## Surface Air Consumption Rate

The compressibility of gasses is also an important consideration for divers due to its affect on how long a diver can stay underwater. Scuba regulators are designed to deliver air to a diver at the same pressure as the surrounding water pressure, at ambient pressure. That means that when a diver fills his lungs at a depth of 33 feet, he is taking in the equivalent amount of air as two breaths at the surface. Obviously then, a tank will only last half as long at 33 feet as it would at the surface. A tank that would last 1 hour at the surface would only last 1/3 as long, or 20 minutes, at a depth of 66 feet, etc.

It can be beneficial to be able to estimate how long a scuba tank might last at a given depth when dive planning. To determine this, it is first necessary to determine a divers Surface Air Consumption (SAC) rate. For example, if you are diving at 33 feet, and use 500 lbs of air in 10 minutes, it is easy to determine that you are using 50 lbs per minute. This is only true for this depth however. How much air would you use at 66 feet, or 99 feet?

The first thing we must do is calculate SAC rate. In the preceding example, a diver using 50 pounds per minute at a depth, would use 25 pounds per minute at the surface. His surface air consumption rate is 25 pounds per minute. With our SAC number of 25, it is easy to calculate our consumption rate for depths of 33, 66, 99 feet etc. We know we are under 3 times the pressure at 66 feet, so we would use 3 times as much air, or 75 pounds per minute at this depth.

The process becomes slightly more complex if depth consumption rate (DCR) is determined at a depth that is not in even atmospheres. (Not at 33, 66, 99 feet etc.) For this situation we use a formula that is simply an adaptation of Boyle's Law to determine our SAC rate:

SAC Rate = (DCR x 33) / (Depth + 33)

Let's look at an example. Suppose you did a 50 foot dive for 25 minutes and used 1700 pounds of air. This would mean our DCR is 1700/25 or 68 pounds per minute. Using this in our formula we get:

SAC Rate = (68 x 33) / (50+33)

or: SAC Rate = 2244/83 or about 27 pounds per minute.

We can then turn the equation around to determine our DCR for any depth.

DCR = SAC Rate x (Depth + 33)/33

Let's assume our SAC Rate is 25 and we want to know how fast will we use 2000 pounds of air at a depth of 75 feet.

Dropping our numbers into the equation we get: DCR = 25 x (75 + 33)/33 or DCR = 25 x 108/33 or DCR = 81.81

This means at a depth of 75 feet, we will use 81.81 pounds of air per minute. Dividing this into the 2000 pounds, we see this amount of air would last 24.4 minutes.

It is important to note that SAC Rate takes into account the assumption that you are exerting the same amount of energy at any given depth, and you are using the same size tank as you used when calculating your DCR.

For example, under strenuous diving conditions, you can consume air 4 times faster than when sitting still taking pictures. Also it is obvious that a 50 cubic foot tank would not last as long as an 80 cubic foot tank, even if they were both filled to the same pressure.