University of Lucknow
Faculty of Engineering & Technology
Central Workshop
Course Code: ME152/ME252/RET409

Manufacturing Practice /Workshop Practice

Engineering:-

- Engineering is a professional art of applying science and technology to optimize the conversion of natural resources to the benefit of mankind. (Natural resources available in the universe are Iron ore, Air, Sun, Water, Space, Human etc.)
- Human resource is a supreme strength to develop Engineering to contribute the welfare and progress of the society or to this nation.

Engineer:-

- Engineer is a person having creative thoughts and ideas to develop technology for the noble cause of the society or to nation.
- All objects begins an idea, Conceived and visualized by the Engineer. He makes an internal representation of the object in his mind and communicates it to others through media of expression.

Professional activities of an engineer:

1. Planning: (Proposal of doing something)

- It means a set of preparation is to do in order to achieve something or any kind of task/work. (Preparation means programmes , drawings, Materials requirement and their sources, time schedule, cost estimate, scheme and design and method of preparation etc.)
- It is a management function of defining goal of an individual / organizations.
- It determines the task/work and resources necessary to achieve set goals.
- It helps to save materials, labor, time, money efforts and process etc. so that any kind of work/task can be performed successfully without having any difficulty with full confidence.

2. Visualization (related to vision / creating picture in mind)

- It is a behavioral technique of improving performance of his individual.
- It encourage for creating metal picture for successful execution of any work.

3. Hard work and practice (doing something repeatedly)

There is no substitute for hard work. A spiritual person says that “Work is Worship”, “Practice makes the man perfect”. Practice makes a person to acquire skill to use their knowledge for gaining self assurance and confidence to handle any kind of work without any difficulty.

4. Punctuality (being in time):

Punctuality is a moral goodness, which is to be practiced very well punctuality is nothing but courtesy to others. By being punctual you respect the value of time of others. This is more than anything else. It helps you to plan your activities and schedule with precision and efficiency.

Er. Abhijeet Maurya
M.Tech (Production Engineering)

5. Work place Environment:
Workplace environment is to be maintained neat and clean, and spread happiness, cheerful, love & affection around your work place, at home and also to the community.
6. Efficiency: It is the ability to do what ever we expected of us as promptly accurately and economically as possible.
These activities are to be performed by an engineer to maintain quality and integrity for successful execution of any task & to face the challenge of globalization.

Workshop:-

It is a place of work for preparing variety of jobs/products by using different kinds of Instruments, hand tools and Machines.
In order to prepare the products in W/s, the w/s is divided in to many branches according to nature of work.
Ex: 1.Fitting shop
2. Welding shop
3. Sheet metal shop
4. M/c Shop
5. Foundry & Forging shop etc

What are the information required to prepare the product?
It is a common experience that when we want to prepare any product, the following information are required.
1. Actual Shape
2. Accurate Size
3. Manufacturing Method

Before taking up the construction of a product, the person who prepares it must have a clear picture of the shape and size of the object in his mind and to know the method of manufacturing process for successful execution of the work.

Engineering Drawing:-

A graphic form of representation of an object which contains all the necessary information like actual shape, accurate size, manufacturing methods etc. required for construction of an object is called Engineering Drawing. It is prepared on certain basic principles, symbolic representation, standard conventions, notations etc.
Engineering drawing is said to be the language of an engineer and it can be considered as a powerful tool to convey his ideas.
In Engineering, it is a practice to record ideas in the form drawing. Since engineering drawing is a graphical medium of expression of all technical details without the barrier of word language. It is also called the universal language of an engineer.

1. Orthographic projection or view. : 2D
2. Isometric projection or view. 3D
Elements of Dimensioning

1. Aligned system.
2. Uni-directional systems

Line Conventions:
1. All visible out lines, edges are drawn in bold, i.e. thick continuous lines.
2. Dimension lines, projection line, leader lines are drawn thin continuous.
3. Arrowhead and dimension figure are shown thick.

Free hand Sketching:
1. Drawing of 2D/3D sketches is drawn using only pencil and eraser is called Free Hand

Sketch.
2. Designers, teachers/ instructors and artists use this for immediate graphical communications.
3. To start with Graph/grid sheets help in practice well
4. The parallel horizontal lines are to be drawn from left to right by right handed people and right to left from left handed people.
5. Vertical lines are to be drawn from top to bottom.
6. Inclined lines are to be drawn from lower left to upper right.
7. Small arcs, circles and ellipses may be drawn in one motion on a trial basis.
8. Big circles and ellipses may drawn by box method.

Prime use of free hand sketches:

1. To serve teaching aid during discussion in class rooms.
2. To prepare tabular column.
3. To sketch circuit diagram of electrical engineering problem.
4. To prepare the layouts of laboratory, Buildings & Production shops etc.
5. To convey information regarding repair of machine on spot.
6. To help the designer is developing new ideas.
7. To covey the idea's of the designer to the draughtsman, management etc.
8. To serve as a basis for discussion between engineers and workmen in the shop floor.

Orthographic View or Projection or 2 D:-

In the orthographic projection, two or more number of principle views are drawn to show the shape and sizes of an object.

Front View

The object is viewed or seen from the front, the shape & size formed in **Vertical Plane** is called the Front View or Elevation.

Top View

The object is viewed or seen from the Top, the shape & size is formed in **Horizontal Plane** is called Top View or PLAN.

Side View

The object is viewed or seen from the left or right, the shape & size is formed in **Profile Plane** is called Left or Right View.

NOTE: To obtains the view of an object to same size. The visual rays should run on parallel to each other and perpendicular to plane of projections.

All Orthographic views are two dimensional

.

ISOMETRIC PROJECTION (OR) Pictorial drawing:-

- Isometric projection is a 3D (pictorial) view.
- It enables the observer not only see the three dimensions of an object in a single view but also measure them directly.
- This is used to convey information to persons, who cannot visualize an object from 2D views and also to show complicated structures such as Air Craft, Rocket cell, **Service manual** layout of pipelines, assembly and disassembly of parts required in maintenance.

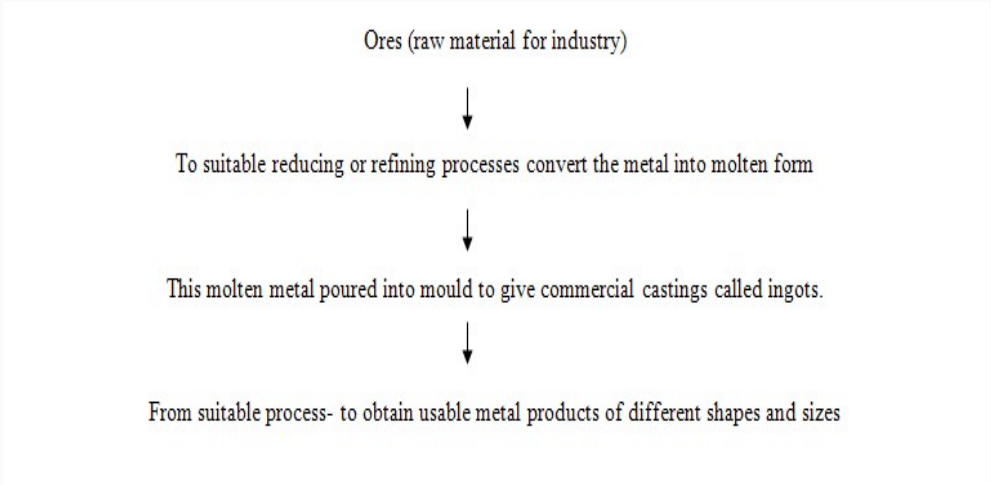
ISOMETRIC CONSTRUCTION:-

When once the Orthographic projection are drawn using isometric scale, then simply transferred the distances from the orthographic views to get the isometric projection.

INTRODUCTION TO WORKSHOP PRACTICE, SAFETY, CARE AND PRECAUTION IN WORKSHOP

1.1 Introduction

Workshop practice is a very vast one and it is very difficult for anyone to claim a mastery over it. It provides the basic working knowledge of the production and properties of different materials used in the industry. It also explains the use of different tools, equipments, machinery and techniques of manufacturing, which ultimately facilitate shaping of these materials into various usable forms. In general, various mechanical workshops know by long training how to use workshop tools, machine tools and equipment. Trained and competent persons should be admitted to this type of mechanical works and permitted to operate equipment.



Processes:

1. Primary shaping processes
2. Machining processes
3. Joining processes
4. Surface finishing processes
5. Processes effecting change in properties.

1.1.1 Primary shaping processes

Some of these finish the product to its usable form whereas others do not and it requires further working to finish the component to the desired shape and size.

Wire drawing lead to the directly usable articles, which do not need further processing before use.

Casting, forging, bending, rolling, drawing, power metal forging, etc

1.1.2 Machining processes

Large number of components need further processing after primary processes known as secondary operation to obtain desired shape and dimensional accuracy. These operations require the use of one or more machine tools, various types of cutting tools and cutters, job holding devices, marking and measuring instruments, testing devices and gauges etc.

Common machining operations are:

Turning, Threading. Drilling, Boring, Planning, Shaping, Sawing, Milling, Grinding, Slotting, etc.

1.1.3 Joining processes

These processes are used for joining metal parts and in general fabrication work. Such requirement usually occur when larger lengths of standard sections are required or several pieces are to be joined together to fabricate a desired structure.

Common processes are Welding, Soldering, Brazing, Riveting, Screwing, Pressing, etc.

1.1.4 Surface finishing processes

These processes should not be misunderstood as metal removing processes in any case as they are primarily intended to provide a good surface finish or a decorative and/or protective coating on to the metal surface, although a very negligible amount of metal removal or addition may take place. Thus, any appreciable variation in dimensions will not be effected by these processes. The common processes employed for obtaining desired surface finish are the following:

1. Buffing 2. Polishing

3. Lapping 4. Belt grinding

5. Metal spraying 6. Painting

1.1.5 Processes effecting change in properties

These processes are employed to impart certain specific properties to the metal parts so as to make them suitable for particular operations. Most physical properties like hardening, softening and grain refinement etc., call for particular heat treatment. Heat treatments not only effect the physical properties, but in most cases also make a marked change in the internal structure of the metal. So is the case with cold and hot working of metals.

1. Heat treatment

2. Cold working

3. Hot working

Workshop safety

The safety in Workshops has been written not only to provide appropriate safety procedures but also to assist trained workshop personnel with the provision of a reference document outlining the general principles of safe working practices relevant to the mechanical engineering aspects. It relates to specific are as where definite safety measures are required for workshop operations

Factories Act and Accident

Various acts relating to accidents are spelt out in workmen's compensation Act-1923, The factories act-1948 and Fatal Accidents Act-1855. These acts describe the regulations for fencing and guarding the dangerous machinery, items and employer's liabilities.

1.1.6 Concept of accident

It is very difficult to give a definition of the word 'Accident'. However, a generally accepted conception that an accident is a mishap, a disaster that results in some sort of injury, to men, machines or tools and equipments and in general loss to the organization.

The said injury or loss may be of minor or major nature and the accident is termed as non-reportable or reportable. For example, a small cut on the body will be reportable accident in a training workshop. It can be treated by first aid and does not involve any appreciable loss of time, and will not be considered a reportable accident in a production unit.

1.1.7 Causes of accidents

The 98% accidents could be easily avoided provided due precautions are taken well in time. A very familiar slogan goes on to say that accidents do not just happen but are caused due to the failure of one element or the other, and the most unfortunate factor is that the human element is the most pronounced of all which fail.

The common causes which lead to accidents are the following:

1. Unsafe working position.

2. Improper or defective tools or their improper use.

3. Improper acts- which result in violation of safety rules and non-observance of safety precautions.

1.1.8 Common sources of accidents

The large number of machines in use and an even larger number of parts. This can be regarded as sources of danger and require guarding for protection against accidents.

Some common sources of accident are listed below :
Projecting nips between sets of revolving parts, viz., gears, rolls and friction wheels, etc.

1. Projecting fasteners on revolving parts.
2. Revolving cutting tools, circular saw blades.

3. Revolving drums, crushers, spiked cylinder and armed mixers, etc.

4. Revolving shafts, spindles, bars and tools like drills, reamers, boring bars and chucks, etc.

5. Projecting sharp edges or nips of belt and chain drives viz., belt, pulleys, chains, sprockets and belt fasteners.

6. Reciprocating tools and dies of power presses, drop hammers, and revolving presses, etc.

7. Grinding wheels and stones.

8. Reciprocating knives and saw blades such as cutting and trimming machines and power hack-saws, etc.

9. Revolving drums and cylinders without casing, such as concrete and other mixers.

10. Intermittent feed mechanisms.

11. Projecting nips between various links and mechanisms, like cranks connecting rods, piston rods, rotating wheels and discs, etc.

1.2. Common Methods of Protection

The common methods of protection against accidents are the following:

1. Safety by position.

2. Safety by construction.

3. Safety by using interlock guards.

4. Safety by using fixed guards.

5. Safety by using automatic guards.

6. Safety by using distance guards.

1.2.1 Safety by construction

When a new machine is designed, it should be ensured that all its dangerous parts are either enclosed in suitable housings or provided with suitable safety guards. For example, the belt drive and motor in a lathe or milling machine are enclosed, the back gears in a lathe are either enclosed or provided with cast iron guards or covers. Lubricating points are provided on the outer surfaces so that the interior parts are not required to be opened every time.

1.2.2 Safety by position

The machine design is in such a way that the dangerous parts are located such that they are always beyond the reach of the operator. The dangerous parts of all the machines should invariably be guarded and undertaking should be made to make them enclosed in the body or housing of the machines.

1.2.3 Safety by using interlock guards

It is a very efficient and sound method of guarding in that the guard cannot be removed and dangerous parts exposed until and unless the machine is totally stopped. Similarly, the machine cannot be started to work unless the guard returns in position and protects the dangerous parts.

An interlocking guard may be mechanical, electrical or some sort of a combination of these. It is essential that it should:

1. Prevent the starting and operation of the machine in case the interlocking device fails.

2. Always acquire its position to guard the dangerous part before the machine can be started.

3. Remain closed in position until the dangerous part is completely at rest.

1.2.4 Safety by using fixed guards

These guards either for man integral part of the machine or are tightly secured to them. They should be made to have rigid construction and should be so placed that any access to the dangerous parts of the machine is totally prevented in the running condition of the machines.

Steel sheets can be advantageously used and they facilitate an easy fabrication of guards and are lighter in weight.

In some cases the fixed guards are made adjustable in order to accommodate different kinds of works or sets of tools. In some cases the fixed guards are provided at a distance from the danger point.

1.2.5 Safety by using distance guards

The principle of a distance guards is that a fencing, enough high, is made of bars, at a suitable distance from the machine such that even if the operative, by chance, extends his hands over it, his fingers, clothes or any part of the body does not reach within the area of dangerous parts. An additional measure of safety, some sort of tripping device is also usually incorporated to stop the machine quickly in case of an accident.

1.2.6 Safety by using automatic guards

The principle of an automatic guard is that its operation is actuated by some moving part of the machine.

It may linked that the part will automatically bring the guard in protecting position before the operation of the machine starts. The design of the guard is such that it automatically forces the operative away from the dangerous area of work before the operation starts and does not permit his access to the area again until and unless the machine stops. It may be noted that due to enough time being required for their operation, this type of guards are not suitable for quick-acting and fast-running machines. Their use is largely favored for heavy and slow acting machines like heavy power presses.

FITTING

It is the process of removing unwanted material with the help of hand tools, from a given stock for making a component or fitting pair.

Fitting Operations

Fitting work involves a large number of hand operations to finish the work to desired shape, size and accuracy.

Some common fitting operations:

1. Measuring : It is a process of finding the dimensions of the work piece by using steel scale, calipers, micrometer, gauge etc.
2. Marking : Making a series of definite lines on the job. These lines act as guidelines to the fitter who works on the job.
3. Punching : It is the operation of making series of dent or punch marks on the line of marking using center punch and ball peen hammer.
4. Drilling : It is the operation of producing holes in the solid materials using Drilling Machine with suitable drill bit.
5. Reaming : It is the operation of smoothening the inner surface of the drilled hole with a reamer.
6. Boring : Boring is the operation of enlarging the size of Previously drilled hole.
7. Counter Boring : It is the operation of increasing the size of the hole at one end through a small depth using counter bore tool.
8. Cutting or Hack Sawing : It is the operation of cutting flat, round rods, pipes etc. using hacksaw frame with suitable blade.
9. Chipping : It is the operation or removing thick layer of metal using cold chisel.
10. Filing : It is the operation of removing thin layer of metal using using different types of files.
11. Scraping : It is the operation of producing a precision surface or smooth a accurate surface. This is done with tools called scrapers, which have very hard with no rake.
12. Tapping : It is the operation of cutting internal threads with a thread cutting tool called taps. Drill size for taping= size of the tap- pitch of the thread.
13. Dieing : It is the operation of cutting external threads using die set.
14. Grinding : Grinding is the process of removing metal using grinding wheel. Grinding is a finishing operation used for accuracy and smoothness. The accuracy in grinding is in the order of 25 microns.

2.1 Introduction

Bench work has its own essential position in all engineering works. In the mechanized workshops, where most of the work is carried out on an automatic machine, while bench work has its own importance. The jobs can be finished to a fairly good degree of accuracy through machining operation; they often require the hand operations to be done on them to finish to the desired accuracy. A fitter's work is unavoidable when different parts are to be assembled in position after they have been finished. Alignment of machine parts, bearings, engine slide valves and similar other works call for a fitter's work. Reconditioning and refitting of machines and machine parts cannot be done without a skilled fitter. All the above

types of works require the use of a large number of hand tools and a fitter must have good working knowledge of all these tools and instruments.

2.2 Filter's vices

Vices are the most suitable and widely used tools for gripping different jobs in position during various operations carried out in a fitting shop.

There are a fairly good number of different types of vices such as parallel jaw vice, machine vice, hand vice and pipe vice.

From these, the parallel jaw vice is the most commonly used in general fitting work. These vices are available in different trade sizes and the selection of a suitable size will depend upon the maximum size of the work. The width of the jaws determines the size of the vice.

In fixing it on the fitter's bench it is held with the help of bolts passing through the planks of the bench. The bolts are tightened by means of nuts and the vice is held firmly on the bench. The jaws of the vice are usually kept overhanging the edge of the bench.

2.2.1 Bench vice

It is the most commonly used vice sometimes also known as parallel jaw vice. It essentially consists of a cast steel body, a movable jaw, a fixed jaw, both made of cast steel, a handle, a square threaded screw and a nut all made of mild steel. A separate cast steel plates known as jaw plates with teeth are fixed to the jaws by means of set screws and they can be replaced when worn. The movement of the vice is caused by the screw which passes through the nut fixed under the movable jaw. The screw is provided with a collar inside to prevent it from coming out and handle at the outer end. The width of the jaws suitable for common work varies from 80 to 140 mm and the maximum opening being 95 to 180 mm.

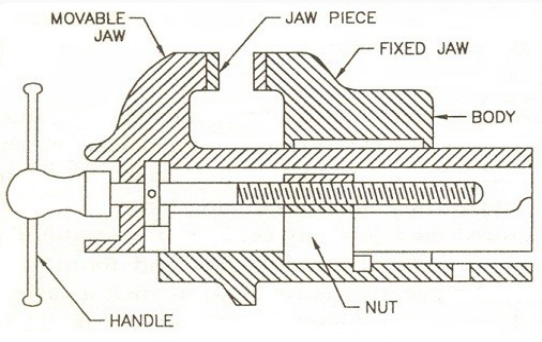


Fig. 2.1 Bench vice

2.3 Surface Plate

Its specific use is in testing the trueness of a finished surface, testing a try square, providing adequate bearing surface for V-block and angle plates, etc., in scribing work.

It is a cast iron plate having a square or rectangular top perfectly planed true and square with adjacent machined faces. The top is finished true by means of grinding and scrapping. This plate carries a cast iron base under it and the bottom surface of the base is also machined true to keep the top surface of the plate in a perfect horizontal plane.

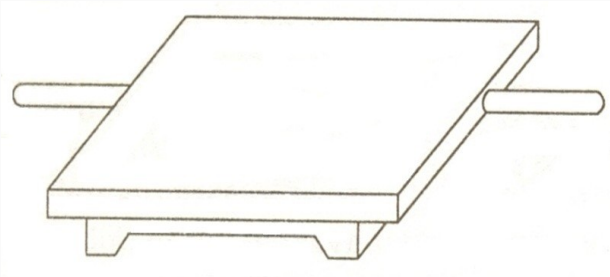


Fig. 2.2 Surface plate

2.4 'V' –Block

A 'V" block serves as a very useful support to the work in marking. It usually works in conjunction with a U-clamp.

Round bar is placed longitudinally in the block and the screw in the clamp tightened. Its specific use is in holding the round bars during marking and center drilling their end faces, which are to be held between centers on the lathe. Also it is very suitable for holding round bars in drilling operations when the axis of the drill is to be kept normal to the axis of the bar.

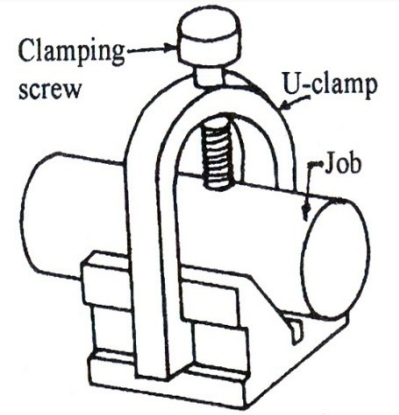


Fig. 2.3 V-Block

2.5 Simple Scribing Block

It is principal marking tool in a fitting shop and is made in various forms and sizes. It consists of a cast iron sliding base fitted with a vertical steel rod. The marker is fitted into an adjustable device carrying a knurled nut at one end. By means of the nut the marker can be loosened or tightened to set it at any desired inclination, moved to and fro inside the hole accommodating it or adjust its height along the vertical pillar. Normally it is used in conjunction with either a surface plate or marking table. Its specific use is in locating centers of round rods held in V-block, describing straight lines on work held firmly in its position by means of a suitable

device like angle plate and also in drawing a number of lines parallel to a true surface.

2.6 Universal Surface Gauge

It consists of a cast base, perfectly planed at the top, bottom and all sides. Two guide pins are provided at the rear end of the base which can be pressed down to project below the base. These pins can be used against the edge of the surface plate or any other finished surface for guiding the instrument during scribing.

A swivel bolt is provided at the top of the base in which the spindle is fitted. This spindle can be swung and locked in any desired position by means of the adjusting screw. The scriber is fitted in an adjustable screw on the spindle and is capable of being adjusted at any inclination and height along the spindle. A rocker is provided at the top of the base and it carries an adjusting screw at its rear end.

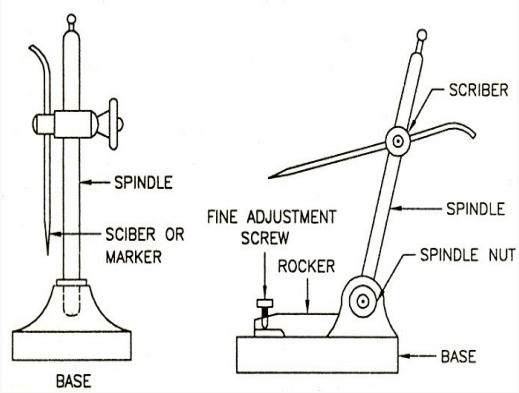


Fig. 2.4 Simple scribing block and universal surface gauge

2.7 Try Square

It is better known as engineer's try square and is a very common tool used for scribing straight lines at right angles to a true surface or testing the trueness of mutually normal surfaces. They are made in different sizes from the steel pieces.

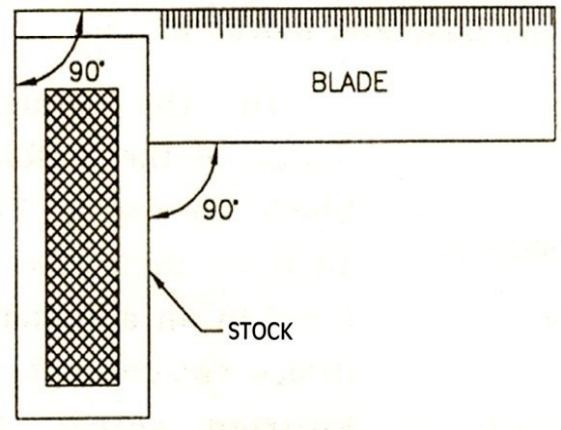


Fig. 2.5 Try square

It consists of a steel blade fitted into a steel stock of rectangular cross-section. They are well hardened and tempered to suit the need. Both inner and outer surface of the blade are kept truly at right angles to the corresponding surfaces of the stock.

2.8 Bevel Gauge

Whenever angles other than right angles are required to be tested or set and marked sliding bevel square or bevel gauge is used.

It consists of a steel stock of rectangular cross-section carrying a slotted steel blade at its end. This blade can be made to slide, set at any desired angle and secured in that position by means of a screw.

2.9 Files

Files of different types are the principal hand tools used by a fitter. All the files, irrespective of their shape, size and grade, essentially consist of two main parts, viz., a toothed blade and a pointed tang, which is fitted in a handle. Files are generally forged out of high carbon steel, followed by cutting of teeth, hardening and tempering etc. Common shapes of the files available are flat, hand, square, pillar, round, half round, triangular, knife edge, etc.

These files are manufactured in different varieties and their classification is governed by the following factors: effective length- i.e. excluding the length of tang, shape or form of the cross-section, depth, spacing and cut of teeth

Length of the files varies according to the need but the most commonly used lengths range from 10 cm to 30 cm and they cover almost all sorts of filing work done by hand.

Length between 10 cm and 15 cm are generally used for fine work, between 15 cm and 25 cm for medium sized work and above 25 cm for all general and large sized jobs.

Square file which carried double cut teeth on all the four faces and is normally made tapered for about one-third of its length near the end opposite to the tang.

Triangular file which normally carries single cut teeth on all the faces and is made tapered towards the end for about two-third of its length near the tip. The cross-section is an equilateral triangle.

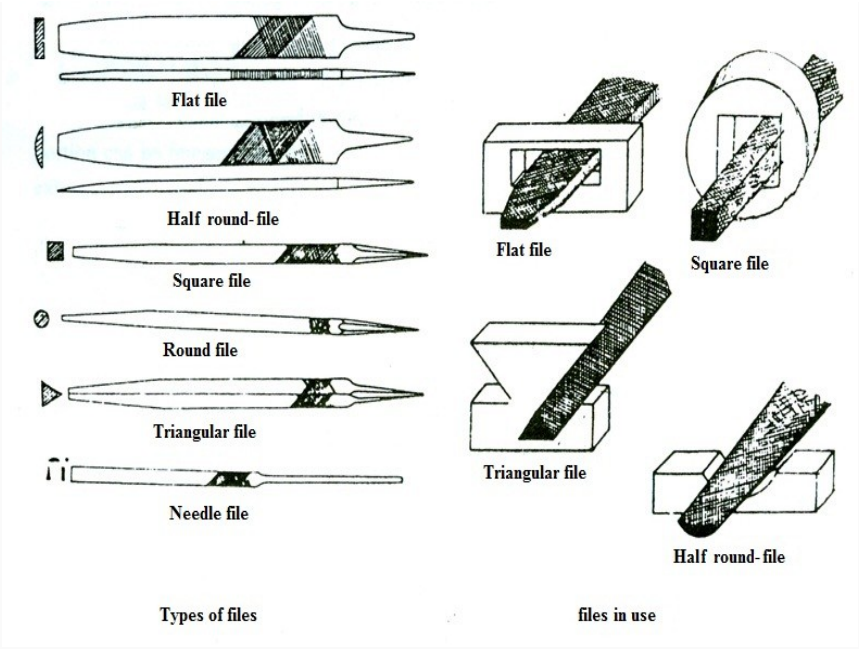


Fig. 2.6 Types of files

Teeth of the files may single cut or double cut. Single teeth are parallel and at angle of 60ºto the center line of the file. Double cut files have two sets of teeth, the overcut teeth are cut at angle of 60º and the uppercut at 75º to 80º to the centre line. Files are also further classified according to the coarseness or spacing between the rows of teeth.

1. Rough (R) with 10 to 4.5 cuts per 10 mm length
2. Bastard (B) with 18 to 6 cuts per 10 mm length
3. Second cut (SC) with 21 to 11 cuts per 10 mm length
4. Smooth (S) with 30 to 15 cuts per 10 mm length
5. Dead smooth (DS) with 35 to 28 cuts per 10 mm length
6. Super smooth (SS) with 63 to 40 cuts per 10 mm length

2.10 Scrapers

Scraping is a very important hand operation in bench work employed for obtaining a fine surface finish on the work, particularly for removing convex spots from machined surfaces, and the tools used for doing this operation are known as scrapers.

They vary in shape and size, depending upon the specific work for which they are employed.

They are usually made from rejected old files. Such files are heated and bent to the desired shape. They are fitted with a wooden handle.

2.11 Chisels

There are many verities of chisels used for chipping work by a fitter. Some very commonly used forms are Flat, Cross-cut, Round nose and Diamond point.

All the chisels are forged from bar stock of carbon steel, to the desired shape and the cutting edge ground to the correct angle.

The forging operation is followed by annealing, hardening and tempering to make chisel body tough and obtain a sharp cutting edge.

Full length of the chisel is never hardened, only a small length about the cutting edge (say about 20 to 30 mm) is hardened.

The included angle at the cutting edge varies between 40 and 70, depending upon the material on which it is to be used. Approximate values of cutting angles for common materials are as follows:

Brass and copper 40

Wrought iron 50

Cast iron and general cutting work 60

Steel (cast) 70

A flat chisel is a general purpose chisel which is most widely used in cutting work, chipping large surface, cutting metal sheets, rods, bar stocks and similar other purposes. Since it cuts the metal in cold state it is also frequently known as cold chisel.

A round nose chisel is used for drawing the eccentric hold back to correct centre which has run off-centre during drilling operation. Another specific use of this type of chisel is in cutting oil grooves and channels in bearings and pulley bushes and cleaning small round corners.

A cross cut is a comparatively narrow chisel having its cutting edge slightly broader than the blade. It is made to keep the blade free when the chisel is used to cut deep groove into the metal. Normal widths of the cutting edge vary from 3 mm to 12 mm. This chisel is used to cut parallel grooves on large surfaces, before chipping by means of a flat chisel, cutting key ways, etc.

A diamond point chisel is a special purpose chisel used for chipping rough plates and cutting cast iron pipes, cutting ‘V’ grooves, chipping sharp corners, squaring up corners of previously cut slots and cleaning angles.

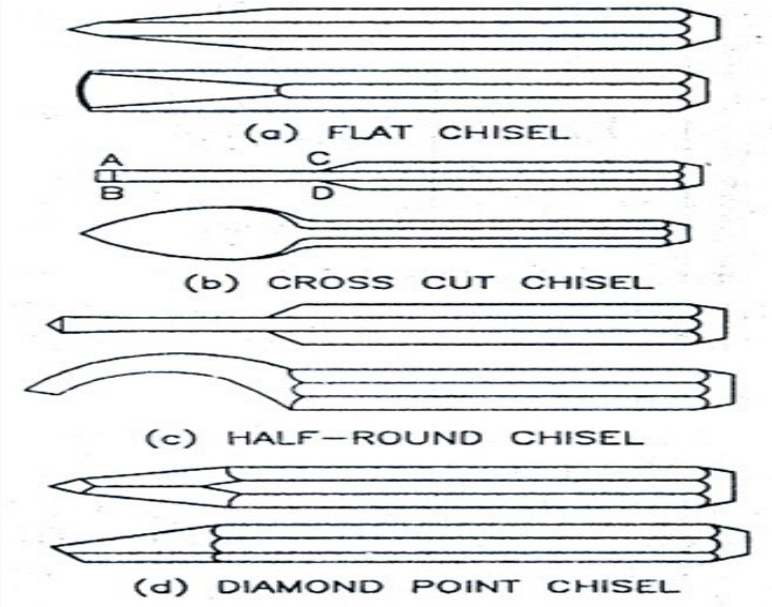


Fig. 2.7 Types of chisel

2.12 Hammers

The hammer is one of the most widely used fitter's tools. It is used for striking chisels in chipping and cutting and the punch in marking.

All the hammers used in a fitting shop are similar in construction to the smith's hand hammers, such as ball peen, cross peen, straight peen, etc. The only difference lies in weight. Hammers used in fitting work are comparatively lighter in weight than the smith's hand hammers. They normally weigh from 0.45 kg to 0.7 kg.

Ball peen hammer is the most commonly used hammer. The peen is ball shaped. It is used for riveting, chipping, drawing and laying out. The weight of the hammer varies from 0.11 to 0.91 kg (as per IS standards)..

Fig. 2.8 Hammers

Cross peen hammer resembles the ball peen hammer in shape except that its peen is in wedge shape and at right angles to the eye. This hammer is used for bending and hammering in the corners.

Straight peen hammer has a peen in line with the handle and is used for peening or stretching the metal.

2.13 Hack-Saw

Desired lengths of bar stocks, rods, tubes, iron flats and metal sheets, etc. are always required to be cut in fitting shop. Hack-saw is a common tool used for this purpose. It consists of a metal frame, fitted with a wooden handle, carrying metal clips with wing-nut at its end to hold. The clip carrying the wing nut is threaded so as to stretch the blade to the desired extent. The frame can be either of fixed type, which can accommodate the same length of blades or adjustable type which is capable of accommodating different lengths of blades.

Hack saw blades are made of high carbon steel or low alloy steel. Hack saw blade is the main part. Push type blades, those which cut in forward stroke only, are generally used. In these, the teeth always point away from the operator. The blades in common use are generally 0.7 mm thick, 12.7 mm wide and 20 cm to 30 long. About 5 to 7 teeth per cm length of blade from the course group and 8 to 12 teeth per cm from the fine group of teeth.

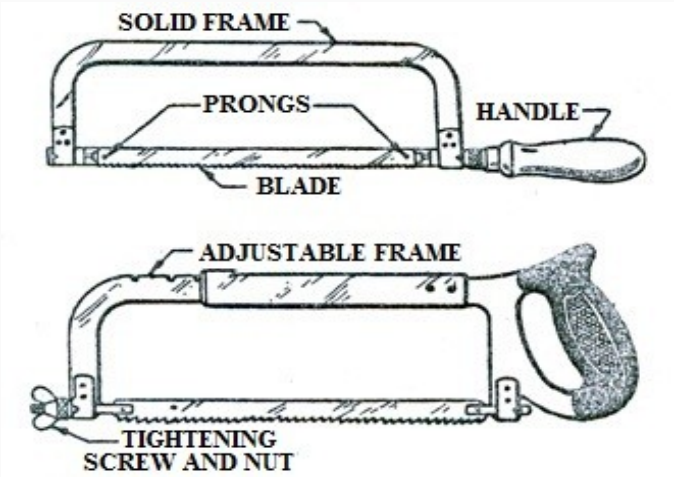


Fig. 2.9 Different parts of a hack saw

CHAPTER 3

THE BENCH WORK TOOLS, ITS USES AND PROCESSES

3.1 Miscellaneous Tools

1. Punch

A punch made from a steel rod with a length of 90 to 150 mm and a diameter of 8 to 13 mm is used in bench work for marking purpose and locating centres in more permanent manner. The punch with a tapered point angle of 40^0 is called a princk punch and that of600 point angle is called a centre punch.

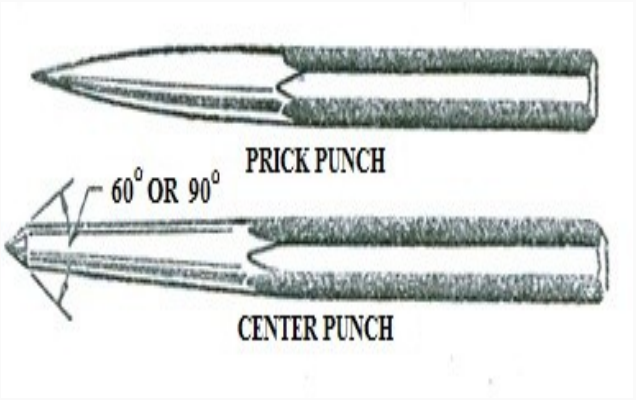


Fig. 3.1 Punch

2. Calipers

Calipers are the devices used for measuring and transferring the inside or outside dimensions of components. Although gradually they are being replaced by the more accurate and precision instruments and gauges, like micrometers in modern workshops, still they stand as the in general work on account of their cheapness and ease in handling.

3. Screw Drivers

It is a very useful hand tool for rotating the screws. It consists of wooden or a plastic handle and steel blade, shaped at the end. The flat end of the tool is inserted into the slot provided on the head of the screw for rotating it. Screw drivers are made in various sizes to suit the corresponding sizes of the slots on the screw heads. Sometimes star headed screw driver is used for star headed screws.

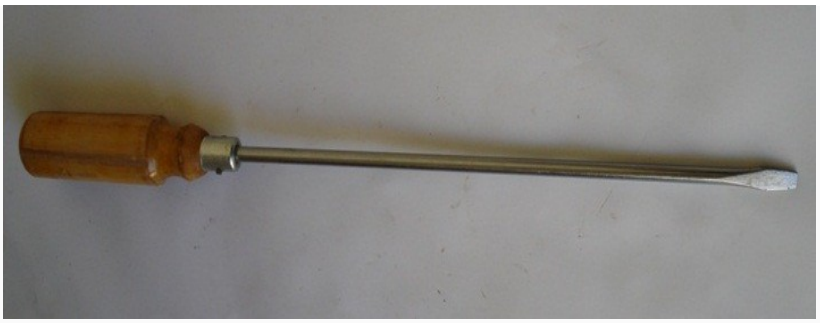


Fig. 3.2 Screw driver

4. Drills

Drilling is an important operation carried out in a fitting shop for producing different types and sizes of holes in various materials. There are many forms of drills used for this purpose.

The simplest form is a flat drill which is used for wood work. The other important and most widely used is a fluted twist drill. It has a cylindrical body carrying the spiral flutes cut on its surface. Twist drills are usually made of high-speed steel, some cheaper varieties are made of high carbon steel. They are made in different forms to suit the work but the most commonly used types are (i) those having parallel shank and (ii) those having tapered shank, Parallel shank is provided on small sized drills (say up to 12.7 mm) only and those above this size are usually provided with a tapered shank.

The twist drill essentially consists of two main parts, a shank which is gripped in the chuck of the drilling machine and the body forms the main cutting unit. Main advantages of using twist drills are:

1. The chips of the metal are automatically driven out of the hole through the spiral flutes.

2. Cutting edges are retained in good condition for a fairly long period.

3. Heavier feeds and speeds can be quite safely employed.

4. For the same size and depth of hole they need less power as compared to other forms of drills.

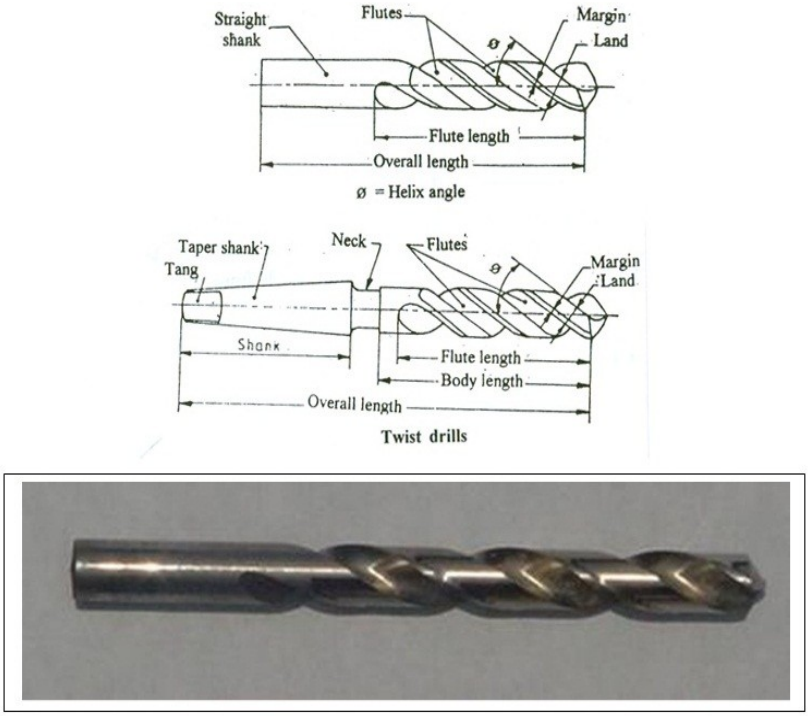


Fig. 3.3 Twist drill

5. Taps

The hand operated taps used in fitting shops are employed for cutting internal threads in cylindrical holes or for cleaning damaged threads in similar parts. A tap consists of a toothed body having flutes (usually 4) cut on its surface, a round shank and a square formation at the end of the shank. The flutes are provided for the same purpose as in case of a twist drill and square formation at the top enables to grip by the tapping handle.

All the hand taps of different sizes are usually available in a set of three taps of each size known as taper or rough, second and finish or plug respectively. The main difference between the three taps is the chamfer angle. In the threading operations they are used in the same order as taper, second and plug.

When starting tapping care should be taken to start the thread in alignment with the hole. Also the tap should be occasionally rotated back about a turn to break the chips and facilitate their removal.

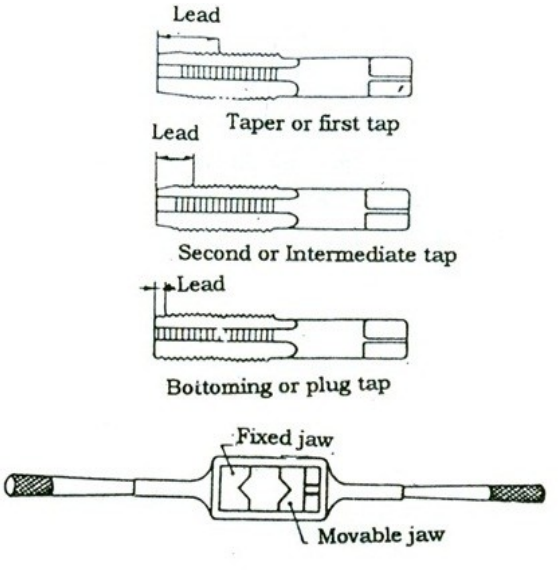


Fig. 3.4 Taps and tap wrench

6. Dies and stocks

Dies are used to cut threads on a round bar of a metal, such as the threads on a bolt. It is a round or square block of hardened steel with a hole containing threads and flutes which form cutting edges. Die may be a solid or adjustable type. Solid die has fixed dimensions. An adjustable die may be split type with a split through one side or two piece rectangular type. These types of dies are fitted into special stocks and closed by means of adjusting screws.The size of a die is specified by the outside diameter of the thread to be cut and pitch of the thread.

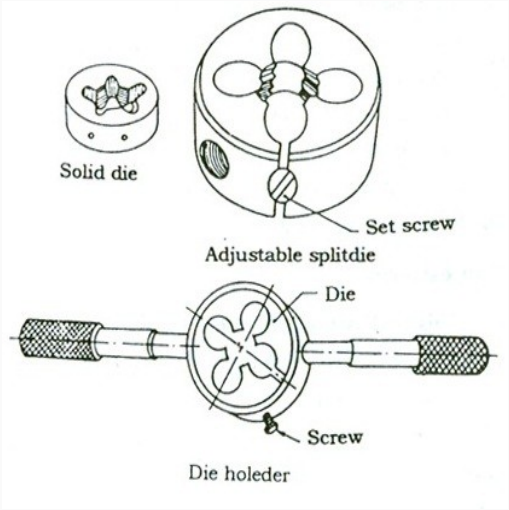


Fig. 3.5 Die and die handles

3.2 Bench Work Processes

Bench work involves following hand operations to finish the work to desired shape and size with required accuracy.

1. Marking
2. Chipping
3. Sawing
4. Filing
5. Draw filing
6. Threading
7. Grinding

Some common bench work processes are described here

1. Marking

- It is the basic and one of the most important operations in bench work.
- It should be remembered that how accurately and carefully one tries to perform other operations it will be of no help until and unless the piece has been properly and accurately marked.
- Sufficient care should be exercised in performing this operation to obtain a desired fitting of the components.
- Marking on the work can be done by setting out dimensions with the help of a working drawing.
- The surface to be marked is coated with either the paste of red lead or chalk and allowed to dry.
- After that, the work is held in a clamp, if it is round. If the work is too thin, it is normally supported against an angle plate keeping the surface to be marked in a vertical plane. Lines in horizontal direction are scribed by means of a scribing gauge.
- Lines at right angles to this can be drawn easily by first turning the work through 90 and then using the scriber.
- Lines can easily be marked with the help of a try square. Circles and arcs on flat surfaces are inscribed by means of dividers.
- After the scribing work is over, indentations on the surface are made, by using the center punch and hammer along the scribed lines and arcs.
- The punch marks serve as the guide during further operations like filing, chipping and drilling. etc.

2. Chipping

- It is the operation employed for removing the excess metal by means of cold chisels.
- To have a properly chipped surface it is essential that the same cutting angle should be maintained throughout the operation.
- In case the surface is too large it is advisable to cut grooves along the whole surface by means of a cross cut chisel and then chip off the remaining metal.
- The cutting angles of the chisels differ for different metals.
- Frequent lubrication and cooling of the cutting edge, while taking heavy cuts for removing large amount of metal, it helps considerably in chipping the metal easily and more effectively.
- To the correct cutting angle of the chisel, proper gripping of the chisel and the hammer and correct standing position of the operator play a significant part.
- The chisel should be firmly gripped in one hand leaving about 3 to 5 cm length above the thumb of the hand, and hammer should be held near the end of the handle to ensure more power in the blows.

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- The operator should stand erect with his two feet sufficiently apart to balance his own weight equally on both the feet.
- The operator should always see the cutting edge of the chisel and not the top of the same.

3. Sawing

- This operation is performed in fitting shop for cutting different metal pieces to the desired size and shape, usually prior to other operations such as filing, drilling, scraping, etc.
- It is also employed for cutting metal pieces of required length out of the bar stock.
- For sawing, the saw blade should be properly fitted, and stretched to have the proper tension, in such a way that the cutting teeth always point away from the operator so as to cut the metal in forward stroke.
- Sawing should be done steadily and slowly.
- An average speed of about 50 strokes per minute is a good practice.
- Sufficient pressure should be exerted in the forward stroke and this be relieved during the backward stroke.
- It is advisable to use a coolant throughout the operation. A new blade should not be directly used on a hard metal.

4. Filing

- Similar to the saw blades, most of the files have their teeth pointing away from the operator such that they cut during the forward stroke.
- The pressure of the hand in filing should also be applied only during the forward stroke and relieved during the return stroke.
- Beginners particularly should be careful enough to practice correct movement of file.
- It should always be more in a perfect horizontal plane for obtaining a truly plane and smooth surface.
- As far as possible, try to use full length of the file during the operation.
- Moving the file diagonally on a flat surface always yields best results. A coarse pitched file should be employed when enough metal is to be removed, followed by finishing with a smooth file.

5. Draw filing

- When the surface is to be finally finished by filing only and no other operation, like scraping, is to follow the filing operation, a special method of filing, called Draw filing, is employed for finishing the surface.
- A flat file of fine cut is used for this operation.
- It should be ensured before use that the file teeth are free from metal particles,
- Other wise a numbers of scratches will be produced on the surface. It is usual to employ a file card quite frequently for cleaning the file teeth both before use as well as during use.

- For draw filing operation the file is held flat on the surface between the two hands.
- The file must move forward and backward. Flatness and evenness of the surface should be checked quite frequently during the operation.

For final finishing, it is a common practice to rub a chalk piece over the entire surface of the file. This helps in producing a finely finished surface.

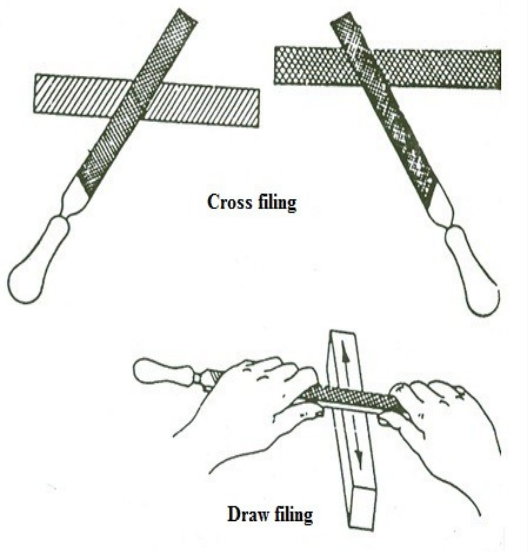

Fig. 3.6 Cross and draw filing