Accuracy of measurement

- Todays accuracy of measurement is of first importance
- **What is the smallest unit of measurement for distance?**

- mili 10^-3
- micro 10^-6
- nano 10^-9
- Angstrom 10^-10
- pico 10^-12
- femto 10^-15
- atto 10^-18
- zecto 10^-21
- yocto 10^-24

Measurement Systems

- English system or standard system of unit`
- Knuckles = 1 inch
- Feet = I foot = 12 inch
- Yard = 36 inch
- Smaller Number like 1/1000 or 1/10000 is possible to measure it with conventional methods

Measurement Systems

- Metric system or international system of units
- In 1670 Gabriel Mouton a French scientist proposed a single decimal measurement. This was based on:

- **The length of one minutes of arc of great circle of the earth**
- **Meter Defined: Unit of Length**
- **Gram Defined : Unit of mass or weight**

- **Meter drives from Greek word METRON meaning Measure**
- **Gram drives from Latin word GRAMMA meaning Weight**

- **The meter defined as 1/10000000 of distance from north pole to the equator**

Measurement Systems

- Today
- Metric is defined as:

Wave length of light given off by Krypton 86 atom

- Gram is defined as:

mass of one cubic centimeter of pure water at the temperature of 4 degree

- **Roll: Architect call it scale, available in 3”,6”12”**
- **Tolerance of rolls are different and is based on graduation 1/8, 1/16, 1/32, 1/64**

micrometer

- A micrometer is a precision measuring tool used in science, engineering, machining and home improvement to measure the diameter, thickness or length of an object.

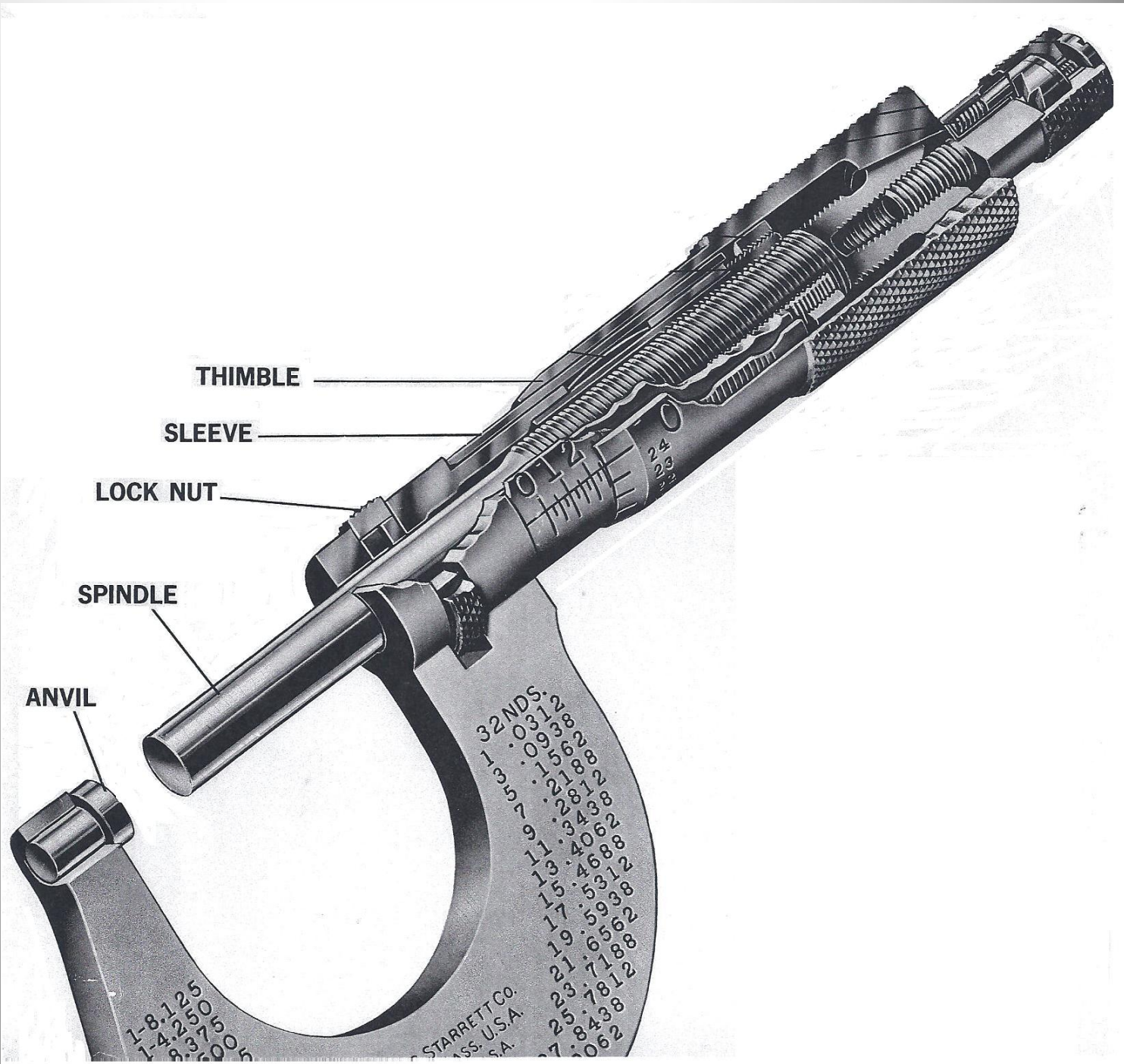
- The micrometer primarily consists of a rotating barrel, sleeve and spindle contained within a sturdy frame.

- The barrel rotates on a precision screw with known thread dimensions which accurately tracks the travel distance.

Micrometer

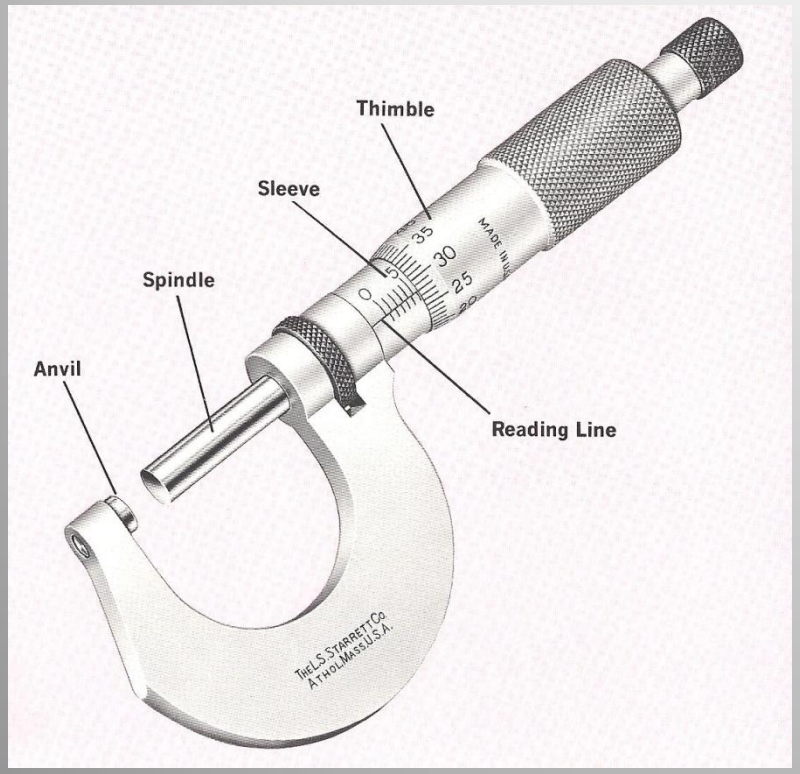

Thimble
Sleeve
Spindle
Anvil
Reading line
35
30
25
0
5
MADE IN U.S.A.
THE L.S. STARRETT CO
ATHOL, MASS. U.S.A.

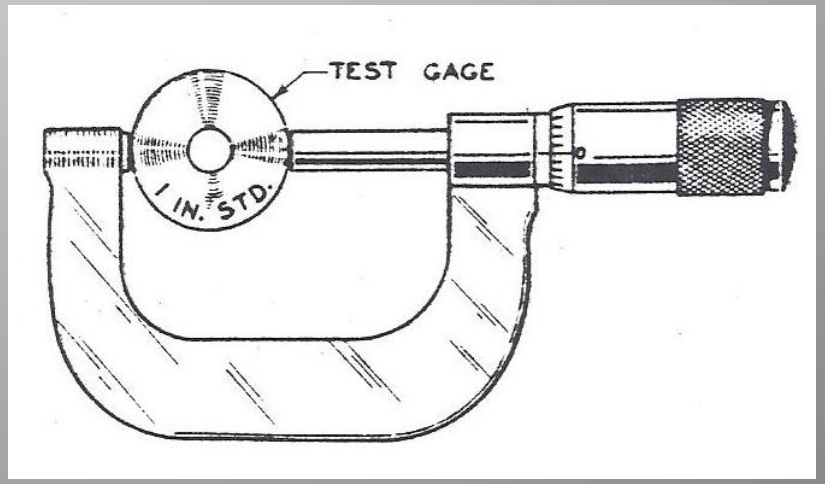
Pitch


THIMBLE
SLEEVE
LOCK NUT
SPINDLE
ANVIL
32NDS.
.0312
.0938
.1562
.2188
.2812
.3438
.4062
.4688
.5312
.5938
.6562
.7188
.7812
.8438
STARRETT CO.
ASS. U.S.A.

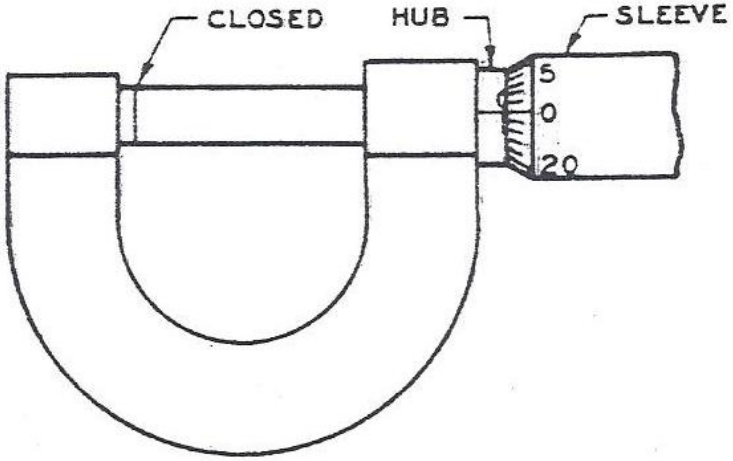
Outside micrometer:

typically used to measure wires, spheres, shafts and blocks.

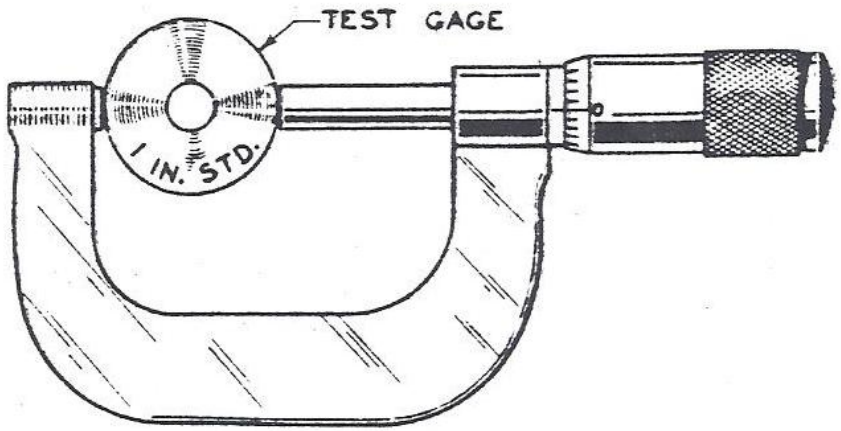




Calibration Test



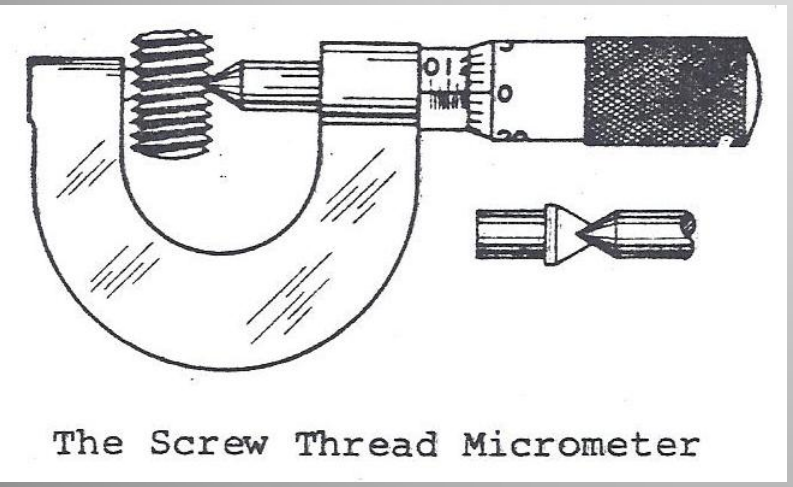
Testing Zero of 1" Micrometer



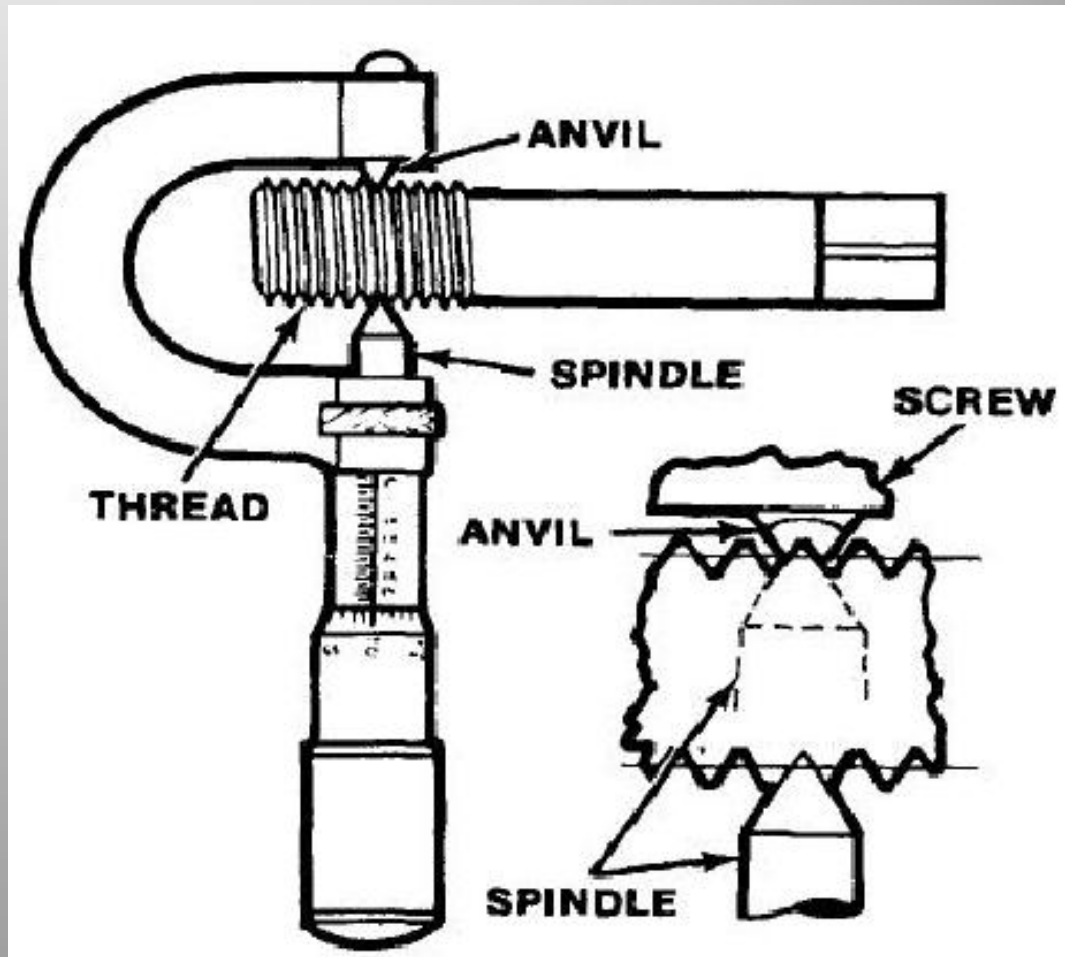
Testing Zero of 2" Micrometer

Thread Micrometer

This is a tool that is used to measure the pitch diameter of a screw. This tool looks like a standard micrometer except that the anvils are specially configured to reach into the screw thread groove...

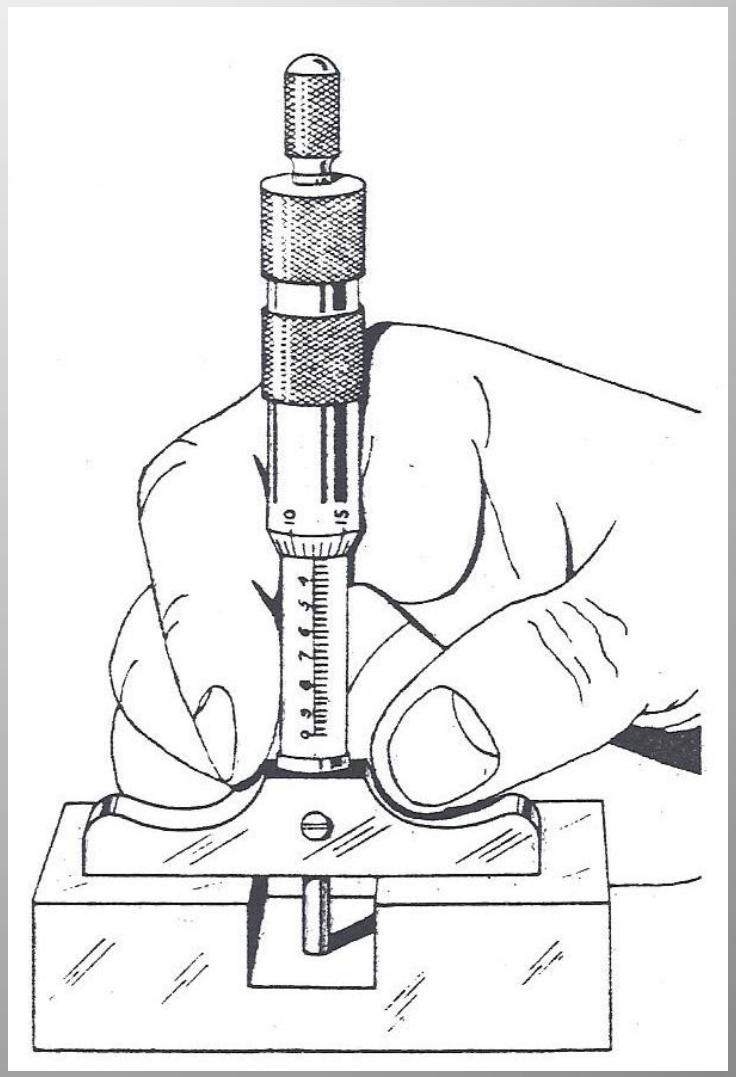


The Screw Thread Micrometer



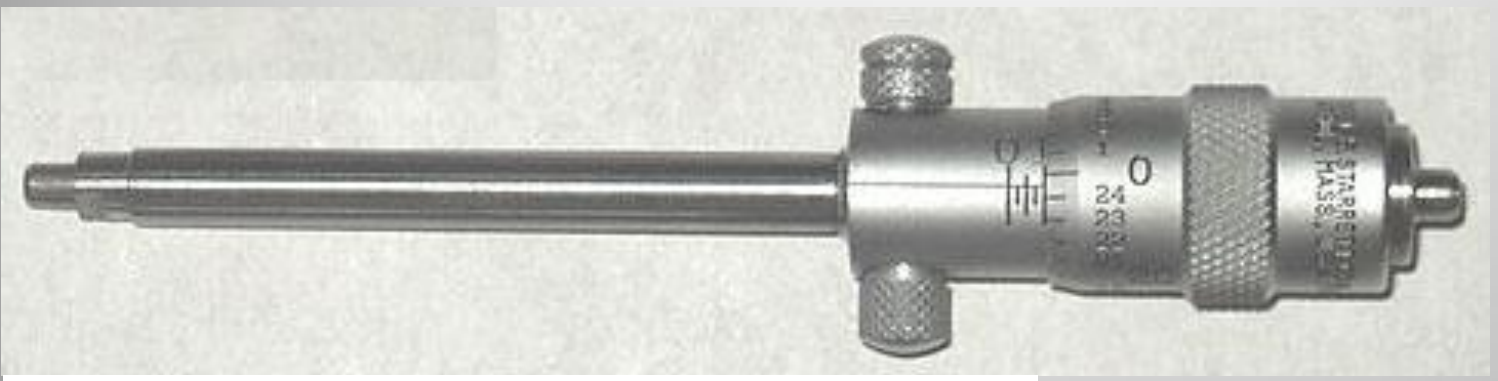
Depth micrometer:

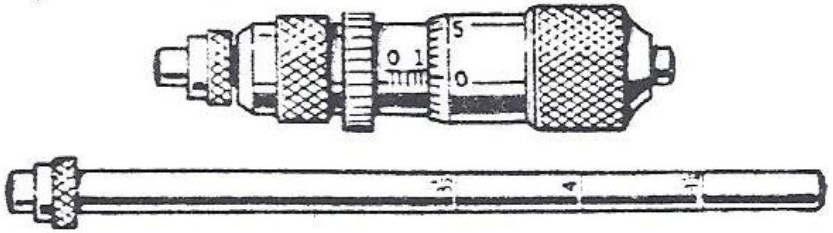
measures depths of slots and steps.



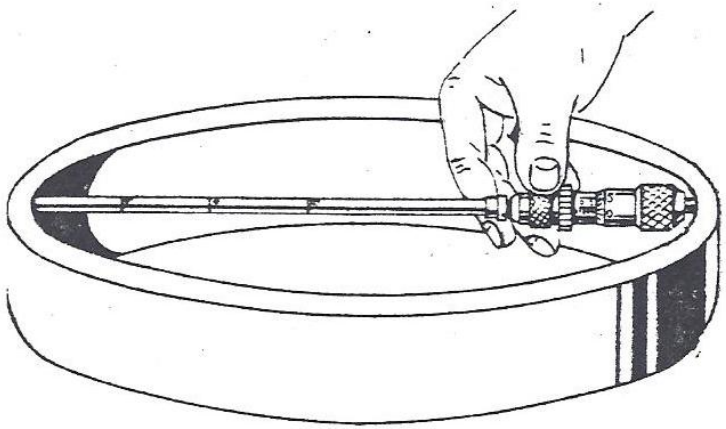
Inside micrometer:

used to measure the diameter of holes.



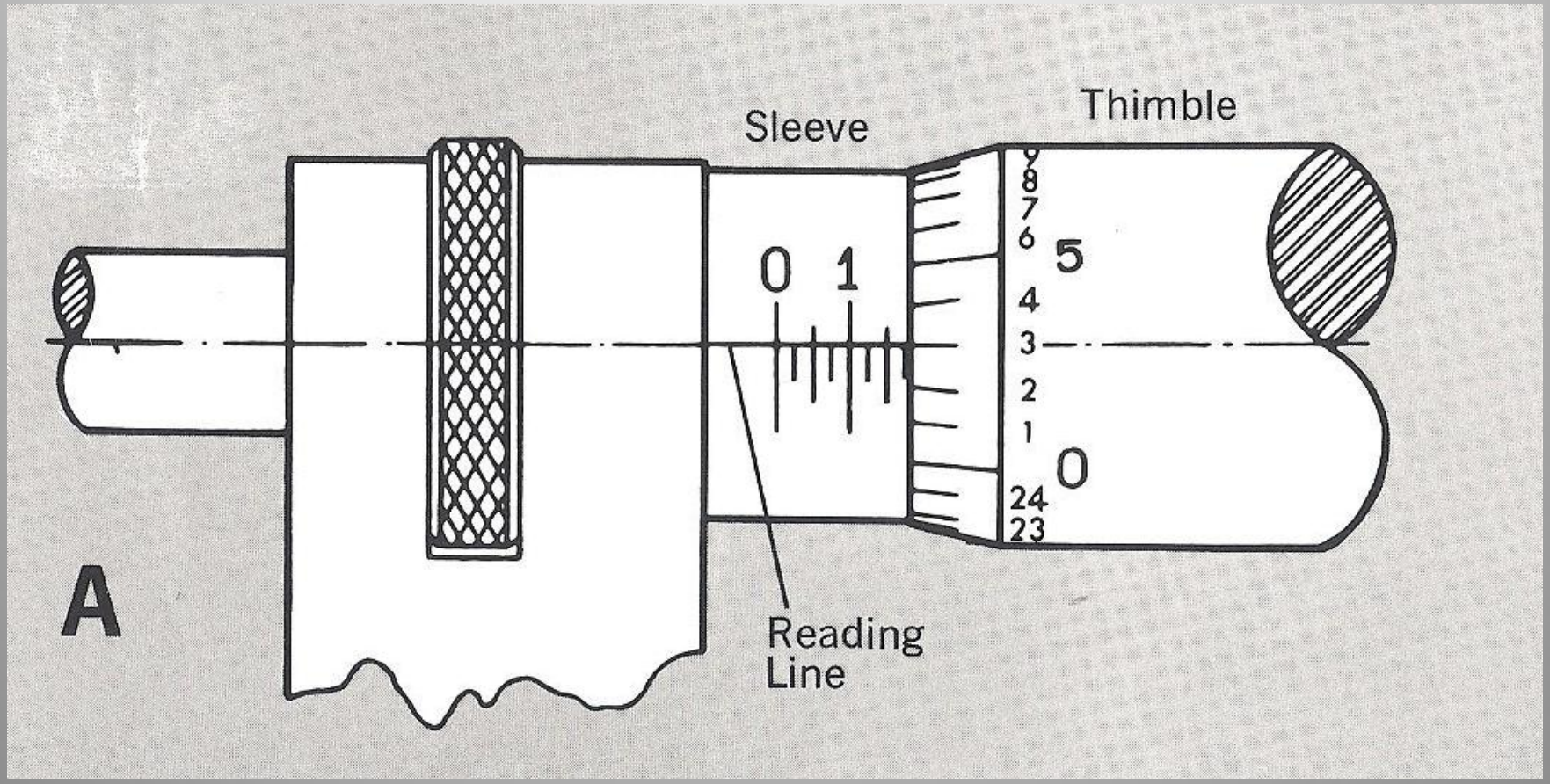


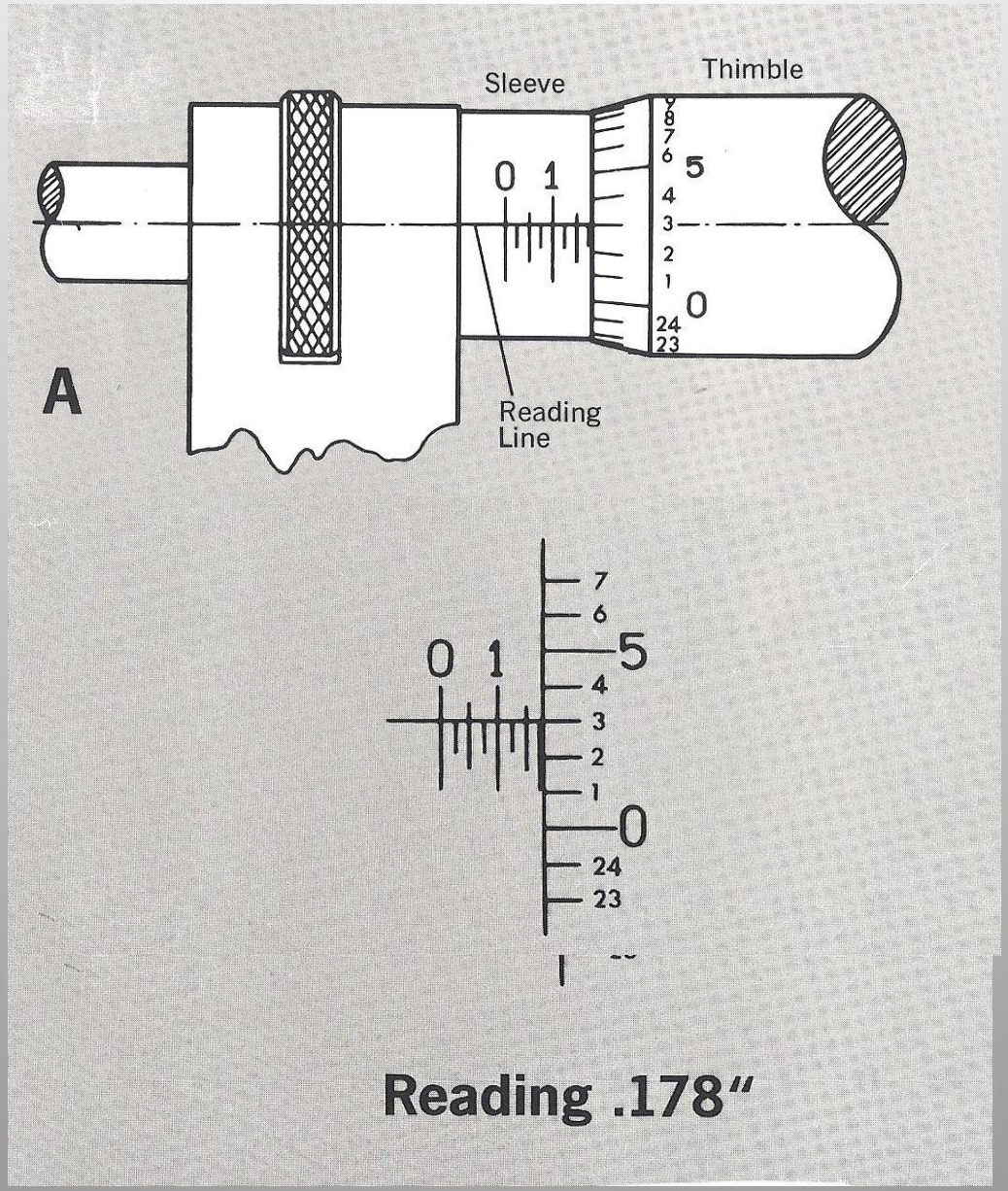
The Inside Micrometer



Measuring With the Inside Micrometer

Reading Micrometer




Sleeve
Thimble
0 1
5
0
24
23
A
Reading
Line
7
6
5
4
3
2
1
0
24
23
Reading .178"

Reading Micrometer

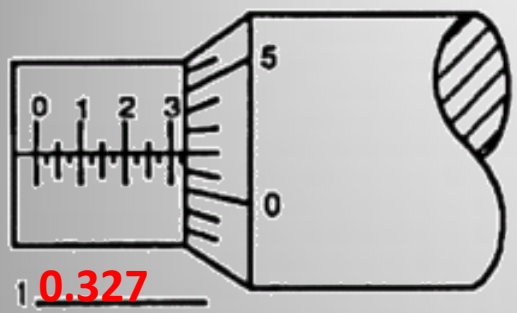
Example: Refer to drawing A

The 1 line on sleeve is visible, representing ..... **.100″**

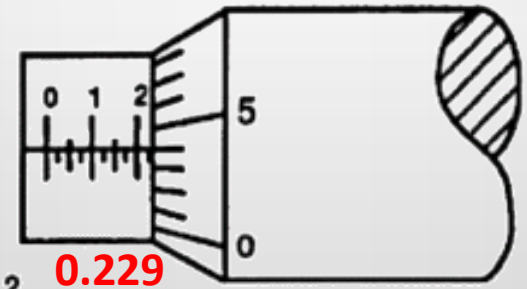
There are three additional lines visible,
each representing .025″ ..... $3 \times .025'' = .075''$

Line 3 on the thimble coincides with the reading line
on the sleeve, each line representing .001″ ..... $3 \times .001'' = .003''$

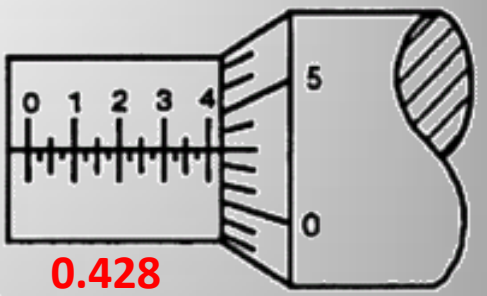
The micrometer reading is ..... **.178″**



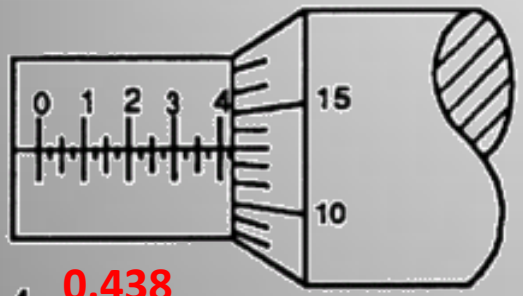
1 0.327



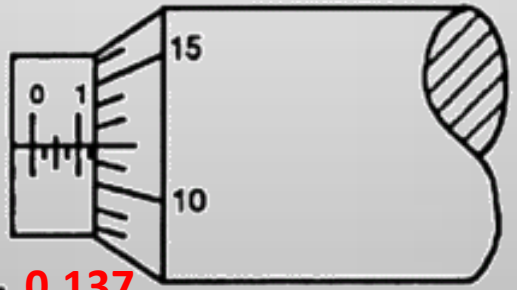
2 0.229



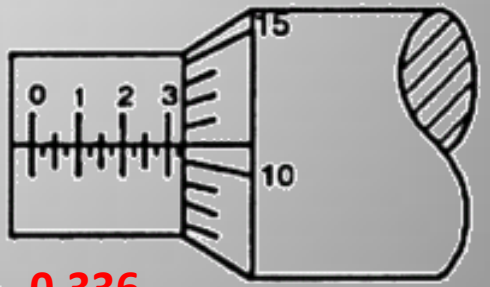
3 0.428



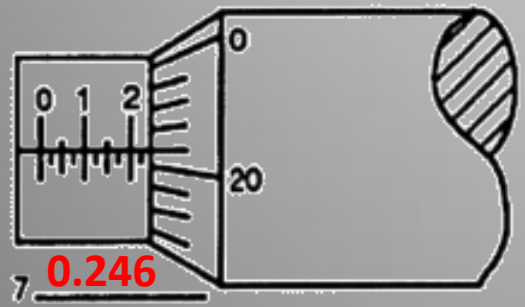
4 0.438



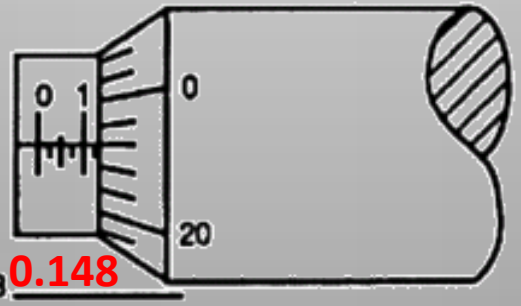
5 0.137



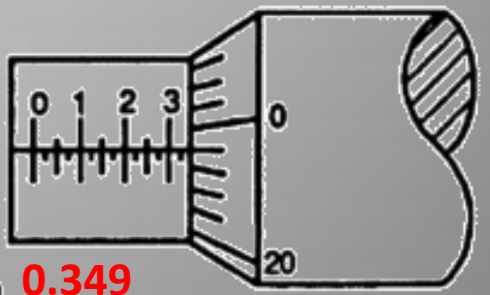
6 0.336



7 0.246



8 0.148

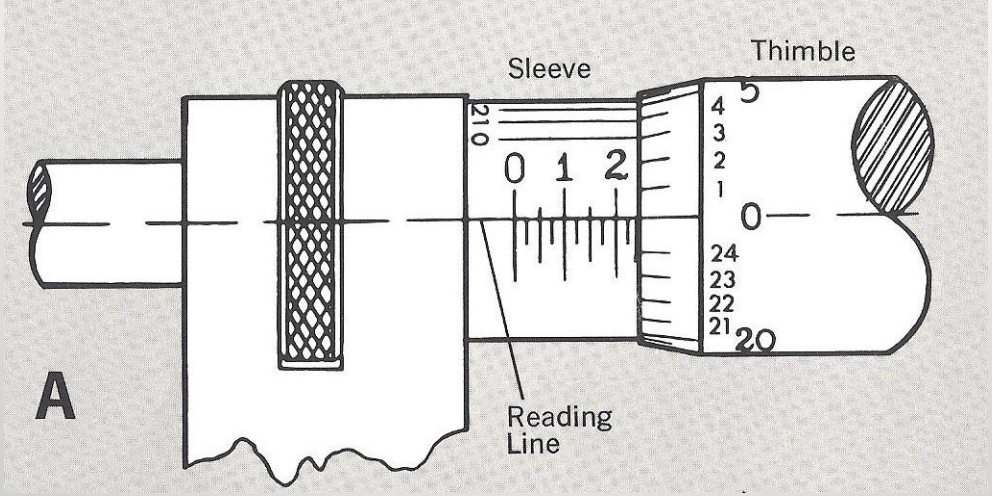


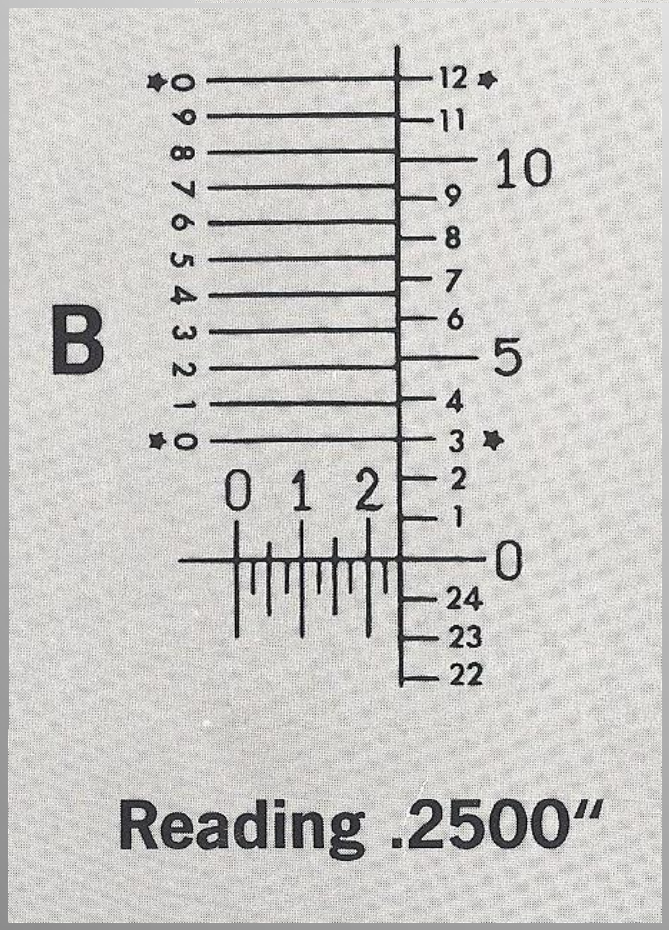
9 0.349

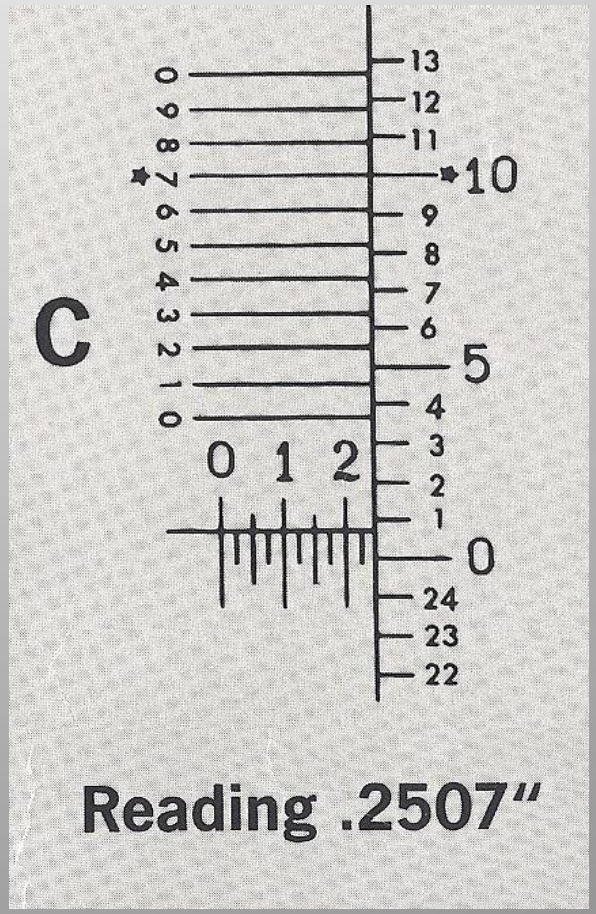
venire

- Some micrometers are provided with a venire scale on the sleeve in addition to the regular graduations.

- These permit measurements within 0.001 milli-metre to be made on metric micrometers, or 0.0001 inches on inch-system micrometers.


Sleeve
Thimble
A
Reading
Line


B
Reading .2500"

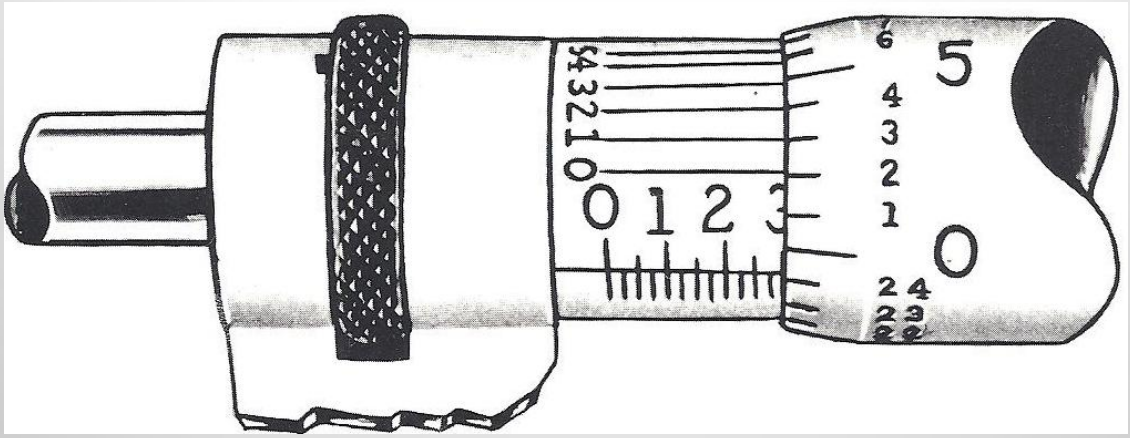

C
Reading .2507"

Example: Refer to drawings A and B (above)

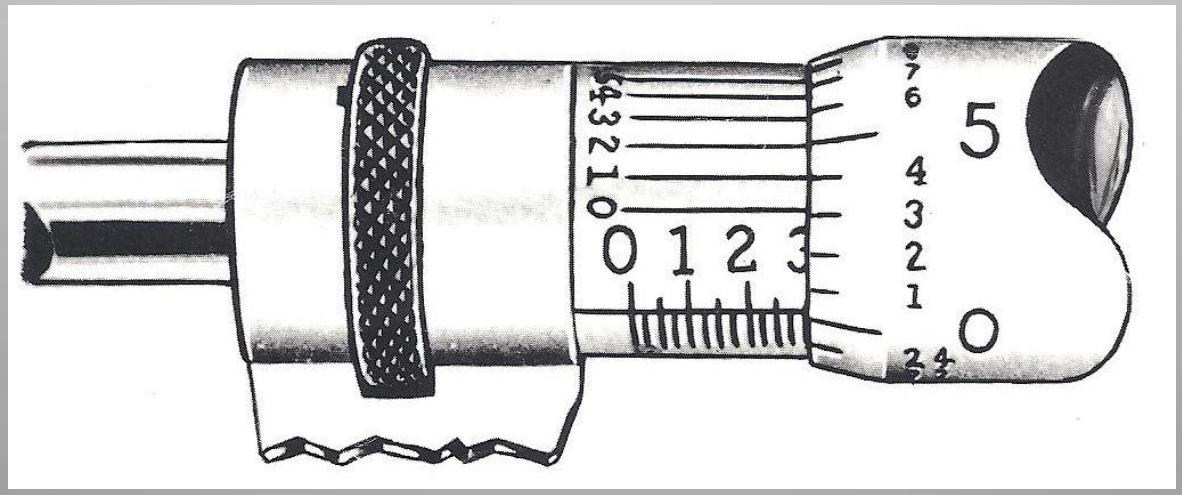
The 2 line on sleeve is visible, representing	**.200″**
There are two additional lines visible, each representing .025″	$2 \times .025'' = $ **.050″**
Line 0 on the thimble coincides with the reading line on the sleeve, representing	**.000″**
The 0 lines on the vernier coincide with lines on the thimble, representing	**.0000″**
The micrometer reading is	**.2500″**

Example: Refer to drawing C

The 2 line on sleeve is visible, representing	**.200″**
There are two additional lines visible, each representing .025″	$2 \times .025'' = $ **.050″**
The reading line on the sleeve lies between the 0 and 1 on the thimble indicating ten-thousandths of an inch are also to be added as read from the vernier	
The 7 line on the vernier coincides with a line on the thimble, representing	$7 \times .0001'' = $ **.0007″**
The micrometer reading is	**.2507″**



Reading .2991"



Reading .3001"

THE METRIC SYSTEM OF MEASUREMENT

The basic dimension of the metric system is the meter (1.0 m). It is 3.281 feet long or about 3 3/8 inches longer than the familiar yardstick. Its multiples and parts are expressed by adding prefixes representing steps of 1000. One thousand meters, for example, equals one kilometer (Km); one-thousandth of a meter equals one millimeter (mm). The machinist, toolmaker and inspector works with metric dimensions in millimeters and fractions of millimeters.

Examples:

one millimeter	1.0 mm = .03937 inch
one-half millimeter	0.5 mm = .01969 inch
two one-hundredths of a millimeter	0.02 mm = .00079 inch
one hundredth of a millimeter	0.01 mm = .00039 inch
two thousandths of a millimeter	0.002 mm = .00008 inch

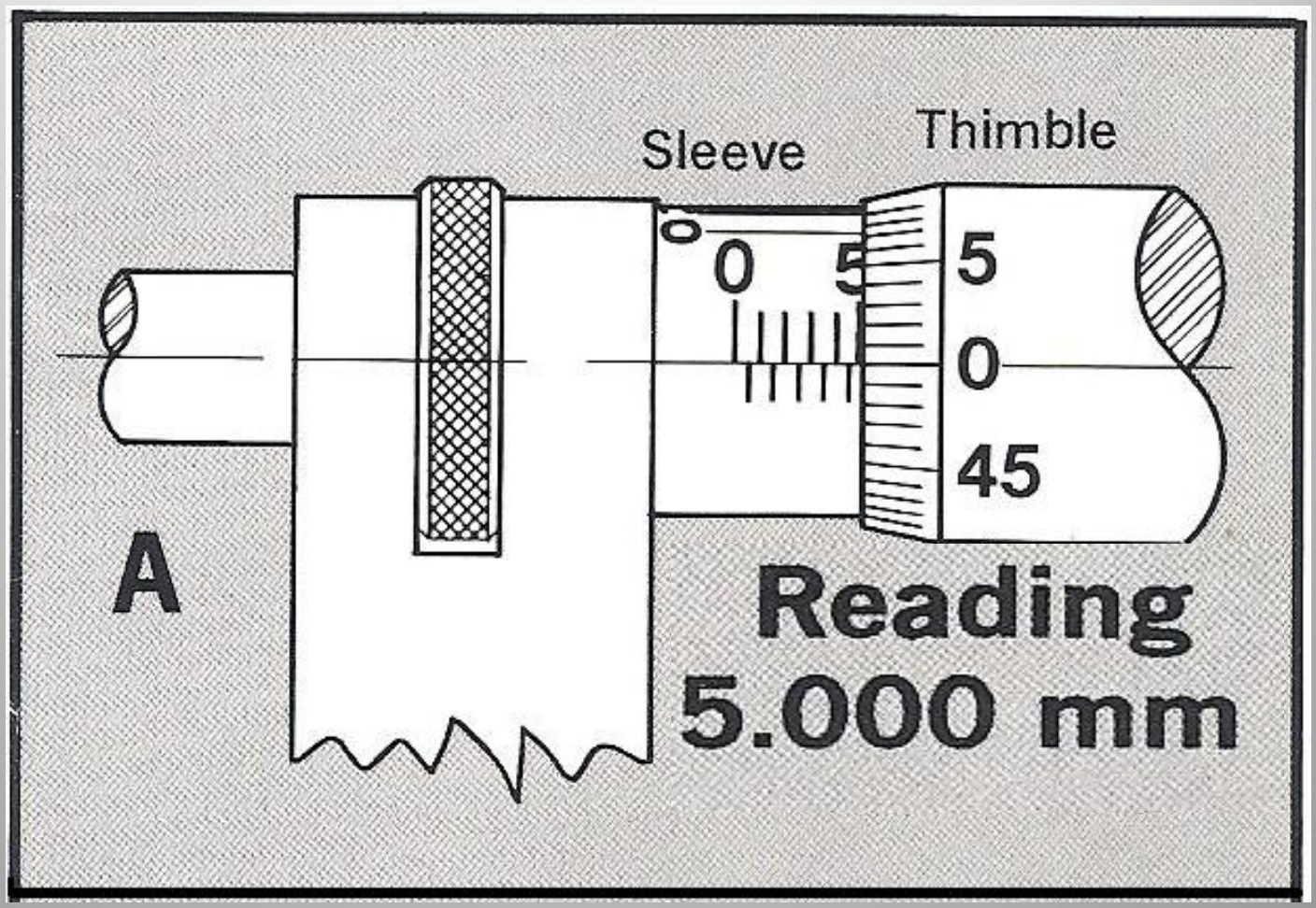
Comparison of English and Metric Micrometers

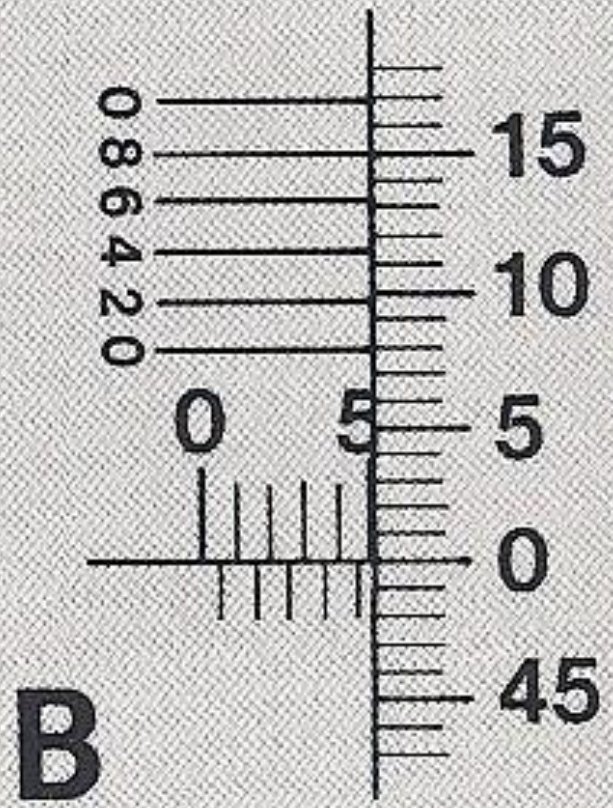
In the metric system, the familiar "one-inch mike" becomes a "25 millimeter mike". The tools look alike, handle alike and read the same way — the only difference being the graduations. Here's how they look, each set to half its range.

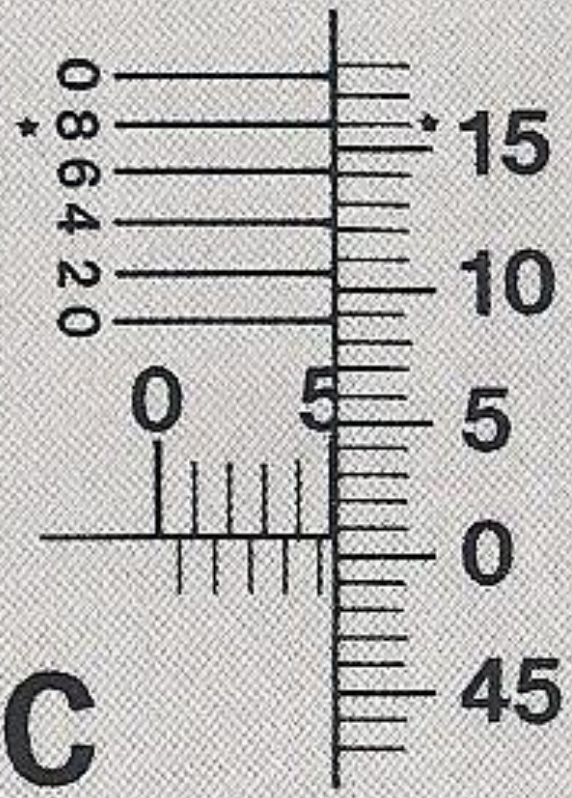
The English micrometer reads .500" (12.7 mm metric equivalent). Each sleeve graduation is .025"; and each thimble graduation is 1/25 of .025", or .001".

The metric micrometer reads 12.5 mm (.492" English equivalent). Each sleeve graduation is 0.5 mm; and each thimble graduation is 1/50 of 0.5 mm, or 0.01 mm.

Metric Micrometer







Reading
5.000 mm

Reading
5.008 mm

Answers for Micrometer Reading Exercise

Micrometer No.	Reading
1	0.327
2	0.229
3	0.428
4	0.438
5	0.137
6	0.336
7	0.246
8	0.148
9	0.349