



SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

COIMBATORE-35

DEPARTMENT OF MECHANICAL ENGINEERING



LINEAR MEASURING INSTRUMENTS AND TYPES

Linear measurement applies to measurement of lengths, diameter, heights and thickness including external and internal measurements. The line measuring instruments have series of accurately spaced lines marked on them e.g. Scale. The dimensions to be measured are aligned with the graduations of the scale. Linear measuring instruments are designed either for line measurements or end measurements. In end measuring instruments, the measurement is taken between two end surfaces as in micrometers, slip gauges etc.

The instruments used for linear measurements can be classified as:

1. Direct measuring instruments
2. Indirect measuring instruments

The Direct measuring instruments are of two types:

1. Graduated
2. Non Graduated

The graduated instruments include rules, vernier calipers, vernier height gauges, vernier depth gauges, micrometers, dial indicators etc.

The non graduated instruments include calipers, trammels, telescopic gauges, surface gauges, straight edges, wire gauges, screw pitch gauges, radius gauges, thickness gauges, slip gauges etc.

They can also be classified as

1. Non precision instruments such as steel rule, calipers etc.,
2. Precision measuring instruments, such as vernier instruments, micrometers, dial gauges etc.

These are limited by the human eye. Basically they are used to compare two dimensions.

- The metric scales use decimal divisions, and the imperial scales use fractional divisions.
- Some scales only use the fine scale divisions at one end of the scale. It is advised that the end of the scale not be used for measurement. This is because as they become worn with use, the end of the scale will no longer be at a 'zero' position.
- Instead the internal divisions of the scale should be used. Parallax error can be a factor when making measurements with a scale.

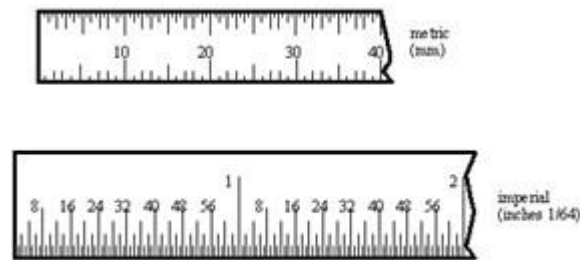


Fig 2.1 Scale

CALIPERS

Caliper is an instrument used for measuring distance between or over surfaces comparing dimensions of work pieces with such standards as plug gauges, graduated rules etc. Calipers may be difficult to use, and they require that the operator follow a few basic rules, do not force them, they will bend easily, and invalidate measurements made. If measurements are made using calipers for comparison, one operator should make all of the measurements (this keeps the feel factor a minimal error source). These instruments are very useful when dealing with hard to reach locations that normal measuring instruments cannot reach. Obviously the added step in the measurement will significantly decrease the accuracy.

VERNIER CALIPERS

The vernier instruments generally used in workshop and engineering metrology

have comparatively low accuracy. The line of measurement of such instruments does not coincide with the line of scale. The accuracy therefore depends upon the straightness of the beam and the squareness of the sliding jaw with respect to the beam. To ensure the squareness, the sliding jaw must be clamped before taking the reading. The zero error must also be taken into consideration. Instruments are now available with a measuring range up to one meter with a scale value of 0.1 or 0.2 mm.

Types of Vernier Calipers

According to Indian Standard IS: 3651-1974, three types of vernier calipers have been specified to make external and internal measurements and are shown in figures respectively. All the three types are made with one scale on the front of the beam for direct reading.

Type A: Vernier has jaws on both sides for external and internal measurements and a blade for depth measurement.

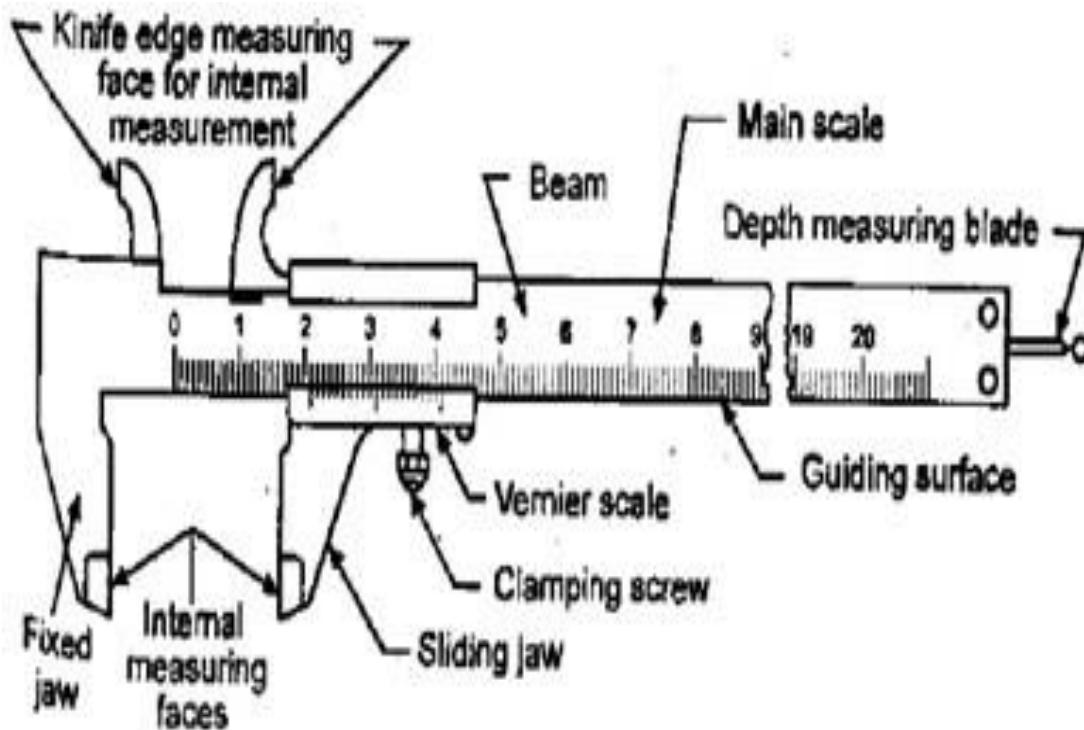


Fig 2.2 Vernier Caliper - Type A

Type B: It is provided with jaws on one side for external and internal measurements.

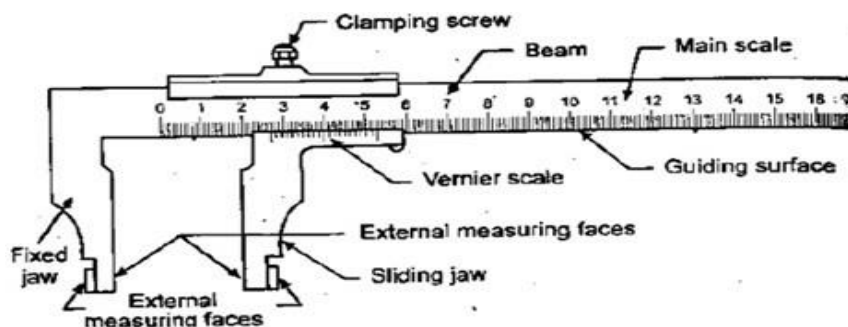


Fig 2.3 Vernier Caliper - Type B

Type C: It has jaws on both sides for making the measurement and for marking operations

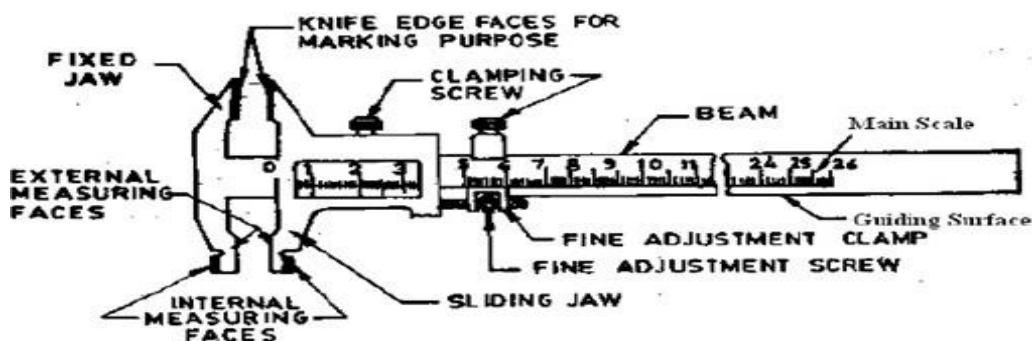


Fig 2.4 Vernier Caliper - Type C

Errors in Calipers

The degree of accuracy obtained in measurement greatly depends upon the condition of the jaws of the calipers and a special attention is needed before proceeding for the measurement. The accuracy and natural wear, and warping of Vernier caliper jaws should be tested frequently by closing them together tightly and setting them to 0-0 point of the main and Vernier scales.

MICROMETERS

There are two types in it.

- (i) Outside micrometer — To measure external dimensions.
- (ii) Inside micrometer — To measure internal dimensions.

An outside micrometer is shown. It consists of two scales, main scale and thimble scale. While the pitch of barrel screw is 0.5 mm the thimble has graduation of 0.01 mm. The **least count** of this micrometer is 0.01 mm.

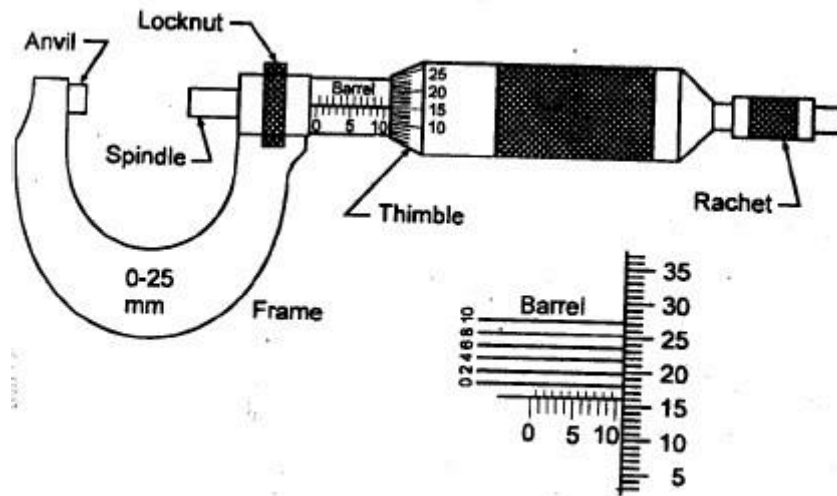


Fig 2.5 Micrometer

The micrometer requires the use of an accurate screw thread as a means of obtaining a measurement. The screw is attached to a spindle and is turned by movement of a thimble or ratchet at the end. The barrel, which is attached to the frame, acts as a nut to engage the screw threads, which are accurately made with a pitch of 0.05mm. Each revolution of the thimble advances the screw 0.05mm. On the barrel a datum line is graduated with two sets of division marks.