

THERMOCOUPLES - Thermocouples are the most common, convenient, and versatile devices used to measure temperature. They convert units of heat into useable engineering units that serve as input signals for process controllers and recorders.

A thermocouple consists of a welded 'hot' junction between two dissimilar metals - usually wires - and a reference junction at opposite ends of the parent materials. Heating the 'hot' junction in the working environment produces a temperature gradient which generates an Electromotive Force (EMF). The EMF appears across the free ends of the thermocouple wires where it is measured and converted into units of heat calibration. Through selection of appropriate thermocouple wires and sheath components, thermocouples are suitable to be used in temperature ranges from (-200 to 2316) °C [-328 to 4200] °F.

RESISTANCE TEMPERATURE DETECTORS - Resistance temperature detectors (RTD) accurately sense temperature with an excellent degree of repeatability and interchangeability of elements. The RTD is composed of certain metallic elements whose change in resistance is a function of temperature. In operation, a small excitation current is passed across the element, and the voltage, which is proportional to resistance, is then measured and converted to units of temperature calibration. The RTD element is manufactured by winding a wire (wire wound elements) or plating a film (thin film elements) on a ceramic or glass core and sealing the element within a ceramic or glass capsule.

Since most RTDs have a low initial resistance, often 100 ohms, and have a small change in resistance per unit of temperature range, the resistance of the lead wire is often compensated for with a three or four wire bridge configuration built into the measuring devices. By selecting the proper elements and protective sheathing, RTDs can operate in a temperature range of (-200 to 600) °C [-328 to 1112] °F.

THERMISTORS - A thermistor is an economical means of precisely sensing heat over a limited range of temperatures. A thermistor is a metal oxide whose change in resistance is typically an inverse function of the change in temperature. An excitation current is passed across the sensor and the voltage, which is proportional to the resistance, is measured and converted to units of heat calibration. Since thermistors usually have a large base resistance and a large change in resistance per unit of temperature change, compensation for lead wire length is not generally needed. Thermistors can operate across a temperature range of (-40 to 150) °C [-40 to 302] °F by selecting the proper sensor and protective materials.

ADDITIONAL REQUIREMENTS - Other components usually essential in integrating the principles of thermocouple, RTD, and thermistor sensors into a functioning system may include: (1) a protection tube or sheath of a material suitable to protect the sensing element from the environment surrounding the point of measurement; (2) a connecting head and terminal block, or possibly a temperature transmitter; (3) leadwire of the correct material and insulation to connect the temperature sensor and the process instrumentation; and (4) recording or controlling instrumentation and control devices to provide a continuous temperature history of the system and to provide constant or programmed temperature regulation.