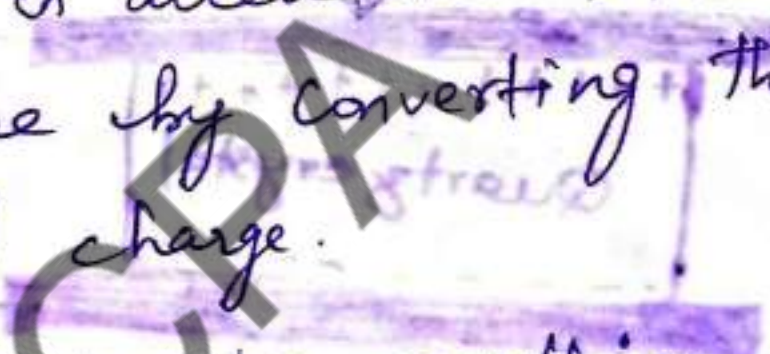
## Piezo electric Transducer :-

A piezoelectric transducer (Piezoelectric Sensor) is a device that uses the piezoelectric effect to measure change in acceleration, Pressure, strain, temperature or force by converting this energy into an electrical charge.



A transducer can be anything that converts one form of energy to another. The Piezoelectric material is one kind of transducers. When we squeeze this piezoelectric material or apply any force or Pressure, the transducer converts

this energy into Voltage.

⇒ The electric voltage produced by a piezoelectric transducer can be easily measured by the Voltage measuring instruments.

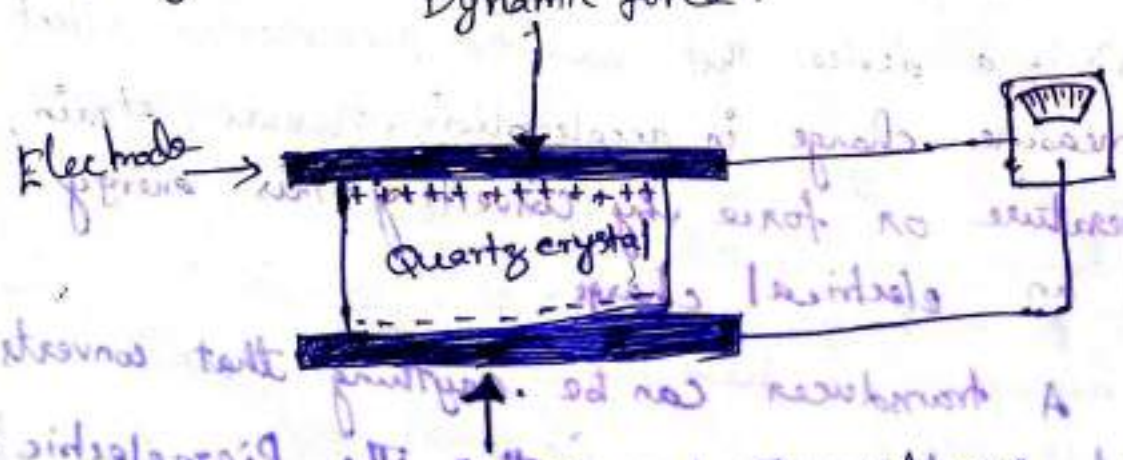
Piezoelectric Transducer working principle.

A quartz crystal exhibits a very important property known as the piezoelectric effect.

⇒ When some mechanical pressure is applied across faces of a quartz crystal, a Voltage proportional to the applied mechanical Pressure appears across the crystal.

⇒ When a Voltage is applied across the crystal surfaces, the crystal is distored by an amount proportional to the applied Volta

This phenomenon is known as the piezoelectric effect and the material that exhibits this Property is known as a piezoelectric material




Materials for piezoelectric Transducers

⇒ The material exhibiting the piezoelectric phenomenon are divided into two groups.

(i) Natural (ii) Synthetics.

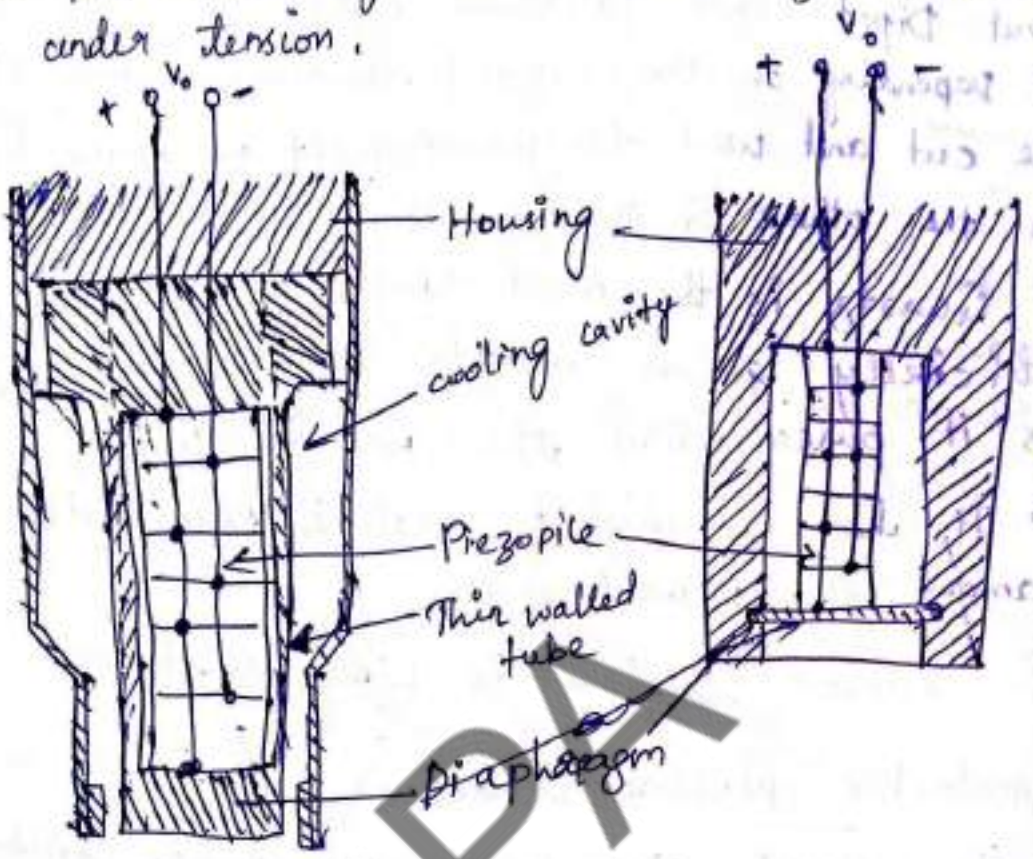
⇒ The natural group consists quartz, Rochelle salt and tourmaline.
⇒ The Synthetic group consists of ammonium dihydrogen phosphate (ADP), lithium sulphate (LS) and Dipotassium Tartarate (DKT)
⇒ Depending on the crystal structure, disc or wafers are cut and used for measurement of force in one or the others of the modes described.
⇒ Quartz is the most stable material and artificially grown quartz is normally preferred as it purer than the natural quartz.
⇒ It has the highest relative permittivity among the natural group.
⇒ Lithium sulphate is highly sensitive.

Piezoelectric pressure Transducers.

⇒ Piezoelectric transducers are more suitable for pressure measurements under dynamic conditions only and are often used as microphones hydrophones and engine pressure indicators.
⇒ In the piezoelectric microphone the diaphragm and the bimorph are connected together by means of a fine needle (spindle).
⇒ The natural frequency of a diaphragm, the bimorph and the associated system should be made higher than the highest frequency to be responded to (10 kHz)
⇒ When used in sound level meters, it is essential for microphone to have flat frequency response upto 10 kHz
⇒ Large pressure variation occuring at frequencies upto 20 kHz in internal combustion engines are measured using multimorphs (piezopile) of quartz elements.

⇒ The transducer is pre-stressed so as to enable Pressure fluctations about a mean value to be measured.

⇒ The Pre-Stressing is produced by a thin-walled tube under tension.




⇒ A very thin diaphragm of flexible material is used for sealing.

⇒ The net force $F_1$ to which the piezo pile responds is given by

$$\frac{F_1}{F} = \frac{k_1}{K_1 + K_2}$$

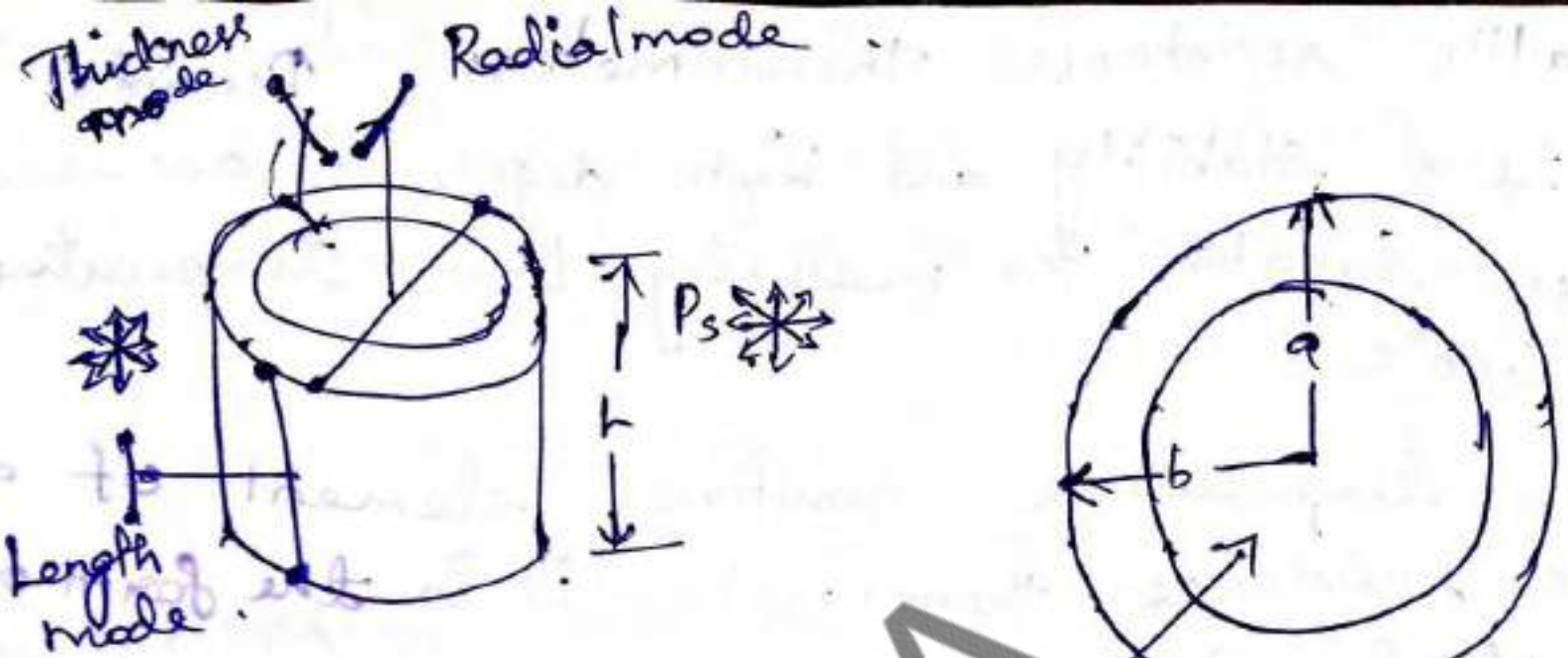
where,

F = Total force acting on the transducer

$k_1$ = Spring rate of piezopile

$k_2$ = Spring rate of preloading tube or diaphragm

For the measurement of air blast pressures and underwater pressure transients.




Sealed cavity.

⇒ The outer and inner surfaces are metallized and used as electrodes.

⇒ The walls are polarized in a radial direction.

⇒ The tube cavity may be sealed against the external pressure and the blast pressure is applied to the outer surface.

⇒ The cylinder responds to the pressure p in all the three modes.