Thermometry

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What is Thermometry?

Thermometry is the process of measuring temperature. Temperature is basically a measure of the amount of kinetic energy, particles possess. Nowadays, there are many different types of thermometers, for example glass in tube, thermistor, thermocouple, radiation thermometer etc.

History of Thermometry

Temperature measurement can be of 3 types:

a) Thermometers

b) Probes

c) Non-contact

Thermometers are the oldest of the group. The need to measure and quantify the temperature of something started around 150 A.D. when Galen determined the ‘complexion’ of someone based on four observable quantities. The first actual thermometer was an air-thermoscope. Up to 1841, there were 18 different temperature scales being used. Sprites of wines were eventually replaced by mercury, for better linear rate of thermal expansion. His calibration techniques was known to be a certain mixture of the melting point of a mixture of sea salt, ice, and water and the armpit temperature of a healthy man as calibration points. The two main calibration points used were boiling point of water and melting point of ice. About 1740 Anders Celsius proposed the centigrade scale. Its not clear who invented the scale, but it divided the range of the melting point of ice (100) to the steam point of water (0) into 100 parts, hence ‘centigrade’. Linnaeus inverted the scale so that 0 was the ice point and 100 was the steam point.Then soon enough the centigrade scale was renamed to Celsius scale.

Types of thermometers

Liquid-in-glass

Liquid-in-glass thermometer is the oldest and widest type of temperature measurement device used nowadays. A fair reading is given within -200 to 600 °C. It is generally possible to read the temperature from eye level. In this thermometer, the thermally sensitive element is a liquid contained in a graduated glass envelope. The main principle used is that of the apparent thermal expansion of the liquid used. It is the difference between the volumetric reversible thermal expansion of the liquid and its glass container that makes it possible to measure temperature. To make sure that mercury wont evaporate at room temperature easily, an inert gas like argon or nitrogen are filled above mercury.

Thermocouple

Introduction

Thermocouples produce a voltage when one spot has a different temperature from the set reference temperature at another spot, this is done by use of two non-similar conductors. It can also work backwards and produce electricity from a temperature difference, so it has other practical uses too. Thermocouples have the ability to work without any external power source, however, they aren't as accurate as most thermometers.

Working

The working principle as talked above, is originally based on a Seebeck's principle. It states that when two conductors are exposed to a temperature, voltage can be produced. This is done several times to get a reference, which can then be used to calculate temperature at any given voltage.

Platinum resistance thermometer(resistance temperature detectors (RTDs)

Introduction

One of the many devices, that measure temperature, this one is unique for its use of stable, ductile-able platinum wire, it is called a Platinum-resistance thermometer. This technology can offer a device that shows sensitivity and range.

Working

Accurate readings are given when the wire used is pure, as it gives a constant proportionality between CHANGE IN temperature and CHANGE IN resistivity. Therefore, when current passes from the wire, we can get the voltage off a voltmeter, then calculate resistance. Now we can make use of the graph or derive an equation of calibration, to determine the temperature.

Thermistor

Introduction

A thermistor works by responding to dynamic temperatures and producing resistance accordingly, much like a simple electrical resistor. It shows negative proportionality or has a negative temperature coefficient, so as temperature rises, resistance falls. SINCE THERMISTORS ARE MADE FROM SEMICONDUCTORS THEIR RESISTIVITY DECREASES WITH TEMPERATURE. Thermistors are regarded to be highly reliable and sensitive.

Working

As spoken of earlier, a thermistor is sensitive to temperature, so when temperature changes, resistance on it changes, which is then used to determine temperature. The graph shows an exponential curve, so giving more sensitivity over small temperature changes. WHICH GRAPH?

Radiation Thermometers (RTs)

Introduction

By using Radiation thermometers we can achieve 1D and 2D temperature images, as well as a 2D temperature maps and distributions. It makes use of thermal electromagnetic radiation, from a spot on the object, to record temperature.

Working

Basically, an RT is made up of an optical system, a detector and an emitivity adjuster. The optical system gets raw energy emission data from the specific target. The detector is used to change this form of energy to a readable electrical signal and the emitivity adjuster matches the thermometer calibration to the emitting properties of the target.

Integrated Circuit Temperature Sensors (IC Sensors)

Introduction

IC sensors can produce current that changes according to the temperature. It consists of two terminal integrated circuit temperature transducers, which means it is small compared to most temperature measuring devices and faster too. However, it cant record above 150 Celsius.

Working

It is most useful in digital control systems like computers, as it has an analog to digital converter that converts the output produced i.e. current or voltage, to digital data. Therefore, it doesn't require any additional circuitry. The current or voltage produced is according to the temperature.

[1]

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