C. V. RAMAN POLYTECHNIC
Bidyanagar, Mahura, Janla, Bhubaneswar-752054
DEPARTMENT OF MECHANICAL ENGINEERING

# LAB MANUAL

## WORKSHOP PRACTICE-II (Pr-3)

**(Semester- 3rd semester Mechanical Engineering)**


**Prepared by:**

- Soumya Dash, Assistant Professor, Mechanical Engineering Department, CVRP, Odisha
- Bibhu Prasad Padhi, Workshop Instructor, Mechanical Engineering Department, CVRP, Odisha

# Outcome Based Education

For the implementation of an outcome based education the first requirement is to develop an outcome based curriculum and incorporate an outcome based assessment in the education system. By going through outcome based assessments, evaluators will be able to evaluate whether the students have achieved the outlined standard, specific and measurable outcomes. With the proper incorporation of outcome based education there will be a definite commitment to achieve a minimum standard for all learners without giving up at any level. At the end of the programme running with the aid of outcome based education, a student will be able to arrive at the following outcomes (as per NBA guidelines):

1. **Basic and Discipline specific knowledge:** Apply knowledge of basic mathematics, science and engineering fundamentals and engineering specialization to solve the engineering problems.

2. **Problem analysis:** Identify and analyse well-defined engineering problems using codified standard methods.

3. **Design/ development of solutions:** Design solutions for well-defined technical problems and assist with the design of systems components or processes to meet specified needs.

4. **Engineering Tools, Experimentation and Testing:** Apply modern engineering tools and appropriate technique to conduct standard tests and measurements.

5. **Engineering practices for society, sustainability and environment:** Apply appropriate technology in context of society, sustainability, environment and ethical practices.

6. **Project Management:** Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities.

7. **Life-long learning:** Ability to analyse individual needs and engage in updating in the context of technological changes.

## Vision, Mission, (PEOs) and PSOs Suggestion Format

**Department Vision:**

Mechanical department is committed to provide value based and quality education through highly qualified professionals with the cutting-edge technologies to meet industrial and social challenges.

**Mission of the Department**

**MI**: To equip Mechanical Engineering students for competitive challenges by imparting knowledge on modern technology and industry-oriented program.
**M2**: To encourage and empower students to enhance their skills by providing training through various Centres of Excellence.
**M3**: To foster a spirit of entrepreneurship through industrial visits, internships and seminars conducted by academic experts.
**M4**: To motivate students to pursue higher studies for betterment of society.

**Program Educational Objectives (PEO):**

**PEO1**: Understand and analyze the industrial needs through knowledge gained in Mechanical Engineering fundamentals.

**PEO2:** Pursue entrepreneurial opportunities by acquiring special knowledge in training programs.

**PEO3:** Creating technical solutions that successfully address environmental and societal issues.

**PEO4:** Understanding technical concepts, engage in lifelong learning, exhibit leadership qualities with ethics in their professional career.

**Program Specific Outcomes (PSOs)**

| | | |
|---|---|---|
| **PSO-1** | Discipline knowledge | Demonstration and understanding of tools with advanced software for design specification and operation of Mechanical Engineering systems, components and processes. |
| **PSO-2** | Professional Skills | Apply contextual knowledge to analyze social, environmental, health, safety, legal, and cultural issues with professional ethics as part of the lifelong learning process. To be equipped to lead a team or operate successfully alone as an individual managing tasks in disciplinary areas. |

**Workshop-II (3rd semester)** **Code-Pr-3** **Full marks: 100**

| **Pr.3 Workshop-II** | | **Levels** |
|---|---|---|
| CO1 | Learn about different fitting practices and prepare job like caliper, try square, hexagonal, square etc. | 2 |
| CO2 | Know about different smithy practices and prepare door rings with hook, hexagonal head bolt, octagonal flat chisel. | 2 |
| CO3 | Knowledge about carpentry practices and prepare mortise and tenon, dove tail joint. | 3 |
| CO4 | Gain insights about welding practices and prepare different joints using arc and gas welding methods. | 3 |

**CO-PO Mapping**

| **Course** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **Average PO** |
|---|---|---|---|---|---|---|---|---|
| CO1 | 3.00 | 1.00 | 1.00 | - | - | 1.00 | 1.00 | 1.40 |
| CO2 | 3.00 | 1.00 | 1.00 | 1.00 | - | 1.00 | - | 1.40 |
| CO3 | 3.00 | 1.00 | 1.00 | - | - | 1.00 | 1.00 | 1.40 |
| CO4 | 3.00 | - | 2.00 | 1.00 | 1.00 | 1.00 | - | 1.60 |
| **Average CO of individual PO** | 3.00 | 1.00 | 1.25 | - | 1.00 | 1.00 | 1.00 | **1.45** **1.38** |

**Sessional Rubrics (50)**

| | Attendance (5) | | | | Record (10) | | Experiment/Job (25) | | | | Viva (10) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | The student attends all the classes. | | | | Report is well written. The Contents are equipped with neat sketch, error free calculations and free from grammatical errors. | | Identifying equipment, instruments and material and setting up of machine tool. Exhibits proper knowledge of the lab procedure. Runs the machine independently. Takes all the readings from machine/apparatus during experiment. The obtained result is calculated correctly to find the result. Analyses if any error occurred with the reason. The experiment is completed within the time limit with taking proper safety precautions. Discipline and ethics is maintained while performing the experiment. | | | | A set of questions is asked relating to the experiment and subject. | | |
| **Rating/Performance criteria** | 25 | 22 | 20 | 15 | 10 | 8 | 5 | 4 | | 3 | 2 | 1 | |
| **Attendance (5)** | | | | | | | Answers to 100% of questions asked | Answers to 90% of questions asked | | Answers to 70% of questions asked | Answers to 50% of questions asked | | |
| **Record (10)** | | | | | Performs 100% of the criteria | Performs 90% of the criteria | Performs 80% of the criteria | Performs 70% of the criteria | | Performs 60% of the criteria | Performs 50% of the criteria | Performs 30% of the criteria | |
| **Experiment/Job (25)** | Performs 100% of the criteria | Performs 90% of the criteria | Performs 80% of the criteria | Performs 70% of the criteria | Performs 60% of the criteria | Performs 50% of the criteria | Performs 40% of the criteria | Performs 30% of the criteria | | Performs 20% of the criteria | | | |
| **Viva (10)** | | | | | Performs 100% of the criteria | Performs 90% of the criteria | Performs 80% of the criteria | Performs 70% of the criteria | | Performs 60% of the criteria | Performs 50% of the criteria | Performs 30% of the criteria | |

## Sessional (50)

| Sl. No. | Name of student | Registration number | Attendance (5) | Record (10) | Job (25) | Viva (10) | Total (50) |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

## Practical Rubrics (50)

| | Report (10) | | | | Experiment/Job (25) | | | | Viva (15) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Report is well written. The Contents are equipped with neat sketch, error free calculations and free from grammatical errors. | | | | Identifying equipment, instruments and material and setting up of machine tool. Exhibits proper knowledge of the lab procedure. Runs the machine independently. Takes all the readings from machine/apparatus during experiment. The obtained result is calculated correctly to find the result. Analyses if any error occurred with the reason. The experiment is completed within the time limit with taking proper safety precautions. Discipline and ethics is maintained while performing the experiment. | | | | A set of questions is asked relating to the experiment and subject. | | |
| **Rating/Performance criteria** | 25 | 24 | 21 | 18 | 15 | 12 | 10 | 8 | 6 | 4 | 2 |
| **Report (10)** | | | | | Answers to 100% of questions asked | Answers to 75% of questions asked | Answers to 60% of questions asked | Answers to 50% of questions asked | Answers to 40% of questions asked | Answers to 30% of questions asked | |
| **Experiment/Job (25)** | Performs 100% of the criteria | Performs 90% of the criteria | Performs 80% of the criteria | Performs 70% of the criteria | Performs 60% of the criteria | Performs 50% of the criteria | Performs 40% of the criteria | Performs 30% of the criteria | | | |
| **Viva (15)** | | | | | | | Answers to 100% of questions asked | Answers to 90% of questions asked | Answers to 70% of questions asked | Answers to 50% of questions asked | Answers to 30% of questions asked |

## Practical (50)

| Sl. No. | Name of student | Registration number | Report (10) | Experiment/Job (25) | Viva (15) | Total (50) |
|---|---|---|---|---|---|---|
| | | | | | | |
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| | | | | | | |

**Syllabus**

# WORKSHOP PRACTICE-II (PRACTICAL-3)

| Name of the Course: Diploma in **Mech/Auto/Aero & Other Mechanical Allied Branches** | | | |
|---|---|---|---|
| Course code: | | Semester | 3rd |
| Total Period: | 90 | Examination | 4 hrs |
| Lab. periods: | 6 P/week | Sessional | 50 |
| Maximum marks: | 100 | End Semester Examination: | 50 |

## COURSE OBJECTIVES:-

Students will develop ability towards

- Practicing fitting, carpentry, smithy and machining
- Understanding the tools and equipment used in the practices
- Realize the time and resource utilization in the practices

**1. Fitting practices**

1.1 Preparation of caliper
1.2 Preparation of try square
1.3 Preparation of hammer, square , Hexagonal

**2. Smithy Practices**

2.1 Preparation of door ring with hook
2.2 Preparation of hexagonal head bolt
2.3 Preparation of octagonal flat chisel

**3 Carpentry Practices**

3.1 Cutting of slot, botch, mortise and Tenon Joint
3.2 Preparation of single dove tail joint

**4 Welding Practice**

4.1 Lap & Butt Joint using Arc Welding
4.2 Lap Joint using Gas Welding
4.3 Joining Two non-ferrous parts through

## DO'S

- Students must always wear uniform and shoes before entering the lab.
- Proper code of conduct and ethics must be followed in the lab.
- Windows and doors to be kept open for proper ventilation and air circulation.
- Note down the specifications/drawings before working on the preparation of models.
- Receive the tools and materials required for preparation of models with signing in register.
- Properly fix hacksaw blade in frame with help of instructor.
- Use of safety goggles/ face shield during welding.
- Do the models under the supervision/guidance of a lecturer/lab instructor only.
- Keep the sufficient distance from other students while preparing models.
- In case of fire use fire extinguisher/throw the sand provided in the lab.
- In case of any physical injuries or emergencies use first aid box provided.
- Any unsafe conditions prevailing in the lab can be brought to the notice of the lab Be away from power tools while demonstrating.

## DONT's

- Do not touch electrical circuits of welding machine.
- Be cautious while fixing hacksaw blade in frame, that may cause injuries to hand.
- Don't touch /operate power tools without aid from instructors.
- Don't gather while preparing models, that may hurt other with tools.
- Don't unlock snip/sheet metal cutter lock, without use.

## PROGRESSIVE ASSESMENT OF MANUAL

| Sl. No. | Name of the experiment | Date of expriment | Date of submission | Page no. | Remarks |
|---|---|---|---|---|---|
| 1 | Safety | | | | |
| 2 | Fitting practices | | | | |
| 3 | Smithy Practices | | | | |
| 4 | Carpentry Practices | | | | |
| 5 | Welding Practice | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

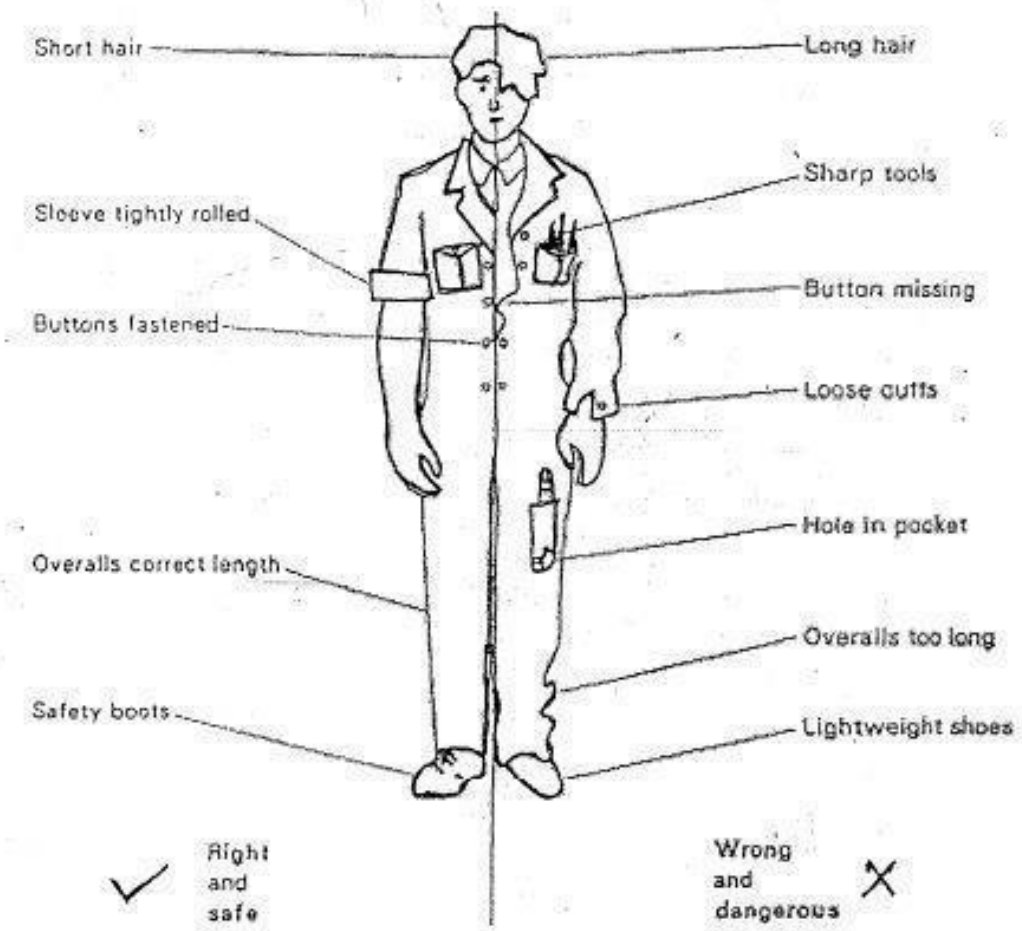
## SAFETY PRACTICE

**INTRODUCTION:**

It is an action which organizes and controls all our acts in such a manner that we don't get involved, expose ourselves or others in accident. So, a technical person should have knowledge about safety.

### Clothing and footwear

Suitable and unsuitable working clothing for use in an engineering machine shop is shown in Fig. Overalls or protective coats should be neatly buttoned and sleeves should be tightly rolled. Safety shoes and boots should be worn (*not* trainers!). Overalls and protective




*Correct and incorrect clothing and footwear*

**Personal Protective Equipment:**

Goggles, face-shields, earplugs, helmets, respirators, gloves and aprons are types of personal protective equipment that reduce worker's exposure to hazards.

## ***FITTING WORKSHOP***

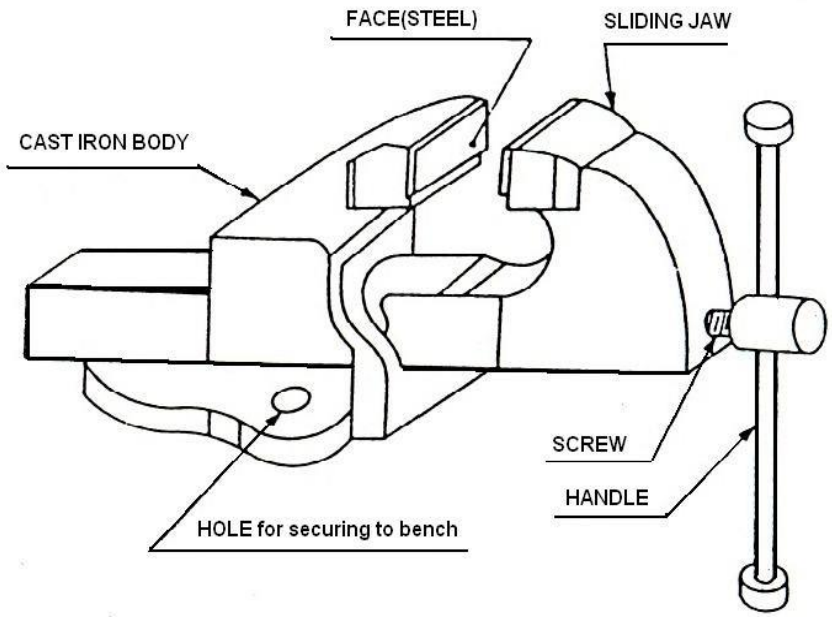
### 1.1 INTRODUCTION

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

### 1.2 HOLDING TOOLS

#### 1.2.1 Bench vice

The bench vice is a work holding device. It is the most commonly used vice in a fitting shop. The bench vice is shown in Figure 1.1.



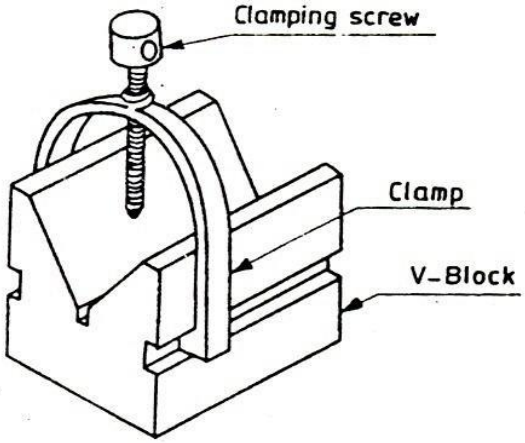

It is fixed to the bench with bolts and nuts. The vice body consists of two main parts, fixed jaw and movable jaw. When the vice handle is turned in a clockwise direction, the sliding jaw forces the work against the fixed jaw. Jaw plates are made of hardened steel. Serrations on the jaws ensure a good grip. Jaw caps made of soft material are used to protect finished surfaces, gripped in the vice. The size of the vice is specified by the length of the jaws. The vice body is made of cast Iron which is strong in compression, weak in tension and so fractures under shocks and therefore should never be hammered.

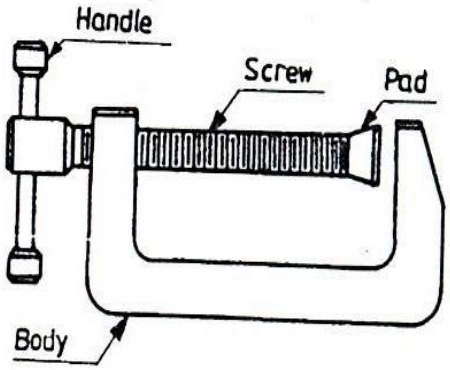
### 1.2.2 V-block

V-block is rectangular or square block with a V-groove on one or both sides opposite to each other. The angle of the 'V' is usually 900. V-block with a clamp is used to hold cylindrical work securely, during layout of measurement, for measuring operations or for drilling for this the bar is faced longitudinally in the V-Groove and the screw of V-clamp is tightened. This grip the rod is firm with its axis parallel to the axis of the v-groove.

### 1.2.3 C-Clamp

This is used to hold work against an angle plate or v-block or any other surface, when gripping is required. Its fixed jaw is shaped like English alphabet 'C' and the movable jaw is round in shape and directly fitted to the threaded screw at the end .The working principle of this clamp is the same as that of the bench vice.

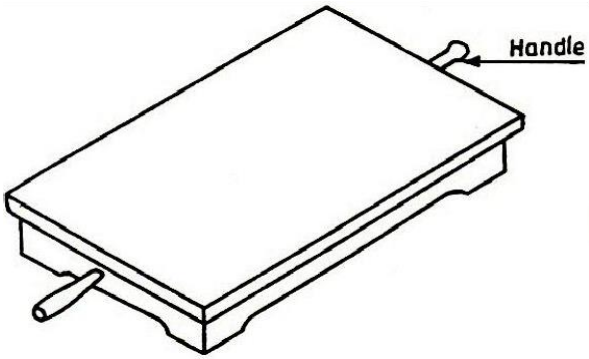



## 1.3 MARKING AND MEASURING TOOLS

### 1.3.1 Surface plate

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



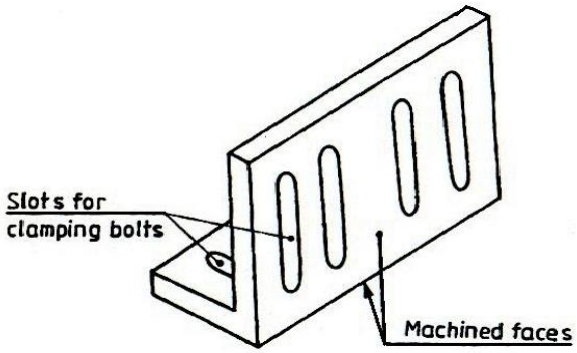




**Figure 1.4**: Surface plate

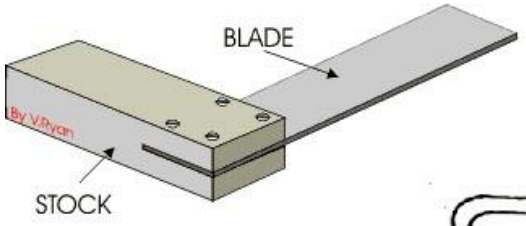
**Figure 1.5**: Angle plate

### 1.3.2 Try square

It is measuring and marking tool for 900 angle .In practice, it is used for checking the squareness of many types of small works when extreme accuracy is not required .The blade of the Try square is made of hardened steel and the stock of cast Iron or steel. The size of the Try square is specified by the length of the blade.

### 1.3.3 Scriber

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



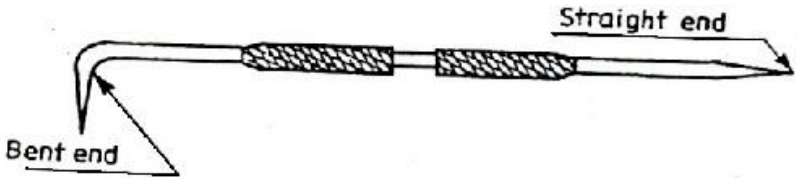




**Figure 1.6**: Try square

**Figure 1.7**: Scriber

### 1.3.4 Odd leg Caliper

This is also called 'Jenny Caliper' or Hermaphrodite. This is used for marking parallel liners from a finished edge and also for locating the center of round bars; it has one leg pointed like a divider and the other leg bent like a caliper. It is specified by the length of the leg up to the hinge point.

### 1.3.5 Divider

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

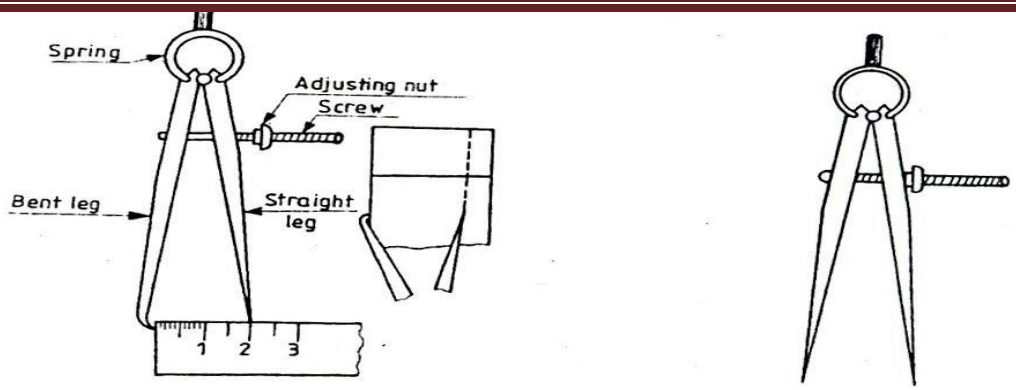



**Figure 1.8**: Odd leg calliper and divider

### 1.3.6 Trammel

Trammel is used for drawing large circles or arcs.

### 1.3.7 Punches

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

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

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

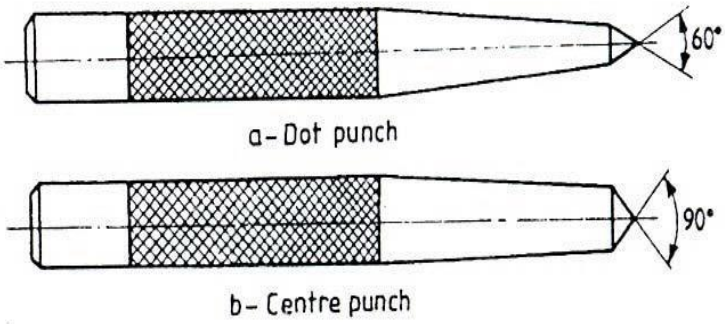



**Figure 1.9**: Punches

### 1.3.8 Calipers

They are indirect measuring tools used to measure or transfer linear dimensions. These are used with the help of a steel Rule to check inside and outside measurements. These are made of Case hardened mild steel or hardened and tempered low carbon steel. While using, but the le gs of the caliper are set against the surface of the work, whether inside or outside and the distance between

the legs is measured with the help of a scale and the same can be transferred to another desired place. These are specified by the length of the leg. In the case of outside caliper, the legs are bent inwards and in the case of inside caliper, the legs bent outwards.

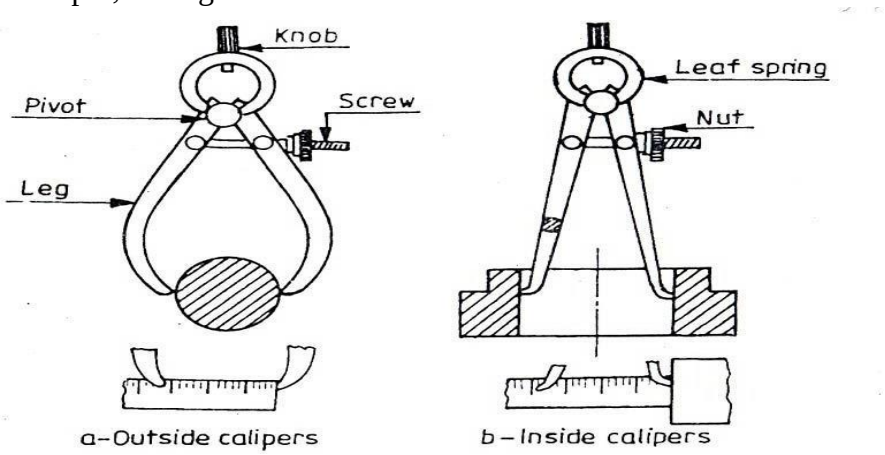



**Figure 1.10**: Calipers

### 1.3.9 Vernier Calipers

These are used for measuring outside as well as inside dimensions accurately. It may also be used as a depth gauge. It has two jaws. One jaw is formed at one end of its main scale and the other jaw
is made part of a vernier scale.

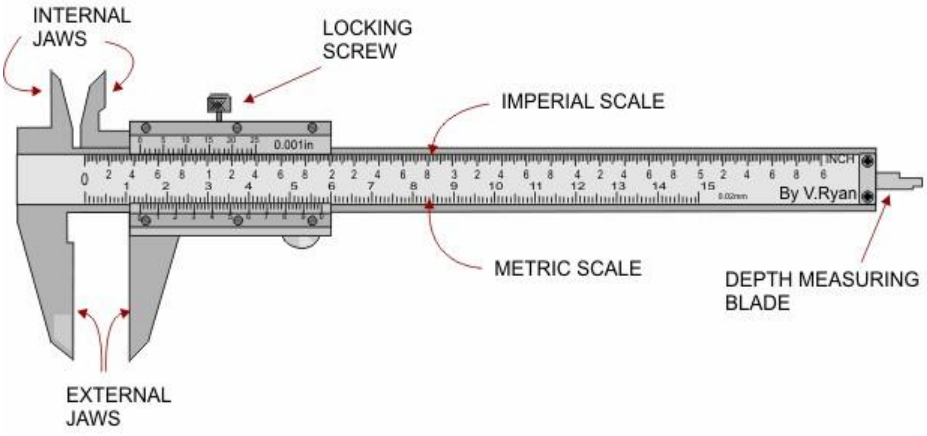



**Figure 1.11**: Vernier caliper

## 1.4 CUTTING TOOLS

### 1.4.1 Hack Saw

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

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

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

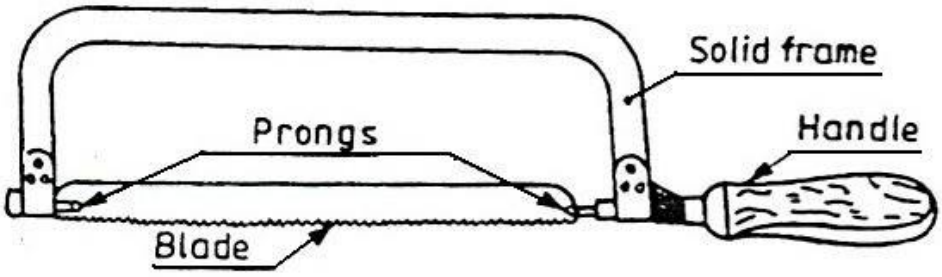



**Figure 1.13:** Hacksaw frame with blade

### 1.4.2 Chisels

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

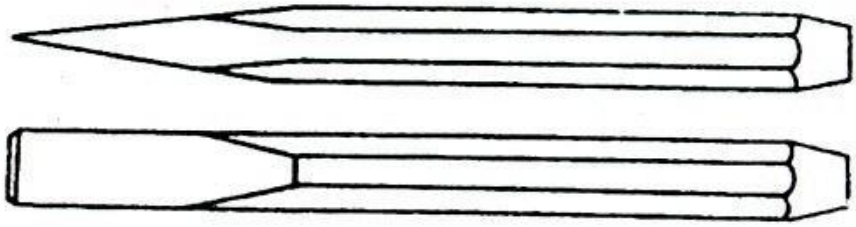


**Figure 1.15: Flat chisel**

### 1.4.3 Twist Drill

Twist drills are used for making holes. These are made of High speed steel. Both straight and taper shank twist drills are used. The parallel shank twist drill can be held in an ordinary self – centring drill check. The tapper shank twist drill fits into a corresponding tapered bore provided in the drilling machine spindle.

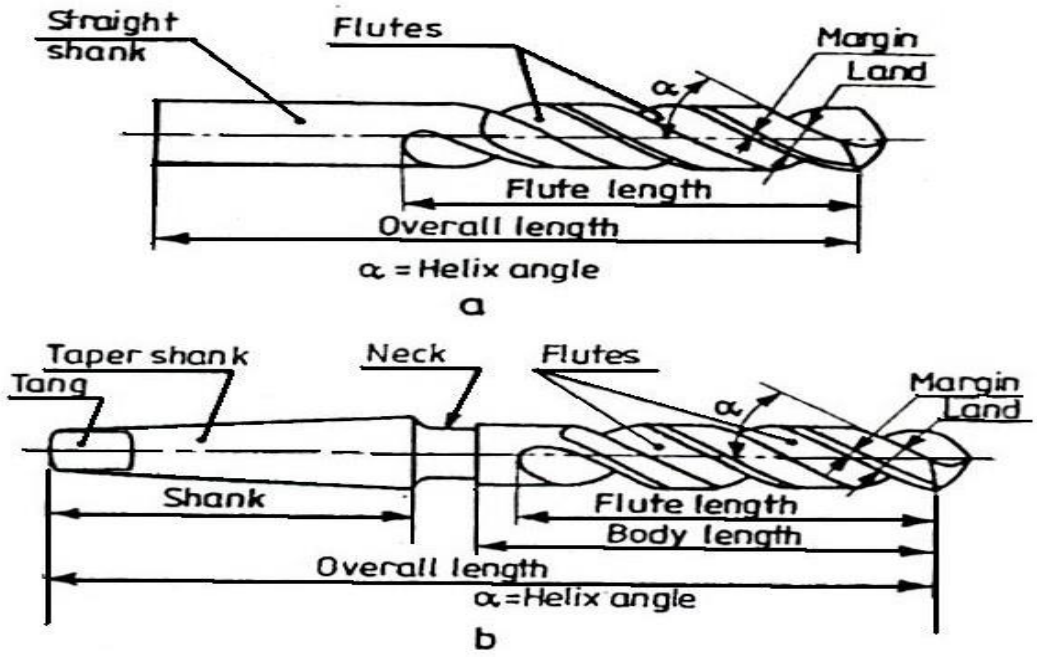



**Figure 1.16:** Twist drills

### 1.4.4 Taps and Tap wrenches

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

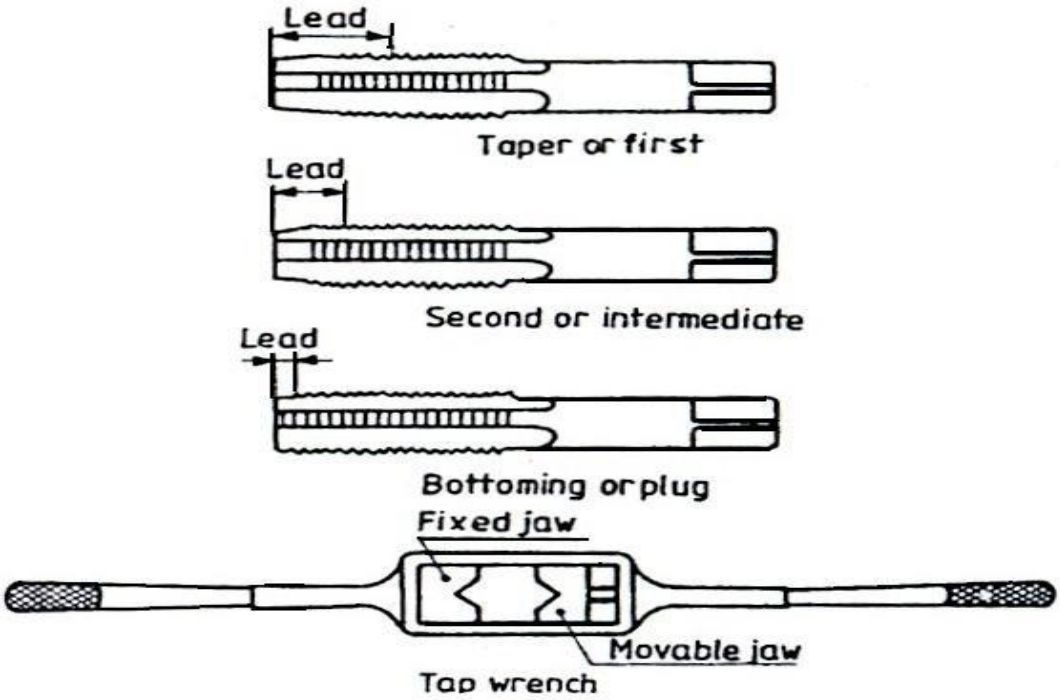



**Figure 1.17:** Taps and tap wrench

### 1.4.5 Dies and die-holders

Dies are the cutting tools used for making external thread. Dies are made either solid or split type. They are fixed in a die stock for holding and adjusting the die gap. They are made of Steel or High Carbon Steel.

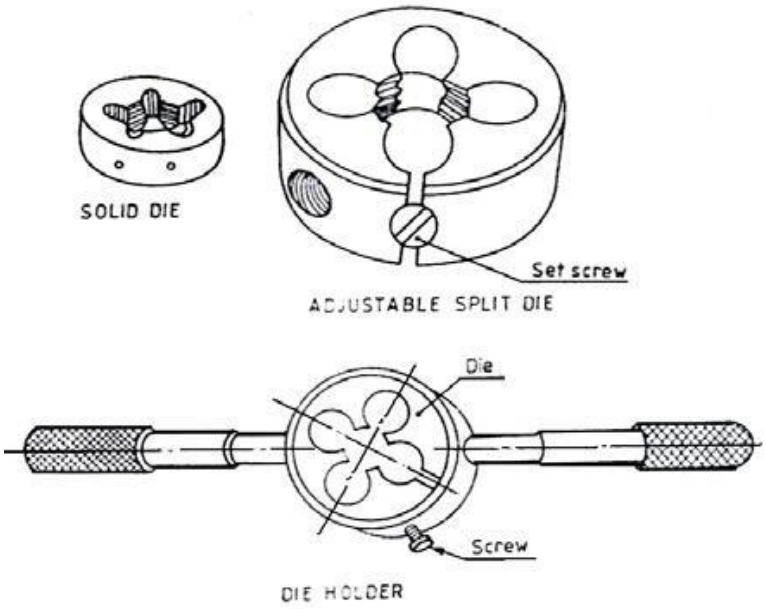



**Figure 1.18:** Dies and die holder

### 1.4.6 Bench Drilling Machine

Holes are drilled for fastening parts with rivets, bolts or for producing internal thread. Bench drilling machine is the most versatile machine used in a fitting shop for the purpose. Twist drills, made of tool steel or high speed steel are used with the drilling machine for drilling holes.

Following are the stages in drilling work

1. Select the correct size drills, put it into the check and lock it firmly
2. Adjust the speed of the machine to suit the work by changing the belt on the pulleys. Use high speed for small drills and soft materials and low speed for large diameter drills and hard materials.
3. Layout of the location of the pole and mark it with a center punch.
4. Hold the work firmly in the vice on the machine table and clamp it directly on to the machine table.
5. Put on the power, locate the punch mark and apply slight pressure with the Feed Handle.
6. Once Drilling is commenced at the correct location, apply enough pressure and continue drilling. When drilling steel apply cutting oil at the drilling point.
7. Release the pressure slightly, when the drill point pierces the lower surface of the metal. This prevents the drill catching and damaging the work or drill.
8. On completion of drilling retrace the drill out of the work and put-off the power supply.

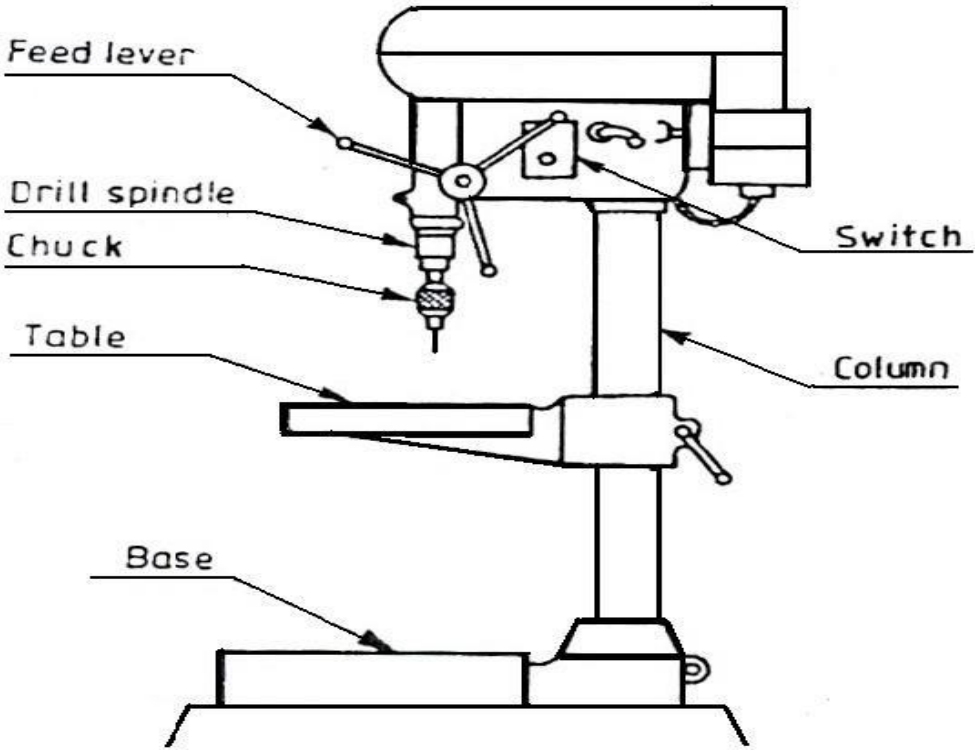



**Figure 1.19:** Bench drill

## 1.5 FINISHING TOOLS

### 1.5.1 Reamers

Reaming is an operation of sizing and finishing a drilled hole, with the help of a cutting tool called reamer having a number of cutting edges. For this, a hole is first drilled, the size of which is slightly smaller than the finished size and then a hand reamer or machine reamer is used for finishing the hole to the correct size.

Hand Reamer is made of High Carbon Steel and has left-hand spiral flutes so that, it is prevented from screwing into the whole during operation. The Shank end of the reamer is made straight so that it can be held in a tap wrench. It is operated by hand, with a tap wrench fitted on the square end of the reamer and with the work piece held in the vice. The body of the reamer is given a slight tapper at its working end, for its easy entry into the whole during operation, it is rotated only in clock wise direction and also while removing it from the whole.

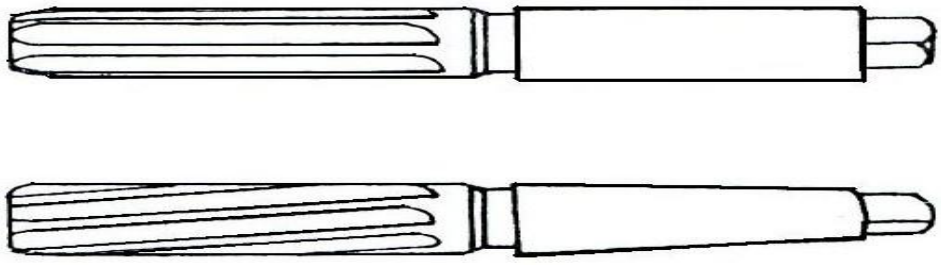


**Figure 1.20:** Reamers

### 1.5.2 Files

Filing is one of the methods of removing small amounts of material from the surface of a metal part. A file is hardened steel too, having small parallel rows of cutting edges or teeth on its surfaces.

On the faces, the teeth are usually diagonal to the edge. One end of the file is shaped to fit into a wooden handle. The figure shows various parts of a hand file. The hand file is parallel in width and tapering slightly in thickness, towards the tip. It is provided with double cut teeth. On the faces, single cut on one edge and no teeth on the other edge, which is known as a safe edge.

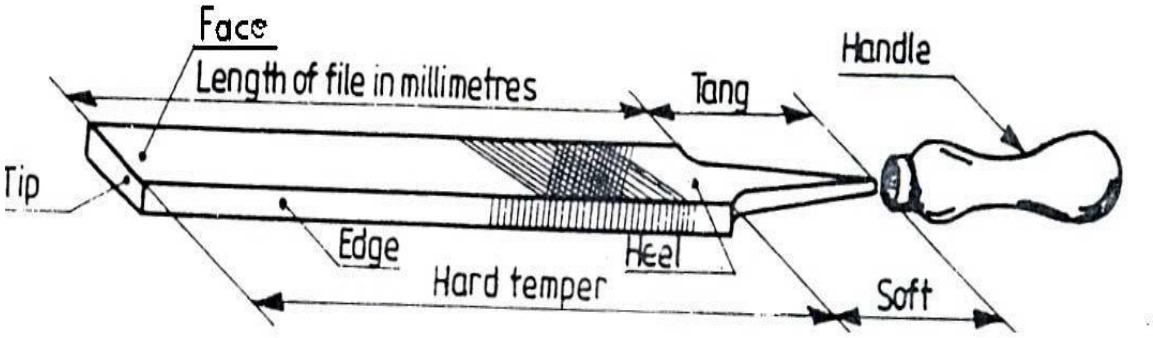



**Figure 1.21**: Parts of a hand file

Files are classified according to their shape, cutting teeth and pitch or grade of the teeth. The figure shows the various types of files based on their shape.

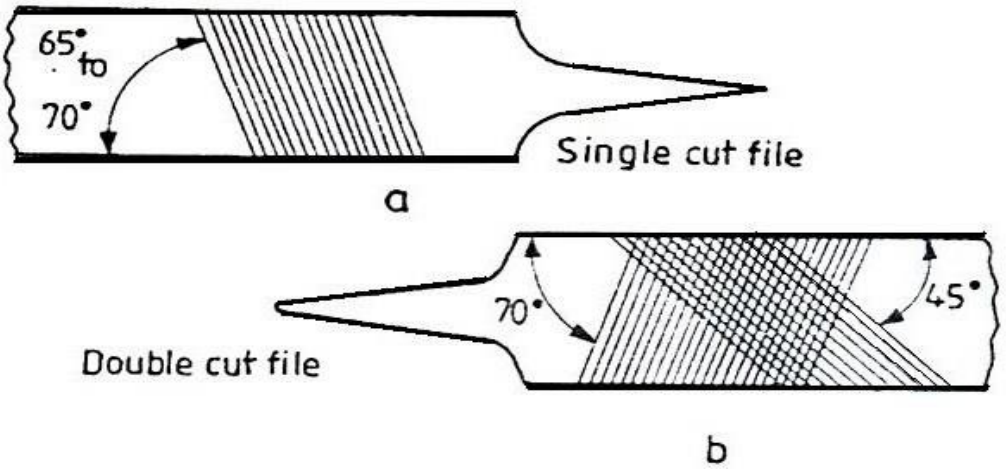



**Figure 1.22:** Single and double cut files

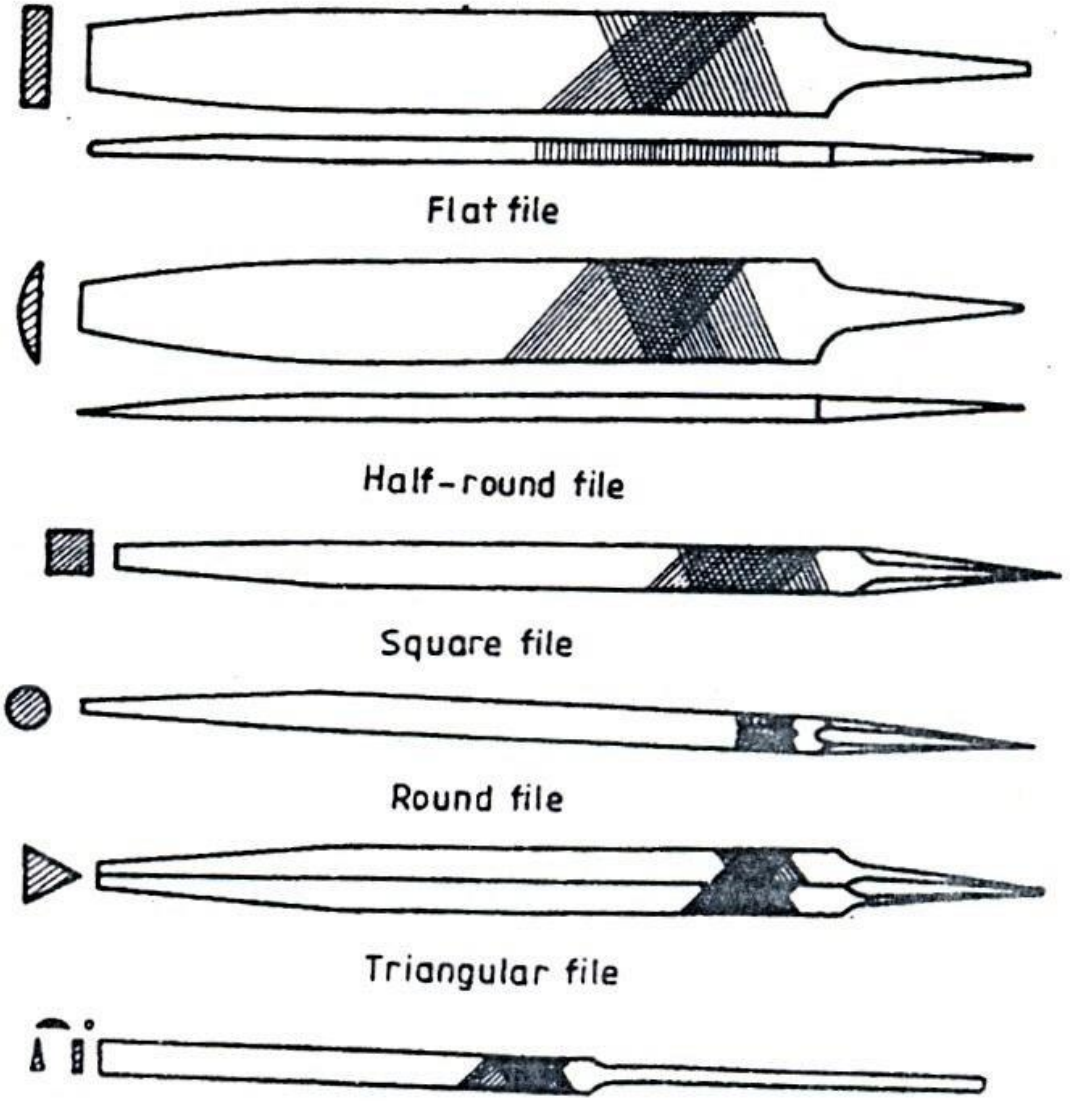


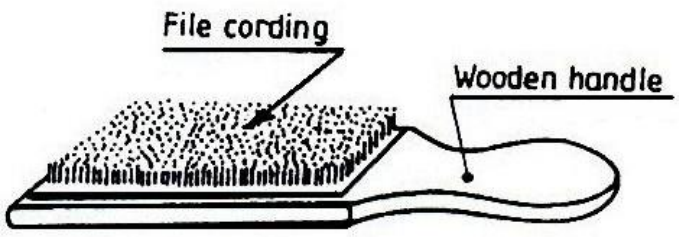

**Figure 1.23:** Types of file

### 1.6 MISCELLANEOUS TOOLS

#### 1.6.1 File card

It is a metal brush, used for cleaning the files, to free them from filings, clogged in-between the teeth.

**Figure 1.24:** File card



### 1.6.2 Ball- Peen Hammer

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

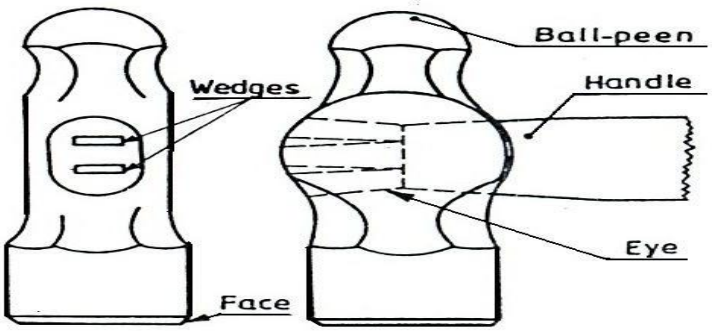



**Figure 1.25:** Ball peen hammer

### 1.6.3 Cross-Peen Hammer

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

### 1.6.4 Straight-Peen Hammer

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

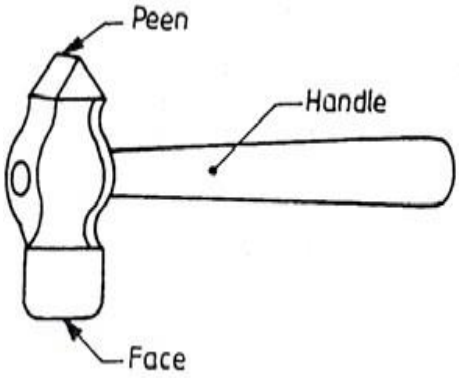



**Figure 1.26: Cross peen hammer**

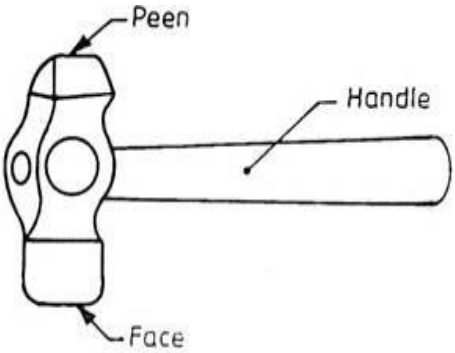



**Figure 1.27: Straight peen hammer**

### 1.6.5 Screw driver

A screw driver is designed to turn screws. The blade is made of steel and is available in different lengths and diameters. The grinding of the tip to the correct shape is very important. A star screw driver is specially designed to fit the head of star screws. The end of the blade is fluted instead of flattened. The screw driver is specified by the length of the metal part from handle to the tip.

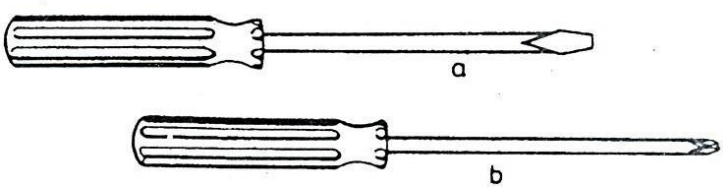



**Figure 1.28: Screw drivers**

### 1.6.7 Spanners

A spanner or wrench is a tool for turning nuts and bolts. It is usually made of forged steel. There are many kinds of spanners. They are named according to the application. The size of the spanner denotes the size of the bolt on which it can work.

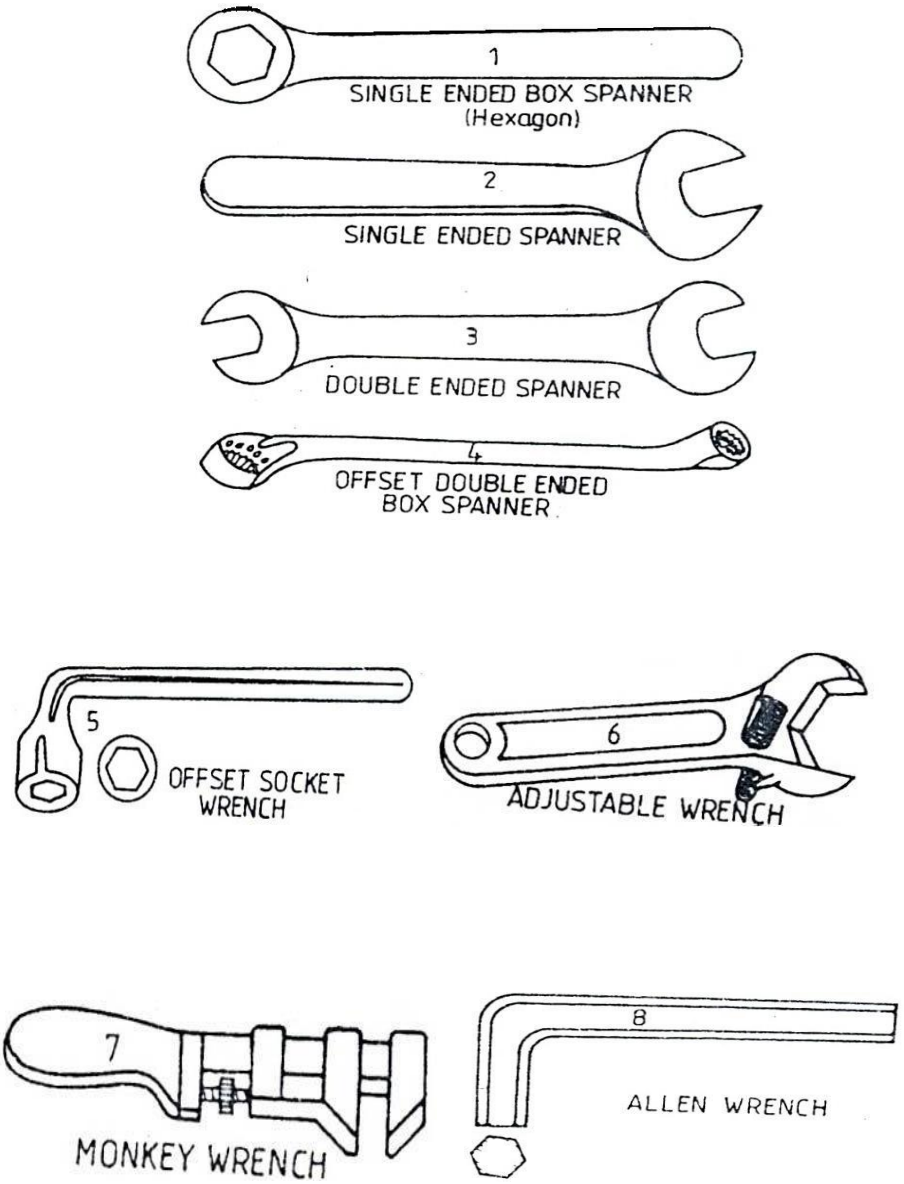



**Figure 1.28:** Spanners

## 1.7 SAFE PRACTICE

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

1. Keep hands and tools wiped clean and free of dirt, oil and grease. Dry tools are safer to use than slippery tools.
2. Do not carry sharp tools on pockets.
3. Wear leather shoes and not sandals.
4. Don't wear loose clothes.
5. Do no keep work tools at the edge of the table
6. Position the work piece such that the cut to be made is close to the vice. This practice prevents springing, saw breakage and personal injury.
7. Apply force only on the forward (cutting) stroke and relieve the force on the return stroke while sawing and filing.
8. Do not hold the work piece in hand while cutting.
9. Use the file with a properly fitted tight handle.
10. After filing, remove the burrs from the edges of the work, to prevent cuts to the fingers.
11. Do not use vice as an anvil.
12. While sawing, keep the blade straight; otherwise it will break
13. Do not use a file without handle.
14. Clean the vice after use.

## EXPERIMENT NO- 01

**AIM OF THE EXPERIMENT: -**

To prepare a caliper.

**APPARATUS REQUIRED: -**

| SL NO | NAME OF THE ITEMS | SPECIFICATION | QUANTITY |
|---|---|---|---|
| **01** | Hacksaw frame with blade | 300mm | 01 |
| **02** | Bastard File | 300mm | 01 |
| **03** | Smooth File | 250mm | 01 |
| **04** | Hammer | 0.25Kg | 01 |
| **05** | Punch | 150mm | 01 |
| **06** | Steel Rule | 300mm | 01 |
| **07** | Drill Bit | Ø6mm | 01 |
| **08** | Marking Media | | As per requirement |
| **09** | Drilling Machine | Bench Type | 01 |

**RAW MATERIAL REQUIRED: -**

| SL NO | NAME OF THE ITEMS | SPECIFICATION | QUANTITY |
|---|---|---|---|
| **01** | M.S. Flat | 2 (160X20X6)mm | 02 |
| **02** | M.S. Rivet | Ø6mmX10mm | 01 |

**PROCEDURE: -**

- File the two adjacent edges of the M.S Flat to right angle.
- Apply the marking media to mark the job as per sketch and punch the marking line.
- Remove the extra material by sawing and chipping and then file the job to the required shape.
- Drill the holes on the two pieces and clean the burrs.
- Assemble the two parts by riveting.
- Finish all sides, edges and surfaces properly.

**CONCLUSION: -**

Hence the outside caliper is made and required dimension has prepared.

## EXPERIMENT NO 02

**AIM OF THE EXPERIMENT: -**

To prepare a Try Square.

**APPARATUS REQUIRED: -**

| SL. NO | NAME OF THE ITEMS | SPECIFICATION | QUANTITY |
|---|---|---|---|
| **01** | Hacksaw frame with blade | 300mm | 01 |
| **02** | Bastard File | 300mm | 01 |
| **03** | Smooth File | 250mm | 01 |
| **04** | Hammer | 0.25Kg | 01 |
| **05** | Punch | 150mm | 01 |
| **06** | Steel Rule | 300mm | 01 |
| **07** | Drill Bit | Ø6mm | 01 |
| **08** | Bench Vice | 125mm | 01 |
| **09** | Vernier Height Gauge | 300mm | 01 |
| **10** | Try Square | 150mm | 01 |
| **11** | Drilling Machine | Bench Type | 01 |
| **12** | Marking Media | | As per requirement |

**RAW MATERIAL REQUIRED: -**

| SL. NO | NAME OF THE ITEMS | SPECIFICATION | QUANTITY |
|---|---|---|---|
| **01** | M.S. Flat | (80x30)mm Beam | 01 |
| **02** | M.S. Flat | (130X30)mm (Blade) | 01 |
| **03** | M.S. Rivet- | Ø6mmX10mm | 01 |

**PROCEDURE: -**

- File the two adjacent edges of the M.S Flat to right angle.
- Apply the marking media to mark the job as per sketch and punch the marking line.
- Remove the extra material by sawing and chipping and then file the job to the required shape.
- Make small hole on each flat by drilling machine.
- File the holes on the two pieces and clean the burrs.
- Assemble the two parts by riveting.
- Finish all sides, edges and surfaces properly.

**CONCLUSION: -**

Finally, a Try Square of required dimension has been prepared.

## EXPERIMENT NO- 03

**AIM OF THE EXPERIMENT: -**

To prepare a Hammer.

**APPARATUS REQUIRED: -**

| SL. NO | NAME OF THE ITEMS | SPECIFICATION | QUANTITY |
|---|---|---|---|
| **01** | Hacksaw frame with blade | 300mm | 01 |
| **02** | Bastard File | 300mm | 01 |
| **03** | Smooth File | 250mm | 01 |
| **04** | Hammer | 0.25Kg | 01 |
| **05** | Scriber | 150mm | 01 |
| **06** | Lathe Machine | Centre Lathe | 01 |
| **07** | Vernier Caliper | 200mm | 01 |
| **08** | Bench Vice | 125mm | 01 |
| **09** | Lathe Cutting Tool | HSS 4” | 02 |
| **10** | Chuck Key | - | 01 |
| **11** | Drilling Machine | Bench Type | 01 |

**RAW MATERIAL REQUIRED: -**

| SL NO | NAME OF THE ITEMS | SPECIFICATION | QUANTITY |
|---|---|---|---|
| **01** | M.S. Rod | (Ø40X60)mm | 01 |
| **02** | M.S.Rod | ((Ø10X200)mm | 01 |

**PROCEDURE: -**

- At first fit the job in chuck of the lathe with the help of chuck key.
- Then fit the cutting tool on the tool post.
- Then test whether the job is properly fixed or not on the lathe machine.
- After that start all operations to prepare a hammer.
- At last complete all the operation and produce a hammer

**CONCLUSION: -**

Hence a hammer is prepared as per the given dimension.

## SMITHY SHOP

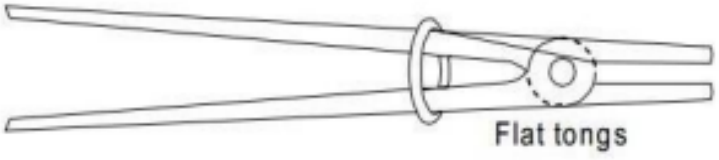
**Introduction:**

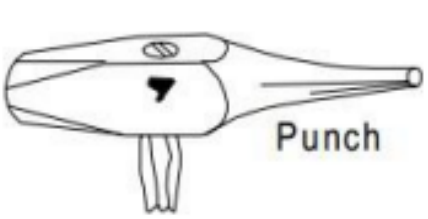
Blacksmithy or Forging is an oldest shaping process used for the producing small articles for which accuracy in size is not so important. The parts are shaped by heating them in an open fire or hearth by the blacksmith and shaping them through applying compressive forces using hammer.

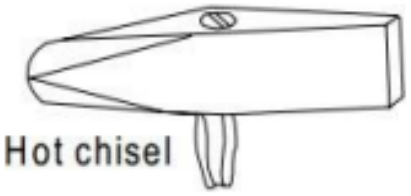
Hand forging process is also known as black-smithy work which is commonly production of small articles using hammers on heated jobs. It is a manual controlled process even though some machinery such as power hammers can also be sometimes used. Black-smithy is, therefore, a process by which metal may be heated and shaped to its requirements by the use of blacksmith tools either by hand or power hammer.

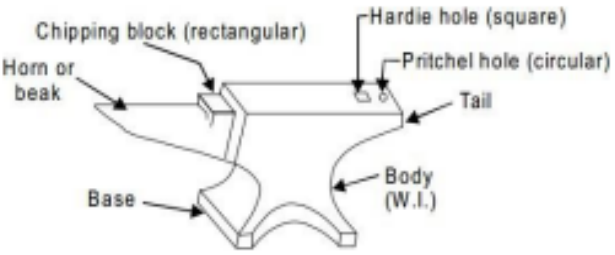
### COMMON HAND FORGING TOOLS

For carrying out forging operations manually, certain common hand forging tools are employed. These are also called blacksmith's tools, for a blacksmith is one who works on the forging of metals in their hot state. The main hand forging tools are as under.

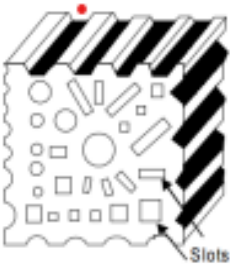



Anvil




Swage block

## EXPERIMENT NO- 1

**AIM OF THE EXPERIMENT: -**

To Prepare a Door ring with Hook.

**APPARATUS REQUIRED: -**

| SL. NO | NAME OF THE ITEMS | SPECIFICATION | QUANTITY |
|---|---|---|---|
| **01** | Round Nose Tong | 300mm | 01 |
| **02** | Hammer | 2Kg and 1.25Kg | 02 |
| **03** | Anvil | 50Kg | 01 |
| **04** | Swage Bock | 80Kg | 01 |
| **05** | Forge or Hearth | - | 01 |

**RAW MATERIAL REQUIRED: -**

| SL NO | NAME OF THE ITEMS | SPECIFICATION | QUANTITY |
|---|---|---|---|
| **01** | M.S. Rod | Ø10X100mm | 01 |
| **02** | M.S. Rod | Ø6X100 mm | 01 |

**PROCEDURE: -**

- At first maintain the required size of the M.S. Rod.
- Now put the two M.S. Rods in the previously burning hearth.
- The M.S. Rod takes heat from the hearth and its temperature begins to increase.
- When its temperature reaches $1000^0$C to $1200^0$C approx., it comes to red hot stage.
- Now remove the M.S. Rod from the hearth and hammering it on the anvil to the required shape.
- Then fitted the hook with the ring.

**CONCLUSION: -**

Finally, a door ring with hook as shown in figure is prepared.

## EXPERIMENT NO- 2

**AIM OF THE EXPERIMENT: -**

Preparation of hexagonal head bolt

**APPARATUS REQUIRED: -**

| SL NO | NAME OF THE ITEMS | SPECIFICATION | QUANTITY |
|---|---|---|---|
| **01** | Round Nose Tong | 300mm | 01 |
| **02** | Hammer | 2Kg and 1.25Kg | 02 |
| **03** | Anvil | 50Kg | 01 |
| **04** | Swage Bock | 80Kg | 01 |
| **05** | Forge or Hearth | -- | 01 |
| **06** | Charcoal | -- | As per requirement |

**RAW MATERIAL REQUIRED: -**

| SL NO | NAME OF THE ITEMS | SPECIFICATION | QUANTITY |
|---|---|---|---|
| **01** | M.S. Rod | (Ø16X150)mm | 01 |

**PROCEDURE: -**

- At first cut the M.S. Rod to the required size.
- Now the rod put on the burning hearth to make it red hot stage.
- The M.S. Rod takes heat from the hearth and its temperature begins to increase.
- When its temperature reaches $1000^0$C to $1200^0$C, it comes to red hot stage.
- Now remove the M.S. Rod from the hearth and hammering it on the swage block/ anvil to the required shape.
- Repeat the above process till we get exact Octagonal shape.
- Then quenching the job in the water

**CONCLUSION: -**

Finally, we got a hexagonal head bolt by following the above procedure.

## EXPERIMENT NO-3

**AIM OF THE EXPERIEMENT: -**

To Prepare Octagonal Flat Chisel.

**APPARATUS REQUIRED: -**

| SL NO | NAME OF THE ITEMS | SPECIFICATION | QUANTITY |
|---|---|---|---|
| **01** | Round Nose Tong | 300mm | 01 |
| **02** | Hammer | 2Kg and 1.25Kg | 02 |
| **03** | Anvil | 50Kg | 01 |
| **04** | Swage Bock | 80Kg | 01 |
| **05** | Forge or Hearth | -- | 01 |
| **06** | Char coal | -- | As per requirement |

**RAW MATERIAL REQUIRED: -**

| SL NO | NAME OF THE ITEMS | SPECIFICATION | QUANTITY |
|---|---|---|---|
| **01** | M.S. Rod | (Ø16X150)mm | 01 |

**PROCEDURE: -**

- At first cut the M.S. Rod to the required size.
- Now the rod put on the burning hearth to make it red hot stage.
- The M.S. Rod takes heat from the hearth and its temperature begins to increase.
- When its temperature reaches $1000^0$C to $1200^0$C, it comes to red hot stage.
- Now remove the M.S. Rod from the hearth and hammering it on the swage block to the required shape i.e. octagonal shape.
- Repeat the above process till we get exact Octagonal shape.
- Then quenching the job in the water.

**CONCLUSION: -**

Finally, we got an Octagonal Flat Chisel by following the above procedure

# CARPENTRY SHOP

## Introduction

Carpentry may be designed as the process of making wooden articles and components such as roots, floors, partitions, doors and windows. Carpentry involves cutting, shaping and fastening wood and other materials together to produce a finished product. Preparation of joints is one of the important operations in wood work. Joinery denotes connecting the wooden parts using different points such as lap joints, mortise and T- joints, bridle joints, etc.

## Carpentry Tools

Carpentry tools are used to produce components to an exact size. The types of carpentry tools are as follows.

1. Marking tools
2. Measuring tools
3. Holding tools
4. Cutting tools
5. Planning tools
6. Boring tools
7. Striking tools
8. Miscellaneous tools

## Marking tools

**It is used to marking lines parallel to the edges of a wooden piece. It consists of a** square wooden stem with a sliding wooden stock on it. On the stem, a marking pin is attached which is made up of steel. This stem is provided with a steel nail to scratch the surface of the work. It consists of two pins; the distance between the pins is adjustable. It is used to draw parallel lines on the stock.

## Measuring tools

The carpentry measuring tools are classified as follows

1. Steel tape
2. Steel rule
3. Caliper

Steel tapes and steel rules are mainly used for measuring short and lengths in millimeters.

A try square is used for testing squareness and marking of joints.

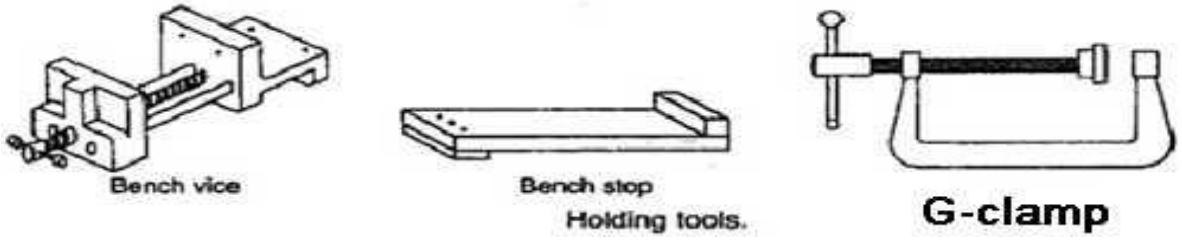
A meter square is used for marking and measuring an angle of 45 degrees.

A bevel square is used for marking and listing angles between 0 degree to 180 degrees.

Calipers are used for the precision measurement of cylindrical surface. Inside calipers are used for measuring outside diameter and outside calipers are used to measure inner diameter of a pipe.

**Holding tools**

The carpentry holding tools are shown in fig.




**Carpentry vice**

A carpentry vice is the common work holding device. It consists of one fixed jaw and one movable jaw. Its one jaw is fixed to the side of the table while the other is movable by means of a screw and a handle.

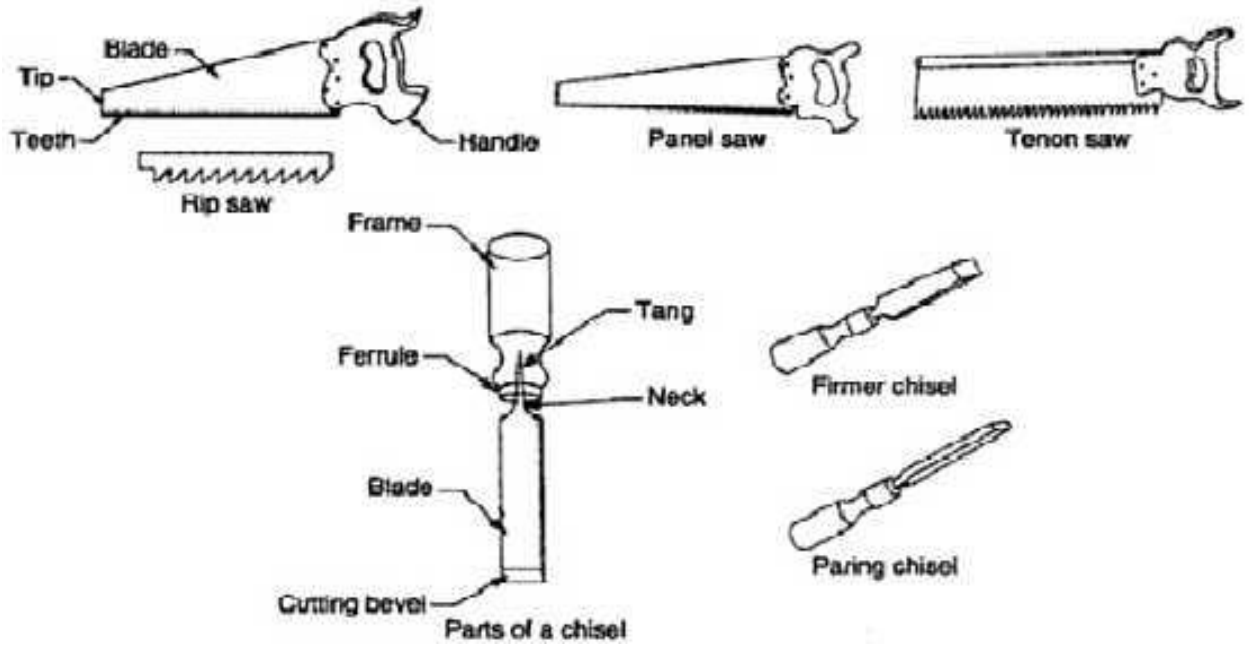
**Bar clamp**

The bar clamp (or) sash cramps are generally used in pairs in gluing up operations at the final assembly of joinery work. It is made up of a steel bar of T-section, wine malleable iron fittings and a steel screw.

**G-clamp**

G-clamp is made up of malleable iron with acme threads of high quality steel. It can be used for clamping small work when gluing up.

## Cutting Tools




### Saws

A saw is used to cut wood into pieces. There is different type of saws, designed to suit different purpose. A saw is specified by the length of its tooled edge. The following saws are used in the carpentry section.

### Rip Saw

The blade of rip saw is either straight or skew-backed. The teeth are so set that the cutting edge of this saw makes a steeper angle about $60^0$.

### Cross Cut saw

This is similar in shape of a rip saw. It is used to cut across the grain of the stock. The correct angle for cross cutting is $45^0$.The teeth are so set that the saw kerf is wider than the blade thickness. This allows the blade to move freely in the cut without sticking.

### Tenon or back saw

A tenon saw is used for fine and accurate work. It consists of a very fine blade, which is reinforced with a rigid steel back. The teeth are shaped like those of cross cut saw.

**Chisels**

Chisels are used for cutting and shaping wood accurately. Wood chisels are made in various blade widths, ranging from 3 to 50mm. Most of the wood chisels are made into tang type, having a steel shank which fits inside the handle.

**Firmer chisels**

These are general purpose chisels and are used either by hand pressure or by a mallet. The blade of a firmer chisel is flat and their sloping face is at an angle $15^0$ to $52^0$.

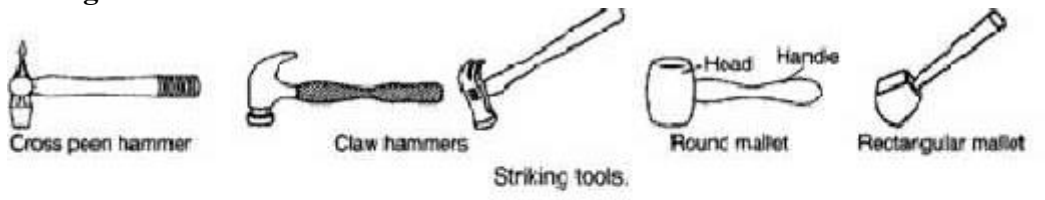
**Boring Tools**

Boring tools are used to make holes in wood. common types of boring tools are as follows.

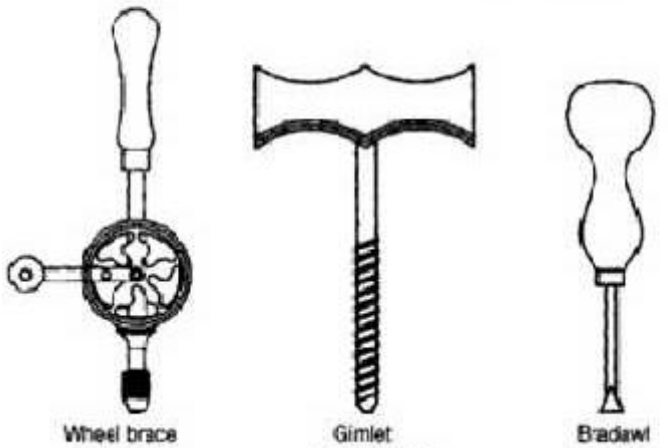
1. Bradawl
2. Gimlet
3. Brace
4. Bit and drill

A brace bolds and turns the bit and boring of a hole is obtained. A brace having two jaws is used for holing the bit in one end. It has two types, namely ratchet brace and wheel brace. A bradawl and a gimlet are used for boring small holes. These tools are hand operated.

**Striking Tools**



Striking tools.



Boring tools.

## EXPERIMENT NO: 01 AIM

**OF THE EXPERIMENT: -**

Cutting of slot, notch, mortise and Tenon.

**TOOLS AND EQUIPMENT REQUIRED: -**

| SL. NO | NAME OF THE ITEMS | SPECIFICATION | QUANTITY |
|---|---|---|---|
| 01 | Carpenter's Vice | 600mm | 01 |
| 02 | Steel Rule | 300mm | 01 |
| 03 | Jack Plane | 250mm | 01 |
| 04 | Try Square | 150mm | 01 |
| 05 | Marking Gauge | 150mm | 01 |
| 06 | Firmer Chisel | 25mm | 01 |
| 07 | Mortise Chisel | 6mm | 01 |
| 08 | Cross Cut Saw | 300mm | 01 |
| 09 | Tenon Saw | 250mm | 01 |
| 10 | Scriber | 150mm | 01 |
| 11 | Mallet | 0.25Kg | 01 |

**RAW MATERIAL REQUIRED: -**

| SL NO | NAME OF THE ITEMS | SPECIFICATION | QUANTITY |
|---|---|---|---|
| 01 | Wood Size | (50X50X250) mm | 01 |

**PROCEDURE:**

- The given raw material is checked to ensure its correct size.
- The material is firmly clamped in the carpenter's vice and one of its faces are planned by the jack plane and checked for straightness.
- The adjacent face is then planed and the faces are checked for squareness with the try square.
- Marking gauge is set and lines are drawn at 30 and 45mm to mark the thickness and width of the model respectively.
- The excess material is first chiseled out with the firmer chisel and then planned to correct size.
- The matching dimension of the part X and Y are then marked using the scale and marking gauge.

- Using the cross cut saw the portions to be removed in part Y (Tenon) is cut followed by chiseling.
- The material to be removed in Part X (Mortise) is carried out by using the mortise and firmer chisel.
- The part X and Y are separated by cross cutting with the Tenon saw.
- The ends of both the part are chiseled to exact length.
- Finish chiseling is done where ever needed so that the parts can be fitted to obtain a near tight joint.

**CONCLUSION: -**The mortise and Tenon joint is thus made by following the above sequence of operations.

## EXPERIMENT NO-02

### AIM OF THE EXPERIMENT:

To prepare a single Dove Tail joints

### TOOLS AND EQUIPMENT REQUIRED: -

| SL. NO | NAME OF THE ITEMS | SPECIFICATION | QUANTITY |
|---|---|---|---|
| 01 | Carpenter's Vice | 600mm | 01 |
| 02 | Steel Rule | 300mm | 01 |
| 03 | Jack Plane | 250mm | 01 |
| 04 | Try Square | 150mm | 01 |
| 05 | Marking Gauge | 150mm | 01 |
| 06 | Firmer Chisel | 25mm | 01 |
| 07 | Mortise Chisel | 6mm | 01 |
| 08 | Cross Cut Saw | 300mm | 01 |
| 09 | Tenon Saw | 250mm | 01 |
| 10 | Scriber | 150mm | 01 |
| 11 | Mallet | 0.25Kg | 01 |

### RAW MATERIAL REQUIRED: -

| SL NO | NAME OF THE ITEMS | SPECIFICATION | QUANTITY |
|---|---|---|---|
| **01** | Wood Size | (50X50X250)mm | 01 |

### PROCEDURE:

- The give raw material is checked to ensure its correct size.
- The material is firmly clamped in the carpenter's vice and any two adjacent faces are planned by the jack plane and checked for straightness.
- The adjacent face is then planed and the faces are checked for squareness with the try square.
- Marking gauge is set and lines are drawn at 30 and 45mm to mark the thickness and width of the model respectively.
- The excess material is first chiseled out with the firmer chisel and then planned to correct size.
- The matching dimension of the part X and Y are then marked using the scale and marking gauge.



- Using the cross cut saw the portions to be removed in part Y (Tenon) is cut

followed by chiseling.

- The part X and Y are separated by cross cutting with the Tenon saw.
- The ends of both the part are chiseled to exact length.
- A fine finishing is given to the parts if required so that proper fitting is obtained.
- The parts are fitted to obtain a slightly tight joint.

**CONCLUSION: -**The Single Dove Tail joint is thus made by following the above sequence of operations.

## WELDING

Welding is a material joining process which produces coalescence of materials by heating them to suitable temperatures with or without the application of pressure or by the application of pressure alone, and with or without the use of filler material. Welding is used for making permanent joints. It is used in the manufacture of automobile bodies, aircraft frames, tanks, furniture, boilers, general repair work and ship building. Welding is usually the most economical way to join components in terms of material usage and fabrication costs.

Types of welding: There are two major groups of welding.

• **Plastic Welding or Pressure Welding:** The piece of metal to be joined are heated to a plastic

state and forced together by external pressure like in the case of Resistance Welding.

• **Fusion Welding or Non-Pressure Welding:** The material at the joint is heated to a molten state and allowed to solidify like in the case of Electric Arc Welding and Gas Welding.

## ARC WELDING PROCESS

The process, in which an electric arc between an electrode and a work piece or between two electrodes is utilized to weld base metals, is called an arc welding process. The basic principle of arc welding is shown in figure. However, the basic elements involved in arc welding process are shown in figure. Most of these processes use some shielding gas while others employ coatings or fluxes to prevent the weld pool from the surrounding atmosphere.

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

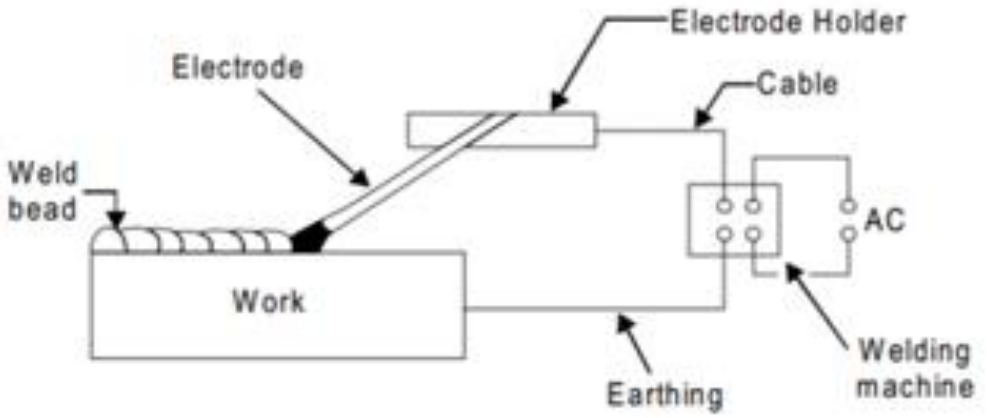



Fig1.The basic principle of arc welding

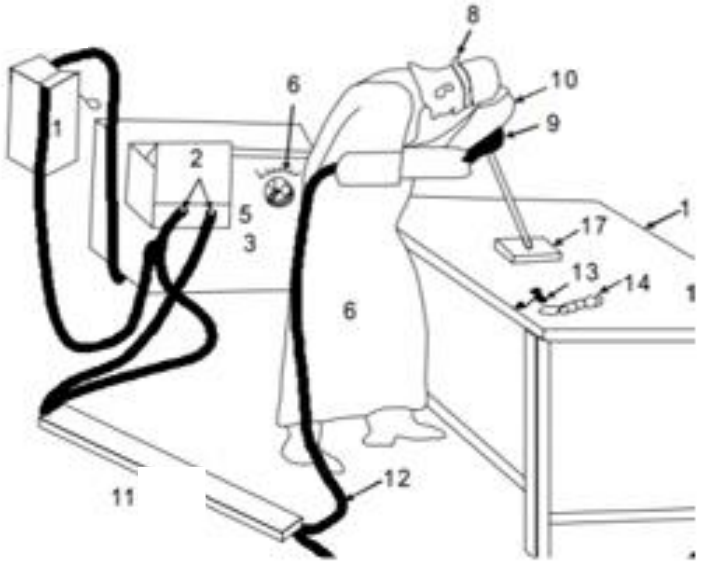



Fig2.The basic elements of arc welding

**Arc Welding Equipment**

Arc welding equipment, setup and related tools and accessories are shown in figures below. However, some common tools of arc welding are shown separately. Few of the important components of arc welding setup are described as under.

1. **Arc welding power source**

Both direct current (DC) and alternating current (AC) are used for electric arc welding, each having its particular applications. DC welding supply is usually obtained from generators driven by electric motor or if no electricity is available by internal combustion engines. For AC welding supply, transformers are predominantly used for almost all Arc-welding where main electricity supply is available. They have to step down the usual supply voltage (200-400 volts) to the normal open circuit welding voltage (50-90 volts). The following factors influence the selection of a power source:

a. Type of electrodes to be used and metals to be welded
b. Available power source (AC or DC)
c. Required output
d. Duty cycle
e. Efficiency
f. Initial costs and running costs
g. Available floor space
h. Versatility of equipment

2. **Welding cables**

   Welding cables are required for conduction of current from the power source through the electrode holder, the arc, the work piece and back to the welding power source. These are insulated copper or aluminum cables.

3. **Electrode holder**

   Electrode holder is used for holding the electrode manually and conducting current to it. These are usually matched to the size of the lead, which in turn matched to the amperage output of the arc welder. Electrodes are available in sizes that range from 150 to 500 Amps.

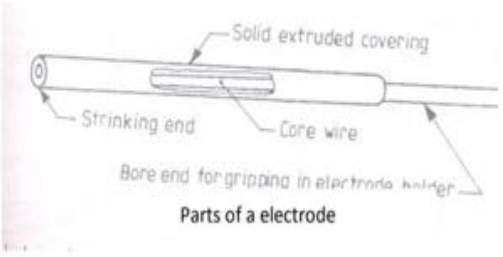
Electrode Holder

## 4. Welding Electrodes

An electrode is a piece of wire or rod of a metal or alloy, with or without coatings. An arc is set up between electrode and work piece. Welding electrodes are classified into following types:

I. Consumable electrodes
   a. Bare electrodes
   b. Coated electrodes

II. Non-consumable electrodes
   a. Carbon or Graphite electrodes
   b. Tungsten electrodes



Parts of a electrode

Consumable electrode is made of different metals and their alloys. The end of this electrode starts melting when arc is struck between the electrode and work piece. Thus, consumable electrode itself acts as a filler metal. Bare electrodes consist of a metal or alloy wire without any flux coating on them. Coated electrodes have flux coating which starts melting as soon as an electric arc is struck. This coating on melting performs many functions like prevention of joint from atmospheric contamination, arc stabilizers etc.

Non-consumable electrodes are made up of high melting point materials like carbon, pure tungsten or alloy tungsten etc. These electrodes do not melt away during welding. But practically, the electrode length goes on decreasing with the passage of time, because of oxidation and vaporization of electrode material during welding. The materials of non-consumable electrodes are usually copper coated carbon or graphite, pure tungsten, throated or zirconated tungsten.

5. **Hand screen**

   Hand screen used for protection of eyes and supervision of weld bead.

6. **Chipping hammer**

   Chipping hammer is used to remove the slag by striking.

7. **Wire brush**

   Wire brush is used to clean the surface to be weld.

8. **Protective clothing**


Operator wears the protective clothing such as apron to keep away the exposure of direct heat to the body.

**Safety recommendations for ARC welding**

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

i. The body or the frame of the welding machine shall be efficiently earthed. Pipe lines containing gases or inflammable liquids or conduits carrying electrical conductors shall not be used for a ground return circuit. All earth connections shall be mechanically strong and electrically adequate for the required current.

ii. Welding arc in addition to being very is a source of infra-red and ultra-violet light also, consequently the operator must use either helmet or a hand shield fitted with a special filter glass to protect eyes.

iii. Excess ultraviolet light can cause an effect similar to sunburn on the skin of the welder.

iv. The welder's body and clothing are protected from radiation and burns caused by sparks and flying globules of molten metal with help of the following:

- Gloves to protect hands of a welder
- Goggles to protect eyes while welding.
- Leather or asbestos apron is very useful to protect welder's clothes and his trunk and thighs while seated and doing welding.
- For overhead welding, some form of protection for the head is required.
- Leather skull cap or peaked cap should be used.
- Leather jackets and leather pants are also available as clothes for body protection
- Welding equipment shall be inspected periodically and maintained in safe working order at all times.
- Arc welding machines should be of suitable quality.
- All parts of welding set shall be suitably enclosed and protected to meet the usual service conditions.

**GAS WELDING**

A fusion welding process which joins metals, using the heat of combustion of an oxygen /air and fuel gas (i.e. acetylene, hydrogen propane or butane) mixture is usually referred as 'gas welding'. The intense heat (flame) thus produced melts and fuses together the edges of the parts to be welded, generally with the addition of a filler metal. Details of Gas welding equipment

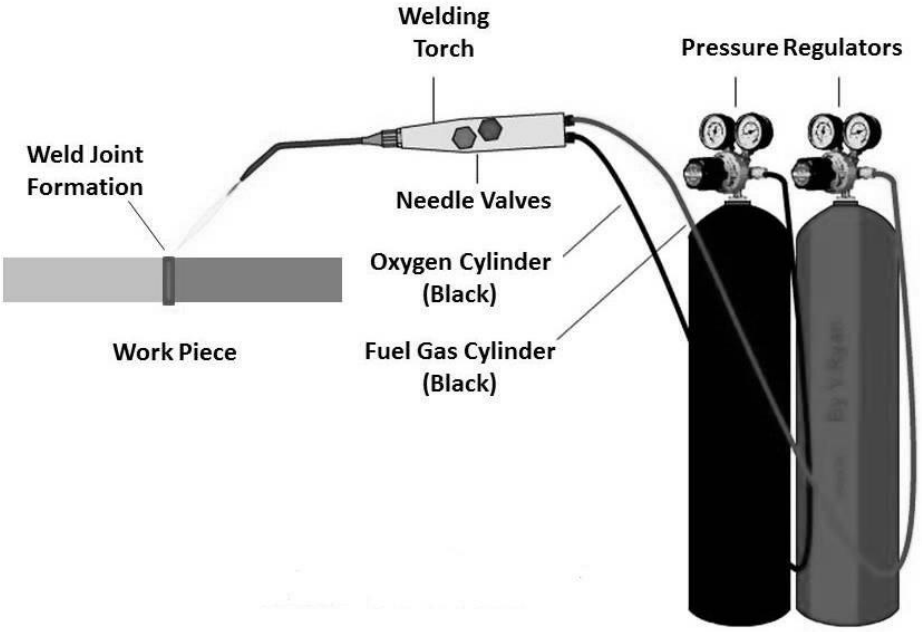



Fig.1 Gas Welding Setup

**Welding torch**

The torch is the tool that the welder holds and manipulates to make the weld. It has a connection and valve for the fuel gas and a connection and valve for the oxygen, a handle for the welder to grasp, and a mixing chamber (set at an angle) where the fuel gas and oxygen mix, with a tip where the flame forms.

Fig.2 Welding torch

**Welding pins**

Weld pins are designed with a long narrow shaft that is spot welded to a metal surface, primarily
to fasten duct liner to metal ductwork, or other materials onto metal surfaces.

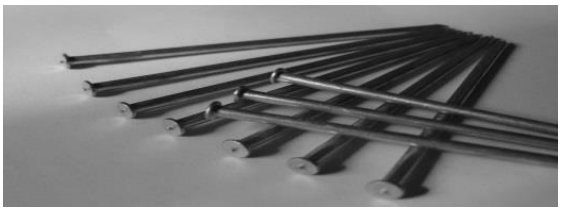


Fig.3 Gas Welding pins

**Pressure regulator**

A pressure regulator is a control valve that reduces the input pressure of a fluid to a desired value
at its output. Regulators are used for gases and liquids, and can be an integral device with an output
pressure setting.

Fig.4 Pressure Regulator

**Oxygen acetylene cylinder**

Acetylene gas is commonly used for gas welding because of its simplicity in production and
transportation and its ability to achieve high temperature in combustion (e.g. around 5,000o F).

**Spark lighter**

A spark lighter is a tool used to ignite flammable gas appliances such as Bunsen burners, welding
torches, and gas grills. A spark lighter produces a spark having sufficient heat to ignite flammable
gas vapor.


Fig.5 Oxygen Acetylene Cylinder

Fig.6 Spark lighter

## EXPERIMENT NO- 01

**AIM OF THE EXPERIMENT:**

**To prepare a Butt Joint through Arc welding.**

**APPARATUS REQUIRED:**

| SL NO. | NAME OF THE APPARATUS | SPECIFICATION | QUANTITY |
|---|---|---|---|
| 01 | Rough File | 300mm | 01 |
| 02 | Arc welding Machine | 350 amperes | 01 |
| 03 | Electrode Holder | 300 amp/800 amp | 01 |
| 04 | Ground Clamp | 100 mm | 01 |
| 05 | Tongs | 300 mm | 01 |
| 06 | Welding Hand Screen | (108 x 82) mm | 01 |
| 07 | Hammer | Chipping Type | 01 |
| 08 | Apron | Lather | 01 |
| 09 | Gloves | lather | 01 pair |

**RAW MATERIAL REQUIRED:**

Two number of M.S Flat with dimension (80x40x6) mm.

**PROCEDURE:**

- The given M.S Flats are thoroughly cleaned.
- The two pieces of M.S Flat positioned on the welding table (as shown in figure) such that they are separated slightly for better weld joints and well penetration of the weld.
- Then electrode is fitted in the electrode holder and the welding current is to be set with proper value according to the requirement.
- Before welding operation some precaution has to be taken. These are wearing apron, using hand gloves and hand screen.
- The welding process is done with proper selection of welding parameters accelerating voltage, welding current, welding speed) on the welding machine.
- Then welding is done by the help of electrode holder with filler metals, then arc is created by the contact with electrode and work piece.

- During the process of welding the electrode is kept at 15 to 25-degree angle from vertical and the direction of welding respectively.
- After welding operation is completed the scale formation on the welding zone is removed by the help of chipping hammer.

**CONCLUSION:**

The Butt Joint is thus made using above procedure.

## EXPERIMENT NO- 02

**AIM OF THE EXPERIEMENT:**

**To prepare a Lap Joint through Gas welding**

**APPARATUS REQUIRED:**

| SL NO. | NAME OF THE APPARATUS | SPECIFICATION | QUANTITY |
|---|---|---|---|
| 01 | Oxygen cylinder | 7 $m^3$/120-150 $Kg/cm^2$ | 01 |
| 02 | Acetylene Cylinder | 6 $m^3$/15-16 $Kg/cm^2$ | 01 |
| 03 | Hand Screen | (108 x 82) mm | 01 |
| 04 | Hammer(Chipping) | 200 gm | 01 |
| 05 | Tongs | 300 mm | 02 |

**RAW MATERIAL REQUIRED:**

Two number of M.S Flat with dimension (75x40x6) mm.

**PROCEDURE:**

- The given M.S Flats are thoroughly cleaned.
- Before welding operation some precaution has to be taken. These are wearing apron using hand gloves, hand screen and Goggles.
- Oxygen and acetylene are supplied through the different cylinder. Oxygen cylinder is painted in Black color and acetylene cylinder is Marked in Maroon color
- The work pieces are positioned (as shown in figure) on the welding table form a lap joint with the required overlapping.
- Then welding flame is required to fuse the metal by combination of acetylene and oxygen with proper value. Acetylene and oxygen are mixed together.
- The alignment of the lap joint is checked and the tack-welded pieces are reset if required.

**CONCLUSION:**

The Lap Joint is thus made using above procedure.

## EXPERIMENT NO- 03

**AIM OF THE EXPERIEMENT:**

**Joining two non-ferrous parts through TIG /MIG.**

**APPARATUS REQUIRED:**

| SL NO. | NAME OF THE APPARATUS | SPECIFICATION | QUANTITY |
|---|---|---|---|
| 01 | MIG welding Transformer | 50-80 amp | 01 |
| 02 | $CO_2$ cylinder | 7 $m^3$ | 01 |
| 03 | Hand screen | (180 x 80) mm | 01 |
| 04 | Hammer(Chipping) | Chipping type | 01 |
| 05 | Tongs | 300 mm | 02 |

**RAW MATERIAL REQUIRED:**

Two number of Aluminum Plates with dimension (75x40x6) mm.

**PROCEDURE:**

- The given Aluminum Plates are thoroughly cleaned.
- Before welding operation some precautions has to be taken. These are Wearing apron, using hand gloves, hand screen and Goggles.
- The work pieces are positioned (as shown in figure) on the welding table to form proper joining.
- The alignment of the weld joint is properly checked.
- The welding operations are performed by using D.C with reverse polarity (Electrode +ve and Work piece -ve).
- A control unit is required which objective is to supply the power, wire drive, movement of the Gun and regulates the gas supply.
- This welding process uses consumable electrode which is fitted through the electrode holder into the arc and the same speed of the electrode is maintained in the welding process.
- A small adjustable speed motor is used to remove wire from a spool and feed it into the arc.

- In some cases, various shielding gases ($CO_2$, He, Ar) for welding various types of carbon sheet.
- In this case the metal transfer occurs by heating both the consumable filler electrode and the work piece so that proper joining of aluminum plate takes place.

**CONCLUSION:**

By using TIG or MIG, we can join two non-ferrous parts.