GreenVETAfrica

Co-funded by
the European Union

GreenVETAfrica mission is to offer an innovative capacity building programme on Green Waste Management in Nigeria and Ghana

UNIT FOUR

MECHANICAL MEASUREMENT& & FITTINGS IN WASTE MANAGEMENT (MACHINERY & EQUIPMENT)

GreenVETAfrica

Co-funded by the European Union

INTRODUCTION

- Measurements
- Standards
- Errors
- Limit and Fits
- Workshop practices and fittings

Objective

- Demonstrate proficiency in the concept of measurement : what is measurement, why measurement etc…
- Comprehend the standards of measurement in place, measuring tool as micrometer, Vernier, direct and indirect measuring tool

GreenVETAfrica

Co-funded by the European Union

Road Map

- This module is scheduled for a duration of one week of which is categorized to virtual and physical.
- Virtual would consist of: Measurement concepts, measuring standards, errors, measurement exercises.
- Physical session entails practical hands-on workshop practices

GreenVETAfrica

Co-funded by the European Union

Overview of Mechanical measurement and fittings:

- Measurement is a system of communication and as well on the basis of an agreed standard ,promoting consistency across various engineering practices.

- Workshop practices

GreenVETAfrica

Co-funded by the European Union

Section 1:

- Measurement is used widely in various industries – recycling and waste industrial plant inclusive. In recycling plant and waste management facilities, you may have standards like degree celsius for temperature, meter cube(m3) or cm cube for volume, pressure as paschal etc to measure varying quantities however in a more mechanically fundamental aspect, we will be working with measurement standards for dimensioning a piece or a component being worked on.

- Interpret dimension that may serve as guide while working and carrying mechanical related exercises in waste management and recycling facilities.

Why Measurement?

- Back in ancient times one of the challenges associated with measurement was lack of standard meaning a high level of inconsistency in measuring as there weren't any agreed standard of measurement, take for instance small-szied goal post measured by feet would vary in trying to quantify the distance due to varying human feet sizes as there would be inconsistency if another human measures the equivalent distance with his or her foot.

- Measurement therefore similarly in waste management can be use to :
- Quantify variable as: - volume of waste, temp, mass etc.
- Decision making:

  for instance a gear to be replaced in waste machinery that does shredding operation we would need to know the diameter, thickness, depth of a bore or the length of a waste carrying conveyor for plant layout purposes etc.
- Communication and trade:

- Communication and trade: Measurement is a means of communication in engineering practices, if a part is to be ordered, specifications can be conveyed in terms of dimension i.e the measurement of the component to be purchased and others descriptive aid.

Where is measurement applied?

- Exercise give 5 area of examples of where measurement can be used or being used

What is Measurement

- Measurement
- Inspection
- Standards used in Measurement
  - metric system
  - Imperial or English system
- Errors:
  - types
- Safety

GreenVETAfrica

Co-funded by the European Union

What is Measurement

- **Measurement**: To measure, we must have the intended object of which we aim to know it dimension and respect to (calibrated) standard. So measurement therefore is the comparison of piece , component , object undergoing test or mechanical operation with a KNOWN STANDARD.

- **Inspection**: Is checking , confirming dimension result of a piece, or the accuracy of how reliable a measuring equipment is

- **Standards used in Measurement**

  Metric system
  Imperial or English system

- **Errors:**

  types

- **Safety**

Co-funded by the European Union

STANDARDS USED IN MEASUREMENT

There are two major standards of measurement in general use , there may also exist other standard form in special areas of application and purpose but fundamentally we have two:

- ❑ Imperial standard (system)
- ❑ Metric standard (system)

STANDARDS USED IN MEASUREMENT

The imperial system also known as the ENGLISH SYSTEM is gradually superseded by the metric system due to the fact that it entails fractional values when computing the total arithmetic value while measuring. It is expressed in:

- ❑ Inches
- ❑ Feet 1 feet = 12”
- ❑ Yards 3 feet = 1 yard

A link is provided In the classroom to further buttress the imperial system

GreenVETAfrica

Co-funded by the European Union

STANDARDS USED IN MEASUREMENT

- The metric system is a widely used system , much easier to work with and compute total arithmetic values in dimension for an object or piece ,It is expressed in an increasing or decreasing order of 10's as a result the prefixes: milli, kilo, centi, hector, deca etc.
- 10mm 1cm
- 10cm 1dm
- 10dm 1m

ERRORS

Errors are bound to happen and as a result can be catastrophic in result and altogether allow for misinterpretation of values.

To mention a few:

Easily eliminated errors

- Arithmetic error
- Alignment error

Not easily (to) eliminate errors

- Scale error
- Reading error

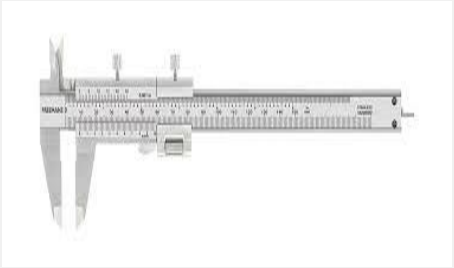
MEASURING EQUIPMENT: MEASURING & MARKING OUT

- Measuring equipment
  - Feeler Gauge
  - Straight Edge
  - Calipers
  - Vernier Calipers
  - Micrometer
  - Dial Indicator etc.
- Measuring and marking out
  - Marking out Table

Feeler gauge

Dial indicator

Micrometer



Vernier caliper

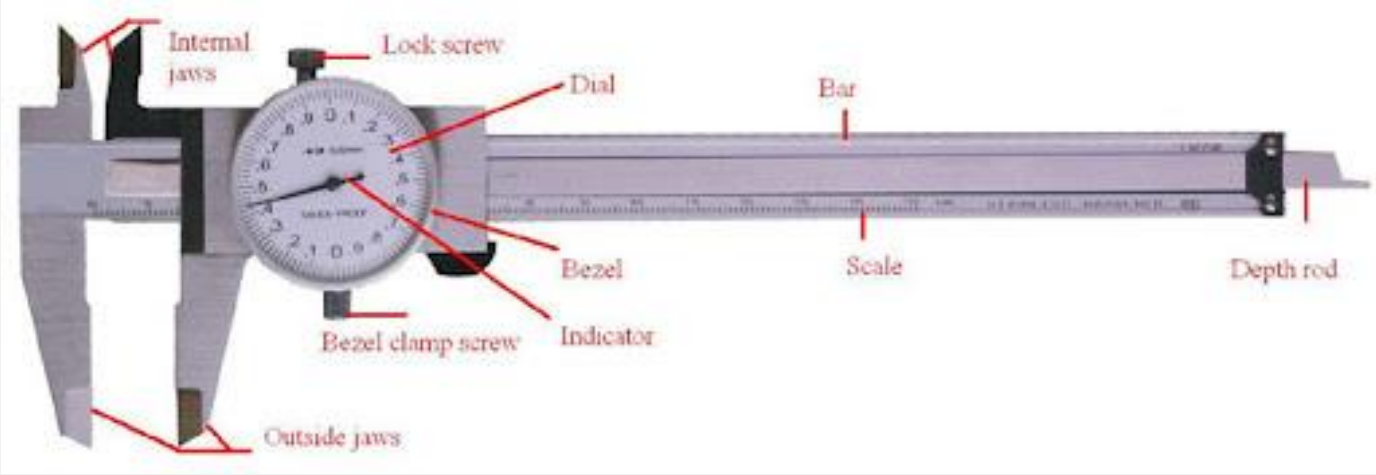
Outside caliper

Inside caliper

indirect

Vernier Calipers:

- A Vernier caliper is used in reading LINEAR DIMENSION of components it can be further used to measure variables as height, depth, diameter etc .
- It is solely or primarily used for LINEAR DIMENSION
- Accuracy is usually embossed by manufacturer between 0.02mm – 0.05mm

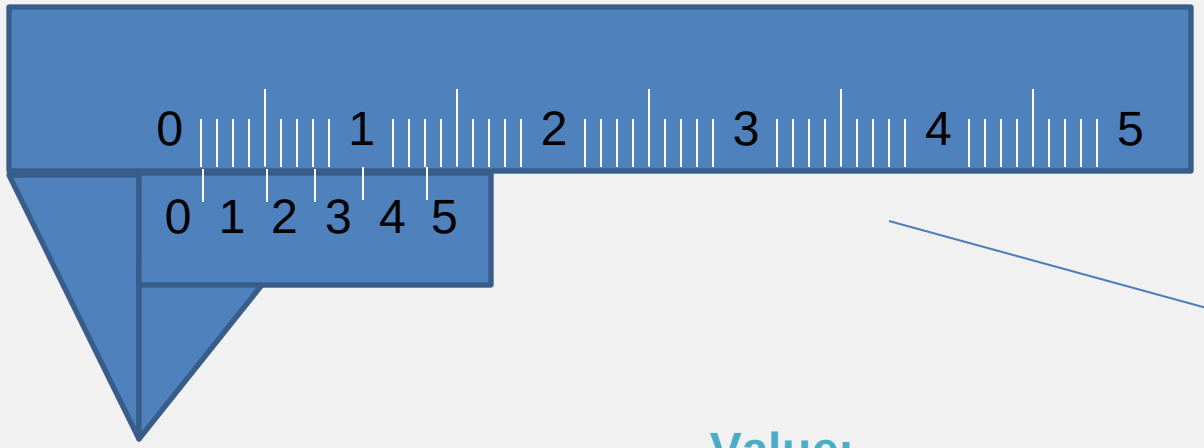


Reading Vernier Caliper

- There are 3 concerns when reading a Vernier caliper which are:
- The Main Scale (identifying the main scale and reading either in inches or metric)
- The Vernier Scale : This is the moveable component on the Vernier scale. It moves relative to the main scale as to how far in distance , depth or height of component to be measured.
- Point of coincision, accuracy: the point of coincision is translated on the Vernier matching with the main scale.
- (practical demonstration)

Find the video reference in the google classroom

Reading Vernier Caliper



Main scale

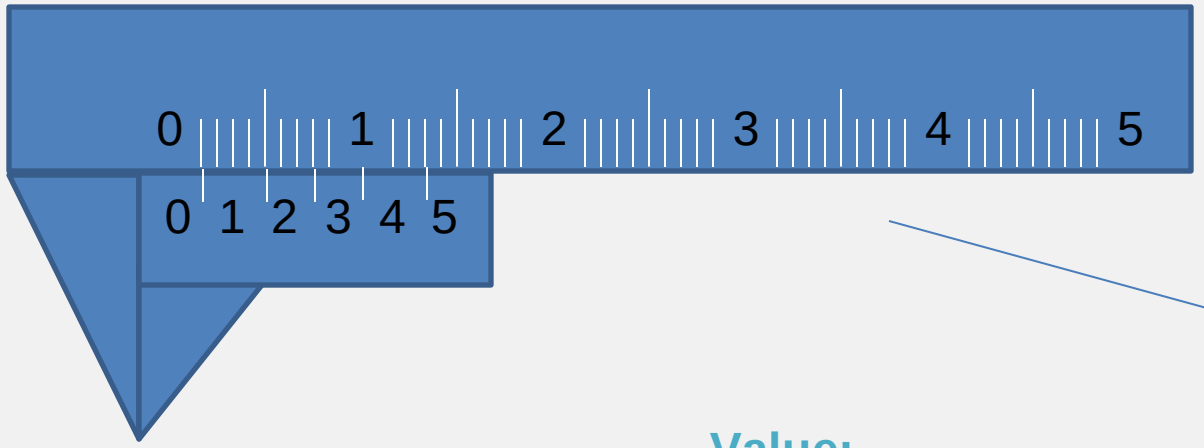
Vernier scale

Value:

Main scale
22mm
Vernier scale
.50mm

Total : 22.50mm

Reading Vernier Caliper



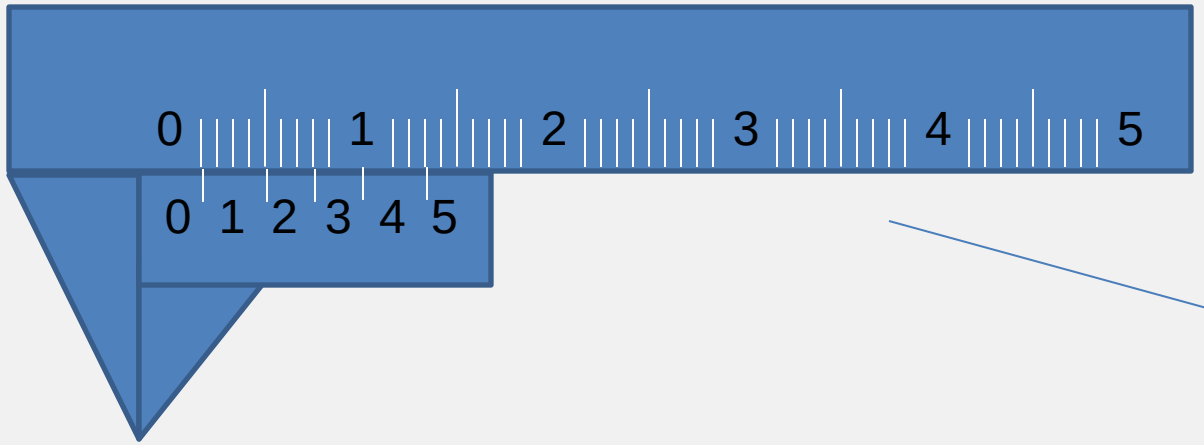
Value:

Main scale
9mm
Vernier scale
.20mm

Total : 9.20mm

Assuming our coincision on Vernier is .20mm

Reading Vernier Caliper



Main scale

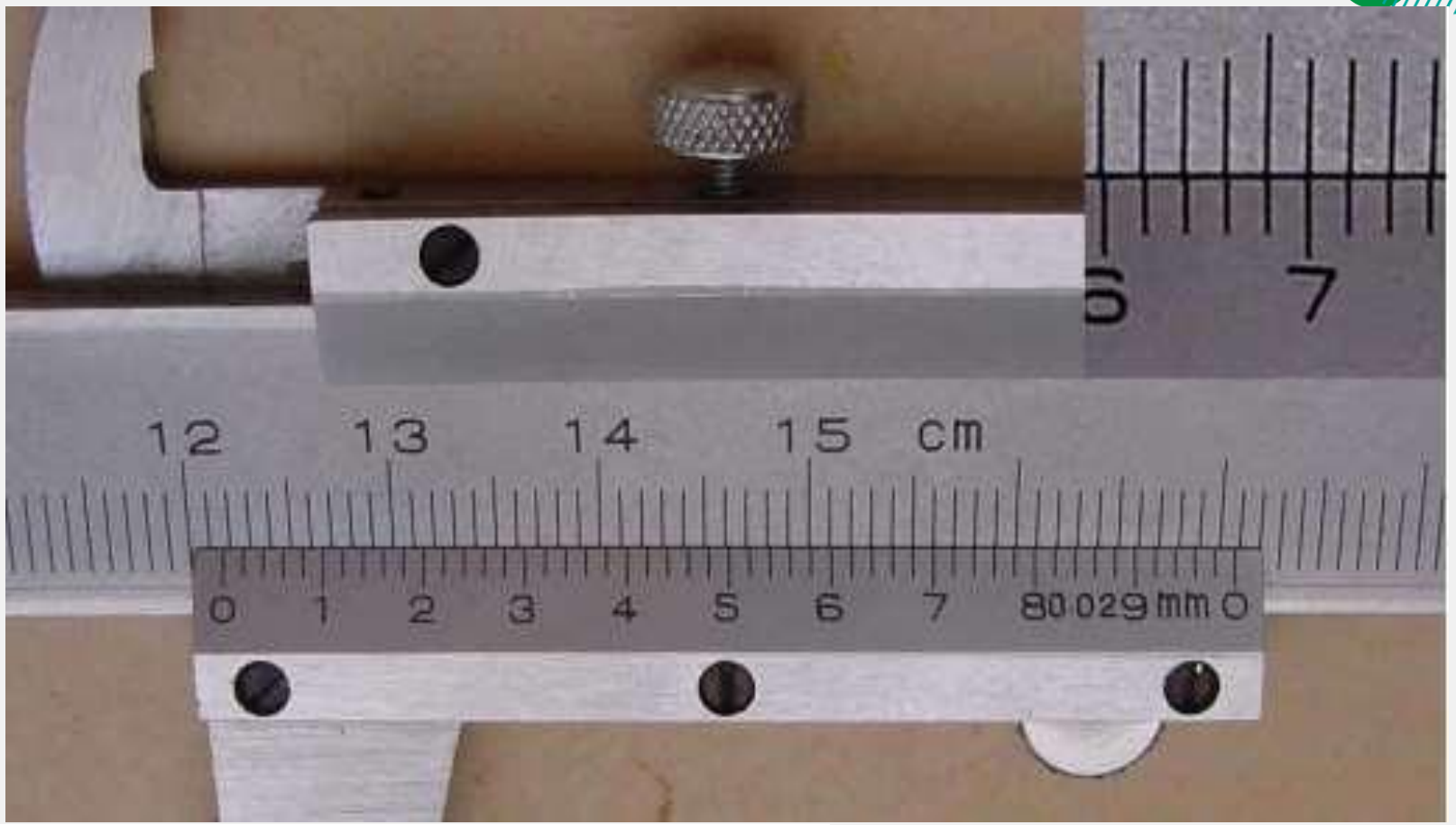
Vernier scale

Value of main scale

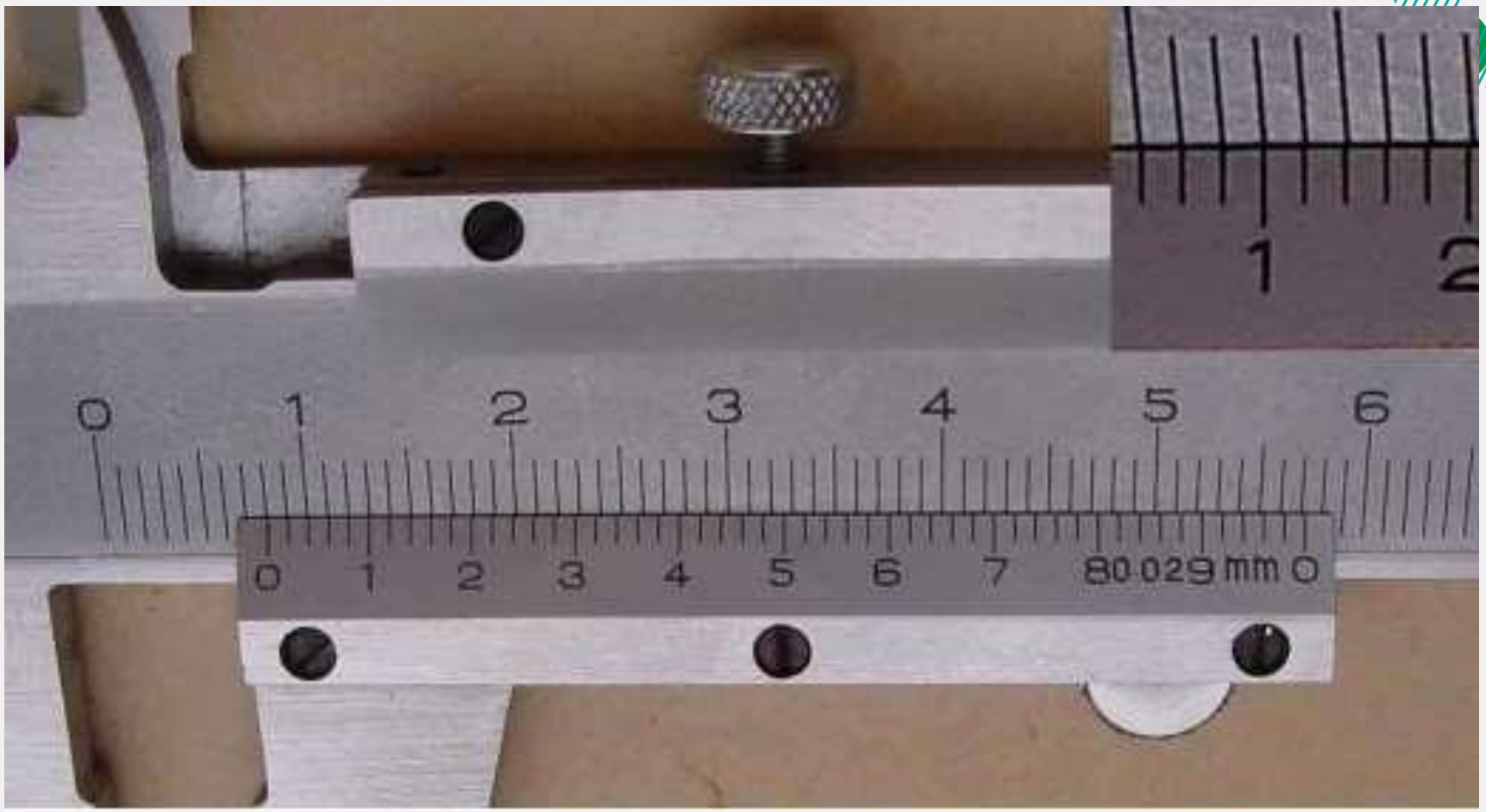
Main scale: 34mm

Note: if what is been measured has no coincision on the Vernier aligning with the main scale then the mainscale value is our total and exact dimension for the component: if mainscale is exactly 20mm and no coincision on the Vernier then our object measured is exactly 20mm

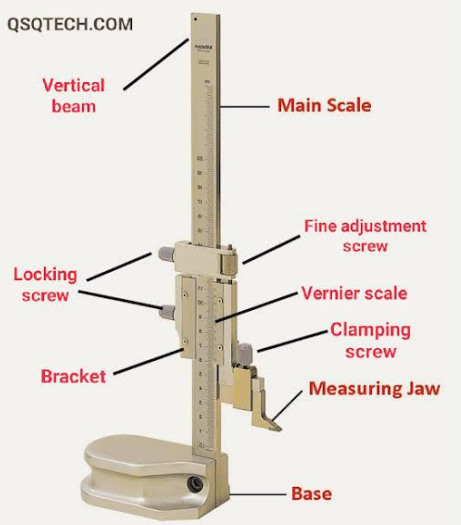
Reading Vernier Caliper



Reading Vernier Caliper

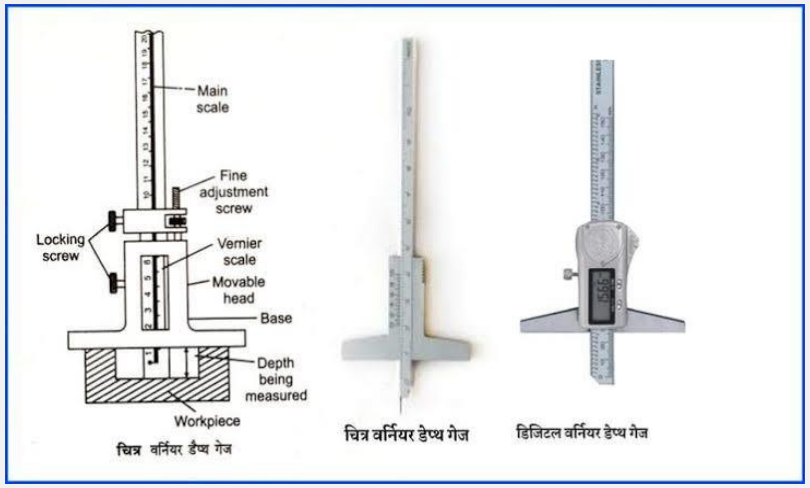


…Other Vernier tools:



1

2



3

1. Vernier height gauge
2. Vernier depth gauge
3. Vernier protractor
4. Digital Vernier tool

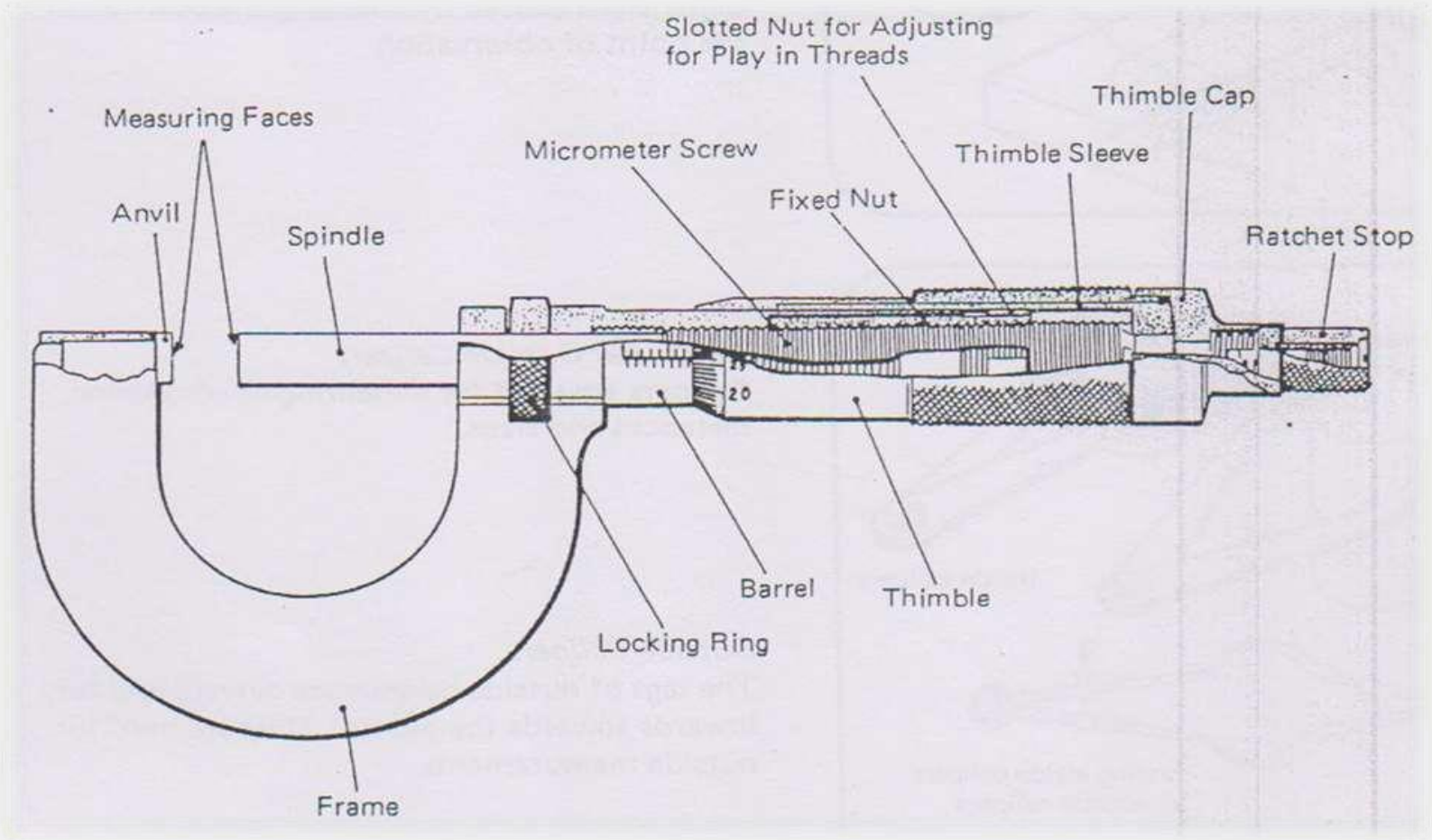
Micrometer

- Another yet useful measuring instrument which has a higher accuracy of 0.01mm is the micrometer, all micrometer uses the same principle once understood - same principle applies across other micrometer tool that available.

- It is majorly used to measure cylindrical in nature component or pieces, comes in different ranges: 0-25mm, 25mm-50mm, 50mm – 75mm, 75mm – 100mm etc.

0 – 25mm micrometer

…Micrometer



Co-funded by
the European Union

Reading Micrometer

when reading a micrometer, we are concerned with 2 particular parts (and a condition) of the micrometer to sum up our total reading. Before taking measurement confirm :

- ❑ The measuring surface of the spindle and anvil must be evenly flat and no form of rust
- ❑ The spindle rotate easily and freely
- ❑ Upon bringing both faces together (touching) no ray of light passes.

When the above is confirmed, to read or translate dimension of the measured component, we consider the reading on

1. The barrel
2. The thimble

Reading Micrometer

The barrel of any micrometer tool has and axial(horizontal line) pointing to the thimble , this line is used as reference to get the value of reading on the thimble

The barrel is in two division of whole mm(1mm) and half mm(0.5mm).

The upper and lower represent the whole mm and 0.5mm division ,

Because per revolution of the spindle, the micrometer travels ½ mm distance and the thimble is calibrated into 50 equal part - the accuracy is given by ½ of 50 is equal to 0.01mm

GreenVETAfrica

Co-funded by the European Union

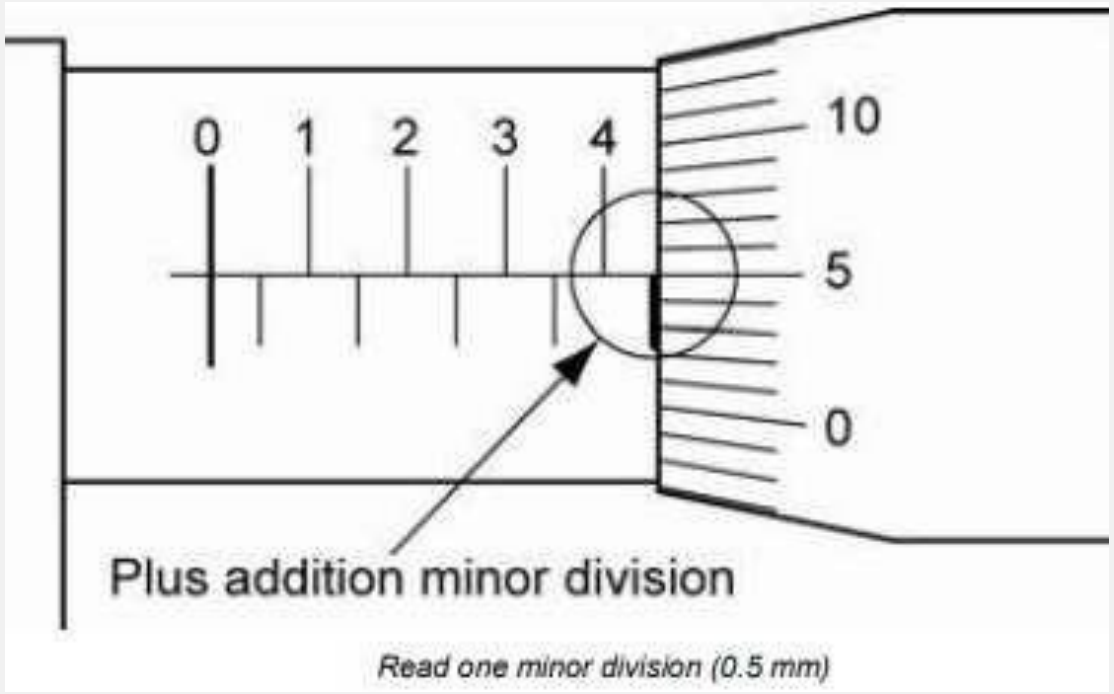
Reading Micrometer

1. How far the spindle moves away from the anvil is read off from the barrel whole mm division , if by measuring the component, the barrel shows or includes the ½ mm, the ½mm division is added altogether with the whole mm : take for instance a component measured 20 in the whole mm division and further extends to having an extra .5mm (1/2 mm) on the barrel we add the whole mm division and 1/2mm as a single value making it a total of 20.5mm reading from the barrel.
2. From the barrel we translate the value the axial (horizontal)line points to on the thimble that is calibrated into 50 equal parts - multiplied by 0.01 .Adding the resulting value together with the barrel value makes the total

Reading Micrometer

Summary:

Micrometer = Barrel(whole mm div and ½ mm div) + thimble(0.01)



Read one minor division (0.5 mm)

Barrel:

whole mm = 4mm

½ mm div = .50mm

Thimble:

5mm X 0.01 = 0.05mm

Total 4.55mm

GreenVETAfrica

Co-funded by the European Union

Reading Micrometer

Summary:

Micrometer = Barrel(whole mm div and ½ mm div) + thimble(0.01)

Barrel:

whole mm = _____

½ mm div = _____

Thimble:

Total _____

GreenVETAfrica

Co-funded by the European Union

Handling Micrometer

- When using micrometer tool rotate the spindle from the ratchet stop , it serves a safety aid to prevent the transfer of human input rotating spindle when spindle is at final revolution and can’t proceed any further - Prevent the wear of fine thread of the spindle .
- Excessive force shouldn’t be used when reading of values of piece , let the spindle and anvil just slide in and out upon measuring any piece,
- Micrometer should be returned back to their protective cases when not in use
- Use the lock ring or lock nut to hold measured value in position so when reading ,values are not adjusted unintentionally.

GreenVETAfrica

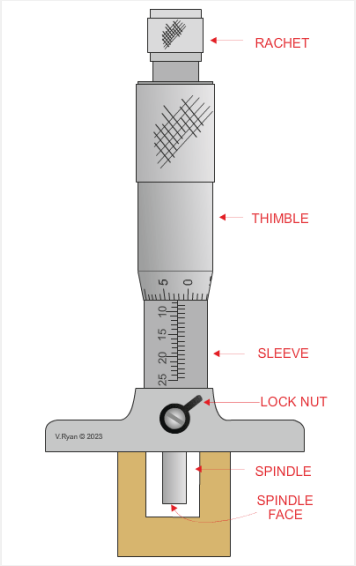
Co-funded by the European Union

Other Micrometer Tool

1. Inside micrometer tool
2. Micrometer depth tool
3. Digital Micrometer
4. Outside Micrometer

1

2



3

Source
Inside micometer: indianmart.com
Digital micrometer: aliexpress

GreenVETAfrica
Co-funded by the European Union

Dial Indicator

This is a gauge like looking equipment used to compare varying height , region of high areas versus low areas, parallelism , height comparison between multiple piece or component .

Distinctive features:

- Main Scale (Pointer – whole mm)
- Moveable (external) Scale

Dial Indicator

The main pointer needle is the smaller pointer of the two pointer which for it to deflect a single whole mm value, the external pointer must have rotated a hundred time

One calibration of the external pointer values is one hundredth (1/100)

The value of the main pointer and the external pointer is summed up to give us the value of total deflection.

The height variation of bearing housing supporting shaft for waste transferring conveyor for alignment purpose

Shaft parallelism used as transmission means to a gear for shredding waste

Using the dial indicator

Dial indicator are provided with a stand which often have magnetic bases and can be adjusted to certain height and overhang for ease of measuring.

Ensure the external needle pointer is on the zero value if not the adjust the movable cover to tilt calibrated value to align with the pointer to value zero.

Place dial indicator plunger on desired component to measure it amount of deflection,

Measure at multiple point to ensure parallelism

Reading the dial indicator

Main scale(whole mm)

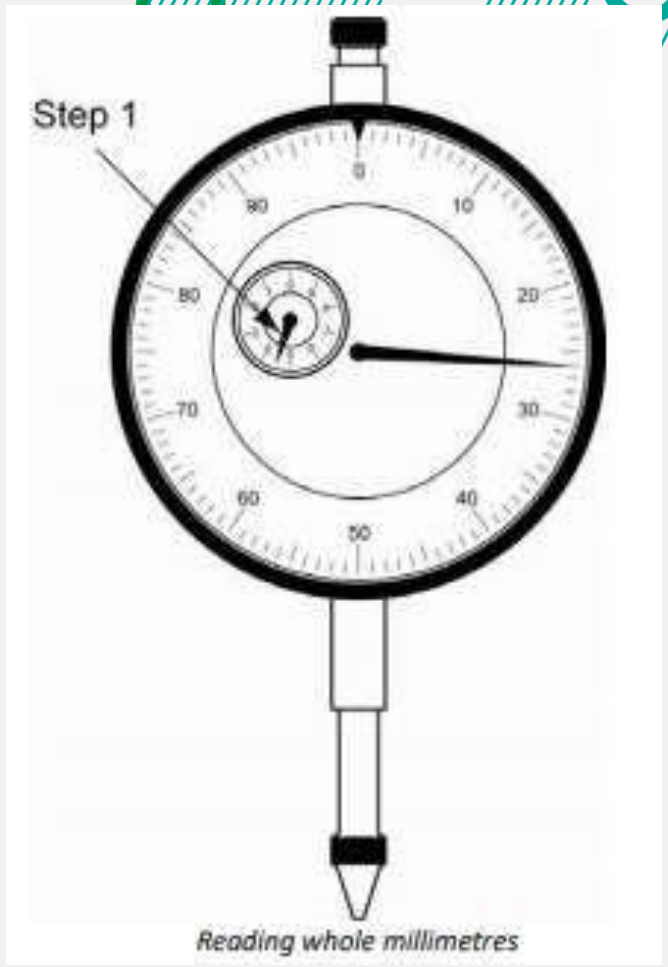
Between 4 and 5 mm , we take the 4mm as our main scale reading

External scale

The pointer points on 26mm multiplied by one hundredth (0.01)

Sum up both values

4.26mm total



Reading whole millimetres

Co-funded by the European Union

Limit and Fits

Fit is a concept of mating shaft and holes in an assembly

- **Clearance or Running Fits: the hole in this type of fit is bigger than the mating shaft, hence there is ease of assembly**
- **Transition / driving fit**

  Diameter of shaft and hole are the same hence a slight amount of force is required for mating this type of fit
- **Interference or Force Fit**

  this is where the shaft itself is greater than the diameter of the hole, a force of larger magnitude (hydraulic press force etc) is required for mating

GreenVETAfrica

Thank you

@GreenVETAfrica

www.linkedin.com/company/greenvetafrica/

Greenvetafrica

www.greenvetafrica.eu

Co-funded by the European Union