

ENGINEERING GATORTRAX MATH EXCELLENCE PROJECT
ENGINEER-FOR-A-DAY LABORATORY MODULES

MECHANICAL ENGINEERING
INTRODUCTORY LEVEL - INSTRUCTION

VOLUMETRIC MEASUREMENTS

INTRODUCTION

Today we are practicing mechanical engineers. As such, we will examine how some of our basic mathematical concepts are used by mechanical engineers. One such mathematical concept is that of volume.

VOLUME

What is volume? It is the measure of the 3-dimensional space occupied by a solid object, or the amount of 3-dimension space which can be occupied by a body. We can best understand this by looking at some examples. We will learn how to calculate volumes of shapes such as boxes, cylinders, cones and spheres. Also, we will look at common applications of volumetric measurements by engineers.

Example 1.

If we have a solid cube (sides of equal length) which has sides of length 'a' centimeters, width 'a' centimeters, and height 'a' centimeters, then the volume of the cube is given by:

$$\text{Volume, } V = \text{length} \times \text{width} \times \text{height} = a \times a \times a = a^3 \text{ cubic centimeters}$$

This is the amount of **space** occupied by the solid cube. The units are **cubic** units

Thus we see that three measurements, or dimensions are required to determine the volume of an object, or the available space in a container.

Example 2.

If we have a hollow cube which has inside measurements on each side of length 'a' centimeters, then the volume of the space within the cube (box) is given by:

$$\text{Volume, } V = a \times a \times a = a^3 \text{ cubic centimeters}$$

This is the amount of **space inside** the box which can be occupied by substances which can be placed inside the box (cube).

Now suppose that we did not have a cube but a rectangular box, how do we determine the volume of the space inside the box?

Example 3.

Consider a rectangular box which has the following dimensions: length 'a' centimeters, width 'b' centimeters, height 'c' centimeters, then the volume of the box is given by

$$\text{Volume, } V = \text{length} \times \text{width} \times \text{height} = a \times b \times c = abc \text{ cubic centimeters}$$

Again, you will notice that all three dimensions are required to calculate the volume of the box.

Now, let us assume that we had a piece of pipe of length 'L' and inside diameter D, how do we calculate the volume of our piece of pipe?