AMIRAJ

COLLEGE OF ENGINEERING & TECHNOLOGY

LABORATORY MANUAL

WORKSHOP/ MANUFACTURING PRACTICES

SUBJECT CODE: 3110012

MECHANICAL ENGINEERING DEPARTMENT

B.E. 1st Year (Semester 1-2)

NAME:_____

ENROLLMENT NO: _____

BATCH NO: _____

YEAR: _____

Amiraj College of Engineering and Technology,
Nr.Tata Nano Plant, Khoraj, Sanand, Ahmedabad.

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Amiraj College of Engineering and Technology,

Nr.Tata Nano Plant, Khoraj, Sanand, Ahmedabad.

CERTIFICATE

This is to certify that Mr. / Ms. _____

Of class_____ Enrolment No _____has Satisfactorily completed the course in Workshop/ Manufacturing Practices as by the Gujarat Technological University for 1st Year (B.E.) semester 1/2 of Mechanical Engineering in the Academic year_____.

Date of Submission:-

Faculty Name and Signature
(Subject Teacher)

Head of Department
(Mechanical)

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List of Experiments

Sr. No.	Title	Date of Performance	Date of submission	Sign	Remark
1	Introduction to Workshop				
2	Safety rules of Workshop				
3	Machine tools of Workshop				
4	Fitting Shop				
5	Carpentry Shop				
6	Tin Smithy Shop				
7	Welding Shop				
8	Plumbing Shop				

1. INTRODUCTION OF THE WORKSHOP

INTRODUCTION:

The word workshop is a combination of two separate words work and shop.

Regarding work Mr. Webster says," work is a physical or intellectual effort directed to some end. Either one, physical effort or intellectual efforts taken alone are drudgery properly combined then produces enthusiasm."

Shop directs us to place where this work is being properly utilized. So in short we can say workshop is a place where physical or intellectual effort gets proper utilization.

Every engineer is in one way or other associated with workshop, whether he may be civil, mechanical, electrical, or of any other branch.

Here it is very important to be familiar with workshop and various departments in workshop and this will give general idea of duty expected from the concerned engineer.

We will give some idea of the following basic types of workshops:

(1) Training workshop and
(2) Production workshop.
(1)Training workshop: ours is a training workshop. Her boys,students or persons are being trained.

We have the following department in the workshop:

(A) carpentry and pattern shop:

Here we know about, various tools useful for working on wood, types of wood

and in details the suitability of wood for a job. Different kinds of joints of wood. How to make a pattern, various kinds of pattern, what is its use, etc

(B) fitting shop:
Along with working with various hard tools to work on metal, this shop will develop a skill to make a part fit with another.
This skill is very essential, as working with help of machines is not every time suitable for this of work.

(C) forging or smithy shop:
This is a place where a work piece is heated and forged to obtain the required shape and size. We study the various tools and equipment's, process and technique for the same.

(1)FOUNDRY SHOP:

Here the pattern is molded, after preparing the mould in sand; the molten metal is poured to obtain required casting. To know in details, we need to learn. Types of pattern, the processes to mould them, the cores for obtaining hoi castings. The various processes to prepare them. Sand its varieties and qualities preparing mould sand; and various techniques of testing above things. Which lead to make a good casting?

(1) Machine shop:
Here we can see basic types of machines such as lathe, drilling machine hacksaw machine etc. we can learn the basics 0f metal removal process.

(2) Production workshop:
The environment of production workshop is full of activities. You can ; the workman doing his work. He/She may be

- Working himself.
- Observing the work.
- Guiding the workmen.
- Transporting the work to be done.
- Transporting the worked work to other place for the process.
- Supervising the work.

In short every one concentrating to the assigned work. All these will remains; continuous, smooth running if every thing goes all right i.e. enough work, enough suppl of material, enough enthusiasm etc.

It has an administrative office, which firstly control the planning, purchase, sale: accounts etc.It has a further drawing and design office, which will design and make th necessary drawing choose the material and make necessary specifications, select thi process and material so that it's cost is minimized.

After this the work material is sent to workshop or departments concerned ir workshop where it is processed, later on inspected for dimension or tested as the *cast* may be; finally various parts are assembled to make the unit.

(3) Similarly people can distinguish some workshop as fabrication workshop or repair and maintenance workshop. Where fabrication of structure work or repair and maintenance work is carried out.

From above discussion an engineer must try to learn in workshop training.

(1) Various workshop procedures used for changing the shape of material, various processes used for joining or assembling of different parts etc.

(2) Understand, the general routine procedure in the workshop, such as allotment of work, material, Inspection, reporting of faults. First aid and reporting of causality etc.

Majority of engineers is engaged in workshop on shop floor. The following points will help in achieving a successful career.

- Ability to lead guides and controls the groups of persons,, and take decision without confusion.
- Shop disciplines; such as carrying out orders and instruction, punctuality of yours and your subordinates, etc.
- Sense of cleanliness.
- Cost-sense, that is reducing the cost wherever, possible.
- Safety consciousness, what factors will lead to safety of personal, equipments or both.

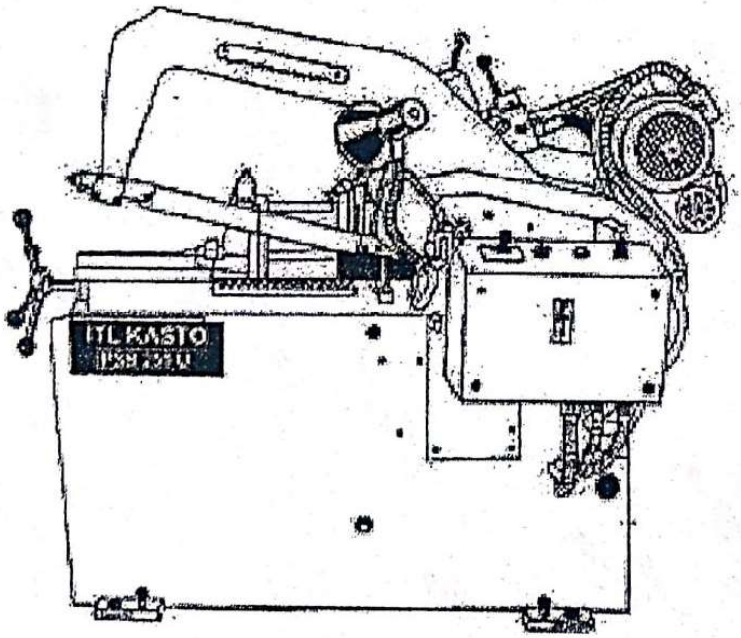
2.SAFETY RULES OF THE WORKSHOP

1. Always follow the instructions & rules of the workshop.
2. Listen Carefully all the instructions given by the instructor.
3. Always wear an Apron as it will protect your clothes & you also.
4. Do not Run in the Workshop.
5. Wear good strong shoes during practical hours in the Workshop.
6. Bags should not be brought in to the workshop.
7. Do not operate any Machinery without any instructions given by the instructor.
8. Keep your working place clean.
9. Make your jobs perfectly in the time period allotted .
10. Give full attendance in yours practical works of workshop.
11. Make necessary sign after completing your job.
12. Do not break any tools, materials or any rule of the workshop.
13. Make necessary sign after completion of your job by the instructor and concerned faculty.
14. Return your tools/materials before leaving the workshop.

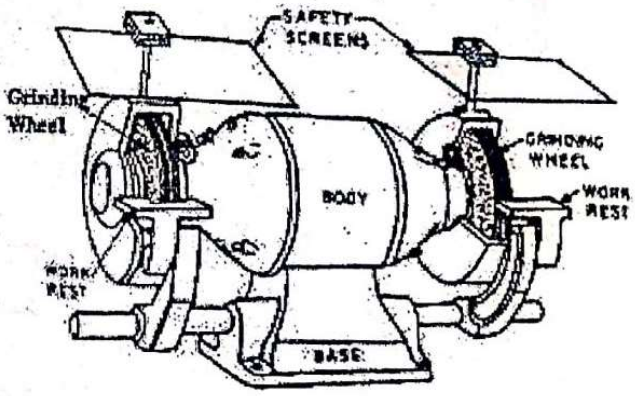
3. MACHINE TOOLS OF THE WORKSHOP

WE HAVE THE FOLLOWING MACHINE TOOLS (POWER TOOLS) IN OUR WORKSHOP.

1) HACKSAW MACHINE
2) GRINDING MACHINE
3) SIMPLE LATHE MACHINE
4) DRILLING MACHINE

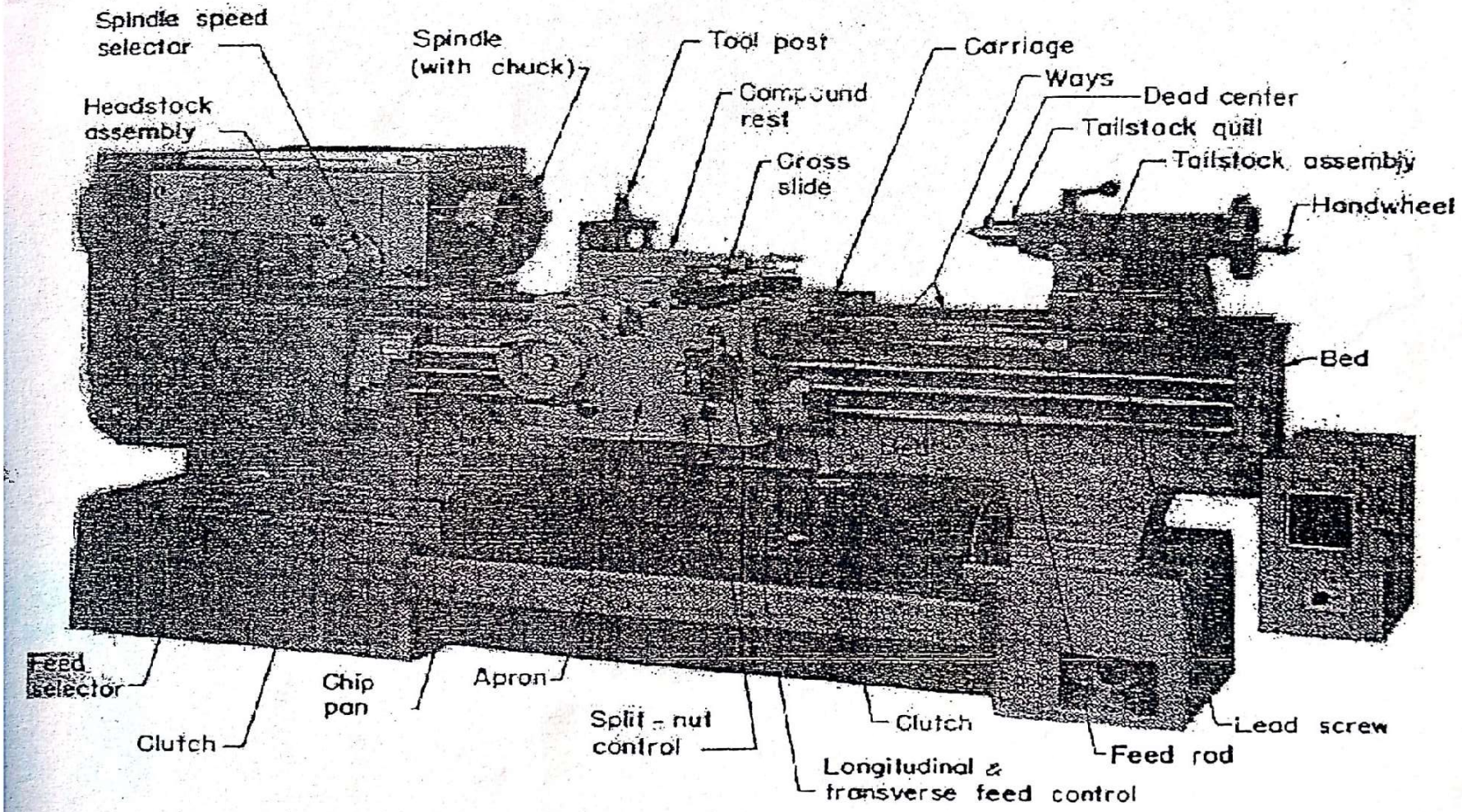


HACKSAW MACHINE

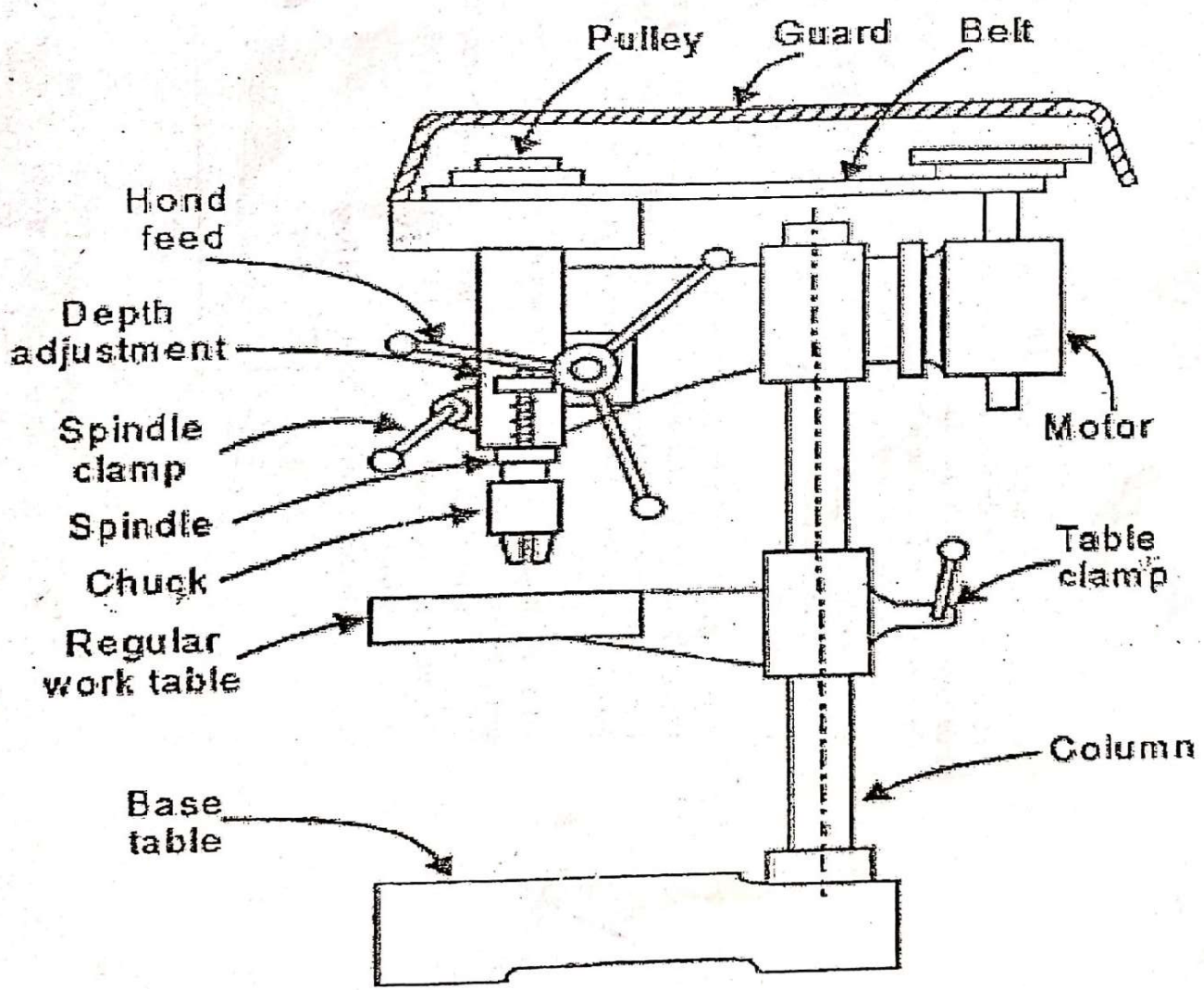


GRINDING MACHINE

DIFFERENT PARTS OF SIMPLE LATHE MACHINE



DIFFERENT PARTS OF DRILLING MACHINE



4. FITTING SHOP

INTRODUCTION:

In heavy and medium engineering industries bench work and fitting have important roles to complete and finish a job to the desired accuracy. Although majority of the work can be finished to a firmly good degree of accuracy in a reasonable time through various machining operations, they still require some operations to be done on them by hand; to finish the job. Much of the raw materials go into the machine shop and reappear as a finished component ready for assembly, some part need both machining and then a certain amount of work in fitting, other parts are entirely made and fitted on the bench. Fitting is the assembling together of part and removing metals to secure the necessary fit.

TOOLS USED IN FITTING SHOP:

FILES: Files are used for cutting, smoothing off or removing small amount of metal. Files are made in various lengths, shapes, cuts and spacing of their teeth. Every file has five parts Tip or Point, Edges, Face, Heel or Shoulder and Tang as shown in fig:1.

Files are classified and named according to three principal factors-sizes, type or cut of teeth and sectional form.

The size of a file is a length, which is the distance from the point to the heel. For fine work files are usually 100 to 200 mm and for heavier work from 200 to 450 mm in length are used

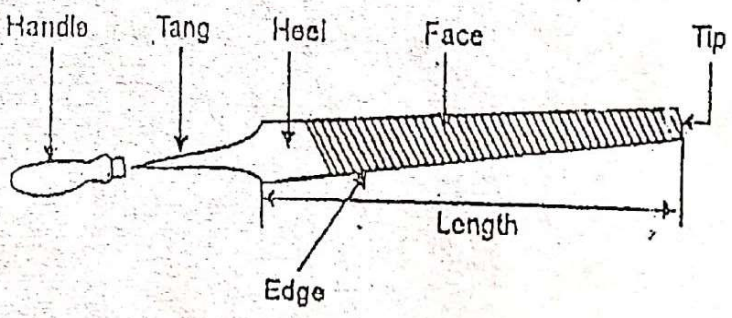
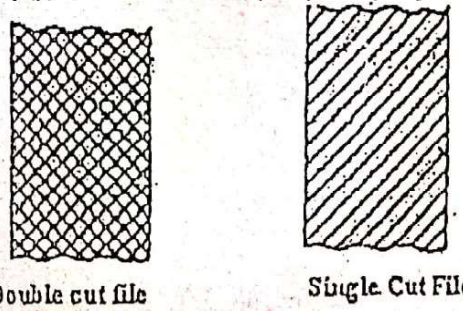


Fig: 1 Parts of File

Cuts of files are divided into two groups - single cut and double cut (Fig: 2). These files are further divided according to spacing between teeth as Rough (R), Bastard (B), Second Cut (SC), Smooth (S), Dead Smooth (DS) and Super Smooth (SS).



As per the cross-section, the files are classified as Square file, Triangular file, Round file, Half Round file, Flat file, Hand file, Knife Edge file, Diamond file as shown in Fig: 3 (a-h).

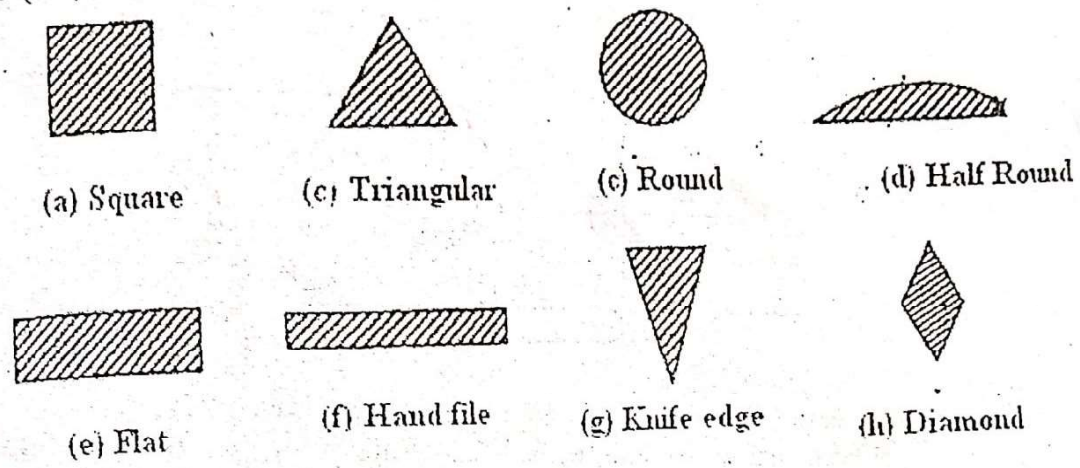


Fig: 3 Cross Sections of file

While ordering a file, following information should be given; Length, Shape, Cut and Roughness (Spacing). Generally there are three methods of filing-Cross filing (Fig: 4a), Straight filing and Draw filing (fig: 4b).

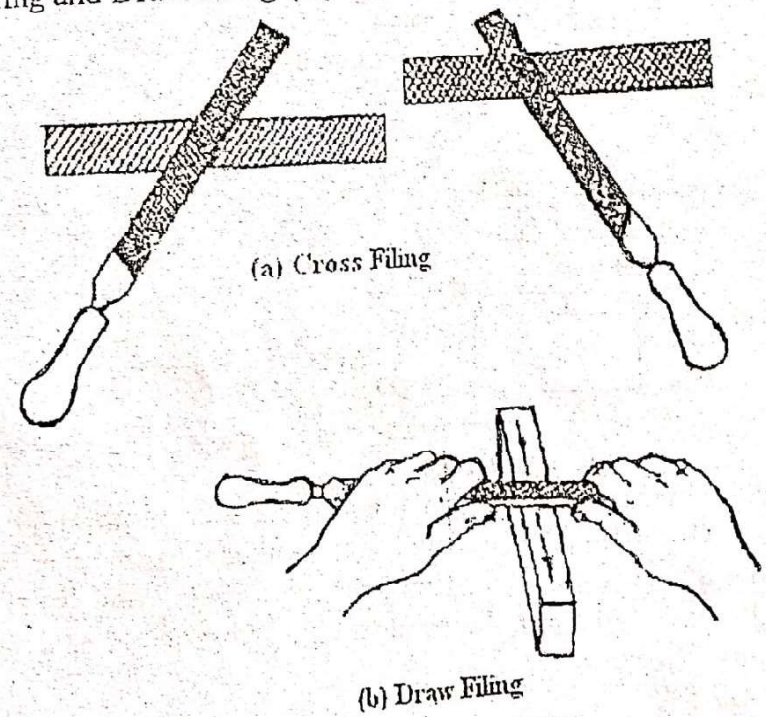


Fig: 4 Methods of Filing

VICES:-The vice is the most common tool for holding work. The Various types of vices, used for various purposes are Bench Vice, Leg Vice, Pipe Vice, Hand vice and Pin vice and Toolmaker's vice.

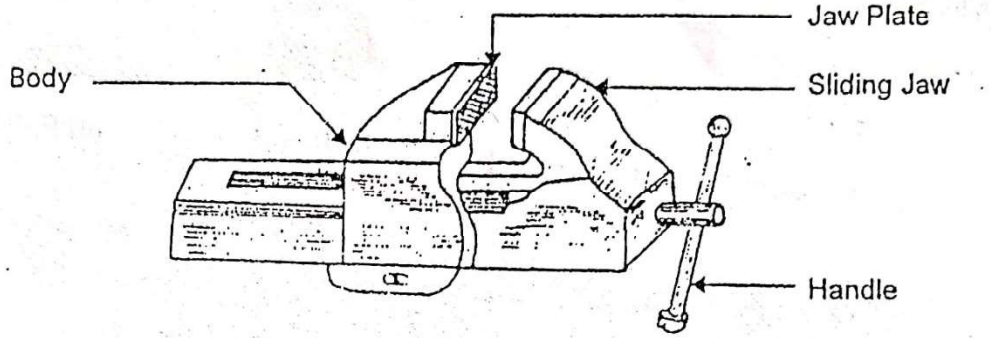


Fig: 5 (a) Bench Vice

Bench vice is sometimes called as Fitter's vice. It must be firmly fixed to the bench. It consists of an iron or steel cast body, square threaded screw, nut handle, two jaw and jaw plate as shown in fig: 5a.

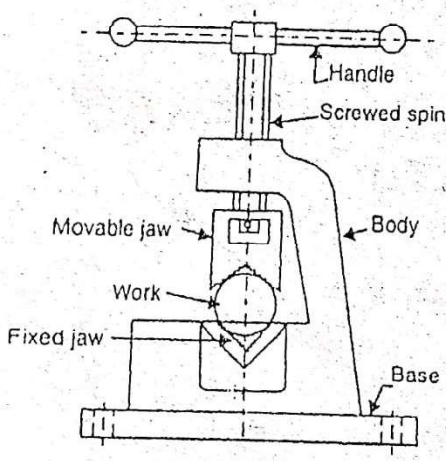


Fig: 5 (b) Pipe Vice

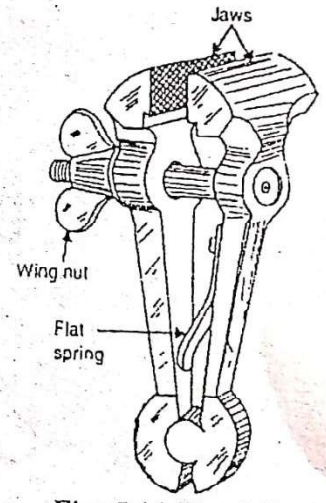


Fig: 5 (c) Hand Vice

The pipe vice is used for holding round section metal, tubes, pipes etc. it consists of two jaw. One of which is movable and another is fixed as shown in fig :5b.

Hand vice is used for griping screws, rivets, keys, small drills and other similar objects. It consists of two jaws which are hinged together on a pivot, on the opposite ends as shown in fig: 5c.

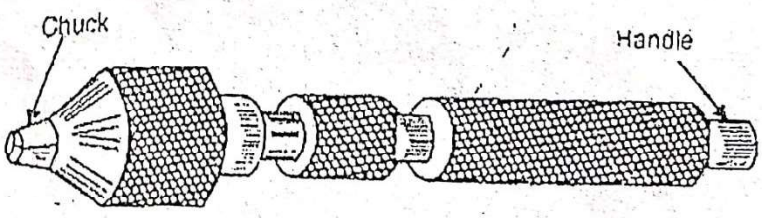


Fig: 5 (d) Pin Vice

The Pin vice is used for holding round material of small diameter such as wire, pins etc. The work is gripped between the jaws of the chuck by rotating the handle (fig: 5d).

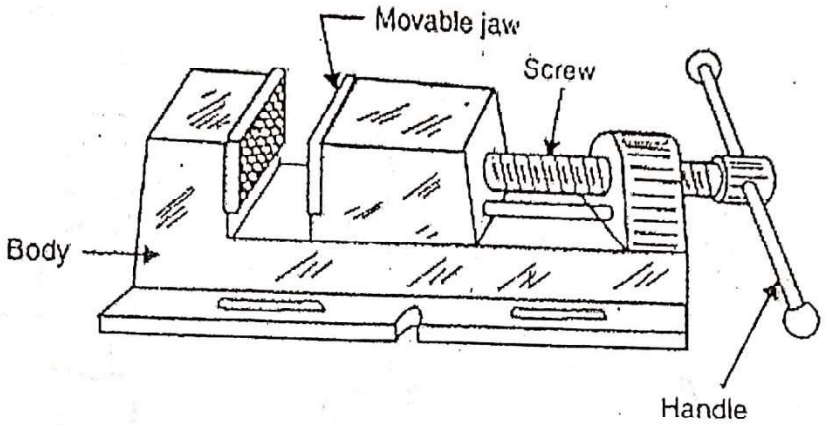
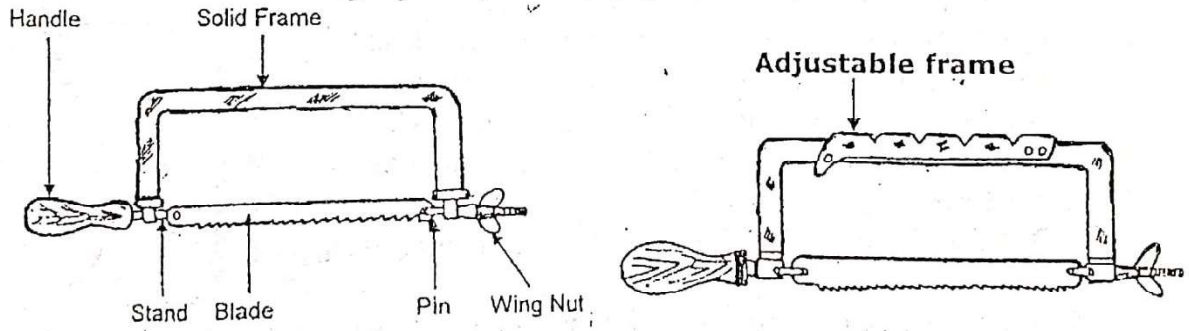


Fig: 5 (e) Toolmaker's Vice

The Toolmaker's vice is particularly useful for holding small work which requires filing or drilling. It consists of a body with a solid jaw, a movable jaw, a screw and a handle for the control of movement of movable jaw, as shown in fig: 5e.

HACKSAW:- The hacksaw is used for sawing all metals except hardened steel. A hand hacksaw consists of a frame, handle, prongs, tightening screw, nut and blade. The frame is made to hold the blade tightly.



(a)Solid Frame **(b) Adjustable Frame**

Fig: 6 Types of Hacksaw

They are made in two types: The solid frame in which the length cannot be changed as shown in fig: 6a and the adjustable frame which has a back that can be lengthened and shortened to hold blades of different length as shown in fig: 6b. The blades are made of high carbon steel, low alloy steel or high speed steel. The blades are specified by length, width, thickness and pitch of the teeth, which are usually in the range of 250 to 300 mm, 13 to 16 mm, 0.63 mm to 0.8 mm and 1.0 to1.8 mm respectively.

HAMMERS:-Hammers are used to strike a job or a tool. Hammers are classified according to the shape of the pean, as Ball pean, Cross pean and Straight pean hammer shown in fig: 7 .

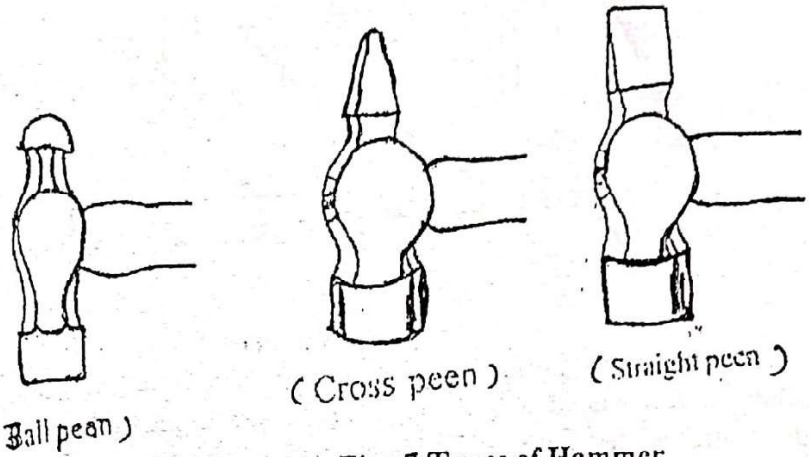
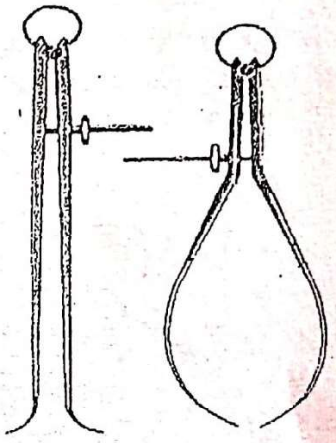


Fig: 7 Types of Hammer

MARKING TOOLS:- Surface plate, Scriber, Centre punch, V-block, Angle plate, Try-square and Marking Block are the common tools used for marking.

CALIPERS:-Outside and inside calipers are used to check outside and inside dimensions. These are used to set the dimensions, to transfer them to work or to check with standards. Inside and outside calipers are shown in fig: 8a and b respectively

DIVIDER:-Divider is used for marking or dimensioning purpose.



(a) Inside Calipers (b) Outside Calipers

Fig: 8

Chisels:-Chisels are used for cutting and chipping away pieces of metal, and are made of carbon steel usually of rectangular, hexagonal or octagonal cross section. Chipping is the process of removing thick layer of metal by means of cold chisels. The five common types of Chisels are (a) Flat Chisels, (b) Cross-cut Chisels, (c) Half-round Chisel, (d) Diamond point Chisel and (e)Side Chisel as shown in fig:9.

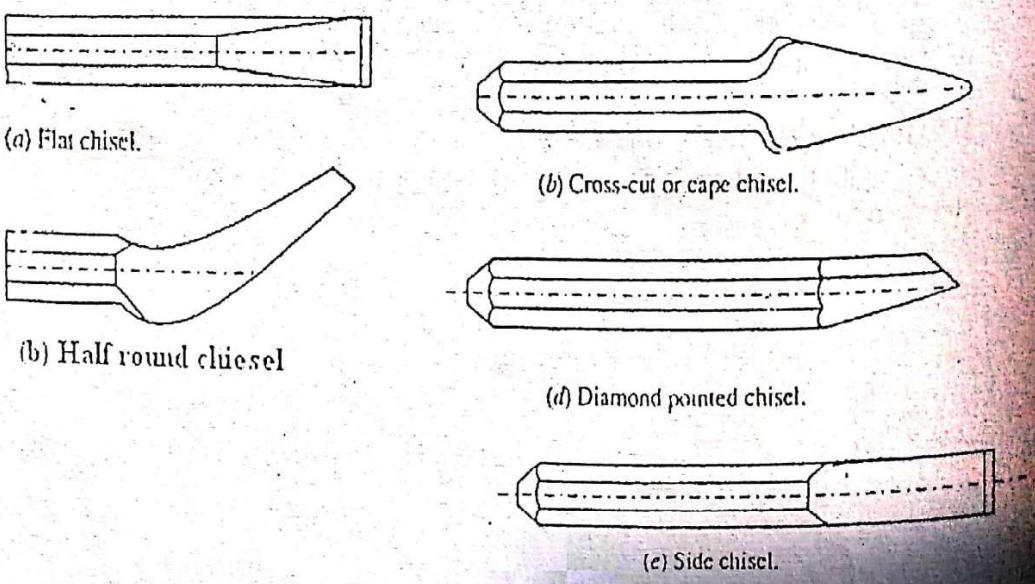
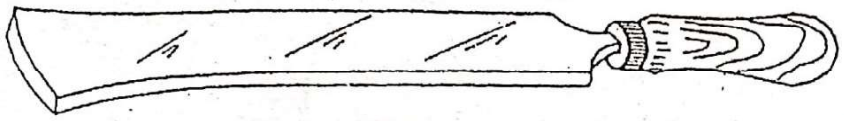
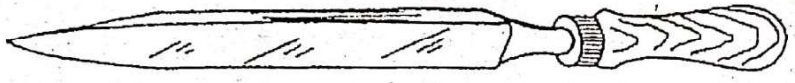


Fig: 9 Types of Chisels

SCRAPERS:-Scrapers are used for shaving or parting off thin slices or flakes of metal to make a fine, smooth surface. The various kinds of scrapers are (a) Flat, (b) Triangular and (c) Half round scrapers as shown in fig: 10.



(*a*) Flat scraper.



(*b*) Triangular scraper.

(*c*) Half round scraper.

Fig: 10 Types of Scraper

DRILL:-A twist drill is a tool with parallel or taper shank and used for making circular holes in a metal piece. In the fitting shop, generally, drilling operation is performed using pillar type drilling machine.

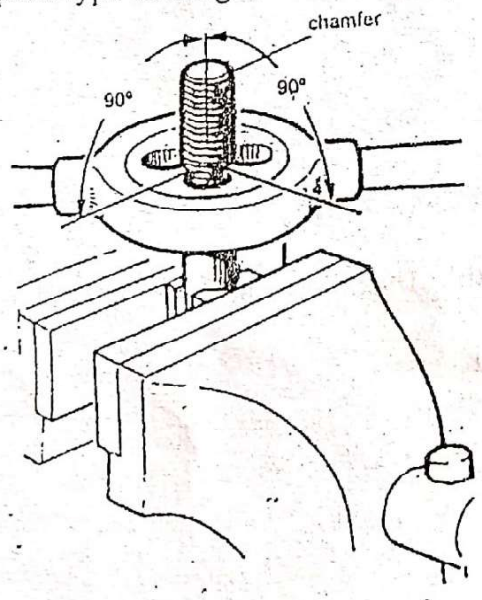


Fig: 11 Threading by Die and Stocks

Taps:-A tap is a screw like tool used to cut threads on the inside of a hole, Taps are made from carbon steel or high speed steel, and are hardened and tempered. Hand taps are usually made in sets of three; (1) Taper tap or Rougher (2) Second tap or Plug tap or Intermediate tap and (3) Bottoming tap or Finisher tap. The upper part consists of a square shank for holding the tap, by a tap wrench, fixed or adjustable.

Dies and Stocks:-Dies are used to cut threads on a round bar of metal as shown in fig: 11. Two main types of dies in common are used solid die and adjustable die. A circular adjustable split die can also be used for threading. The tool for holding and turning the threading die is called a die stock, often called as a stock. Cutting external threads on a round rod with a die and stock is called dieing or external threading.

SPANNERS & SCREW DRIVERS:-Spanners and screw drivers are used to tighten or loosen nut bolts, screw or pipe plugs etc.

Quiz

Q.1 What is the function of file?
Q.2 What is the function of scriber?
Q.3 Name various methods of filing.
Q.4 Which precautions will you take in filing operation?
Q.6 State the main types of dies.
Q.7 What specifications of file needed while purchasing it?
Q.8 List the parts of the file.
Q.9 Classify the files according to spacing between teeth.
Q.10 How files are classified according to cross section?
Q.11 Bench vice is also known as _____.
Q.12 The length of the hacksaw blade is usually in the range of _____.
Q.13 Classify the hammers.
Q.14 What is the application of pin vice?
Q.15 What do you mean by fitting?
Q.16 What is the size of a file?
Q.17 What is the size of files for fine work?
Q.18 What is size of files for heavier work?
Q.19 _____ is the most common tool for holding work.
Q.20 List various types of vices.
Q.21 What is the application of pipe vice?
Q.22 What is the application of hand vice?
Q.23 List the parts of the hacksaw.
Q.24 Which materials are used for hacksaw blades?
Q.25 How hacksaw blades are specified?
Q.26 What is the usual range for length, width, thickness and pitch of the teeth of hacksaw blades?
Q.27 _____ is used to strike a job or a tool.
Q.28 List the common tools used for marking.
Q.29 What is the use of callipers?
Q.30 What is the use of divider?

5. CARPENTRY SHOP

Introduction:
Carpentry is a term used with any class of work with wood. It deals with all works of carpentry such as roofs, floors, partitions etc. of a building. Timber is a basic material used for any class of wood working.

Classification of wood:
For commercial purpose, timbers are divided into two classes:
(1) Softwood
(2) Hardwood

Softwood belongs to coniferous, which has long narrow leaves. They contain turpentine and resinous matters in their cells they are light in weight and light coloured. The fibers are generally coarse but straight and hence, capable of resisting direct axial stresses. But they cannot resist any kind of stress development across their fibers and the timber gets splitted easily, examples are deodar, pine, fir etc.

Hard woods belong to broad leave trees. They do not contain any resinous matter. They are darker in colour, comparatively heavy, the fibers are fine grained, compact, properly bonded and often found very straight. So hard woods are nearly equally strong in both along and across directions. The fibers can resist axial stress as well as transverse strain, shock and vibration satisfactory e.g. Sal, Teak, Shisham etc.

Common Varieties of Indian Timber:-Indian timbers most commonly used for wood are as follows:

Babul: - The wood is pale red to brown in colour, close grained, hard and tough, but elastic and takes a good polish. They are used for bodies of carts and wheels, agricultural implements, tool handles etc.

Deodar:-It is light colored and has close well marked coarse grains. It is used in making tea boxes, sports goods and packing material. It is widely found in northern and central India.

Mango: - The wood is of inferior quality, coarse and open grained and of deep gray colour. They decay readily when expose to wet and are readily eaten by white ants. They are widely used for common doors, windows and furniture.

Sal: - The wood is of dark brown colour, hard, close grained, heavy, resistant to white ants and durable. It is hard to work and does not take a high polish. It is widely used for constructional purposes.

Shisham: - The wood is dark brown in colour, tough, durable and has well marked coarse grains. It is one of the best Indian woods for joiner's works, tables, chairs and other furniture.

Teak: - The wood is brown in colour, straight grained and is fragrant when freshly cut, very strong and durable, yet light and easily worked. It shrinks little, takes a smooth polish and can be seasoned easily.

Industrial Timber: The timber which is prepared scientifically in a factory is termed as the industrial timber and such timber possesses desired shape, appearance, strength etc. Following are the varieties of industrial timber:

Veneers: - These are thin sheets of wood of superior quality. The thickness of veneers varies from 0.04 mm to 6 mm or more. They are obtained by rotating a log of wood against a sharp knife of rotary cutter or saw. The veneers after being removed are dried to kilns to remove moisture. The edges of veneers are joined and sheets of decorative designs are prepared. The Indian timbers which are suitable for veneers are mahogany, oak, rosewood, teak etc.

Plywoods:-The meaning of term ply is a thin layer. The plywoods are boards which are prepared from thin layers of wood of veneers. Three or more veneer in odd numbers are placed one above the other and direction of grains of successive layer is at right angle to each other. They are held in position by application of suitable adhesives. The placing of veneers normal to each other increase the longitudinal and transverse strength of plywoods

The plywoods are used for various purposes such as ceiling, doors, furniture, partitions, paneling walls, packing cases, railway coaches etc. The use of plywood and its products has become so common at present that it has totally changed the design and complexity of various structures such as buildings, offices theaters, restaurants, hospitals etc.

The plywoods are available in different commercial forms such as batten-board, laminboard, metal faced plywood, multiply veneered plywood etc.

- The batten board is a solid block with core of sawn thin wood. The thickness of core is about 20mm and total thickness of board is 50mm.
- The lamin board is similar to batten board except that the core is made of multi-ply veneers. The thickness of each veneer does not exceed 6mm and thickness of core is about 50mm.
- In metal faced plywood the core is covered by a thin sheet of aluminum, copper, bronze, steel etc. This plywood is rigid and it is clean.

- The plywood prepared from more than three plies is designated as multi-ply. The number of veneers is odd. The thickness may vary from 6mm to 25mm.

Fiber boards: These are rigid boards and they are also known as the pressed wood or reconstructed wood. The thickness varies from 3mm to 12mm. They are available in lengths varying 3m to 4.5m and in widths varying from 1.2 m to 1.8 m. The fiber boards form an ideal base for practically all types of decorative finishes such as distemper oil paint etc. The hard board is also suitable for polish and varnish.

Hard board: Hard board panels are made of wood chips that have been exploded, leaving cellulose fibers and lignin. These are fused under heat and pressed into hard, durable-boards which are available in a variety of finishes and workshop to hang tools and other equipment on specially made hooks which fit into the perforations.

Common Market forms of timbers:-

'Log' is the felled tree after being trimmed.
'Bulk' is the log squaring up.
'Planks': 275 to 450 mm wide and 75 to 150 mm thick.
'Deals': upto 225mm wide and 50 to 100 mm thick.
'Batten': upto 135mm wide and 35 to 50 mm thick.
'Bourd': Less than 35 mm thick and over 150 mm wide.
'Quartering': 25mm by 50 mm up to 150mm by 150mm sq stuff.
'Scantling': Odd cut stuff as 75 mm by 50 mm, 100 mm by 50 mm, 100mm by 75mm etc.

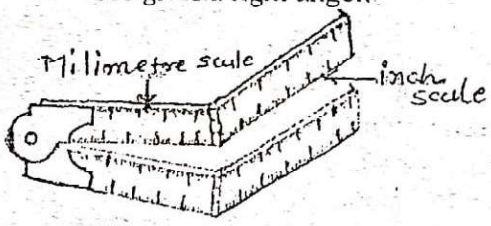
Tools used in Carpentry shop: The tools used in carpentry can be categorized as follows:

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

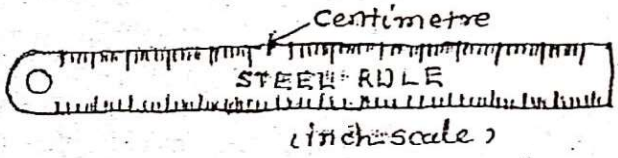
1. Marking and Measuring Tools:

- Steel rule or four fold box wood rule or flexible measuring tapes are used to measure and set out dimensions of wood. While straight edge is used to test trueness of large surfaces and edges.
- Try squares are used to mark and test angels of 90 deg.
- Meter squares are set so that they measure angels of 45 deg.

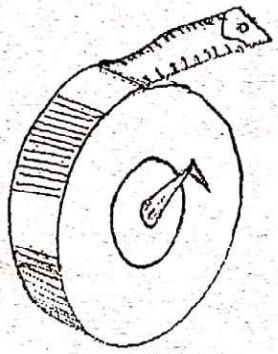
- The blade of Bevel square may be swiveled to any angel between 0° to 180°. It can measure any angle between 0° to 180°.
- Marking knife is used for converting the pencil lines into the cut lines.
- Marking gauge gives an accurate cut line parallel to a true edge, usually with the grain.
- Mortise gauge has two marking points. One is fixed and other can slide. These can cut two parallel lines called mortise lines.
- Cutting gauge is used for gauging fine deep lines for such joints as dovetails on wood.
- Divider is used for dividing out centers.
- Spirit level tests the horizontal position.
- Plumb bob used to test for vertical position, combination of spirit level and plumb bob gives a right angel.



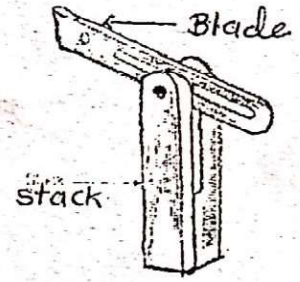
(Four fold box and wood Rule)



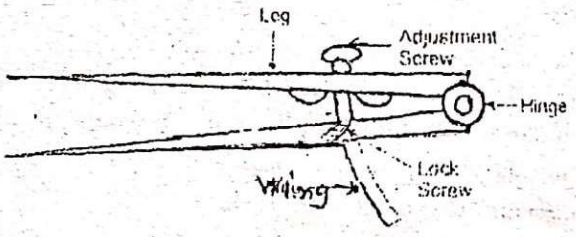
(Steel Rule)



Inch Tape



(Bevel)

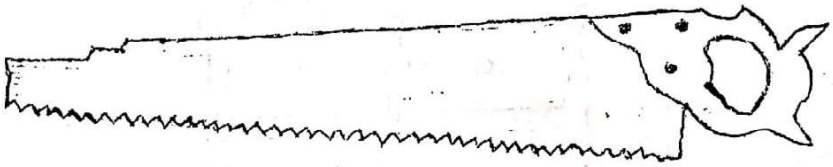


Divider

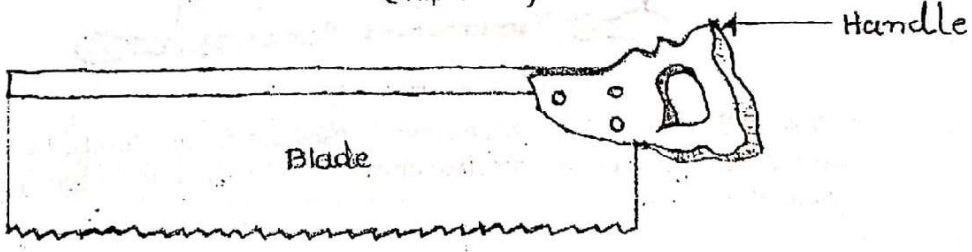
2. Cutting Tools: Saws, Chiesels and gauges are the Cutting tools used in carpentry.

Saws: Saw is used for parting off the wooden plank of smaller dimensions and cutting the wood across or along the grain. A saw is generally specified by the length of its blade and pitch of the teeth.

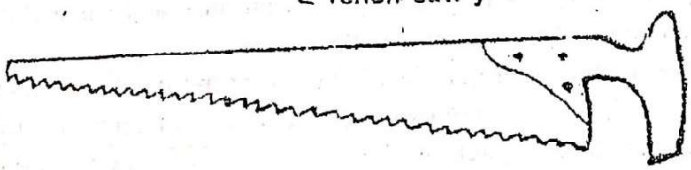
- Rip saws are about 700mm long with 3 to 5 teeth per 25mm and are used for cutting along the grain in thick wood.
- Cross cut saws or hand saws are 600mm to 650mm long with 8 to 10 teeth per 25mm and are used for cutting across the grain in thick wood.
- Panel saw is about 500 mm long with 10 to 12 teeth per 25mm and is used for the fine work or bench for ripping as well as cross cutting.
- Tenon or Back saw about 250 to 450mm long with 13 teeth per 25mm and used for cross cutting when finer and more accurate cut is required.
- Dovetail saw about 200 to 350 mm length with 17 to 25mm and is used for greatest accuracy and fine shallow cuts.
- Bow saw consists of narrow 250 to 350 mm long blade held in wooden frame and is used for cutting quick curves.
- Coping saw is similar to bow saw is used for small radius curves.
- Compass saw has a narrow tapering blade of about 250 to 400mm length and is used for sawing small curves in confined spaces.
- Pad or key hole saw is used for cutting key holes or the starting of any interior cuts.



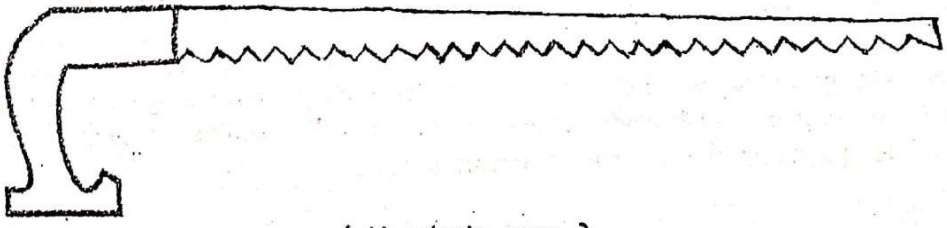
(Rip saw)



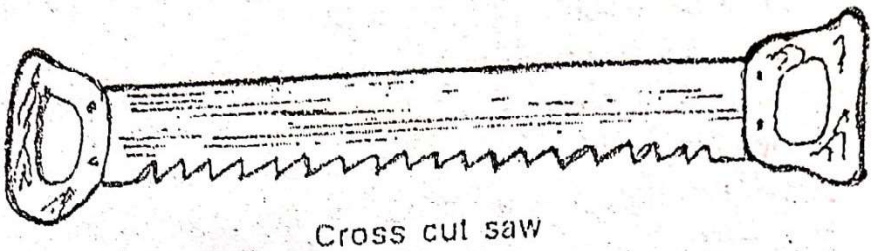
(Tenon saw)



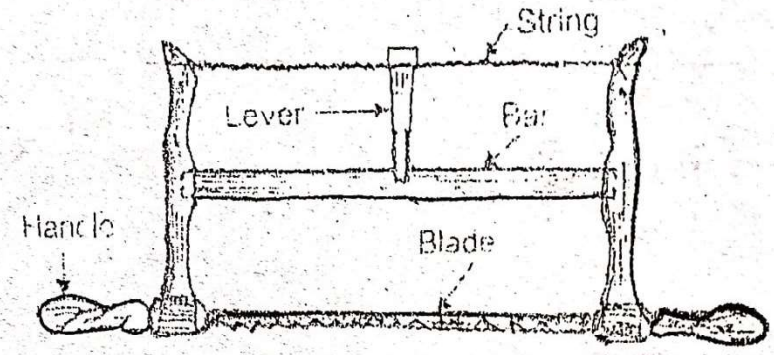
(Coping saw)



(Keyhole saw)



Cross cut saw

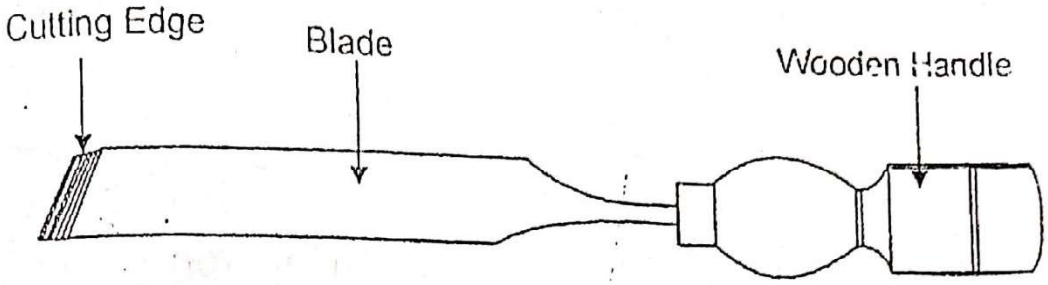


Bow saw

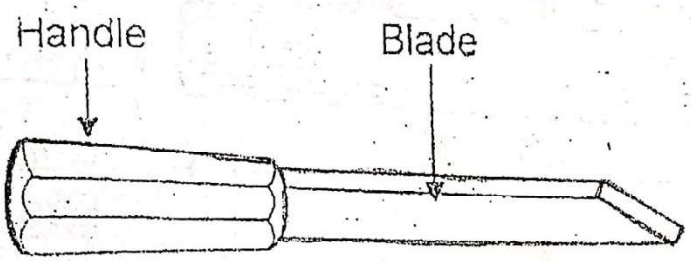
Chisels: Wood chisels most commonly used are firmer chisels, beveled edge firmer chisels, Paring chisels and mortise chisels. Chisels are usually specified by length and width of the blade.

- Firmer chisel is used for general purpose and has a flat blade about 125mm length and 15 to 50 mm width.
- Bevelled edge firmer chisel is used for more delicate and fine work.
- Both firmer and beveled edge chisel with long and thin blades are called paring chisels which are having length 225 mm and are used for shaping and preparing surfaces.
- Mortise chisel is used for chipping out mortise. The widths of blades vary from 3 to 16 mm.

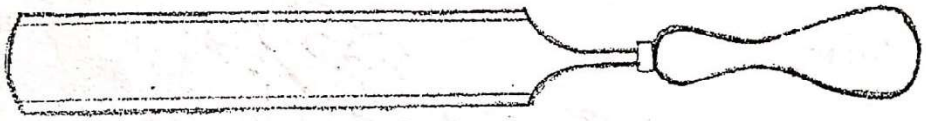
Gouges: Gouges are chisels with curved sections, out side ground gouges are called firmer gouges and inside ground gouges are called scribing gouges. When gouges are long and thin, they are called paring gouges.



Firmer chisel



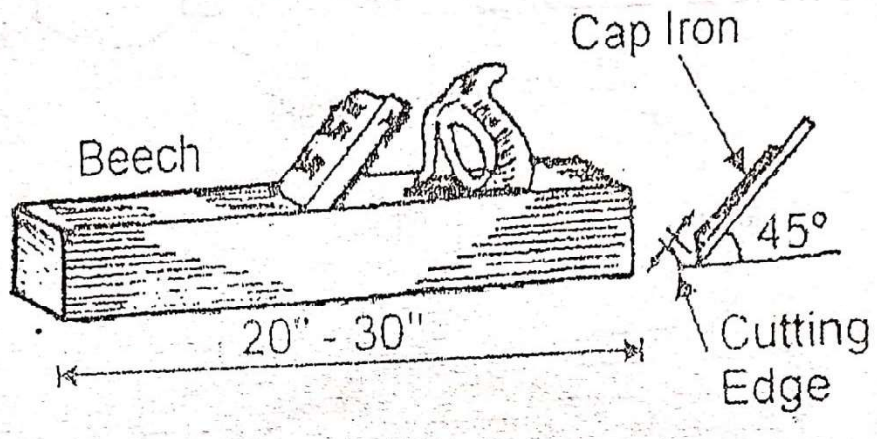
Mortise chisel



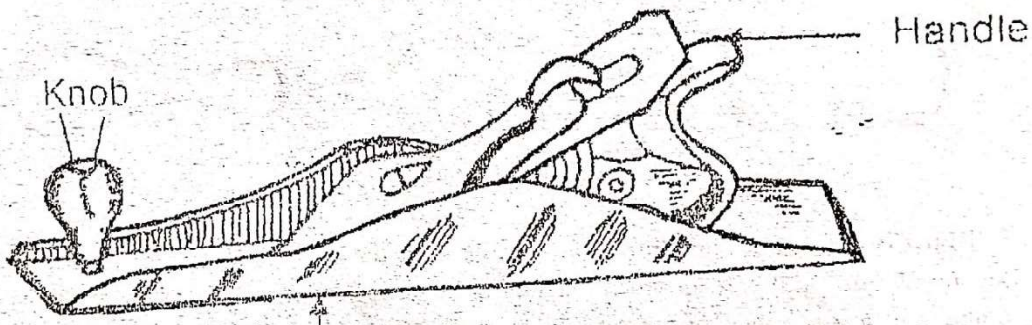
Gauge chisel

3. Planning Tools: The Plane can be linked to the chisels fastened into a block of wood or metal. The planes in general use are jack plane, Trying plane, Smoothing plane, Rebate plane, Plough plane, Router, Spokeshave. In addition a number of special planes are used for special purpose; they are compass or circular plane, Bull nose rebate plane, Shoulder plane, Block plane etc. A metal plane is used now a day which facilitates a smoother operation and better finish.

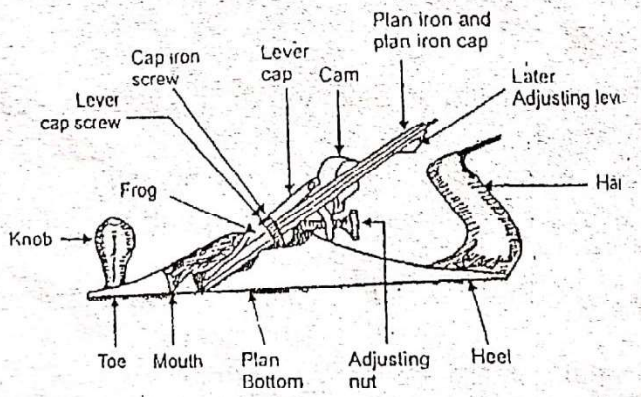
- Jack plane is the most common instrument in wood working and used for the first trying up of a piece of wood.
- Trying plane is a finishing plane and is set with a very fine cut.
- Smoothing plane as its name indicates is used for smoothing or finishing after a jack plane.
- Rebate plane is used for sinking one surface below another and shouldering one piece into another.
- Router is used for cleaning out and leveling the bottom of grooves to a constant depth after the bulk of the waste material has been taken out with saw and chisels.



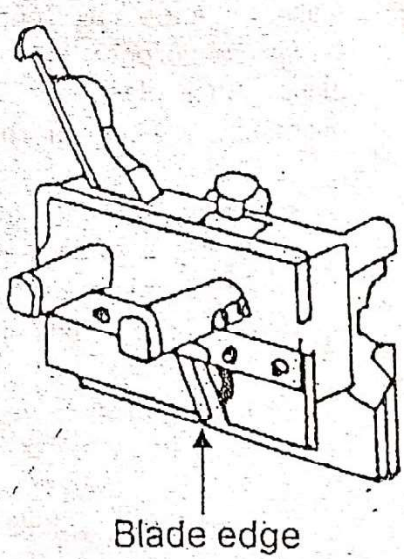
Wooden Jack Plane



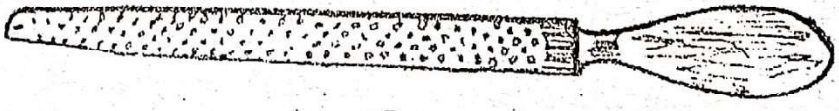
Iron Jack Plane



Trying Plane

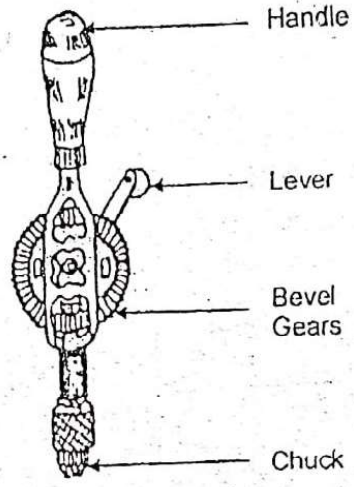


Rebate Plane

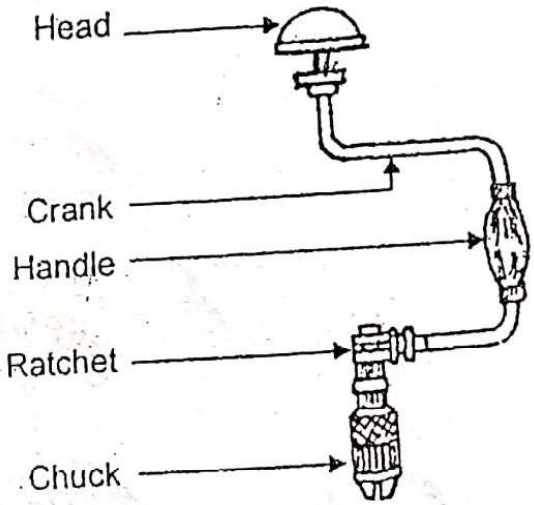


Rasp

4. **Boring tools:** Gimlet, Bradawl, Brace, Bit and Drill are common boring tools used in carpentry to make round holes in wood.



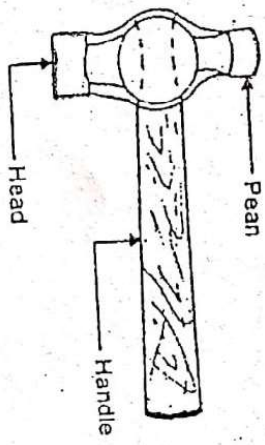
Hand Drill

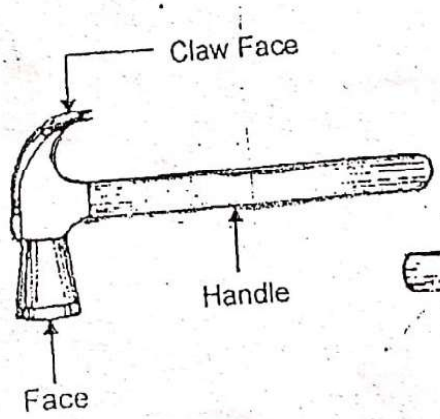


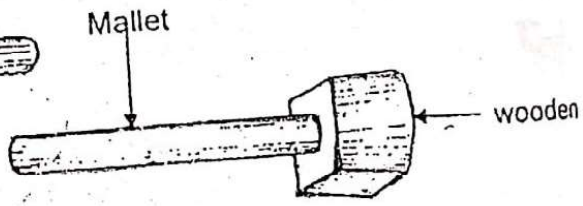
Ratchet

5. **Striking Tools:** Hammers and Mallets are common striking tools. The hammers are identified by size, number and weight.

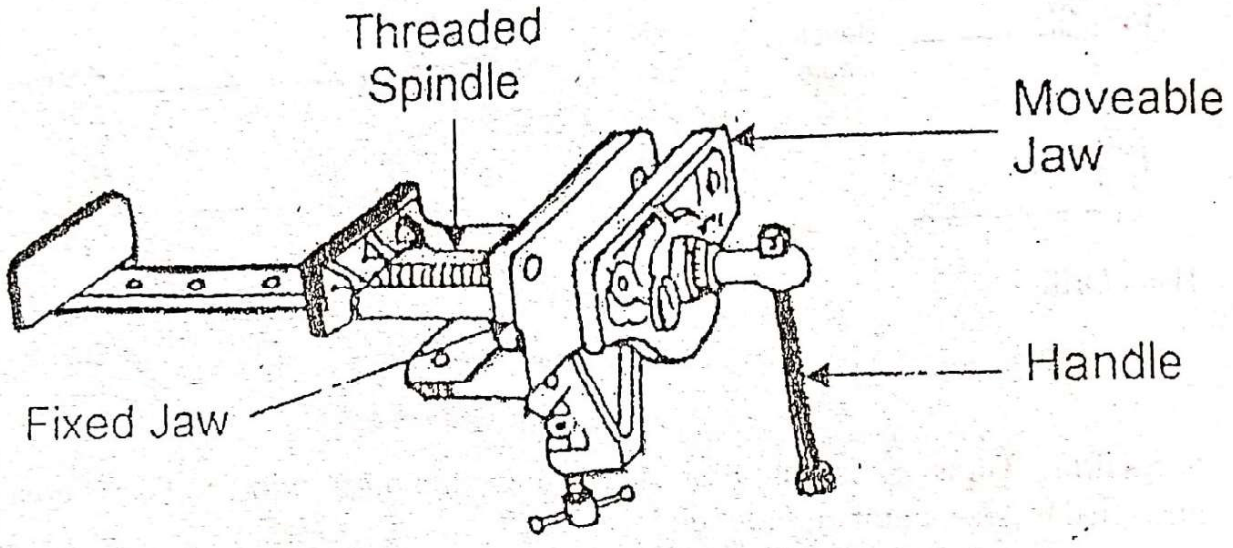
Claw hammer serves the dual purpose of a hammer and a pair of pincers. The claw is used for pulling out any nails accidentally bent in driving. These hammers are numbered sizes from 1 to 4 weighing 375, 450, 550, 675 gm. Mallet is a wooden hammer of round or rectangular cross section.







6. **Holding Tools:** Bench vice, C-clamp, Hand screw are common holding devices used in carpentry work.



Clamping Vice

7. **Miscellaneous Tools:** Rasps and files, Scrapers, Pincers, Screw Driver etc. are the other tools used in carpentry.

Apart from the above hand tools, power driven wood working machines such as wood turning lathe planning machine, the bend saw, wood shaper machine, electric router etc. are used in wood working.

QUESTIONS

CARPENTRY

1. Which are the marking and measuring tools used in carpentry shop?
2. What is the difference between try square and Meter Square?
3. What is the difference between marking gauge and mortise gauge?
4. What is the softwood?
5. What is the hardwood?
6. What is the carpentry?
7. Which wood is used for bodies of carts and wheels?
8. What is the use of deodar wood?
9. What are the characteristics of the mango wood and its use?
10. Which is the best Indian wood for joiners work?
11. Describe the teak wood.
12. What is industrial timber?
13. What are veneers?
14. What is plywood?
15. Which are the different commercial forms of the plywood?
16. What are the fiber boards?
17. What is the use of fiber boards?
18. What are the common market forms of timber?
19. What are the different cutting tools?
20. What are the different types of saws?
21. What are the different types of chisels?
22. What is difference between firmer chisel and mortise chisel?
23. What are the different planes used in carpentry?
24. What is the use of router in carpentry?
25. What are the boring tools used in carpentry?
26. What are the different striking tools used in carpentry?
27. What is the difference between hammer and mallet?
28. What are the different holding tools used in carpentry?
29. What are the miscellaneous tools?
30. What is the pattern?

6. TIN SMITHY SHOP

Introduction:

Sheet metal work is generally regarded as the working of metal, from 16 gauge to 30 gauge, with hand tools and simple machines into various forms by cutting, forming into shape and joining. Sheet metal work is an operation used for producing various house hold and engineering goods from metallic sheets. Common examples of sheet metal work are hoppers, covers, hoods, funnels, boxes etc.

Metals Used In Sheet Metal Work:

In sheet metal work, the sheet metal used is black iron, galvanized iron, copper, brass, aluminium etc. The Thickness of sheets is specified by standard gauge numbers. The larger the gauge numbers, the lesser the thickness.

Hand Tools:

The various hand tools used in sheet metal working are:

1. Different types of hammers.
2. Mallets
3. Stakes or forming supports
4. Shears or snipes.

Hammers:

There are many types of hammers, but most commonly used hammers are:

1. Riveting hammers used for riveting.
2. Setting hammer useful for setting down the edge.
3. Raising hammer used for forming of a flat sheet of metal into curved shape.

Mallet: These are soft hammers used to strike a soft and light blow on the metal.

Stakes: Stakes are usually used as supporting and forming tools. They also help in bending operations.

Snipes & Shears: A snipe, also called a hand shear is used like a pair of scissors to cut thin, soft metal, It should be used only to cut 20 gauge or thinner metal.

Sheet Metal Operations:

The major types of sheet metal operation are:

1. Shearing
2. Bending
3. Drawing
4. Squeezing

1. Shearing:
Shearing is a cutting in a straight line across a strip, sheet or bar.

2. Bending:
Bending occurs when forces are applied to localized areas, such as in bending of a piece of metal into a right angle.

3. Drawing:
Drawing is the operation of producing thin walled hollow or vessel shaped parts from sheet metal.

4. Squeezing:
Squeezing is a quick and widely used way of forming ductile metal.

Various types of sheet metal joints used in sheet metal works are:

1. Lap joint
2. Seam joint
3. Locked seam joint
4. Wired edge joint
5. Hem joint
6. Flanged joint and
7. Angular joint.

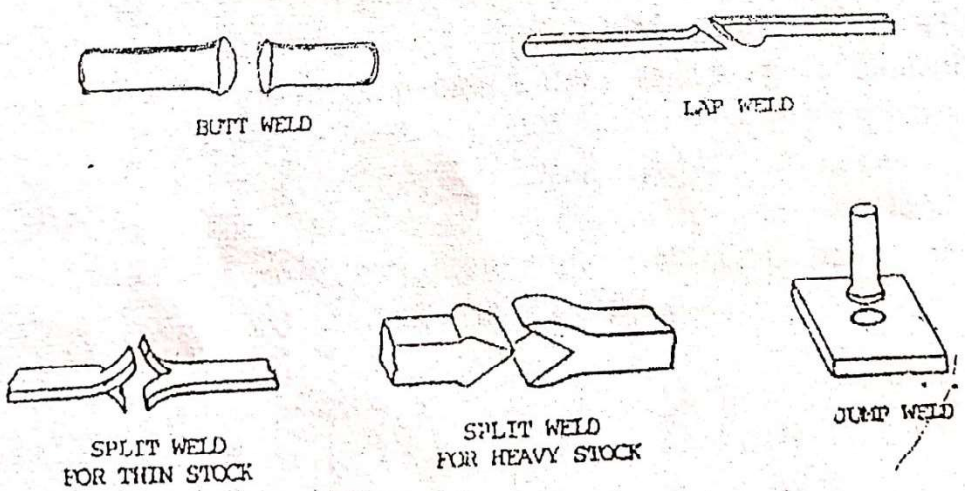


Figure 12-48. Forge welds.

QUESTIONS

TIN SMITHY

Q.1 Define Tin-smithy.
Q.2 Give common examples of sheet metal work.
Q.3 Which are the different types of sheet metals used in sheet metal work?
Q.4 How the thickness of the sheet metal are specified.
Q.5 Which sheet is thicker out of 16 gauge sheet and 24 gauge sheet?
Q.6 List the different types of hand tools used in tin smithy.
Q.7 List the different hammers used in tin-smithy.
Q.8 What is the use of setting hammer?
Q.9 What is the use of raising hammer?
Q.10 What is the use of mallet?
Q.11 What is the use of the stakes?
Q.12 What is the use of snips?
Q.13 What is the limitation of snipes?
Q.14 List the different sheet metal operation.
Q.15 What is shearing?
Q.16 What is bending?
Q.17 What is drawing operation?
Q.18 What s squeezing operation?
Q.19 List various types of sheet metal joints.
Q.20 What is the thickness range of sheet metals used in tin smithy?

7. WELDING SHOP

INTRODUCTION:

Joining of two or more elements to make a single part is termed as a fabrication process. A fairly large number of industrial components are made by fabrication processes. Common examples are aircraft and ship bodies, bridges, building trusses, welded machine frames, sheet metal parts, etc. The fabrication is often the most economical method and relies on raw material obtained from one of the primary manufacturing processes such as rolling, extrusion etc. Hence it may be called a secondary manufacturing process.

The various fabrication processes can be classified as follows:

1. Mechanical joining by means of bolts, screws and rivets.
2. Adhesive bonding by employing synthetic glues such as epoxy resins.
3. Welding, brazing and soldering.

The choice of particular fabrication method depends on a number of factors pertaining to the joint such as

- Type of assembly permanent, semi permanent or temporary.
- Materials being joined steels, cast irons, aluminum, similar or dissimilar metals.
- Economy achieved, and
- The types of service required, such as assembly subjected to heavy loading, impact loading and high temperatures.

Joining obtained by bolts and screws is temporary in nature and can be disassembled whenever necessary. Rivets are semi permanent fastening devices and the joint can be separated only by destroying the rivet without harming the parent elements.

Adhesive bonding does not disfigure the joining parts, but would generally have less strength than the mechanical fasteners. But adhesive bonding helps in joining, awkward shaped parts or thin sheets which may not lend themselves to mechanical fastening. Similarly, metals and non-metals can be best joined by adhesive bonding as in the case of automobile brake shoe linings also.

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

Welding is a process of joining two similar metals by application of heat, with or without application of pressure and addition of filler material. The result is a continuity of homogeneous material of the composition and characteristics of two parts which are been jointed together. The application of welding are so extensive that it would be no

exaggeration to say that there is no metal industry and no branch of engineering that does not use welding process in one or other form.

TYPES OF WELDING: Modern method of welding may be classified under two broad headings.

1. *Plastic welding:* In the plastic or pressure welding the piece of metal to be jointed are heated to plastic state and forced together by external pressure. This procedure is used in forged welding, resistance welding and Thermit welding in which pressure is required. It also called pressure welding.

2. *Fusion welding:* In the fusion welding or non pressure welding the material at the joint is heated to a molten state and allowed to solidify. This includes gas welding, arc welding, Thermit welding etc. It is also called non pressure welding.

ARC WELDING:

Arc welding is the most extensively employed method of joining metal parts. Here the source of heat is an electric arc.

The arc column is generated between the anode and cathode. When these two conductors of an electric circuit are brought together and separated for a small distance (2 to 4mm) such that the current continues to flow through a path of ionized particles (i.e. gaseous medium) called plasma, an electric arc is produced (Fig:1). Here electrical energy is converted into heat energy. Approximately 1 kW of electricity will create 10000J, the temperature at the center of arc being 6000° to 7000° C. The temperature of electric arc, of course depend upon the types of electrodes between which it is struck.

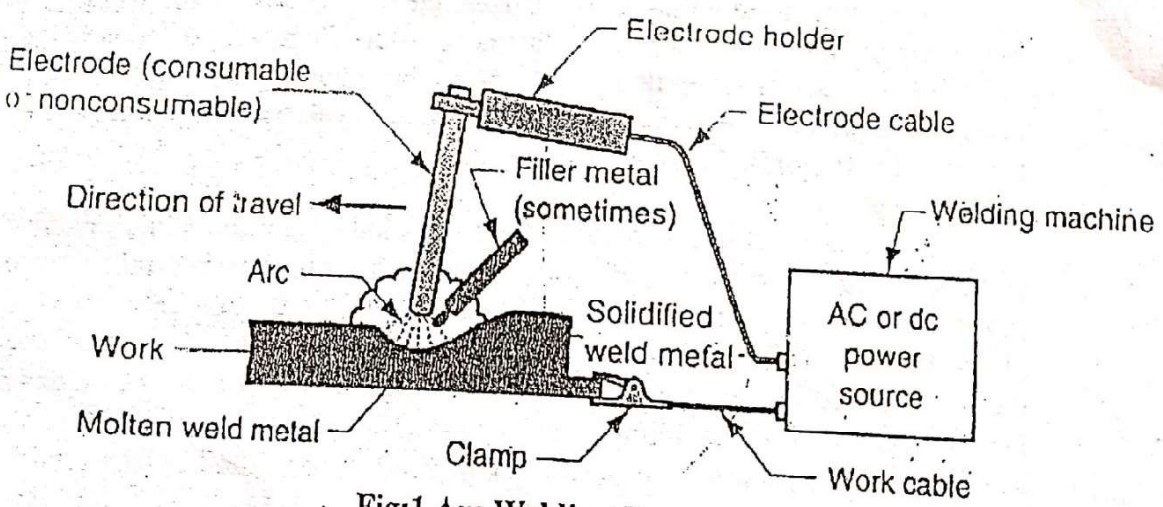


Fig:1 Arc Welding Process

The heat of the arc raises the temperature of the parent metal which is melted, forming a pool of molten metal. The electrode metal or welding rod is also melted and is transferred into the metal in the form of globule of molten metal. The deposited metal serves to fill and bond the joint or to fuse and build up the parent metal surface.

Two-third of the heat is developed near the positive pole while the remaining one-third is developed near the negative pole. As a result, an electrode that is connected to the positive pole will burn away approximately 50 percent faster than that is connected to the negative pole. This is helpful in obtaining the desired penetration of the base metal.

Arc welding equipments: The most commonly used equipments for arc welding consists of the following.

- **Arc welding machine:** The transformer is used for almost all arcs welding, where mains electricity supply is available. They have to step down the usual supply voltage (200-400V) to the normal open circuit welding voltage (50-90V). A 100 to 200A machine is small but portable and satisfactory for light manual welding.

- **Electrodes:** Both non-consumable and consumable electrodes are used for arc are welding. Non- consumable electrodes may be made of carbon, graphite or tungsten which do not consume during the welding operation. Consumable electrodes may be made of various metals depending upon their purpose and the chemical composition of the metals to be welded.

- **Electrode holder:** It is used to hold the electrode. It is connected with arc welding machine by insulated copper cable.

- **Helmet, Safety goggles, Hand gloves and Aprons:** Because of the intensity of heat and light rays from electric arc, the operator's hand, face and eyes are to be protected while the arc is in use. Heavy gloves are worn and a hand shield or a helmet with window of colored glass should be used to protect the face.

Arc welding method: Various arc welding methods are as follows.

1. Carbon arc
2. Metal arc
3. Metal inert gas arc (MIG)
4. Tungsten inert gas arc (TIG)
5. Atomic hydrogen arc
6. Plasma arc
7. Submerged arc
8. Electro-slag welding
9. Flux - cored arc etc.

GAS WELDING: Gas welding is done by, burning a combustible gas with air or oxygen in concentrated flame of high temperature. The purpose of the flame is to heat and melt the parent metal and filler rod of a joint. It can weld most of the common materials. Welding equipments are inexpensive, versatile and serves adequately in many jobs and repair shops. Various gas combinations can be used for producing a hot flame for various welding metals. Common mixture of gases is oxygen and hydrogen, oxygen and other fuel gas (like acetylene) and air and acetylene. The temperature of the oxy-acetylene flame in its hottest region is about 3200°C. the process is explained below.

- **Oxy acetylene gas welding:**

Oxy acetylene gas welding is accomplished by melting the edges or surface to be jointed by gas flame and allowing the molten metal to flow together, thus forming a solid continuous joint upon cooling. This process is particularly suitable for joining metal sheets and plates having thickness of 2 to 50 mm. With material thicker than 15 mm, additional metal called filler metal is added to the weld in the form of welding rod. The composition of the filler rod is usually the same or nearly the same as that of the parts being welded.

The correct adjustment of the flame is important for reliable work. When oxygen and acetylene are supplied to the, torch in nearly equal volumes, a neutral flame is produced having maximum temperature of 3200°C. This neutral flame is desirable for most welding operation. It is widely used for welding steel, stainless steel, cast iron, copper, aluminum etc. A carburizing flame is one in which there is an excess of acetylene. An oxidizing, flame is one in which there is an excess of oxygen. This flame is used for welding of brass, steel etc.

- Gas welding equipments: The most common equipments used for gas welding are shown in fig:2 and explained as follows:

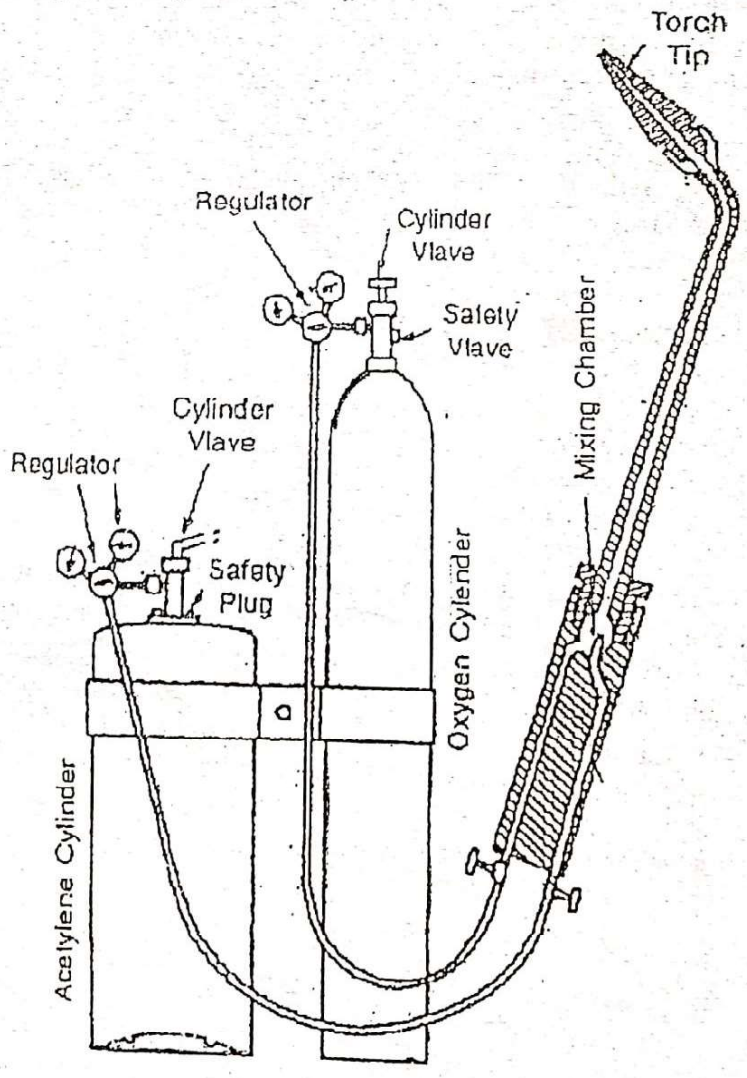


Fig:2 Equipments of Gas welding

Welding torch: This is tool for mixing oxygen and acetylene in correct proportion and burning the mixture at the end of the tip.

Welding tip: It is that portion of the welding apparatus through which the gases pass just prior to their ignition and burning. The tip sizes are governed by the diameter of the opening. The diameter of the tip opening used for welding depends upon the types of metal to be welded.

Pressure regulator: The functions of the pressure regulator are

1. To reduce cylinder pressure to the required working pressure.
2. To produce steady flow of gas regardless of the pressure variation at the source.

Hose and Hose fittings: The hose of welding torches should be strong, durable, non porous and light. The most common method of piping both oxygen and acetylene gas is the reinforced rubber hose, which comes in black, green and red colors. Black is standard colors of oxygen hose, red for acetylene and green for other industrial available welding gases. Special hose fitting or connections are provided for attachment to the torch and pressure regulators.

Gas cylinders: In gas welding, there are separate cylinder of oxygen and acetylene. Oxygen cylinder is charged with approximately 40 liters of oxygen at a pressure of 154 kg/cm^2. A full cylinder has weight of about 80kg.

Other equipments are also used for the safety of the welder such as, Goggles fitted with colored lenses are used to protect the eyes from harmful heat and ultraviolet and infrared rays. Gloves are used to protect the hands from any injury and spark lighter provides a convenient and instant means for lighting the weld torch.

RESISTANCE WELDING: This type of welding is further sub-divided into six main methods, each having its own perticular applications:

(i) spot welding
(ii) seam welding
(iii) butt welding
(iv) flash welding
(v) projection welding
(vi) percussion welding

Spot welding is used for making Lap welds for sheets upto 13 mm thickness. It is expressed by the figure shown below.

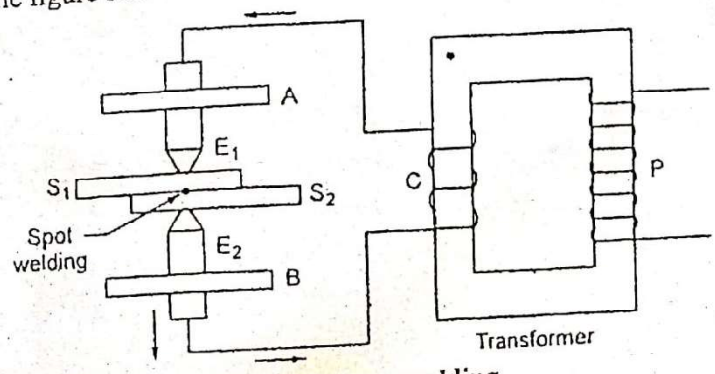


Fig:3 Spot welding

It consists of a transformer having primary and secondary windings P and C. This welding consists of two arms, first is a movable arm E_1 and the other is fixed arm-E_2, both these arms are connected by the secondary coil of the transformer. In the process we take two sheets S_1 and S_2 to be joined and it is placed in the manner shown between the two arms, then a supply of high amperage and low voltage is supplied between the two sheets. The pressure is also exerted by the fixed and the movable arm as a result the temperature of the adjoining surfaces is brought upto the melting point and it is joined due to external pressure. This principle is fixed in a spot welding machine in which the pressure is applied by lever fixed in the lower portion of the machine that is operated by foot.

Quiz

Q.1 What is welding?
Q.2 List various types of welding.
Q.3 List various types of fusion welding.
Q.4 What is the source of heat in arc welding?
Q.5 List various arc welding equipments.
Q.6 List various safety devices used in arc welding.
Q.7 List various arc welding methods.
Q.8 How do you obtain neutral flame in gas welding?
Q.9 What is carburising flame?
Q.10 What is oxidizing flame?
Q.11 Name different type of oxy – acetylene flames.
Q.12 List various gas welding equipments.
Q.13 What are the functions of pressure regulator used in gas welding?
Q.14 What is the importance of safety in the case of arc welding?
Q.15 Which type of power sources are used in the electric arc welding?
Q.16 What is the temperature of arc generated in electric arc welding?
Q.17 Name the material which can be welded by neutral flame?
Q.18 Which material can be welded by oxidizing flame?
Q.19 What is the function of welding torch?
Q.20 Give the specification of oxygen cylinder.
Q.21 Give the thickness range of plate for which gas welding can be used.
Q.22 Give name of gases used in gas welding.
Q.23 What do you mean by fabrication process?
Q.24 Give examples of industrials products made by fabrication process.
Q.25 How mechanical joining is carried out?

9. PLUMBING SHOP

INTRODUCTION: Plumbing is the work related to the materials and fixtures used in installation or maintenance of pipe fitting. In industry, plumbing system can be divided into three categories.

1. The supply system where the water comes from
2. The fixtures where the water is used
3. The drainage-disposal of waste water etc

A properly laid pipe line is needed in industry for supply of water, air, steam, oil etc. The term pipe and tubes are synonymously used both in specification and application as well. The standard codes of practice followed for specification of pipes is British system only. However the sizes may be converted into metric units by taking 1 inch=25.4 mm as a multiplying factor. There does not exist a separate metric system of specification.

The pitches given in TPI (Threads per Inch) for BSW pipe threads are standard as given below in Table-1:

Table:1

Pipe size, mm (standard inches)	TPI
20 (1/2")	14
25 (3/4")	14
32 to 63 (1" to 2")	11 ½
75 to 63 (2 ½" to 6")	8

PLUMBING TOOLS

The main tools used in plumbing are

1.Pipe vice: A plumber's vice (Fig:1) has serrated jaws to grip the pipe and prevent it from turning.

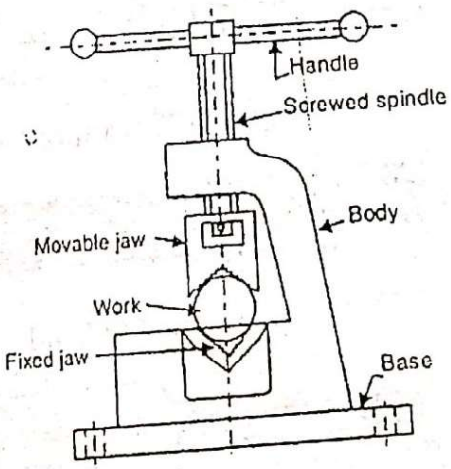
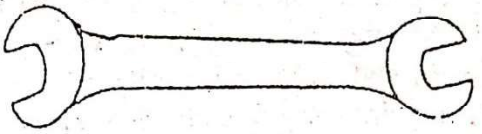


Fig:1 Pipe Vice

2.Wrenches: Wrenches are broadly classified as

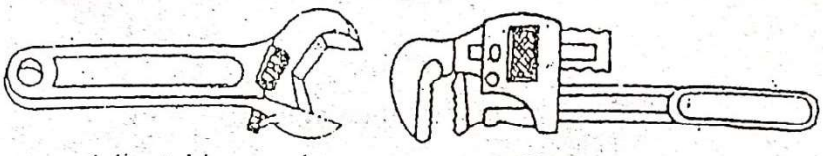
a. Fixed Wrenches: - These Wrenches are of specific sizes and can't be adjusted (Fig: 2a).

b. Adjustable Wrenches: - These can be opened and closed with in limitation of the individual wrench (Fig:2b).



Double ended spanner

Fig:2(a) Fixed Wrench



Adjustable wrench Pipe wrench

Fig: 2(b) Adjustable Wrench

3. Pliers: Pliers are used for holding and gripping objects.

4. Threading dies and taps: Threading dies & die handles are used for cutting external threads on pipes. Similarly tapping is done with the help of taps and cutting internal threads. Threading die for external threads is shown in fig: 3a. The tap tool and tap wrench is shown in fig: 3b & c respectively.

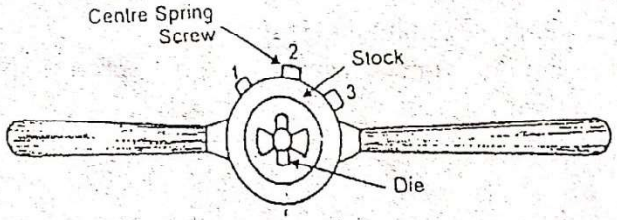


Fig: 3(a) Threading Die

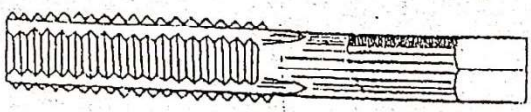


Fig: 3(b) Tap Tool

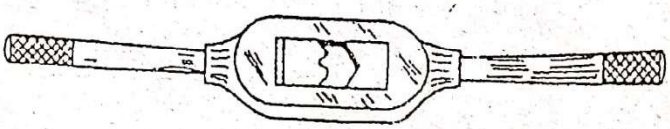


Fig: 3(c) Tap Wrench

5. Hacksaw: A hacksaw is used for cutting metal rods, bars, pipes etc. The pipe is to be held in a vice and the blade is moved to and fro for cutting materials. The cutting operation takes place on the forward stroke.

PIPE FITTINGS

The pipe fittings are used to join adjacent lengths pipes. They are also frequently used to provide changes in direction, to provide branch connection at different angles or to effect a change in size. The various screwed fittings commonly used with malleable iron and steel pipes are as follows:

1. **Tee:** It is a threaded T-Shaped component used for distributing the supply of water at right angles to direction of flow (Fig: 4a).
2. **Elbow:** It is a threaded fitting used for joining two pipes at right angle (Fig: 4b), while bend is used for any angle
3. **Cross:** It is used to connect four pipes at right angles to each other (Fig: 4c).
4. **Socket:** It is used to connect two pipes of same diameter (Fig: 4d).
5. **Increaser or Reducer:** It is a threaded pipe fitting having one of its end larger than the other. It is used for joining the pipes of different diameters (Fig: 4e).
6. **Nipple or coupler:** it is a small length pipe having outside threads at ends. It is used to get extra length of the pipe, by screwing it with the two pipes having internal threads (Fig: 4f).
7. **Union:** it is used to connect two pipes and can be disconnected easily when desired (Fig: 4g).
8. **Plug:** it has external threads and is used with Tee or Cross to close the opening of the pipe which is left for further use (Fig: 4h).
9. **Cap:** it has internal threads and is used to close the threaded end of the pipe (Fig: 4i).

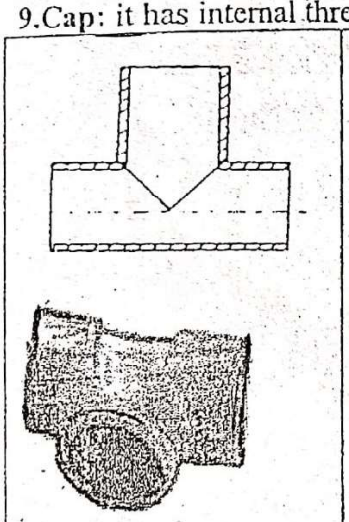


Fig: 4(a) Tee

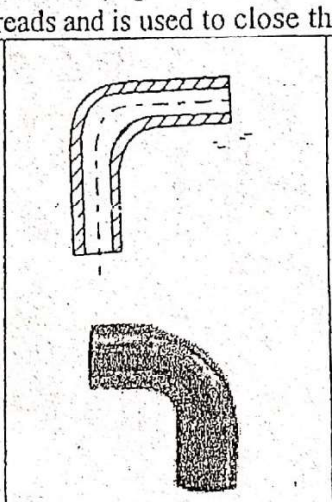


Fig: 4(b) Elbow

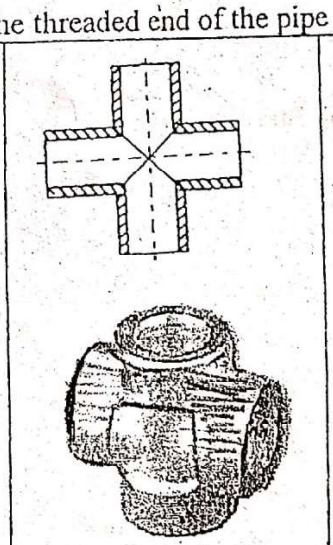


Fig: 4(c) Cross

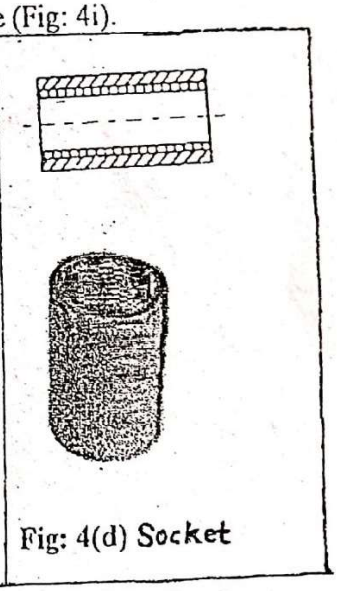


Fig: 4(d) Socket

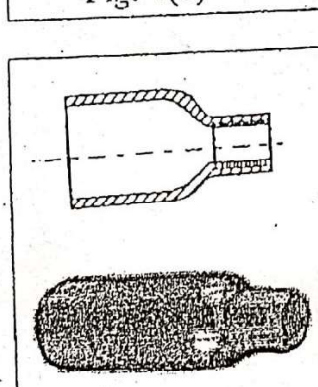


Fig: 4(e) Increaser/ Reducer

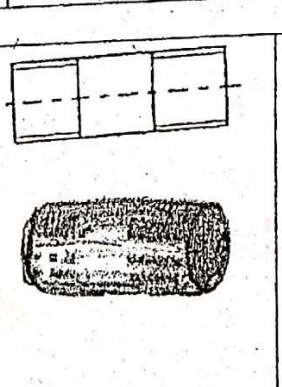


Fig: 4(f) Nipple/ Coupler

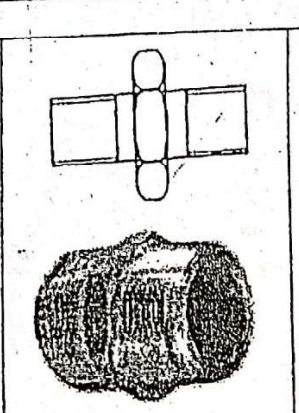


Fig: 4(g) Union

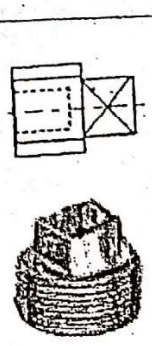


Fig: 4(h)Plug

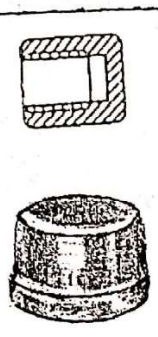
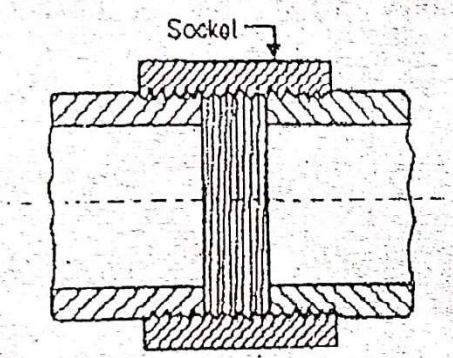
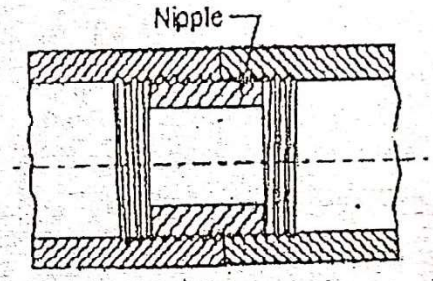


Fig: 4(i) Cap

The joint with the help of nipple and socket is shown in fig: 5 a & b.



(a) Joint by Socket



(b) Joint by Nipple

Fig: 5

Quiz

Q.1 What is plumbing?
Q.2 What are the three different categories of plumbing system divided in industries?
Q.3 What are the different plumbing tools?
Q.4 What is the use of pipe vice?
Q.5 What are the different types of wrenches?
Q.6 What is the use of pliers?
Q.7 What is the use of threading die?
Q.8 What is the difference between die and tap?
Q.9 What is the use of hacksaw?
Q.10 What are the standard accessories used in plumbing?
Q.11 What is the different material for pipe?
Q.12 What is the use of increaser or reducer?
Q.13 What is the use of tee?
Q.14 What is the elbow?
Q.15 What is the use of union?
Q.16 What is nipple?
Q.17 What is the difference between elbow and bend?
Q.18 What is the use of Socket?
Q.19 In a hacksaw cutting operation takes place in _____ stroke?
Q.20 For what purpose pipelines in industry is required?

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Time allowed Hours…….....

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Material issued on:					
Repeat Material issued on:					
WORK DETAILS					
Date	Time		Hours	Instructor's Sign	Remark
	From:	To:			
		Date		Instructor	Officer in Charge
Job Started on					
Job Completed on					

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