INSTRUCTIONS FOR STUDENTS

1.1. General Information

Laboratory experiments are integral part of the course. It is said that **"You see you forget; you read you remember; you do you understand**". That makes the practical as an integral part of learning process.

Some of the purpose of conducting experiments can be enumerated as below:

- To get familiarized with the basic components, measuring instruments, workbench and basic machines.
- Observing basic phenomena and characteristics of machine .
- Reporting and analyzing the observations.
- Verify observations, basic rules and understanding physical concepts.
- Hands-on experience on machines.
- Observing safety and developing group-working culture.

To make laboratory experiments safe and effective, each student must obey the following rules.

1.2. Safety

- **Dress:**
  Boys: Loose clothes not allowed. Shirt should be tucked-in properly, shoes with the rubber sole, no slippers.
  Girls: Skirts with large flares not permitted, shoes with the rubber sole, no slippers.
- Make sure that all the power sources are off, when you are connecting the circuit.
- Keep safe distance from machines.
- Follow the instructions given by the faculty or course instructor.
- Failure to obey safety rules may result in the disciplinary action.

1.3. Attendance

All students are required to attend and contribute adequately while performing experiments in the group. Performance will be judged based on experiments conducted, quality & punctual submission of the lab report for each experiment.

Faculty will take attendance. Failure to be present for an experiment will result in losing entire mark for the corresponding lab. However, genuine cases may be considered to repeat the experiment.
Students must not attend a different lab group/section from the one assigned at the beginning of the class (unless otherwise approved by the instructor).
If a student misses a lab session due to unavoidable circumstances, can provide a legitimate proof as soon as possible, he/she may then be allowed by the lab instructor, to make-it-up with a different section.

1.4. Preparation and performance

- Before leaving the laboratory, each student must ask the lab instructor for the experiment number to be conducted on the next lab turn, so that the students come prepared after reading and reviewing the reallocated experiment. Faculty might check your preparedness and understanding of the experiment and failure to satisfactory reply may de-bar you from conducting the experiments.
- Record your observations and calculations in the Lab Manual's observation tables. Do not hesitate to clear any of your doubts concerning the experiments.
- Leave the work place clean after you have finished with your experiments. Dismantle the circuit and put all the wires and equipment back at its original place.

1.5. General working discipline in the Lab

Students are advised to strictly follow the instructions given below while working in the Workshop Practice Lab:

1. Attendance in the laboratory is mandatory. For any absence, students have to fill up the format available in the lab to indicate reasons for absence.
2. Students will not be allowed after 10 minutes from the scheduled time.
3. No student will leave the Lab without permission.
4. Students should bring their Lab Manual and are understood to have gone through the manual thoroughly.
5. Any confusion may be clarified from the faculty before starting the experiments.
6. Students must maintain discipline and silence in the lab.
7. Students are to remain within their allotted experimental area.
8. Be attentive all the time.

1.6. Lab Reports

- Each student is required to write reports for the experiments conducted.
- Reports are due one week after the completion of the experiment.
- All reports must be neatly written.
- The Lab report must contain the following:
  1. Duly completed Title pages.
  2. Each report to include Objective, Material required, Tools required, Operations involved, Procedure and Precautions.
  3. Summary section can be included explaining what you have learned doing the experiments and subsequent calculations.(Note: Summary space is not provided on the report page, thus students are requested to write it in the footer space.)
  4. Questions given under the lab report to be answered by student in the space provide in the Lab Manual.
  5. Individual comments/Notes must be written for the further improvement of the lab manual, on the space provided at the end of the manual, however extra pages could be attached if required.

QUESTIONS FOR VIVA-VOICE:

1. FITTING SHOP

1.1) What do you mean by fitting shop?

Ans. Fitting shop means a place where dimensional accuracy are produced in metal Work pieces by manual operation.

1.2) How will you specified a steel scale?

Ans. Steel scale is made up of the thin steel strip which is calibrated inches and mm both. It is specified by total length of calibration such as 150 mm, 300 mm and 600 mm etc.

1.3) Why scale is made up of steel and not of mild steel. Explain.

Ans. Steel is selected for making steel scale due to following main reasons:

a) steel has good corrosion resistance ability.

b) It has low coefficient of thermal expansion than mild steel.

c) Due to low coefficient of thermal expansion effect of change in temperature will diminished up to a certain extent.

d) Its shining and appearance far better than mild steel.

1.4) What is the material used to made surface plate and why?

Ans. Surface plates made up of casting of high carbon steel and properly hardened and tempered after making top surface ture leveled through machining other material does not take in place of high carbon steel due to following reasons:

a) Economical consideration

b) Hardness at room temperature.

c) Stability surface trueness at room temperature.

d) High resistivity against corrosion etc.

1.5) What do you mean by temporary marking and permanent marking?

Ans. **Temporary marking** carried out where one or two processes are to be performed on job. In this marking only scratched lines are produced over job containing any marking media.

Permanent marking is carried out over temporary marking by making dots with center punch and hammer.

1.6) What is a try square, how it cab be specified?

Ans. It is made up of hardened and tempered of high carbon steel having two arms rivet riveted at true 90 degree angle used for checking right angles of job etc., one arm called stock and other arm called as blade. This blade is used for checking angle of at 180 degree angle and it is specified by blade length.

1.7) What is the difference between a) bevel square and try square b) surface gauge and universal gauge

Ans. A) Difference between Bevel square and Try square:

Try Square	Bevel Square
It can used for 90 degree angle and 180 degree angle both.	It can used for various desired angle along with parallel line marking.

B) Difference between Surface gauge and Universal gauge:

Surface gauge	Universal surface gauge
It is consisting a fixed spindle or column.	It consists adjustable spindle or column.

1.8) Explain the files according to number of teeth?

Ans.

Rough	8 TPC
Coarse	10 TPC
Bastard	12-14 TPC
Second Cut	14-16 TPC
Smooth	20-24 TPC
Dead Smooth	24-40 TPC
Supper Smooth	40-60 TPC

1.9) Explain center line marking method?

Ans. For center line marking method a center line marked on the work piece and rest of

marking completed with respect to this center line.

1.10) What do you mean by drill bit?

Ans. It is bar shaped structure having a sharped cutting edge at its one end and all over its body. It is used for marking internal hole in work piece.

2. WELDING SHOP

2.1) What do you mean by Welding Process?

Ans. Welding is a process of joining two or more than two similar or dissimilar metals with or without application of pressure along with or without application of filler material.

2.2) What do you mean by electrical arc welding?

Ans. In an open circuit two terminals carrying high amperage and low voltage current, brought closer till the resistance offered by air gap between both terminals dimished by high value of current/voltage then a certain amount of electrons tends to jump from one terminal to another terminal having currents of different polarities due to this jumping of electrons a large amount of heat generated and this flow of jumping electrons termed as electric arc and this amount of heat used to melt the base metal and filler material and this pool of molten metal and filler metal make a welding joint. This is termed as electric arc welding.

2.3) How much temperature produced at electric arc?

Ans. Approx.3400 degree celcius.

2.4) Explain the term"Polarity"?

Ans. Polarity may be defined as operation as the relation of positive and negative terminals with respect to the electrode and job. It may be classified in following types:

1) Straight polarity: work piece is made positive terminal and electrode is made negative terminal. It is used for more thick plate etc.
2) Reverse polarity: work piece is made negative terminal and electrode is made positive terminal. It is used with thin plates welding etc.

2.5) Differenciate between A.C. and D.C. arc welding?

Ans.

S.N	PROPERTIES	D.C.WELDING	A.C.WELDING
1.	Installation	Higher	Lower
2.	**Maintenance cost**	Higher	Lower
3.	**Polarity**	Fixed polarity	Change in every half cycle.
4.	**Electrode**	Bare and coated	Only coated
5.	**Voltage drops**	Higher	Lower

2.6) What do you mean by electrode?

Ans. **Electrode-** is a filler metal rod used for filling the gap between welding joints during welding. This is made in thick wire shape of different metals as per requirement.

2.7) How will you classified a flux coated electrode?

Ans. Depending upon its length, diameter, material flux, melting point and position of welding, etc specifies it.

2.8) How will you classified a flux coated electrode?

Ans. **(a)** Dust coated or light coated**.**

(b) Electrode semi medium coated electrode.

(c) Heavily coated or shielded electrodes**.**

2.9) What do you mean by gas welding?

Ans. It is a non-pressure welding and in this method of welding heat is produced due to combustion of some inflammable gasses in presence of O_2. For example combustion of acetylene with oxygen termed as oxy-acetylene gas welding.

2.10) List the inflammable gasses can used for gas welding.

Ans. (a) Acetylene Gas (b) Hydrogen Gas
(c) Retort Gas (d) Natural Gas

3. SMITHY SHOP

3.1) What do you mean by smithy process?

Ans. In this the metal heated up to just below to it critical temperature and then by applying external pressure (like hammer blow) and required shape and size achived.

3.2) Name important tools required for smith work?

Ans. For heating:

a) Coal fired furnace (open hearth furnace)
b) Oil fired furnace

For holding/ supporting:

a) Leg vice b) Tongs c) Anvil d) Swage block

For striking/ shaping:

a) Various hammers b) Fuller set c) Hardi d) Flatter e) Set hammers

For cutting: hot chisels

For drilling: drift and punch etc.

3.3) How many forms of tongs used in smithy work?

Ans. Flat tong - for flat work piece.

Flat mouth tong – for longer flat piece.

Pincer tong – for round objects.

Chisel or belt tong – for unsymmetrical jobs holding.

Round hollow tong – for round unsymmetrical jobs.

Sewer tong – for triangular and square jobs.

Pick up tong – for very small jobs.

3.4) What do you mean by punch and drift work piece?

Ans. Punch is placed on red hot job and a blow of hammer applied. These punches are available in various shapes like round, triangular, square and hexagonal etc.

Drift is the secondary and finishing tool used after punching for accuracy finishing

dimensions of hole.

3.5) Differentiate between hot and cold chisel?

Ans.

S.NO.	Properties	Hot Chisel	Cold Chisel
1.	Application	Used for hot jobs	Used for cold cheseling
2.	Hardness	Not hardened	Hardened and tempered
3.	Length	Comperatively less	More length
4.	**Cutting angle**	Almost kept 30 degree	Almost 60 degree

3.6) What do you mean by poker?

Ans. **Poker** is a mild steel rod pointed and bended at other end. It is used to remove Clinker and to adjust heat at proper place by adjusting the position of burning coals in furnace.

3.7) Describe the mainly used materials along with their forging temperature?

Ans.

Materials	Forging temperature(in degree celceius)
Wrought Iron	850-1300
Mild Steel	750-1300
Medium Carbon Steel	750-1250
Stainless Steel	950-1200
Brass, Copper Bronze	300-850
High Carbon Steel	750-1150
Aluminium, Magnisium	300-850

3.8) What do you mean by Up setting?

Ans. Upsetting may be defined as the process in which the cross-section of the work Metal increased on the cost of its length.

1) Head Upsetting: in this process cross-section of a complete work metal is increased.

2) Head Upsetting: The cross-section at the end of work piece is increased.

3) Central Upsetting: The cross-section of the work pieces increases at middle point of work piece only.

4. CARPENTRY SHOP

4.1) Name various type of chisels used in carpentry shop?

Ans. **Chisel-** it is another most important tool in wood working it is made up of high carbon steel. It is specified by the width of cutting edge. It is used with the help of any impact load such as blow of hammer etc.

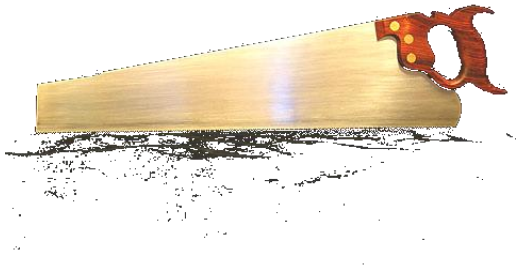
Farmer chisel

Dovetail chisel

Mortise chisel

4.2) Difference of ripsaw and crosscut saw?

Ans. **Ripsaw: -** It is used along the grain cutting.



Cross cut saw: - it is used across the grain cutting.

4.3) Describe five safety precautions in carpentry shop?

Ans. Five safety precautions in carpentry shop:

1) Always adopt right tools and right procedure for every operation in carpentry shop
2) Work piece should be well tight in vice in proper position.
3) Tools should be in good condition and well sharped, if necessary, on the job.
4) Teeth of saw should be well set and sharpened.
5) During marking, keep suitable margin desired as per the operation to be carried out on the job.

4.4) What is the difference between hard wood and soft wood?

Ans.

PREPARATION	SOFT WOOD	HARD WOOD
Colour appearance	Light in colour	Comparatively dark in colour
Fibre structure	Straight fibre and fine texture	Fibres are closer and compact
Strength	Less	More
Durability	Less	More
workability	Easily workable	Difficult to work

5. MACHINE SHOP

5.1) What do you mean by machine shop?

Ans. Machine shop is associated with performing different operation along with the application of different machine ans the plece used for these operation are known as machine shop.

5.2) What do you mean by lathe machine?

Ans. It is most widely used machine tool for different operations like turning, threading and knurling, etc. in the ancient time the lathe machine were powered by engine so it was termed as engine lathe machine. But in present it is known as center lathe machine it consists two center (one called as live center and other known as dead center) in which the work metal mounted and a stationary tool mounted in tool post cuts the material is thin chips from to achieve the desired dimensions

.

5.3) Define the following tems:

1) Centering 2) Facing 3) Turning 4) Step Turning 5) Form Turning 6) Taper Turning 7) Knuring

Ans. 1) Centering may be defined as process of mounting work piece in center in four jaw chuck on lathe machine.

2) Facing may be define as process of metal removing from the front face of work piece on the cost of its length.

3) Turning may be defined as the metal removing process on lathe machine in the form of chips on cost of diameter of work piece.

4) Step turning may be define as the process of making certain different diameters of diameters of jobs of various certain lengths by turning.

5) Form turning involves making different articles using form tool (griended tool bit as per the requirement) like handle of machine, etc.

6) Taper turning may be defined as the turning process in which the diameter of work piece decreased gradually.

7) Knurling-in this operation different types of hatch lines are made over the surface of work piece.

5.4) What do you mean by tool life?

Ans. Tool life is a measure of gradually wear and tear occurred in tool bit which occurs due to regular service and its service condition.

5.5) What do you mean by chips?

Ans. During any machining process some material removed from work metal in the form of fine strips of metal that is known as **chips.**

Types of chips:

1) **Continuous chips**: the chips having certain length known as continuous chips. Normally these chips produced during machining of soft metals and ductile metals.

2) **Discontinuous chips**: these chips consists comperatively small length or in segments of chips. These are normally produced in machining of brittle metals and hard metals etc.

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EXPERIMENT NO-1

OBJECTIVE:

To study of tools and operation in fitting shop.

TOOLS USED: -

MEASURING TOOLS: -

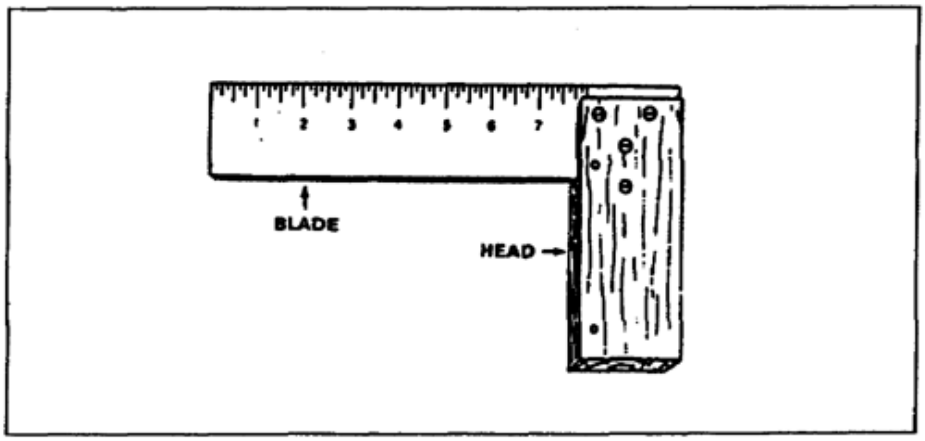
- **Scale (Steel rule):** -It is flat in shape and calibrated up to 1/16 inches in BIS system and up to half mm in metric system. Its length specifies it. Generally available in length of 6", 12", 24" and 1 meter.

- **Out side caliper:** used for out side measurements.

- **In side caliper:** used for are inside measurements

- **Divider:** It is basically similar to the calipers except of its legs which are kept straight pointed at measuring edge .it is used for dividing any linear dimensions, for marking arc /circle on a flat surface, and for transferring the required dimensions from one Pointe to another.

- **Try square:** it may be defined as a measuring and marking tools for 90^o angle. It has true machined stock and blade jointed together true 90^oit is used through in direct measuring method.



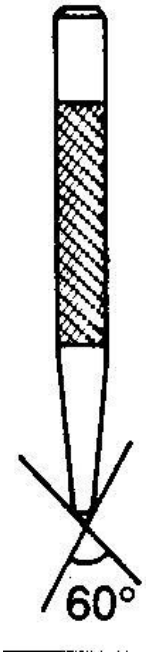
MARKING TOOLS: -

- **Scriber:** - made up of hardened and tempered high carbon steel. Tip of scriber is grinded at $12^{o\ to}\ 15^o$ and is generally available in 125mm to 250 mm. It is for used fore tempered marking.

- **Punch: -** used for permanent marking and it is made up of hardened high carbon steel. It is specified by its length and dia. of center punch, for example 150x 12.5 mm. It consists a cylindrical knurled body witch is plane up to some height at top of it. This plane part of its body is used for applying impact load like hammer blow. At is other end of its knurled body, it consists grinded point with different angles of grinding.

Classification of punch

- **Dot punch: -**it is very much similar to prick punch except of its tips is sharpened at an angle of 60^0. It is used in permanent marking of harder metals. It is made by high carbon steel and specified by its total length.



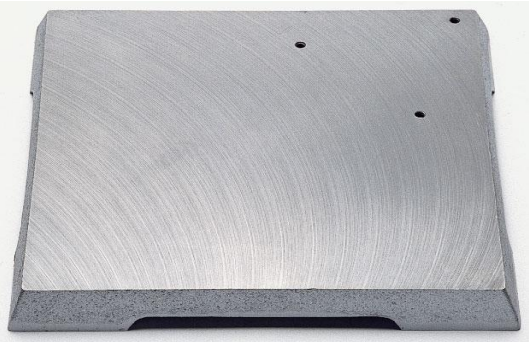
- **Center punch: -** it is also similar to dot punch except of having sharpened tip at an angle of 90^0. It is made by high carbon steel and specified by its total length. It is used in general-purpose permanent marking in almost all metals having hardness below high carbon steel.

HOLDING DEVICES: -

- **Bench Vice: -** The job is supported and holded in between the jaws of vice. In most of vices one jaw is kept fixed type and other is moving type witch move witch the help of spindle rotated by the handle fixed at one of spindle.

Classification of Vice

- **Pipe vice**
- **Leg vice**
- **Hand vice**
- **Pipe vice**
- **Pin vice**
- **Machine vice**
- **Surface plate: -** It consists flat rectangular true mechanical surface. It is made up of cast iron casting. It is generally used for caking surface flatness of any job and also used for temporary marking.



- **V- blocks: -**it is used to provide support for round object during marking and machining etc. It is true machine at 900 at ever edge. It is made up gray cast iron or high carbon steel. Its side length such as 2" to 4" etc specifies it.

CUTTING TOOLS:

- **Hacksaw frame:** it is made up to case hardened mild steel in C shape having a wooden handle and awing nut used fore tightening the blade.
  It is used for mounting hacksaw. The process of cutting by it is called hacks awing.

Classification:

- **Adjustable frame**
- **Fixed frame**

File: - it is a fine cutting tools, having number of cutting teeth on its face and it is used for finishing purpose it is made up of high carbon steel and cast steel etc. Except of tang all body of file is made well hardened and tempered**.**

Classification according to shape

- **Flat file**

- **Round file**

- **Half round file**
- **Triangular file**

- **Square file**
- **Hand file**
- **Knife edge file**

Classification according to cut

- **Double cut**
- **Single cut**

Tap: - it is used to make internal threads in a material after making a suitable drilled hole. It is made up to high carbon steel and H. S. S etc. it is specified by thread size.

Drill: It is use to make a hole in a material. It is made by high carbon steel. And high speed steel.
It is specified by the other dia. Of flutes, length of drill and types of flutes and shank etc.

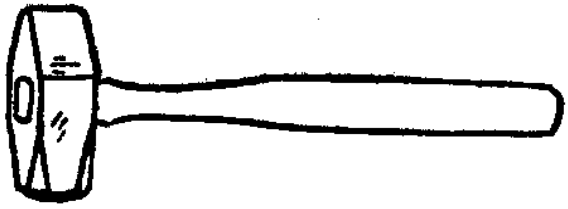
STRIKING TOOLS: -

Hammer: -It is striking tool. It is specified by its weight excluding the handle weight. All hammers consist commonly the following parts (a) face (b) eye hole (c) pain (d) handle. The shape and material of hammers varies depending upon the requirement of hammer blow and work metal. Depending of the nature of the work, hammer is a categorized of hand hammer a power hammer. Hand hammer are designed in different shape and size of different materials but power hammers are generally made in similar shape commonly having different capacities as per requirement.

- **Ball peen hammer: -** It has round peen at one end and straight face at other end. It is generally used during chiseling and riveting processes.

- **Cross peen hammer: -** It consist a cross peen at one end and straight face at other end, its peen is perpendicular with handle. It is generally used in groove making and hammering etc.

- **Straight peen hammer: -** It is same as cross peen hammer except of its peen is parallel with its handle. It is also used in groove making and hammering etc.



EXPERIMENT NO-2

OBJECTIVE: -

To make a 90^0 angle, cutting, drilling & taping.

MATERIAL REQUIRED:

M.S. Flat Piece of size (48 x 48 x 6) mm.

TOOLS REQUIRED:

Steel Scale, Parallel jaw bench vice, Scriber, Hacksaw, Flat Bastard file, Try square, Flat smooth file, Ball peen hammer, center punch, V-Block, Surface gauge, surface plate, Divider drill bit with drilling machine, Tap set with tap handle

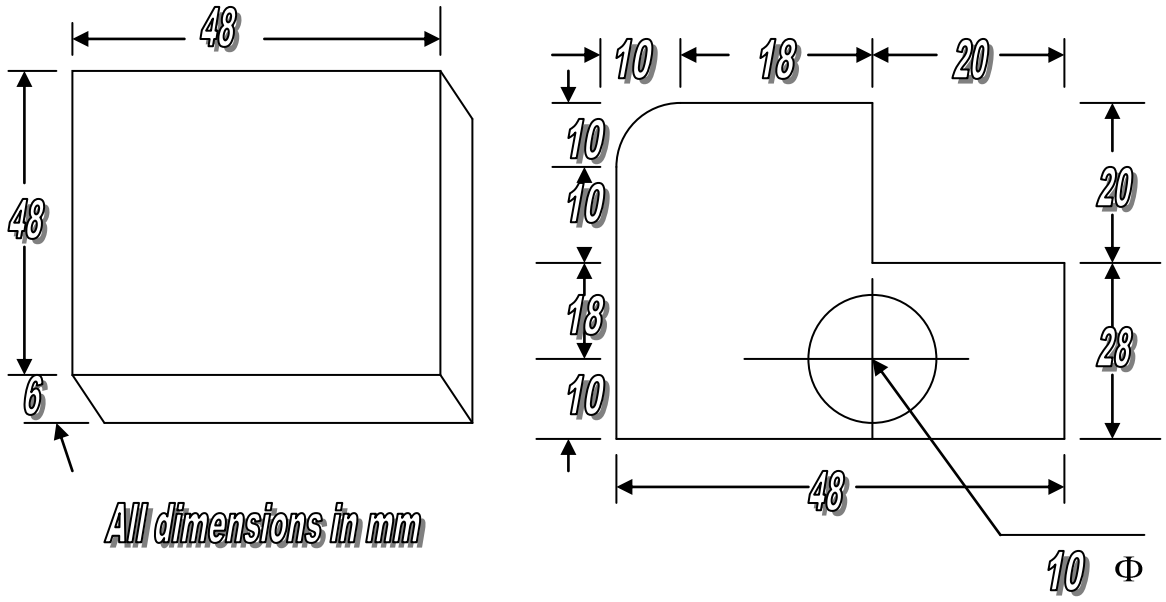
.

OPERATIONS INVOLVED:

- Measuring and marking
- Hack sawing
- Flat filing
- Radius filing
- Surface finishing
- Drilling
- Tapping etc.

PROCEDURE:

- At first make sure that the given M.S flat piece is well Sufficient to achieve desired dimension of job
- Then make two adjacent sides perpendicular to each other by filing the job.
- After this, make coating of chalk & water paste on one face of the job.
- Make temporary marking on job consisting chalk paste with the help of Steel scale, scriber, surface plate, surface gauge, V-Block &divider etc
- Make permanent marking over temporary marking with the help of center punch & hammer.
- After marking, achieve desired shape and dimensions by doing hack sawing & Filing with the help of hacksaw & bastard file.
- Then make indent with center punch for drilling and make drilled hole with drilling machine. After making drilled hole, make internal threading with the help rotating Specific taps in clockwise direction.



PRECAUTIONS:

- Make sure that the job is fixed properly in the jaws of parallel jaw bench vice up to appropriate height of job.
- During filing, always drag file over job making it perpendicular.
- Never do hammering and permanent marking etc. over surface plate.
- Make sure blade is well tightened in hacksaw frame and teeth of blade is placed in forward direction.
- Always adopt right tools/equipments and procedure for every operation.
- When filing and hacksawing are being carried out on same face of job, take proper margin for filing during marking for hack sawing process.
- Drill bit should be well tightened in drill chuck.
- Never do drilling without machine vice on any electrically drive drilling driver drilling machine.
- Make tap straight during taping process.

EXPERIMENT NO.3

OBJECTIVE: -

To study of tools and operation in sheet metal shop.

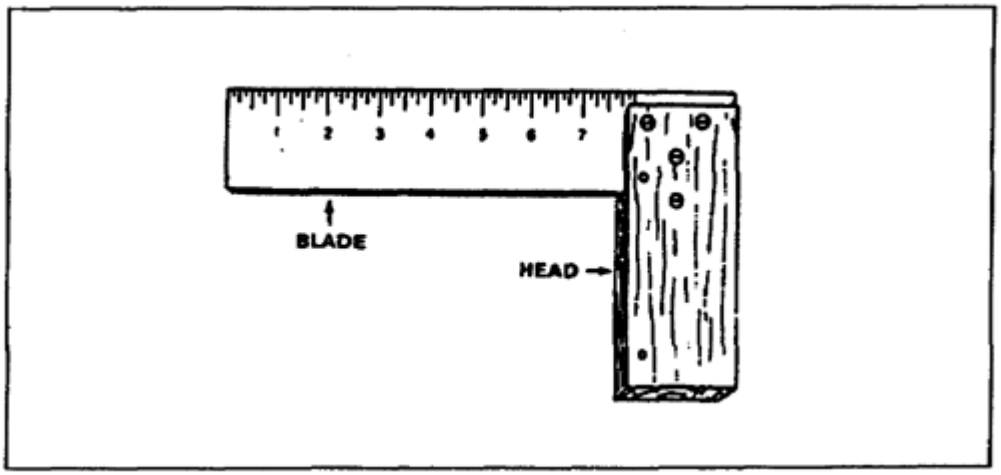
TOOLS USED: -

MEASURING TOOLS

- **Standard wire gage: -** it is a piece of sheet in rectangular / circular shape having slots /holes on its outer periphery from 0. 19mm to8.23 mm or we may say zero to thirty six-gauge numbers. The diameter of slots increases as the S.W.G number decreases. Generally it is made up to stainless steels

- **Scale- (steel rule):** -it is flat in shape and calibrated up to 1/16 inches in BIS system and up to half mm in metric system. Its length specifies it. Generally available in length of 6", 12", 24"and 1 mtr. Etc. As per application, these are made up to various materials some to them are mentioned below:

Try square: - it may be defined as a measuring and marking tools for 90^{o} angle. It has true machined stock and blade jointed together true 90^{o}it is used through in direct measuring metho



MARKING TOOLS:

- **Scriber: -** made up of hardened and tempered high carbon steel. Tip of scriber is grinded at 12^0 to 15^0 and is generally available in 125mm to 250 mm. It is for used fore tempered marking.

HOLDING AND SUPPORTING TOOLS:

- **Stakes:** -These tools are commonly used in sheet metal shop for supporting jobs. It has different shape on the tope of stake as per the requirement and shank, which helps in mounting on table etc. some of them are as under,

Bick iron Stake: - it consists tapered cylindrical face at one end rectangular tapered at the other end. Its top is generally made up of tool steel and rest body is made by mild steel. It is generally used in forming long tapered cylindrical items.

1. **Hatchet stake: -** it is triangular in cross- section at the tope side. Generally it is used in forming, bending and seaming the edge etc. material used is same as bick iron stake.
2. **Creasing stakes: -** it consists two flat tapered horns at both ends at top face. It is generally used in creasing, banding and corns/ edge making etc.

3. **Tea- Kettle stake set: -**it consist a bended shank at one end and a straight shank at other end with four adjustable heads. It is multi purpose stake, useful making round forming of the difficult job.

CUTTING TOOLS:

- **Shear:** - in sheet metal working, generally shearing process is widely employed. In this method sheet metal is supported at one end some force is applied from other end in opposite direction so that the sheet get sheared.

Classifications of shear

- **Hand shear**
- **Power shear machine**
- **Bench shear**

STRIKING TOOLS: -

- **Soft face hammer**- these are employed in light work where surface finishing is more important. Generally made by wood, plastic, rubber, and leather

EXPERIMENT NO.4

OBJECTIVE: -
To make M.S. sheet tray as per given drawing.

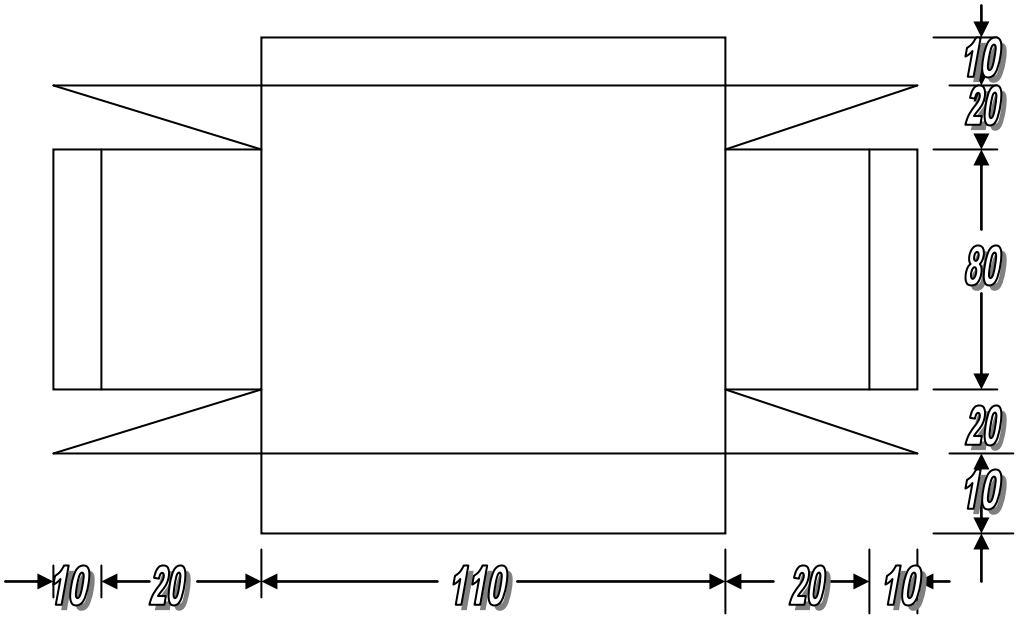
MATERIAL REQUIRED: -
M.S. sheet.

TOOLS/EQUIPMENT REQUIRED –
Steel scale, scriber, try square, flat surface, straight hand shear, mallet, Flat base hammer etc.

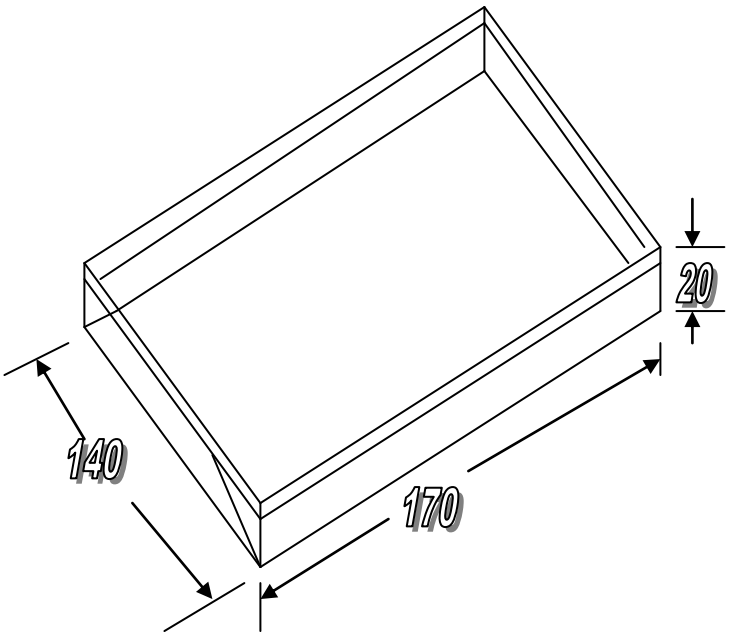
OPERATION INVOLVED: -
Measuring, making, shearing, banding (hand forming) and edge forming etc.

PROCEDURE: -

- Make sure that the M.S. sheet piece is well sufficient to acquire the given dimensions of tray.
- Make any two adjacent sides perpendicular to each other with the help of try square & straight hand shear etc.
- Then complete rest of marking assuming reference sides to these perpendicular sides.
- Then remove all unwanted portion of sheet wit the help of straight hand shear.
- Then using suitable stake, mallet etc. do all bending.
- After bending check flatness of tray at bottom and all dimensions



All dimensions in mm



PRECAUTIONS: -

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- Right tool and right procedure should always be used for every operation in workshop.
- Never feel the edges of sheet after shear.
- Be careful that any scratch should not appear on the surface plate.
- Never do any kind of punching or hammering over surface plate.
- Bending should be followed from outside to inside always.

EXPERIMENT NO.5

OBJECTIVE: -

To study of tools and operation in welding shop.

TOOLS/EQUIPMENTS USED: -

- **A.C. welding machine**: - These are simple in construction containing a step-down transformer set oil cooled/ air-cooled, which supplies different current values as per requirement. These are available single face to three face in market.

- **Electrode: -**Electrode may be defined as a filler metal rod used to fill up the gap between the joints during welding procedure. Generally these are in wire shape and made up of different metals as per requirement. It works to transport current from electro holder to work metal, which causes for arc development.
- **Electrode holder**: -It is used for electrode holding. It consists of two jaws. One jaw is fixed type and another jaw is movable which is operated by a screw or spring connected arm mounted over insulated handle.

- **Welding cable**: -It is generally made up of many thin copper wire collection them together and wrapped in a suitable insulating material. It is specified by cross section of cable and current carrying capacity of electrode etc.

Hand shield / facemask: -These is used for protection of face and eyes from the spatter, ultraviolet and infrared rays etc. generally during welding process. It is made up of fiber sheet and black glass is fitted to look at weld

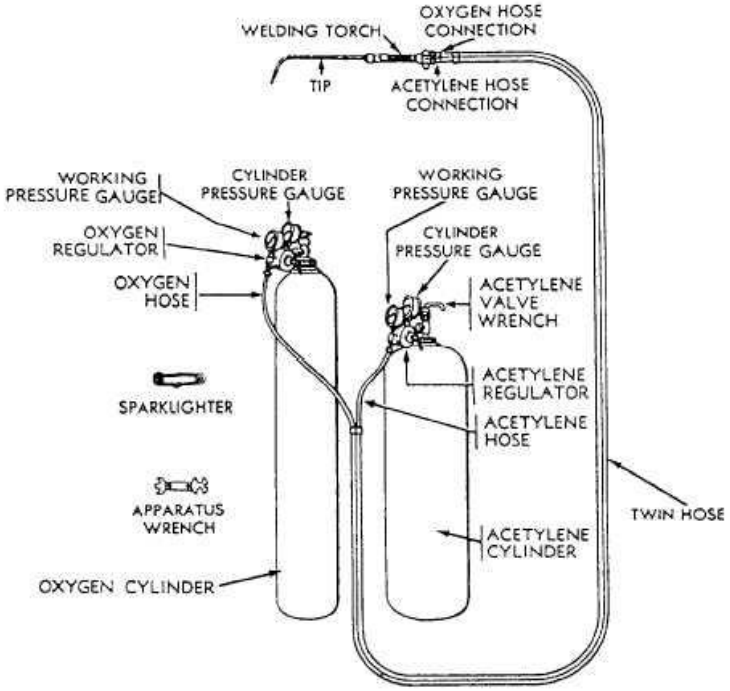
- **Chipping hammer**: -These are hammers having pointed or sharp striking face and used for removing slag and spatter.

- **Wire brush**: -Wire brush is used for removing slag and unwanted materials from metal surface in fine way than chipping hammer.

SAFETY TOOLS: -

- Leather gloves
- Apron
- Goggles

Gas welding equipments: - In gas welding process different tools and equipments are used. Some of the mainly used are mentioned below:



- **Welding torch: -** Welding torch or blow pipe may be defined as the equipment designed for mixing oxygen and combustible gas in required proportion and injecting for combustion and making flame.
- **Hosepipe: -**It is used for supplying gases from pressure regulator to welding torch.
- **Pressure regulator**: -it is pressure-controlling device used for supply of desired pressure of gas to hosepipe connected with welding torch. It is mounted directly over gas cylinders.

- **Welding torch lighter**: - It is an instrument, which produces spark used for lightening welding torch. In practice electronic gas lighter are mainly used now.

Oxygen acetylene flame: - It is produced by combustion of gases and due to oxidation different temperatures are achieved. A flame can be adjusted for different temperature range. So these different flame have a distance role in gas welding process.

Classification of flame

- **Natural flame (temperature 3200^{o} c): -**It is achieved when acetylene and oxygen are used in equal quantity. It consists only two parts of flame, one is inner cone and outer envelop. It is most widely used in gas welding. It produces above 3200^{0} c temperature.

- **Carburising flame (temperature 3100^{o}c): -** This can be achieved by increasing acetylene gas quantity in flame. It produces above 3100^{0} c temperature.

- **Oxidizing flame (temperature 3300^{o}c): -** It can be achieved by increasing percentage of oxygen in natural flame. It is used only with brass welding etc. It produces above 3300^{0} c temperature.

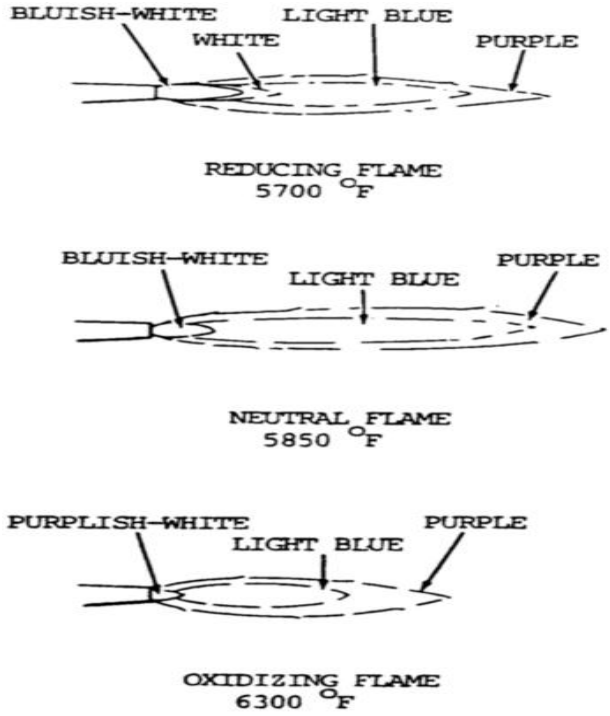
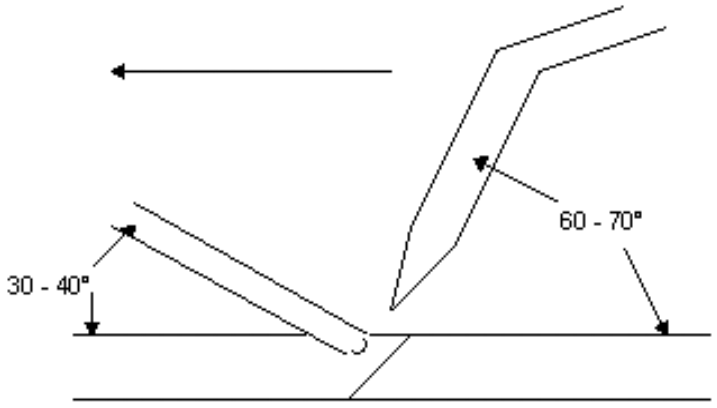


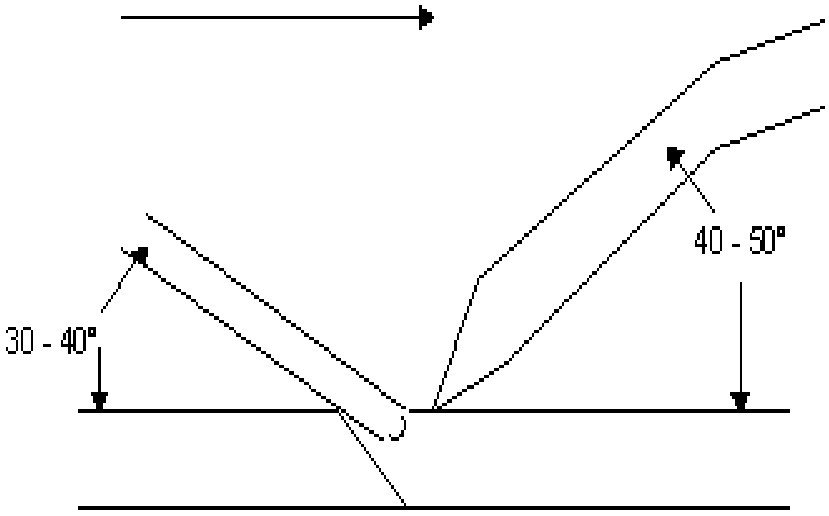
Figure 11-2. Oxyacetylene flames.

Welding methods: -

- **Left ward welding: -**In this process most of heat is absorbed by filler material rod so it is preferred in welding thin sheet about up to 6 mm thick sheet.



- **Right ward welding: -** In this process most of heat of flame is absorbed by so it is preferred in welding thick sheet 6 mm to 25 mm thick.



EXPERIMENT NO.6

OBJECTIVE: -
To makes a butt joint using arc welding as per given drawing.

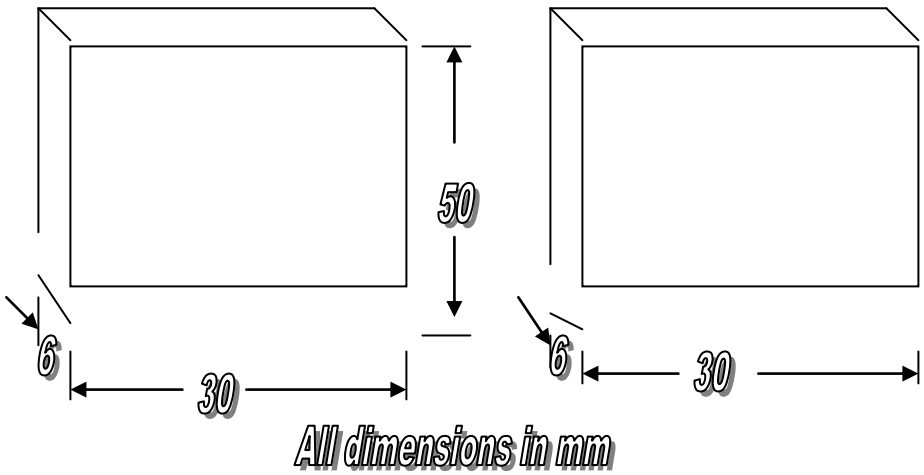
MATERIAL REQUIRED:
Mild steel flat piece (30 x50 x6mm)-2 Nos.

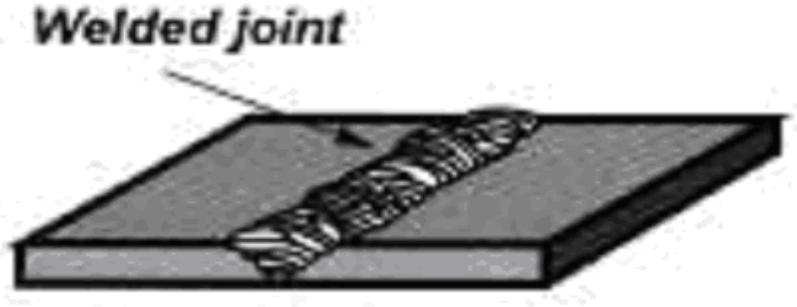
TOOLS / EQUIPMENTS REQUIRED:
Suitable A.C. arc welding set, face shield, suitable Electrodes, chipping hammer, wire brush, tong, apron, bastard file and
bench vice etc

OPRETAION INVOLVED: -
- Edge preparation for single V-butt joint
- Flat position arc welding process

PROCEDURE:

- File one edge of both pieces as shown in fig. To make V-groove. This process of edge filing to make V-groove by combination of both pieces is known as edge preparation.
- Place the work piece on the table for doing welding by applying any waving method.
- Remove slag by chipping with the help of chipping hammer.
- Remove fine particle of slage by using wire brush.





PRECAUTIONS: -

- Check all the connections before starting the welding.
- Use suitable current and voltage values for welding.
- Always adopt right tool and right procedure for every operation in welding shop.
- Use suitable apron, hand gloves, and face shied during welding operation.
- Avoid stacking electrode at job in arc welding.
- Avoid chatting with others while doing welding.

EXPERIMENT NO.7

OBJECTIVE:--
To makes a **lap joint** using arc welding as per given drawing.

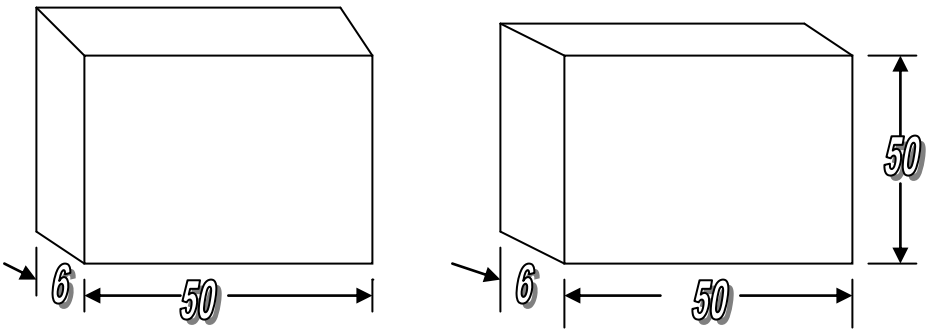
MATERIAL REQUIRED: -
Mild steel flat piece (50 x50 x6mm)-2 Nos.

TOOLS / EQUIPMENTS REQUIRED: -
Suitable A.C .arc welding set, face shield, suitable electrodes, chipping hammer, wire brush, tong, apron & gloves etc.

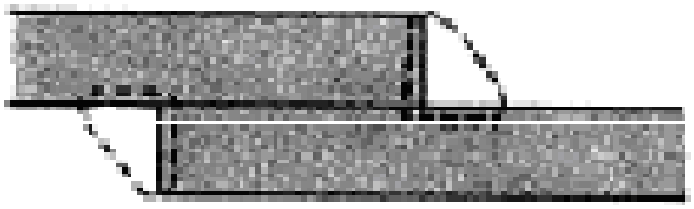
OPERATION INVOLVED:
Flat position is welding process by making lap joint.

PROCEDURE: -

- Check all the connections of welding set up like phase & earthing lug etc.
- Place job on table in proper position after cleaning surface of flat piece with the help of wire brush etc.
- Make welding on the joint as shown in fig.



All dimensions in mm



LAP JOINT

PRECAUTIONS:

- Always adopt right tool and right procedure for every operation in welding shop.
- Use suitable current and voltage values for welding.
- Always adopt right tool and right procedure for every operation in welding shop.
- Use suitable apron, hand gloves and face shield during welding operation.
- Avoid stacking electrodes at job in arc welding.
- Avoid chatting with others while doing welding.

EXPERIMENT NO.8

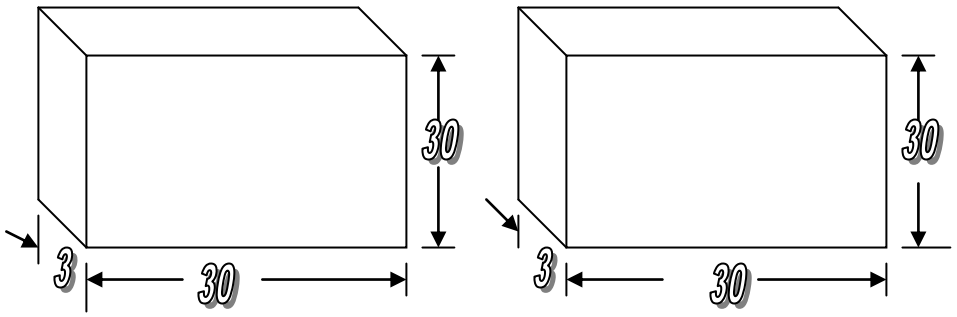
OBJECTIVE: -
To make a lap joint by oxy-acetylene Gas welding.

MATERIAL REQUIRRED: -
Two mild steel pieces (30x30x3mm)

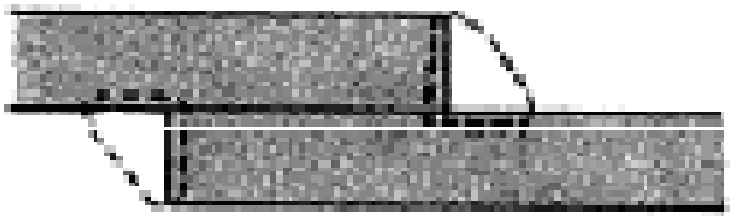
TOOLS / EQUIPMENTS REQUIRED : -
oxy – acetylene gas, filler rod, welding torch, welding table, tong, apron and goggles &wire brush. Bench vice hand hacksaw and file.

PROCEDURE : -

- Check all the connections oxy-acetylene gas cylinder
- Clean surface of mild steel flat piece surface.
- Place carefully the M.S flat piece in proper position on the worktable.
- Set properly the welding flame by adjusting the pressure of both gases.
- Start welding flowing instructions of instructors
- The above same procedure may be adopted in making lap joint welding by changing the position of the work piece.



All dimensions in mm



Lap joint

PRECAUTIONS: -

- Always adopt right tool and right procedure for every operation in welding shop.
- Always check carefully all connections etc. before starting welding.
- Detect carefully if any leakage etc. before welding.
- Use suitable apron & goggles etc.
- After welding, stop the supply of acetylene first and the stop the supply of oxygen.

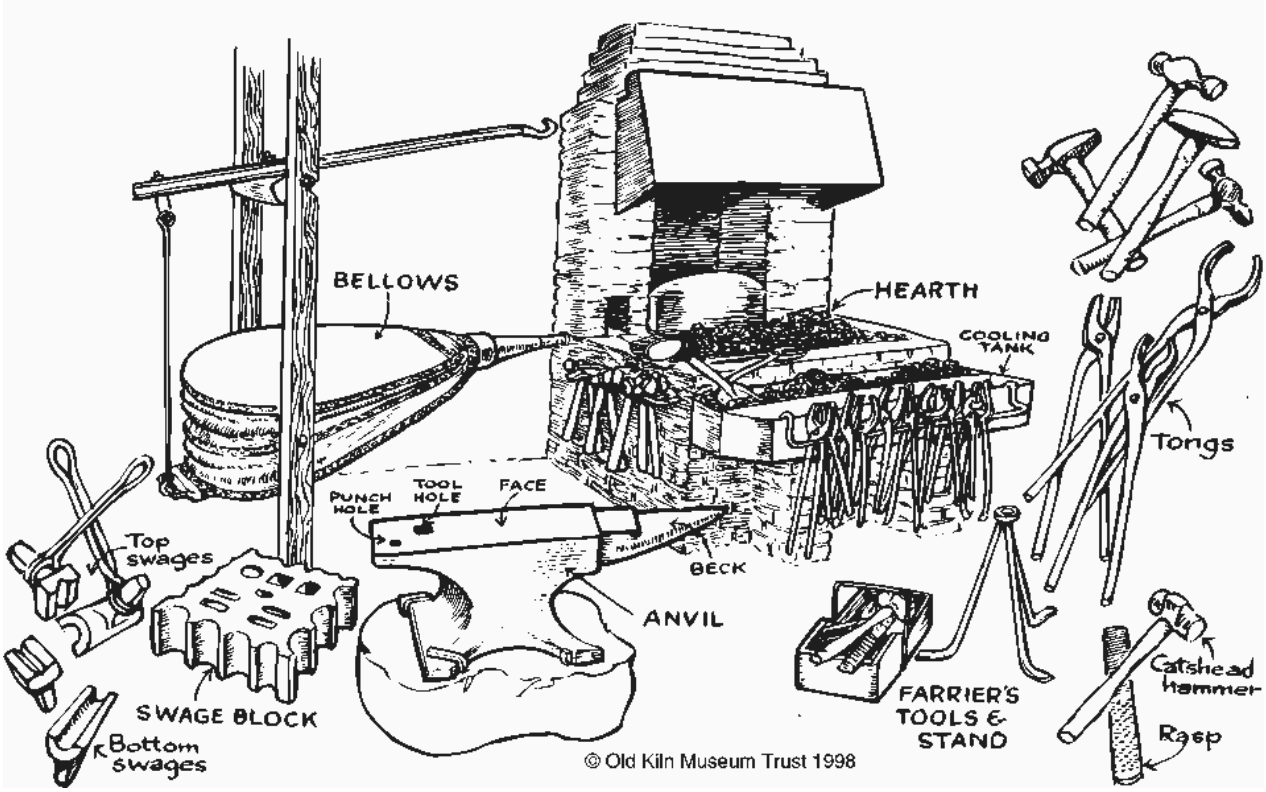
EXPERIMENT NO.9

OBJECTIVE: -

To study of tools and operation in black smithy shop.

TOOLS/EQUIPMETS USED:

- **Open-heart Furness: -** The furnace desired for heating purpose for metal job is known as hearth or smith forge. It has four legs, one water tank and another tank consists fire brakes and hood with chimney mounted over forge coal is burnt in tank and air is a blow from tuyer. Its metallic structure is made up to mild steel and in M.S tank a layer of firebricks is arranged in such a manner so that the heat of forge may not damage metallic structure. Tuyer may be provided from side of tank and from bottom of tank and the water tank is used for cooling tools and jobs from time to time during various operations**.**



- **Blower:** - it is used for providing fresh air for combustion of coal. These are manually operated and power operated both and is used, as per the capacity of Forge Normally air pressure to the forge should be 15- 20 cm of hg.

- **Sowel: -** It consists a flat M.S sheet jointed at one end of a wooden handle or M.S pipe. It is used for charging fuel (coal/wood scrap) in to forge and it is also used for cleaning ash etc. from forge. Fig. A

- **Poker: -** It is a M.S road pointed and banded at one end. It is used to remove clinker and to adjust heat at proper place by adjusting the position of burning coals. Fig. B

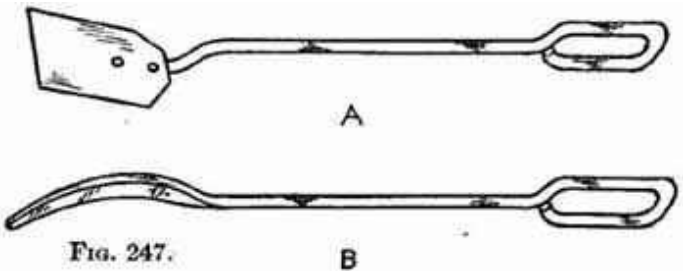
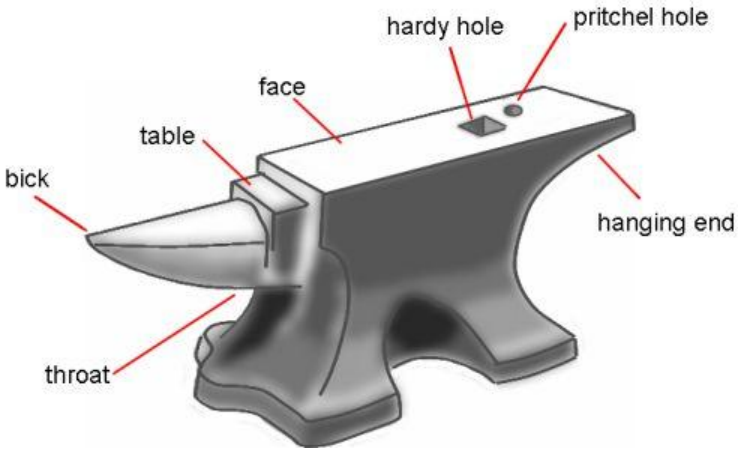


Fig. 247.

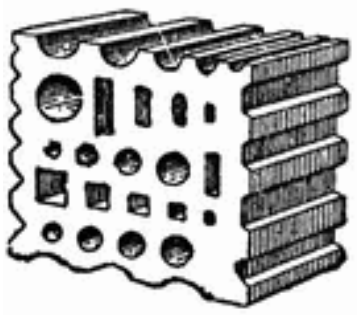
<u>HOLDING /SUPPORTING TOOLS:</u> - The tools are used in smithy work for holding and supporting purpose. Some of them are mentioned below.

- **Leg vice: -** It is used to hold the hot job for further operations like hammering and banding etc. these are made up of mild steel. It is specified by length of it jaw.

- **Anvil: -** It is used too provide support to job to withstand heavy blows of hammers etc. it is normally made up of caste mild steel or wrought iron providing 20- 25mm thick tool steel plate on the top if the anvil which escape anvil top to de shape from heavy blows of hammering etc. it is specified by its weight i.e. 25kg, 50kg, 100kg etc.



- **Swage block; -** it is also a supporting device which have number of slots and holes which give support to job to get that in desired shape and size. it is made by casting of cast steel / cast iron.



- **Tongs: -**It is a holding device used to handle job while some operation is to be carried out. It is made up of mild steel. It is specified by its length and shape of mouth. On the basis of application, it may be classified in to following types:

  (1) Flat tong
  (2) Flat mouth tong/ two side supported tongs
  (3) Round hollow tongs
  (4) Pickup tongs

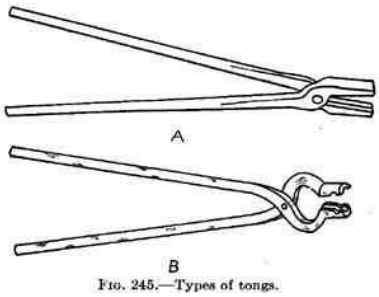
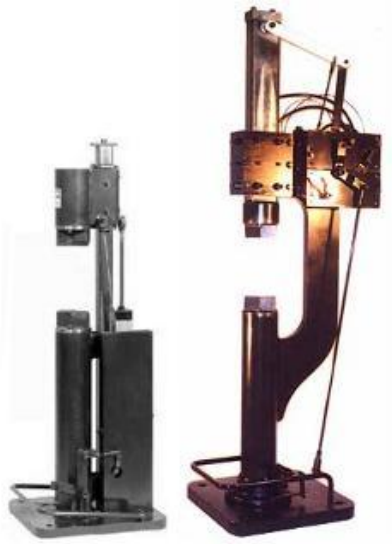


FIG. 245.—Types of tongs.

STRIKING TOOLS: - To provide a blow or impact load on job to acquire desired shape and size, hammer is the best tool in hand tools. Hammers are generally made up of high carbon steel / tool steel by forging method. It is specified by its weight excluding the handle. One the basis of shape it may be classified in to following types: -

- **Hand hammers /manually operated hammer: -**The hammers, which are operated by manual energy, come under this category.

- **Power hammer: -** some heavy hemmers are operated by other power than manual power. These hammers come under this category. These are used in heavy blow such as spring hammer, pneumatic hammer, steam hammer and drop hammer or drop stamp etc.



CUTTING TOOLS: - The various tools, which are used in cutting metals in smithy work, are kept under this category.

- **Chisel: -** it is most widely used as cutting tool. On the basis of its working conditions.
- **Hot chisel: -** These chisels are used when metals in hot condition. It is made up of medium carbon steel/ high carbon steel/tool steel etc. its cutting angle is kept about 30^{o} due to cutting of metal in plastic stage by it.

- **Cold chisel: -** It is almost similar to hot chisel but its length is generally kept more than hot chisel and its cutting angle is usually kept about 60o. It is specified by its cutting width and length. It is available with and without handle in market.

Forging temperature of mainly used materials is as under: -

Wrought iron	850^{o}C ----------1300^{o}C
Mild steel	750^{o}C---------- 1300^{o}C
Medium carbon steel	750^{o}C----------1250^{o}C
High carbon steel	750oC----------1150oC
Stainless steel	950^{o}C----------1200^{o}C
Brass, copper bronze	550^{o}C----------900^{o}C
Aluminum	300^{o}C----------850^{o}C

EXPERIMENT NO.10

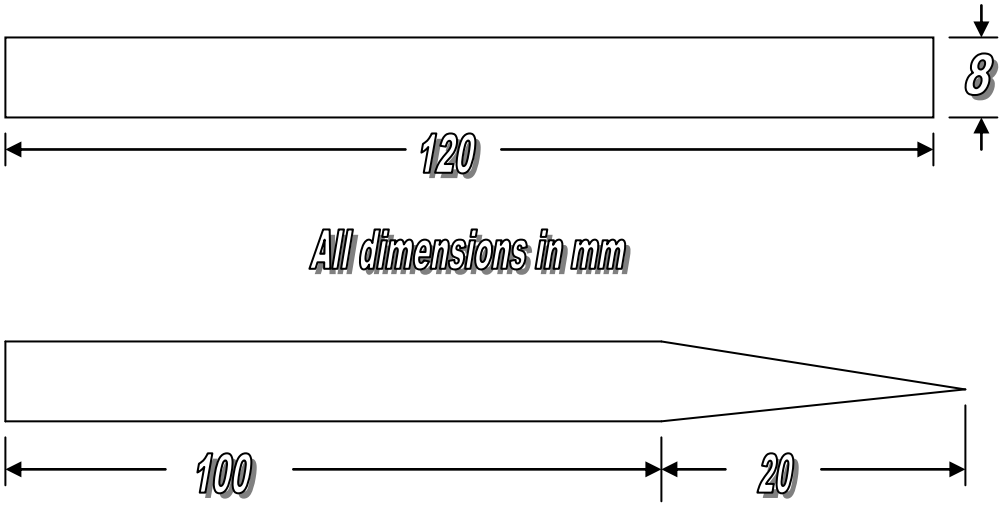
OBJECTIVE: -
c

MATERIAL REQUIRED: -
Mild steel round bar length by (8mmx 100mm)

TOOLS /EQUIPMENTS REQUIRED: -
scale, bench vice, hand hacksaw open-hearth furnace with blower, hammer anvil, sewage block tongs etc.

OPERATIONS INVOLVED: -

- **Measuring and marking**
- **Heating**
- **Hammering etc**



PROCEDURE: -

- Clean the grate of furnace, charge the wooden chips, small peace of wood and then put coal over wooden pieces and unite the coals when combustion if coal starts properly, put mild steel bar on fire and cover it with coal completely.
- When work peace hoots up to its smithy temperature (at most red colour) extract the job and put it on the anvil.
- Carry out hammering flowing the instruction of instructor till its one end gets the dimension as per drawing.
- Repeat the heating procedure again and put the job on anvil after sufficient heating and do hammering.
- Repeat the heating process and hammering to make it on end nail and round as per drawing

PRECAUTIONS: -

- Adopt right tools etc. and right procedure for every operation in smithy shop.
- If more smoke is producing in furnace, avoid placing of job in fire because coal may not attain full temperature, which will be insufficient for proper heating of job.
- Always use proper clothing, goggles and shoes etc. while working.
- Avoid damaged tools, and wrongly positioned tools etc like loose/ broken handle of hammer and unbalanced anvil etc.
- Don't spread the tools / materials at work place and put all things in well manner to its proper place.
- Use suitable tong for good gripping.
- Avoid overheating and under heating of work piece
- If any confusion, contact immediately the shop incharge.

EXPERIMENT NO.11

OBJECTIVE: -

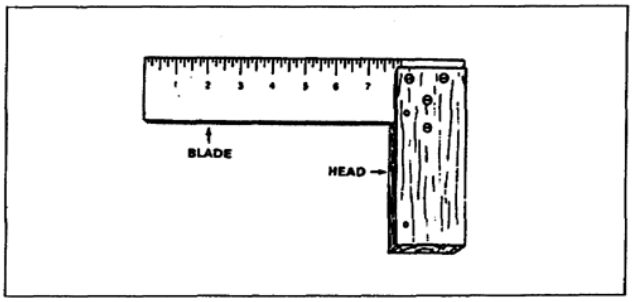
To study of tools and operation in carpentry shop.

TOOLS USED: -

MEASURING TOOLS: -

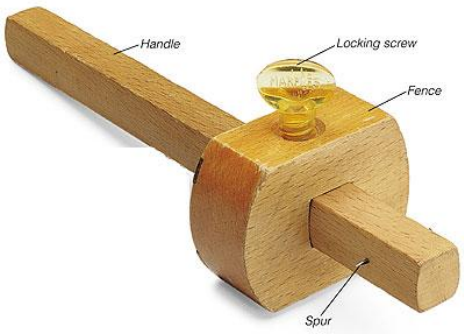
- **Scale- (steel rule): -**it is flat in shape and calibrated up to 1/16 inches in BIS system and up to half mm in metric system. Its length specifies it. Generally available in length of 6" 12", 24" and 1 meter etc.

- **Try square: -** It may be defined as measuring and marking tools for 90^o angle. It has true machined stock and blade jointed together true 90^oit is used through in direct measuring method.

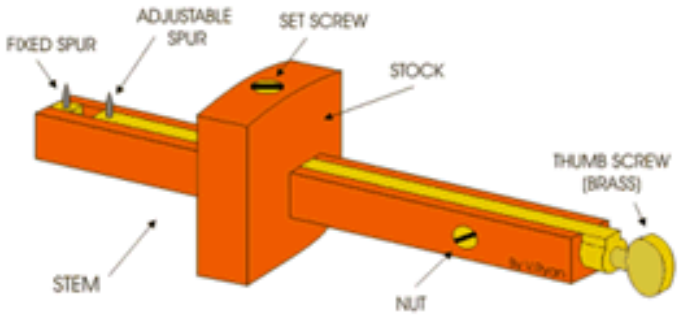


MARKING TOOLS: -

- **Marking gauge: -** It is used for parallel line marking it is made up of wooden it has a marking pi at one end a stock is housed in stem which can be adjusted at desired distance.



Mortise gauge: - It is similar to marking gauge but in integrated form. It has two marking pins – one is fixed and other is movable which can be adjusted at any described distance between two marking

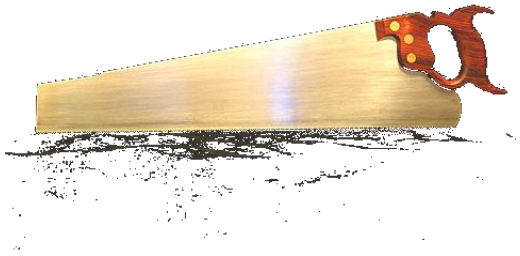


HOLDING / SUPPORTING TOOLS: -

- **Carpentry vice:** -The job is supported and holed in between the jaws of vice. In most of vices one jaw is kept fixed type and other is moving type witch move witch the help of spindle rotated by the handle fixed at one of spindle. a wooden strip is also fixed on the jaw.

CUTTING TOOLS: -

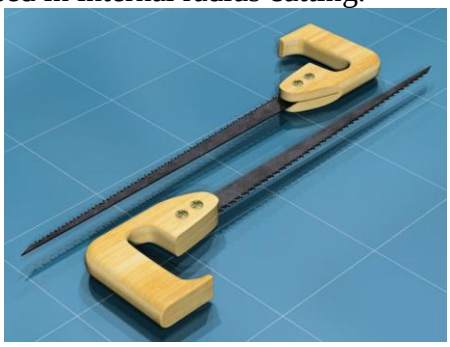
- **Ripsaw: -** It is used along the grain cutting.



- **Cross cut saw: -** it is used across the grain cutting.

- **Compass saw-** tapered in shape having less height so mostly used in radius cutting.

- **Keyhole saw –**ITS blade is same as compass saw except of its smaller size and its handle is same as file handle. It blade can be adjusted in to handle at desired length so that it is mostly used in internal radius cutting.



- **Chisel-** it is another most important tool in wood working it is made up of high carbon steel. It is specified by the width of cutting edge. It is used with the help of any impact load such as blow of hammer etc.

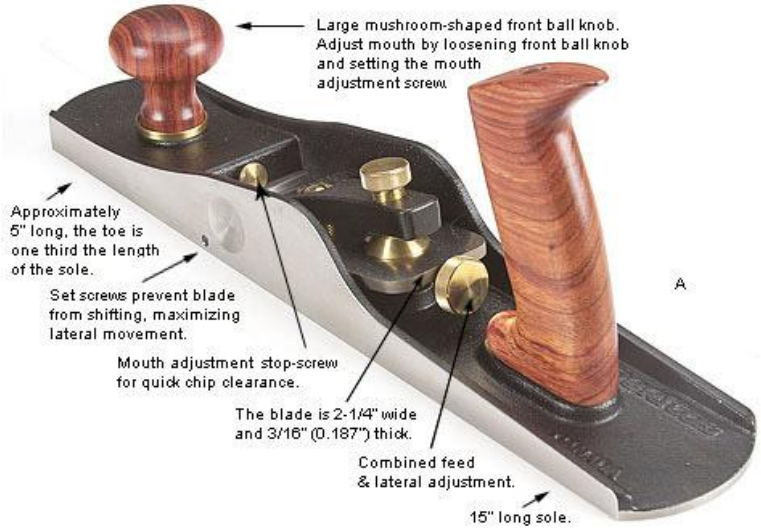
Farmer chisel

Dovetail chisel

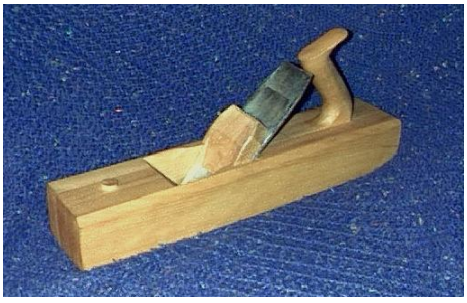
Mortise chisel

FINISHING TOOLS:-

- **Iron jack plane-** for more life and durability, some planes body / stock is made up of iron, which comes under this category.



- **Wooden jackplane –** The places whose stock or body is made up of wood are known as wooden planes.



- **Rasp cut file –** It is a fine cutting tool having number of cutting teeth on its face and it is used for finishing purpose. Process of cutting by this tool is called filing. It is made up of high carbon steel or cast steel. Its all body is hardened and tempered except of tang. Mainly it is specified by its length from tip to heel etc.

STRIKING TOOLS: -

- **Mallet: -**It is a wooden hammer used for striking purpose where dent / cracks danger are more important. It is made up of hard wood rectangular or cylindrical in shape having wooden handle housed in for gripping.

- **Claw hammer: -** It is a metallic hammer used for heavier blow where dent / crack danger are not so important, it consists a cylindrical striking face with claw on top of it and a wooden handle is housed in it for gripping purpose. Striking face is used for providing blow and claw is used as a nail puller. it is made up of high carbon steel or cast steel .

EXPERIMENT NO.12

OBJECTIVE: -
To make a mortise & Tenon joint as per given drawing.

MATERIAL REQUIRED: -
Two wooden pieces (155 x 50 x 45mm).

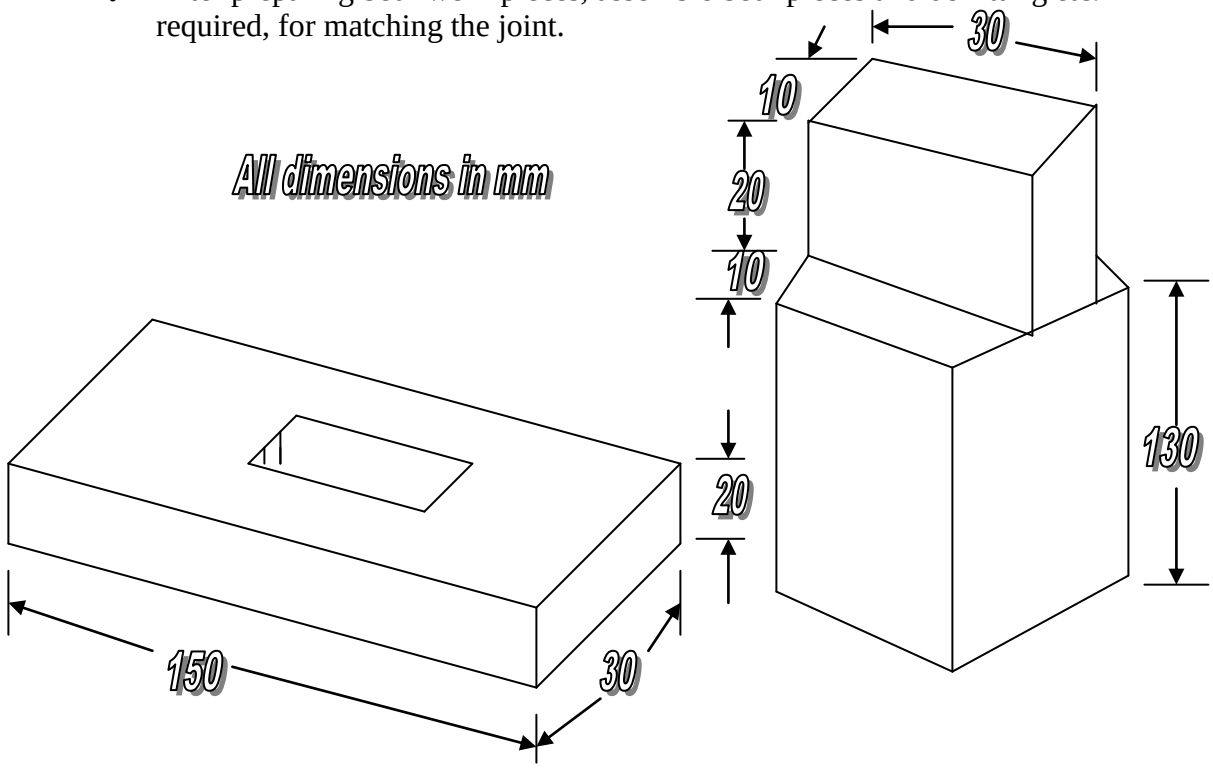
TOOLS/ EQUIPMENTS REQUIRED:
Steel scale, Scriber, Try square. Marking gauge, Tenon saw, carpentry bench vice, Iron jack/smooth plane, Rasp file, Firmer chisel and mallet etc.

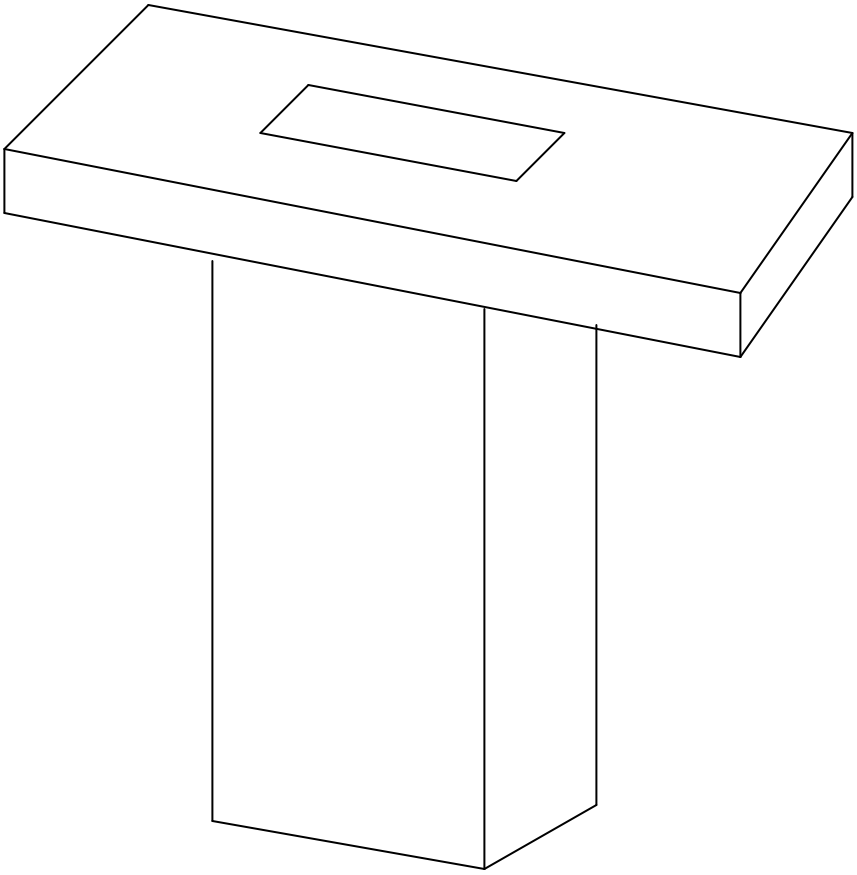
OPERATIONS INVOLVED:

- Measuring & Marking
- Planning
- Sawing
- Mortise & Tenon joint making practice.

PROCEDURE:

- 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 fitting etc. if required, for matching the joint.





PRECAUTIONS:

- Always adopt right tools and right procedure for every operation in carpentry shop.
- Work piece should be well tight in vice in proper position.
- Tools should be ready and in good condition.
- Teeth of saw should be well set and sharpened.
- During marking, keep suitable margin desired as per the operations to be carried out.

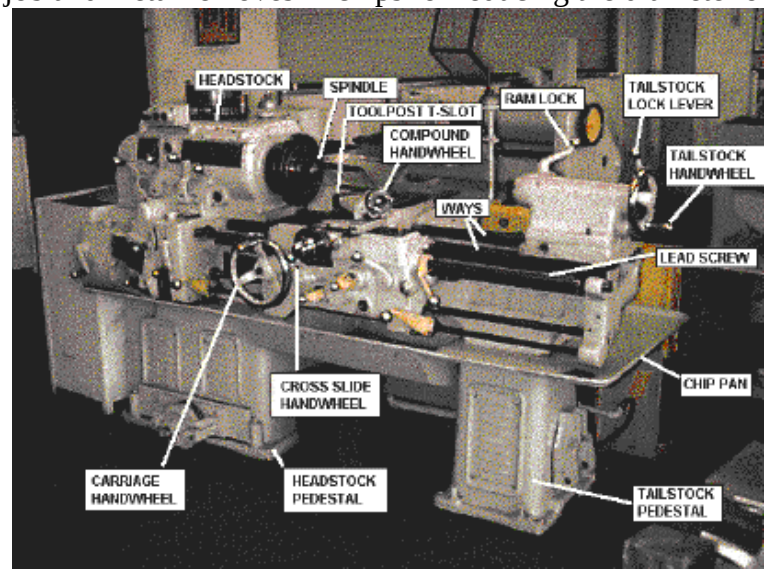
EXPERIMENT NO.13

OBJECTIVE: -

To study tools and operation in machine shop.

INTRODUCTION: -

- **LATHE MACHINE: -**It is most widely used machine tool for different operations like turning, threading and knurling etc. in this machine the work metal is fixed between two canters (one is live& other called dead center) and revolves in anticlockwise direction normally. A stationary tool is feeded closer to their revolving job and metal removes in chips for reducing the diameter of metals etc.



Main parts of Lathe: -

- **Bed: -** It is heavy structure made up of casted iron in single piece or in two or more then two pieces (in split form) also. Single piece casted iron in small machine and in large machines, split bed is use normally, commonly the bed casting consists fine grained structure and possesses hardness of 200 +- 10 %BHN. It usually works as supporting and guiding base for carriage, headstock and tailstock etc. on the top of bed v-grooved structure is provided for proper movement of carriage and tailstock etc.

- **Head stock: -** It is a hollow rectangular casted structure mounted over bed and works as housing for chuck and shafts etc. on the basis of driving mechanism used for driving shaft.
- **Tai stock: -** It is a casted structure mounted at other end of bed. It provides housing for dead center. Tapered shank drill, drill chuck, and reamers etc. tail stock can slide over V- shaped guide way provided over bed surface.
- **Carriage: -** It is a casted structure providing housing for apron, cross slide and tool port etc. it is situated between tail stock and head stock on the V- Shaped guide ways provided on the bed. It can slide over bed in left and right position.
- **Compound rest: -** It is mounted on the cross slide with the help of a swivel plate by which it can rotate in horizontal plane. It provides housing for tool post.

Tool post: - It is mounted over compound rest and provides housing for tool. Al most all types of tool post may rotate at 360^{o} angle. It is a mild steel machined structure a designed for holding tool bit. These are made in various designs. Some

- of them are designed for single tool holding capacity and some are designed for holding multh tools at a single time. In general multi tool holding, tool posts are common in use. It consists two square mild steel plates. One of them consists clamping bolts, which clamp tool bit in tool post.
- **Leg: -** These are supporting structure and provide support for bed or we say whole body of lathe machine. These are made casting of cast iron etc.

MEASURING TOOLS-

- **Scale: -** It is flat in shape and calibrated up to 1/16 inches in BIS system and up to half mm in metric system. Its length specifies it. Generally available in length of 6" 12", 24" and 1 meter etc

- **Out side caliper: -** used for out side measurements.

- **In side caliper: -** used for in side measurements.

MARKING TOOLS

Scriber: - Made up of hardened and tempered high carbon steel. Tip of scriber is grinded at 12^0 to 15^0 and is generally available in 125mm to 250 mm. It is for used fore tempered marking

HOLDING DEVICE: -

- **Chuck:** -it is used fore holding / gripping work piece. It is mounted at one end of spindle. According to construction and application, these may be divided in to flowing types.
    (a) **Three-jaw chuck:** - it is also known as self-centering chuck because it contains three jaws, which operate simultaneously while operating any pinion. But its use is limited because it requires uniform surface of work from where it is to be gripped
    (b) **Four jaw chuck / dog chuck: -** it contains four jaws, every jaw moves in dependently to any jaw containing non- uniform surface which can also be centered in this chuck, so generally this chuck is most popular.
    (c) **Magnetic chuck:** - magnetic chuck contains no jaws. In absence of jaw, these chuck use magnetic power for griping fore the job. According to the power

CUTTING TOOLS: -

- **Single point cutting tools: -**these cutting tools contain only one cutting edge/ point. For example turning, parting & grooving tools for lathe machine, shaper tools and planer tools etc.
- **Multipoint cutting tools: -**these cutting tools contain more than one cutting edge/ points. For example – drill bit, broach and milling cutters etc.

EXPERIMENT NO.14

OBJECTIVE: -
To make a job on lathe machine as per given drawing.

MATERIAL REQUIRED-
Mild steel bar (102 x32mm)

TOOLS / EQUIPMENTS REQUIRED: –
Chuck key, tool post key, turning tool bit, surface gauge, outside caliper with scale & vernier caliper etc.

OPERATION INVOLVED: -
- Centering
- Facing
- Turning
- Taper turning
- Knurling
- Grooving

CALCULATION INVOLVED:-

$$\text{Taper turning angle} = \frac{D-d}{2L} = \tan\alpha$$

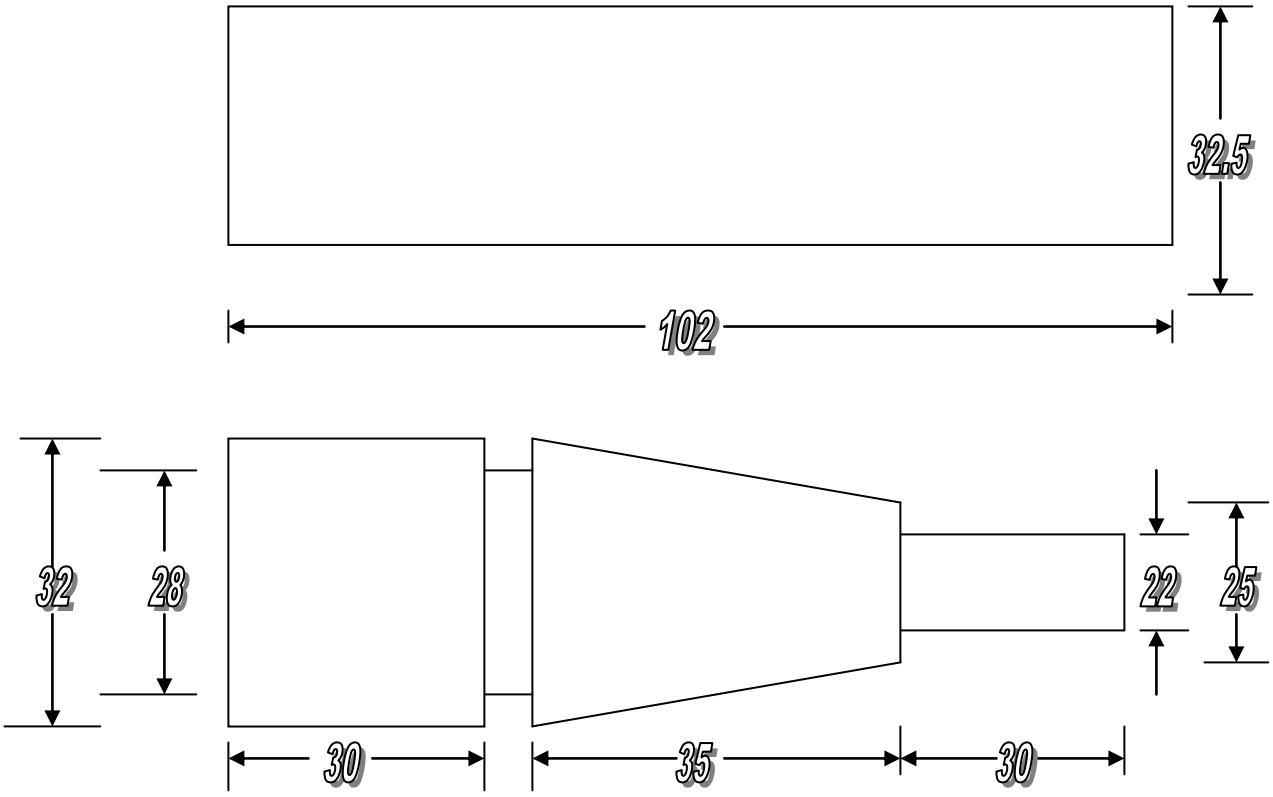
$$\alpha^0 = \tan^{-1}\frac{D-d}{2L}$$

(α = Angle For tilting the compound rest)

PROCEDURE: -

- Hold the mild steel bar properly in chuck of lathe machine.
- Check the position of job, it should be in center of chuck, check with the help of surface gauge.
- Check all the levers etc. should be in unengaged position before starting the machine.
- After switching on the machine see visually the approximate center of job .it should not revolve in elliptical position.
- Switch off the machine and mount the tool bit in the tool post in proper position. It should be well tightened and tip of tool bit should coincide with the center of job.
- Tilt the position of tool post in such a manner that the tip of tool bit come about 30-40” with the job.

- Then by feeding with the help of cross-slide feeding wheel till the tip of tool bit reach at center of job. This process of metal removing is known as facing.
- After right angle position with job .Now feed will be given with the help of star wheel facing tilt back the tool post to its previous position so that the tip of tool bit come at. This metal removing process from surface of job is known as plain turning till you get the required diameter of bar as per given drawing.
- Now change the position of job in chuck and tilt the compound rest at desired angle and feed the tool with help of compound rest wheel till get the desired dimensions.
- After taper turning engage back gear and reduce the speed of spindle and replace the taper turning tool bit with knurling tool bit and do knurling same applying feed as in plain turning applied. After knurling, turn the position of job in chuck.
- After knurling tilt back the tool post to its previous position and reducing dia for a short length of called groove and process making called grooving.



PRECAUTIONS: -

- Know the basics of operational mechanism very well before operating lathe machine.
- Adopt always-right tool and right procedure for every operation in machine shop.
- Always check all the gears and levers should be unengaged or in ideal position before switching on the machine.
- tightened enough before starting machine.
- Use proper feed to the tool bit along with appropriate speed.
- Avoid starting machine after applying feed / load.
- Always adopt appropriate r.p.m. Of spindle desired as per the operation.
- Always make large diameter first and smaller one in the last.
- Never use outside caliper / steel scale /vernier caliper etc. in running condition.
- Avoid chatting while working on any machine.
- Avoid any emotional disorder / disabilities while working on any machine.
- If feeling any abnormality in sound etc. of machining, switch off the machine and inform to the shop incharge immediately.