatters, punch & drift, electric blower, wood coal & railway coal.

Sequence of operations:

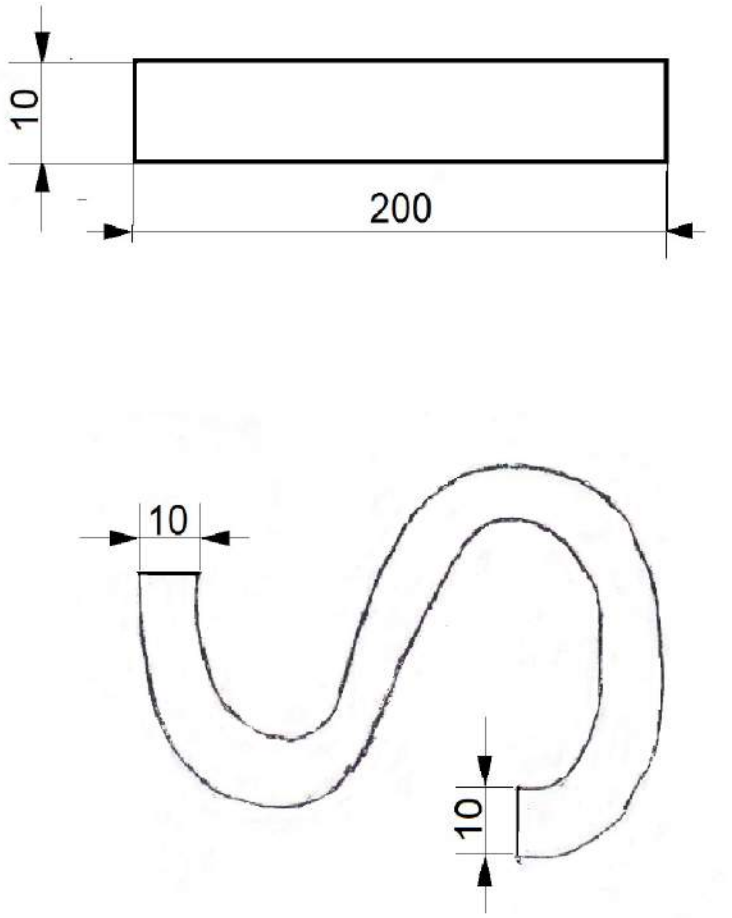
1.Preparation of forge
2.Heating and
3.Shaping.

Procedure:

Result:

Precautions:

1. Wear tight overauls, safety shoes, goggles and hand gloves.
2. Heated stock should be close to the ground.
3. Hold the job rigidly while shaping.
4. Stand at a safe distance from the forge.
5. The hammer handle should be properly wedged.



S - HOOK

SHAPE – J

Expt No:

Date:

Aim: To make the shape J as per the given sketch with the given MS round rod.

Tools required: Smith forge/hearth, anvil, swage block, ball/straight/cross peen hammer, sledge hammer, tongs, chisels, flatters, punch & drift, electric blower, wood coal & railway coal.

Sequence of operations:

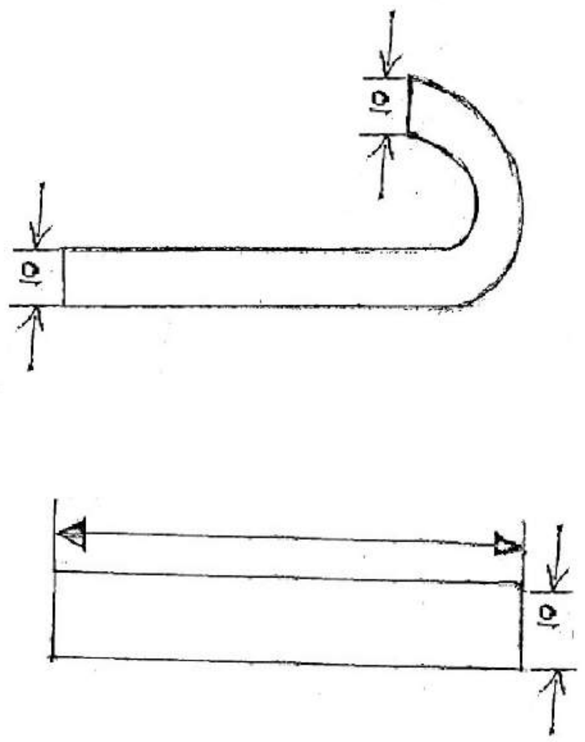
1.Preparation of forge
2.Heating and
3.Shaping.

Procedure:

Result:

Precautions:

1. Wear tight overauls, safety shoes, goggles and hand gloves
2. Heated stock should be close to the ground.
3. Hold the job rigidly while shaping.
4. Stand at a safe distance from the forge.
5. The hammer handle should be properly wedged.



J- HOOK

WELDING INTRODUCTION

"Welding" is a metallurgical fusion process, in which the interface of the two parts to be joined are brought to a temperature above the melting point and then allowed to solidify so that a permanent joining takes place. Because of the permanent nature of the joint and strength being equal to or sometimes greater than that of the parent metal makes welding one of the most extensively used fabrication method. Welding is not only for making structures but also for repair work such as the joining of broken castings. Products obtained by the process of welding are called "weldments".

Types of joints:

Different types of welding joints are classified as but, lap, corner, tee and edge joints. These are shown in fig (1). The choice of the type of the joint depends on the weldment being made and the sheet thickness.

Edge preparation is required, when the thickness of the two pieces to be joined is small, so that heat of welding penetrates the full depth of the joint. However, when the thickness increases it becomes necessary to prepare the edge in such a way that heat would be able to penetrate the entire depth. To facilitate this, the joint is widened as shown in fig (2). For very thick plates, the welding needs to be done from both sides. To provide the necessary access into the joint, it could be made as V or U, as shown in fig (3). The V-joint is easier to make but the amount of extra metal to be filled in the joint increases greatly with an increase in the thickness. From this account a U-joint is preferable, since the amount of extra metal to be added to fill the joint is generally less beyond a certain plate thickness. The double U and double V edge preparations are used when welding is to be carried from both sides.

By virtue of the metal being melted at the interface in a welded joint, it is necessary that the interfaces are very clean. If the interfaces are not clean, with any oil, dirt, paint or grease residue left, then these would interfere with proper fusing of the metal and thus weaken the joint. Hence it is essential that the joint surfaces are thoroughly cleaned before the welding is attempted. Another requirement of welding is a filler metal to fill the gap between the parts to be joined. Ideally the composition of the filler metal should be same as that of the base metals which are being joined, for proper mixing of the filler metal with base metal.

TERMINOLOGY OF WELDING

- **Backing:** It is the material support provided at the root side of a weld to aid in the control of penetration.
- **Base metal:** The metal to be joined or cut is termed as the base metal
- **Bead or weld bead:** Bead is the metal added during a single pass of welding. The bead appears as a separate material from the base metal.
- **Crater:** In arc welding, a crater is the depression in the weld metal pool at the point where the arc strikes the base metal plate.
- **Deposition rate:** The rate at which the weld metal is deposited per unit time, is the deposition rare is normally expressed as Kg/h.
- **Filled weld:** The metal fused into the corner of a joint made of two pieces placed at approximately 90^{o} to each other [fig. (1)] is termed as fillet weld.
- **Penetration:** It is the depth upto which the weld metal combines with the base metal as measured from the top surface of the joint.
- **Puddle:** The position of the weld joint that melted by the heat of welding is called puddle.
- **Root:** It is the point at which the two pieces to be joined by welding are nearest.
- **Tack weld:** A small weld, generally used to temporarily hold the two pieces together during actual welding is the tack weld.
- **Toe of weld:** It is the junction between the weld face and the base metal.
- **Torch:** In gas welding, the torch mixes the fuel and oxygen and controls its delivery to get the desired flame.
- **Weld face:** It is the exposed surface of the weld.
- **Weld metal:** The metal that is solidified in the joint is called weld metal. It may be only base metal or a mixture of base metal and filler metal.
- **Weld pass:** A single movement of the welding torch or electrodes along the length of the joint which results in a bead, is a weld pass.

ARC WELDING: In arc welding the heat required for joining the metals is obtained from an electric arc. Transformers or motor generator sets are used as arc welding machines. These machines supply high electric currents at low voltages and an electrode is used to produce the necessary arc. The electrode serves as the filler rod and arc melts the surfaces so that the metals to be joined are actually fused together. Fig(4) shows the principle of arc welding using a transformer.

In addition to the welding machine, certain accessories are needed for carrying out the welding work.

- **Welding Cables:** Two welding cables are required, one from the machine to the electrode holder and the other from the machine to the ground clamp. Flexible cables are usually preferred because of the case of using and coiling the cables. Cables are specified by their current carrying capacity, say 300A, 400A etc.
- **Electrodes:** Filler rods used in arc welding are called electrodes. They are generally made of a rod of alloying elements, suitable for the job, coated with a flux. They are specified by the diameter in SWG and length, apart from the brand and code names, indicating the purpose for which they are most suitable.
- **Electrode Holder:** The electrode holder is connected to the end of the welding cable and holds the electrode. It should be light, strong and easy to handle and should not become hot while in operation. Fig(5) shows one type of electrode holder. The jaws of the holder are insulated, offering protection from electric shock.
- **Ground Clamp:** It is connected to the end of the ground cable and is clamped to the work or welding table to complete the electric circuit Fig (6). It should be strong and durable and give a low resistance connection.
- **Wire Brush and Chipping Hammer**: A wire brush is used for cleaning and preparing the work for welding. A chipping hammer Fig. (7) is used for removing slag formation on welds. One end of the head is sharpened like a cold chisel and the other, to a blunt, round point. It is generally made of tool steel.
- **Working Table:** It is made of steel plate and pipe. It is used for positioning the parts to be welded properly.
- **Face Shield:** A face shield is used to protect the eyes and face from the rays of the arc and from spatter or flying particles of hot metal. It is available either in hand or helmet type Fig.(8). The hand type is convenient to use wherever the work can be done with one hand. The helmet type, though not comfortable to wear, leaves both hands free for the work.
- **Welding Screen:** When people are around where welding is done, they may be protected from the rays of the arc by means of a protected screen. In some shops, separate welding booths are provided for the purpose.

TECHNIQUE OF WELDING

Preparation work:

Before welding, the work pieces must be thoroughly cleaned of rust, scale and other foreign material. Thin pieces of metal are generally welded without beveiling the edges. However, thick work pieces should be beveled or veed out to ensure adequate penetration and fusion of all parts of the weld. But, in either case, the parts to be welded must be separated slightly to allow better penetration of the weld Fig.(2) and Fig.(3).

Note: While making butt welds in thin metal, it is a better practice to tack-weld the pieces at intervals to hold them properly while welding.

Striking an arc:

The following are the stages and methods of striking an arc and running a bead:

1. Select an electrode of suitable kind and size for the work and set the welding current at a proper value.
2. Fasten the ground clamp to either the work or welding table.
3. start or strike the arc by either of the following methods Fig.(9)
   i) Stroke and withdraw: In this method, the arc is started by moving the end of the electrode on to the work with a slow sweeping motion, similar to striking a match Fig.(9).(a).
   ii) Touch and withdraw: In this method, the arc is started by keeping the electrode perpendicular to the work and touching or bouncing it lightly on the work. This method is preferred as it facilitates restarting the momentarily broken arc quickly Fig.(9).(.b).

If the electrode sticks to the work, quickly bend it back and forth, pulling at the same time. Make sure to keep the shield in front of the face, when the electrode is freed from sticking.

4. As soon as the arc is struck, move the electrode along, slowly from left to right, keeping at 15^o to 25^o from vertical and in the direction of welding.
5. While welding, maintain proper length of arc. It is the distance from the tip of the electrode to the bottom of the crater.
6. As the end of the electrode melts-off, lower it continuously to maintain the same length of arc.
7. Break the arc at the end of the head, by holding the electrode still, along enough to fill the crate and gradually lifting it up from the work.

Note: It is better to make the bead in one continuous sweep. If the welding is stopped for any reason, chip the slag from the crater at the end of the bead and restart the welding.

Filler Rods: For oxyacetylene gas welding, filler rods are not coated with flux, however they are applied separately. Mild steel welding rods are usually copper coated to prevent rusting. Cast iron rods are square shaped. Brazing rods are made of brass or bronze. They are usually one meter ling. Filler rod size increases as the metal thickness to be joined increases 1.5mm diameter filler rod is recommended for 18 SWG sheet and 2 to 3 mm diameter for 3 mm thick sheet and so on.

Types of Joints: The type of joint needed depends on the nature of material, its thickness and the kind of job. The types of joints used are common to both arc and gas welding. Both ferrous and non-ferrous welding may be carried out in gas welding.

Technique of Welding:

Adjusting equipment and lighting the torch

The recommended stages for adjusting the gas welding equipment and lighting the torch are as follows:

1. Select the proper size tip for the job and insert it carefully into the torch.
2. Check the valves on the torch to ascertain that they are turned-off (clock-wise).
3. Open the acetylene cylinder valve slightly, say ¼ to ½ turn.
4. Open the oxygen cylinder valve slowly, till it is fully open.
5. Open the acetylene valve on the torch and turn the acetylene regulator screw clockwise, until the guage reads 0.5 to 1 kg/cm^2 of pressure. Then close the valve on the torch.
6. Open the oxygen valve on the torch to check the flow and close it.
7. Put-on the welding goggles, gloves and apron.
8. Open the acetylene valve on the torch by ¼ turn. Light the torch with a lighter, keeping it tip away from the cylinders and your body.
9. Adjust the acetylene valve on the torch until the flame extends slightly from the end of the tip.
10. Open and adjust the oxygen valve on the torch until the desired flame is obtained.

Weaving:

A steady, uniform motion of the electrode produces a satisfactory bead. However, a slight weaving or oscillating motion is preferred, as this metal molten a little longer and allows the gas to escape, bringing the slag to the surface. Weaving also produces a wider bead with better penetration as shown in Fig.(10).

Effect of current and speed:

The current setting and the speed of electrode movement greatly affect the penetration and the strength of the weld as shown in Fig.(11). In both the figures, weld A shows proper adjustment of current and electrode speed with good fusion and no overlap or undercutting. Too low a current results in high bead with poor penetration. Low speed results in large, wide bead with overlap, as shown at B. Too high a current results in deep penetration, undercutting edges of the bead, and excessive spatter, whereas fast movement results in small, narrow, irregular bead with poor penetration as shown at C.

Welding joints:

Fig.(1) shows some common types of welded joints. Wherever possible, it is better to weld by placing the parts in the flat position. In this, welding is done on top, so that gravity helps pull the molten metal in the joint.

Welding positions:

Depending on the location of the welding joint, appropriate position of the electrode and hand movement are selected. Fig.(12) shows different welding positions.

GAS WELDING: Oxyacetylene flame is commonly used for gas welding. It consist of the supply of oxygen and acetylene under pressure in cylinders, pressure regulators, a torch, hoses and accessories like goggles and a lighter. The oxygen and acetylene cylinders are connected to the torch through pressure regulators and hoses Fig.(13). The regulator consists of two pressure gauges, one for indicating the pressure within the cylinder and other shows the pressure of the gas fed into the torch, which may be regulated. The torch mixes the two gases and the flame may be controlled by adjusting the oxygen and acetylene supply.

Goggles: Goggles with coloured glasses are used to protect the eyes form the glare and flying bits of hot metal Fig(14). A welding table with a top of fire bricks is recommended for oxyacetylene welding.

Types of Flames: The correct adjustment of the flame is important for efficient welding. When oxygen and acetylene are supplied to the torch in nearly equal volumes, a neutral flame is produced Fig.(15), having a maximum temperature of 3200^0C. The neutral flame is widely used for welding steel, stainless steel, cast iron, copper, aluminium etc. Carburising flame Fig.(16) with excess of oxygen is used for welding brass.

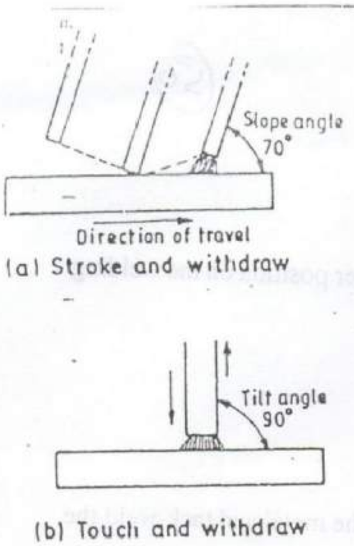
Depending on the thickness of the job, different torch nozzle sizes are used. The pressure of the gases and the flame size vary depending on the size of the nozzle tip.

Welding process

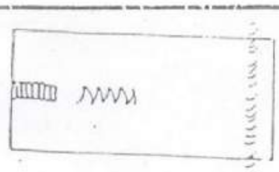
The following are the steps involved in a gas welding work:

1. Prepare the work pieces to be welded and place then in proper position on the welding table.
2. Wear goggles, gloves and apron.
3. Select proper size tip for the job and fix it to the torch.
4. Select the filler rod f recommended size.
5. Adjust the welding equipment and light the torch.
6. Adjust the torch for neutral flame.
7. Hold the torch with the inner cone, about 3mm away from the metal and tack-weld the pieces at either end.
8. Starting form one end, weld along the edge with a zig-zag torch movement. Add the filler metal to the joint as welding progresses. The two techniques of gas welding are shown in Fig (17).

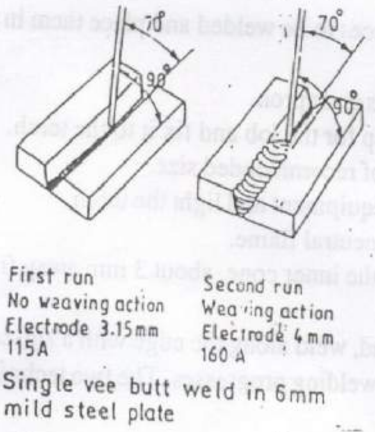
Note: Do not touch the torch tip with the rod or molten metal. Always keep the rod in the melt. If the torch tip is too close to the melt, it will form small blow holes in the weld and the torch may back fire. Practice the rhythm of torch and rod movement for achieving good results.



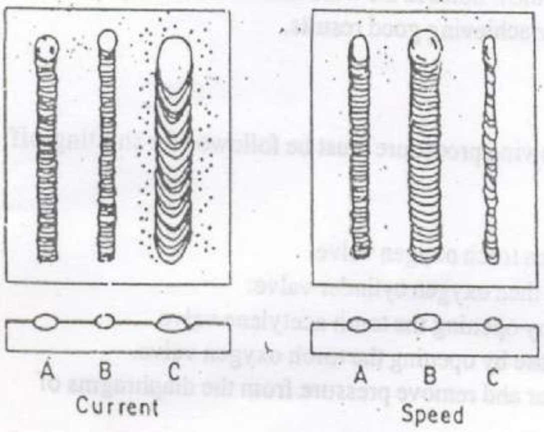
Fig(9) Striking an arc



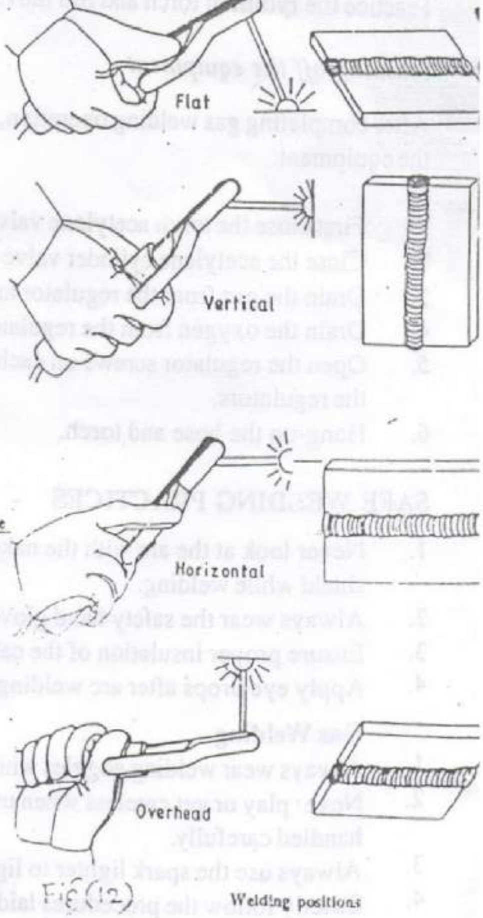
Weaving



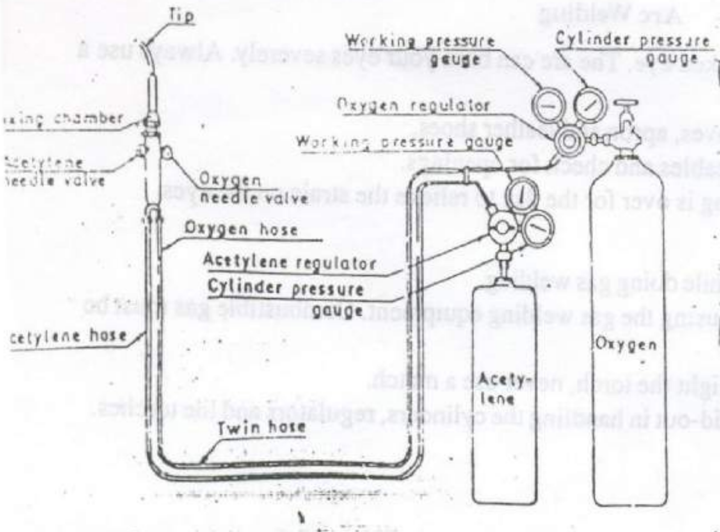
Fig(10). Weaving



Fig(11) Effect of current and speed



Fig(12) Welding positions



Fig(13) Gas welding equipment

Shutting-off the equipment:

After completing gas welding operation, the following procedure must be followed for shutting-off the equipment:

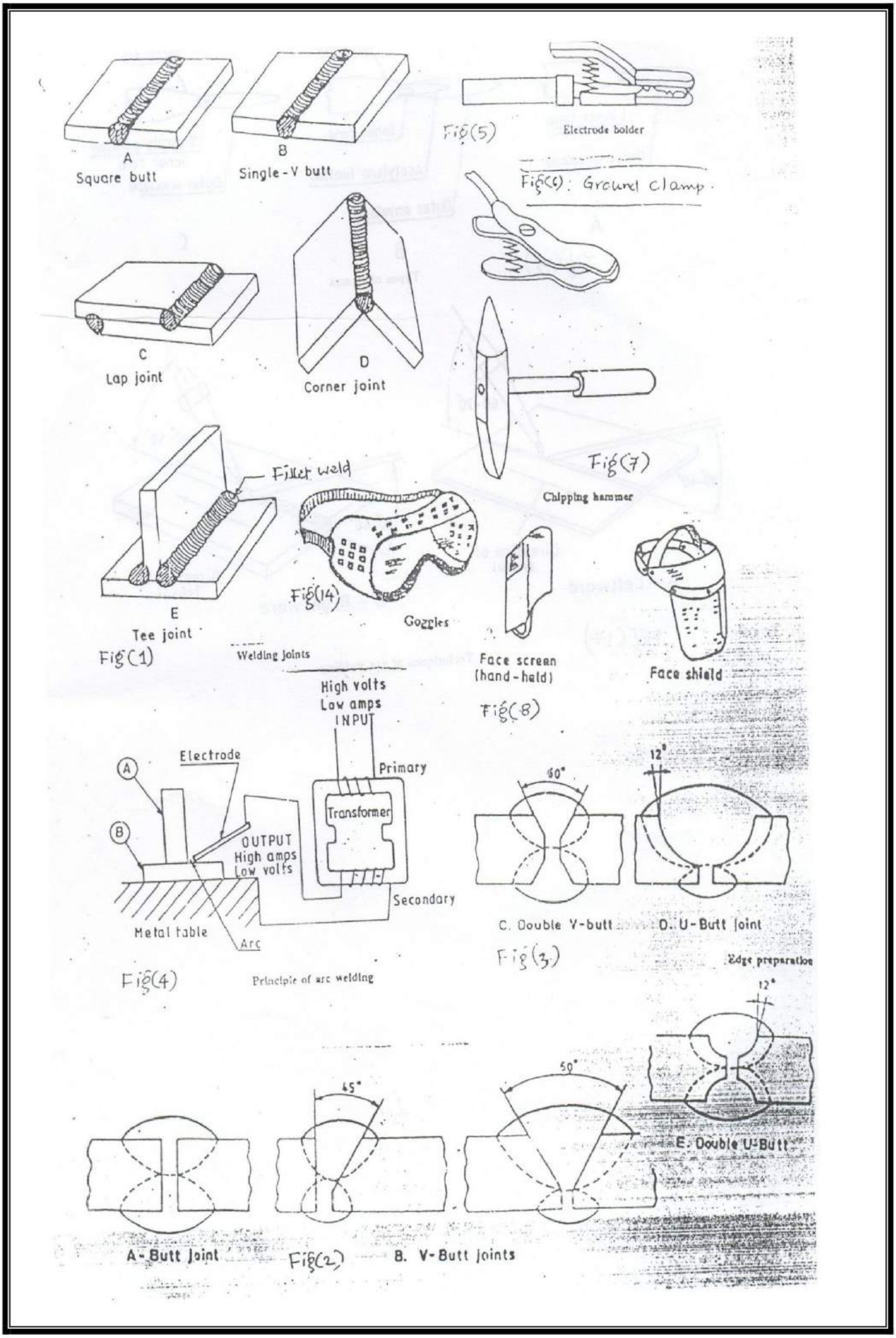
1. First close the torch acetylene valve and then torch oxygen valve.
2. Close the acetylene cylinder valve first and then oxygen cylinder valve.
3. Drain the gas from the regulator and hose by opening the torch acetylene valve.
4. Drain the oxygen from the regulator and hose by opening the torch oxygen valve.
5. Open the regulator screws on each regulator and remove pressure from the diaphragms of the regulators.
6. Hang-up the hose and torch.

SAFE WELDING PRACTICES – Arc Welding

1. Never look at the arc with the naked eye. The arc can burn your eyes severely. Always use a shield while welding.
2. Always wear the safety hand gloves, apron and leather shoes.
3. Ensure proper insulation of the cables and check for openings.
4. Apply eye drops after arch welding is over for the day to relieve the strain on the eyes.

Gas Welding:

1. Always wear welding goggles while doing gas welding.
2. Never play or get careless when using the gas welding equipment. Combustible gas must be handled carefully.
3. Always use the spark lighter to light the torch, never use a match.
4. Strictly follow the procedures laid-out in handling, regulators and the torches.


A
Square butt
B
Single-V butt
Fig(5)
Electrode holder
Fig(6): Ground clamp.
C
Lap joint
D
Corner joint
Fig(7)
Chipping hammer
Fillet weld
E
Tee joint
Fig(1)
Welding Joints
Fig(14)
Goggles
Face screen
(hand-held)
Fig(8)
Face shield
High volts
Low amps
INPUT
Electrode
Primary
Transformer
OUTPUT
High amps
Low volts
Secondary
Metal table
Arc
Fig(4)
Principle of arc welding
60°
12°
C. Double V-butt
D. U-Butt joint
Fig(3)
Edge preparation
12°
45°
50°
E. Double U-Butt
A- Butt Joint
Fig(2)
B. V-Butt joints

EXERCISE NO.1

ARC WELDING

AIM

To study the effect of arc current on weld strength and heat effected zone in Arc welding and to prepare a double V-butt joint using the given two flat 'L' shaped mild steel pieces by Arc welding process.

EQUIPMENT AND MATERIAL REQUIRED:

A.C Welding machine (input supply 230 Volts, single phase, 50 Hz frequency, maximum welding current 150 amps) bench vice, M.S Plates (2 No.s)

TOOLS REQUIRED:

Hack saw, electrode holder, electrode, cable and cable connectors, cableplug, chipping hammer, earthling clamp, wire brush, helmet, safety goggles, hand gloves, apron, sleeves etc.

PRINCIPLE OF D.C ARC WELDING:

In arc welding, arc is generated between the when these two poles are brought together, and separated for a small distance (1.5 to 3mm) such that the current continues to flow through a path of ionized particles, called plasma, an electric arc is formed. Since the resistance of this ionized gas column is high, so more ions will flow anode to the cathode. Heat is generated as the ions strike the cathode.

1. **PRINCIPLE OF A.C ARC WELDING:**

In A.C arc-welding heat required for welding is obtained from the arc struck between a coated electrode and work piece. The arc heat can be increased or decreased by employing higher or lower arc current. A high arc current with a smaller arc length produces very intense heat

The arc melts the electrode end and the job. Material droplets are transformed from the electrode to the job through the arc and deposited along the joint to be welded. The flux coating melts and produces a gaseous shield and slag to prevent atmospheric contamination of molten weld metal.

2. **STRAIGHT POLARIT:**

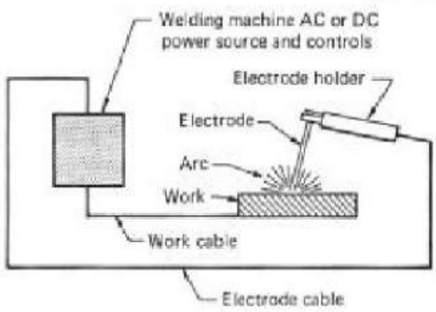
In straight polarity, electrode is having negative terminal while workpiece is connected to the positive terminal of the direct current power source

3. **REVERSE POLARITY:**

In reverse polarity, electrode is connected to positive terminal whereas workpiece is connected to the negative terminal of the direct current power source.

DESCRIPTION OF EQUIPMENT:

Arc welding setup is shown in the fig. The work piece is kept on a metallic table to which the ground lead of the secondary windings of the welding transformer is connected. The other lead of the secondary is connected to an electrode holder. Into which the electrode is gripped. When the electrode is



brought into the contact with the work then welding will takes place.

The maximum rated open circuit voltage, which is the voltage between the output terminals when no welding is being done. It is normally fixed at about 80 volts. This is the maximum normally a voltage of the order of the 40 to 50 volts is enough to starting an arc, where as for continuous welding 20 to 30 V is sufficient.

The minimum welding load voltage can be calculated as
$V_m=20+0.4I$
Where I=load current in amperes.

The duty cycle as defined by American Welding Society (AWS) is "the percentage of time in a 10 min. period, that a welding machine can be used at its rated output without overloading". Most of the welding machines need not to have to operate the full time, since a good length of time is spent in setting up, metal chipping, cleaning and inspection.

Normally a 60% duty cycle is suggested. The Indian standard specific 5 min. as the cycle and hence for every 5 min. of welding transformer operation, 3 min. is for welding and 2 min is for no loading operation. But continuous, automatic-welding machines may require the welding machine to operate at 100% duty cycle.

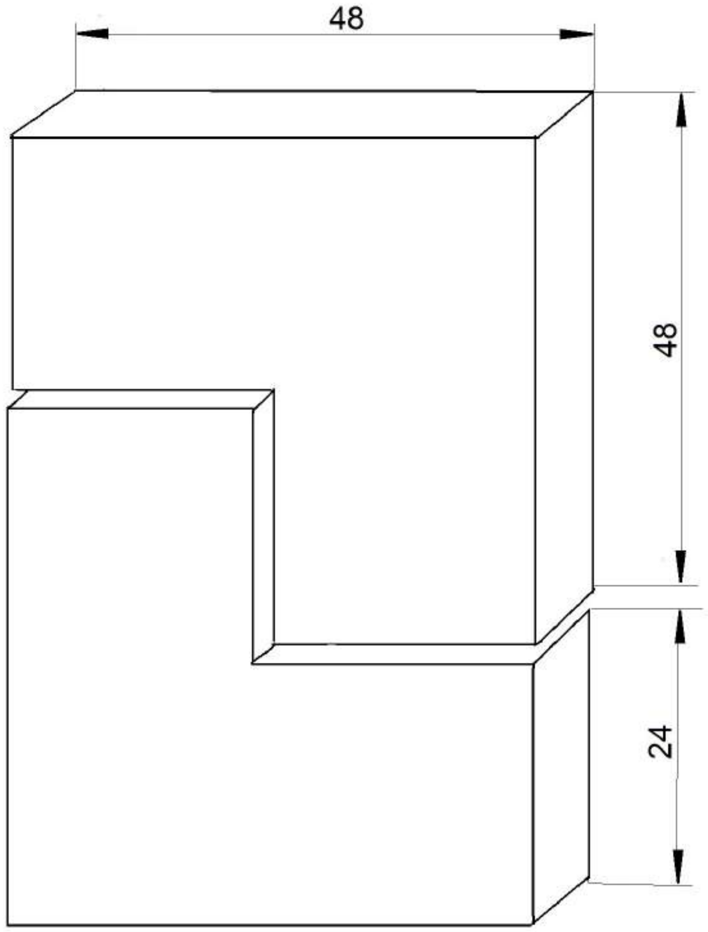
PROCEDURE:

1. Given two MS plates are filed at an angle of 45^0 at the surface to be joined.
2. Now the pieces are placed on table at some gap and weld properly for both sides.
3. After welding let it cool (quenching) sometime in the water and remove the slag formation with the help of chipping hammer.

PRECAUTIONS:

1. Edge preparation should be done very carefully.
2. Before welding ensure that the surfaces are extremely clean
3. While welding always use face shield or goggles
4. Note the current values carefully

RESULT:



ARC WELDING

EXERCISE NO.2

GAS WELDING (OXY-ACETYLENE)

AIM

To make a butt joint by using gas welding equipment.

GAS WELDING EQUIPMENTS:

1. **Oxygen gas cylinder:** oxygen cylinders are painted black and valve outlets are screwed right-handed.
2. **Acetylene gas cylinder:** Acetylene cylinder is painted maroon and the valves are screwed left-handed, to make this easily recognizable, they are chamfered or grooved.
3. Oxygen and Acetylene pressure regulators.
4. Oxygen and Acetylene gas hoses and hose connections
5. Welding torch or Blowpipe
6. Trolleys for the transportation of oxygen and acetylene cylinders
7. Set of keys and spanners
8. Filler rods and fluxes
9. Gas lighter
10. Protective clothing for the operator (e.g apron, gloves, goggles etc..)

MATERIAL REQUIRED:

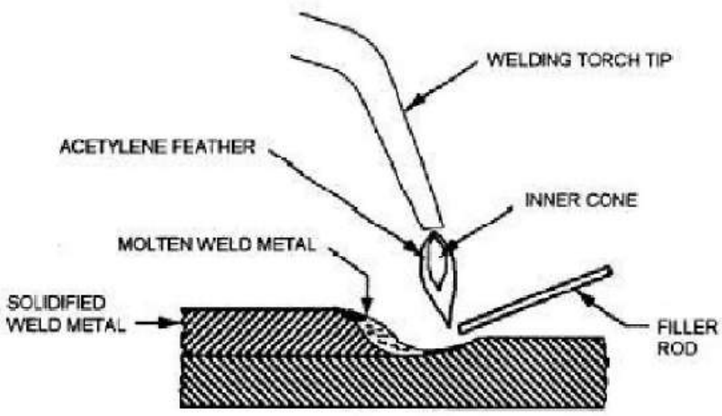
M.S Sheets of 100 x 50 x 5mm (2 No.s)

TOOLS REQUIRED

Wire brush, hand gloves, chipping hammer, spark lighter.

PRINCIPLE OF OPERATION:

When acetylene is mixed with oxygen in correct proportions in the welding torch and ignited, the flame is produced which is sufficiently hot to melt and join the parent metal. Temperature of flame is about 3100^0 C. a filler rod is generally added to build up the seam for greater strength.



DESCRIPTION:

Oxy-acetylene welding outfit contains the supply units for oxygen, acetylene with associated regulators and the torch, which mixes the two gases before they are ignited. The oxygen normally stored in strong cylinder at a pressure ranging from 13.8 MPa to 18.2 MPa. Free acetylene is highly explosive if stored at a pressure more than 200 KPa. Hence, acetylene needs to be carefully stored in a cylinder of the equipment. The principal advantage fo an oxy-acetylene welding set up is the versatility of the equipment. The same equipment with a range of torches would be used for oxygen cutting as well as for brazing and braze welding. Thus it useful for general purpose shops particularly smaller ones. Also the source of heats separate from the filler rod and condense, the filler metal can be properly control and heat is properly adjusted giving rise to a satisfactory weld. However, this method of welding is somewhat slower and as such cannot compete with other production welding methods such as electric arc welding.

ADVANTAGES OF GAS WELDING:

1. It can be applied to a wide variety of manufacturing and maintenance situations
2. Rate of heating and cooling of weld deposit and job is low
3. No electric current is required
4. Equipment is having less cost
5. Operator is having better control because sources of heat and filler metals are separable
6. Cost and maintenance of the welding equipment is low

DISADVANTAGES OF GAS WELDING:

1. Flame temperature is less than the temperature of the arc
2. Refractory metals (e.g. tungsten, molybdenum, tantalum etc.) and reactive metals (titanium and zirconium) cannot be gas welded.
3. Gas flame takes a long time to heat up the metal than an arc
4. Heat affected zone is wider
5. Acetylene oxygen gases are rather expensive

APPLICATIONS OF GAS WELDING:

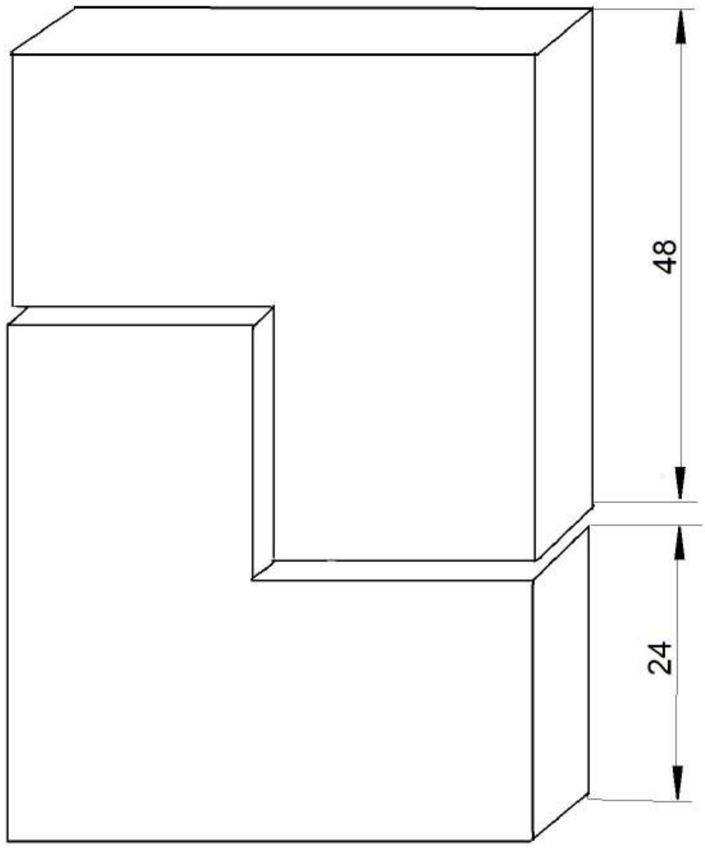
1. It is used for welding of mild steel, stainless steel, copper, cast iron, high carbon steels, etc
2. For joining thin materials
3. In automotive and aircraft industries
4. In sheet metal fabricating plants

PROCEDURE:

1. Acetylene valve on the torch is opened slightly and lightened with the help of spark lighter.
2. Now acetylene valve is opened to get the require flow of acetylene.
3. Oxygen valve is opened till the intermediate flame feather reduces in to inner cone to get a neutral flame.
4. The torch tip to be positioned above the plates so that white cone is at a distance of 1.5mm to 3mm for the plates.
5. Torch to be held at an angle of 30^0 to 45^0 to the horizontal plane
6. Now filler rod is to be held at a distance of 10m from treh flame and 1.5mm to 3mm from the surface of the weld pool
7. As back ward welding allows better penetration, backward welding is to be used for welding
8. After completion of welding slag is to be removed by means of chipping hammer, wire brush.

PRECAUTIONS:

1. Ensure that torch movement to be uniform.



GAS WELDING

PLUMBING

INTRODUCTION

It is an art of laying the pipe line for the transportation of fluid from one place to other. So plumbing involves joining of various pipes by different joints and fitting valves in the pipe line. The various tools used for plumbing work are

1) Pipe Wrench 2) Pipe vice 3) Hack Saw 4) Pipe Cutter

5) Pipe Bender 6) Pipe Threading Dies.

Pipe Wrench: It is used for holding and turning the pipes, rods and machine parts. It consists of an adjustment of opening between the jaws. For assuring firm grip over pipe the inner surfaces of jaws are serrated.

Figure – 1

Pipe Vice: It holds the pipes in position cutting threading and fitting of bends, couplings etc, The pipe vice consists of two jaws for holding the work, which are serrated to ensure positive grip. One jaw is integral with the base and the other jaw can be moved up and down by a handle as shown in figure.

Figure –2

Dies: A pipe die is used for cutting external threads on pipe. One or two piece dies are used in the die stock. It is a hand operated tool. It is a hardened steel nut having flutes cut along its inside surface. In case of two piece die, the two pieces are set at a desired distance and secured in position by means of a set screw.

Figure – 3

Pipe cutter: For an occasional pipe work, a hacksaw is quite satisfactory. Pipe cutters are also used where considerable amount of pipe work is involved. The pipe cutter mainly consists of three wheels which are hardened and with sharp cutting edges a long their periphery of these three wheels one can be adjusted to any desired distance from the other fixed wheels, to accommodate different sizes of pipes, after adjusting cutter on a pipe, it is turned around the pipe so that cutter wheels cut the pipe along a circle.

Figure - 4

Pipe Bender: while laying the pipe line sometimes a part of the pipe may have to be bent to the required curvature. For this a pipe bending machine is used. It is mounted on a tripod stand and can be swiveled about a vertical axis to any desired angle to cover the required range for the operation.

Figure - 5

Pipes and pipe fittings: Pipes are available in either galvanized or black from. Black pipes are used for oil, gas or air. Galvanized pipes are used for water supply system. Coating of zinc over pipes is known as galvanization galvanized pipes offer good corrosion resistance. The pipe size is indicated by its inside diameter whereas the pipe fitting size is designated by size of the pipe on which it fits. The list of common pipe fittings are given below. The pipe fittings should be selected depending on pipe line layout.

- **Coupling:** It is a short cylindrical sleeve with internal threads throughout. It is used for joining two pipes in a straight line and where at least one pipe can be turned.

Figure:5 (d)

- **Union:** It is used for joining two pipes where neither can be turned. It consists of there parts, two parts will be screwed on to two pipe ends and the third one which is a nut draws the pipe together tightly.

Figure – 5 (e)

- **Nipple:** It is a short piece of pipe (1<300 mm) with external threads at both ends nipples a4re available in standard short lengths. It is used to make up the required length of pipe line.

Figure –5 (j)

- **Elbow:** It is used to make an angle between adjacent pipes. The angle is usually 90 unless other wise stated.

Figure – 5 (a)

- **Tee:** it is a fitting that has one side outlet at right angles to the run. It is used for a single outlet branch pipe.

Figure – 5 (c)

- **Reducer Coupling:** It is used to couple two pipes of different sizes.

Figure – 5 (b)

- **Bush:** It is a short sleeve like pieces, used to reduce the size of a thread opening. It is threaded fully on the inside, and at one end on the outside. The other outer end is hexagonal shaped.

Figure – 5 (f)

- **Flange:** These are available either in oval or in circular shape. These contain internal threads in hub and holes the body to receive the bolts. Two pies may be joined together in line using flanges and bolts.

Figure – 5 (I)

- **Gate Valve:** Pipe valves are fitted in pipe line tyo control fluid flow though it. It is used where it is a important not to obstruct the flow and where the valve is closed only rarely. In this valve, the flow is reduced by lowering wedge shaped gate towards its seat.

Figure – 6 (a)

- **Globe Valve:** This control the fluid flow in a pipe lien, however the passage of flowis is restricted.

Figure – 6 (b)

- **Check Valve:** It is used to stop reverse flow in a pipe line. The swing type valve is more commonly used in this category.

Figure – 6 (c)

- **Common Top:** This is used for trapping fluid at required points in pipe line.

Figure – 6 (d)

Pipe Layout: For better pipe layout it is advisable to sketch first, the pipe layout, showing dimensions and types of fittings to be used. Careful planning makes it possible to complete the work with fewer joints and fittings in cutting pipe to length the portion of pipe that will screw into fittings must be taken into account.

Pipe Threading: After pipes are cut to lengths, to suit the layout, they must be threaded before the assembly. The following steps are involved while threading pipe by means of pipe die. Clamp the pipe securely in a pipe vice.

1. Select proper die set and insert into stock.
2. Place the die on pipe end and apply pressure while the die is slowly turned.
3. Once threading is started apply cutting oil and continue to turn the die into pipe, till one thread p0rojects through the die.

Precaution: While threading turn die stock handle back and forth frequently to loosen chip.

Assembly: Pipe layout should be made so as to avoid strains and bending at joints. To ensure tight joints in pipe work, the threads are applied with some kind of thread compound, before screwing them together. While screwing the pipe in its fitting, it is advised to use two pipe wrenches, making one to fit the pipe and the other to fit pipe fitting. To avoid damaging a tap or valve with wrench marks, it is advised to use a monkey wrench with smooth jaws.

Some fittings like unions and flanges require gaskets to make tight joints. When fittings are disassembled, gaskets and must be replaced. Gaskets are made from materials such as rubber sheet or fiber sheet.

6

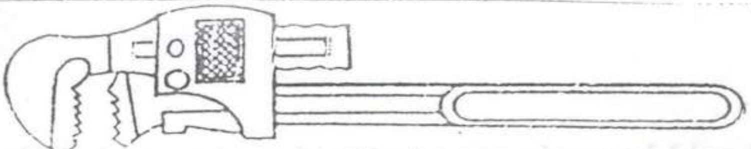


Fig. 1

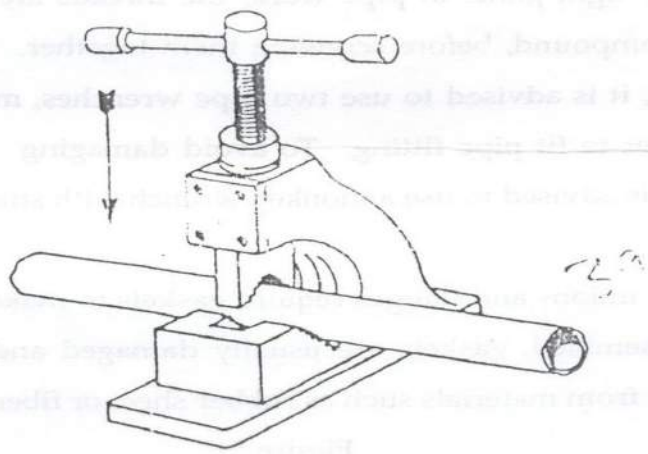


Fig. Pipe vice 2

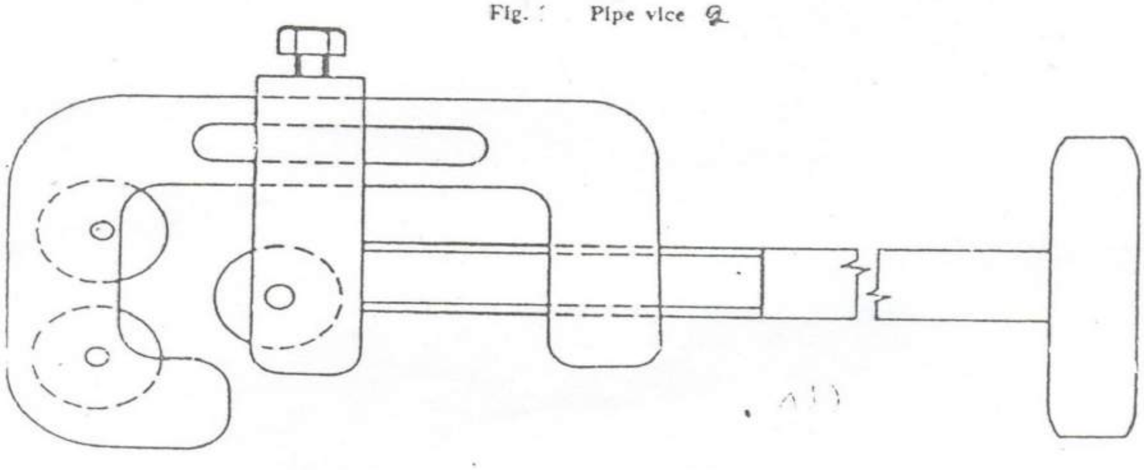


Fig. 4 Pipe cutter

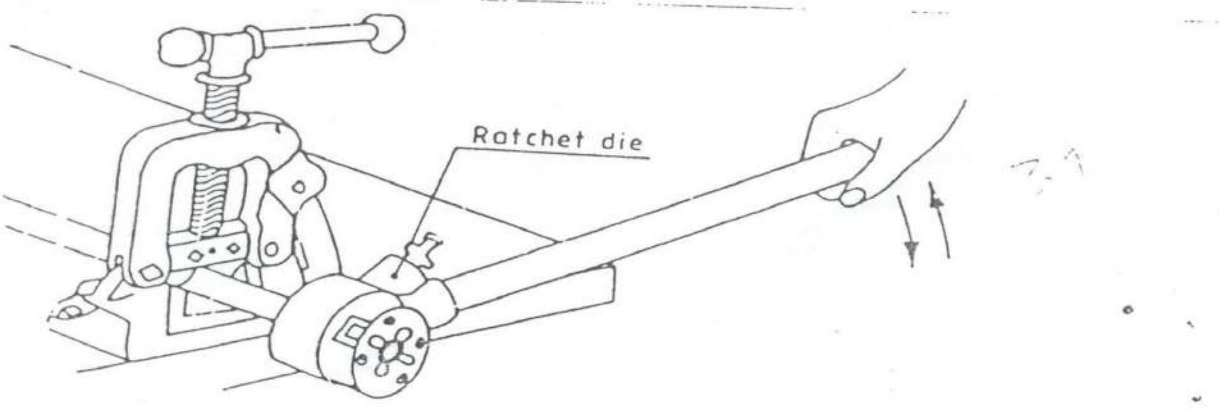


Fig. 3 Pipe threading

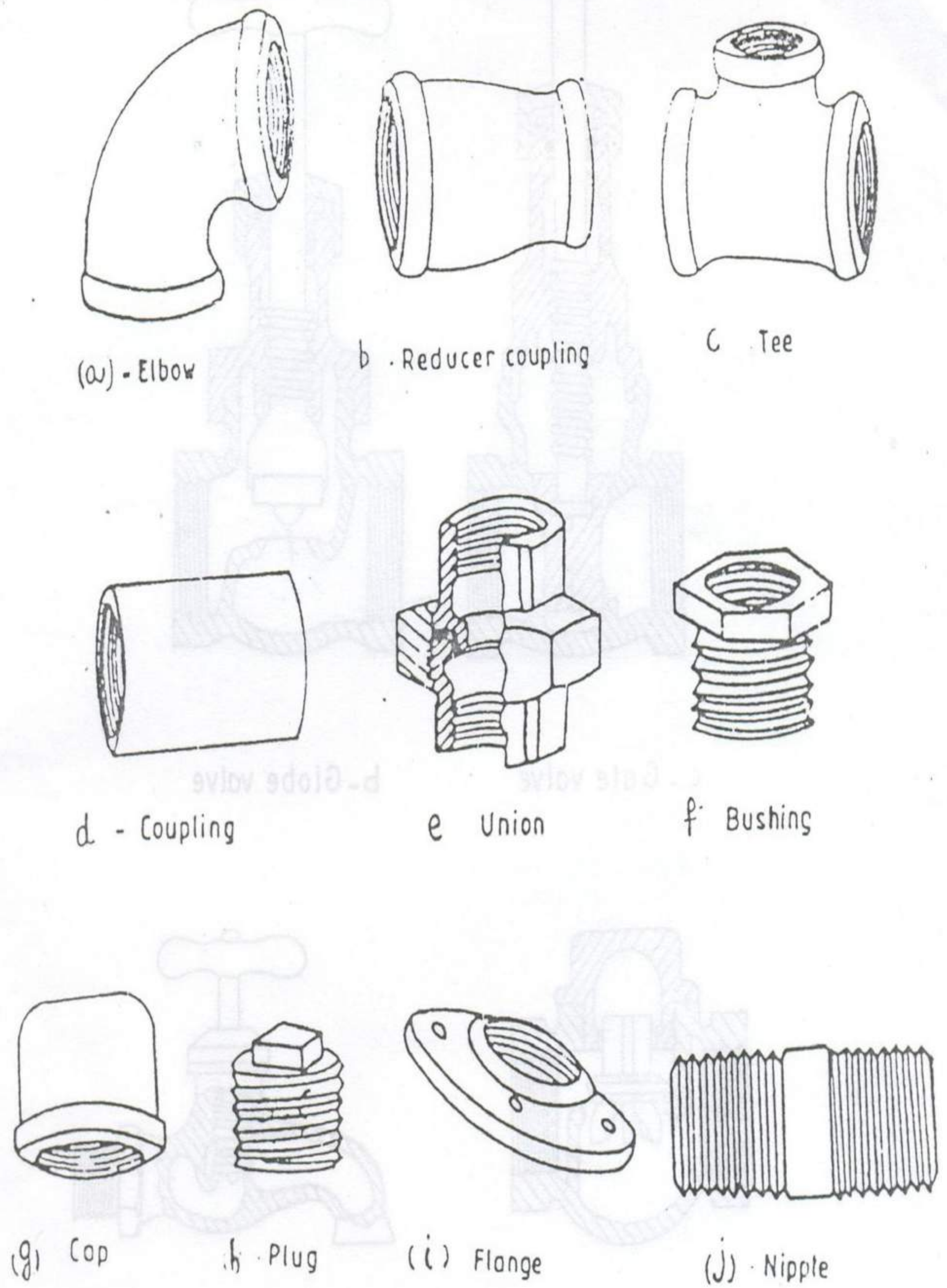
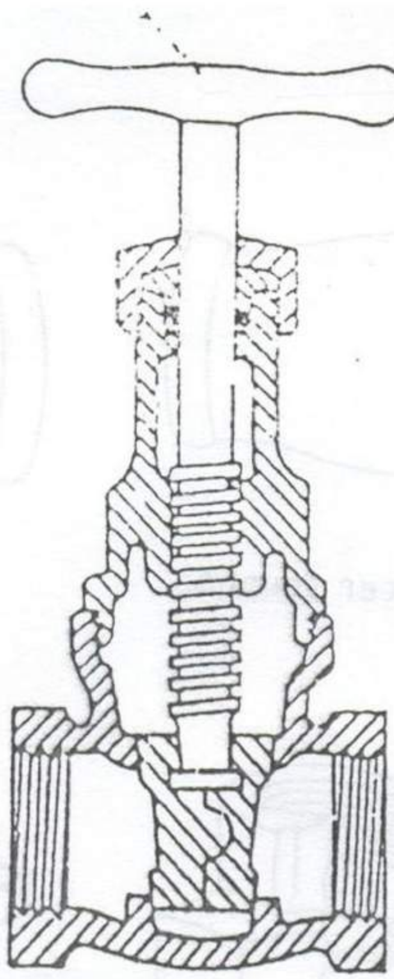
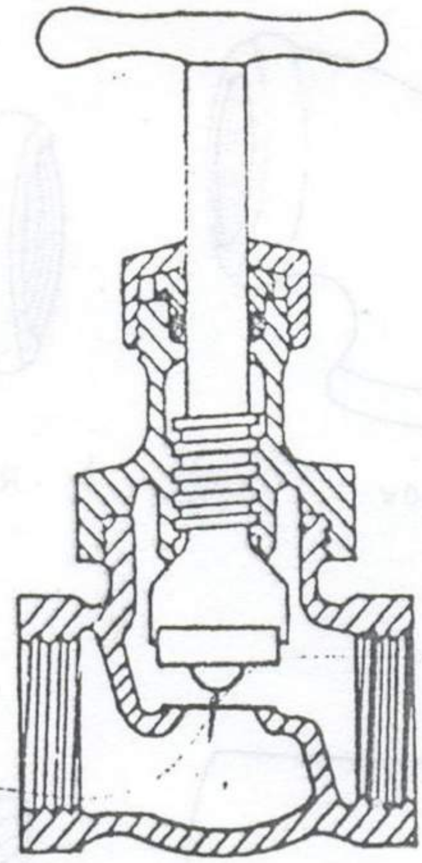


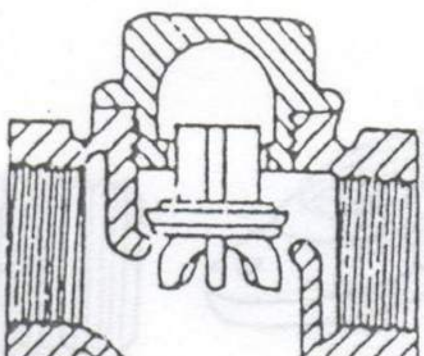
Fig. 5 Common pipe fittings



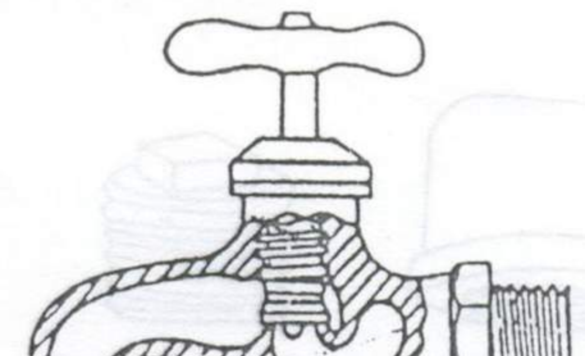
a - Gate valve



b- Globe valve



c - Check valve



d - Common tap

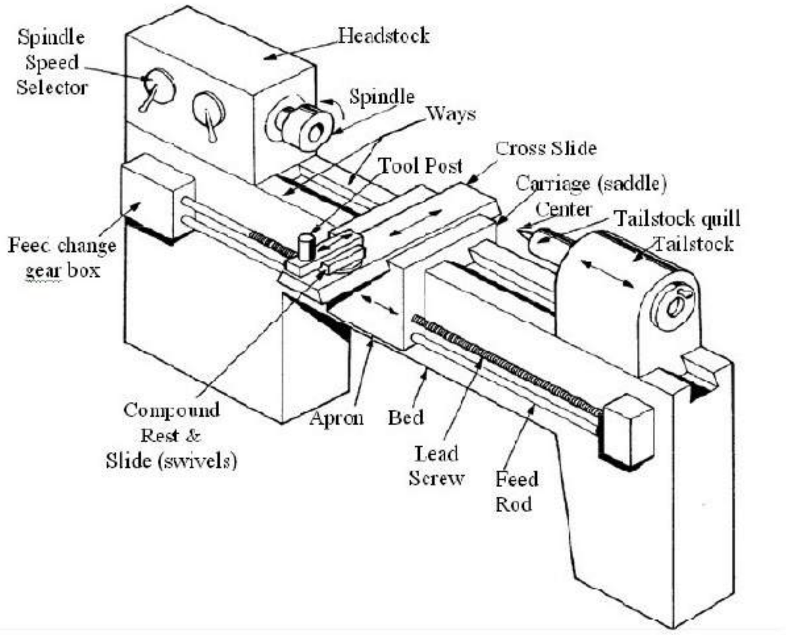
MACHINE SHOP

INTRODUCTION

Various machining purpose used these all type of mechanical machining machines are Lathe machine, Shaper machine, Slotting machine, Planning machine, Drilling machine, Boring machine, Milling machine, Grinding machine, Lapping machine Honing machine and Broaching machine

These machines are to producing various operations like namely Facing, Chamfering, Step turning, Taper turning, Plain turning, Knurling, Grooving, Thread cutting, Drilling, Tapping, Precision grinding, Cylindrical grinding, Surface grinding, grinding of tool angles e.t.c

LATHE MACHINE:



A lathe s a machine tool which rotates the workpiece on its axis to perform various operations such as cutting, sanding, knurling, drilling, or deformation with tools that are applied to the workpiece to create an object which has symmetry about an axis of rotation.

Lathes are used in woodturning, metalworking, metal spinning, and glass working. Lathes can be used to shape pottery, the best-known design being the potter's wheel. Most suitably equipped metalworking lathes can also be used to produce most solids of revolution, plane surfaces and screw threads or helices. Ornamental lathes can produce three-dimensional solids of incredible complexity. The material can be held in place by either one or two centers, at least one of which can be moved horizontally to accommodate varying material lengths. Other work holding methods include clamping the work about the axis of rotation using a chuck to a faceplate, using clamps or dogs.

SHAPER MACHINE:

A shaper is a type of machine tool that uses linear relative motion between the workpiece and a single-point cutting tool to machine a linear tool path. Its cut is analogous to that of a lathe, except that it is linear instead of helical. (Adding axes of motion can yield helical tool paths, as also done in helical planning.) A shaper is analogous to a planer, but smaller, and with the cutter riding a ram that moves above a stationary work piece, rather than the entire workpiece moving beneath the cutter. The ram is moved back and forth typically by a crank inside the column; hydraulically actuated shapers also exist.

A shaper is a type of machine tool that uses linear relative motion between the workpiece and a single-point cutting tool to machine a linear tool path. Its cut is analogous to that of a lathe, except that it is linear instead of helical. (Adding axes of motion can yield helical tool paths, as also done in helical planning.) A shaper is analogous to a planer, but smaller, and with the cutter riding a ram that moves above a stationary workpiece, rather than the entire workpiece moving beneath the cutter. The ram is moved back and forth typically by a crank inside the column; hydraulically actuated shapers also exist.

DRILLING MACHINE:

A drill or drill motor is a tool fitted with a cutting tool attachment or driving tool attachment, usually a drill bit or driver bit, used for drilling holes in various materials or fastening various materials together with the use of fasteners. The attachment is gripped by a chuck at one end of the drill and rotated while pressed against the target material. The tip, and sometimes edges, of the cutting tool does the work of cutting into the target material. This may be slicing off thin shavings (twist drills or auger bits), grinding off small particles (oil drilling), crushing and removing pieces of the workpiece (SDS masonry drill), countersinking, counterboring, or other operations.

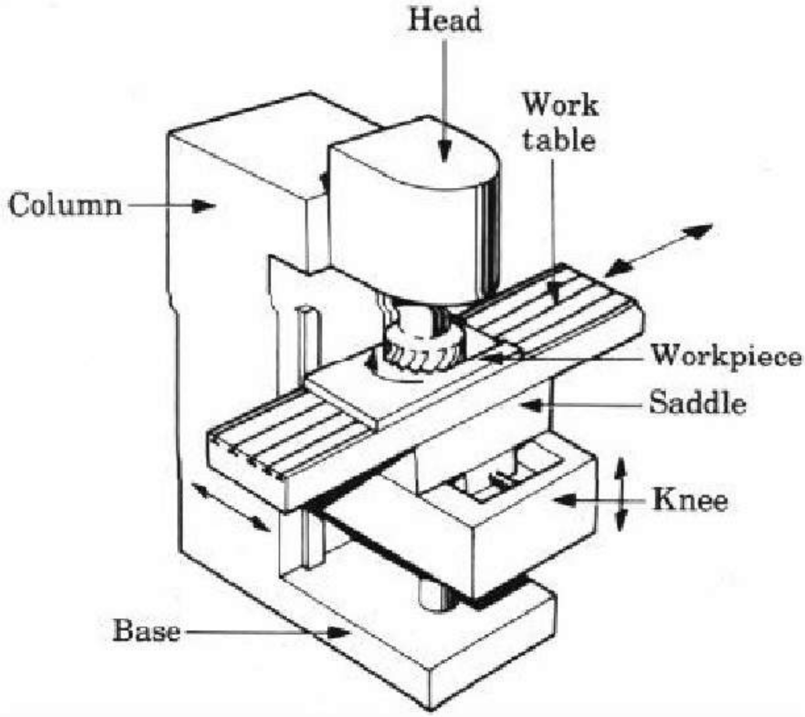
Drills are commonly used in woodworking, metalworking, construction and do-ityourself projects. Specially designed drills are also used in medicine, space missions and other applications.

BORING MACHINE:

In machining, boring is the process of enlarging a hole that has already been drilled (or cast), by means of a single-point cutting tool (or of a boring head containing several such tools), for example as in boring a cannon barrel. Boring is used to achieve greater accuracy of the diameter of a hole, and can be used to cut a tapered hole.

There are various types of boring. The boring bar may be supported on both ends (which only works if the existing hole is a through hole), or it may be supported at one end. Line boring (line boring, line-boring) implies the former. Backboring (back boring, back-boring) is the process of reaching through an existing hole and then boring on the "back" side of the workpiece (relative to the machine headstock).

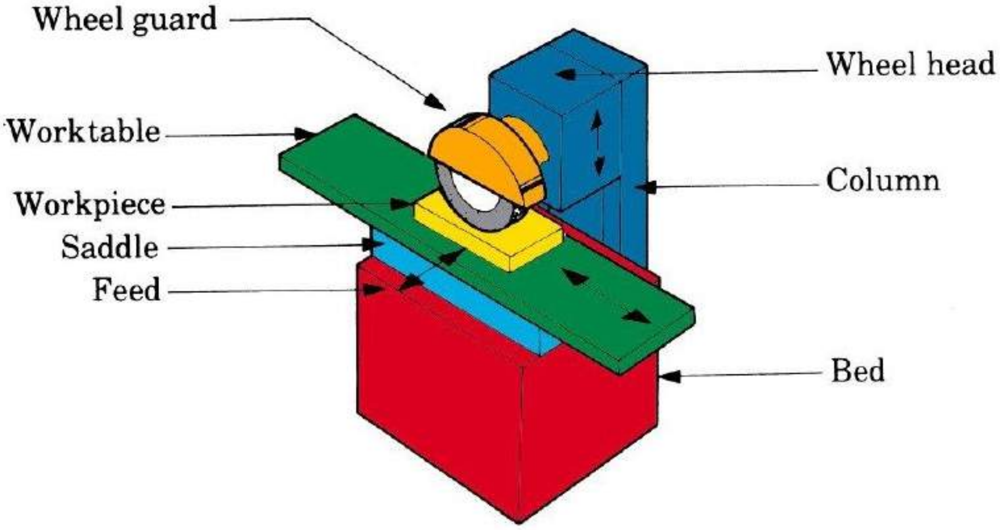
MILLING MACHINE:



A milling machine (also see synonyms below) is a machine tool used to machine solid materials. Milling machines are often classed in two basic forms, horizontal and vertical, which refers to the orientation of the main spindle. Both types range in size from small, bench-mounted devices to room-sized machines. Unlike a drill press, this holds the workpiece stationary as the drill moves axially to penetrate the material, milling machines also move the workpiece radially against the rotating milling cutter, which cuts on its sides as well as its tip. Workpiece and cutter movement are precisely controlled to less than 0.001 in (0.025 mm), usually by means of precision groun slides and lead screws or analogous technology. Milling machines may be manually operated, mechanically automated, or digitally automated via computer numerical control (CNC).

Milling machines can perform a vast number of operations, from simple (e.g., slot and keyway cutting, planing, drilling) to complex (e.g., contouring, die sinking). Cutting fluid is often pumped to the cutting site to cool and lubricate the cut and to wash away the resulting swarf.

GRINDING MACHINE:



A grinding machine, often shortened to grinder, is a machine tool used for grinding, which is a type of machining using an abrasive wheel as the cutting tool. Each grain of abrasive on the wheel's surface cuts a small chip from the workpiece via shear deformation.

The grinding machine consists of a power driven grinding wheel spinning at the required speed (which is determined by the wheel's diameter and manufacturer's rating, usually by a formula) and a bed with a fixture to guide and hold the workpiece. The grinding head can be controlled to travel across a fixed work piece or the workpiece can be moved whilst the grind head stays in a fixed position. Very fine control of the grinding head or table's position is possible using a Vernier calibrated hand wheel, or using the features of numerical controls.