



Pressure

What is Pressure?

Pressure is the continuous physical force exerted on an object by something in contact with it.

The pressure exerted by the weight of a fluid is the weight of the fluid (mg) divided by the area A supporting it, so $P=mg/A$.

The mass of the fluid can be calculated from its volume and density, $m = \rho V$.

The volume of the fluid V is related to the dimensions of the water or $V = Ah$, where A is the cross-sectional area and h is the depth.

Combining the last two equations gives $m=\rho Ah$ so $P = h\rho g$ which tells us that pressure is directly related to depth h below the surface of the water.

Why do we measure pressure? What is the significance of measuring pressure?

The density of seawater is a function of temperature, salinity, and pressure. The density increases with increasing salinity and pressure and decreases with increasing temperature.

An important note to consider - at greater depths, the density of seawater increases, demonstrating the compressibility of seawater under tremendous pressure in the deep ocean.

If seawater did not have some compressibility, then it would expand, and cause seawater rise.

Water pressure sensors are used to measure the level of water in a tank, or the rate of change in that level. They can also be used to gauge the pressure in pipes in water distribution systems, to automatically determine whether pumps need to be activated to increase the flow rate. Sensors can also be used to gauge the depth of a submerged object – for example, in deep-sea diving.

Pressure is pertinent to maintaining quality and standards in many industries and areas as well as monitoring our health. A common example of a pressure sensor is a tire gauge. Other pressure sensors are found in washing machines, pressure cookers, oil and gas gauges, manufacturing processes and blood pressure measuring devices.

How does a pressure sensor work?

Pressure sensors measure the pressure exerted by the flow of a liquid or the pressure exerted by the atmosphere. A piezoresistive pressure sensor, like the one in GoSense, contains thin layers of silicon in between protective surfaces connected to a device that detects electrical resistance variations. Piezoresistive materials change their resistance to current flow when they are compressed or strained.

What data is collected? Units of measure?

Pressure has units of force per unit of area. In English units, pressure is calculated in pounds per square inch (psi). In the metric system, it is measured newtons per square meter, also known as a Pascal.





To calculate the pressure at a depth of one foot under water, determine the force (weight) of water acting on a unit of area (one square inch) at the bottom. The density of water is 62.4 pounds per cubic foot (a cube of water with a volume of one cubic foot, has a weight of 62.4 pounds).

The bottom surface area of that cube of water is 12 inches x 12 inches = 144 square inches.

Therefore, the pressure at the bottom of the cube of water is 62.4 pounds /144 square inches or 0.433 psi (pounds per square inch).

We indicate pressure in terms of gauge pressure, a reference value relative to atmospheric pressure because we are typically operating under ambient atmospheric conditions.

Resources

[What is pressure? \(article\) | Fluids | Khan Academy](#)

Extension Activities

- **Density column**
- **Descartes diver**
- **Flinker**
- **Water pressure**

Glossary

Force (noun): A force is a push or a pull on an object. A force happens when two objects interact—that is, when one object does something to the other object. When the interaction stops, the force stops, too. Units of force include Newtons and pounds.

Area (noun): the surface inside a figure or shape especially; the number of unit squares equal to the amount of space the surface covers

Mass (noun): a quantity of matter or the form of matter that holds or clings together in one body

Density (noun): the quantity of something per unit volume, unit area, or unit length; as the mass of a substance per unit volume density expressed in grams per cubic centimeter; the average number of individuals or units in a unit of area or volume

Volume (noun): an amount of space as measured in cubic units

Compressibility (noun): capability of compression; the ability of something (such as a fluid) to be reduced in volume or size under pressure

