

Principles and Methods of Temperature Measurement

Course Content

Temperature can be measured via a diverse array of sensors. All of them infer temperature by sensing some change in a physical characteristic. There are four basic types of temperature measuring devices, each of which uses a different principle:

- 1) Mechanical (liquid-in-glass thermometers, bimetallic strips, bulb & capillary, pressure type etc.)
- 2) Thermojunction (thermocouples)
- 3) Thermoresistive (RTDs and thermistors)
- 4) Radiative (infrared and optical pyrometers)

Each of these is defined and discussed in this learning module.

Mechanical Temperature Measuring devices

Principle of Operation

A change in temperature causes some kind of mechanical motion, typically due to the fact that most materials expand with a rise in temperature. Mechanical thermometers can be constructed which use liquids, solids, or even gases as the temperature-sensitive material.

The mechanical motion is read on a physical scale to infer the temperature. The examples include:

- 1) *Liquid-in-glass thermometer*

The most common and well-known thermometer is the liquid-in-glass thermometer.



As the temperature rises, the liquid expands, moving up the tube. The scale is calibrated to read temperature directly. Usually, mercury or some kind of alcohol is used for the liquid.

- 2) *Bimetallic strip thermometer*

Two dissimilar metals are bonded together into what is called a bimetallic strip as figured below.



Suppose metal A has a smaller coefficient of thermal expansion than does metal B. As temperature increases, metal B expands more than does metal A, causing the bimetallic strip to curl upwards as sketched.

Principles And Methods Of Temperature Measurement

Thomas D. McGee



Principles And Methods Of Temperature Measurement:

Principles and Methods of Temperature Measurement Thomas D. McGee, 1988-05-19 The concept of temperature The thermodynamic temperature scale Entropy temperature and statistical mechanics The international practical temperature scale General characteristics of temperature measuring devices and treatment of data Liquid in glass thermometers Sealed liquid or gas sensing instruments and bimetallic sensors Electrical resistance temperature measurement using metallic sensors Thermistors and semiconductors for temperature measurement Thermoelectric temperature measurement Theory of radiant heat transfer as a basis for temperature measurement by radiant techniques The disappearing filament optical pyrometer Photoelectric optical pyrometers automatic and infrared Total radiation pyrometers Novel methods of temperature measurement Pyrometric cones Calibration methods Installation effects Dynamic response of sensors Temperature instrumentation and control Thermocouple reference tables

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A. Bhatia, 2014-10-17 Temperature is a principle parameter that needs to be monitored and controlled in most engineering applications such as heating cooling drying and storage Temperature can be measured via a diverse array of sensors All of them infer temperature by sensing some change in a physical characteristic be it a thermal expansion thermoelectricity electrical resistance or thermal radiation There are four basic types of temperature measuring devices each working on a different principle 1 Mechanical liquid in glass thermometers bimetallic strips bulb Understand the principle of operation of thermocouples Peltier effect Thompson effect and Seebeck effect Describe the basic construction of a thermocouple including materials used Understand the three laws of thermocouples law of intermediate metals law of intermediate temperatures and law of additive voltages Describe the difference between grounded ungrounded and exposed junctions Describe the basic principle and construction of RTD s and Thermistors Understand the difference between the two main types of thermistors i e positive temperature coefficient PTC and negative temperature coefficient NTC Explain how RTD resistance varies for increase and decrease of temperatures using bridge circuits Describe the basic principles of radiative temperature measurement including infrared and optical pyrometers

Springer Handbook of Atmospheric Measurements Thomas Foken, 2021-11-09 This practical handbook provides a clearly structured concise and comprehensive account of the huge variety of atmospheric and related measurements relevant to meteorologists and for the purpose of weather forecasting and climate research but also to the practitioner in the wider field of environmental physics and ecology The Springer Handbook of Atmospheric Measurements is divided into six parts The first part offers instructive descriptions of the basics of atmospheric measurements and the multitude of their influencing factors fundamentals of quality control and standardization as well as equations and tables of atmospheric water and soil quantities The subsequent parts present classical in situ measurements as well as remote sensing techniques from both ground based as well as airborne or satellite based methods The next part focusses on complex measurements and methods that integrate different techniques to establish more holistic

data Brief discussions of measurements in soils and water at plants in urban and rural environments and for renewable energies demonstrate the potential of such applications The final part provides an overview of atmospheric and ecological networks Written by distinguished experts from academia and industry each of the 64 chapters provides in depth discussions of the available devices with their specifications aspects of quality control maintenance as well as their potential for the future A large number of thoroughly compiled tables of physical quantities sensors and system characteristics make this handbook a unique universal and useful reference for the practitioner and absolutely essential for researchers students and technicians

Standards of the American Institute of Electrical Engineers American Institute of Electrical Engineers,1922 **Standard Handbook for Electrical Engineers** Frank Fuller Fowle,1922 **Humidity and Moisture: Principles and methods of measuring moisture in liquids and solids. P.N. Winn, Jr., editor** Arnold Wexler,1965

Handbook for Electrical Engineers Harold Pender,William Arthur Del Mar,1922 Principles of Solar Gas Turbines for Generating Electricity Amos Madhlopa,Richard Nkhoma,2025-07-19 This book now in its second expanded and updated edition is dedicated to solar gas turbines providing fundamental knowledge and state of the art developments in the field A gas turbine is a heat engine in which a mixture of fuel and air is burned in a chamber that is an integral part of the flow circuit of the working fluid The burnt gas mixture expands and turns the turbine which can be connected to a generator for electricity production Solar gas turbines offer an important alternative to conventional gas turbines driven by non renewable polluting fossil fuels such as diesel or natural gas The book provides a comprehensive overview of the topic as well as numerous illustrations The second edition provides step by step linchpins from fundamentals to advanced concepts of solar gas turbines The book features methods of designing and testing of this green technology It includes economic and environmental considerations of solar gas turbines that are crucial for sustainable energy production In addition worldwide case studies on the development of solar gas turbines are presented in this book and each chapter contains worked examples

Electric Motors, Their Theory and Construction Henry Metcalf Hobart,1923 **Transactions of the American Institute of Electrical Engineers** American Institute of Electrical Engineers,1921 List of members in v 7 15 17 19 20

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