

Application

Measuring the temperature of small objects or small amounts of fluid can be a big challenge. While the RTD has the advantage over the thermocouple for sensor accuracy, there are cases where the measurement accuracy may be better with the less accurate thermocouple. For example, measuring temperature of a fluid inside a 5/8" diameter vial that has 1/16" of fluid depth presents such a challenge. It is very important note the distinction between sensor accuracy and measurement for applications such as this because the two can be very different. Details of the installation and ambient conditions are very important when selecting a temperature sensor for maximum accuracy.

Challenge

An RTD requires an immersion depth of about 10 times the sensor diameter plus the sensing element sensitive length to provide an accurate measurement. Less than that and the measurement will be affected by the ambient conditions due to heat conducting along the non-immersed portions. The smallest RTD elements available are not adaptable to accurately measure fluid that has a depth of only 1/16" and 5/8" diameter. If an RTD were used for this measurement the error may easily be 1°C or more. And the error may change due to variations in ambient conditions completely independent of the actual fluid temperature.



Small Diameter Thermocouple

Solution

A small diameter thermocouple although not as accurate as the RTD will provide a better measurement accuracy because it can be fully immersed in the fluid. A type T thermocouple with special limits of error has a sensor accuracy of 0.5°C and is available in diameters down to .040". Additional immersion depth can be accomplished by coiling the thermocouple sheath in a flat coil and immersing that in the fluid nearly eliminating the effects of conduction. This type of design although not ideal represents the most accurate compromise between sensor accuracy and measurement accuracy.