Pressure Metrology. Diaphragm- and Sensor Technology.

Absolute-, Relative(Gauge)- and Differential Pressure.

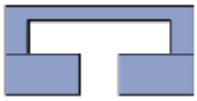
With the steam age came the demand for pressure measuring instruments. Bourdon tubes or bellows, where mechanical displacements were transfered to an indicating pointer were the first pressure instruments, and are still in use today.

Pressure metrology is the technology of transducing pressure into an electrical quantity. Normally, a diaphragm construction is used. In piezoresistive and in thin- or thick film technology, resistors are fixed onto a pressure diaphragm. Under the pressure-induced strain, the resistors change their value (strain gauges). In capacitive technology, the pressure diaphragm is one plate of a capacitor that changes its value under pressure-induced displacement.

Pressure sensing using diaphragm technology measures the difference in pressure of the two sides of the diaphragm. Depending on the reference pressure, we use the following terms:

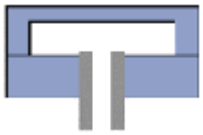
Absolute Pressure

Measurement referenced to a sealed, mostly an evacuated, volume.



Relative Pressure

Measurement referenced to atmospheric pressure.



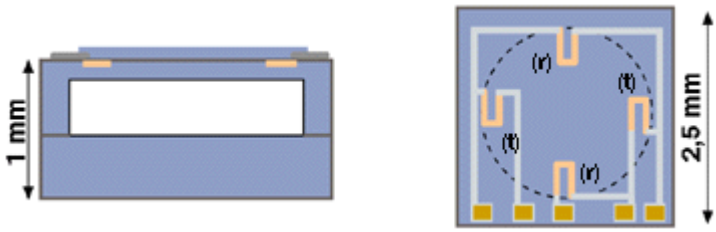
Differential Pressure

With 2 pressure ports for differential measurement of two pressures.

The Piezoresistive Pressure Sensor. The Silicon Cell.

The sensor consists of a micro-machined silicon diaphragm with piezoresistive strain gauges diffused into it, fused to a silicon or glass backplate.

The resistors have a value of approx. 3,5 kOhm. Pressure-induced strain increases the value of the radial resistors "r", and decreases the value of resistors "t" transverse to the radius. This resistance-change can be as high as 30%. The resistors are hooked up as a Wheatstone bridge. The bridge output is directly proportional to the pressure.



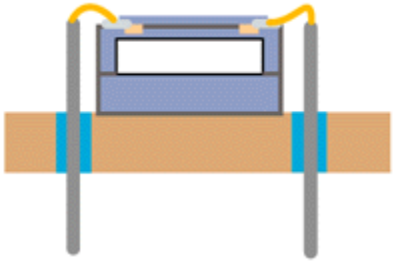
Leadouts from the Bridge.

Two leadout methods are used:

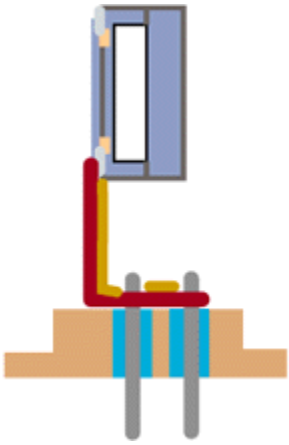
- Gold- or aluminum wires are welded to the aluminum contacts on the chip and to the glass feed-through, pins of the header.

- TAB (Tape Automated Bonding). The contacts on the chip have a gold dot. A pretinned flexible printed circuit is directly soldered to these gold dots and the other end to a PC-board or the header.

In the first method, the sensor must be fixed on the header. The TAB printed circuit, however, holds the sensor in place itself.



Cells on glass feed-through header with gold wires



Cells on glass feed-through header with TAB

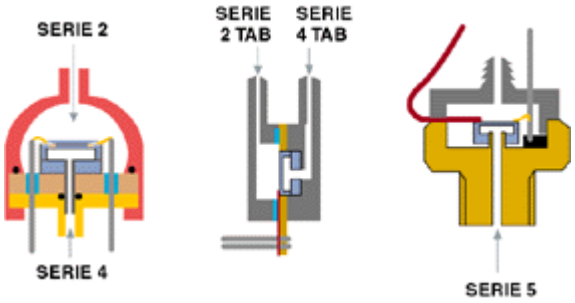
Low Cost Sensors.

Low Cost Sensors are devices where the sensors are exposed to the media without protection. The Series 2, 4 and 5 are such sensors.

In Series 2 and 4, the glass feed-through and the silicon cell is mounted in

a plastic housing with pressure ports for positive pressure (Series 2); and positive and negative pressure (Series 4).
In Series 2 TAB and Series 4 TAB, the silicon sensor with the TAB print is fixed between two plastic mouldings with pressure ports.

In the Series 5, the silicon sensor is bonded to a brass pressure port. The contacts are made either by gold wires to soldering pins, or by TAB flexible printed circuit.



Series 2: Pressure acting on front of chip: for dry media only.
Series 4, Series 5: Pressure acting on back of chip: suitable for wet media also.