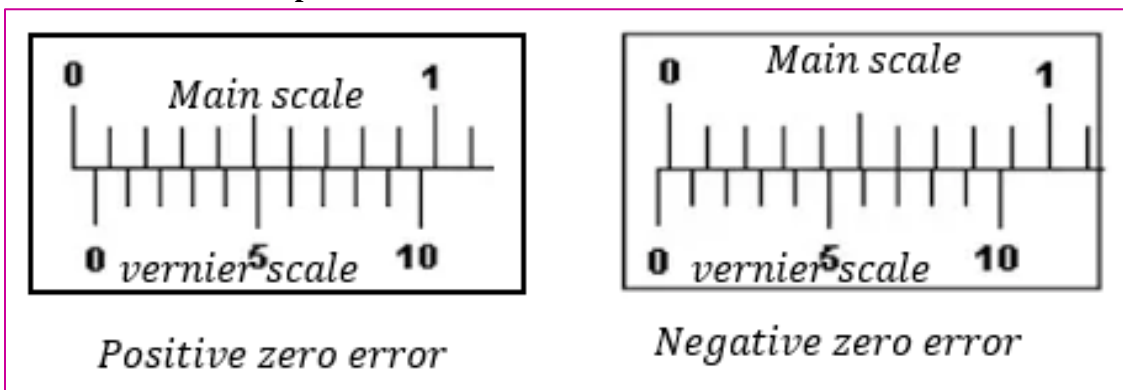


Vernier constant (VC): The vernier constant of a vernier calliper is the difference in length between a main scale division and a vernier scale division in the calliper.

In a vernier calliper, least count is equal to the vernier constant.

Zero error in vernier calliper:



When two jaws of vernier callipers are brought in contact, the zero of vernier scale may or may not coincide with the zero of main scale. If the zero of main vernier scale exactly coincides with zero of vernier scale, then the calliper is said to have no zero error. But if the zeros do not coincide, then the calliper is said to have zero error.

Depending upon the position of zeros in scale, there are two types of zero error:

1. Positive zero error: If the zero of vernier scale lies right to the zero of main scale, then the zero error is said to be positive.
2. Negative zero error: If the zero of vernier scale lies left to the zero of main scale, then the zero error is said to be negative.

Working formula to determine volume and density:

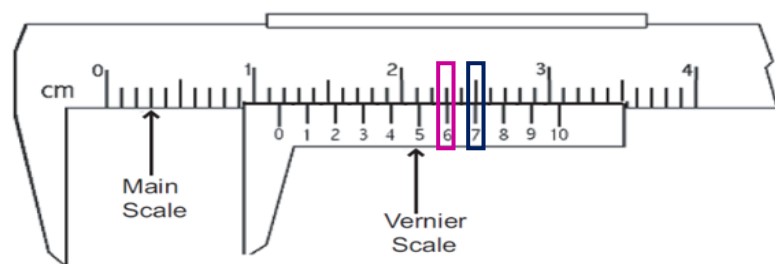
- If, l = length of given hollow tube [measured using the calliper]
 d_e = external diameter of the tube [measured using the calliper]
 d_i = internal diameter of the tube [measured using the calliper]
 m = mass of given test plate [measured from digital balance (weighing balance)]

Then, Volume of hollow tube = external volume – internal volume

$$\begin{aligned}
 &= \frac{\pi d_e^2}{4} l - \frac{\pi d_i^2}{4} l \\
 &= \frac{\pi}{4} (d_e^2 - d_i^2) l \\
 &= \frac{\pi}{4} (d_e + d_i)(d_e - d_i) l
 \end{aligned}$$

and $Density = \frac{mass}{Volume}$

[We expect the density of the given aluminum hollow tube to be **2.7 gram cm⁻³**.]



Main scale reading = 1.1 cm
 Vernier scale division = 6
 Vernier scale reading = 6 × 0.01cm
 Total reading = 1.16 cm