Engineer's Notebook

What Is Pressure?

Pressure is a very important parameter in the modern world. The measurement and control of pressure influences our everyday activities. Pressure is important in many applications such as automotive, aerospace, power generation, gas distribution, semi-conductor, pharmaceutical, HVAC and process control. As we strive to make our products better and manufacture them more efficiently, the validity and the measurement of pressure becomes more important.

Pressure results from molecules in either a gas or liquid exerting a force by impacting over a defined area. The relationship is given by:

$$\text{Pressure (p)} = \frac{\text{Force (F)}}{\text{Area (A)}}$$

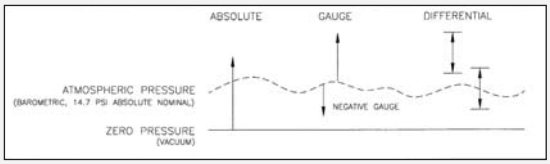
Commonly used engineering units for pressure, such as pounds per square inch (psi), describe this above relationship.

Early pressure measurement devices were dial gauges and these instruments were calibrated by instruments such as Deadweight Testers. A deadweight tester applies a known force (mass times gravity) over a known area (the cross section area of the piston) so that a precise pressure is applied to the instrument under test. Deadweight testers are generally used as primary standards and there are many examples in the catalog. A Deadweight Tester is usually found in a calibration laboratory or instrument workshop and forms the basis of that company's traceability to NIST for pressure.

Nowadays, there are many, many types of electronic pressure transmitters, switches, indicators and controllers in the marketplace. There are also many types of electronic pressure calibrators available, but the fundamental primary pressure standards used are still deadweight testers and in some applications (aircraft instrument), precise mercury manometers.

Pressure terminology can be confusing. What is the difference between gauge, absolute, differential, negative gauge, vacuum, etc.? These different pressure modes are used in different applications. For example, absolute pressure measurement is common in the semi-conductor industry or for measurement of altitude (based on pressure at sea level). Negative gauge is used in engine manifold measurements or in many process applications. Differential pressure is used in the gas industry to determine flow, by measuring the difference in pressure between two points in the pipeline that are on opposite sides of an orifice plate.

The following graph highlights the differences between the terms.



Absolute pressure = pressure relative to vacuum (zero pressure)

Gauge pressure = pressure relative to atmospheric pressure (barometric pressure)

Differential pressure = difference between two pressures where the reference pressure may not necessarily be zero or atmospheric pressure, but some other value.

Negative gauge = Pressure below atmospheric pressure, relative to atmospheric pressure.

Vacuum = a term used to describe very low absolute pressures or, sometimes, negative gauge.

Content for this article contributed by Druck

Return To Index