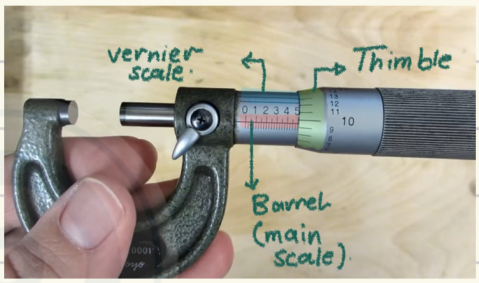
① Dial Indicator :



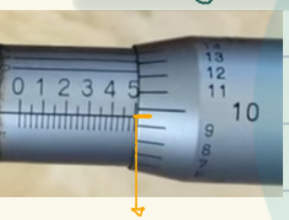
- Precision measurment tool
- measure small linear distances or displacements
- indicator is perpendicular to the workpiece
- relative to the zero or reference point
- eliminates sys. error.

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② Micrometers :



1) Reading inch Micrometers :



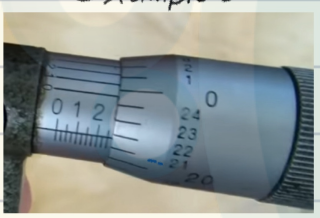
- 0.025 inch each devision.
- main scale reading = 0.5 inch
- Thimble with 25 graduations.
  $= \frac{0.025}{25} = 0.001$ inch
- Thimble reading = 0.009
- Vernier with 10 devisions.
  $= 0.0001$
- vernier Reading = 0.0005

* Reading line between 2 numbers.

0.5 + 0.009
= 0.509
+0.0005
= 0.5095 inch

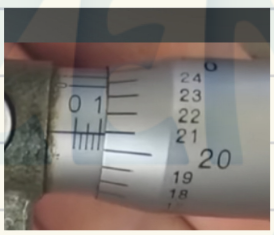
Solu : 0.500
+ 0.009
0.509
+0.0005
0.5095 inch.

Example :



0.2
+ 0.05
+ 0.021
0.271

0.271
+ 0.0007
0.2717 inch.



0.100
+ 0.020
0.120

0.120
+ 0.0009
0.1209 inch.

---

2) Reading Metric Micrometers

- Reading in main scale = 0.5 mm
- Thimble with 50 graduations. $= \frac{0.5}{50} = 0.01$ mm



Example :



7 mm
+ 0.30
7.30 mm

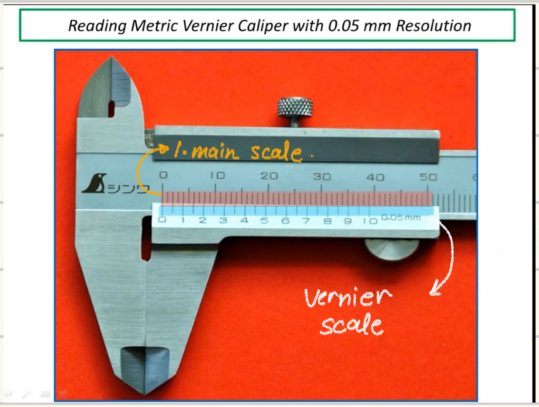


9.5 mm
+ 0.22
9.72 mm

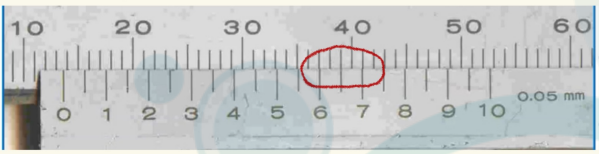
③ Metric Vernier caliper :

- How to calculate the accuracy

$$\left[\frac{C}{N} = \frac{\text{Smallest reading in the main scale}}{\#\text{of devision on the vernier scale.}}\right]^{*}$$



Example :



Soln :

$$\frac{C}{N} = \frac{1mm}{20} = 0.05$$

$$13 + (13 * \frac{5}{100})$$

$$= 13 + 0.65 = 13.65.$$

$$\text{accuracy} = \frac{1mm}{20} = 0.05$$



$$\frac{C}{N} = \frac{1}{20} = 0.05.$$

$$48 + (11 * 0.05) = 48.55$$



$$\frac{C}{N} = \frac{1}{20} = 0.05.$$

$$75 + (8 * 0.05)$$

$$= 75.40 \text{ mm}.$$

---

④ Dial Calipers :

- Measures outside & inside diameter



Example :



$$86 + (0.7 + (3 * 0.02))$$

$$86 + (0.7 + 0.06)$$

$$= 86.76 \text{ mm}$$



each grade represent (0.02 mm)

* Best accuracy.

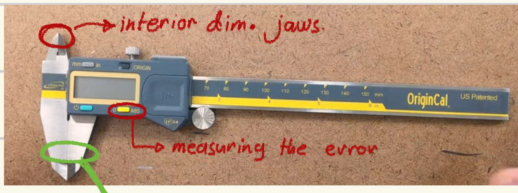
---

⑤ Depth micrometer :

- hardened ground base
- Sleeve graduations in the Opposite direction.



⑥ Digital Calipers :



- measuring depth, Outside dim., interior dim.
- Reading from (0.00) if it is calibrated
- * The edges of the Object should be parallel with the jaws.

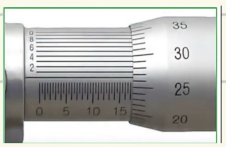
Outside dim. jaws

depth gauge for measuring depth of inside holes.



---

⑦ Metric Vernier Micrometer :



in the main Scale = 17.000

Thimble = 26 · = 0.260

vernier = 4 = 0.004

Fainal Reading = 17.264 mm



main = 5.500

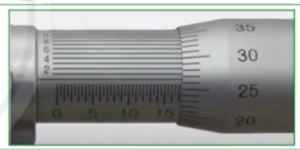
Thimble = 0.280

vernier = 0.003

Fainal Reading = 5.783

Reading Metric Vernier Micrometer with 0.001 mm Resolution





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⑧ Depth micrometer :

- Reading from max. covered reading.

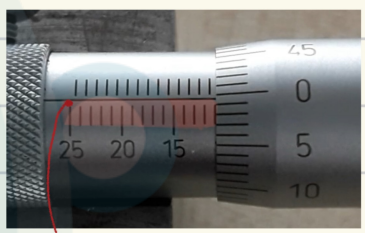
Example :



Max. covered = 12.00

Thimble = 0.25

final = 12.25



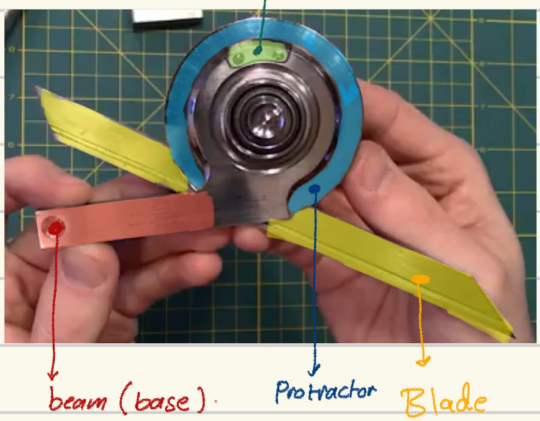
Opposite direction in the reading.

---

⑨ Types of Micrometers :

⑩ Universal vernier Protractor :

- check angles with accuracy up to (5')
- with vernier scale
- Base is stationary
- Blade is rotating



Example :



start from the Zero in the vernier

Main scale = 30°

vernier = 25'

30° 25'

counter clockwise.



main = 76°

vernier = 45'

76° 45'

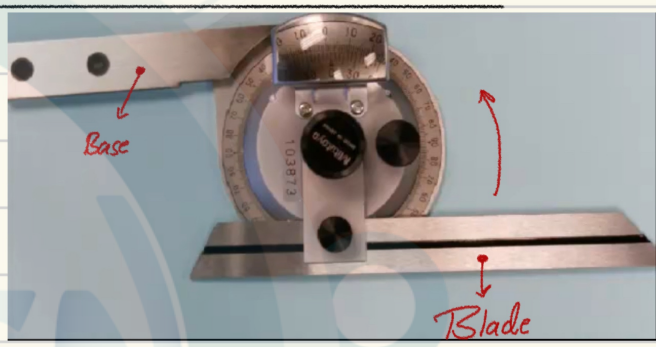


54° 50'

---

⑪ Universal Bevel (vernier) Protractor

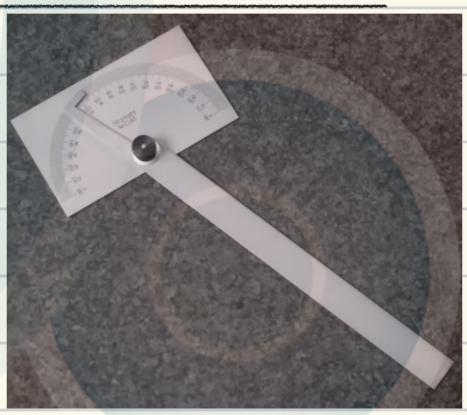
- Measurement taken from Base, and acts as an area for an acute angle



---

⑫ Protractor :

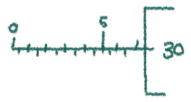
- Determining or sitting angles within a degree. (accuracy 1°).
- Not for inspecting precise angle tolerances.



Out Side micrometer :

How to read micrometers :

main scale smallest devi. = 0.05



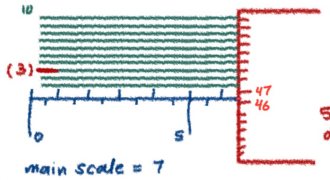
7.30 mm

on the Thimble = 0.01 mm
with 50 graduation

($\frac{1}{2}$ mm per revolution)

$\frac{0.5}{50} = 0.01$

Vernier micrometer :



main scale = 7

Thimble ⇒ $\frac{0.5}{50} = 0.01$

0.46

counter clock wise.
تنكس العقارة

* Vernier : $\frac{0.01}{10} = 0.001$

$= 7 + 0.46 + 0.003$
$= 7.463$

改善 KAIZEN TEAM