Mechanical 3ND YEAR

DATE -23/03/2020 **SUBJECT- Mechatronics** **TIME 10:30-11:20**

Topic- Pressure sensing elements

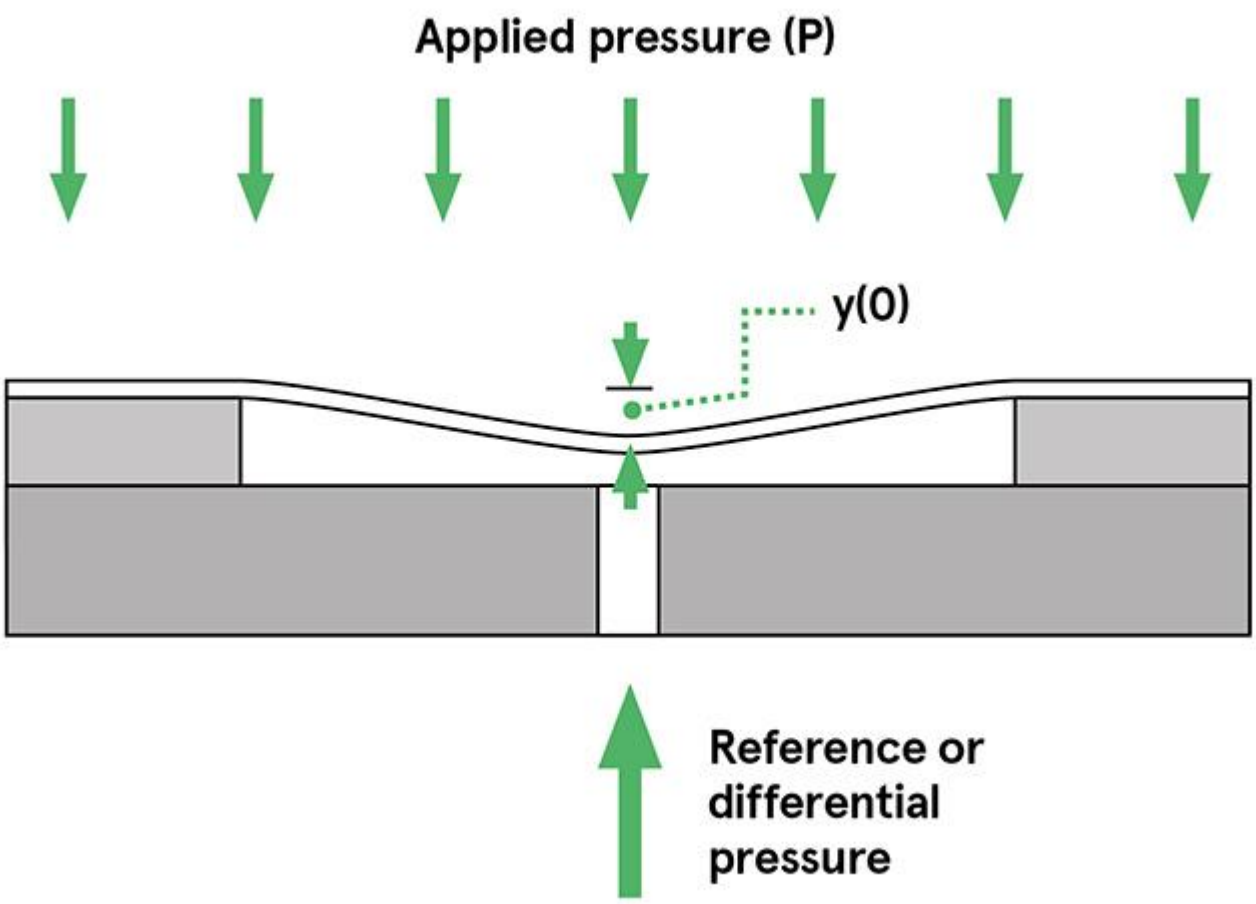
Sensing pressure usually begins with converting the force exerted by the pressure media – gas or liquid - into a physical displacement. This can be used to move a pointer relative to a calibrated scale, or to cause an electrically measurable response such as resistance or capacitance change proportional to the pressure.

The pressure sensing diaphragm, capsule, Bourdon tube, and expanding bellows are proven mechanisms for converting pressure to displacement.

Pressure sensing diaphragms

How they work

The pressure-sensing diaphragm is a circular plate, fixed around the edge, and exposed to the pressure media on one side (see diagram below). On the opposite side may be a sealed chamber, in the case of an absolute pressure sensor, or it may be vented in the case of a gauge or differential sensor.



When pressure is applied, through the media, the diaphragm deflects to an extent proportional to the magnitude of the pressure. This deflection can be used to create a change in capacitance or resistance.

In a capacitive sensor, the diaphragm represents one electrode of a capacitor that has a fixed plate as the second electrode. Pressure-related deflection of the diaphragm reduces the separation of the electrodes, causing a capacitance change proportional to the applied pressure.

Alternatively, a network of resistive elements is attached to the surface of the diaphragm. These may be foil strain gauges bonded to the surface, or metal resistors deposited using a thin-film sputtering or thick-film process depending on the diaphragm material. Deflection of the diaphragm, under pressure, causes these elements to stretch and changes their resistance.

Advantages and disadvantages

Pressure-sensing diaphragms have a simple construction and are easy to miniaturise. Precision resistors require only small deflection, minimising diaphragm fatigue. Media-isolated sensors maintain high accuracy. And diaphragm-based sensors can measure lower pressures than a Bourdon tube.

The choice of materials for the construction of the diaphragm enables broad media compatibility. Metal diaphragms can measure high pressures. And piezoelectric sensors allow a wide range of measurement.

One potential downside is that conventional, i.e non-MEMS, diaphragms have limited low-pressure measurement capability.