

Below you will find the formula used to calculate body fat %. This formula is also used by the US NAVY.

Body Fat Formula For Women

Factor 1	(Total body weight x 0.732) + 8.987
Factor 2	Wrist measurement / 3.140
Factor 3	Waist measurement x 0.157
Factor 4	Hip measurement x 0.249
Factor 5	Forearm measurement x 0.434
Lean Body Mass	Factor 1 + Factor 2 - Factor 3 - Factor 4 + Factor 5
Body Fat Weight	Total bodyweight - Lean Body Mass
Body Fat Percentage	(Body Fat Weight x 100) / total bodyweight

Body Fat Formula For Men

Factor 1	(Total body weight x 1.082) + 94.42
Factor 2	Waist measurement x 4.15
Lean Body Mass	Factor 1 - Factor 2
Body Fat Weight	Total bodyweight - Lean Body Mass
Body Fat Percentage	(Body Fat Weight x 100) / total bodyweight

THE DEP. OF DEFENCE

The Department of Defense formula to compute body-fat percentage is somewhat complicated.

MALES

$$\% \text{ body fat} = 86.010 \times \log_{10}(\text{abdomen} - \text{neck}) - 70.041 \times \log_{10}(\text{height}) + 36.76$$

FEMALES

$$\% \text{ body fat} = 163.205 \times \log_{10}(\text{waist} + \text{hip} - \text{neck}) - 97.684 \times \log_{10}(\text{height}) - 78.387.$$

However, the Department of Defence has prepared charts, based on the above formula, that one can use to look up their body-fat percentage, after taking the proper measurements.

Correct measuring method for DOD (Male)

Abdomen - Measure abdominal circumference against the skin at the navel, measure should be horizontal. Arms are relaxed at the sides. Record the measurement at the end of ones normal, relaxed exhalation. Round the abdominal measurement down to the nearest ½ inch.

Neck - Measure the neck circumference at a point just below the larynx and perpendicular to the long axis of the neck. Do not place the tape measure over the Larynx. Client should look straight ahead during measurement, with shoulders relaxed down (not hunched). The tape will be as close to horizontal as anatomically feasible (the tape line in the front of the neck should be at the same height as the tape line in the back of the neck). Care should be taken so as not to involve the Trapezius in the measurement. Round neck measurement up to the nearest ½ inch.

Subtract the neck measurement from the abdomen measurement.

Correct measuring method for DOD (Female)

Neck - Measure the neck circumference at a point just below the larynx and perpendicular to the long axis of the neck. Do not place the tape measure over the Larynx. Client should look straight ahead during measurement, with shoulders relaxed down (not hunched). The tape will be as close to horizontal as anatomically feasible (the tape line in the front of the neck should be at the same height as the tape line in the back of the neck). Care should be taken so as not to involve the Trapezius in the measurement. Round neck measurement up to the nearest ½ inch.

Waist. Measure the natural waist circumference, against the skin, at the point of minimal abdominal circumference, usually located about halfway between the navel and the lower end of the sternum (breast bone). When you cannot easily see this site, take several measurements at probable sites and use the smallest value. Be sure that the tape is level and parallel to the floor. The clients arms must be at the sides. Take measurements at the end of ones normal relaxed exhalation. Round the natural waist measurement down to the nearest ½ inch.

Hip. Measure the hip circumference while facing the clients right side by placing the tape around the hips so that it passes over the greatest protrusion of the gluteal muscles (buttocks) as viewed from the side. Make sure the tape is level and parallel to the floor. Apply sufficient tension on the tape to minimize the effect of clothing. Round the hip measurement down to the nearest ½ inch.

Add the waist and hip measurements together, then subtract the neck measurements.

Body average density measurement

Prior to the adoption of DXA, the most accurate method of determining body fat percentage was to weigh a person underwater in order to obtain the average density (mass per unit volume). Since fat tissue has a lower density than muscles and bones, it is possible to estimate the fat content. This estimate is distorted by the fact that muscles and bones have different densities: for a person with a more-than-average amount of bone tissue, the estimate will be too low. However, this method gives highly reproducible results for individual persons ($\pm 1\%$), unlike the methods discussed below, which can have an error up to $\pm 10\%$.^[2] The body fat percentage is commonly calculated from one of two formulas:

- Brozek formula: $BF = (4.57/\rho - 4.142) \times 100$
- Siri formula is: $BF = (4.95/\rho - 4.50) \times 100$

In these formulas, ρ is the body density in kg/L. For a more accurate measurement, the amount of bone tissue must be estimated with a separate procedure. In either case, the body density must be measured with a high accuracy. An error of just 0.2% (e.g. 150 mL of trapped air in the lungs) would make 1% difference in the body fat percentage. The body density is measured by weighing a person underwater, with all air expelled from the lungs. This procedure is normally carried out in laboratories with special equipment. However, it is possible to make an estimation without assistance in a swimming pool. A person who neither floats nor sinks with empty lungs in a swimming pool would have a density of 1 kg/dm³ and an estimated body fat percentage of 43% (Brozek) or 45% (Siri), which would be extremely obese. Persons with a lower body fat percentage would need to hold some kind of

Description	Women	Men
Essential fat	10–13%	2–5%
Athletes	14–20%	6–13%
Fit	21–24%	14–17%
Acceptable	25–31%	18–24%
Obesity	32%+	25%+

floatation device, such as an empty bottle, in order to prevent them from sinking. If the floatation device has mass m and volume v , and the person has a mass M , then his or her density is

$$\rho = \frac{\rho_w}{1 + m/M - \rho_w v/M},$$

where ρ_w is the density of water [0.99780 kg/L at 22 °C (72 °F)]. For example, a person weighing 80 kg needs to hold a floater with a volume of 4.5 L and a mass of 0.5 kg has a density of 1.05 kg/L and hence a body fat percentage of 21%. Note that both the Brozek and Siri formulas are claimed to give systematically too high body fat percentages.

Hope this material has helped you!