

**DEPARTMENT  
OF  
MECHANICAL ENGINEERING**



**LAB MANUAL  
WORKSHOP PRACTICE LAB  
ES-164**

**DR. AKHILESH DAS GUPTA INSTITUTE OF TECHNOLOGY  
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**GURU GOBIND SINGH INDRAPRASTHA UNIVERSITY,  
NEW DELHI**

### **Vision of Institute**

To produce globally competent and socially responsible technocrats and entrepreneurs who can develop innovative solutions to meet the challenges of 21<sup>st</sup> century.

### **Mission of Institute**

- M1.** To Provide Value-Based Education through Multi Grade Teaching Methodologies and Modern Education Facilities.
- M2.** To Sustain an Active Partnership Program with Industry and Other Academic Institutes with an Aim to Promote Knowledge and Resource Sharing.
- M3.** To Conduct Value-Added Training Programme to Enhance Employability.
- M4.** To Provide a Conducive Environment for Development of Ethical and Socially Responsible Technocrats, Managers and Entrepreneurs.

### **Vision of Department**

To produce competent mechanical engineers having distinct employability skills, involving innovative ideas to fulfill societal needs.

### **Mission of Department**

- M1.** To provide resourceful education through training and skill upgradation.
- M2.** To inspire the young dynamic minds towards innovation and research to meet the societal needs and responsibilities.
- M3.** To strengthen the industry-academia interface for better employability.

### **Program Educational Objectives (PEOs)**

- PEO1.** Graduates shall excel in their career through participation in multidisciplinary fields.
- PEO2.** Graduates shall develop cost effective innovative technologies and methodologies to solve engineering problems and contribute to sustainable development.
- PEO3.** Graduates shall have a successful career in academia, industries or as an entrepreneur to serve societal needs.

#### Do's & Don'ts

1. Always listen carefully to the teacher and follow instructions.
2. Do not run and rush in practical work.
3. Don't talk aloud or crack jokes in Lab.
4. Know the location of power ON/OFF switch of the Lab.
6. Wear good strong shoes.
6. Bags should be stored away, during practical sessions.
7. Use proper safety devices while using machines.
8. Keep hands, hairs and clothing's away from moving parts of machinery.
6. Use hand tools carefully, keeping both hands behind the cutting edge.
10. Report any damage / faults to machines/equipment to Lab Incharge.
11. Keep your workbench tidy.
12. Never distract another student.
13. Do not eat, drink and chew gum in the lab.
14. On completion of practical work return the tools.

#### Course Outcomes

<b>Course Objectives:</b>	
<b>1</b>	The students will learn basics of safety precautions to be taken in lab. / workshop
<b>2</b>	The students will have an overview of different machines used in workshop and the operations performed on these machines.
<b>3</b>	The students will have understanding of various welding processes
<b>4</b>	The students will have understanding of sheet metal shop and fitting shop

<b>Course Outcomes (CO):</b>	
CO1	Ability to safely work in a Lab./Workshop.
CO2	Ability to use machines (lathe, mill, shaper, planer, grinder, drill)
CO3	Ability to Weld.
CO4	Ability to use sheet metal tools and fitting shop tools

### **Safety Precautions**

When operator enters into the workshop, he should first observe safety to save himself/herself and others.

### **I. Precautions in Machine shop**

- i) Do not lean against any machine, it is very dangerous.
- ii) Do not work on a machine in Dim light.
- iii) Never switch on a machine unless or otherwise you know all mechanism and operation of machine.
- iv) When using any grinding parts, protect the eyes by wearing goggles or using shields.
- v) Do not clean metal chips by hand, use wire brush for cleaning.
- vi) Be in a habit of cleaning the machine, equipment and tools regularly.

### **II. Precautions in workshop**

- i) Keep the Workshop neat and tidy. Avoid tipping over things and trying over gangways.
- ii) Do not run in the workshop. Walk carefully.
- iii) See that the floor is free from slippery substances.
- vi) Keep pathways clean and clear.
- v) Everything should be in place and throw waste material into the dustbin.
- vi) Workshop should have proper lighting and ventilation.

### **II (a) Precautions while using hammer**

- i) There should be no grease or oil on the handle.
- ii) Hammer head should not be projecting outward.
- iii) Handle should not be too long or too short.

### **(b) Precautions while using chisel**

- i) It should be handled carefully and must be grounded.
- ii) Goggle must be used while chipping.

### **(c) Precautions while using file**

- i) The finger of left hand must not be crooked under file as this may injure the fingers.
- ii) Metal chips must not be removed while doing job by bare hands, brush is to be used.

iii) Files without handles or those with crook must not be used.

#### **(D)Precautions during welding**

- i) Acetylene or oxygen cylinder must be kept separately.
- ii) Do not weld in continued space without adequate ventilation.
- iii) We should always use goggles while welding.
- iv) Make sure that connections are airtight by using soap water.
- v) Never use matches for lighting while welding. .
- vi) When welding is to be stopped, close the cylinders and release gas pressure.
- vii) Do not touch the electrode or the work circuit.
- viii) Always wear gloves without holes
- ix) Wear eye protection at all times during welding.

#### **(E)Precautions on clothing**

- i) Tight fitting coats are safer than loose fitting coats.
- ii) Avoid wearing rings, long sleeved shirts and watches while working.
- iii) Clear covered footwear having thick soles and tough above.
- iv) Hair must be tied up properly.

## Maintenance

Maintenance processes and maintenance programs are the foundation of business productivity and reliability. Thus, many types of maintenance coexist in order to provide manufacturers with opportunities to optimize their production. Each company defines its industrial maintenance needs and implements a planning strategy. The main types of industrial maintenance are:

- **Corrective maintenance**
- **Preventive maintenance**
- **Predictive maintenance**
- **Systematic preventive maintenance**
- **Conditional preventive maintenance**

**Corrective maintenance:** As its name implies, corrective maintenance is carried out to correct deterioration and malfunctions of any equipment or production line as soon as they occur. If the failure that disrupts the production process has not been anticipated by other types of maintenance, such as preventive maintenance, industrial maintenance technician's deal with the problem as soon as it occurs. This is unplanned /unscheduled preventive maintenance or curative maintenance. This type of intervention can be costly for companies. To limit this repair cost, manufacturers opt for the so-called palliative corrective maintenance, which consists in repairing and fixing the problem at a lower cost and more quickly.

**Preventive maintenance:** This type of maintenance is performed by the technicians in charge of industrial maintenance before any failure or malfunction occurs. It concerns spare parts, components and machinery and equipment in order to reduce the risk of failure. The digitalization of industrial companies has provided many computerized and technological solutions that allow technicians to perform, monitor, keep track and plan preventive maintenance effectively.

**Predictive maintenance:** The emergence of data processing and analysis solutions, as well as artificial intelligence, has enabled manufacturers to plan predictive maintenance based on the prediction of failures and malfunctions. This type of industrial maintenance allows companies to anticipate problems by planning the necessary interventions and maintenance operations based on predictions. It thus makes it possible to limit the expenses caused by unexpected breakdowns, equipment downtime and production disruption.

**Systematic preventive maintenance:** is therefore based on regular inspection of the various equipment, enabling maintenance technicians to collect the necessary information on the various components of the production line and to effectively prevent breakdowns and repair costs.

**Conditional preventive maintenance:** Conditional preventive maintenance consists of monitoring the key parameters and indicators of the property's operation and implementing the necessary corrective actions to anticipate any failure or malfunction. Many emergent computer tools are available to automate

this type of industrial maintenance. Thus, technicians and maintenance workers can simplify and facilitate their work by opting for the digitalization of industrial maintenance processes.



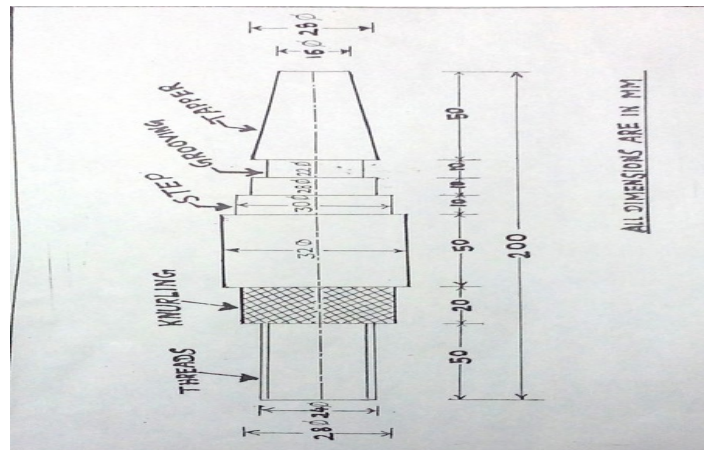
S.No.	Experiments Description	CO's	Experiment date	Page No.		Remarks / Signature
				From	To	
1	To Perform Job Involving Turning (Step & Taper), Knurling and Grooving Practices on Lathe Machine.	CO2		10	12	
2	To prepare V-Groove Preparation on the Shaper.	CO2		13	14	
3	To study Arc and Gas Welding tools and Equipments.	CO3		15	20	
4	To prepare lap joint, T joint and butt joint in welding shop.	CO3		21	22	
5	To Study different types of flames in Oxy- Acetylene Welding.	CO3		23	25	
6	To study tools used in Sheet Metal shop.	CO4		26	30	
7	To make a rectangular tray using sheet metal tools.	CO4		31	32	
8	To study the tools and equipment in fitting shop.	CO4		33	38	
9	To make V- section and T slot in fitting shop.	CO4		39	40	
<b>Beyond Syllabus</b>						
1.	To prepare mould and casting in foundry shop.			41	42	
2.	To make a half lap T joint in carpentry shop.			43	44	

## Experiment No: 01

1.1 Objective 1.2 Material Required 1.3 Tools/Equipment Required 1.4 Procedure 1.6 Result 1.6 Precautions 1.7 Post requisite

**1.1 OBJECTIVE:** To Perform Job Involving Turning (Step & Taper), Knurling and Grooving Practices on Lathe Machine.

**1.2 MATERIAL REQUIRED:** Mild Steel round bar (200mm)



**Fig: 01 Machined Part on Lathe**

**1.3 TOOLS/ EQUIPMENT REQUIRED:-**

- (1) Centre Lathe machine
- (2) Right hand side cutting tool
- (3) V shape cutting tool
- (4) Knurling and Grooving tool
- (5) Tool post spanner
- (6) Steel rule
- (7) Outside Calliper
- (8) Surface gauge and Vernier calliper, etc.

**1.4 PROCEDURE:**

- Hold the mild steel job properly in the chuck on lathe machine.
- Check the position of the job, it should be in the centre of chuck with the help of surface gauge.
- Check all the levers, etc. they should be unengaged before starting the machine.

- After switching on the machine, see visually the approximate centre of the job. It should not revolve in elliptical position.
- Switch of the machine & mount the tool bit in the tool post in proper position. It should be well tightened and tip of the tool bit should coincide with the centre of the job.
- Tilt the position of the tool post in such a manner that the tip of the tool bit come about 30-40 degree with the job.
- Then feed the tool post towards the job with the help of cross slide till the tip of the tool bit reach at centre of job. This process of metal removing is known as facing.
- After facing, tilt back the tool post to its previous position so that the tip of the tool bit come at right angle position with the job. Now feed will be given with the help of carriage. This metal removing process from the surface of job is known as plain turning & when a workpiece having different diameters is turned, the surface forming the step from one diameter to other is called step turning.
- Fix the carriage into the position. Now tilt the compound rest to desired angle. And feed the tool into the job with the help of cross slide and compound rest feed handle.

Angle of taper can be calculated as:

$$\tan a = D-d / 2L$$

Where, D = Large Diameter

D = Small Diameter

L = Length of tapered

- For grooving operation, fix the grooving tool on the tool post. Feed the tool into the revolving job with the help of carriage and cross slide to get grooving of required dimensions as shown in figure.
- After grooving engage back gear and reduce the speed of spindle and replace the grooving tool bit with knurling tool bit and press it over the surface to be knurled.
- For threading, engage the feed rod lever and suitable gears in proper way etc. Now threading tool will be moved with the help of half nut lever.

**1.6 RESULT:** -The various machining operations had performed on Lathe Machine

**1.6 PRECAUTIONS:-**

- (1) Know the basics of operational mechanism very well before operating lathe machine.
- (2) Do not wear loose clothes.

- (3) Adopt always right tool and right mechanism.
- (4) Always check that all gears and levers should be engaged or in ideal position before switching on the machine.
- (5) Make sure that the job and tool bit are mounted well in proper position and tightened enough before starting the machine.
- (6) Use proper feed to the tool bit along with appropriate speed.
- (7) Never use outside calliper/ steel rule/ Vernier calliper, etc. in running condition.
- (8) Threading and Knurling should be done on minimum speed along with sufficient cutting fluid / coolant, etc.
- (9) If you are feeling any abnormality in sound etc. of the machine, switch off the machine and inform the shop in-charge immediately.

### **1.7 viva- voce**

**Q1.** What is taper turning?

**Q2.** Explain knurling?

**Q3.** What is grooving?

**Q4.** Explain the applications of lathe?

**Q 6.** Explain drilling operation on lathe?

**Q6.** Explain thread cutting operation?

## EXPERIMENT NO: 2

2.1 Objective 2.2 Materials required 2.3 Tools required 2.4 Procedure 2.5 Result 2.6 Precautions 2.7 viva- voce

**2.1 Objective:** V-Groove Preparation on the Shaper

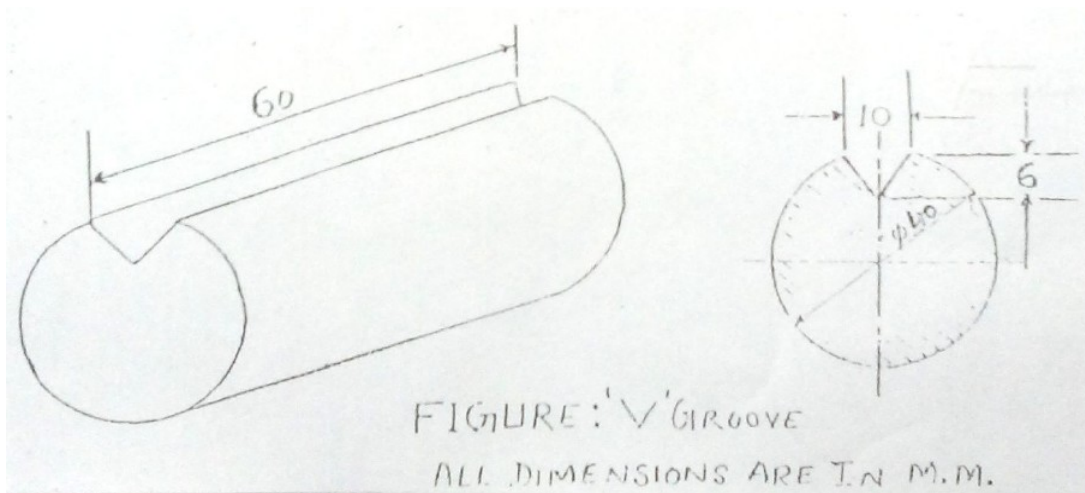
**2.2 Materials required:** Mild Steel round bar (60mm x 40mm)

**2.3 Tools required:**

- (1) Shaper machine
- (2) V shape cutting tool
- (3) Spanner set
- (4) Surface plate and scribe
- (5) Hammer and centre punch

**2.4 Procedure:**

- Clamp the work piece in the vice & tight it properly.
- Then adjust the stroke of the ram, adjustment of the stroke is made such that the tool cross the job completely & after that 10-16 mm of clearance should be provided.
- Then give the feed to the tool & feed should be given nominal.



**2.5 Result:** The required V-Groove has been prepared on the shaper.

## **2.6 Precautions:**

- (1) The job should be clamped tightly in the vice.
- (2) Stroke should be adjusted properly.
- (3) Don't stand in front of the ram while running.
- (4) Tool should be tightly fixed.
- (5) Depth of cut should be minimum.
- (6) Coolant should be supplied continuously during the cutting operation.

## **2.7 Pre requisite:**

**Q1.** What is shaper tool?

**Q2.** What are the applications of shaper?

**Q3.** Which type of cutting tool is used in shaper?

**Q4.** Explain the quick return mechanism?

**Q6.** Why return stroke is idle?

**Q6.** What is the difference between plainer and shaper?

## Experiment No: 3

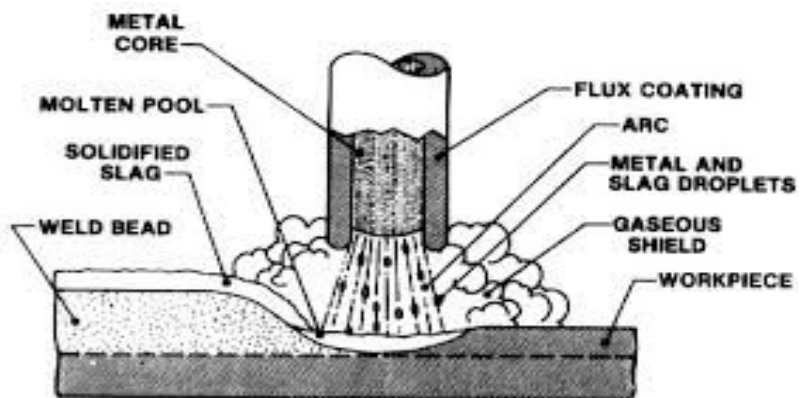
### 3.1 Objective 3.2 Tools and Equipments used in welding 3.3 viva-voce

**3.1 Objective:-** To study Arc and Gas Welding Tools and Equipment.

#### 3.2 Tools and Equipment used in welding:

**Welding:-** Welding is a process of joining two similar or dissimilar metal by bringing the junction of to fusing point by the use of intense heat with or without the application of pressure and with or without addition of filler materials.

**Electric arc welding:-** Electric arc welding is the process by which welding is done by producing heat from an electric arc, between the work and electrode. Heat generated in an arc welding is in the range of 36000C to 60000 C. Both AC as well as DC is used in producing an arc each having its particular application.



#### ARC WELDING PROCESS

**ARC welding equipment:-** Both alternating current AC and DC are used for arc welding. When DC arc to be employed the current is generated by a DC generator. This generator can be given by means of an electric motor or by means of a petrol or diesel engine. For AC arc welding a step down transformer is used which receives current from the supply main at 400-440 volts and transforms it to the required voltage for welding i.e. 80-100 volts.



**Fig :AC welding transformer (air cooled)**

### **Arc welding equipments:**

- (1) Face shield/Hand screen: - When arc is produced around the job infrared rays and ultraviolet rays are produced. To protect the face and eyes from these dangerous rays a shield is necessary. The body of a shield is made of fiber glass and colored glasses arc used to see the arc.
- (2) Hand gloves apron and leather shoes: - The hand gloves apron and leather shoes are used to protect hand. Cloths and foot. While welding. These are made of lather or asbestos material.
- (3) Cables or Leads:-These leads are made up of copper or aluminium wire. The wire is insulated with rubber and clothes fibre. A heavy insulation is necessary for these cables.
- (4) Electrode holder: - It is connected to electrode lead and is used to hold the metallic electrode during metal is welding. It should be light in weight, balanced insulated except jaws, heat resistant and easy to receive and eject the electrode.
- (5) Cleaning tools: - Chipping hammer and wire brushes are used to clean the weld area & to remove the slag and spatter. The chipping hammer is generally double ended.
- (6) Chipping goggles: - This is wearied to protect eyes from slag during chipping process.
- (7) Tong: - It is made of forge steel and is used to hold the work piece.
- (8) Electrode: - Electrodes are of two types.
  - a) Coated electrodes:- Coated electrodes are generally applied in arc welding processes. Metallic core is coated with some suitable material. The material used for core are mild steel nickel steel chromium molybdenum steel etc. one end of the coated core is kept bare for holding.
  - b) Bare electrode: - Bare electrode produce the welding of poor quality. These are cheaper than coated electrodes. These are generally used in modern welding process like MIG welding.



- (9) Fire extinguishers: - Fire extinguishers are used to prevent the fire that may break out by chance. Sand filled buckets and closed cylinders are kept ready to meet such accidents.



**Fig ; Face Screen**



**Fig; Electrode**



**Fig: Chipping Hammer**



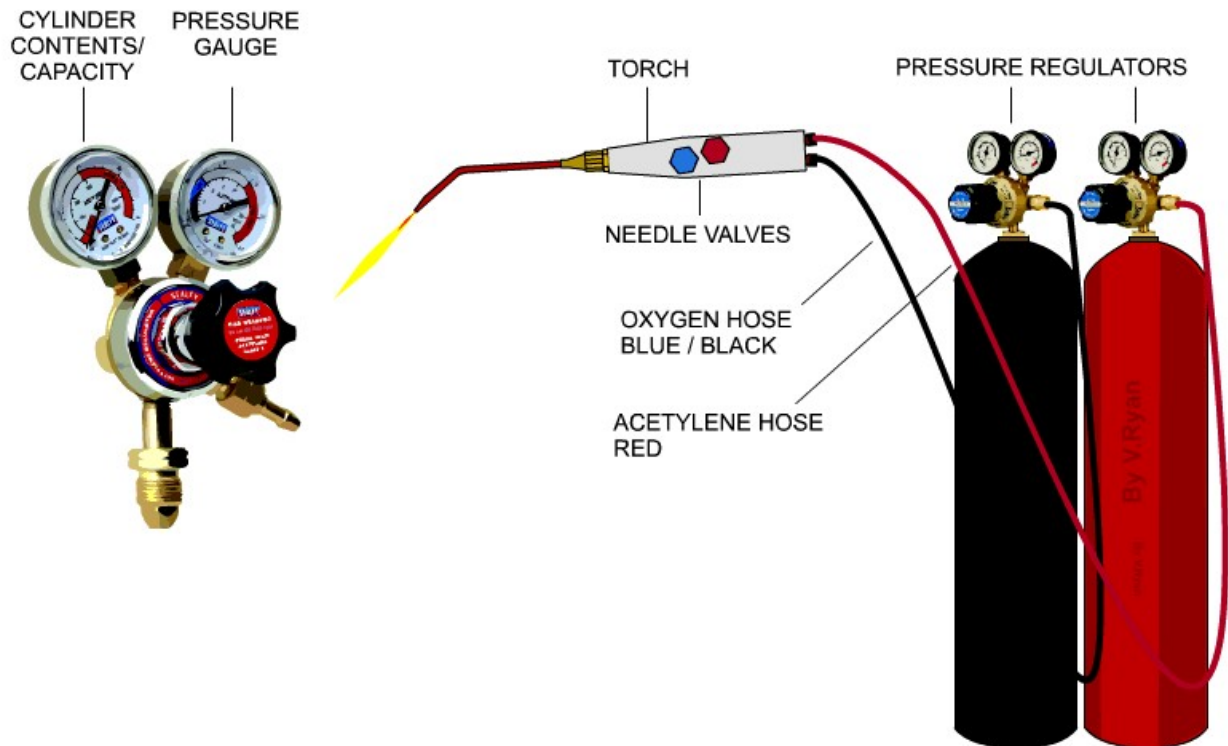
**Fig: Gloves**



**Fig: Tong**



**Steel Rule**



**Fig: GAS WELDING EQUIPMENT**

## **PRINCIPLE OF OXY-ACETYLENE WELDING**

A very hot flame is produced by burning of the gases coming through the torch tip. The edges to be welded are heated up to melting point. A filler metal is also added to complete the welding. This molten metal mixture when solidifies on cooling form a welded joint.

### **Gas welding equipments and tools:**

**1. Oxygen cylinder:** Cylinder is made up steel in capacity range 6.3m<sup>3</sup> to 7 m<sup>3</sup>. The cylinder is filled with oxygen at about 126 to 140 kg/cm<sup>2</sup> at 21°C. a safety valve is also provided on it. The cylinder

can be opened or closed by a wheel which operates a valve. A protector cap is provided on the top of the cylinder to safe guard the valve.

**2. Acetylene cylinder:** Cylinder is made up steel. Gas is filled at a pressure of 16-20 kg/cm<sup>2</sup>.

Capacity of cylinder is about 4m<sup>3</sup> to 6m<sup>3</sup>.regulator valve and safety valve is mounted on cylinder. Safety plugs are also provided on the cylinder, when acetylene is filled into the cylinder then it is dissolve in the acetone.

**3. Regulator:** regulator is used to control the flow at gases from high pressure cylinder .A simple type of regulator is as below.

**4. Torch/Blow pipe:** Torch is a device used to mix acetylene and oxygen in the correct proportion and the mixture flows to the tip the torch.

There are two types of torches: Low pressure or injector torches and Medium pressure or equal pressure torches.

**APPLICATION:** All the metal can be welded with proper filler metals. Some equipment may be used for cutting purposes. Oxyacetylene welding is particularly used for sheet metal work

### **3.3 viva-voce:**

Q.1.What is welding?

Q.2.Name the various types of welding?

Q.3 Discuss about various types of flames used in gas welding?

Q.4 Name the supply of source for arc welding?

Q.6 Name different types of joints made by you in welding?

Q.6.What do you mean by electrodes?

Q.7.What is meant by “preparation of work”, which is carried out before welding?

## Experiment No: 04

4.1 Objective 4.2 Equipments 4.3 Tools used 4.4 Procedure 4.5 diagram 4.6 Result 4.7 Precaution 4.8 viva-voce

**4.1 Objective:** To prepare lap joint, T joint and butt joint in welding shop.

**4.2 Equipments:** A.C. Welding set Air/ Oil cooled transformer.

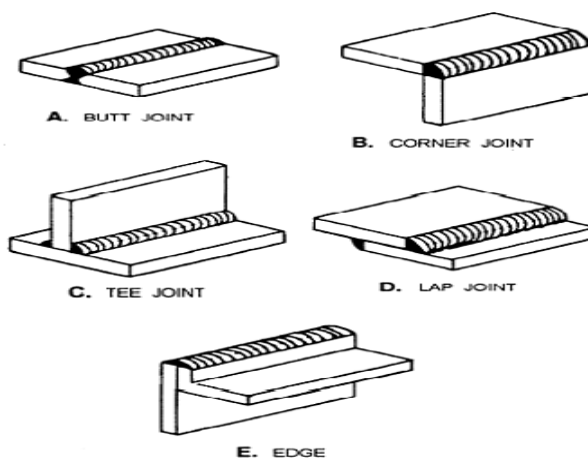
**4.3 Tools used:** (i) Electrode holder, Earthing clamp, Hand screen, Hand gloves, Apron Leather shoes, wire brush, Tongs, chipping hammer, welding goggles Welding table etc.

**Material required:** Two pieces of MS of given size, electrode and current.

### 4.4 Procedure:

- Cut the work piece according to the given dimensions (60mm x 60mm).
- Prepare the work pieces for welding.
- Start the welding machine and set the current as required (60 to 120 Amp).
- Connect Earthing clamp to the base plate and keep the job on the base plate.
- Put electrode in the electrode holder.
- Place the work piece together on the welding table.
- First mark two tag on the both ends of the work piece so that the pieces may not shift while welding.
- Weld the pieces together from top to bottom.
- Complete the weld with finishing run.
- Chip of the slag by chipping hammer and clean the joint by wire brush.

### 4.5 Diagram:



## **Fig.4.5 Different types of Welding Joints**

**4.6 Result:** A proper lap joint, T joint and Butt joint has been made.

### **4.7 Precautions:**

1. Never look at the arc by naked eyes .Use face screen /goggles.
2. Always wear the safety hand gloves, apron& leather shoes.
3. Never chip slag while it is hot, without wearing chipping goggles.
4. Avoid use of damaged tools.
5. Always use tong for holding the heated job.

### **4.8 viva-voce**

Q.1What are the areas in which welding is employed?

Q.2 What do you mean by Arc welding?

Q.3 Name any the three basic joints?

Q.4 Name the material used for coating the electrodes?

Q.6 How the size of an electrode is designated?

Q.6 What are the methods of starting or striking an arc?

## Experiment No: 5

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5.1 Objective 5.2 Apparatus required 5.3 PROCEDURE 5.4 Type of Flames with diagram  
5.5 Precaution 5.6 Pre-Requisite 5.7 Post- Requisite

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**5.1 OBJECT:** To make different types of flames in oxy- acetylene welding.

### 5.2 APPARATUS REQUIRED

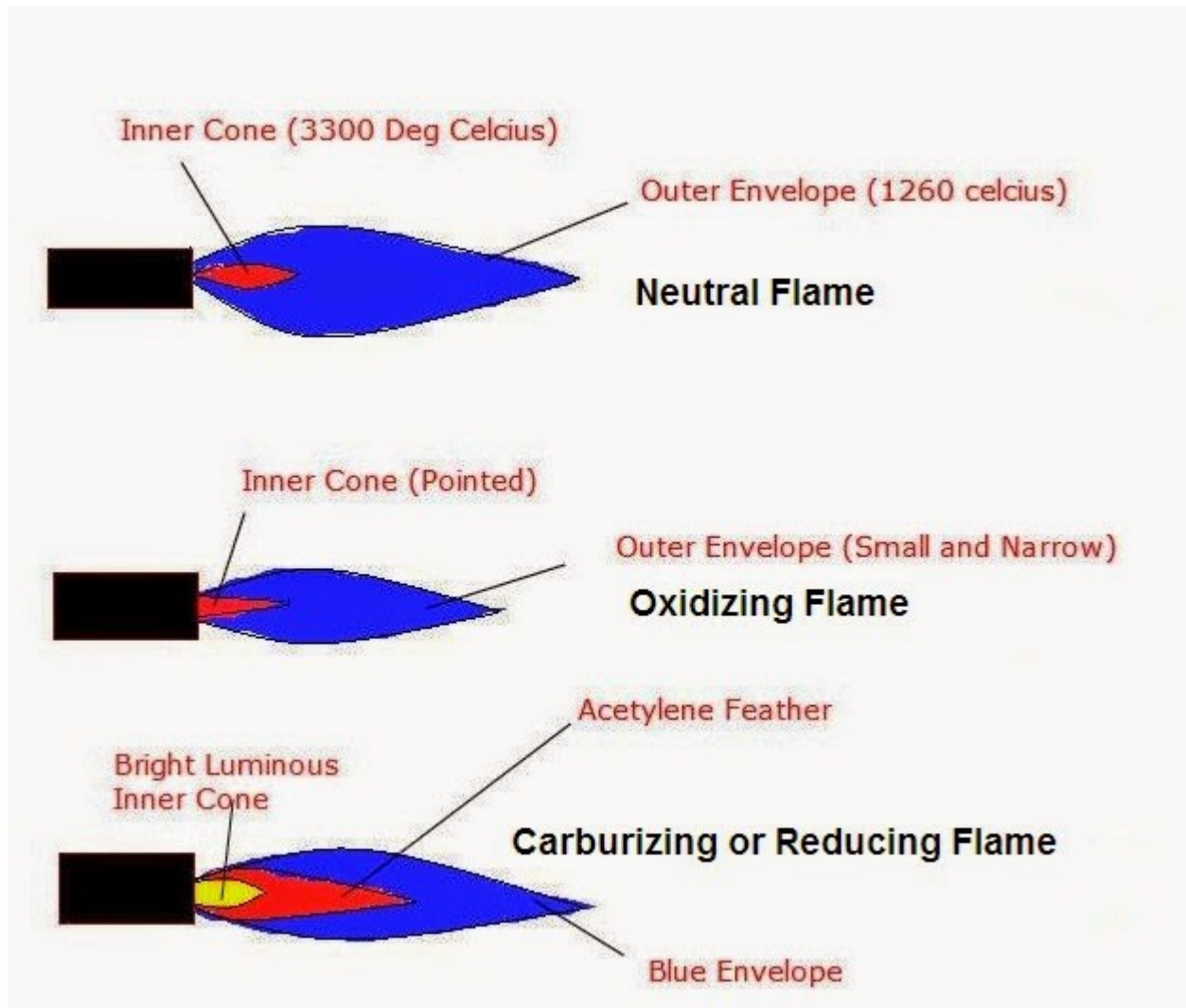
- (i) Oxygen cylinder
- (ii) Acetylene cylinder
- (iii) Oxygen and acetylene pressure regulators
- (iv) Hose pipe & hose clip
- (v) Blow pipe/ Welding torch
- (vi) Goggles and hand gloves
- (vii) Spark lighter
- (viii) Spanner and valve key.

**5.3 PROCEDURE:** first of all regulator is tight with the of regulator key on oxygen & acetylene cylinders. Hose pipes of cylinder & oxygen cylinders are connected to the blow pipe. Oxygen cylinder valve is opened with a valve key, and working pressure is adjusted with the help of pressure adjusting screw. Similarly acetylene cylinder valve is opened with a valve key, and working pressure is adjusted with the help of pressure adjusting screw. Now gas leakage is checked by applying soap water foam on the blow pipe tip before igniting the gas to ensure that there is no leakage of gas in the joints.

Thereafter blow pipe of acetylene needle valve is opened for half cycle and the flame is ignited with spark lighter and the flame is set by opening.

### 5.4 TYPES OF GAS FLAMES:

- (i) **CARBURING FLME:** When the volume of acetylene in the flame is more than the oxygen, carburizing flame is formed. This flame is used for welding Nickel, Hard facing etc.



**Fig 6.4 DIFFERENT FLAMES**

- (ii) **NEUTRAL FLAME:** It is known as balanced flame. Oxygen and acetylene gases are mixed in equal volumes. Neutral flame is used for normal welding of steel, cast iron, stainless steel, copper & aluminum etc.
- (iii) **OXIDISING FLME:** when the volume of the oxygen gas is more than the volume of acetylene mixed in the torch. This flame is used for welding Brass, and is also used for cutting the metals.

### 5.5 Precaution:

1. Always handle the gas cylinders carefully.
2. The adjusting screw of the regulator must be fully released before opening a cylinder valve.
3. The cylinder should be leak proof.
4. Never use match stick for lighting a torch. Always a spark lighter.



5. Acetylene cylinder should be stored in upright position.
6. Always use goggles while welding.
7. Always use tong for holding the heated job.
8. Keep in mind the location of the fire extinguishers.

### **5.6 Pre-Requisite:**

Q.1. what do you mean by welding.

Q.2.Name different flames used in gas welding.

Q.3.Name the gases used in oxy acetylene gas welding process.

### **5.7 Post- Requisite:**

Q.1.Explain the purpose of different flames used in gas welding.

Q.2.Name the flux used in gas welding process.

Q.3.Where the gas welding process is preferred.

## Experiment No: 6

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### 6.1 Objective 6.2 Materials used 6.3 Tools used 6.4 viva-voce

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6.1 **Objective:** To study tools used in Sheet Metal shop.

#### 6.2 **Materials used in sheet metal work**

1. **Galvanized iron sheet:**-This is soft steel coated with zinc to resist corrosion and improves its appearance. The zinc coating helps to prevent oxidation. Galvanized iron sheet is used for shutter work, furnace and air conditioner, ventilators, tanks guards.
2. **Tin Plate:** - Tin plate is made by coating by iron with pure tin. These are used in food containers, dairy equipments etc.
3. **Copper:** - Copper sheet are of high cost but it is used for long lasting roofing material and ducts that demands resistance to corrosion. The metal is easily fabricated because of its malleability.
4. **Aluminium:** - It is a rust proof metal, light and has long wearing qualities. It is used for boats, flashing, roofing material as a house siding and other industrial products.
5. **Stainless steel:** - It has high percentage of chromium. It has higher tensile strengthen and hardness than ordinary steel, therefore is harder to work .It has good corrosion resistance, Stainless steel used for sink and other products that require strength hardness, beauty and resistance to corrosion.

#### 6.3 **Tools used in sheet metal shop:-**

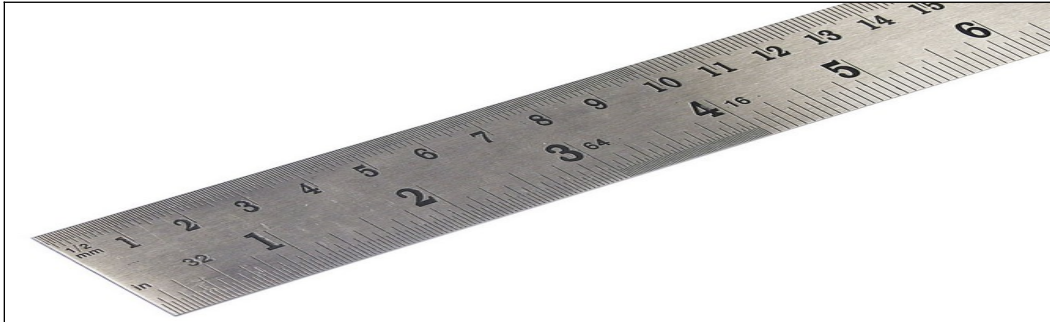
##### **Cutting tools:-**

1. **Straight shear:** - The main purpose of the shear is to cut the sheet along the lines scribed on it. The line may be straight line or curve. For cutting along straight lines, straight shear is used whose blades are straight.

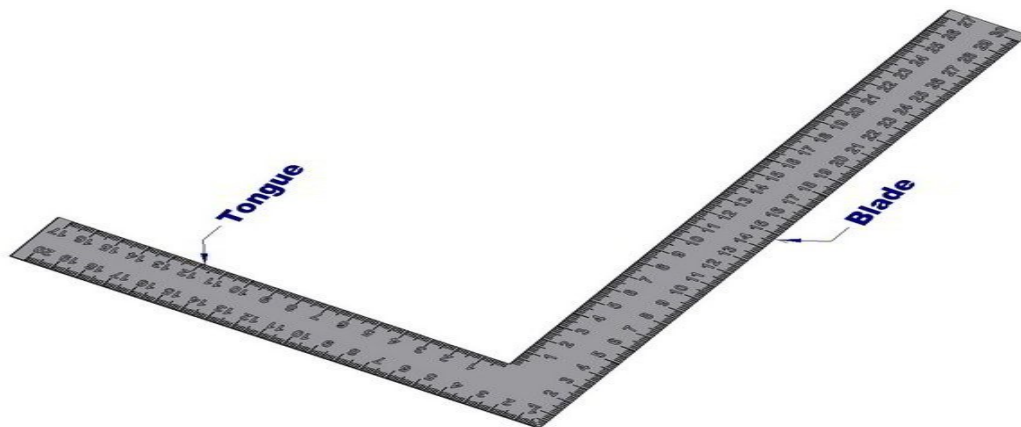


**Marking tools:-**Marking tools are used to mark the sheet according to required dimensions. Various marking tools are:

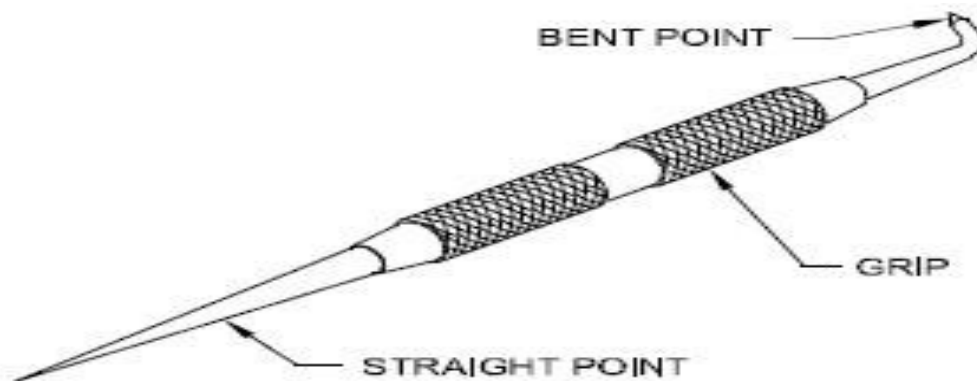
1. Steel rule:-These are available in various sizes. The rule could be steel foot rule, folding rule or tape rule.



2. Steel square:-It is L-shaped piece of hardened steel. It is used to make square corner. It is also used for checking and making right angles.



3. Scriber:-It is used for marking lines on metallic sheets. It is made up of hardened steel.



4. **Divider:-** It is used for scribing arcs and circles on the metallic sheets. It is also made up of hardened steel.



**Punch:-** The under mention punch are made of tool steel and commonly used for sheet metal work:

1. **Prick punch:-**These punches are used for making small dents or indentations marks for locating the centre position for divider or trammel points. The punches have tapered points grounded to  $30^\circ$  included angles.
2. **Centre punch: -** These are used for marking the location of points and centre of holes to be drilled. Its taper point is grounded to  $60^\circ$ .
3. **Dot punch: -** It is used for making dotted lines. It is made up of high carbon steel or high speed steel. Its taper point is grounded to  $60^\circ$ .

point angle =  $90^\circ$



centre punch

**Striking and supporting tools:-** The mallets are used in sheet metal shop for bending the sheets, flattening of sheets, riveting works, to give hollow or curved shape, for locking seam joints etc. For these operations, the following hammers are generally used.

1. **Mallet:-** This is generally used in sheet metal shop. These are made of good quality of hard wood, plastic, hard fibre etc.

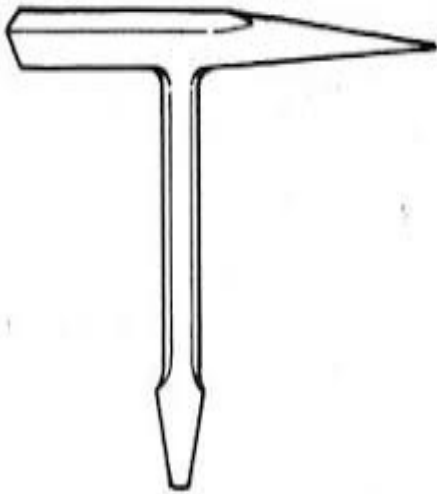


2. **Square face**

**Mallet:-** This mallet is also called setting mallet and has a square flat face. It is used for flattening the seams without damaging the metal sheet.



**Stakes:-** Stakes are supporting tools without which nearly most of the basic operations such as bending seaming forming riveting punching etc. cannot be carried out. They are fitted in wood and jobs are worked upon them.



#### **6.4 viva-voce questions:**

- Q.1 What are the applications of sheet work?
- Q.2 Name the various materials used in sheet metal work?
- Q.3 What are various tools used in sheet metal shop?
- Q.4 What is purpose of zinc coating on G I Sheet?
- Q.6 Differentiate between snip (straight shear) and scriber?
- Q.6 Name the different joints in sheet metal?
- Q.7 What are various operations used in sheet metal shop?

## Experiment No: 7

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**7.1 Objective 7.2 Material Used 7.3 Tools required 7.4 Procedure 7.5 Tray diagram  
7.6 Result 7.7 Precaution 7.8 viva-voce**

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**7.1 Objective:-** To make a rectangular tray using sheet metal tools.

**7.2 Material used:-** G I sheet of 28 SWG (standard wire gauge) thickness

**7.3 Tools required:-** Straight shear (Snip) ,Steel rule, Scriber, Try square, Smooth file ,Wood mallet ,Standard wire gauge(SWG), Bick iron, Anvil & Bench vice.

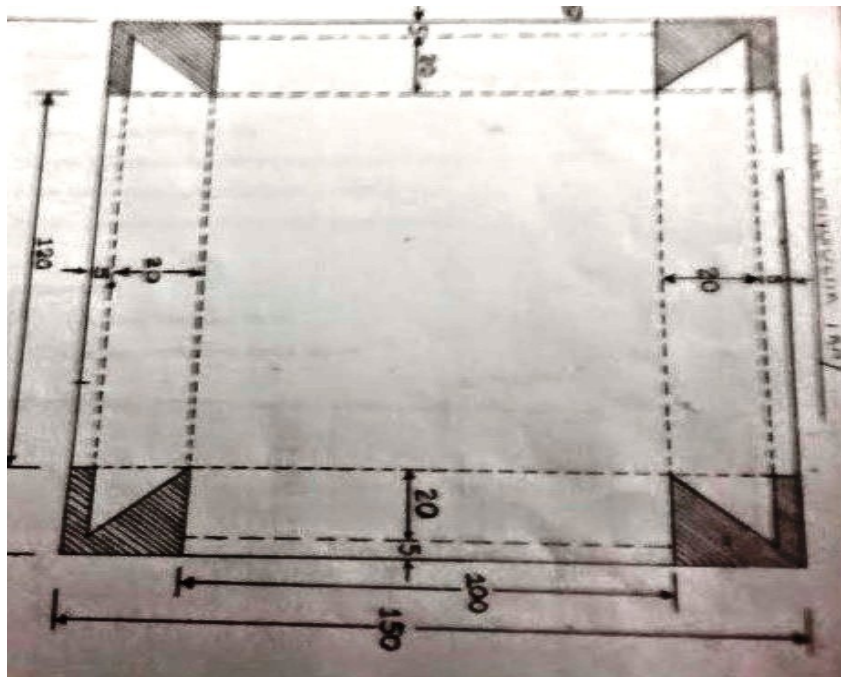
**7.4 Procedure:**

**Sheet metal shop operations**

1. Measuring and marking: Measured and mark the sheet, Cut a piece of size 170mm x160mm from 30 Gauge thickness GI Sheet with the help of straight shear.
2. Cutting off: This means severing a piece from a strip with a cut along single line.
3. Parting: Parting signifies that scrap is removed between the two pieces to part them.
4. Lying Out: Scribing the development of the surface of the article on the sheet.
5. Notching: It is a process of removing metal to the desired shape from the side or edge of a sheet or strip.
6. Lancing: This makes a cut part away across a strip.
7. Trimming: It is an operation of cutting away excess metal in a flash from a piece.
8. Hand forming: Folding and bending of sheet in three dimensions to get required Shape.

Soldering: soldering is a process of joining two similar metals by using another low temperature alloy. The metal used for the joining purpose is called solder.

### 7.5 RECTANGULAR TRAY (All Dimensions are in mm)



**7.6 Result:** A rectangular tray is made as per drawing.

### 7.7 Precaution:-

- i) Perform the operations as per sequence given in the procedure.
- ii) Use stakes of proper size to give good shapes to the job.
- iii) Protect your hands from sharp corners of edges of the sheet.
- iv) Don't allow any scratch mark to come on the sheet surface

### 7.8 Viva-voce

- Q.1.What are the various materials used in sheet metal shop?
- Q.2.What are the articles generally made of sheet metal?
- Q.3. How the thickness of sheet is measured?
- Q.4.What are the various tools used in sheet metal shop?
- Q.6.What is the difference between hammer and Mallet?
- Q.6.What is the purpose of snip and scriber?



## Experiment No: 08

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### 8.1 Objective 8.2 Tools required 8.3 viva-voce

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**8.1 Objective:** To study the tools and equipment in fitting shop.

**8.2 Tools:- Vices:** - Vices are used for gripping different jobs in position during various operations. Main body and detachable jaws are made of cast steel.

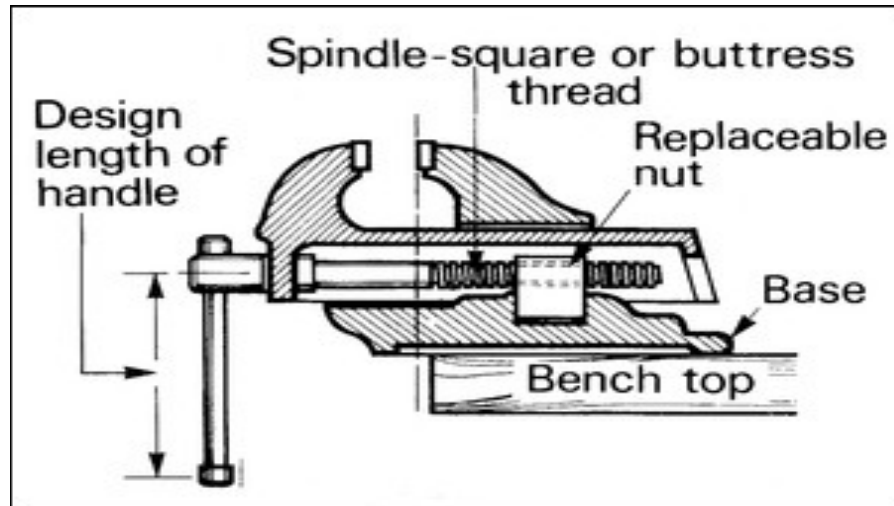


Fig: Bench vice

**V Block:** - It is usually works in conjunctions with a u- clamp and is used to support the work in marking and drilling.

**Surface plate:** - It is used for testing trueness of finished surfaces, testing a try square. It is made of cast iron.



Surface plate

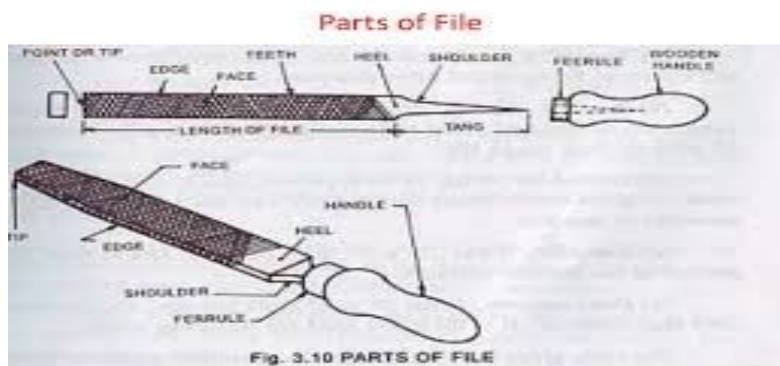
**Try square:** - It is used for testing true surface at right angles or testing the trueness of normal surfaces



Try square

**Bevel protector:** - It consists of a steel dial divided into 360 divisions. Dial can be rotated around the centre. The lines at any angle can be marked or measured by the straight edge. Straight edge can be slide along the length.

**Files:-** Files are used to remove extra material by rubbing the metal . Files are available in a number of sizes and degree of coarseness.



File

Classification of files on the basis of grade:-

- Rough (20 Teeth per inch)
- Bastard (30 Teeth per inch)
- Second Cut (40 Teeth per inch)
- Smooth files (60-60 Teeth per inch)
- Dead Smooth (70-80 Teeth per inch)

**Scriber:** - It is used for marking lines on metal / sheets. It is made of high carbon steel.

**Chisel:** - Chisels are used for chipping away the material from the work piece. Chisels are generally made of high carbon steel. They are 6" to 8" long. The top is flattened and a sharp cutting edge is made at other end.

**Type of chisels:-**

- Flat Chisels
- Cross cut Chisels
- Half round Chisels
- Diamond point Chisels

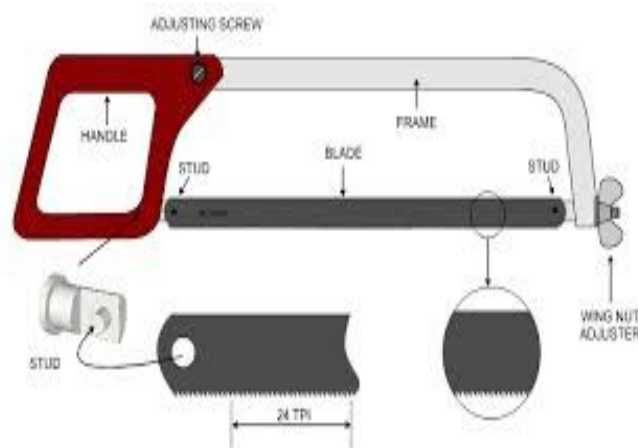
**Classification of Chisels:-**

Chisels are classified with their shape and width of the cutting edge.

Cutting of Chisels is kept as:-

- For hard materials- $70^{\circ}$  to  $76^{\circ}$
- For medium hard-  $60^{\circ}$
- For soft materials - $46^{\circ}$

**Hacksaw:-** Hacksaw is used for cutting metals, flats etc. in fitting shop.



Hacksaw

It consists of a metal frame, fitted with a wooden handle, carrying metal clips with wing nuts at its end to hold and stretch the metal blade. Teeth of the blade are

generally forward cut. The hacksaw should be used in straight direction otherwise it will result in breaking of blades.

The thickness and width of blade are 1mm and  $\frac{1}{2}$  respectively.

**Blades are classified as under:-**

- a) Depending upon the direction of cut
  - (i) Forward cut
  - (ii) Backward cut
- b) Depending upon the pitch of the teeth
  - i) Coarse - (8 to 14 Teeth per inch)
  - ii) Medium- (16 to 20 Teeth per inch)
  - iii) Fine - (24 to 32 Teeth per inch)

**Universal marking surface gauge:** - It consist of a heavy base a scribe and a bar. The scribe can be adjusted to any position with the help of screw and nut. It is used for marking purpose.

**Steel rule:** - It is made of stainless steel and is available from  $\frac{1}{2}$  feet to 2 feet. These are marked in inches/millimeters.

**Punch:** - It is used for marking round indentation on the metal surface for providing operation of marking for further operation such as cutting, sawing, drilling and chipping etc.

- a) **Dot punch:** - It is used for marking dotted lines. Punching angle is  $60^0$ .
- d) **Center punch:** - It is used to mark the centre of the hole before drilling. Angle of punching end is  $60^0$ .

**Hammer:** - It is used for striking chisels in chipping and the punch in marking. A hammer consists of a heavy iron body with a wooden handle. The weight ranges from 0.26 kg to 2 kg. The main types of hammers are as follows.

- (i) Ball peen hammer
- (ii) Straight peen hammer
- (iii) Cross peen hammer



**Caliper:** It is generally used to measure the inside or outside

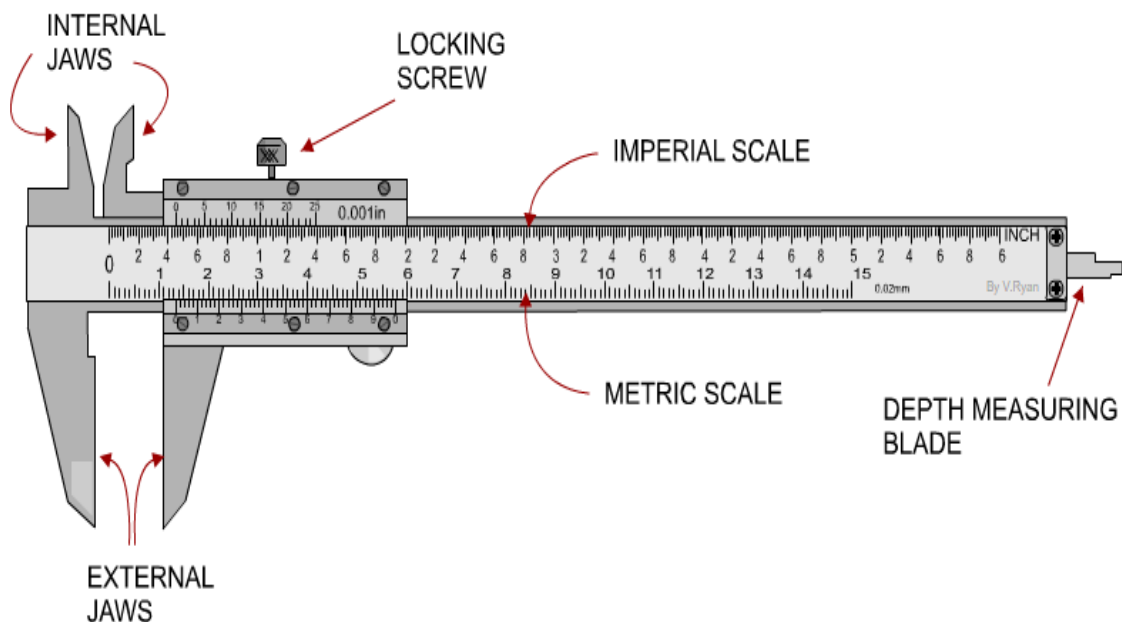
diameters of round objects. It is made up of different size and shapes. It consists of two leg connected to one end by means of rivet or bolt. The edges are made to just to touch the job, and then the diameter is measured with the help of steel rule. These are of four types:

- (a) Outside caliper
- (b) Inside caliper
- (c) Spring caliper
- (d) Odd leg caliper



**Fig:** Outside and inside caliper

**Vernier caliper:** - It is used for measuring length and diameter. It can be used for measuring external and internal diameter. It can be used for measuring external and internal dimensions. The minimum dimension that can be expressed on vernier caliper is known as least count. Material of all parts is stainless steel.



Vernier caliper

Fig: **Vernier caliper**

### 8.3 **Viva- voce**

Q.1 Define the term, Bench work and fitting?

Q.2 What is material used in fitting shop?

Q.3 Name the different types files used in fitting shop?

Q. 4 Name the operations that are normally performed under bench work?

Q.6 what is the meant by pinning of files?

Q.6 What is the purpose of vernier caliper?

## Experiment No: 9

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**9.1 Objective 9.2 Tools required 9.3 Material used 9.4 Procedure 9.5 Diagram 9.6 Result 9.7 Precaution 9.8 viva-voce**

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**9.1 Objective:** To make V section and U & T joint in fitting shop.

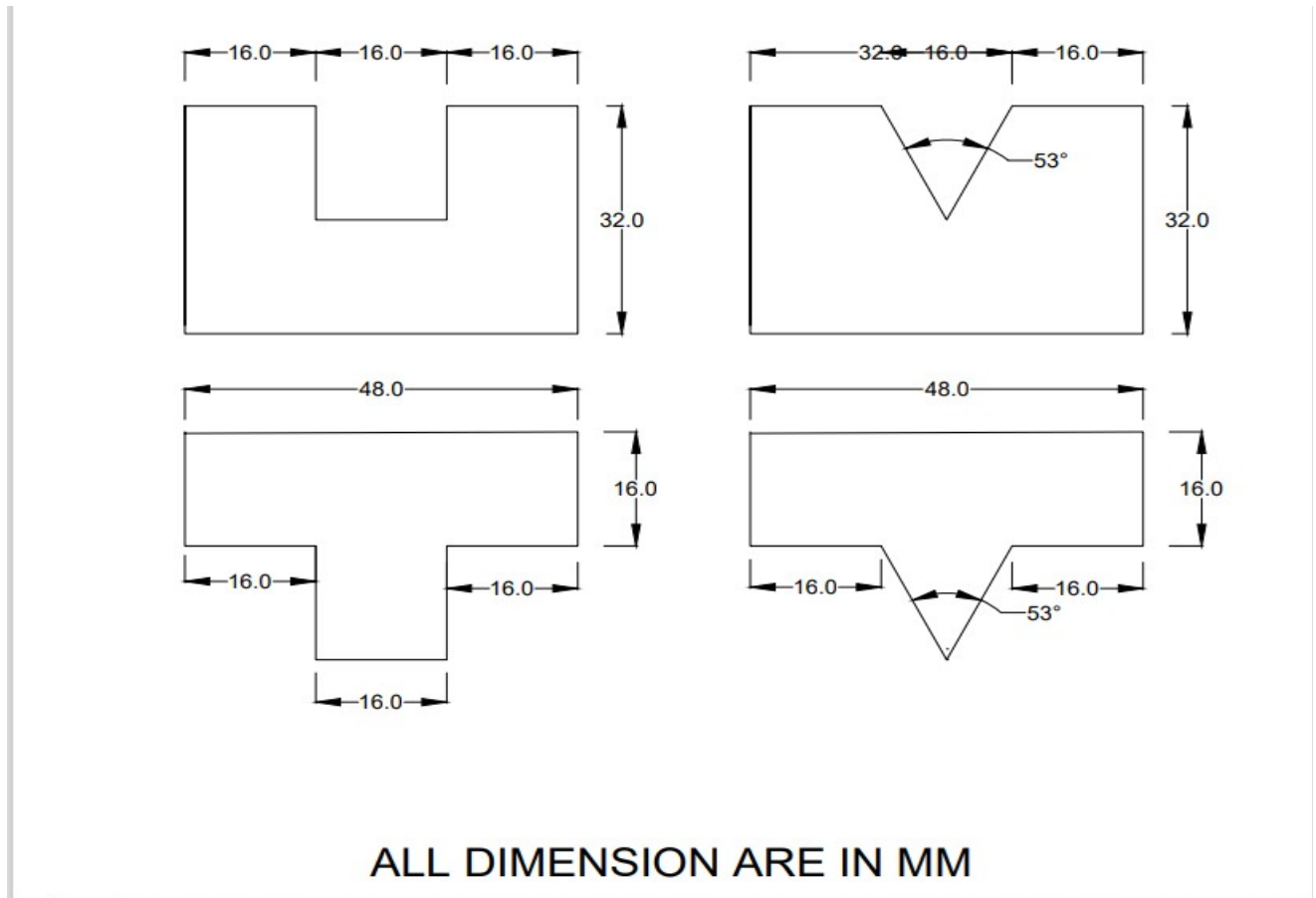
**9.2 Tools required:-**

**Vice, Try square, Files, Scriber, Chisel, Hacksaw, Steel rule, Punch, Dot punch, Centre punch, Hammer, Vernier caliper**

**9.3 Material used:** - Two piece of mild steel, 6mm thickness size 48mmx33mm

**9.4 Procedure:-**

- To mark the flat with the help of steel rule and scriber.
- Hold the MS flat in the vice and cut two pieces of required dimensions with the help of hacksaw.
- Do filing, make all the side surfaces flat and check with the try square repeat it on another piece.
- Now make a coating of chalk and water paste on one side of both work pieces and dry it.
- Carryout marking on both work pieced with the help of scriber and steel rule according to the given drawing.
- Remove unwanted material from the job piece with the help of hacksaw.
- File the job surface, as per the required dimensions with the help of triangular file.
- Now check the final dimension of V slot with the help of vernier calipee
- Now check the final dimension of T slot with the help of vernier caliper.



**Fig : V slot and U & T Joint.**

**9.5 Result:** - V-section and T-slot is prepared as per drawing..

**9.6 Precaution:-**

- Marking of the job should be carried out carefully.
- Never use a file like striking tool.
- While filling the job should be hold firmly in the vice.
- Blade in hacksaw should not be loose and over tight.
- Always use coolant while cutting with hacksaw to prolong the life of the blade.



## 9.7 Viva- voce

Q.1 Define the term, Bench work and fitting?

Q.2 What is material used in fitting shop?

Q.3 Name the different types files used in fitting shop?

Q. 4 Name the operations that are normally performed under bench work?

Q.6 what is the meant by pinning of files?

Q.6 What is the purpose of vernier caliper?

# Beyond Syllabus

## Experiment No: 01

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**1.1 Objective   1.2 Material used   1.3 Tools & equipments required   1.4 Procedure  
1.5 Diagram   1.6 Result   1.7 Precautions   1.8 viva-voce**

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**1.1 Objective:** To make a half lap T joint in carpentry shop.

**1.2 Material required:** Two wooden piece of size- (120x36x36 mm)

**1.3 Tools & equipments required:** Steel scale, scribe/pencil, Try square, cross cut/Rip saw Carpentry bench vice, working table, Iron jack plane, Smooth planer and Rasp File etc.

**1.4 Procedure:**

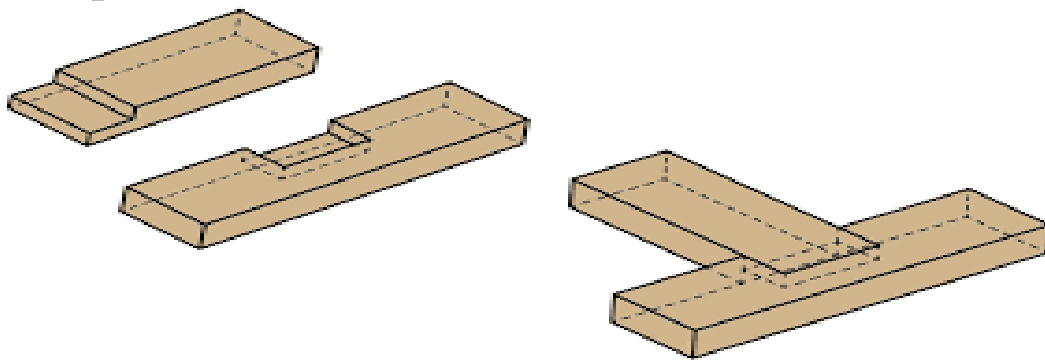
1. Measuring & marking
2. Planning
3. Sawing
4. Half lap T joint making practice

Plane one face of work piece and check the trueness of this face with try square.

- Then plane another adjacent side and check its trueness and right angle position with the help of try square.
- Carry out marking as per given drawing.

- Remove extra material by sawing and planning respectively.
- Prepare other work piece following the same procedure.
- After preparing both work pieces, assemble both pieces and do fit etc. If required, for matching the joint.

### 1.5 DIAGRAM:



Half lap -T joint

Size =120x40x40mm (Two Piece) All dimensions are in mm

**1.6 Result:** A proper half lap T joint has been prepared according to the given dimensions.

### 1.7 Precautions:

1. Work piece should be well tight in vice in proper position.
2. Teeth of saw should be well set and sharpened.
3. Tool should be ready and in good condition.
4. During making, keep suitable margin desired as per the operation to be carried out.

### 1.8 viva-voce

Q.1.On what parameters, the strength of joint depends?

Q.2.What are the types of wood available in the market.

Q.3. Name the tools used for cutting the wood?

- Q.4 What are the sources of getting the wood/timber?
- Q.6 Name various type of joints made in carpentry work?
- Q.6 What for a jack plane is used in carpentry shop?
- Q.7 Name the tools used for holding the work piece in position?
- Q.8 Name the various joinery materials used in carpentry?
- Q.6 Differentiate between marking gauge and knife?

## Experiment No: 2

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**2.1 Objective 2.2 Material & tools required 2.3 Procedure 2.4 Diagram 2.5 Result 2.6 Precautions 2.7 viva-voce**

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**2.1 Objective:** To prepare mould and casting in foundry shop.

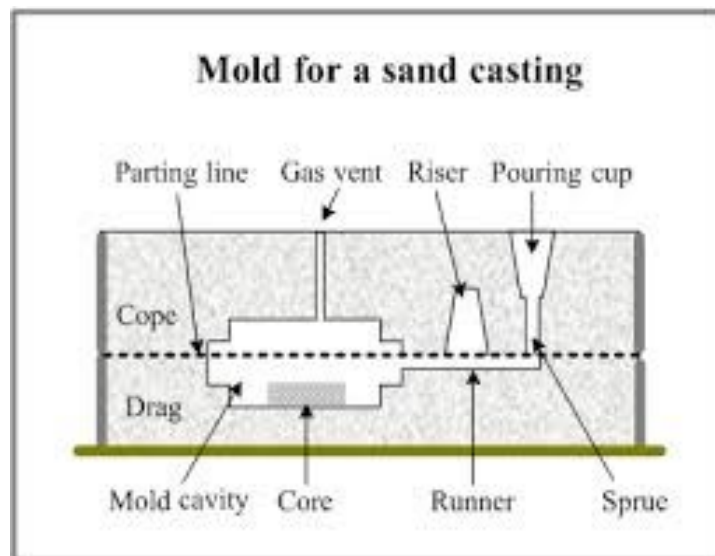
**2.2 Material and tools required:** Sieves, trowel, shawl, water, clay, molding box, riddle rammers gate cutter, crucible, lead, parting sand, lifter, runner, riser etc.

**2.3 Procedure:** The procedure for making a mould either by green or dry sand is as follows:

- First of all a suitable flask is selected large enough to accommodate the pattern and also allow some space around it for ramming of sand.
- The drag part is placed on the moulding board.
- The pattern is placed on the board inside the flask in such a position that space is left for gate cutting.
- If it is in two parts the lower part of the pattern is placed in the drag.
- The drag is then filled with ordinary moulding sand and rammed properly.
- The excess sand cut off to bring it in level with the edges of the flask.
- A small amount of dry loose sand is sprinkled over the top surface and the drag turned upside down along with a bottom both placed over it, after venting.
- The cope is then placed over the drag and the top part the pattern assembled in position.
- Dry, loose parting sand is then sprinkled over the entire surface of the drag and pattern.
- Runner id riser are put in position and supported vertically by tucking a small amount of moulding sand around them.

- The axis sends is them cut of runner and riser pins removed venting perform pouring basin format and dry sand sprinkled on the top surface.
- A bottom board is placed over the cope and the latter rolled over.
- The pattern parts are then removed from both the drag and cope.
- Repairs, if any are made and gates are cut, dressing is then applied.
- If it is dry sand mould it is baked the dry sand cores if any are located in position in mould closed for pouring.
- The molten metal is poured to achieve the desire mould.

## 2.4 Diagram



## SOLID PIECE PATTERN (MOULDING AND CASTING)

2.5 **Result:** - Mould is prepared.

## 2.6 Precautions:-

- a) Ramming of sand should be done properly.
- b) Water content should be in proper proration in moulding sand.

## 2.7 viva-voce

1. What do you mean by casting?
2. What is the purpose of parting sand?
3. What are various allowances provided to pattern?
4. What is the purpose of draw spike and vent wire?
5. Explain the purpose of cope and drag?
6. Define the various metals used for pattern?

