Threshold

It is a particular case of resolution. It is defined as the minimum value of input below which no outp[ut is] detected.

Static Sensitivity

This static characteristic is defined as the ratio of the magnitude of response (output signal) to the magn[itude of] the quantity being measured (input signal), i.e.

$$\text{Static sensitivity,} \quad K = \frac{\text{change of output signal}}{\text{change in input signal}}$$

$$= \frac{\Delta q_0}{\Delta q_i}$$

Where q_0 and q_i are the values of the output and input signals, respectively.

Linearity

A linear indicating scale is one of the most desirable features of any instrument. Therefore, manufact[urers of] instruments always attempt to design their instruments so that the output is a linear function of the input.

- ***Independent of the input :*** If the deviation of the output of the instrument from the best fitting s[traight] line (drawn through the calibration points) does not vary with the input , then non – linearity is sp[ecified] in the terms of higher value of the maximum deviation that occurs on the positive and negative si[des of] the best fitting or idealized straight line. This value is usually expressed as ± percentage of full [scale] deflection.

- ***Proportional to input:*** If the deviations of the output of the instrument from the idealized straig[ht line] vary with the input, then non–linearity is specified as a function of the input. In such case[s,] maximum deviation points on the positive and negative sides of the idealised straight line are j[oined] with the origin and their slopes are determined'. The higher value of the percentage change in slop[e with] respect to the idealized line is usually expressed as ± percentage non–linearity with respect t[o] magnitude of input values.

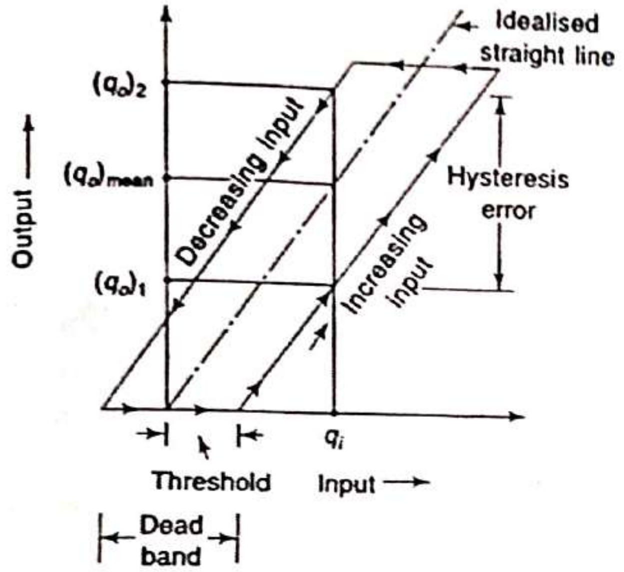
- ***Combined independent and proportional to the input:*** In certain cases, the deviations of the o[utput] may not vary with the input for a part of the range and may show proportional variation for the re[st of] the range. In typical calibration curve shown as independent deviation at the lower range [and] proportional variations at the higher range with respect to the idealized straight line.

Range and Span

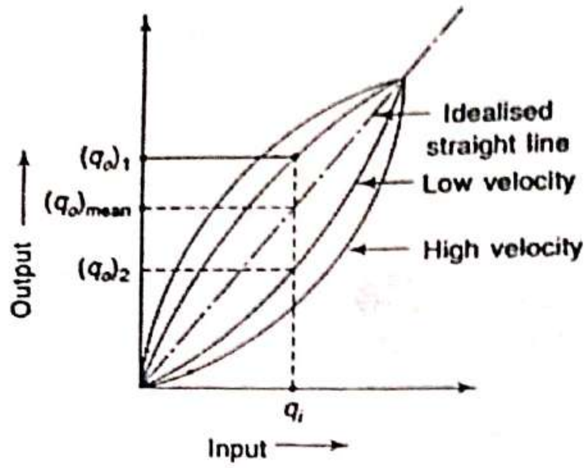
The range of the instrument is specified by the lower and upper limits in which it is designed to operate for measuring, indicating or recording the measured variable. The algebraic difference between the upper and lower range values is termed as the span of the instrument.

Hysteresis

It is defined as the magnitude of error caused in the output for a given value of input, when this value is approached from opposite direction, i.e. from ascending order and then descending order.



(a) Hysteresis loop due to Coulomb's friction



(b) Hysteresis loop due to viscous friction

Fig. Typical output–input curves showing hysteresis effects

Dead Band

It is defined as the largest change of the measurand to which the instrument does not respond.

Backlash

It is defined as the maximum distance or angle through which part of the mechanical system may be moved in one direction without causing motion of the next part.

Drift

It is defined as the variation of output for a given input caused due to change in the sensitivity of the instrument due to certain interfering input like temperature changes, component instabilities, etc.

2 RESISTIVE INDUCTIVE AND CAPACITIVE TRANSDUCER

Resistive Transducers

It is generally seen that methods which involve the measurement of change in resistance are preferred to those employing other principles. This is because alternating as well as direct currents and voltages are suitable for resistance measurements.

The resistance of a metal conductor is expressed by a simple equation that involves a few physical quantities. The relationship is

$$R = \rho L/A.$$

where R = resistance ; Ω L = length of conductor ; m, A= cross – sectional area of conductor; m^2,

and ρ = resistivity of conductor material; Ω – m.

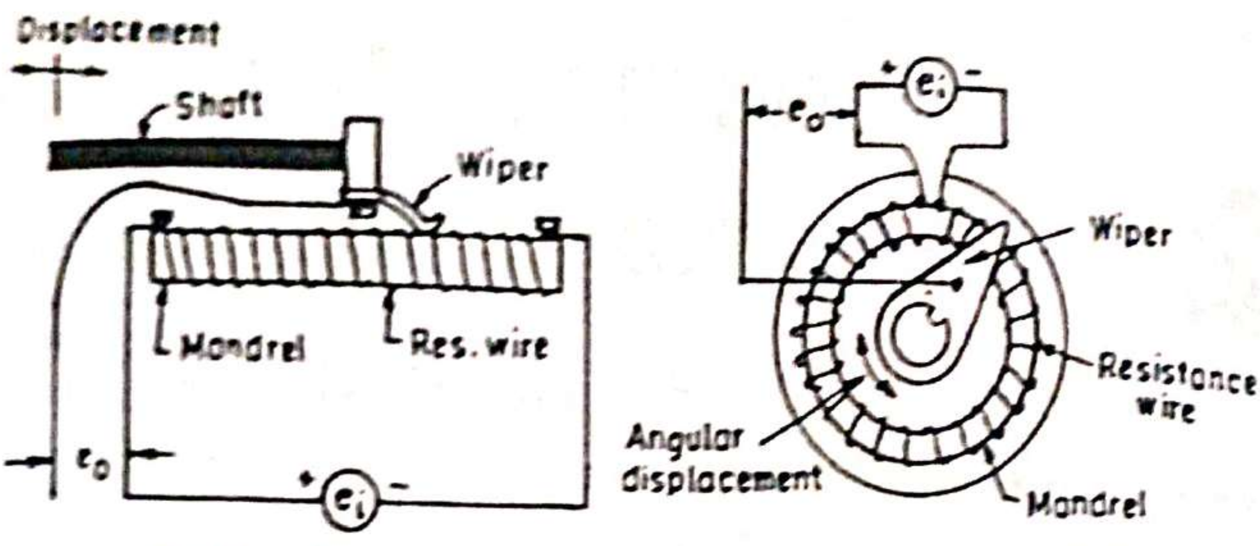
Any method of varying one of the quantities involved in the above relationship can be the design basis of a electrical resistive transducer.

There are a number of ways in which resistance can be changed by a physical phenomenon. The translational and rotational potentiometers which work on the basis of change in the value of resistance with change in length of the conductor can be used for measurement of translational or rotary displacements.

Strain gauges work on the principle that the resistance of a conductor or a semiconductor changes when strained. This property can be used for measurement of displacement, for and pressure. The resistivity of materials changes with change of temperature thus causing change or resistance. This property may be used for measurement of temperature. Thus electrical resistance transducers have a wide field of application.

Potentiometers

Basically a resistance potentiometer, or simply a POT, (a resistive potentiometer used for the purposes of voltage division is called a POT) consists of a resistive element provided with a sliding contract. This sliding contact is called a wiper. The motion of the sliding contact may be translator or rotational. A linear pot and a rotary pot are shown in Fig. (a) and (b) respectively.



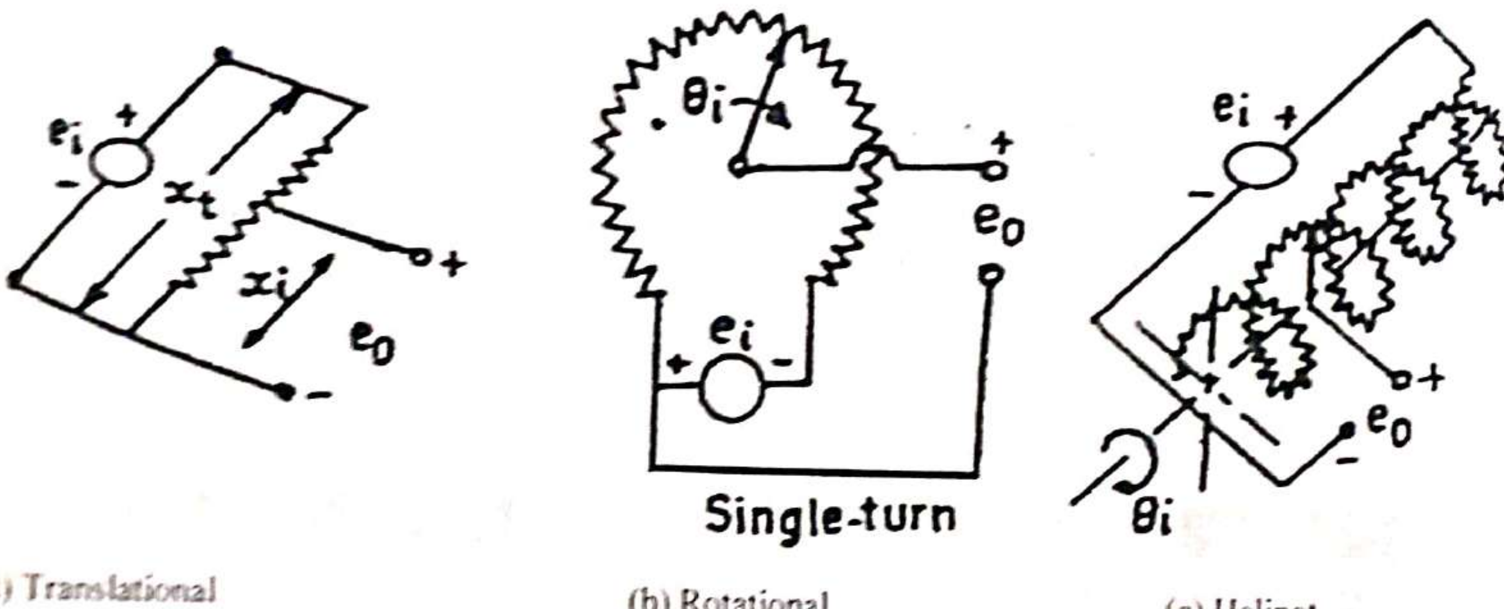
(a) Linear (translational) POT (b) Rotary POT

Fig. Resistive potentiometers (POTS)

So the POTS use the combination of the two motions, i.e. translational as well as rotational. These POTS their resistive element in the form of a helix and therefore, they are called helipots.

The translational resistive elements are straight devices and have a Stroke of 2 mm to 0.5 m. The rota devices are circular in shape and are used for measurement of angular displacement.

They may have a full sole angular displacement as small as 10°. A full single turn potentiometer may pr accurate measurements. upto 357°. Multiturn potentiometers may measure upto 3500° of rotation through of helipots .



(a) Translational (b) Rotational (c) Helipot

Fig. Diagrams for translational rotational and heliports

The POT is a ***passive transducer*** since it requires an external power source for its operation. The resis body, of potentiometer may be wire wound. A very thin, 0.01 mm diameter of platinum or nickel allo carefully wound on an insulated former.

The resistance elements are also made up from cermet, hot moulded carbon, carbon film and thin metal.