O'BRIEN analytical

Temperature Sensors

Where temperature monitoring of a Tracepak or Stackpak sample lines is required, it is important to select the proper temperature sensor. Thermocouples and RTDs are the most common types of commercially available temperature sensors. O'Brien has standardized on types J, K, and T thermocouples and 100 ohm 3 wire platinum RTD. These four were chosen because most temperature controllers will accept one or more of these sensors.

The thermocouple is created by the junction of two different metal alloys. This junction generates an electric potential (voltage) that is a function of temperature. Each type of thermocouple has a different useful temperature range and sensitivity. Thermocouples can be very small and respond rapidly to changes in temperature. The simplicity of a thermocouple makes for a robust sensor ideal for application in tubing bundles.

An RTD is a resistive element that changes resistance as a function of temperature. The resistive element in the RTD we use is made from platinum and has a resistance value of 100 ohms at 32°F (0°C). The resistance curve for the platinum RTD is linear and very stable over a wide temperature range.

Installing temperature sensors in a heated sample line is a unique application and commonly held beliefs regarding the advantages of one sensor over another do not hold true. Conventional wisdom is that an RTD is more accurate while thermocouples respond to temperature changes quicker. During extensive testing in tubing bundles we have found no appreciable difference in either accuracy or response time between any sensor type listed below. Table 1 summarizes the major differences between the temperature sensors used by O'Brien.

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Table 1 - Temperature Sensor Comparison

	Type J Thermocouple	Type K Thermocouple	Type T Thermocouple	RTD 100_Platinum 3 Wire
Maximum Useful Temperature Range	32 to 1283°F (0 to 750°C)	-328 to 2282°F (-200 to 1250°C)	-328 to 662°F (-200 to 350°C)	-436 to 1562°F (-260 to 850°C)
Error at 350°F (177°C)	± 2°F (± 1.1°C)	± 2°F (± 1.1°C)	± 1.2°F (± 0.7°C)	± 2.1°F (± 1.2°C)
Applicable Specifications	ANSI MC96.1	ANSI MC96.1	ANSI MC96.1	DIN-IEC-761 Class B
Lead Wire Colors	White (+) Red (-)	Yellow (+) Red (-)	Blue (+) Red (-)	Red (1) White (2)
Wire Gage	20	20	20	22
Types of Metal	Fe (+) Cu-Ni (-)	Ni-Cr (+) Ni-Al (-)	Cu (+) Cu-Ni (-)	Pt Element Cu Lead Wires
Maximum Run Length (85 m)	280 ft (52 m)	170 ft (102 m)	335 ft (38 m)	125 ft
Response Time	Excellent	Excellent	Excellent	Good
Durability	Excellent	Excellent	Excellent	Good
Stability of Sensor	Good	Good	Good	Excellent

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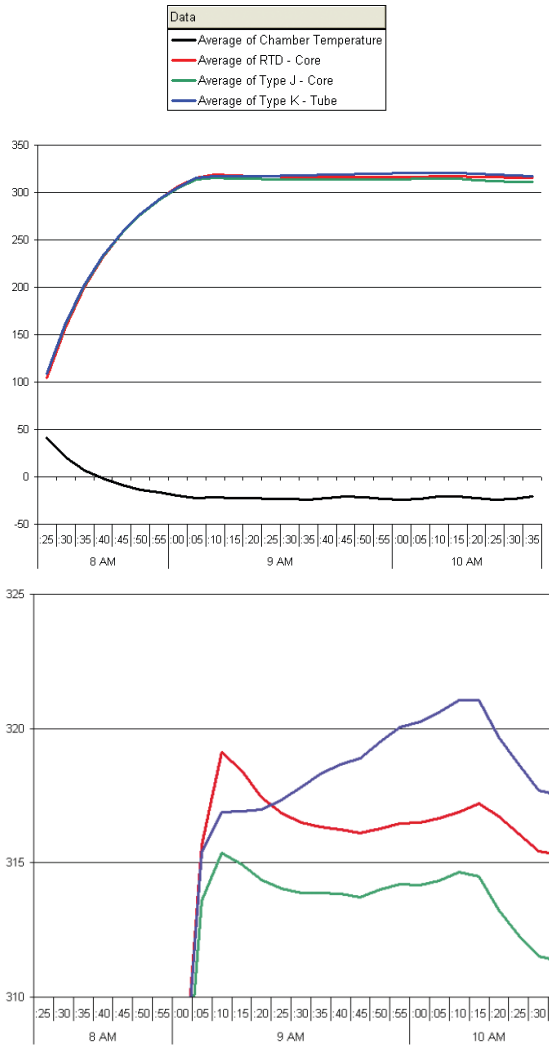
To offset the difference in accuracy between RTD and thermocouples, O'Brien utilizes thermocouple wire with special limits of error. This makes the response of thermocouples nearly as accurate as an RTD for this application. An example of our test data is shown below. The temperature traces for the Type J and K thermocouples are almost identical to the temperature trace from the RTD. The range of temperatures measured by these three sensors during testing was found to be just 2.8°F (1.6°C). This is a difference of less than 1% in the indicated temperatures.



Within the thermocouple family, it is important to select the appropriate thermocouple for an application. This includes checking the temperature range and the material compatibility of the thermocouple with the environment it will be operating in. It should be noted that type J thermocouples are not recommended for use below 32°F (0°C), and that some temperature controllers will not function and/or show an error message if the temperature of the type J thermocouple falls below 32°F (0°C). Consequently if you use a Type J thermocouple in a situation where you may be starting the system at temperatures below 32°F (0°C) you may have to operate the system manually until the bundle heats up.

Figure 1
Factory Sensor Installation

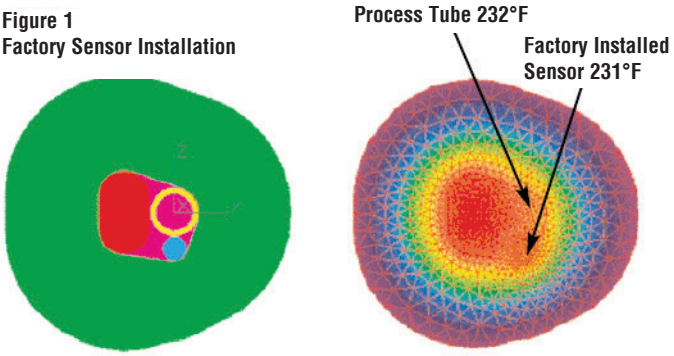
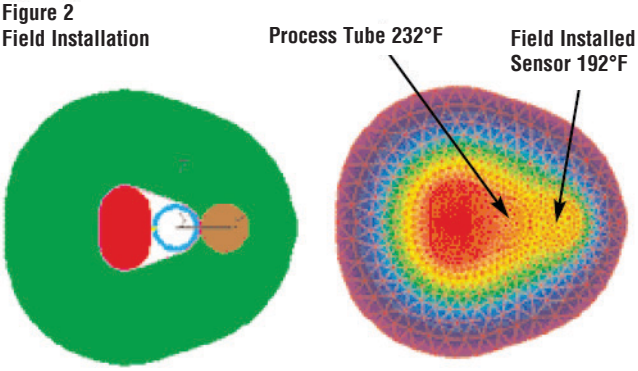


Figure 2
Field Installation



Data from O'Brien's tests show that accurate results may be obtained with either a thermocouple or an RTD. Since the selection of a temperature sensor is left to the customer, it is important that a customer select a temperature sensor that is compatible with their process temperature and controller.

It is also important to consider the manner in which the temperature sensor is installed. The data shown in Figure 1 is from temperature sensors that were installed properly in O'Brien Corporation's manufacturing facility. Figure 2 shows data from temperature sensors where a type K thermocouple was not installed correctly in a test bundle. The resulting temperature reading was off by 10.6°F (5.9°C). This is an error of 3.4% showing that accuracy is more dependent upon sensor placement than the type of sensor used.