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* Graded Activity :- 01 *

Q1 Explain in detail construction, working principle and applications of RTD? What are selection criteria of RTD one should take into consideration for specific applications?

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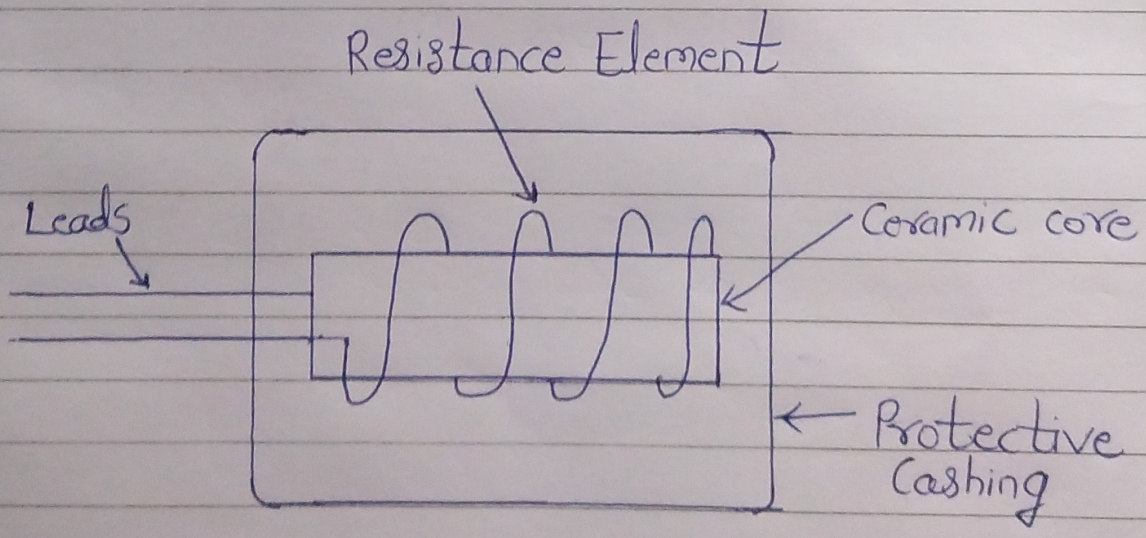
Construction of RTD :-

The resistance temperature detector is constructed by woounding resistance wire on mica base. The wire is woond like a helical coil on support to reduce the inductance effect. The terminal (Leads) are brought out of the pipe. The coil is protected by stainless steel case.



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Working Principle of RTD :-

Resistance Temperature Detectors (RTD) operates on the principle that the resistance of a metal changes with changes in temperature.

The variation of resistance R with temperature t can be represented by equation,

$$R_t = R_0(1 + \alpha \Delta t)$$

α = Temperature co-efficient
R_0 = Resistance

Application of RTD Sensor :-

1] This sensor is used in automotive to calculate the engine temperature, an oil level sensor, and intake air temperature sensors

2] It is used in power electronics, computer, consumer electronics, food handling and processing, industrial electronics, medical electronics, military and aerospace

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There are many factors to consider when selecting an RTD :-

1] Temperature range :-
RTD are available in wide range of temperature ranges, from -200°C to 850°C. Temperature range of RTD must be able to accomodate the maximum & minimum temperature that will be encountered in application

2] Accuracy :-
RTD are available in variety of accuracies, from 0.1°C - 0.01°C. The accuracy of RTD must be sufficient for the requirements of application.

3] Repeatability :-
RTDs are repeatable to within 0.01°C

4] Stability :-
RTDs are stable within 0.01°C per year

5] Cost :-
RTDs are available in a range of prices

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Q.2 let, the RTD has $\alpha_0 = 0.005/°C$ and $R = 500\,\Omega$ at 20°C. The RTD is used in bridge circuit as shown in figure with $R_1 = R_2 = 500\,\Omega$ and R_3 a variable resistor used to null a bridge. If supply voltage is 12 V and RTD is placed in bath at 0°C, find value of R_3 to null bridge, assume that now RTD has dissipation constant $P_0 = 25$ mW/°C at 20°C and find value of R_3 to null bridge. Comment on variation in the answer

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

$$R = 500\,[1 + 0.05(0-20)] = 450\,\Omega$$

If we exclude effects of self-heating we would expect bridge to null with R_3 equal to 450 Ω, Now, as we see effect of self-heating for this problem
We found power dissipated in RTD

$$P = I^2 R$$

$$I = \frac{V}{R} = \frac{12}{500+450}$$

$$I = 12.63\ mA$$

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$P = (12.63 \times 10^{-3})^2 \times 450$

$P = 71.8\ mW$

Temperature rise $(\Delta T) = \frac{P}{P_D} = \frac{71.8}{25} = 2.872$

Thus RTD is not actually at bath temperature of 0°C but at temperature of 2.872°C

$R = 500[1 + 0.005(2.872 - 20)]$

$R = 457.18$

Thus bridge is null with $R = 457.18$