

SA - ASSIGNMENT - 1

- Q1) Explain in detail construction working principle and applications of resistance temperature detectors [RTD]? what are the selection criteria of RTD one should take into consideration for specific applications?

Explain with example

- A resistance temperature detector is an electronic device used to determine the temperature by measuring the resistance of an electric wire. This wire is referred to as a temperature sensor to measure the temperature with high accuracy, as RTD is the ideal solution as it has good linear characteristics over a wide range of temperatures. The temperature is typically such that the wire is typically wound on a coil is protected by a stainless steel sheath or a protective tube.

So, that the physical strain is negligible as the wire expands and increases the length of the wire with temperature change. If the strain on the wire increases the length of wire is increasing, then the tension increases due to that the resistance of the wire will change which is undesirable. So we don't want to change the resistance of the wire by any other

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unwanted changes except the temperature changes. This is also useful to maintain while the plant is in operation. Mica is placed in between the steel sheath and resistance wire for better electrical insulation. Due to less strain in resistance wire, it should be carefully wounded over mica.

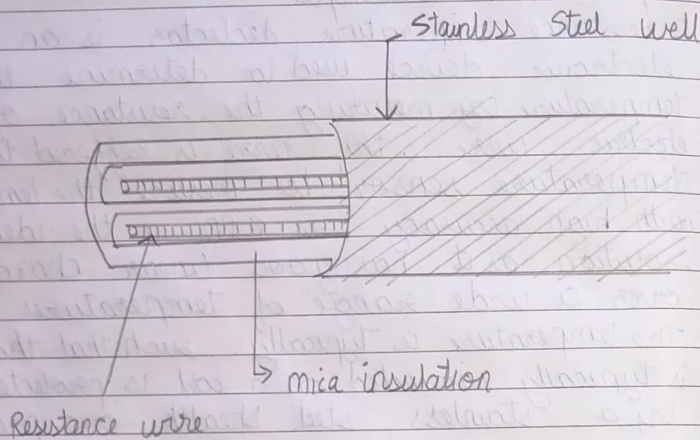


Fig. 1:
3D view of RTD (cross section)

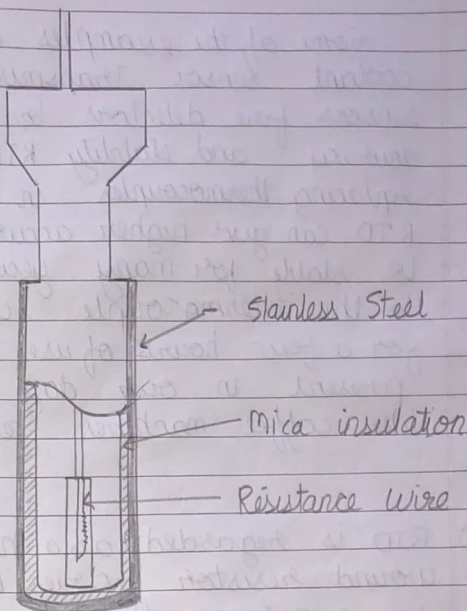


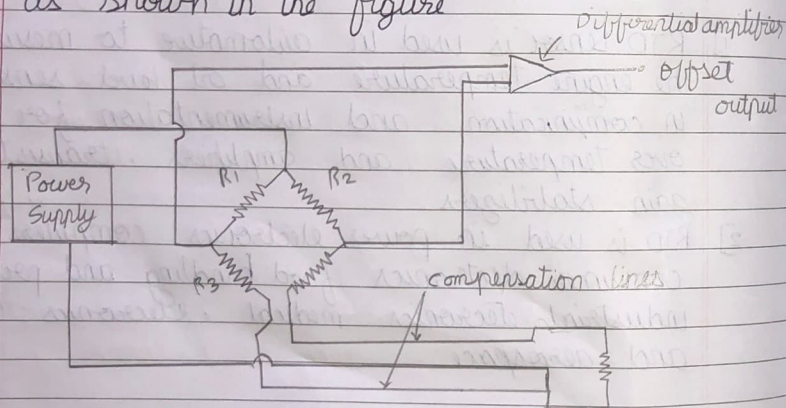
Fig 2: RTD

Applications of RTD-

- 1] RTD sensor is used in automotive to measure the engine temperature and oil level sensors in combustion and instrumentation for sensing over temperature and amplifiers, transistors gain stabilizers
- 2] RTD is used in power electronics computers, consumer electronics, food handling and processing, industrial electronics, medical, electronics, military and aerospace

Some of the examples of RTD sensor are coolant sensor transmission oil temperature sensors fire detectors etc. Due to their accuracy and stability RTD sensors are rapidly replacing thermocouples in industrial application. RTD can give higher accuracy values. RTD can be stable for many years comparatively to the thermocouple which stable only for a few hours of use. There are RTD present in our day of day appliance like coffee machines cell phones.

- Q2) RTD is regarded as a high precision wire wound resistor varies with temperature. By measuring the resistance of the metal its temperature can be determined. To detect the small variations of resistance of the RTD a temperature transmitter in the form of a wheatstone bridge is generally used as shown in the figure.



→ In part (a)

The value of RTD resistance at 0°C without including the effects of dissipation

$$R = 500 [1 + 0.005 (0 - 20)]$$

$$= 450 \Omega$$

If we exclude the effects of self heating we would expect the bridge to null R_3 equal to 400Ω . Now, as we see the effects of self-heating. For this problem. First we find the power dissipated in the RTD from the ckt

B) $P_0 = 25 \text{ mW}/^{\circ}\text{C}$ at 20°C

$$P = I^2 R$$

$$i = \frac{12}{500 + 450} = 12.63 \text{ mA} \quad \text{or} \quad 0.01263 \text{ A}$$

$$\therefore P = (0.01263)^2 \times 450$$

$$= 71.78 \text{ mW} \quad \text{or} \quad 0.07178 \text{ W}$$

$$\therefore \text{Temp rise } \Delta T = \frac{P}{P_0} = \frac{71.78 \text{ (mW)}}{25 \text{ mW}/^{\circ}\text{C}}$$

$$= 2.87^{\circ}\text{C}$$

\therefore The RTD is not actually at both temperatures of 0°C but a temperature of 1.66°C

$$R = 500 [1 + 0.005 (2.87 - 20)]$$

$$= 457.175 \Omega$$