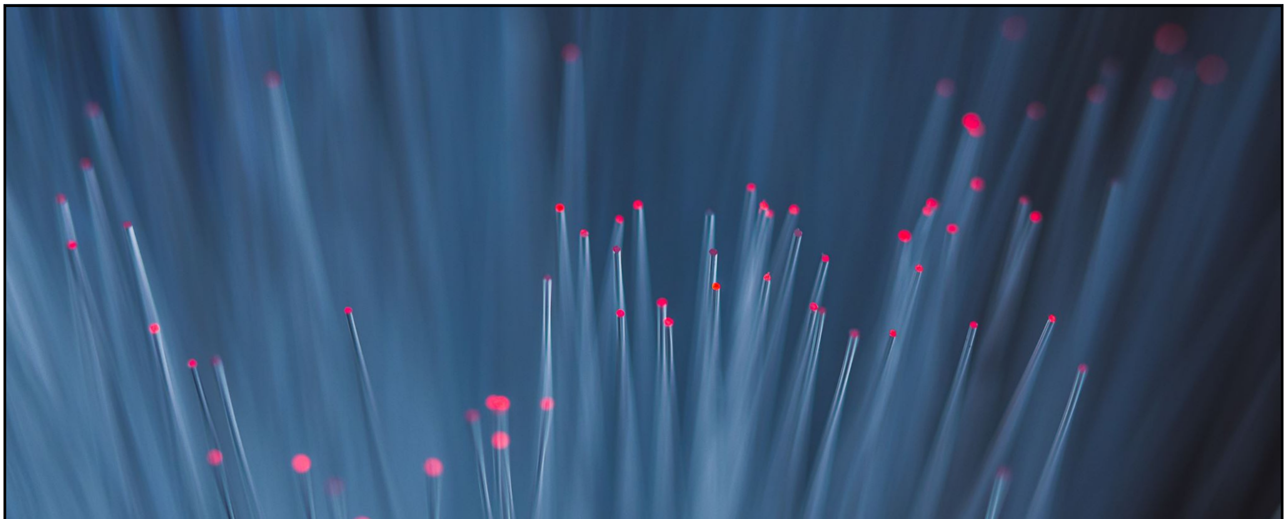


Resistance Temperature Detector

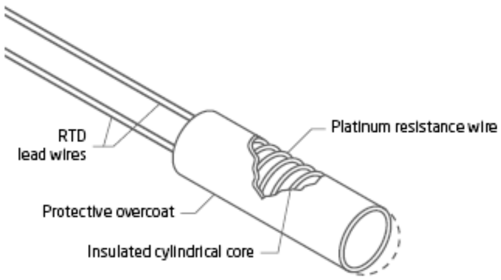
KIMBERLY OWEN
PETER THOMSEN
DANNY RIPPE

Overview

- Temperature to resistance relation
- Pure metal

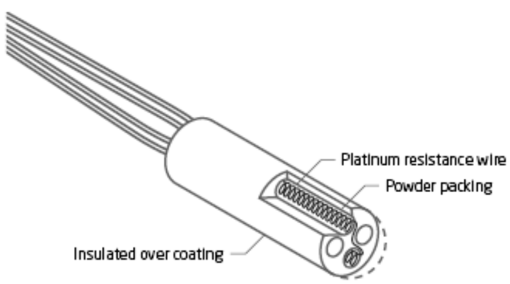
Wire Wound RTD

Most Accurate
Fragile
Slower Response Time



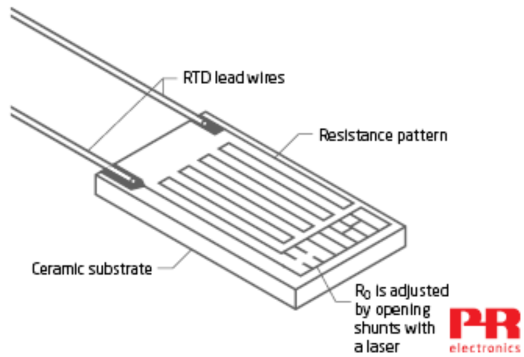
Coiled Element RTD

Fairly Accurate
Sturdy
Good Response Time



Thin Film RTD

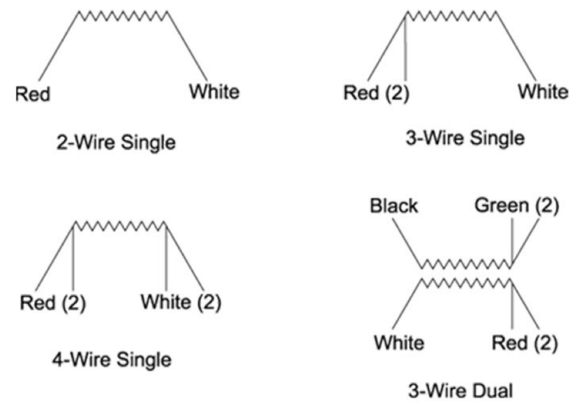
Least Accurate
Cheap
Best Response Time

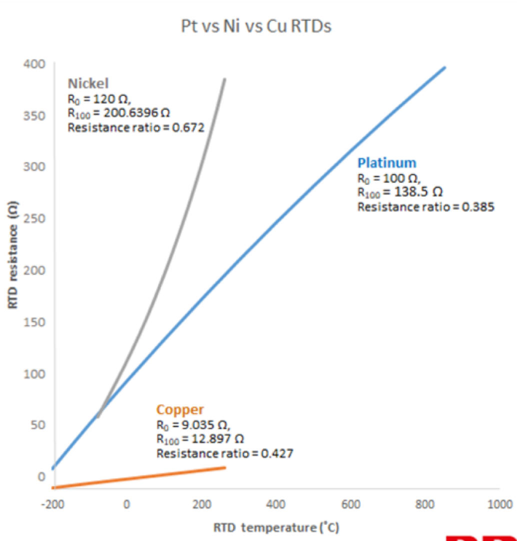


In-Depth

Sensor Connections

-





PR electronics

Temperature Calculation

Temperature Calculation

Resistance Ratio:

((R @ 100° C) - (R @ 0° C))/(R @ 0°C)

- Metals with higher resistance ratios and higher resistances at 0°C give greater accuracy

Error:

Lead wire resistance / [((R @ 100° C) - (R @ 0° C))*0.01]

- Select material based on necessary error for application

Temperature Calculation

- Resistance Ratio defines the average slope of the curve relating resistance and temperature from 0°C to 100°C
- Often, for other ranges, the curve is no longer linear (produces error calculation)
- Use resistance ratio to calculate approximate value, then use error to calculate tolerance range
- Range of linearity defines the class of RTD
- Tables and graphs give accurate values for reference
- Callendar Van Dusen Equations give greater accuracy

Materials

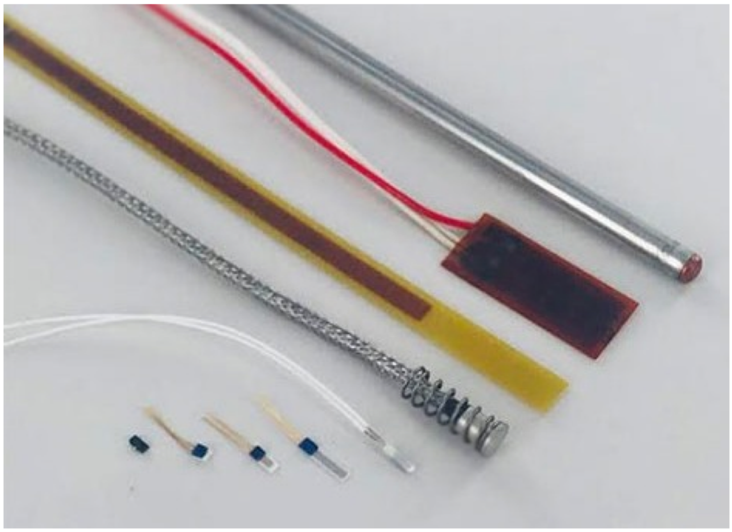
RTD type	Maximum measurement range	Long term stability	Corrosion resistance	Temperature vs. resistance linearity	Typical resistance at 0°C	Typical resistance at 100°C	Change in resistance 0...100°C	Resistance ratio $(R_{100}-R_0)/R_0$	Alpha (α) $(R_{100}-R_0)/(100 \times R_0)$
Platinum	-200...850°C	Excellent	Excellent	Good	100 Ω	138.5 Ω	38.5 Ω	0.385	0.00385
Nickel	-80...260°C	Fair	Good	Fair	120 Ω	200.64 Ω	80.64 Ω	0.672	0.00672
Copper	-200...260°C	Good	Fair	Excellent	9.035 Ω	12.897 Ω	3.86 Ω	0.427	0.00427

PR electronics

Sources of Error

- At high temperatures, the resistivity of some materials can change

- Must make design considerations at high temperatures such as protecting it with a probe made of a ceramic

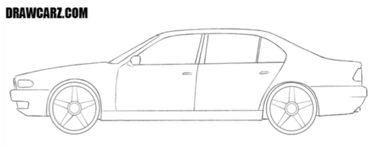


Applications

RTD Pros and Cons

	RTD	Thermocouple	Thermistor
Temp. range	-260 to 850°C (-436 to 1562°F)	-270 to 1800°C (-454 to 3272°F)	-80 to 150°C (-112 to 302°F) (typical)
Sensor cost	Moderate	Low	Low
System cost	Moderate	High	Moderate
Stability	Best	Low	Moderate
Sensitivity	Moderate	Low	Best
Linearity	Best	Moderate	Poor
Specify for:	• General purpose sensing • Highest accuracy • Temperature averaging	• Highest temperatures	• Best sensitivity • Narrow ranges (e.g. medical) • Point sensing

https://instrumentationtools.com/difference-between-rtd-thermocuples-and-thermistors/



Questions?