Measurement of Pressure

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Overview

Pressure (P) expresses the magnitude of normal force (F-N) per unit area (A-m^2) applied on a surface(Crowe et al. 2005)

$$P = \frac{F}{A} \quad or \quad P = \frac{\Delta F}{\Delta A}$$

Units: Pa(= $N/m^{2)}$, psi(=lbf/in^2), bar (=10^5 Pa=100 kPa), mbar (=100 Pa=1 hPa), atm (=101.3 kPa), mmHg (or Torr), inHg, etc.

Note: For every Unit: hUnit=hectoUnit=100 Unit

$$P_{abs} = P_{atm} + P_{gage}$$

Where P_{abs} : Absolute pressure P_{atm}

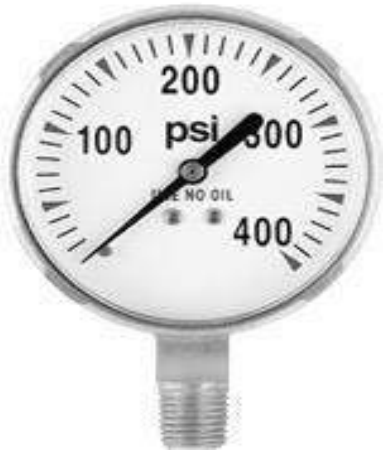
: Atmospheric pressure

(standard is: 101.3 kPa =14.696 psi=760 mmHg=29.92 inHg)

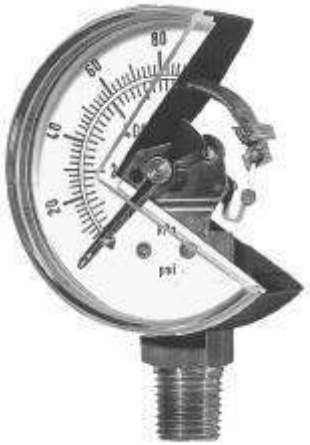
P_{gage} : Gage pressure

Pressure Measuring Devices

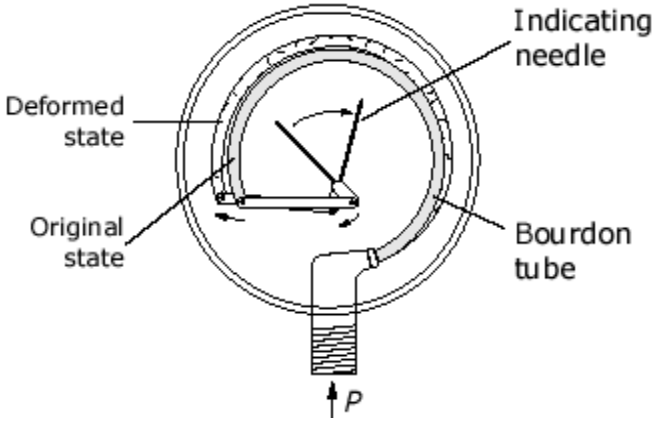
Bourdon Gage:



http://www.cpigauges.com/images/gauges/WeldGageStlCsBM400psi.jpg



http://www.hydraulicspneumatics.com/FPE/images/sensors1_1.jpg



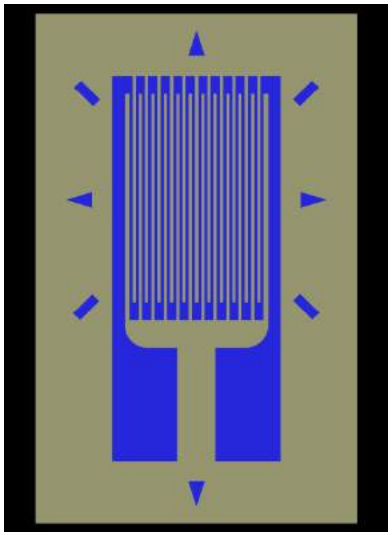
http://www.efunda.com/DesignStandards/sensors/bourdon_tubes/images/Bourdon_tube_A.gif

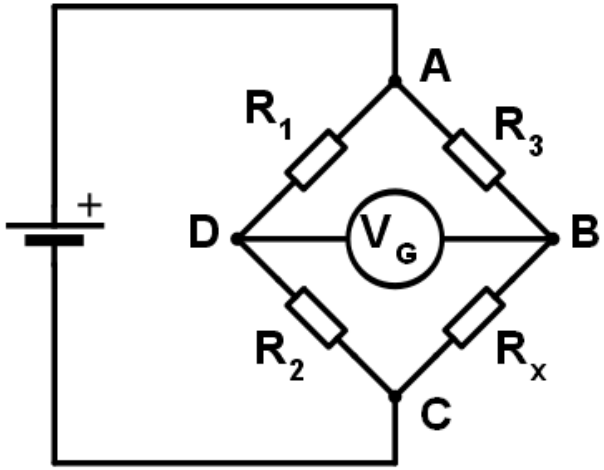
Principles: change in curvature of the tube is proportional to difference of pressure inside from that outside the tube

Applications: tire pressure, pressure at the top or along the walls of tanks or vessels

Pressure Measuring Devices

Strain Gage



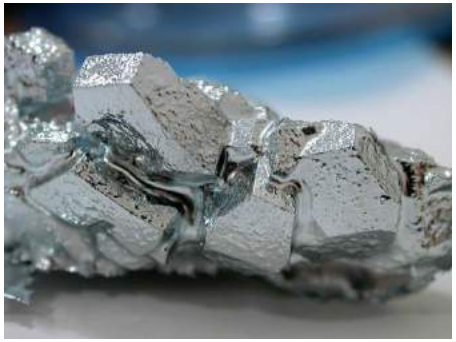


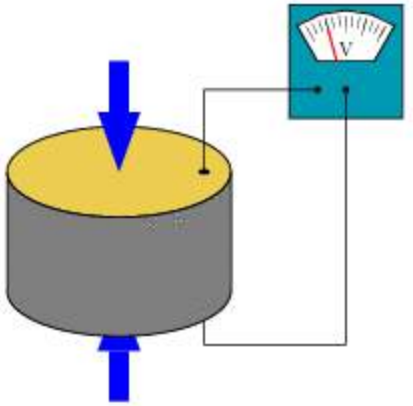
Principles: Δ P ⟶ Δ Resistance ⟶ Δ Voltage

Applications: Sensors for internal combustion engines, automotive, research etc.

Pressure Measuring Devices

Quartz Gage





http://upload.wikimedia.org/wikipedia/commons/c/c4/SchemaPiezo.gif

Principles: Δ Pressure → Δ Charge → Δ Voltage

Applications: measurements with high accuracy, good repeatability, high resolution.
e g. Quartz Clock

Pressure Measuring Devices

Piezoresistive Gage

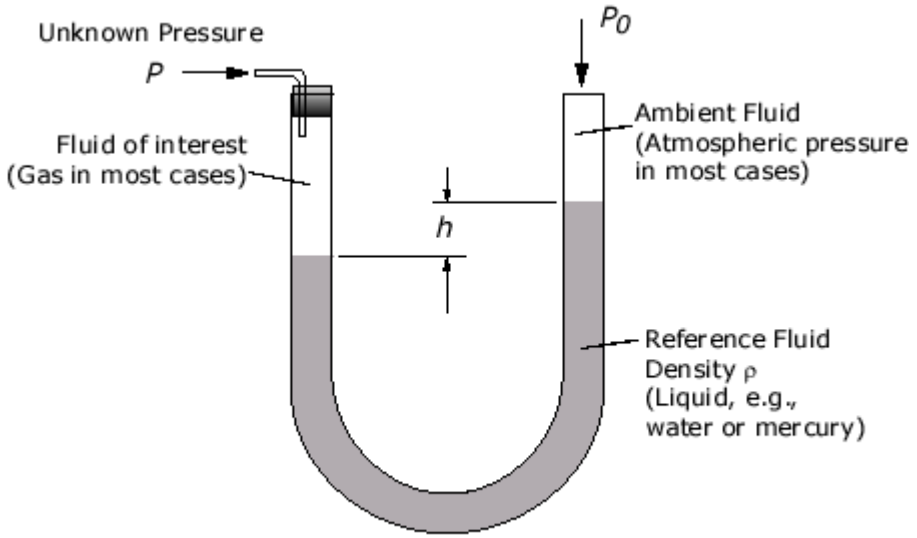
Digital Manometer

Principles: ΔPressure = ΔCharge = ΔResistance = ΔVoltage

Applications: Very accurate for small pressure differentials
e.g. Difference between indoor and outdoor pressure

Pressure Measuring Devices

U-tube Manometer



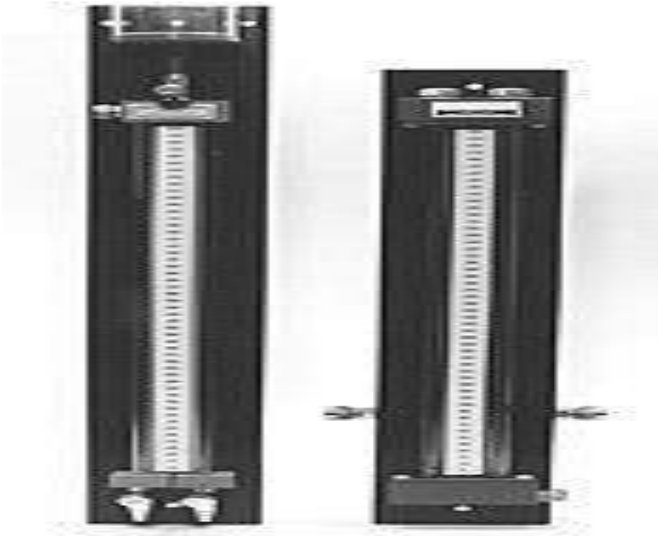
http://www.efunda.com/formulae/fluids/images/Manometer_A.gif

Principles: Hydrostatic Law

$$\Delta P = \rho g h$$

Pressure Measuring Devices

U-tube Manometer



http://www.armfield.co.uk/images/H12.gif

Mercury Water Manometer

http://hyperphysics.phy-astr.gsu.edu/Hbase/fluids/flupic/bern5.jpg

Air Water Manometer

Applications: air pressure, pipe pressure, etc.

UT Manometer Applet