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From the Glass Thermometer to Fiber Optics

An Overview of Leading Sensor Technologies & Applications

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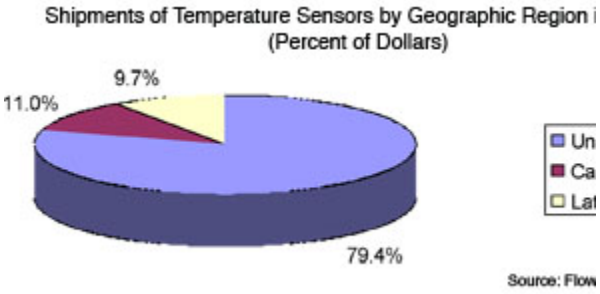
The form of temperature measurement that most people are familiar with is the thermometer. German physicist Gabriel Daniel Fahrenheit was the first person t mercury as a thermometric fluid when he developed the mercury thermometer i Mercury is a good conduit for measuring temperature because its freezing point substantially below that of water, and its boiling point is significantly higher. Me expands smoothly with changes in temperature.

When Fahrenheit created his thermometer, he did not use the freezing and boili of water as reference points. Instead he used a mixture of ice and salt as a refe a cold point, and the temperature of the human body as a reference for the wa Fahrenheit associated zero degrees with his mixture of ice, water, and salt. The water mixture without the salt read 32 degrees. The temperature of the human read 96 degrees.

Fahrenheit's thermometer has since been recalibrated, and while 32 degrees Fahrenheit is still recognized as the freezing point, the temperature of the human body is now recognized as 98.6 degrees Fahrenheit. The boiling point of water is 212 degrees on the Fahrenheit scale.



Swedish astronomer Anders Celsius created his temperature scale in 1742. In t zero degrees was the boiling point of water and 100 degrees was the freezing p water. These points were later reversed, so the freezing point is now recognizec degrees and the boiling point of water is 100 degrees. For many years, these de were called degrees centigrade, until in 1948 the National Conference on Weigh Measures decreed that degrees centigrade should be called degrees Celsius.

While glass thermometers are sufficiently precise to handle many of the tempera measurement needs of daily life, they are not suited to the needs of most indus environments, primarily because they do not have an output and require a man reading. Also, glass thermometers are not designed to survive the temperature found in many industrial applications, and their range of measurement is rather

For industrial environments, there are five main types of temperature sensors p

in today's marketplace. These include thermocouples, resistance temperature de (RTDs), thermistors, infrared thermometers, and fiber-optic temperature sensor

Thermocouples are the most widely used temperature sensor in industrial manufacturing environments. Thermocouples consist of two wires made of diffe metals that are joined at one end. This point is called the measurement junctior other end of the conductors is called the reference junction. When the measure junction and the reference junction have different temperatures, a continuous c flows in the circuit. The resulting voltage is a function of the difference in tempe between the measurement and the reference junctions. The amount of voltage on the types of metals used. A voltmeter or other device is required to interpret voltage reading as a temperature value.

Thermocouples are the workhouse of the temperature sensor world, as they are most widely used type of temperature sensor. They come in a multitude of type composed of different mixtures of metals and designed for different temperatur and conditions.

Resistance temperature detectors, or RTDs, monitor the flow of electricity t wire under different temperature conditions to arrive at a temperature measure Platinum is the most commonly used wire material in RTDs. There are two type RTDs — wirewound and thin-film. Wirewound RTDs consist of wire wound on a which is enclosed in glass or metal. For thin-film RTDs, a film is etched onto a c substrate and sealed. RTDs are more accurate and stable than thermocouples, b cannot be used to measure extremely high temperatures.

Thermistors, like RTDs, also change resistance with changing temperatures, b are more sensitive than RTDs, and they are highly nonlinear. Because of their e sensitivity and nonlinearity, thermistors are limited to measuring temperatures c hundred degrees Celsius. They are also less rugged than RTDs, which further lir application.

Thermistors have a narrower temperature range than either RTDs or thermocou they are more capable of registering temperature changes within those narrowe Thermistors are widely used in food service, food transportation, and HVAC indu Increased concern with food safety is leading to more government regulations t require food temperature to be monitored and recorded during shipping and sto This is increasing the demand for thermistor probes that monitor food temperat

Infrared thermometers are primarily used to measure temperature when oth temperature measurement methods aren't feasible. For example, infrared therm are used to measure the temperature of moving objects, such as moving machi conveyor belt. They are also used in hazardous environments where contaminat present, or in applications where the distance is too great for contact sensors. I sensors detect the infrared energy given off by materials. The most common de includes a lens to focus the infrared energy onto a detector. The amount of infra energy is then converted into a temperature measurement, according to specifia units.

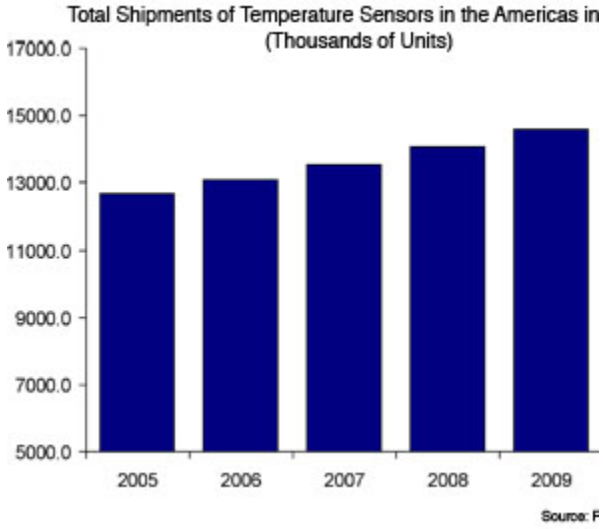
The infrared thermometer market is undergoing rapid growth for several reason of which has to do with end-user familiarity. Infrared is actually not a new techr and infrared thermometers have been around for more than 35 years. Even tho infrared thermometers have a number of technical advantages, there are many in which infrared cannot easily replace thermocouples and RTDs. Infrared therm are mainly used when contact temperature sensing is impractical. For example, thermometers are often used to measure the temperature of rotating machinery

make measurements in environments where extremely high voltages are preser

Fiber-optic temperature sensors are a form of temperature measurement th optical fibers to arrive at a temperature measurement. Most types of fiber-optic temperature sensors work by placing a temperature-sensing component on one optical fiber. The other end is attached to a measuring system that collects radia processes it into a temperature value.

Fiber-optic temperature sensors are the newest kid on the temperature-sensing These temperature sensors function well in harsh environments, including radio frequency (RF), microwave, and high-voltage environments. While they are mor expensive than other technologies, fiber-optic temperature sensors succeed in s applications where temperature cannot be reliably measured by other means.

Technology Shifts the Market



The temperature sensors market in 2007 is marked by several important shifts in technology. One is the shift away from contact to noncontact measurement. This involves a shift away from thermocouples, RTDs, and thermistors to infrared thermometers and fiber-optic temperature sensors. Both infrared thermometers and fiber-optic temperature sensors are forms of noncontact temperature measurement.

Another technology shift that is occurring in the temperature sensor market is a shift within contact-type from thermocouples to RTDs. Users are increasingly selecting RTDs over thermc because of their higher accuracy and stability. Also, an increasing number of hig RTDs are being produced. As a result, thermocouple revenues are projected to over the next several years.

Still another technology shift in the temperature market is the shift from wirewo thin-film RTDs. Thin-film RTDs are becoming more popular because their techno improved significantly and because they cost less than wirewound RTDs. Wirew RTDs are still preferred for the most rugged applications. Sensitivity to vibration traditionally been a problem for RTDs, and thin-film RTDs are now made that ar sensitive to vibration. Other improvements include improvements to the lead wi make them less likely to break off. This has been a problem in the past for some film RTDs.

Expect continued improvements in temperature sensing technologies, as compa continue to battle for market share. There has been a substantial amount of consolidation among temperature sensor suppliers in the past five years, and th is likely to continue as well.

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This article is based on Flow Research's study, "The Market for Temperature Se the Americas." For more information on this study visit Flow Research's tempera portal www.tempflows.com.