

## INTRODUCTION

The bench work and fitting plays an important role in every engineering workshop to complete and finish the job to the desired accuracy. Though today in industries most of the work is done on automatic machines and finished to a fairly good degree of accuracy. The work carried out by hand at the bench is called bench work, whereas fitting is the assembling of parts together by filing, chipping, sawing, scraping, tapping etc., necessary after the machine operations. This may or may not be carried out at the bench.

## PRECISION MEASURING INSTRUMENTS

### VERNIER CALIPER

A caliper is a precision measuring instrument. It is used to measure upto an accuracy of 0.02mm. It consist of a beam carrying main scale, inside measuring jaws and outside measuring jaws and a depth gauge bar, vernier slide, vernier scale and a thumb screw. The thumb screw helps to set the vernier slide in any position on the main scale.

### MICROMETER

A micrometer is a precision instrument used to measure a job, with an accuracy of 0.01mm. They are available in various ranges like 0-25mm, 25 to 50mm, 50-75mm. etc.

**(1) Outside micrometer** : It is used for measuring the outside dimensions of the job, such as diameter of rod, thickness etc.

**(2) Inside micrometer** : It is used for measuring inside dimensions of the objects such as inside diameter of holes, width of slots and for checking parallelism of deep bores etc.

**(3) Depth micrometer** : It is used to measure the depth of holes, grooves, recesses, height of shoulders of projections etc.

### VERNIER BEVEL PROTRACTOR

The vernier bevel protractor is used for measuring angles precisely to an accuracy of 5 minutes (5'). It is used to measure acute angles (i.e. less than 90°), obtuse angles (i.e. more than 90°) and for setting work holding devices at required inclination - on machine tools, work tables etc.

## DRILLING TOOLS

The drilling tools called drills are used for making round holes in the work. The following three types of drills are commonly used:

### **1. Flat Drill**

It is simple type of drill and has two cutting edges bevelled at 60°.

It is easily made by flattening a round bar of tool steel at one end by forging. It is then ground hardened and tempered. The flat drill can not be used to drill deep holes because the chips do not come out of the hole during the operation. The cutting edge of the drill wear quickly due to the metal chips remaining in the hole and by grinding every time, the diameter gets reduced.

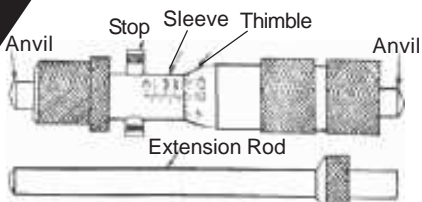
**2. Straight fluted Drills:** It is a drill used for drilling softer metals such as brass. It has straight flutes running parallel to the drill axis. It does not lift the job which is thin (like sheet metal) where as the twist drill lifts the lighter as well as the thinner job.

**3. Twist drills :** The most widely used form of drills is twist drill. It has cylindrical body, carrying two spiral flutes that run length wise around it. Point angle of twist drill is 118°. There are two types of twist drill. (1) Parallel shank or straight shank and (2) Taper shank. **Straight Shank drill :-**

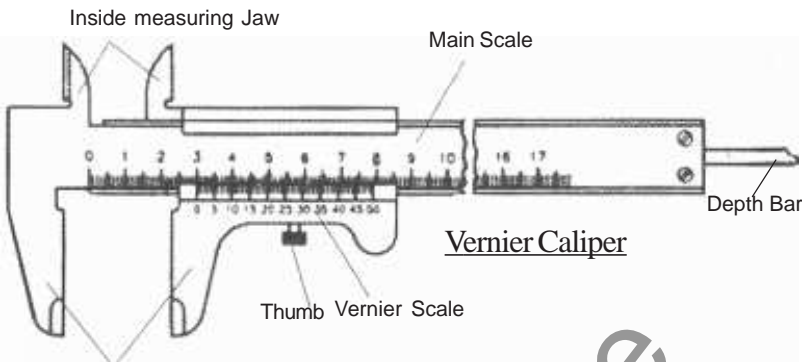
Straight shank drills are held in drill chuck. The diameter of the drill ranges from 0.5 to 40 mm. They are commonly used on portable drilling machines such as electric drills.

**Taper Shank drills :-** Taper shank drills can be quickly and accurately inserted into the spindle of the drilling machine, which holds the drill by friction between the taper shank and spindle. The shank of the drills are provided with five different sizes of Morse tapers which are numbered from MT1 to MT5. The diameter ranges from 3mm to 100mm.

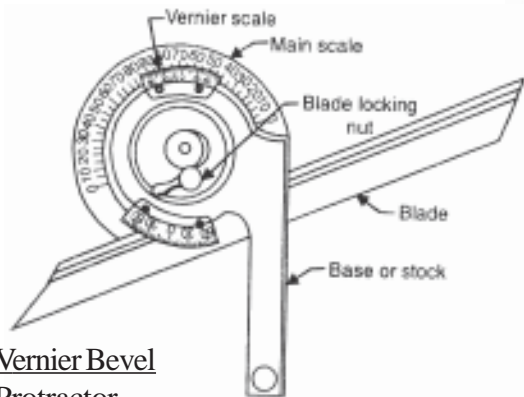
Drills are taken out of the spindle hole by a taper cotter called drift. To accommodate different sizes of taper shank drills on a spindle of the drilling machine, drill sockets and sleeves are used.



Inside Micro meter

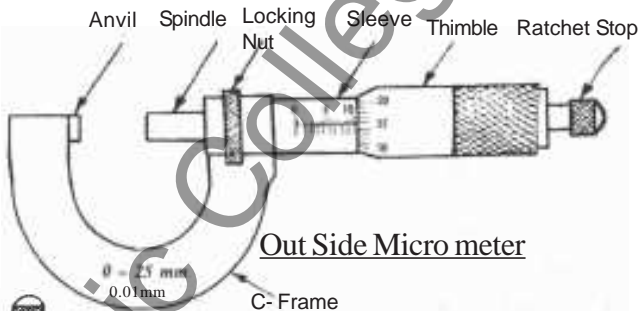


Vernier Caliper



Vernier Bevel Protractor

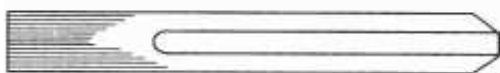
Out Side measuringJaw



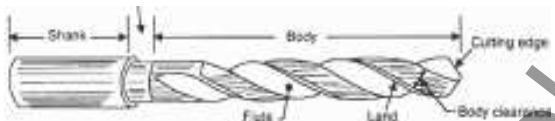
Out Side Micro meter



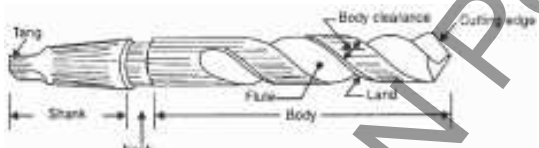
Flat Drill



Straight fluted Drills



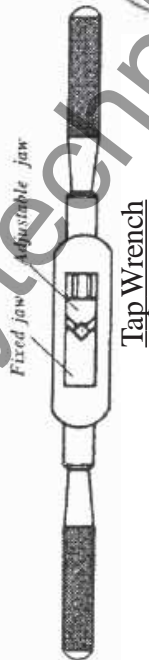
Twist Drills



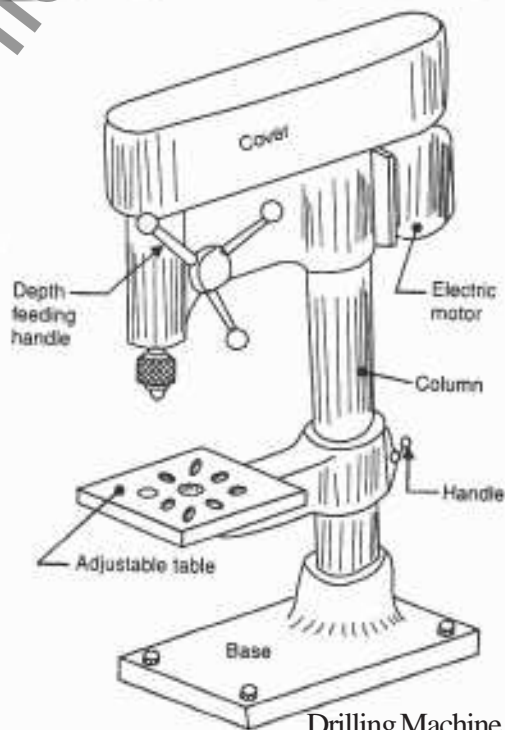
Taper shank Drills



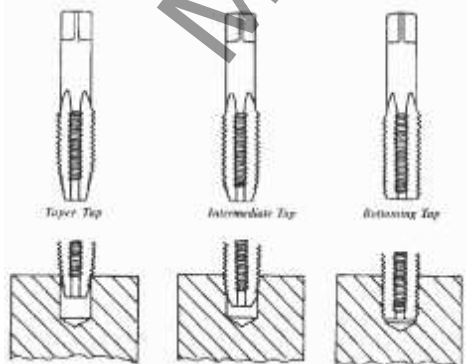
Morse taper Sleeve



Tap Wrench



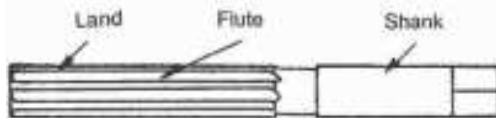
Drilling Machine



Half Die



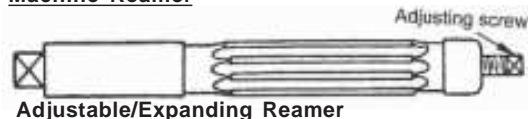
Solid Die (Die Nut)



Straight fluted Reamer



Machine Reamer



Adjustable/Expanding Reamer

### Twist Drill Nomenclature

**(a) Point :** The cone shaped end which does the cutting is called point. It consist of a dead centre, lips or cutting edges, and a heel.

**(b) Shank :** This is the driving end of the drill which is fitted on the machine.

**(c) Tang :** The flattened end of the taper shank intended to fit in to a drift slot in the spindle, socket or drill holder.

**(d) Body :** The portion between the point and the shank is called the body of a drill. The parts of the body are flute, land or margin, body clearance and web.

**(e) Flutes :** Flutes are spiral grooves in the body of the drill. The function of the flutes are to form the cutting edges on the point, to allow chips to escape, to cause chips to curl and to permit the coolant flow to the cutting edge.

**(f) Land or Margin :** It is the narrow strip which extends to the entire length of the flutes. Diameter of the drill is measured across the land or margin.

**(g) Body clearance :** The part of the body which is reduced in diameter to cut down the friction between the drill and the hole being drilled.

### DRILLING MACHINE

The most common drilling machine is used in fitting shop is sensitive drilling machine which may be either bench or pedestal mounted type, A vertical drilling machine consist of base, adjustable table, electric motor, drill spindle, pulleys, belt and column. The machine is provided with four or six speeds. The speed can be varied by changing the position of Vee- belt on the pulleys.

### REAMERS

A reamer is a multi point cutting tool used for enlarging and finishing previously drilled holes to accurate sizes. Reaming produces high quality surface finish to close limits. Also small holes which cannot be finished by other processes can be finished by reaming.

Reamers are classified as hand reamers and machine reamers. Hand reamers are provided with square shank held with a tap wrenches and are turned manually. Machine reamers are provided with Morse taper shanks and are fitted on spindles of machine tools and rotated for reaming. There are also reamers with blades, which can be expanded - known as expanding reamers - it allows one reamer to be used for a wide range of hole sizes. Taper reamers are also available for standard tapered bores.

Expanding reamers, it must either be ground down to the next smaller size or the teeth slightly enlarged by softening the teeth, expanding them slightly by hammering their fronts with a punch, re-hardening and grinding up again to size. In order to avoid this, expanding reamers are used. These are of various types. When the reamer has lost its size the diameter of the flutes is increased slightly by springling them open with a tapered pin operated by an adjustable screw, after which they are re-ground to the correct size.

### REAMING

The reaming is a process of imparting necessary smoothness, parallelism, roundness and accuracy in size, to the previously drilled hole by using a reamer. The reaming does not correct any errors which may be in the hole with regards to its position or direction because the reamer merely follows the previously drilled hole. The hand reaming is mostly done when exactness is required. In its operation, the work is held in a vice and the reamer is placed into the hole which is operated by a tap wrench fitted on the square end of the reamer.

### HAND TAPS AND WRENCHES

Hand taps are used for internal threading of components. They are made from high carbon steel or high speed steel, hardened and ground. Threads are cut on the surface and are accurately finished. To form cutting edges, the flutes are cut across the thread. Parts of a four fluted tap consist of shank - squared at the end, a body with threads and clearance flutes. Hand taps are usually made in sets of three, as mentioned below,

**Rough or Taper Tap:** The rough or taper tap is to start the thread; cutting the full threads gradually. It is tapered off for 8 to 10 threads.

**Intermediate or second tap :** It is slightly larger in diameter than rough tap and cutting threads more to size. It has two or three threads chamfered. The second tap can finish a through hole.

**Finishing or bottoming tap:** It is also known as plug tap. It has a full-sized un tapered thread to the end, and is used to finish the work prepared by the other two tapss. In case of a blind hole, this tap must be used to finish the threads to the correct depth.