## Experiment No. 1

**Title:-** Measurement of Machine parts with common measuring instruments.

**Specific Outcomes:-** Students will able to

1) To acquire the skill of measurement.
2) To learn the proper handling of the instrument.
3) To eliminate or compensate the error in measurement.

**Instruments/ Equipment with Specifications:-**

| Sr.No. | Instrument | Size (mm) | Least Count (mm) | Range (mm) |
|---|---|---|---|---|
| 1 | Steel Scale | | | - |
| 2 | Vernier Caliper | | | - |
| 3 | External Micrometer | | | - |
| 4 | Vernier Height Gauge | | | - |
| 5 | Telescopic Gauges | | -- | -- |
| 6 | Surface Plate | | -- | -- |
| 7 | V Block | | -- | -- |

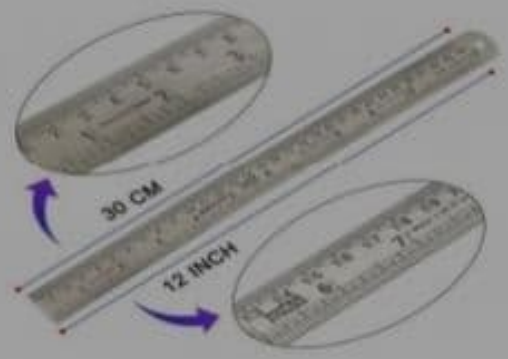


Fig. 1.1 Steel Scale

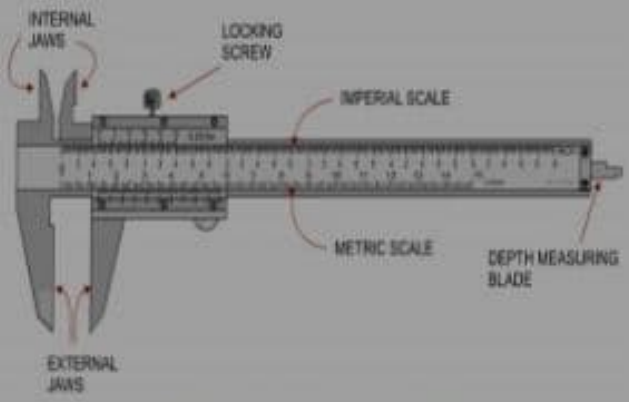


Fig. 1.2 Vernier Caliper


Fig. 1.3 External Micrometer

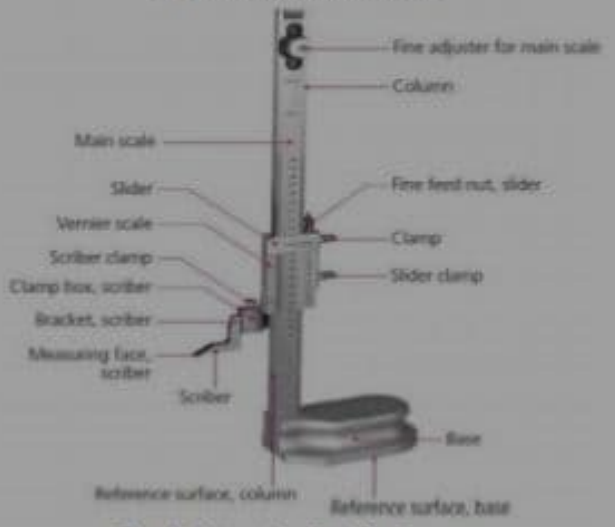


Fig. 1.4 Vernier Height Gauge

## Instruments / Equipment with specification =

| Sr. No. | Instrument | Size (mm) | Least count (mm) | Range (mm) |
|---|---|---|---|---|
| 1. | Steel scale | 300 or 150 | 0.5 | 0-300 |
| 2. | Vernier Caliper | 300 or 150 | 0.02 | 0-300 |
| 3. | External Micrometer | 50 mm to 200 mm depend on requirment | 0.01 | 0-25 |
| 4. | Vernier Height Gauge | 300 | 0.02 | — |
| 5. | Telescopic Gauges | 150 | — | — |
| 6. | Surface plate | 450x450 | — | — |
| 7. | V-block | 30x30x50 | — | — |

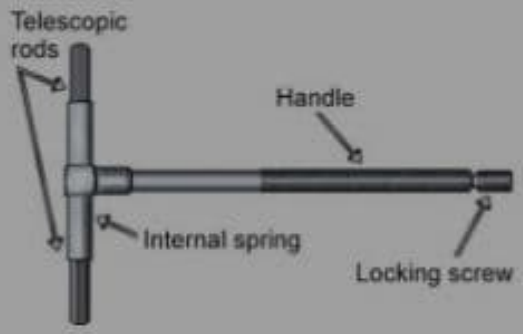


Fig. 1.5 Telescopic Gauges

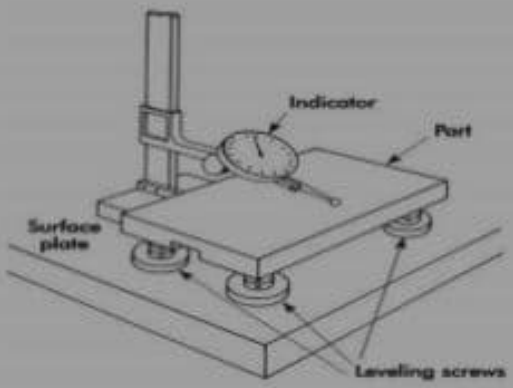


Fig. 1.6 Surface Plate

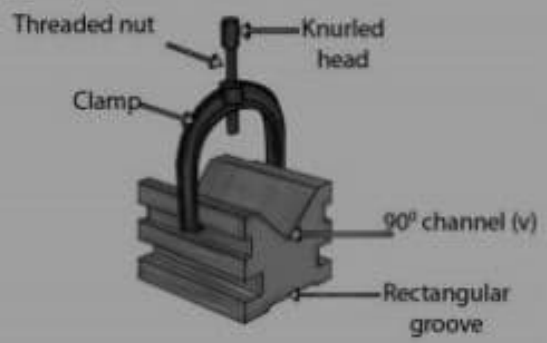


Fig. 1.7 V Block

Image Source: Google Images

**Working Principle :-**

**A) Vernier Calliper:**

It is a simple arrangement using a fixed Scale and sliding scale to obtain measurement of accuracy higher than that of ordinary scale. It relies on the difference between two carefully calibrated scales, i. e. the difference between one division of Main scale and one division on Vernier Scale and known as Least Count. In this way the length standard can be measured to greater accuracy.

**B) Micrometer:**

This relies on the principle of operation on the relative movement of precision screw and nut.

**C) Vernier Height Gauge :**

The principle of working of height gauge is same as that of Vernier calipers.

**Procedure :**

1) Study the given measuring instruments.
2) Identify their main elements and their functions.
3) Note their specification, L.C. and maximum range of instrument.
4) Understand the working principle of instruments.

5) Note their main and subsidiary divisions.
6) Calculate the least count of instrument.
7) Check errors if any.
8) Measure the required dimensions of specimen jobs as per the standard practice.
9) Read and record the readings in the given Performa / observation table.
10) Keep all instruments in their own casing.

**Observations:-**

**Drawing of Job :**

| Dimensions to be measured | Notation | Instrument Used | Obs. No. | Readings | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Least Count mm | M.S.R. (x1) mm | V.S.R. or C.S.R. (x2) mm | Total = x1+ x2 mm | Mean Reading mm |
| | | | 1 | | | | | |
| | | | 2 | | | | | |
| | | | 3 | | | | | |
| | | | 1 | | | | | |
| | | | 2 | | | | | |
| | | | 3 | | | | | |
| | | | 1 | | | | | |
| | | | 2 | | | | | |
| | | | 3 | | | | | |
| | | | 1 | | | | | |
| | | | 2 | | | | | |
| | | | 3 | | | | | |
| | | | 1 | | | | | |
| | | | 2 | | | | | |
| | | | 3 | | | | | |

## Observations :-

| Dimensions To be Measured | Notation | Instrument Used | Obs. No. | Least count mm | M.S.R (x1) mm | V.S.R or C.S.R (x2 mm) | Total $x_1+x_2$ mm | Mean Reading mm |
|---|---|---|---|---|---|---|---|---|
| Height | (H) | Rectangular Block | 1. | 0.02 | 20.6 | 0.18 | 20.78 | 20.73 |
| | | | 2. | 0.02 | 20.6 | 0.08 | 20.68 | |
| | | | 3. | 0.02 | 20.6 | 0.14 | 20.74 | |
| Width | (B) | Rectangular Block (by scale) | 1. | 0.5 | 90.9 | 0.14 | 91.04 | 91.213 |
| | | | 2. | 0.5 | 90.9 | 0.1 | 91 | |
| | | | 3. | 0.5 | 90.9 | 0.16 | 91.06 | |
| Length | (L) | Cylinder | 1. | 0.02 | 60.6 | 0.04 | 60.64 | 60.713 |
| | | | 2. | 0.02 | 60.7 | 0.02 | 60.72 | |
| | | | 3. | 0.02 | 60.6 | 0.18 | 60.78 | |
| Height | (H) | Cylinder | 1. | 0.02 | 30.7 | 0.02 | 30.72 | 30.76 |
| | | | 2. | 0.02 | 30.8 | 0.18 | 30.84 | |
| | | | 3. | 0.02 | 30.7 | 0.04 | 30.74 | |
| Internal Diameter | (D1) | Cylinder | 1 | 0.02 | 20.8 | 0.02 | 20.82 | 20.84 |
| | | | 2 | 0.02 | 20.7 | 0.04 | 20.82 | |
| | | | 3. | 0.02 | 20.8 | 0.14 | 20.84 | |

**Sources of error :-**

**Precautions :-**

- **Steel Scale and Vernier Calipers**
  1) Check if steel rule ends are worn round or unsquare before using.
  2) The end of the scale must never be set with edge of the part to be measured because the end of the scale is usually worn out in an old scale.
  3) The scale should never be laid flat on the part to be measured because by doing so the graduations of the scale are not in direct contact with the surface of the part.
  4) All instruments should be thoroughly cleaned, covered with mobil oil and put in dust free covers.
  5) When putting any instrument on table it should not be put violently or with a jerk.
  6) While measuring length standards by above instrument error of parallax or zero error should be avoided.
  7) In vernier calipers, there should be no play between sliding jaw and the fixed scale.

- **Micrometers**
  1) The part to be measured must be held in left hand and micrometer in right hand. The way for holding the micrometer is to place the small finger and adjoining finger in the U-shaped frame. The forefingers and thimble are placed near the thimble to rotate it and middle finger supports the micrometer while holding.
  2) The micrometer should be wiped clean and free from oil, dirt, dust and grit.
  3) Clean the measuring surfaces of anvil and spindle for every measurement.
  4) Check for zero reading. If there is no ratchet, use the pressure on thimble for checking zero error.
  5) The anvil and spindle measuring surfaces should be flat and square to the anvil and spindles respectively.
  6) When micrometer feels gummy, dust ribbon and thimble fail to turn freely, take the micrometer apart and thoroughly wash each component free from dirt and then assemble. Stickiness may be due to damaged threads or due to warping of frame or spindle.
  7) Never leave the micrometer stored away with the spindle clamped down on empty anvil as electrolytic action takes place on contacting surfaces and measuring surfaces get corroded.
  8) It is better to hold the micrometer anvil stationary and firmly against the work in one hand and take care of gauging pressure and locating the correct position of spindle by the movement of fingers of the other hand causing rotation of the spindle.

## Source of Error :-

Main sources of error includes scale misreading [parallax effect] excessive measuring force cause jaws tilt thermal expansion caused by a temperature difference between the caliper and workpeice and small hole diameter error caused by inside jaws offset.

## Conclusion :-

In conclusion we were able to learn how to get accurate measurements and use the micrometer, vernier caliper, height gauge etc. This lab allowed to us to get a better understanding of the principal of the system of fits and practice using the difference measuring instruments for a variety object.

**Conclusions :-**

**Assignment:-**

1. Explain the L.C. of Vernier Calipers with the help of examples.
2. Explain the L.C. of Micrometer with the help of examples.
3. Explain Zero Error with suitable examples.
4. What are the Sources of error in the Linear measurement?
5. What are the precautions should be taken to avoid the above errors?

**References**

| Title of Article | Web Link |
|---|---|
| Experiment No. 1 : Measurement With Metrology Lab Scale And Vernier Calipers | http://egyankosh.ac.in/bitstream/123456789/27378/1/Experiments%281-20%29.pdf |
| Experiment No. 2 : Measurement With Micrometers – Internal And External | |
| Experiment No. 3 : Measurement With Height And Depth Gauge | |
| Job Shop Measuring & Metrology Tips with Mitutoyo! | https://www.youtube.com/watch?v=LZtN0OKi9Os |
| Measuring Instruments, Least Count, Parts name and Details | https://www.youtube.com/watch?v=J7fKbrFO_y0 |
| Mechanical Measuring Instrument in Hindi | https://youtu.be/TyhzlzPRzxw |
| Measuring Instruments, Least Count, Parts name and Details | https://www.youtube.com/watch?v=J7fKbrFO_y0 |

## Assignment

1. Explain the L.C. of vernier calipers with the help of examples

Answer:- The least count of a measuring instrument is the smallest and accurate value in the measure quantity that can be resolved on the instruments scale. least count is the least length that can be measured by using vernier calliper.

Least count can be calculated as (L.C) =

$$\frac{\text{Select Division on Main Scale.}}{\text{Total Division on Main Scale}} = \frac{1}{50} = 0.02$$

2. Explain the L.C of Micrometer with the help of examples.

Answer:- The least count of screw when screw rotates by one division on a circular scale. This is least count.
Least count for the micrometer of 1/2 mm pitch and 50 division on a circular scale.

$$\text{So L.C. Will be} = \frac{\text{Pitch of the Micrometer}}{\text{No of divisions on a circular scale.}} = \frac{1}{2 \times 50} = 0.01$$

3. Explain Zero error with suitable examples.

Answer:- Zero error is defined as a condition where the measuring instruments register a reading when there should be not any reading.

In case of vernier caliper zero error occures when the main scale does not coincide with zero on vernier caliper.

As well as in micrometer when anvil and spindle of micrometer touches each other then the zero on the main ~~sd~~ scale should match with zero on circular path.

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4. What are the sources of error in the Linear measurement?

Answer:- Misalignment of jaws in vernier callipers

Dirt stuck in screw gauge abuse and low operator skill are the main sources of error in micrometers.

Damaged and uncleaned base which causes inaccuracy in vernier height gauge.

If any end od ruler in broken at that time error can occur.

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5. What are the precautions should be taken to avoide the above errors.

Answer :- Buy better quality measuring instrument and cheak it before measuring instrument.

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