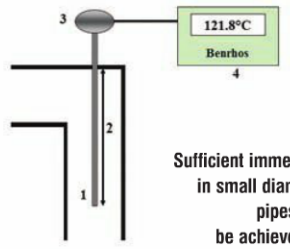
How to... Maintain the accuracy of your PRT

PRTs – Platinum Resistance Thermometers – can suffer from issues such as contamination and moisture ingress. **Dave Ayres** of Benrhos takes a look at how to solve problems with your PRTs

As a measurement technology designed to determine temperature, Platinum Resistance Thermometers – or PRTs – offer accuracy, repeatability and sensitivity. They should, in fact, be used in applications where accuracies of better than ±0.5°C are required. Of additional benefit to users, many PRTs comply with BS EN 60751 (2005) or an equivalent.

PRTs measure the electrical resistance of platinum wire, also known as the temperature sensor and, if maintained carefully and regularly calibrated, will be a reliable temperature measurement solution.

There are, however, a number of issues that will affect the accuracy and reliability of a PRT, so how do you go about solving these problems?



Sufficient immersion in small diameter pipes can be achieved by using a bend

Factors to consider

Sensor: The most accurate sensor construction is the wire wound type; whereas the most robust sensor construction is the thin film type. Very few metal sheathed PRTs work reliably above 450°C due to changes in the sensor and contamination of the sensor by the out-gassing of the containment sheath.

The ingress of moisture into the PRT due to faults in the sheath and operation below 0°C will result in a lowering of the indicated temperature. Although moisture can be removed from a faulty PRT by taking it above 100°C, it can be driven out. It will, however, return if used at low temperatures.

Other issues include mechanical shock and vibration, which can cause strain in the sensor and an increase in the indicated temperature. While annealing the PRT may reduce the strain, if the annealing temperature is too high it will damage the sensor. Furthermore, the drive current used to measure the resistance of the PRT can cause serious self-heating if it is too high or the sensor is very small and in air.

Immersion: To reduce stem conduction errors, PRTs should be immersed into the object whose temperature is to be measured to at least 20 times its diameter plus the length of the sensor. For example, for a probe with good thermal contact with the object, then a 6mm diameter PRT with a 25mm long sensor should be immersed by more than 145mm.

Sufficient immersion in small diameter pipes can be achieved by using a bend (see diagram above). If there is turbulent flow in the pipe then pointing it downstream will tend to give the average temperature, but pointing it upstream will lesson stem error. Thermowells will require similar consideration to reduce stem errors.

Connections: A 4-wire connection will give the most accurate temperature measurement, followed by 3-wire connections. A 2-wire connection will give a simple lightweight temperature measurement – as is required in space vehicles – but can be inaccurate due to the resistance of the 2-wires being part of the overall resistance measurement.

The accuracy of a 2-wire system can be improved by using a 1000 ohm rather than a 100 ohm sensor, or nulling out any error by calibrating at the operating temperature. However, magnetic fields, such as those found in electric motors used to stir calibration baths or pump process fluids, can interfere with connection cables, causing incorrect or unstable temperature indications.

Indicator: DC instruments can suffer from thermo-electric errors developed in the PRTs cables and connections. A 0.04mV thermoelectric voltage will cause a 0.1°C error in an indicator using a 1mA current, and a 1°C error for a sensing current of 0.1mA.

To determine the thermoelectric voltages in a circuit, disconnect the indicator and use a microvolt sensitive meter to measure across the wires. Switched DC or AC instruments give the most accurate measurements; and indicators should be fit for purpose.

By considering the points above, you should have a PRT that offers the reliability and accuracy that your application demands.

Temperature measurement solutions

Not only does Benrhos offer a wide range of temperature measurement solutions, but it also offers a design service to create products specifically for customer applications. Product accuracy is ensured by thorough calibration. However, if on-site calibration is needed once you have purchased your product, the company also offers equipment in the form of calibration baths.

If additional knowledge and expertise is needed, the company provides industrial temperature training courses which provide practical experience in both temperature and humidity measurement.

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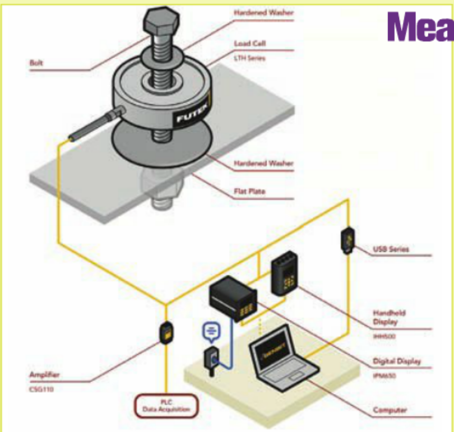

Measuring tightening force with Thru-Hole load cells

The LTH series of Thru-Hole (Donut) load cells from FUTEK are being used in applications where measurement of the tightening of load is required. As an example, the load cells can be installed between a bolt head and the nut, where they measure the load as torque is applied.

Engineers at FUTEK recommend that a hardened washer is added between the load cell and nut to avoid high friction and maintain flatness of the load cell during tightening and untightening.

As the bolt starts to tighten, the load cell measures the force applied. It is then possible to monitor data during this process via the company's IPM650 digital display or handheld IHH500 display. Alternatively, it can be streamed to a computer via FUTEK's USB solutions.

The acquired data enables engineers and operators to verify whether they have reached the desired tension on the fastener, stud or bolt via the SENSIT test and measurement software.

Benefits of the Thru-Hole load cell in this application include: it avoids damage to bearing surfaces; there is a decrease in problematic tightening of large bolts; easier untightening; and simultaneous tightening improvements.

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