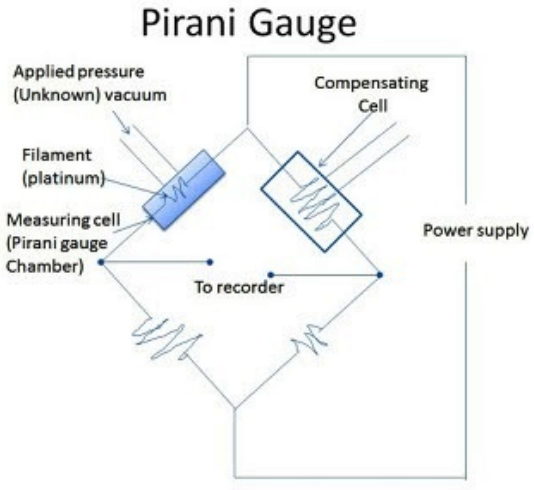
PIRANI VACUUM GAUGE



The Pirani Gauge is a type of Thermal Conductivity Gauge.

The Pirani gauge consists of a metal filament (usually platinum) suspended in a tube which is connected to the system whose vacuum is to be measured. Connection is usually made either by a ground glass joint or a flanged metal connector, sealed with an o-ring. The filament is connected to an electrical circuit from which, after calibration, a pressure reading may be taken.

A conducting wire (platinum filament) gets heated when electric current flows through it. This wire suspended in a gas will lose heat to the gas as its molecules collide with the wire and remove heat. As the gas pressure is reduced (by the vacuum pumps) the number of molecules present will fall proportionately, the conductivity of the surrounding media will fall and the wire will lose heat more slowly. Measuring the heat loss is an indirect indication of pressure.

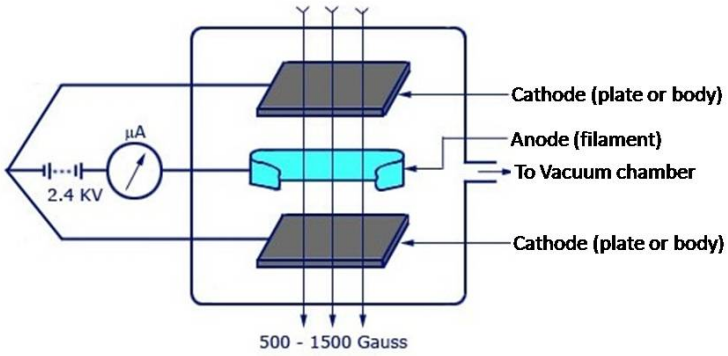
The electrical resistance of the wire varies with its temperature, so the measurement of resistance also indicates the temperature of wire. Now the change in resistance of the filament is determined using the bridge. This change in resistance of the pirani gauge filament becomes a measure of the applied pressure when calibrated.

In many systems, the wire is maintained at a constant resistance R by controlling the current I through the wire. The resistance can be set using a bridge circuit. The power delivered to the wire is I^2R, and the same power is transferred to the gas. The current required to achieve this balance is therefore a measure of the vacuum.

The gauge may be used for pressures between 0.5 Torr to 10^{-3} Torr. The thermal conductivity and heat capacity of the gas may affect the readout from the meter, and therefore the apparatus may need calibrating before accurate readings are obtainable. For lower pressure measurement other instruments such as a Penning gauge are used.

Animation of Pirani Gauge can be seen at : https://www.youtube.com/watch?v=T-0Nt7xzb2Y

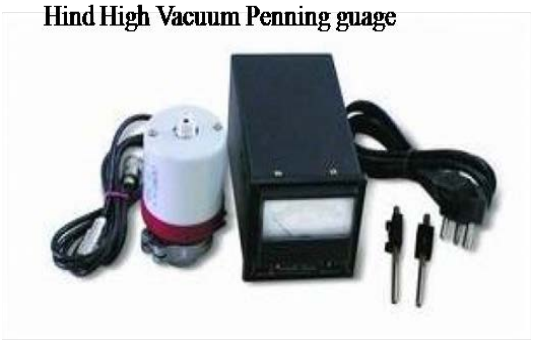
PENNING VACUUM GUAGE

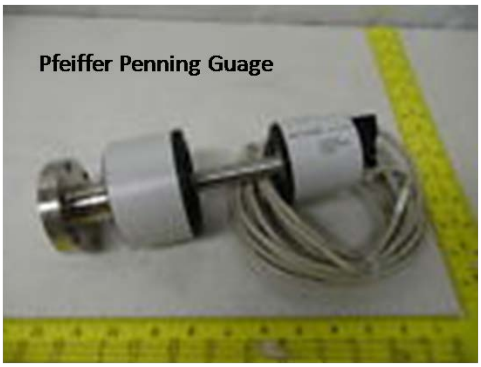


The Penning gauge is a cold cathode type ionisation gauge consisting of two electrodes anode and cathode. The outer cylinder of the gauge is the cathode and is at room temperature. The anode consists of a tungsten wire mounted in the center of the tube A potential difference of about 2 to 3 KV is applied between anode and cathode through current limiting resistors. A magnetic field is introduced at right angles to the plane of the electrodes by a permanent magnet having nearly 800 gauss magnetic field which will increase the ionisation current.

The electrons emitted from the cathode (gauge head body) of the gauge head are deflected by means of magnetic field applied at right angles to the plane of the electrodes and are made to take helical path before reaching the anode loop. Thus following very long path, the electrons ionize the gas by collision, even at low pressures. The secondary electrons produced by ionisation themselves perform similar oscillations and the rate of ionisation increases rapidly. Eventually, the electrons are captured by the anode and equilibrium is reached when the number of electrons produced per second by ionisation is the sum of positive ion current to the cathode and the electron current to the anode. This small current is calibrated to give a measure of the pressure of the gas and hence the chamber to which it is attached.

The Cold Cathode Penning gauge can detect vacuum from 10-2 to 10-7 Torr or mbar.





Animation of Penning gauge can be seen at: https://www.youtube.com/watch?v=TG9vtKK-LLw