PHYSICAL STRAIN GAGE TRANSDUCERS

Strain gages are used in physical transducers to measure the strain induced in a summing device by a displacement, force and load, pressure, or torque. Figure 5.11a shows a simple cantilever. Figure 5.11b shows a type of spring element used in load cells, that is, transducers for measuring loads. In each of these, the bending of a composite beam is utilized to obtain strains of opposite signs designated as T for tensile and C for compressive. When strain gages are fixed at those locations, the bridge output could be doubled or quadrupled if two or four active gages are used.

Semiconductor gages can also be used with various types of spring elements to measure displacements, pressure, temperature, and force.

<u>Thermo resistive detectors</u>

Metals and semiconductors experience an increase in their electrical resistivity when heated, and consequently their resistance increases with temperature.
This transduction mechanism, in metals like nickel, nichrome, tungsten, copper, and platinum, is used in resistance temperature detectors (RTDs).

Platinum resistance temperature detectors (PRTDs) yield a reproducible resistance temperature relationship, and their resistance varies quite linearly with temperature.

The relationship between resistance and temperature for a platinum wire RTD is given by the Callender-Van Dusen equation

$$R_t = R_0 \left\{ 1 + \alpha \left[t + \delta \left(1 - \frac{t}{100} \right) \frac{t}{100} + \beta \left(1 - \frac{t}{100} \right) \left(\frac{t}{100} \right)^3 \right] \right\} \qquad (5.13)$$

where R_t=resistance at some temperature t
R_0=ice point resistance (0.01°C or 273.16 K)
α=temperature coefficient of resistance near 0°C
β=Van Dusen constant
t=temperature, degrees Celsius

Typical values are α=0.003926, δ=1.491, and β=0 when t>0 and 0.1103 when t<0. The exact values of α, δ, β, and R_0 are obtained by measuring the resistance of the detector at four temperatures including t=0°C and solving the resulting equations.

The PRTD assembly is composed of a resistance element made from 99.9 percent pure platinum wire, a sheath that encloses the element, and lead wires that connect the element to the external measuring circuitry. RTDs are also made from platinum metal film with a laser trimming system and are bonded directly to the surface under test. Owing to the intimate thermal contact, the self-heating is minimal and therefore they can be operated at a higher excitation voltage.

In most measuring circuits, the PRTD forms an arm of a dc Wheatstone bridge circuit. Since the RTD is connected by wires to the bridge, there is a need to compensate for the wire resistance RL. For this reason, the RTD is supplied in a three-wire (as shown in Fig. 5.12) and a four-wire configuration.

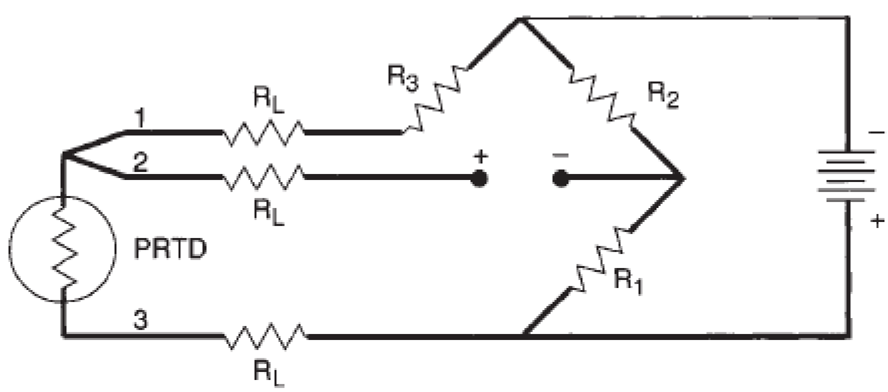

Figure 5.12 A PRTD in a three-wire configuration.

Source: http://mediatoget.blogspot.in/2012/05/physical-strain-gage-transducers.html