ULTIMHEAT® UNIVERSITY

How to use micrometers
Comment utiliser un micromètre

Micrometer

Outside, inside, and depth micrometers

A **micrometer** is a device used widely in mechanical engineering And Machining for precisely measuring, along with other metrological Instruments such as dial calipers and

Types

Basic types

The image shows three common types of micrometers; the names are based on their application:

- **Outside micrometer** (aka micrometer caliper), typically used to measure wires, spheres, shafts and blocks.
- **Inside micrometer**, used to measure the diameter of holes.
- **Depth micrometer**, measures depths of slots and steps.
- **Bore micrometer**, typically a three-anvil head on a micrometer base used to accurately measure inside diameters.
- **Tube micrometer**, used to measure the thickness of tubes.

Specialized types

Each type of micrometer caliper can be fitted with specialized anvils and spindle tips for particular measuring tasks. For example, the anvil may be shaped in the form of a segment of screw thread; in the form of a v-block; in the form of a large disc; etc.

Universal micrometer sets come with interchangeable anvils: flat, spherical, spline, disk, blade, point, knife-edge, etc. The term **universal micrometer** may also refer to a type of micrometer whose frame has modular components, allowing one micrometer to function as outside mic, depth mic, step mic, etc (often known by the brand names Mul-T-Anvil and Uni-Mike).

Blade mics have a matching set of narrow tips (blades). They allow, for example, the measuring of a narrow o-ring groove.

Pitch-diameter mics have a matching set of thread-shaped tips for measuring the pitch diameter of screw threads.

Limit mics have two anvils and two spindles, and are used like a snap gauge. The part being checked must pass through the first gap and must stop at the second gap in order to be within specification.

Micrometer stops are essentially inside mics that are mounted on the table of a manual milling machine or other machine tool, in place of simple stops. They help the operator to position the table precisely.

Operating principles

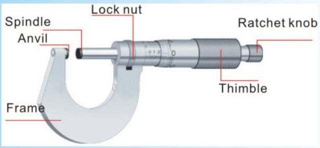
The accuracy of a micrometer derives from the accuracy of the threadform of the screw that is at its heart.

The basic operating principles of a micrometer are as follows:

1.The amount of rotation of an accurately made screw can be directly and precisely correlated to a certain amount of axial movement (and vice versa), through the constant known as the screw's *lead* (/li:d/). A screw's *lead* is the distance it moves forward axially with one complete turn (360°). (In most threads [that is, in all single-start threads], *lead* and *pitch* refer to essentially the same concept.)

2.With an appropriate lead and major diameter of the screw, a given amount of axial movement will be *amplified* in the resulting circumferential movement.

For example, if the lead of a screw is 1 mm, but the major diameter (here, outer diameter) is 10 mm, then the circumference of the screw is 10□, or about 31.4 mm. Therefore, an axial movement of 1 mm is amplified (magnified) to a circumferential movement of 31.4 mm. This amplification allows a small difference in the sizes of two similar measured objects to correlate to a larger difference in the position of a micrometer's thimble.



Parts

The parts of a micrometer caliper, labeled.
(Notice also that there is a handy decimal-fraction equivalents chart printed right on the frame of this inch-reading micrometer.)

A micrometer is composed of:

Frame

The C-shaped body that holds the anvil and barrel in constant relation to each other. It is thick because it needs to minimize flexion, expansion, and contraction, which would distort the measurement.

The frame is heavy and consequently has a high thermal mass, to prevent substantial heating up by the holding hand/fingers.

Explanation: if you hold the frame long enough so that it heats up by 10° C, then the increase in length of any 10 cm linear piece of steel is of magnitude 1/100 mm. For micrometers this is their typical accuracy range.

Micrometers typically have a temperature specified, at which the measurement is correct.

Anvil

The shiny part that the spindle moves toward, and that the sample rests against.

Sleeve / barrel / stock

The stationary round part with the linear scale on it. Sometimes vernier markings.

Lock nut / lock-ring / thimble lock

The knurled part (or lever) that one can tighten to hold the spindle stationary, such as when momentarily holding a measurement.

Screw

(not seen) The heart of the micrometer, as explained under "Operating principles". It is inside the barrel. (No wonder that the usual name for the device in German is *Messschraube*, literally "measuring screw".)

Spindle

The shiny cylindrical part that the thimble causes to move toward the anvil.

Thimble

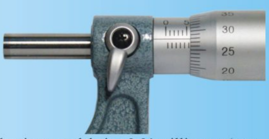
The part that one's thumb turns. Graduated markings.

Ratchet stop

(not shown in illustration) Device on end of handle that limits applied pressure by slipping at a calibrated torque.

Reading

Metric system



Micrometer thimble reading 5.78mm

The spindle of an ordinary metric micrometer has 2 threads per millimetre, and thus one complete revolution moves the spindle through a distance of 0.5 millimetre. The longitudinal line on the frame is graduated with 1 millimetre divisions and 0.5 millimetre subdivisions. The thimble has 50 graduations, each being 0.01 millimetre (one-hundredth of a millimetre). Thus, the reading is given by the number of millimetre divisions visible on the scale of the sleeve plus the particular division on the thimble which coincides with the axial line on the sleeve.

Suppose that the thimble were screwed out so that graduation 5, and one additional 0.5 subdivision were visible (as shown in the image), and that graduation 28 on the thimble coincided with the axial line on the sleeve. The reading then would be 5.00 + 0.5 + 0.28 = 5.78 mm.

Vernier

Micrometer sleeve (with vernier) reading 5.783mm

Some micrometers are provided with a vernier scale on the sleeve in addition to the regular graduations. These permit measurements within 0.001 millimetre to be made on metric micrometers, or 0.0001 inches on inch-system micrometers.

The additional digit of these micrometers is obtained by finding the line on the sleeve vernier scale which exactly coincides with one on the thimble. The number of this coinciding vernier line represents the additional digit.

Thus, the reading for metric micrometers of this type is the number of whole millimetres (if any) and the number of hundredths of a millimetre, as with an ordinary micrometer, and the number of thousandths of a millimetre given by the coinciding vernier line on the sleeve vernier scale.

For example, a measurement of 5.783 millimetres would be obtained by reading 5.5 millimetres on the sleeve, and then adding 0.28 millimetre as determined by the thimble. The vernier would then be used to read the 0.003 (as shown in the image).

Inch micrometers are read in a similar fashion.

Note: 0.01 millimetre = 0.000393 inch, and 0.002 millimetre = 0.000078 inch (78 millionths) or alternately, 0.0001 inch = 0.00254 millimetres. Therefore, metric micrometers provide smaller measuring increments than comparable inch unit micrometersthe smallest graduation of an ordinary inch reading micrometer is 0.001 inch; the vernier type has graduations down to 0.0001 inch (0.00254 mm). When using either a metric or inch micrometer, without a vernier, smaller readings than those graduated may of course be obtained by visual interpolation between graduations.

Torque repeatability via torque-limiting ratchets or sleeves

An additional feature of many micrometers is the inclusion of a torque-limiting device on the thimbleeither a spring-loaded ratchet or a friction sleeve. Normally, one could use the mechanical advantage of the screw to force the micrometer to squeeze the material or tighten the screw threads, giving an inaccurate measurement. However, by attaching a thimble that will ratchet or friction slip at a certain torque, the micrometer will not continue to advance once sufficient resistance is encountered. This results in greater accuracy and repeatability of measurementsmost especially for low-skilled or semi-skilled workers, who may not have developed the light, consistent touch of a skilled user.

Testing and calibration

The accuracy of micrometers is checked by using them to measure gauge blocks, rods, or similar standards whose lengths are precisely and accurately known. If the gauge block is known to be 0.7500" (± .00005"), then the micrometer should measure it as 0.7500". If the micrometer measures 0.7516", then it is out of calibration.

The accuracy of the gauge blocks themselves is traceable through a chain of comparisons back to a master standard, such as are maintained in measurement standards laboratories.