

Temperature Measurement

Course 277: Temperature Measurement

Covers units in thermal measurement and operation of RTDs (and wheatstone bridges), thermistors, and thermocouples and thermometers. Includes principles of pyrometry and operation of narrowband, broadband, and bandpass pyrometers. Discusses calibration standards, typical calibrating methods, and instrument testing.

TPC Training is accredited by IACET to offer **0.5 CEU** for this program.



Lesson 1: Temperature Measurement Principles and Indicators

Topics

Temperature; Heat; Specific Heat; Changing Physical State; Fahrenheit and Celsius Temperature Scales; Rankine and Kelvin Scales; Calibration of Temperature Scales; Primary and Secondary Standards; Industrial Uses of Temperature Measurements; Temperature-Measuring Instruments; Color Change as a Temperature Indicator; Melting Point as a Temperature Indicator

Objectives

- Define thermal energy and explain the relationships among thermal energy, heat, and temperature in a substance.
- Correlate changes in temperature with changes in a substance's physical state.
- Compare four temperature scales, and convert temperature readings from one scale to another.
- Explain how primary and secondary temperature calibration standards are used.
- Describe various temperature-measuring devices and contrast thermometers and pyrometers.

Lesson 2: Bimetallic and Fluid-Filled Temperature Instruments

Topics

Bimetallic Thermometers; Liquid-in-Glass Thermometers; Filled-System Thermometers; Liquid-Filled Systems; Gas-Filled Systems; Vapor-Pressure Systems; Thermometer Bulbs; Capillary Tubes and Bourdon Tubes; Temperature Transmitters for Filled Systems; Advantages and Disadvantages of Filled Systems

Objectives

- Discuss the physical characteristics and operation of bimetallic thermometers.
- Describe how liquid-in-glass thermometers are constructed and how they operate.
- Compare liquid-, gas-, and vapor-filled systems and discuss their advantages and disadvantages.
- Explain how a mercury thermometer operates.

Lesson 3: Electrical Instruments

Topics

How Resistance Thermometers Work; Wheatstone Bridge Circuits; Lead-Wire Error; RTD Elements; Advantages and Disadvantages of RTDs; Thermistors; Advantages and Disadvantages of Thermistors; Thermocouples; Extension Wires; Compensating for Changes in Reference-Junction Temperature; Advantages and Disadvantages of Thermocouples

Objectives

- Discuss the relationship between temperature and electrical resistance.
- Describe the function of RTD bridge circuits and explain how to calculate lead-wire errors.
- Compare the accuracy, response time, stability, and circuit complexity of RTDs and thermistors.
- Describe the operation of a thermocouple and explain how to compensate for changes in the reference junction temperature.

Lesson 4: Pyrometry

Topics

Molecular Activity and Electromagnetic Radiation; Principles of Pyrometry; Effects of Emittance; Effects of Temperature; Wavelength of Radiated Energy; Pyrometers and Wavelengths; Narrowband Pyrometers; Manual Optical Pyrometers; Using the Optical Pyrometer; Automatic Optical Pyrometers; Broadband Pyrometers; Using the Broadband Pyrometer; Bandpass Pyrometers

Objectives

- Discuss the principles that govern noncontact thermal measurements.
- Define electromagnetic radiation and emittance.
- Discuss the characteristics of a blackbody.
- Describe the effects of temperature and emittance on radiation intensity.
- Describe the operation of optical and radiation pyrometers.

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Lesson 5: Temperature Instrument Maintenance and Calibration

Topics

Primary Calibration Standards; Primary Standard Instruments; Secondary Standard Instruments; Instrument Inspections; Controlled-Temperature Environments; Using Triple-Point Baths; Ice Baths; Other Fixed-Temperature References; Calibration and Testing Methods

Objectives

- Compare and define primary, secondary, and working calibration standards.
- Describe typical testing procedures for temperature-measuring instruments.
- Describe routine maintenance and calibration procedures for temperature-measuring instruments.
- Explain how to use controlled-temperature environments—ice baths, triple-point baths, fluid baths, and fluidized baths.
- Explain how to calibrate liquid-in-glass thermometers, thermocouples, resistance thermometers, and pyrometers.