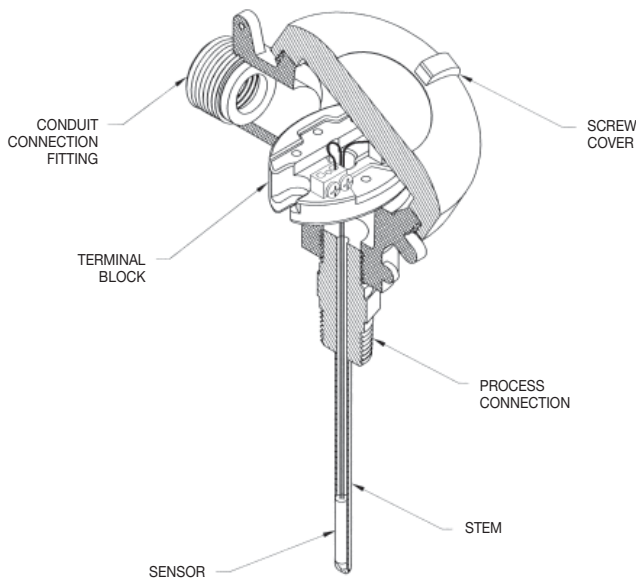


Electronic Temperature Sensors

DESIGN & OPERATION



Description

A temperature sensor is a device, typically a thermocouple or RTD, that provides for temperature measurement through an electrical signal. A thermocouple (T/C) is made from two dissimilar metals that generate electrical voltage in direct proportion to changes in temperature. An RTD (Resistance Temperature Detector) is a variable resistor that will change its electrical resistance in direct proportion to changes in temperature in a precise, repeatable and nearly linear manner.

Principles of Operation

Thermocouples

A thermocouple is made from two dissimilar metal wires. The wires are joined together at one end to form a measuring (hot) junction. The other end, known as the reference (cold) junction, is connected across an electronic measurement device (controller or digital indicator). A thermocouple will generate a measurement signal not in response to actual temperature, but in response to a difference in temperature between the measuring and reference junctions. A small ambient temperature sensor is built into the electronic measuring device near the point where the reference junction is attached. The ambient temperature is then added to the thermocouple differential temperature by the measuring device in order to determine and display the actual measured temperature.

Only two wires are necessary to connect a thermocouple to an electrical circuit; however, these connecting wires must be made from the same metals as the thermocouple itself. Adding wire made from other materials (such as common copper wire) will create new measuring junctions that will result in incorrect readings.

RTDs

To greater or lesser degrees, all electrical conducting materials have some amount of resistance to the flow of electricity. When a known electric voltage is applied across a conductor, the resistance varies based on the temperature of the conductor. This resistance can be measured and will correspond to a specific temperature. While various elements are affected by temperature in different ways, platinum is commonly used in an RTD due to its purity, linearity and stability over a wide range of temperatures. An electronic readout device, such as a controller or digital indicator designed to measure resistance, is required for use with RTD sensors.

Only two standard copper wires are necessary to connect an RTD to an electrical circuit, however, these connecting wires are also subject to small changes in resistance based on surrounding temperature. For this reason an "extra" third hookup wire is built into most RTDs as a compensation wire to allow the controller or display unit to correct for these variations.

Selecting an Electronic Temperature Sensor

All Trerice Thermocouples and RTDs should be carefully selected to meet the demands of the particular application. The information contained in this catalog is only offered as a guide to assist in making the proper selection. Improper application may cause failure of the sensor, resulting in possible personal injury or property damage.

To ensure minimum response time, Trerice Heat Transfer Paste should be applied to the sensing portion of the stem before installation into a thermowell. 1 oz. tube: Item No. 107-0001

Style

Trerice Temperature Sensors are available in a variety of styles. The weather proofed screw cover style provides an electrical conduit connection and can be used to house a transmitter (optional). For open system sensing, a non-threaded style is offered. This design is provided with integrated leadwire and can be Teflon covered to protect the stem and leadwire against corrosive environments. A standard plug with a mating jack may also be furnished.

Stem (Sheath)

All Trerice Thermocouples and RTDs are furnished with a 316 stainless steel stem, with the internal wiring packed in powdered ceramic. The screw head cover style is available in two stem types: welded and spring loaded. The welded stem is suitable for use in liquid applications. The spring loaded stem is designed to bottom out inside a thermowell, providing maximum heat sensitivity. Spring loaded stems are not pressure tight and may allow process media to escape; therefore, they must always be installed in a thermowell.

Insertion (U) Length

The insertion (U) length of a thermocouple or RTD represents its depth into the process vessel or thermowell. Trerice Thermocouples and RTDs are available in standard U-lengths from 2" to 24". Other lengths are available upon special order; please consult factory.

Measuring (Hot) Junction

Trerice Thermocouples are available in Type J and Type K, and use ceramic insulation to provide an ungrounded measuring junction. Other thermocouple types may be available, please consult factory.

Trerice RTDs are a platinum, 3-wire design, and are furnished with either 100 Ω or 1000 Ω resistance at 32°F (0°C), and a temperature coefficient of 0.00385 $\Omega/\Omega/^\circ\text{C}$.

Connection (Termination)

Trerice Thermocouples are provided with terminal block (screw cover head), mating jack, or integrated leadwire connections. The terminal block connection has no leadwire, therefore extension wire must be attached and routed to the electronic measuring device. Thermocouple extension wire must be identical to the thermocouple type, otherwise multiple measuring junctions will be made, causing inaccurate temperature readings.

Trerice RTDs are provided with a terminal block (screw cover head) or integrated leadwire connection. The terminal block connection has no leadwire, therefore extension wire must be attached and routed to the indicator or controller.