UNIT 2 BENCH WORK AND FITTING

Structure

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2.1 INTRODUCTION

In engineering, bench work and fitting have important roles to play to complete and finish a job to the desired accuracy. The term bench work generally denotes the production of our article by hand on the bench. Fitting is the assembling together of parts and removing metals to secure the necessary fit, and may or may not be carried out at the bench.

The main operations commonly performed in bench and fitting work may be classified as :

(a) Chipping

(b) Filing

(c) Scrapping

(d) Grinding

(e) Sawing

(f) Marking

(g) Drilling

(h) Reaming

(i) Tapping

(j) Dieing

Objectives

After studying this unit, you should be able to

- know the tools used in bench work and fitting,
- perform the experiments on bench vice,
- perform sawing operation, and
- measure with micro-meter, vernier gauge, etc.

2.2 TOOLS USED

Vices

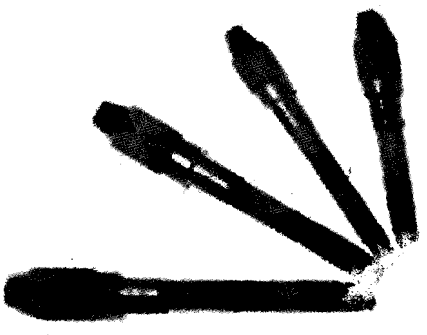
The vice is the most common tool for holding work. Various types of vices are used for various purposes. They include bench vice, leg vice, pipe vice, hand vice, pin vice and toolmaker's vice.

Bench Vice

The most commonly used in the engineer's parallel join bench coach screws or with nuts and bolts. The vice essentially consists of a cost iron body, a fixed jaw, both made of cast steel, a handle, a square headed screw, and a nut all made of mild steel. Separate cast iron plates known as jaw plates are fixed to the jaws by means of set screws. Protective grips or clamps which can be made of lead, fibre-tin plate, etc. are usually fitted over the jaws.

The width suitable for common work varies from 80 to 140 mm the maximum opening being 95-180 mm.

Pipe Vice



Pin Vice

Leg Vice

The leg vice is used by blacksmiths but it is also suitable for heavy hammering, chipping and cutting in the fitters work. The vice is secured to the top of the strap which is fastened to a plate bolted to the bench top. The leg of the vice is fastened to the bench leg with staples and its end fit into a hole in the floor. This is suitable for heavy work.

Pipe Vice

The pipe vice is used for holding round section metal, tubes, pipes, etc. It grips the work at four points on its surface.

Hand Vice

The hand vice is used for gripping screws, revets, beep, small drills and other similar objects which are to be conveniently held in the bench-vice. The length varies from 125-150 mm and jaw width from 40-44 mm.

Pin Vice

The pin vice is used for holding round material of small diameters such as wire and pins during working. It also forms a very useful handle for small files.

Toolmakers Vice

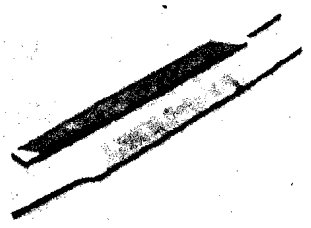
The toolmaker's vice is particularly useful for holding small work which requires filing or drilling and for such work as laying out small jobs on the surface plates. These are made of mild steel.

Files

A file is a hardened piece of high grade steel with slanting row of teeth. It is used to cut, smooth, or fit metal parts. The tong is the pointed part which is fitted into the handle.The point is the end opposite to the tang. The heel is next to the handle. The safe edge or side of a file is that which has no teeth.

Flat File

It is tapered in width and thickness and one of the most commonly used files for generate work. They are always double cut on faces and single cut on the edges.



Flat File

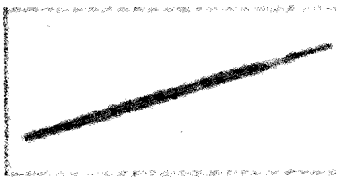
Hand File

It is parallel in its width and tapered in thickness. A hand file is used for finishing flat surfaces. It has one edge and therefore it is useful where the flat file cannot be used.

Hand File

Square File

It is square in cross section double cut and tapered towards the point. This is used for filing square corners enlarging square or rectangular openings as splines and key ways.



Square File

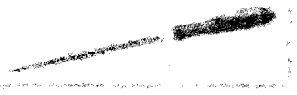
Round File

They are round in cross-section and usually tapered when they are termed rat-tailed. When parallel, they are described as parallel round. Round files are used for or filing curved surfaces and enlarging round holes and forming fillets. They may be single cut or double cut.

Round File

Triangular Files

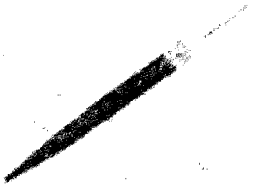
Three square or triangular file is tapered, double cut and the shape is that of an equilateral triangle. They are used for rectangular cuts and filing corners less than 90.



Triangular File

Half Rounded File

This is tapered double cut and its cross-section is not a half circle but only about one-third of a circle. This file is used for round cuts and filing curved surfaces.



Half Round File

Hammer

Hammers are used to strike a job or a tool. They are made of forged steel of various sizes and shapes to suit various purposes.

Hammer

Ball Peen Hammers

This is the most common form of hammer and is sometimes called engineer's hammer or chipping hammer. The peen has a shape of a ball which is hardened and polished.

Cross Peen Hammer

This is similar to ball peen hammer in shape and size except that the peen which is across the shaft or eye. This is mainly used for bending, stretching, hammering into shoulders inside curves, etc.

Straight Peen Hammer

This hammer has a peen straight with the shaft, i.e. parallel to the axis of the shaft. This is used for stretching or peening metal.

Soft Hammer

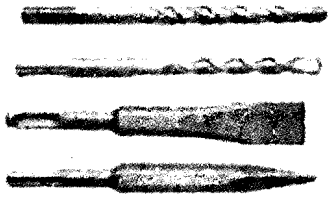
Where it is necessary to strike the metal a blow with minimum damage to the surface, a soft hammer called mallet is used. Mallet's heads go by the numbers or by the diameter of the head.

Chisel

Cold chisels are used for cutting and chipping away pieces of metal and are made of carbon steel usually rectangular, hexagonal or octagonal in cross section. They are forged to shape, roughly ground and then hardened and tempered.

Flat Chisel

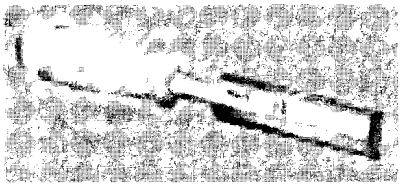
This is the most common of all kinds of chisels used in engineering. It is generally used for chipping operations. It may be used for removing surplus metal from surfaces of jobs. The flat chisels should be drawn to the shape and the cutting edge should be slightly curved.



Flat Chisel

Cross-cut Chisel

The cross-cut chisel or cope chisel as its sometimes called is used for cutting groove in large surfaces previous to using the flat chisel and it is also used cutting key ways in wheels and shafts.



Cross-cut Chisel

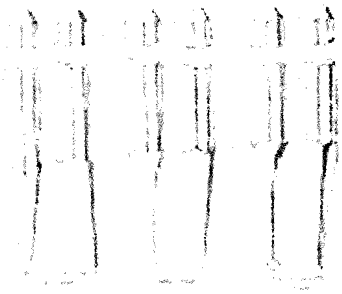
Half Round Chisel

A half round chisel is used for cutting oil-warp or groves in, bosses and pulley bearings, etc. They are also used for settling over pilot holes. When a hole is to be drilled a smaller or a pilot hole is chilled first.

Half Round Chisel

Diamond Point Chisel

The diamond point chisel is used for cutting 'V' groves, cleaning corners and equating small holes. The chisel is drawn to a square sector and end is ground off at an angle producing a "diamond" shape.



Diamond Point Chisel

Side Chisel

A side chisel is useful in chipping and removing the surplus metal in cotter ways and sets, which may have to be cut by hand after having been drilled. The shank of this chisel is bent out a little sideways and then vertically down again.

Side Chisel

Scraper

Scraping means shaving or parting off thin slices or flakes of metal to make a fine, smooth surface. This is done with tools called scrapers which have very hard cutting edges are usually left very hard. Old files makes excellent scrapers.

Flat Scrapper

The flat scraper is the most common and the most easily made. The cutting edge is at end. It should most easily made. It should be curved a little looking at the broad side. A flat scrapper is used for producing a perfectly flat surface.

Flat Scraper

Triangular Scraper

The triangular scraper has three cutting edges and is made from a triangular file. It is used to scrap round or curved surfaces and to remove sharp corners and burns.

Half Round Scraper

A half round scraper is trig-shaped like a half round file. In fact they are often made from old half round files. They are used to scrape round or curved surfaces.

Hacksaw

The hacksaw is used for sawing all metals except hardened steel. A hacksaw consists of a frame handle prop tightening screw and nut blade. The frame is made to hold the blade tightly. They are made in two types: the solid frame in which length can't be changed and the adjustable frame which has a back that can be lengthened or shortened to hold blades of different length.

Solid Frame Hacksaw

Hacksaw blades are made of special steels for hand saws either high carbon steel low alloy steel or high speed steels is used. All hard blades made of high speed steel are used for cutting the harder metals such as alloy steels while flexible blades are less liable to break and are used for general work.

Power Hacksaw

The power hacksaw is very similar to the hand hacksaw with the addition of a suitable driving mechanism the drive is either given a belt from a line shaft or by an enclosed motor. Suitable mechanisms are provided whereby length of the stroke and the weight applied may be varied.

2.3 MARKING TOOLS

The following tools are used for making :

(a) Surface plate

(b) Scriber

(c) Punch

(d) V- block

(e) Angle plate

(f) Try square

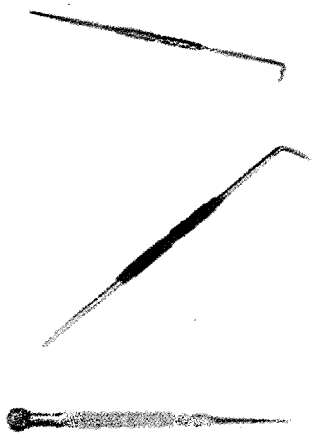
Surface Plates

The surface plate is used for testing flatness of work itself and is also used for making out work. This is used for small pieces of work while marking out table is used for larger jobs.

Surface tables are made of gray cast iron and of solid design or with ribs. They should be well and reflection free illuminated and rest horizontally on a firm support, the height being about 800 mm from the floor.

Scriber

The scriber is a piece of hardened steel about 150 to 300 mm in length and 3 to 5 mm in diameter pointed at one of both ends like a needle. It is held like a pencil to scratch or scribe lines on metal. The bent end is used to stretch line in places where the straight and cannot reach. The ends are sharpened on an oilstone when necessary.



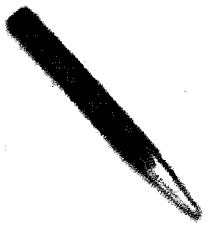
Scriber

Punch

A punch is used in a bench work for marking work locating centers etc. in a more permanent manner. The two types of punches are :

Prick Punch

The prick punch is a sharply pointed tool. The tapered point of the punch is sharply angled at usually 40. It is used to make small punch marks on layout lines in order to make them last longer



Prick Punch

Centre Punch

The centre punch looks like a prick punch. Its point has an angle more obtuse than that of the prick punch point this angle usually being 60°. The centre punch is used only to make the prick punch marks larger at the centres of holes that are to be drilled.

Centre Punch

V-Block

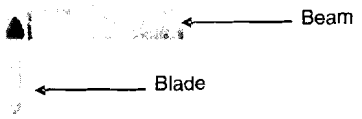
The V-block of steel with V-shaped grooves. Roundly shaped workpieces which are to be marked or drilled are firmly supported in a horizontal position and can't rotate easily.

Angle Plates

The angle plates which is made of grey cast iron has two plane surfaces at right angles to each other. This is used in conjunction with the surface plate for supporting work in the perpendicular position. It has various slots in it to enable the work to be held firmly by bolts and damps.

Try Square

The try square is made of one-piece, both blade and beam. This is used when it is necessary to get another edge or surface exactly at right angles to an already trued edge or surface and also for laying out work. The sides and edges of any square may be tested by placing the beam of the square against the straight edge.



Try Square

2.4 MEASURING INSTRUMENTS

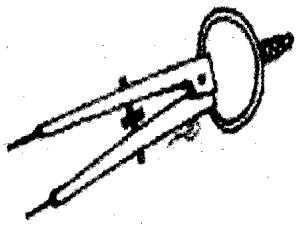
Steel Rule

It is one of the most useful tools for taking linear measurements of blanks and articles to an accuracy of range from 1.0 to 0.5 mm. It consists of a strip of hardened steel having line graduations etched or engraved at interval of fraction of a standard unit of length. Depending upon the interval at which the graduations are made the scale can be manufactured in different sizes and styles.

Steel Rule

Divider

The tool is used for transferring dimensions. Scribing circles, and doing general layout work. In practice one point is placed in the centre top making the exact centre, and the circle or arc may then be scribed on the joint with the other point. The size is measured by the greatest distance it can be opened between the leap. Thus a 100 mm divider open 100 mm between the points. Steel scale must also be used with this instrument.



Divider

Micrometer

The micrometer is primarily used to measure dimensions like diameters of shafts, screw threads, diameter of holes, thickness of parts etc. to an accuracy of 0.01 mm. The frame is made of steel, cast steel, malleable cast iron or light alloy. The reading is taken with the help of two scales like :

(a) Main scales, and

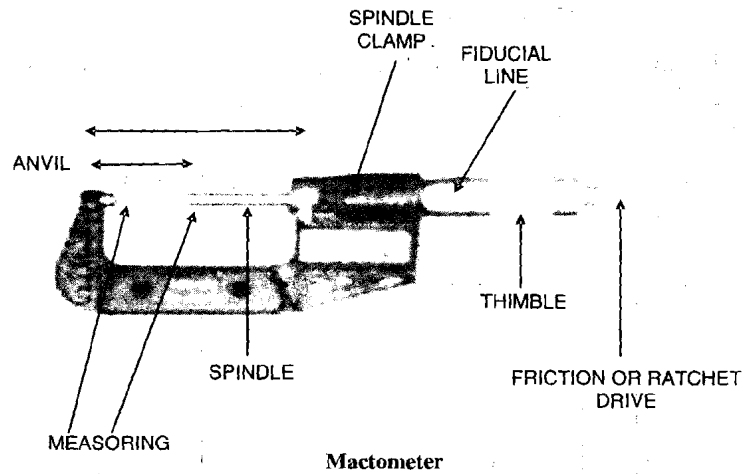
(b) Circular scales.

The least count of the micrometer is 0.01 mm. It is of three types like :

(a) External,

(b) Screw-thread, and

(c) Internal/Inside.



Mactometer

Varnier Caliper

It is primarily used for measuring both inside and outside diameters of shafts, thickness, of parts, etc. to an accuracy of about 0.02 mm by a vernier scale attached to the caliper. A vernier scale is the name given to any scale making use of the difference between two scales which are nearly, but not quite alike, for obtaining small difference. The instruction comprises of a beam or main scale which carries the fixed graduations, two measuring jaws, a vernier head having a vernier scale engraved on it and an auxiliary head of a vernier clan which is used for a specific dimensions by a micrometer screw. The vernier head and the auxiliary head can be locked to the main scale by the knurled screw.

2.5 FITING JOB 1

Aim

To prepare 2 smooth rectangular blocks of mild steel having dimensions $5.5 \times 5 \times 0.4$ cm^3 from the given piece of metal.

Tools Required

Bench Vice, hacksaw, trysquare, hand file, surface plate and scale and a scriber.

Procedure

(a) Placed the workpieces on the table and using scriber drawn straight lines parallel on it 55 mm apart.

(b) Fixed the workpieces firmly in the jaws of the vice.

(c) Cut along the marked line using a hacksaw.

(d) The cut out workpieces was now again placed firmly between the jaws of the vice in such a way that a small portion of one of its edges is above the level of the jaw.

(e) Now filing was done by using a hand file.

(f) Using try, square, it should be ensured that all the edges of the workpieces are at the right angles to adjacent edges.

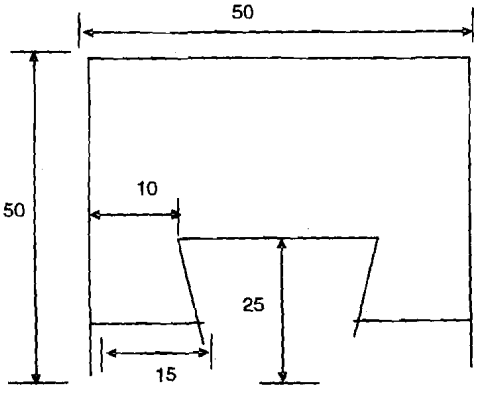
(g) Placed the work on one of the faces on the surface plate and moved it along its surface to check the area on the work where strain has accumulated. File them properly.

Precautions

(a) While filing caution should be taken that the file moves in straight strokes and not slanting in any condition.

(b) While filing, dimensions should be checked again and again then required single hand file should be used so that the piece of proper dimensions is obtained.

(c) The piece should be fixed straight in the jaws of the bench vice otherwise error in shape might occur.



Dove Tail Assembly

2.6 FITING JOB 2

Aim

To prepare two metal pieces as male and female socket as per required specifications.

Apparatus

(a) Bench Vice

(b) Hacksaw

(c) Try Square

(d) Flat File

(e) Half-round file

(f) Steel Scale

(g) Divider

(h) Surface Plate

(i) Vernier Height gauge

(j) Punch

(k) Hand Hammer

Material Used

Mild Steel

Procedure

The following steps are carried for preparation of pieces :

(a) A steel of mild steel is taken and mounted on a bench vice.

(b) Two piece of dimensions given were cut with the help of a hacksaw keeping in consideration the allowances.

(c) One surface and the edges of the two pieces were filed and it was made sure that the adjacent edges are perpendicular to each other (with the help of try square).

(d) A paste of crushed chalk and water was applied and allowed to dry up to give a plain white surface easy for marking.

(e) The marking was then carried out on two workpieces with the help of surface plate. Scale and vernier height gauge.

(f) The quachants were then marked with the help of a divider at the corners. The marking were made more prominent with the help of punch and hammer.

(g) The required cutting is done with the hacksaw.

(h) Surface are made smooth by filing first the hand file is used to smoothen the rough surface and then the half round file is used to give a fine surface finish.

Precautions to be Taken

(a) The teeth of the hacksaw should be facing forward.

(b) The piece should be fixed straight in the jaws of the bench vice otherwise error in shape might occur.

(c) Marking should be done with great care.

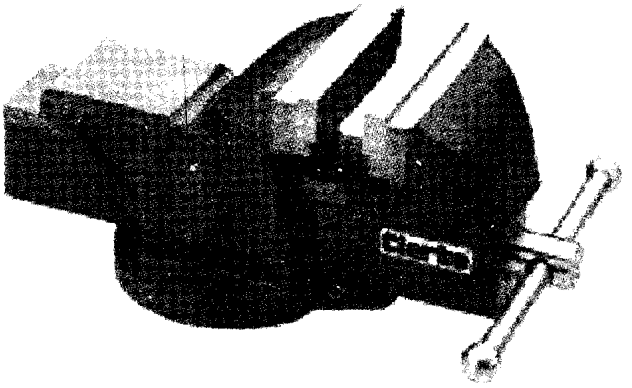
(d) While Sawing allowances should be made for filing.

(e) While filing, caution should be taken that the file moves in straight strokes and not slanting in any conditions.

(f) All the edges should be smooth.

(g) While filing, dimensions should be checked again and again and half round file should be used so that piece of proper dimension is obtained.

(h) Workpieces and tools should be regularly oiled to avoid rusting.



Bench Vice