

Using a Hydrometer to Measure Liquid Densities

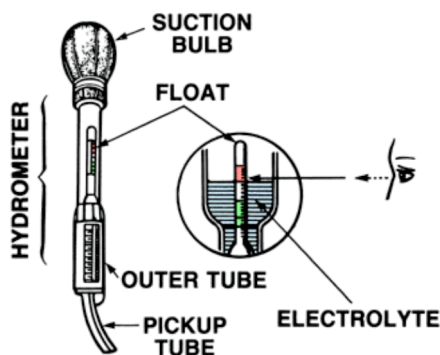
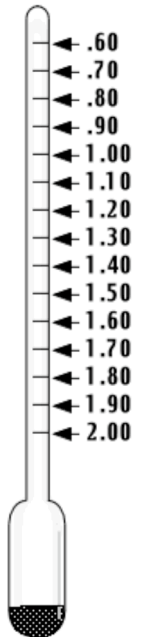
Density as you know is the amount of mass in a given volume and it can be calculated by using the formula, $\text{Density} = \text{mass} \div \text{volume}$. Water as we've learned previously, has a density of 1.00 g/cm^3 .

In many situations however, a measurement known as Specific Gravity is used. Specific gravity is the ratio of a substance's density to that of water. For most instances this specific gravity measurement is almost identical to the density.

The main advantage to using the hydrometer is it involves just one measurement. The hydrometer is placed in a container of the liquid. The floating hydrometer has a numerical scale on it as shown at right. As you can see the scale increases in value from top to bottom. This might seem strange but if a hydrometer is placed in a low density liquid, it would sink further, leaving less of the hydrometer above the surface. Where the surface of the liquid lines up on the scale, is the liquid's specific gravity.

Another advantage is that using the hydrometer is usually quicker than finding the mass, volume and then calculating the density. Auto mechanics especially find this helpful when checking the specific gravity of the acid in car batteries or the coolant in a radiator. This measurement allows them to determine the concentration of acid in the battery or antifreeze in a radiator.

Other uses for hydrometers are to measure sugar concentrations in various solutions such as juices or wines.



A disadvantage to using the hydrometer is you need to have enough liquid for the hydrometer to float freely. One way to get around this obstacle is to use a small hydrometer inside of a larger tube or container with a suction bulb at the top, somewhat like a baster used in cooking meat (see diagram at left). The bulb is squeezed and the tip placed in the liquid to be measured. Releasing the bulb draws liquid up into the tube and the small hydrometer (or floating pointer) then floats inside of the larger tube.

Questions:

1. You place a hydrometer in fresh water and then into salt water. What would be different about the way the hydrometer floats in each of the two liquids?
2. Suppose a hydrometer is placed in a liquid and the level of the liquid lines up with the 1.40 mark on the scale. However you also notice that the hydrometer is resting on the bottom of the container. What can be determined about the density of the liquid based on this information alone? Explain your answer.
3. Water has a density of 1.00 g/cm^3 while rubbing alcohol has a density of 0.79 g/cm^3 . When a hydrometer is placed in a mixture of the two liquids, it then reads 0.84 g/cm^3 on the scale. Based on what you already know, which liquid is present in a greater amount, water or the rubbing alcohol? Explain your answer.