Reading a Vernier Caliper

A *vernier caliper* is used to precisely measure dimensions to within *thousandths* of a centimeter. We will use the vernier caliper frequently throughout the year, so it is important that you learn to read the scale properly; a small error in measurement may greatly affect subsequent calculations.

Figure 1 below is a sketch of a typical vernier caliper, similar to the type you will use in this course. You will use the larger "jaws" **(A)** most frequently to measure outer dimensions, such as the width of a block or circular rod (*Figure 1a*). You can also use section **(B)** to measure inner dimensions, such as the diameter of a hole (*Figure 1b*), or section **(C)** to measure the depth of a hole (*Figure 1c*). The vernier scale is read the same in each case, no matter which portion of the caliper is used take your measurement: therefore, parts **A**, **B** and **C** give you the same length.
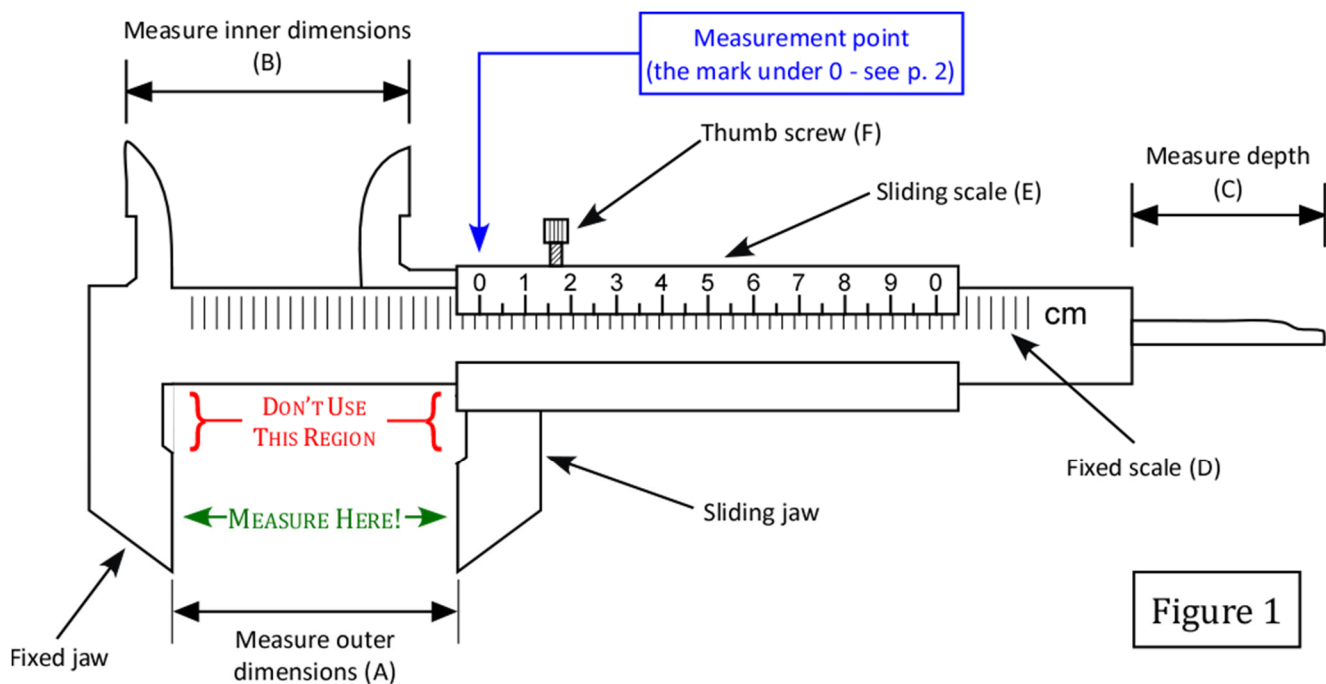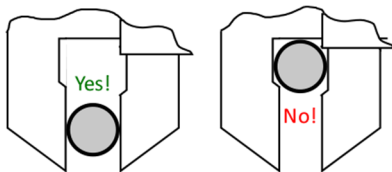

Figure 1

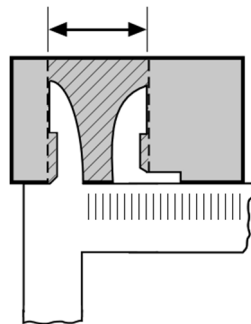**Figure 1a**
Correctly measure outer dimension of a rod

Figure 1b
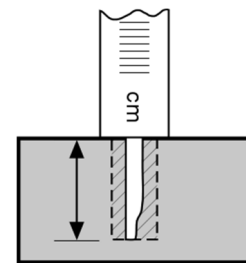Measurement of diameter inside a hole

Figure 1c
Measurement of hole depth

Most vernier calipers have both metric and English scales; <u>make sure that you read the correct scale</u>. The fixed portion of the scale **(D)** is marked in increments of 0.1 *cm*; the sliding scale **(E)** has numbers marking 0.01 *cm* increments, and small lines marked in 0.002 *cm* increments. A detailed view of the scale appears on the next page.

Measurements are taken as follows:

1. Loosen the thumb screw clamp **(F)**, if necessary, and close the sliding jaw so that it fits snugly on the object to be measured. If the object is circular or spherical, make sure you're measuring at the widest point. When measuring outer dimensions, be sure to use the flat section of the caliper jaws; don't use the region marked in *Figure 1*. See *Figure 1a* for the proper placement of a small circular object

2. Gently tighten the thumb screw clamp, and remove the caliper from the object; the screw will allow you to move the caliper *without* changing the position of the sliding jaw. *Hint*: You can make a first approximation of the measurement – within 0.1 *cm* – by laying the caliper on top of a ruler or meterstick and measuring the distance between the jaws.

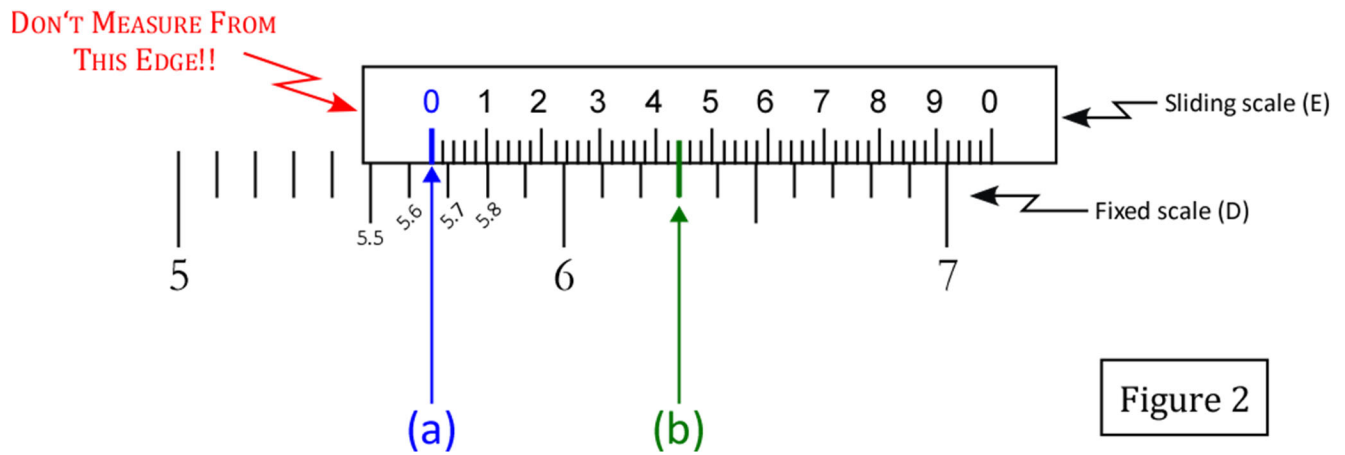3. Now look at the scale on the sliding jaw, as shown in the magnified image of this region below:

Figure 2

The measurement up to the first digit after the decimal point is obtained by looking at the line below the *first* zero (drawn thicker in *Figure 2* above for emphasis) that appears on the sliding scale **(E)**, as indicated by point **(a)** above. In this example you will note that this line falls between the 5.6 and 5.7 *cm* line on the fixed scale **(D)**, so we know our measurement falls within this range. Therefore, we'll start our measurement with **5.6**.

> *Note*: A common mistake is to begin reading from the edge of the sliding scale; make sure your measurements are taken from point **(a)**, the line directly below the first zero on the sliding scale, or your reading will be short by two-tenths of a centimeter!

4. The next two digits are read by *carefully* finding the line on the sliding scale **(E)** that is <u>straight across</u> from a line on the fixed scale **(D)**. Several may look as though they line up, but only one will match best; this line is again drawn thicker in *Figure 2* for emphasis. *Hint*: Hold the caliper at a slight angle away from you, and close one eye!

In the example above, we see that the second small line to the right of 4 on the sliding scale is straight across from a line on the fixed scale, at point **(b)**. The last two digits of your measurement come from the sliding scale, *not* the fixed scale! Since the lines on the sliding scale are 0.002 *cm* apart, the line at point **(b)** represents 0.044 *cm*. Now adding the total measurements together, you get 5.6 + 0.044 = **5.644 *cm*** as the final reading.

> *IT IS IMPORTANT TO REMEMBER THAT THE LAST DIGIT OF YOUR MEASUREMENT WILL ALWAYS BE AN EVEN NUMBER WITH THE VERNIER CALIPERS USED IN THIS COURSE!*

Practice using the vernier caliper by measuring the width of your calculator, or the thickness of the lab bench. Check your measurements with your lab partner; if there is disagreement, read the vernier scale again. Be sure to ask your instructor if you are still unsure of the correct procedure!