

**NATIONAL INSTITUTE OF TECHNOLOGY, KURUKSHETRA**  
**CENTRAL WORKSHOP**  
**FITTING SHOP**

### **FITTING**

The term fitting, is related to assembly of parts, after bringing the dimension or shape to the required size or form, in order to secure the necessary fit. The operations required for the same are usually carried out on a work bench, hence the term bench work is also added with the name fitting.

The bench work and fitting plays an important role in engineering. Although in today's industries most of the work is done by automatic machines which produces the jobs with good accuracy but still it (job) requires some hand operations called fitting operations. The person working in the fitting shop is called fitter

### **CLASSIFICATION OF METAL**

#### **1. FERROUS METALS**

Ferrous metals may be defined as those metals whose main constituent is iron such as pig iron, wrought iron, cast iron, steel and their alloys. The principal raw materials for ferrous metals are pig iron. Ferrous materials are usually stronger and harder. Ferrous materials possess a special property that their characteristics can be altered by heat treatment processes or by addition of small quantity of alloying elements. Ferrous metals possess different physical properties according to their carbon content.

#### **2. NON-FERROUS METALS**

Non-ferrous metals are those which do not contain significant quantity of iron or iron as base metal. These metals possess low strength at high temperatures and have more shrinkage than ferrous metals. They are utilized in industry due to following advantages:

1. High corrosion resistance

2. Easy to fabricate, i.e., machining, casting, welding, forging and rolling

3. Possess very good thermal and electrical conductivity

4. The various non-metals used in industry are: copper, aluminum, tin, lead, zinc, and nickel and their alloys.

### **FITTING TOOLS:**

Fitting shop tools are classified as below:

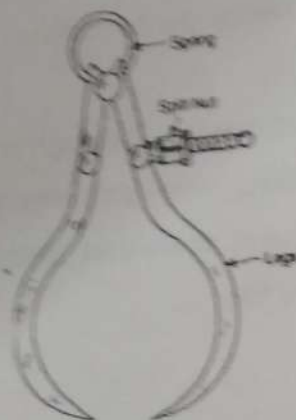
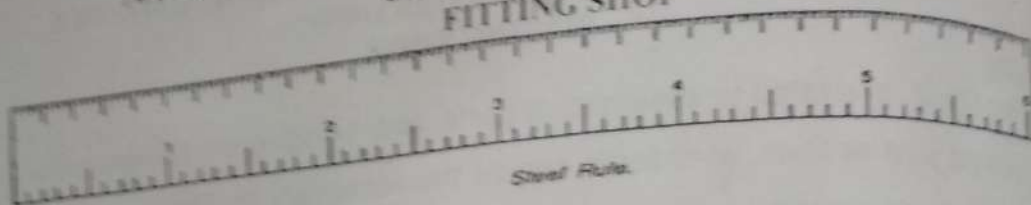
1. Measuring and Marking Tools

3. Work Holding Devices / Clamping Tools

2. Cutting Tools

4. Striking Tools

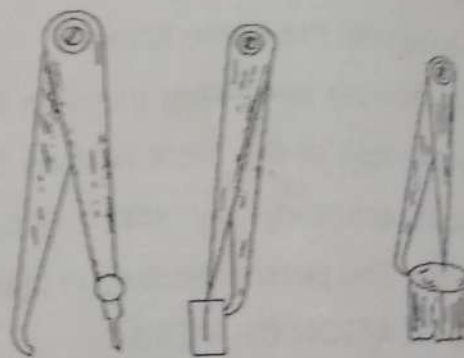
NATIONAL INSTITUTE OF TECHNOLOGY, KURUKSHETRA  
CENTRAL WORKSHOP  
FITTING SHOP



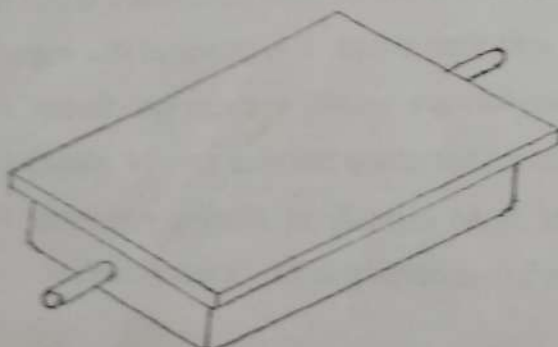
(a) Outside Spring Caliper



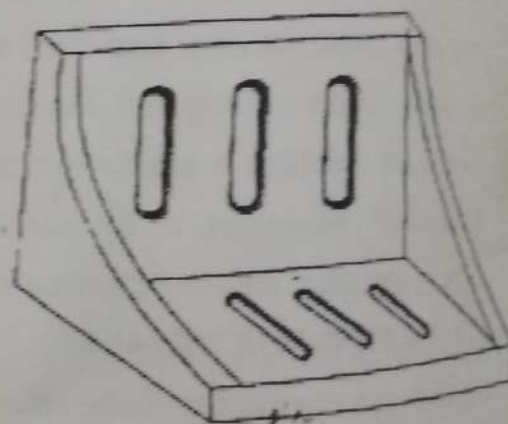
(b) Inside Spring Caliper



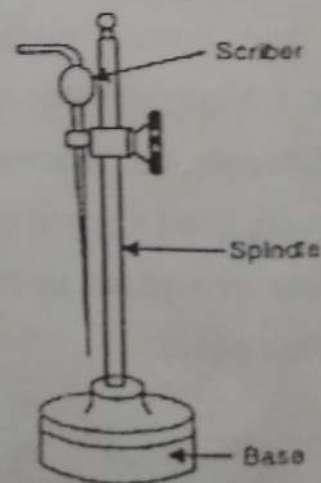
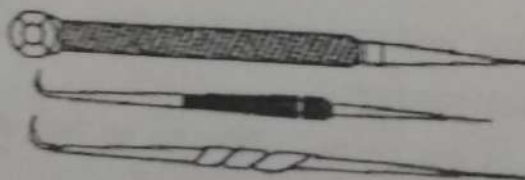
(c) Odd Leg Calipers  
Calipers.



Surface Plate



Angle Plate



Scriber and Surface Gauge

(A) MEAS

1. Steel R

ranging fr  
machined

2. Caliper

Different t

i. Outside

ii. Inside

iii. Spring

lock any

iv. Herm

other ha

3. Scrib

a steel

from th

the line

4. Surf

made

surface

woode

5. Ang

at right

mean

the n

6. Ve

squa

used

0.02

NATIONAL INSTITUTE OF TECHNOLOGY, KURUKSHETRA  
CENTRAL WORKSHOP  
FITTING SHOP

**(A) MEASURING & MARKING TOOLS**

1. **Steel Rule:** - These are made up of stainless steel and are available in many sizes ranging from 6" to 24". These are marked in inches or millimeters. All the faces are machined true. The edges of steel rule should be protected from rough handling.

2. **Calipers:** - These are generally used to measure the inside or outside diameters. Different types are:

i. **Outside Caliper:** It is used to measure the outside dimensions.

ii. **Inside Caliper:** It is used to measure the inside dimensions.

iii. **Spring Caliper:** Spring is provided to apply the pressure and lock nut is provided to lock any desired position.

iv. **Hermaphrodite, Jenny or Oddleg Caliper:** One leg is bent at the tip inwardly and the other has a straight pointed end. It is used to scribe lines parallel to the straight edges.

3. **Scriber and Surface Gauge:** - It consists of a cast iron base on the center of which a steel rod is fixed vertically. Scriber is made up of high carbon steel and is hardened from the front edge. It is used for locating the centers of round bars or for marking of the lines.

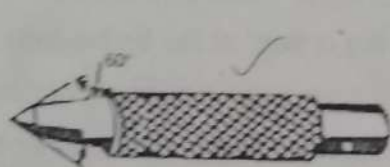
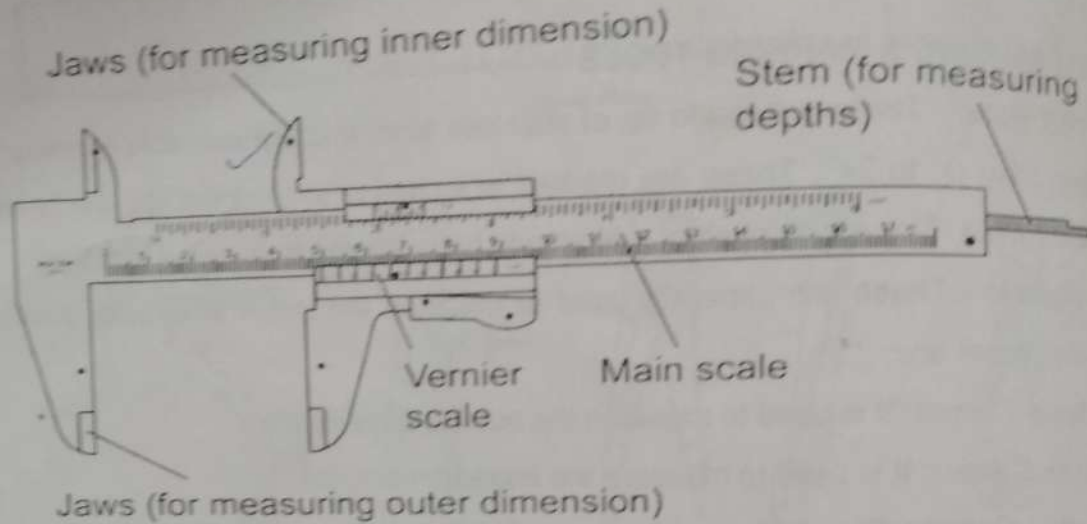
4. **Surface Plate:** - It is used for testing the flatness, trueness of the surfaces. It is made up of cast iron or graphite. Its upper face is planned to form a very smooth surface. It is also used in scribing work. While not in use, it should be covered with a wooden cover.

5. **Angle Plate:** - It is made up of cast iron in different sizes; it has two planed surfaces at right angles to each other and has various slots in each surface to hold the work by means of bolts and clamps. Never do hammering on the angle plate to fasten (tighten) the nuts and bolts.

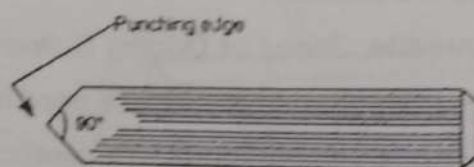
6. **Vernier Caliper:** - It is used for measuring the outer dimensions of round, flat, square components and also the inner size of the holes and bore. A narrow blade is used to measure the depth of bar slots etc. The reading accuracy in metric system is 0.02 mm and British system it is 0.001". It is made of stainless steel.



NATIONAL INSTITUTE OF TECHNOLOGY, KURUKSHETRA  
CENTRAL WORKSHOP  
FITTING SHOP

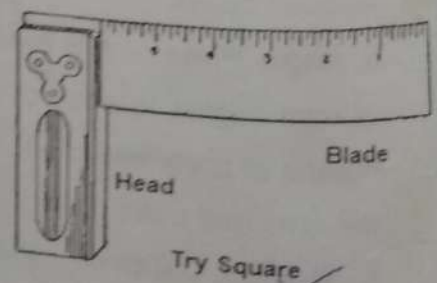
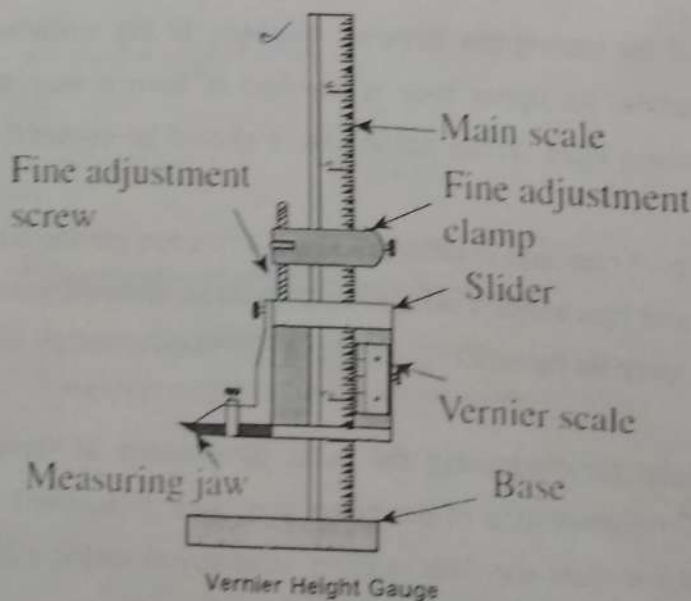


(a) Dot Punch



(b) Centre Punch

Punches.



NATIONAL INSTITUTE OF TECHNOLOGY, KURUKSHETRA  
CENTRAL WORKSHOP  
FITTING SHOP

7. **Punches:** - Punches are used for marking purposes. Dot punches are used for marking dotted line and centre punch is used to mark the centre of hole before drilling. Punches are made up of high carbon steel or high speed steels. One end is sharpened. Hammering is done on the second end while working. For dot punch, angle of the punching end is  $60^\circ$  while in center punch angle of punching end is  $90^\circ$ .

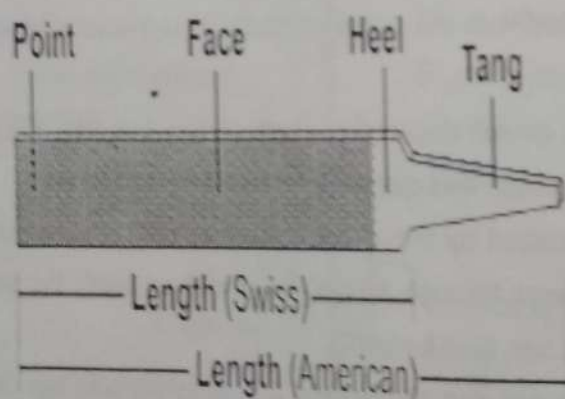
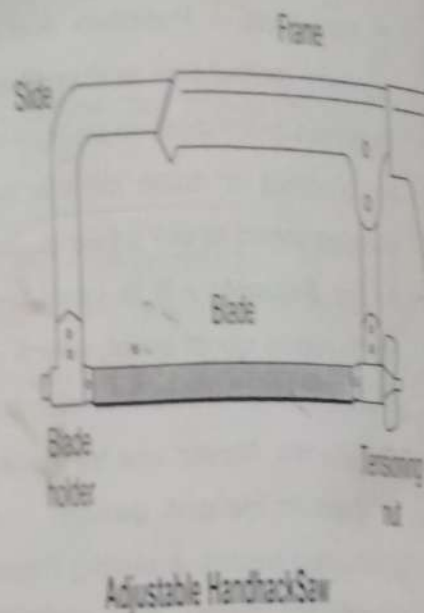
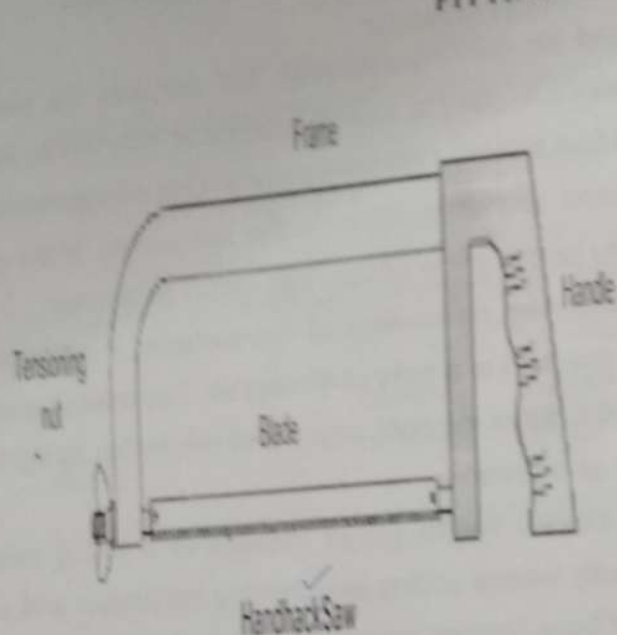
8. **Try Square:** - It is used for checking squareness of two surfaces. It consists of a blade made up of steel, which is attached to a base at  $90^\circ$ . The base is made up of cast iron or steel. It is also used to mark the right angles and measuring straightness of surfaces. Never use try square as a hammer.

9. **Vernier Height gauge:** - A Vernier height gauge consists of a heavy base, a graduated beam, a sliding head with Vernier sliding jaws holding the scriber and a fine adjustment clamp. It is similar to large Vernier calipers in construction, except that it consists of a heavy base which allows the gauge to stand upright instead of a fixed jaw in a Vernier. The movable jaw of Vernier height gauge consists of a projection or extension which is leveled to sharp edge for scribing lines at any required height. The least count of the Vernier Height gauge is 0.02mm.

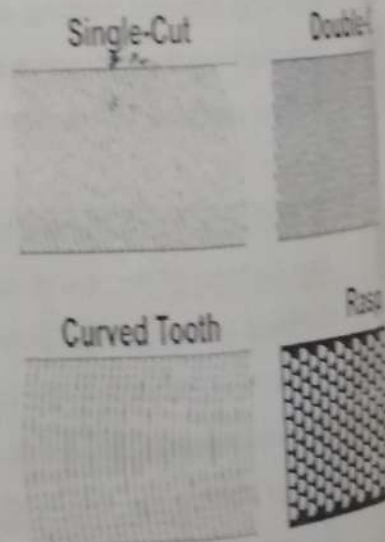
**METHOD OF MARKING: -**

Marking means setting out dimensions with the help of a working drawing or directly transferring them from a similar part. The procedure of marking is as follows:

1. The surface to be marked is coated with the paste of chalk or red lead and allowed to dry.
2. Then the work is held in a holding device depending upon shape and size. If it is flat, use surface plate, if it is round use V block and clamp, else use angle plate etc.
3. Lines in horizontal direction are scribed by means of a surface gauge. Lines at right angles can be drawn by turning the work through  $90^\circ$  and then using the scriber. If true surface is available, try square can also be used.
4. The centre on the end of a round bar can be located by using an odd leg caliper, surface gauge etc.
5. The circles and arcs on a flat surface are marked by means of a divider.
6. After the scribing work is over, indentations on the surface are made using dot punch and hammer.



File Nomenclature



(B) CUTTING

1. Hacksaw:

frame, which is tightened with high speed steel. The points of the body of the are generally 1. Depending up

A) Forward cut

Depending up blades is clas

(i) Coarse (8-

(iii) Fine (24-3

2. FILES:

rubbing it on coarseness.

(i) On the ba

(ii) On the ba

Rough (R) (2

Second Cut

Dead smooth

Rough and

files are use

smooth and

has degree

(iii) On the

Single cut f

In single cu

Another ro

removal is



**NATIONAL INSTITUTE OF TECHNOLOGY, KURUKSHETRA**  
**CENTRAL WORKSHOP**  
**FITTING SHOP**

**(B) CUTTING TOOLS**

1. Hacksaw: - Hacksaw is used for cutting of rods, bars, pipes, flats etc. It consists of a frame, which is made from mild steel. The blade is placed inside the frame and is tightened with the help of a flange nut. The blade is made up of high carbon steel or high speed steel.

The points of the teeth are bent in a zig-zag fashion, to cut a wide groove and prevent the body of the blade from rubbing or jamming in the saw cut. The teeth of the blades are generally forward cut so pressure is applied in the forward direction only.

Depending upon the direction of cut, blades are classified as:

A) Forward cut

B) Backward cut.

Depending upon the pitch of the teeth (Distance between the two consecutive teeth) blades are classified as:

(i) Coarse (8-14 teeth per inch)

(ii) Medium (16-20 teeth per inch)

(iii) Fine (24-32 teeth per inch)

2. FILES: - Files are multi points cutting tools. It is used to remove the material by rubbing it on the metals. Files are available in a number of sizes, shapes and degree of coarseness. Classification of files

(i) On the basis of length 4", 6", 8", 12"

(ii) On the basis of grade:

Rough (R) (20 teeth per inch)

Bastard (B) (30 teeth per inch)

Second Cut (SC) (40 teeth per inch)

Smooth File (S) (50 teeth per inch)

Dead smooth (DS) (100 teeth per inch)

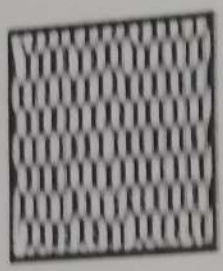
Rough and bastard files are the big cut files. When the material removal is more, these files are used. These files have bigger cut but the surface produced is rough. Dead smooth and smooth files have smaller teeth and used for finishing work. Second cut file has degree of finish in between bastard and smooth file.

(iii) On the basis of number of cuts:

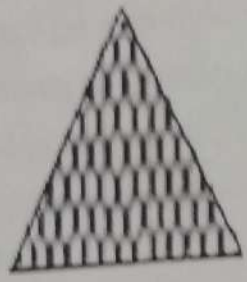
Single cut files, Double cut files, Rasp files.

In single cut files the teeth are cut in parallel rows at an angle of 60 degree to the face. Another row of teeth is added in opposite direction in case of double cut files. Material removal is more in case of double cut files.

Square



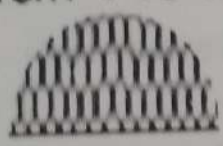
Triangle



Round



Half Round



Mill



Flat



iv. On  
various  
square  
Flat fil  
in wid  
Hand  
given  
edge  
Squa  
then  
corner  
Trian  
towa  
and  
sharp  
Rou  
is not  
round  
files  
Half-  
circle  
towa  
singl  
Kn  
the  
teet  
Dia  
Nee  
poi  
the  
cut



NATIONAL INSTITUTE OF TECHNOLOGY, KURUKSHETRA  
CENTRAL WORKSHOP  
FITTING SHOP

iv. On the basis of shape and size: The length of the files varies from 4' to 14". The various shapes of cross-section available are hand file, flat file, triangular, round, square, half round, knife-edge, pillar, needle and mill file.

**Flat file:** This file has parallel edges for about two-thirds of the length and then it tapers in width and thickness. The faces are double cut while the edges are single cut.

**Hand file:** for a hand file the width is constant throughout, but the thickness tapers as given in flat file. Both faces are double cut and one edge is single cut. The remaining edge is kept uncut in order to use for filing a right-angled corner on one side only.

**Square file:** It has a square cross-section. It is parallel for two-thirds of its length and then tapers towards the tip. It is double cut on all sides. It is used for filing square corners and slots.

**Triangular file:** It has width either parallel throughout or up to middle and then tapered towards the tip. Its section is triangular (equilateral) and the three faces are double cut and the edges single cut. It is used for filing square shoulders or corners and for sharpening wood working saws.

**Round file:** It has round cross-section. It carries single cut teeth all round its surface. It is normally made tapered towards the tip and is frequently known as rat-tail file. Parallel round files having same diameter throughout the length are also available. The round files are used for opening out holes, producing round corners, round-ended slots etc.

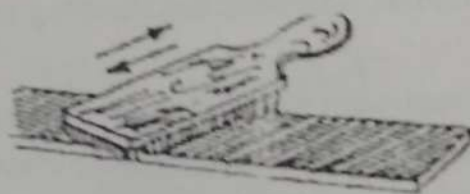
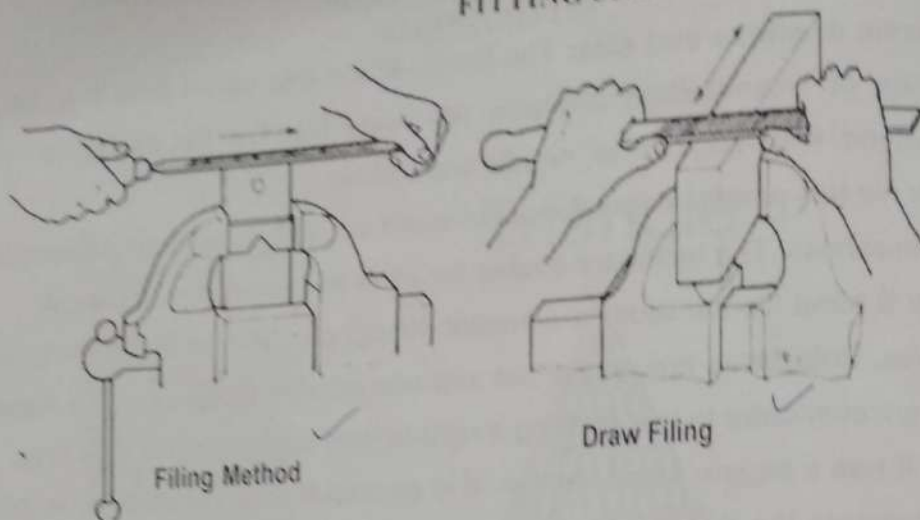
**Half-round file:** Its cross-section is not a true half circle but is only about one-third of a circle. The width of the file is either parallel throughout or up to middle and then tapered towards the tip. The flat side of this file is always a double cut and curved side has single cut. It is used for filing curved surfaces.

**Knife edge file:** It has a width tapered like a knife blade and it is also tapered towards the tip and thickness. It carries double cut teeth on the two broad faces and single cut teeth on the edge. It is used for finishing sharp corners of grooves and slots.

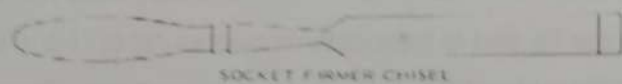
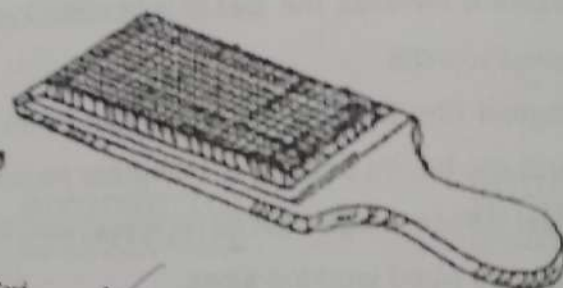
**Diamond file:** Its cross-section is like a diamond. It is used for special work.

**Needle file:** These are thin small files having a parallel tang and a thin, narrow and pointed blade made in different shapes of its cross-section to suit the particular need of the work. These are available in sizes from 100 mm to 200 mm of various shapes and cuts. These files are used for filing very thin and delicate work.

# NATIONAL INSTITUTE OF TECHNOLOGY, KURUKSHETRA CENTRAL WORKSHOP FITTING SHOP



File Card



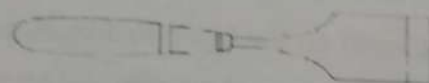
SOCKET FINNER CHISEL



TANG FAKING CHISEL

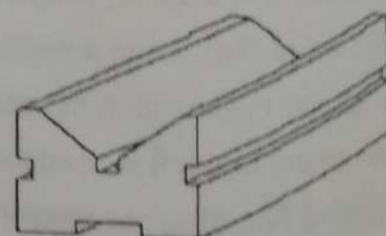
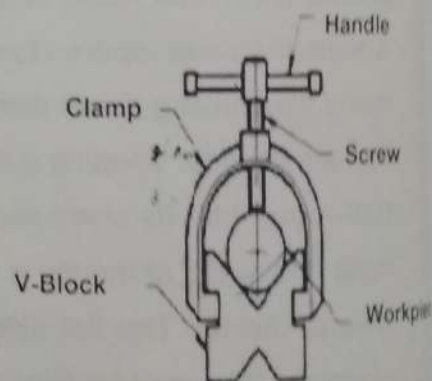


MORTISING CHISEL



BUTT CHISEL

Types of Chisel



**NATIONAL INSTITUTE OF TECHNOLOGY, KURUKSHETRA  
CENTRAL WORKSHOP  
FITTING SHOP**

**File Card:** - It is a device fashioned like a wire brush used to clean dirt and chips from the teeth of a file. When particles of metal clog the teeth the file is said to be pinned, a condition that causes scratching of the surface of the work. Files, therefore, require cleaning by means of a file card or by dislodging the material between the teeth by means of a piece of soft iron, copper, brass, tin plate and so on, sharpened at the end. Hardened steel should never be used.

**Methods of Filing**

The following are the two commonly used methods of filing:

**Cross Filing:** - This method is used for efficient removal of maximum amount of metal in the shortest possible time. It may be noted that the file must remain horizontal throughout the stroke (long, slow and steady) with pressure only applied on the forward motion.

**Draw Filing:** - This method is used to remove file marks and for finishing operations. Here, the file is gripped as close to the work as possible between two hands. In this filing method, a fine cut file with a flat face should be used.

**3. CHISEL**

A chisel is a tool with a characteristically shaped cutting edge (such that wood chisels have lent part of their name to a particular grind) of blade on its end, for carving and/or cutting a hard material such as wood, stone, or metal. The handle and blade of some types of chisel are made of metal or wood with a sharp edge in it. There are different types of chisels like Butt chisel, Carving chisels, Corner chisel, Flooring chisel, Framing chisel, Mortise chisel

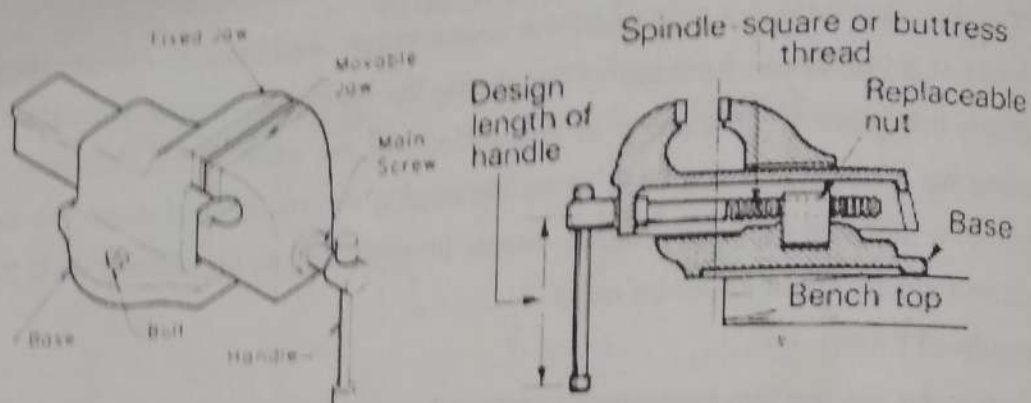
**(C) WORK HOLDING DEVICES / CLAMPING TOOLS:**

**1. WORK BENCH:** - A fitting process can be done at various places, but most of the important operations of fitting are generally carried out on a table called work bench. The work bench is a strong, heavy and rigid table made up of hard wood. The size of the work bench required is about 150 to 180 cm length, nearly 90 cm width and approximately 76 to 84 cm height.

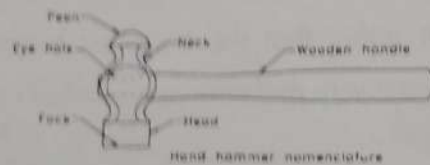
**2. V-BLOCK:** - In V Block, V grooves are provided to hold the round objects longitudinally. The screw of the clamp applies the holding pressure. When the handle is rotated there is movement in the screw.



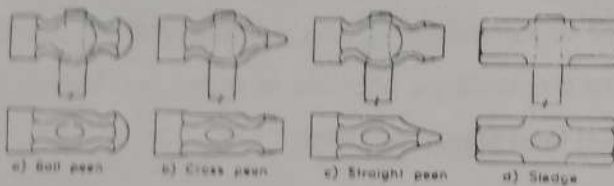
# NATIONAL INSTITUTE OF TECHNOLOGY, KURUKSHETRA CENTRAL WORKSHOP FITTING SHOP



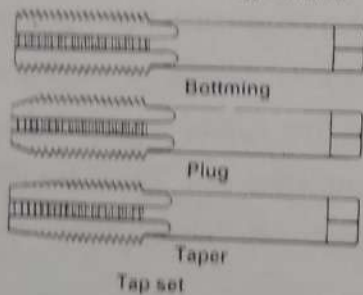
Bench Vice ✓



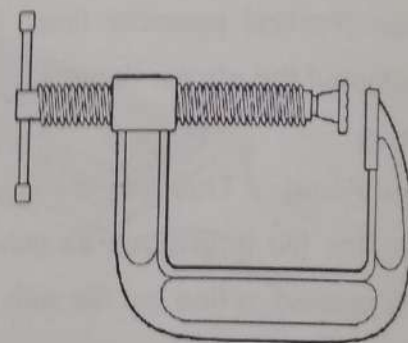
Hand hammer nomenclature



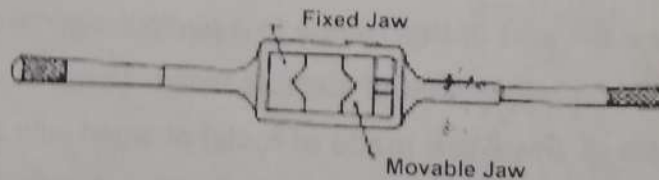
Type of Hammer



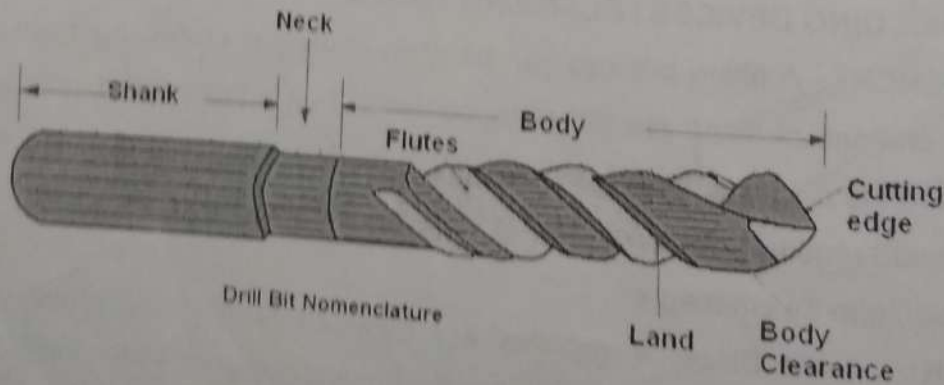
Tap set



C-Clamp



Tap Handle



Drill Bit Nomenclature

**NATIONAL INSTITUTE OF TECHNOLOGY, KURUKSHETRA**  
**CENTRAL WORKSHOP**  
**FITTING SHOP**

**3. BENCH VICE:** - It is firmly fixed to the bench with the help of nuts and bolts. It consists of a cast Iron body and cast iron jaws. Two jaw plates are fitted on both the jaws. The holding surface of the jaw plates is knurled in order to increase the gripping. Jaw plates are made up of carbon steel and are wear resistant. One jaw is fixed to the body and the second slides on a square threaded screw with the help of a handle. The jaws are opened up to required length; job is placed in the two jaws and is fully tightened with the help of handle. Handle is used to move the movable jaw.

**4. CLAMPS:** - Once work piece is located, it is necessary to press it against locating surfaces and hold it there against the force acting upon it. The tool designer refers to this action as clamping and the mechanisms used for this action are known as clamp. Clamp should firmly hold the work piece without distorting it. Clamp should overcome the maximum possible force exerted on work piece by using minimum clamping force.

**(D) STRIKING TOOLS**

**1. HAMMERS**

Hammer is a tool meant to deliver blows to an object. The most common uses are for driving nails, fitting parts, and breaking up objects. Hammers are often designed for a specific purpose, and vary widely in their shape and structure. Usual features are a handle and a head, with most of the weight in the head. There are different type of hammers like Ball-peen hammer, Rubber mallet, Wooden mallet, Claw hammer etc.

**2. TAP AND TAP WRENCHES:** - A Tap is hardened steel tool used for cutting internal threads after drilling a hole. Hand Tap is usually available in set of three for each diameter and thread pitch. Every set of Tap consists of a taper tap, intermediate tap and plug or bottom tap.

**3. DIE & DIE HOLDER:** - A Die is hardened steel tool used for cutting external threads. Dies are made of solid or split type. The dies are holding in the die holder for making external thread.

**4. DRILL BIT:** - Drill bits are cutting tools used to remove material to create holes, almost always of circular cross-section. Drill bits come in many sizes and shapes and can create different kinds of holes in many different materials. In order to create holes drill bits are usually attached to a drill machine, which powers them to cut through the work piece.