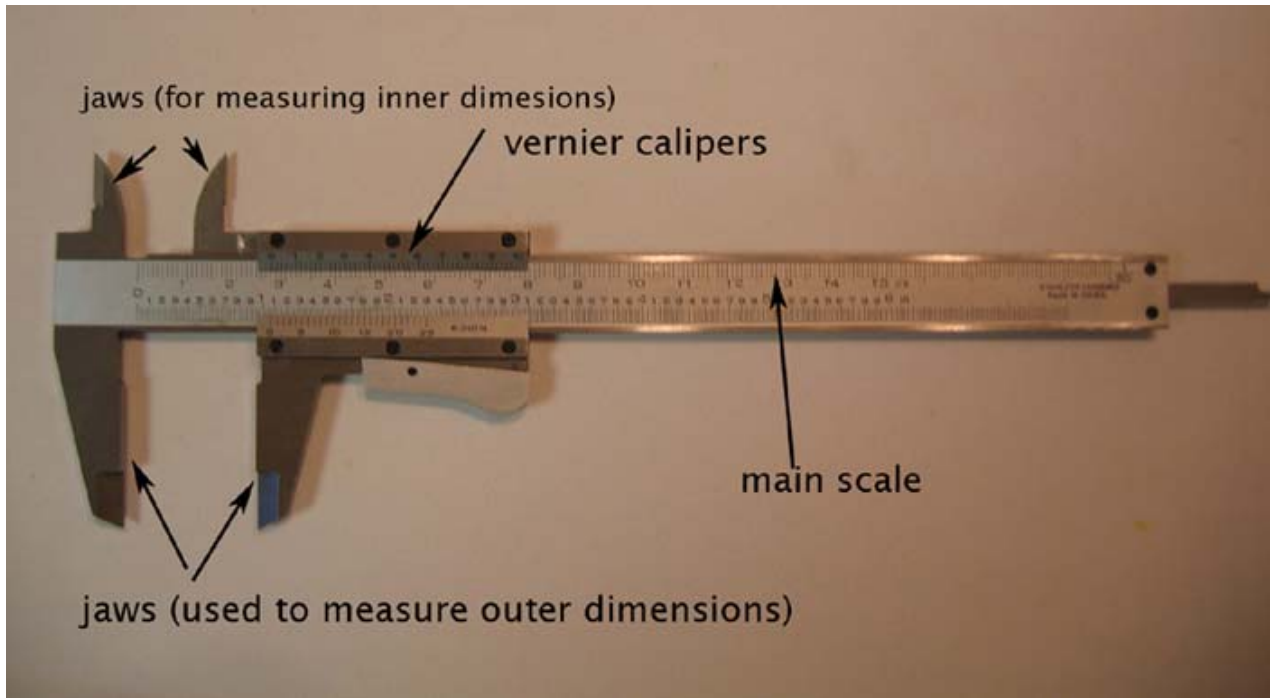*Using the Vernier Calipers*

The Vernier caliper is an instrument that allows you measure lengths much more accurate than the metric ruler. The smallest increment in the vernier caliper you will be using is $(1/50)$mm $= 0.02$mm $= 0.002$cm. Thus, the uncertainty is $\Delta x = (1/2)0.002$ cm $= 0.001$ cm.

The vernier scale consists of a fixed metric scale and a sliding vernier scale. The fixed scale is divided into centimeters and millimeters, while the vernier scale is divided so that 50 divisions on it cover the same interval as 49 divisions on the main scale. Thus, the length of each scale vernier division is 49/50 the length of a main scale division. Close the jaws completely and note that the first line at the far left on the vernier scale (called the "zero" or "index" line) coincides with the zero line on the main scale. Carefully compare and see that the first vernier division is 0.02 mm short of the first main scale division, the second vernier division is 0.04 mm away from the second main scale division, and so on. If the jaws are slightly opened it is easy to tell what fraction of the main scale division the vernier index has moved by noting which vernier division best coincides with a main scale division.

A measurement is made with a vernier caliper by closing the jaws on the object to be measured and then reading the position where the zero line on the vernier falls on the main scale. The measurement is incomplete until an additional fraction of a main scale division is determined. This is obtained by noting which line on the vernier scale (0,2,4,6,8) coincides best with a line on the main scale.

As an example, let's consider measuring the length of the aluminum block below.
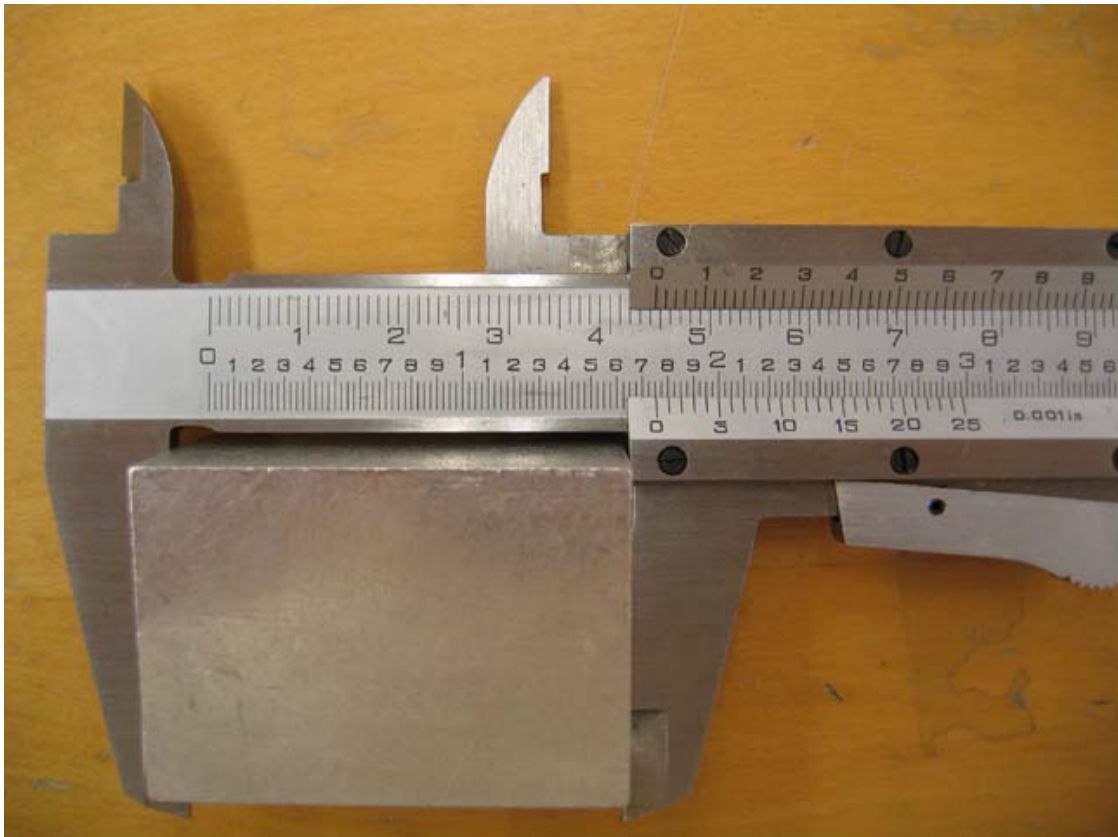
Note that the zero line on the vernier scale falls between the 4.4 cm and 4.5 cm mark on the main scale. Thus, the first significant digits are 4.4 cm. The remaining two digits are obtained by noting which line on the vernier scale (0,2,4,6,8) coincides best with a line on the main scale. Looking closely at the picture below indicates that the 46 line lines up the closest. Therefore, the reading is 4.446 cm. Or in standard form 4.446 cm ± 0.001 cm.