Bab 10. Temperature Transmitter

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Temperature Measurement

1. **Contact Temperature Sensors**
   - Thermocouple, Resistance Temperature Dependent (RTD), Thermistor

2. **Non-contact Temperature Sensors and Thermography**
   - Infrared Thermometer, Thermal Imagers

Contact Temperature Sensors

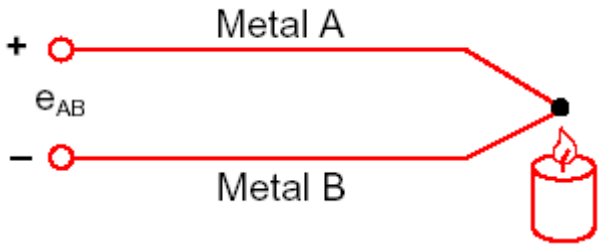


Fig. Thermocouple

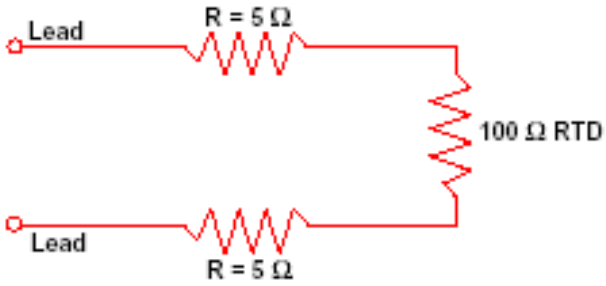


Fig. RTD

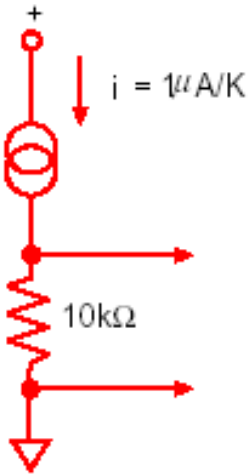


Fig. Thermistor

Temperature Sensor Attributes			
Criteria	**Thermocouple**	**RTD**	**Thermistor**
Cost-OEM Quality	Low	High	Low
Temperature Range	Very wide -450°F +4200°F	Wide -400°F +1200°F	Shot to medium -100°F +500°F
Interchangeability	Good	Excellent	Poor to fair
Long-term Stability	Poor to fair	Good	Poor
Accuracy	Medium	High	Medium
Repeatability	Poor to fair	Excellent	Fair to good
Sensitivity (output)	Low	Medium	Very high
Response	Medium to fast	Medium	Medium to fast
Linearity	Fair	Good	Poor
Self Heating	No	Very low to low	High
Point (end) Sensitive	Excellent	Fair	Good
Lead Effect	High	Medium	Low
Size/Packaging	Small to large	Medium to small	Small to medium

Non-contact Temperature Sensors

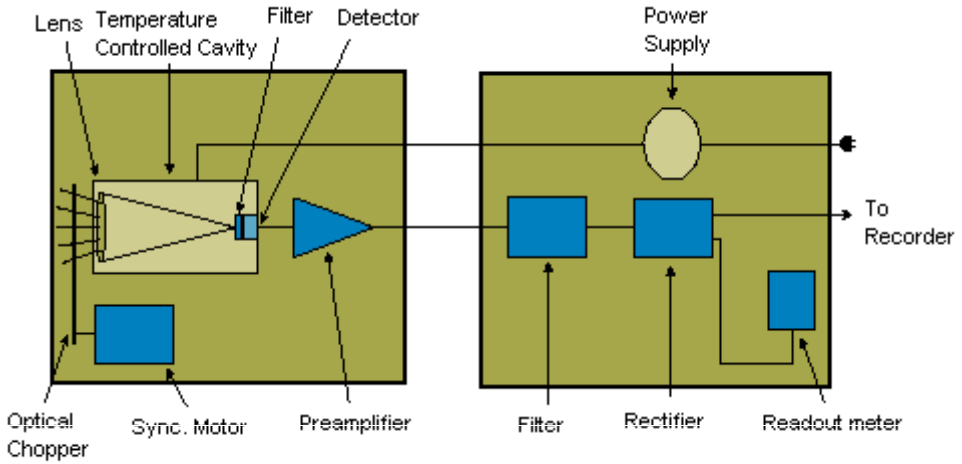


Fig. Pyrometer

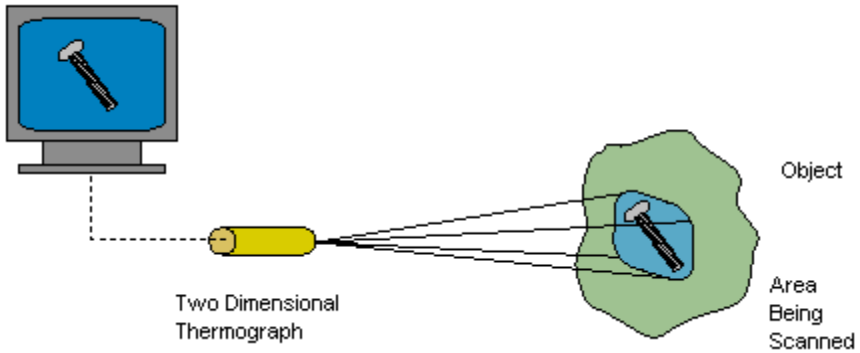


Fig. Thermal Imaging

Temperature Sensor Advantages/Disadvantages		
Sensor	**Advantages**	**Disadvantages**
Thermocouple	•Self-powered •Simple •Rugged •Inexpensive •Wide variety •Wide range	•Non-linear •Low voltage •Reference required •Least stable •Least sensitive
RTD	•Most stable •Most accurate •More linear than thermocouple	•Expensive •Current source required •Small •Low absolute resistance •Self heating
Thermistor	•High output •Fast •Two-wire ohms measurement	•Non-linear •Limited range •Fragile •Current source required •Self heating
Infrared	•No contact required •Very fast response time •Good stability over time •High repeatability •No oxidation/corrosion to affect sensor	•High initial cost •More complex/support electronics •Spot size restricts application •Emissivity variations affect readings •Accuracy affected by dust, smoke and background radiation