# BENCH WORK & FITTING

Bench working and fitting work is done to finally fit together separately manufactured or purchased Parts of a product. This work require accuracy and precision.

Bench work generally denotes the production of a product by hand on the bench.

Fitting deals with the assembly of parts together by making finish of work, alignment of machine Parts, close inspection of component to check their suitability after assembly with use of appropiate tools and instruments.

## Tools and Equipments :-

These are categorised into three categories :-

(i) Supporting or holding Tools
(ii) Marking Tools.
(iii) Processing Tools.

### (1) Supporting or holding Tools :-

These are used to support the work piece when it is being Processed.

For eg :- Bench Vice, Vee-Block.

### (2) Marking Tools :-

These are the tools used to layout the dimensions on the work piece before carrying out any operation over it.

For eg :- Surface plates, Try square, Punch, Surface Gauge, Caliper, Dividers, Scriber, Bevel ~~Gauge~~, Bevel Protactor. Wire Gauge.

**Processing Tools :-** These are the tools used to process the work piece according to the dimension marked.

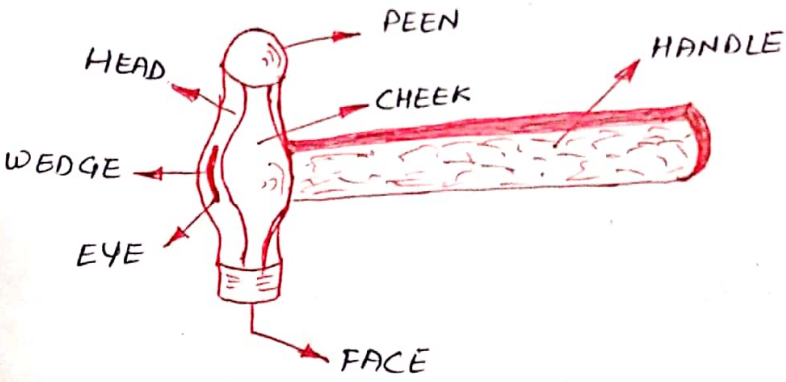
For eg:- File, Hacksaw, Chisels, Tap, Dies, Drills, Reamer.

These are also called hand tools.

**Hand Tools :-** File, Tap, Hacksaw, Drills, chisel, Dies, Hammer, Reamers

**HAMMER :-**

Hammer is a striking tool used to provide impact required to perform various operations like marking, chipping, chiseling etc.




PARTS OF HAMMER

Main parts of a hand hammer are peen, head, eye, face, wedge and handle. the size of hammer is determined by the length of its handle, size and weight of its head.

**MALLET :-** soft hammers are used to strike the metal softly or gently with minimum damage to the surface of metal. Mallet is a type of soft hammer and chiefly used in wood working. Soft hammers are made of any soft material like wood, hard rubber, lead, copper and brass.

## CHISEL :-

Chisel are classified in two catogories :-

(i) Hot Chisel (ii) Cold chisel.

**Hot Chisel :-** Hot chisel, used to cut the metal in hot state.

**Cold Chisel :-** Cold chisel used to cut the metal in cold state.

In Bench working operations, most of the time Cold Chisel is used.

**Cold Chisel :-** Cold chisel are made of high carbon steel. A chisel, in general consists of shank, head and a prepared cutting edge. the shank of the chisel is rectangular, hexagonal or octagonal in cross-section. Cold Chisel are made by forging. sharpner and including angle of cutting edge of a chisel are maintained by grinding, then it is hardened. Angle of cutting edge depend upon the hardness of material to cut. lower angles are used to cut soft materials and higher angles are used to cut harder materials. Normally, angle of cutting edge varies from 35 degree to 70 degrees.

Size of a chisel is determined by length and width of the cutting edge. shank of the chisel should be enough long so that operator can view the cutting when chisel is in use. Cold chisels are classified into different catogeries based on shape of cutting edge and cross-section of shank.

## Flat Chisel:-

Cutting edge of flat chisel is straight and curved slightly to prevent the digging of corners. It is used for chipping operation in metal working.

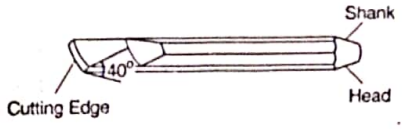



Fig. 6.22 Flat Chisel

## CROSS CUT CHIESEL:-


Fig. 6.23 Cross cut Chisel

width of cutting Edge is more at its joint with the shank. width is smallest at lower end of cutting edge. It is used for cutting grooves, key ways in metallic objects where the use of other Power is difficult.

Fig. 6.24 Round Nose Chisel

## Round Nose Chisel:-

It is also called half round chisel. It width varies from 2 to 16mm and length from 150 to 250mm. Its cutting edge is maintained at 45°. Round nose chisel is used for chipping of concave surfaces & corners, making flutes, grooves & channels for flow of lubricants in bearing, bushes and pulleys.

## Diamond point chisel:-

It is called diamond point chisel because its cutting point is made of the shape of a diamond. Its cutting edge is maintained at 60°. width of its cutting edge & length of chisel vary from 6 to 16 mm & 100 to 300 mm respectively. It is used to make sharp corners, 'V' shaped slots, & square holes etc.

## Side Chisel:-

It is straight cutting edge always remain slightly away from the line of its body. It is used for making & finishing cotter ways & slots.

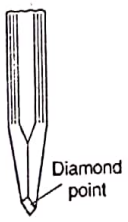
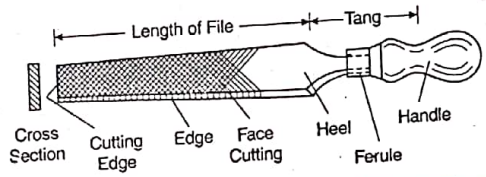



Fig. 6.25 Diamond Point Chisel

Fig. 6.26 Side Chisel

## FILE :-

A file consist of point, edge, face, heel, tang and handle. It is made of hard steel, generally having rectangular cross-section, in the form of thick strip. It consist of series of inclined parallel cutting edges on its face. File is a hard tool used to smoothen the metal surface. Hardness of material of file should be more than three times the hardness of material to be finished for its succesful operation.




## CLASSIFICATION OF FILE :-

Files are classified according to :-

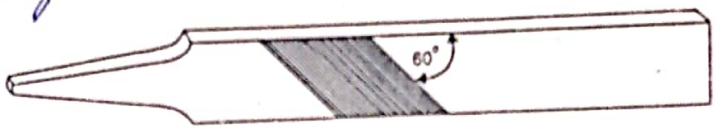
i) size of file
ii) cut of Teeth
iii) Grade of cut of file.

**Size of File :-** the size of file is indicated by its length. It is the distance from the point to heel with tang The length of the file, in general use is 200mm to 450mm and 100mm to 200mm for finer work.

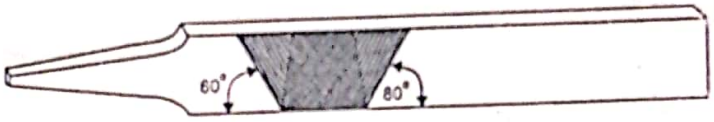
(b) Cut of teeth :- The files according to the cut of teeth are divided into two groups :-

(i) single cut (ii) Double cut

Single cut :- The teeth are cut parallel to each other running across the faces and at angle of 60° to the centre line of the file. These files are frequently termed as flats and are particularly used for very hard metals.




(a) Single cut file.




(b) Double cut file.

Fig. 16.13. Single cut and double cut file.

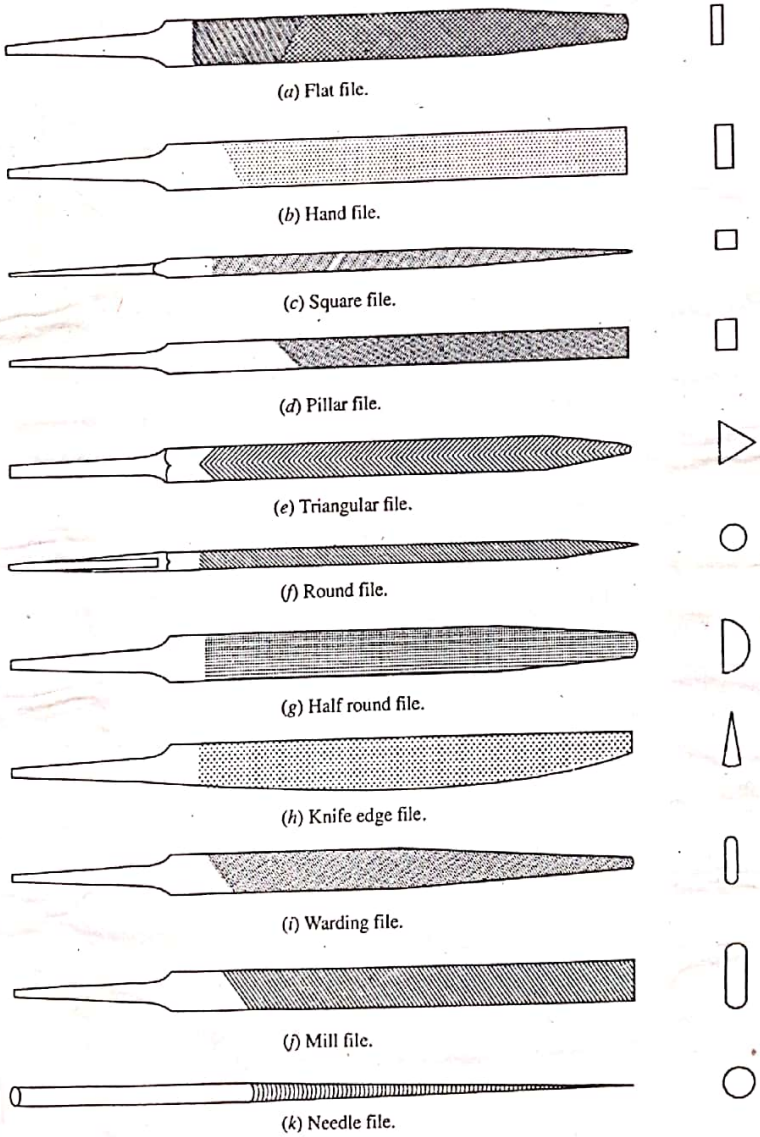
Double Cut File :- There are two set of teeth, the first set of teeth are similar to those of single cut files (i.e at 60° to the centre line of the file) while the second set of teeth are cut diagonally across the first set of teeth at an angle of about 80° to the centre line of file. All the teeth have negative rake i.e, sloping backwards by which they cut only on the forward stroke. It removes metal at a faster rate.

(c) Grade of Cut of File :- The single cut and double cut files, depending upon the pitch of the teeth (i.e spacing b/w the rows of teeth)

may be classified as rough (R), bastard (B), second cut (SC), smooth (S), Dead smooth (DS) and superfine or super smooth (SS).

It may be noted that coarseness or pitch of the file varies directly as the length of the file. Thus larger the length of the file, coarser will be the pitch and smaller the file, finer will be the pitch.

Shapes of file :- The files according to their shape of cross-section are classified as:-



(a) Flat file.

(b) Hand file.

(c) Square file.

(d) Pillar file.

(e) Triangular file.

(f) Round file.

(g) Half round file.

(h) Knife edge file.

(i) Warding file.

(j) Mill file.

(k) Needle file.

## Hacksaw :-

Hacksaw is a tool used to cut the metal into pieces. Hacksaw consists of saw blade, frame, handle, lever, adjusting screw and nut. The blade is fitted to frame tightly.
Frame of hacksaw is of two types :-

(i) **Solid frame :-** the frame, which can accomodate the blade of fixed length i.e its length cannot be changed.

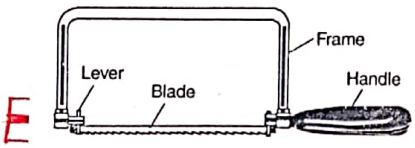



Fig. 6.27 Hacksaw with Solid Frame

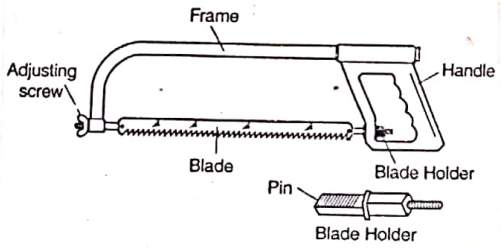



Fig. 6.28 Hacksaw with Adjustable Frame

(ii) **Adjustable Frame :-** The frame, which can hold the blade of different lengths, i.e its length can be adjusted by a short amount with the help of adjustable screw and nut.

## HACKSAW BLADE :-

Saw is most important part of hacksaw. Hardness of blade material should be at least three times than the hardness of material to cut. Blades having bigger teeth or less number of teeth per centimeter is used for cutting harder material. Blades having smaller sized teeth or more number of teeth per centimeter is used for cutting softer material. Size of saw blade is determined by four parameter (i) pitch of teeth, (ii) length, (iii) width and thickness of blade.

**TAP :-**

Taps are made of hard steel. A tap consists of cutting edges on circumference of its body. At the top of body shank is made and it is given square cross-sectional shape to ensure proper gripping.

Tap is used to make internal threads in a hole of fixed diameter. Taps are available in different sizes varying from 2mm to 50mm in diameter

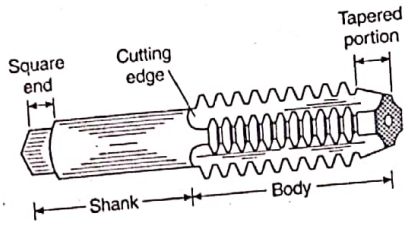



Fig. 6.31 Tap

**DIE :-**

Die is also a hand-operated tool made of hard steel used to make external threads on a cylindrical rod. Two types of dies are (i) Solid Die (ii) Adjustable split Die.

**Solid Die :-** A solid die has fixed dimension that cannot be adjusted. It is used on the rod of fixed diameter.

**Adjustable or split die :-** Adjustable or split die is split at one of its side. This die is capable to make external threads on the rod of the dimension within a range. However the range is very small.

**Die stock :-** Die stock is a holding tool. It is used to hold the die to put it in operation. Die stock is made of high carbon steel.

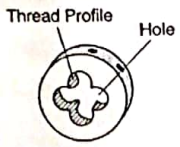



Fig. 6.33 Solid Die

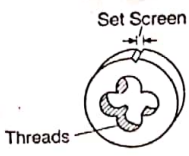



Fig. 6.34 Adjustable Split Die

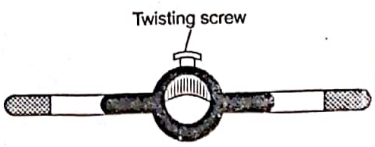



Fig. 6.35 Die Stock

## MARKING TOOLS:-

(i) **Surface plate:-** Surface plate is a flat, smooth and solid plate made of Grey cast iron. having straight edges. It consist of handles at two opposite edges for the purpose of handling and four levelling screws one at each corner. Surface plate is treated as referenc surface for inspection, making and setting out dimensions for any other operation.

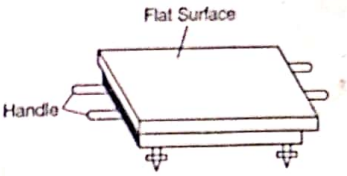
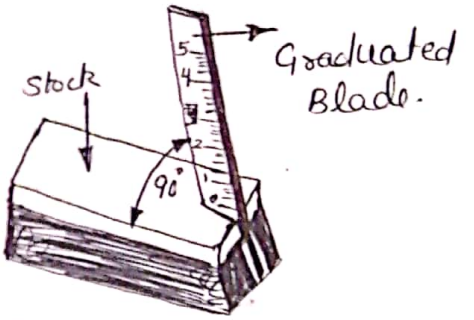



Fig. 6.5 Surface Plate

(ii) **Try square:-** Try square is a marking Tool. It consists of blade and stock made of corrosion resistant, wear resistant, temperature insensitive, hard steel. The blade is rigidly fixed by rivets to the stock in a slot at corner and middle of its thickness. Inner and outer edges are kept straight and absolutely at right angle to corresponding edges of stock. The blade of try square is graduated in millimeters and centimeters at the inner and outer edge.




Engineering Try Square

Try square is used to examine the flatness of a metallic surface and to check the perpendicularity of two adjacent surfaces or edges.

## Bevel Square :-

It is also called bevel gauge. It is used to check or measure the included angle between two surfaces. It consists a slotted blade of straight edge hinged at one of its end to a metallic stock. the blade can swing about the hinge. other end of slotted blade is screwed on another slotted auxiliary blade. The auxiliary blade can move along its own slot as well as along the slot of other blade. The two adjustable blades can be fixed in any relative position and so can have any included angle. the way of angle measurement is first to set the blade parallel to the surface whose included angle is to be measured and then it is transfered to some other measuring device for its measurement.

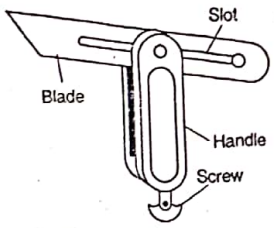
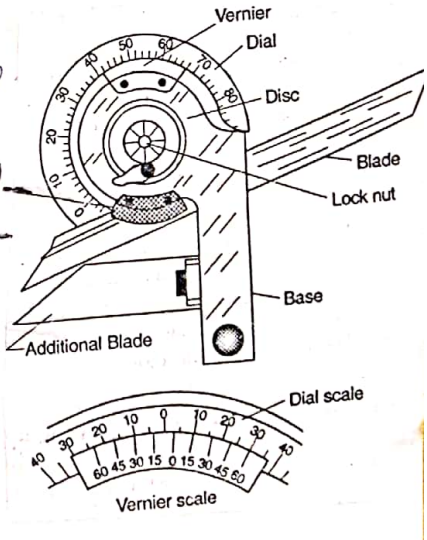


Fig. 6.7 Bevel Square

## Bevel protactor :-

The working of bevel protactor is similar to that of bevel gauge with an additional facity of direct measurement of angle. Bevel protactor consists of a circular scale attached to one blade and a ~~Point~~ Pointer to other blade. if both blades kept Parallel i.e angle b/w them is zero, the pointer points out zero on the circular scale. It mean pointer points out the included angle between the blades.



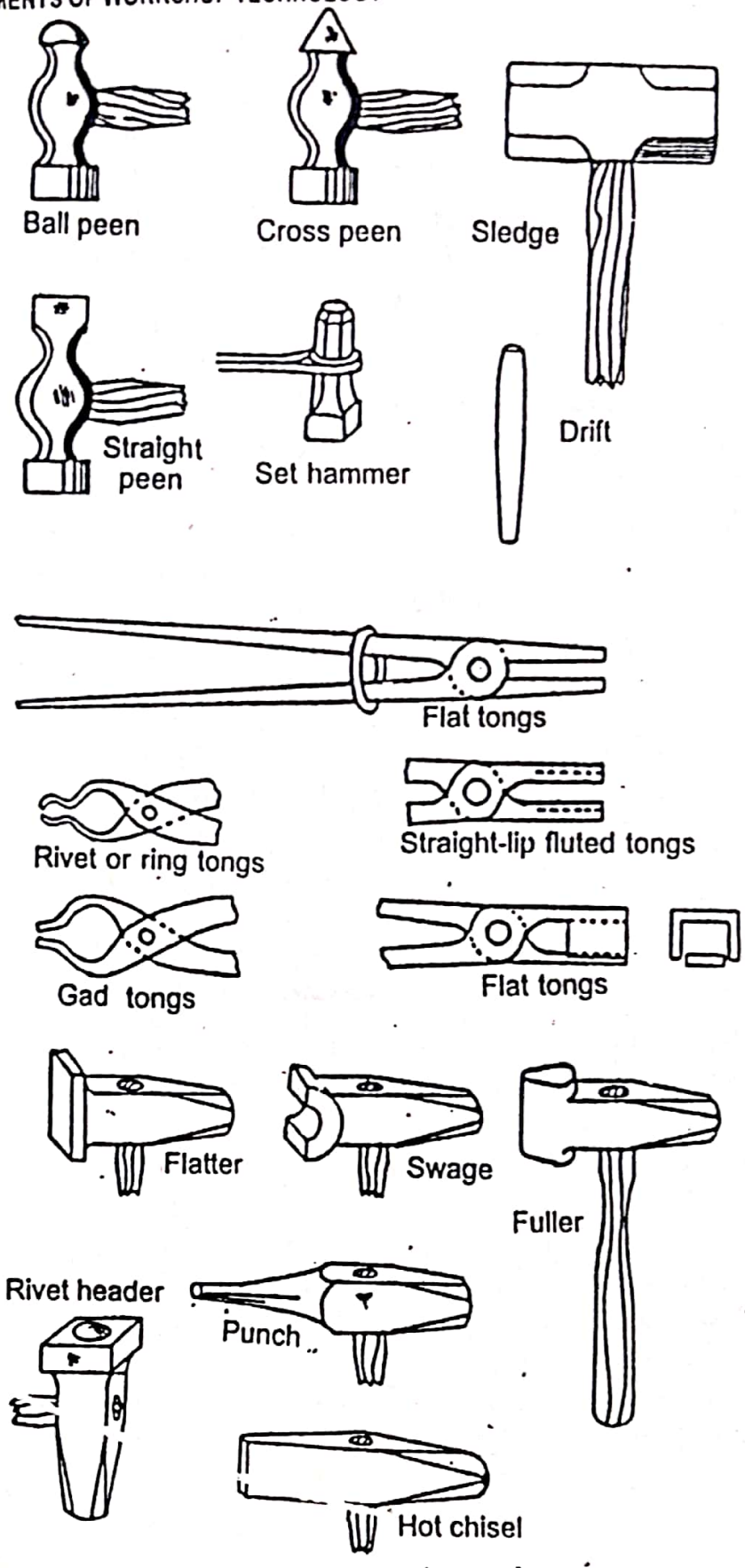



**Figure 8.5 Forging tools**