Choosing the Right Size Mic

The first step in using a micrometer is choosing the right size mic. Micrometers come in various sizes, but are only designed to measure within a range of about one inch. For example, the set shown in figure 1 includes three micrometers:

- Zero to 1 inch
- 1 to 2 inches
- 2 to 3 inches

The thing to remember is that the first digit in your measurement will always be the smaller of the two measurements in the range. That is, if you’re using a zero-to-one inch mic, the first digit will always be a zero: 0.xxx".

If you’re using a 1-to-2 inch mic, your first digit will always be a 1: 1.xxx".

How do you choose the right size mic? That’ll be painfully obvious the first time you try it: The right mic is the one that fits over the object you’re measuring, and adjusts tight enough to provide a measurement. If the thimble rotates past the sleeve measurements, and the part you’re measuring doesn’t fit snugly between the anvil and spindle, you’re using the wrong mic.

Reading the Scale Imperial (Inches)

Now we’re ready to look at the scale. This is the part of using a mic that’s fairly consistent, regardless of what type of mic you’re using.

Start by looking at the sleeve (figure 2). It has a number of different-size graduations. The largest graduations are numbered, from zero to 9. Those each indicate a tenth of an inch, or 0.1000".

Each of those graduations is divided into four equal parts. So those smaller graduations are each equal to 0.0250", because $4 \times 0.0250" = 0.1000"$.

Now look at the thimble (figure 3). Each full rotation of the thimble is equal to one of the small graduations.
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Reading a Micrometer

on the sleeve, or 0.0250”. The thimble is divided into different sized graduations, too. The longest graduations are numbered by fives; each of them is equal to 0.0050”.

Those graduations are divided again; how many times depends on the resolution of your micrometer. In this case, the larger graduations are each equal to 0.0010”; the smaller equal 0.0005”, or five ten-thousandths of an inch.

That’s pretty good, but it’s not the limit of our resolution. Take another look at the sleeve. See those extra divisions, running perpendicular to the first set we discussed (figure 4)? That’s called the vernier scale; each graduation on the vernier scale is equal to 0.0001”. So this micrometer can provide measurements that resolve down to one ten-thousandth of an inch! The trick to reading the micrometer is to add the readings on each scale, to provide a single, complete measurement of the object.

TIP: Not all micrometers have a vernier scale; in fact, not all mics have a scale that reads down below 0.001” (figure 5). In that case, all you can do is estimate the ten-thousandths measurement, based on the position of the thimble in relation to the spindle.

Measuring with a Mic Imperial (Inches)

Now let’s see how to read the micrometer scales to measure an object. For this measurement, I’ve chosen a small adjustable wrench. To make the measurement (figure 6):

- Zero the micrometer.
- Open the micrometer enough to allow the item to fit between the anvil and spindle.
- Close the micrometer against the area you want to measure, using the ratchet to adjust it against the object without overtightening it.
- Lock the micrometer spindle using the locknut.

If you’re unsure of any of these procedures, read the Accurate Measurements article in the last issue of GEARS.

Now we’re ready to read the measurement. To make it easier to read and explain, I’ve decided to cheat just a bit: I’m using a flattened drawing of the micrometer scale, adjusted exactly the way the micrometer displayed its measurement (figure 7). This just makes it easier for you to read the display all at once, without having to rotate the micrometer to see all the different scales. Think of it like...
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Reading a Micrometer

using a map of the world instead of a globe; everything’s right there in front of you, instead of rotating it to see what’s on the back.

Since the micrometer we used was a zero-to-1 inch mic, the first digit will be a zero:

0.xxx”

Next we look at the large, numbered graduations on the sleeve. The thimble is back far enough to reveal the third numbered graduation, so the measurement is at least three tenths of an inch. Here’s what we have so far:

0.3xxx”

A closer look at the sleeve reveals at least one smaller graduation is showing; maybe two. So which is it, one or two? It’s one; here’s how we know:

Look at the graduations on the thimble (figure 8). Notice we’re close to the 20; that is, we’re near the end of its scale. Remember, each rotation of the thimble is equal to one small graduation on the sleeve. So, since we’re near the end of the scale on the thimble, we’re just short of the second graduation on the sleeve. That’s why we can see a little of the next graduation, even though we haven’t reached the second graduation yet.

Okay, so we have one small graduation showing on the sleeve; that’s another 0.0250”:

0.3000”
+ 0.0250”

0.3250”

Next, look at the graduations on the thimble (figure 9). The zero indicator line on the sleeve is lined up just a bit shy of 21. 21 would be 0.0210”; since this is less, it’d be 0.0200”. But there’s another, short graduation, between the 20 and 21. That’s 0.0005”, so the thimble reads 0.0205”.

That’s how much we add to the formula:

0.3000”
0.0250”
+ 0.0205”

0.3455”

But wait; there’s more! Notice that the zero indicator is just a tiny bit past the 0.0005” mark. This is where the vernier scale comes in. Look at the vernier scale, and find the graduation that lines up with a graduation on the thimble (figure 10). In this case, it’s the 3. That’s another 0.0003” to add to the total. So our final measurement is:

0.3000”
0.0250”
0.0205”
+ 0.0003”

0.3458”

And that’s the final measurement in inches: 0.3458”.

Reading a Metric Mic

Some of you aren’t forced to fight with measuring length in inches, feet, yards and miles. Some of you get to work in simple decimal equivalents, known as the Metric
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system. For you, there are specially designed micrometers, calibrated in millimeters.

One of the first things you might notice about this Metric micrometer is that it doesn’t have a vernier scale (figure 11). It only measures down to hundredths of a millimeter. Why aren’t Metric micrometers calibrated to resolve as well as an Imperial micrometer?

Actually, there isn’t much difference between the two. Remember, millimeters are a lot smaller than inches: It takes 25.4 of them to equal just one inch. A hundredth of a millimeter equals just under 0.0004”. So the Metric micrometer provides almost the same resolution as the Imperial one, even without a vernier scale. And you can still approximate more precisely, simply by paying attention to how close the graduations are to the zero line.

NOTE: While there may be some Metric mics with a vernier scale, I couldn’t find one. I presume it’s because of the inherent resolution in the Metric mics, eliminating the need for it. If anyone has a Metric mic with a vernier scale, I’d be happy to use it to add a section to the upcoming booklet for the ATRA web site.

The next thing to notice is the scale on the sleeve (figure 12). There are two sets of graduations: one above the zero line and a second below it. The set above the line is the measurement in millimeters: Each graduation equals one millimeter. The set below the line is calibrated in half-millimeters, or 0.5 mm.

And the scale on the thimble is divided into 50 graduations. Each rotation moves the thimble a half millimeter, so each graduation on the thimble equals 0.01 mm.

Let’s use the Metric micrometer to measure the same wrench, and see how close the two measurements are. We’ll use the same technique to measure the wrench as before, and then read the scale.

The sleeve shows 8 graduations above the zero line, so it’s more than 8 mm, but less than 9 mm (figure 13). And there’s one additional graduation showing below the line, so that’s another half millimeter. So far, the wrench is at least 8.5 mm.

Now look at the thimble. The zero lines up almost exactly with the 28th graduation (figure 14); that’s 0.28 mm. So we add the two measurements:

\[
\begin{align*}
8.50 \text{ mm} \\
+ 0.28 \text{ mm} \\
8.78 \text{ mm}
\end{align*}
\]

So the wrench is 8.78 mm thick, according to the Metric micrometer. How does that compare with the measurement in inches? \(8.78 / 25.4 = 0.3457\)” — just 0.0001” difference in the measurements… and that difference could have been cause by position of the mic, pressure, temperature… any number of things that are beyond our control.

That’s all there is to using a micrometer. There are no real tricks… nothing special to memorize. It’s mostly about taking the time to measure carefully, and to add the measurements together.

Or you can get a digital, and leave the math to someone else!
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