

Body density measurement with only a gallon jug (and a couple thousand tons of water)

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1 Formulae

You can measure your body fat percentage (%BF) with a gallon jug, a swimming pool, and the following formulae:

$$\%BF = \frac{495}{\rho} - 450 \quad (1)$$

$$\rho = \frac{m}{\frac{m}{0.997 \text{ kg/liter}} - 0.1 \text{ liters} - v_{\text{buoy}} - RV} \quad (2)$$

$$v_{\text{buoy}} = 1 \text{ gallon} - v_{\text{water}} \quad (3)$$

$$RV \approx VC/3 \quad (4)$$

m is your weight, v_{buoy} is the volume of air in the jug, and RV is the residual volume of air in your lungs after complete exhalation.

2 Procedure

First, estimate RV . Exhale completely through a straw or tube into a gallon jug (or two) filled with water and inverted with the mouth under the water. The volume of air that you exhaled is your vital lung capacity (VC). Divide by 3 to estimate RV . The average person has an RV of about 1.2 liters. Although your RV can change over time, it changes slowly and you don't need to measure it frequently.

Exhale as completely as possible and submerge yourself and the gallon jug. If you float to the surface, add more water to the jug. If you sink to the bottom, remove some water. Repeat until you find the point of neutral buoyancy, where you neither sink nor float.

Record your weight and the amount of water in the jug (v_{water}), then convert weights to kilograms, volumes to liters, and use the formulae to calculate ρ (your body density, in kg/liter) and %BF.

More accurate formulae, the physics behind them, and a spreadsheet are available at <http://hans.fugal.net/density>.