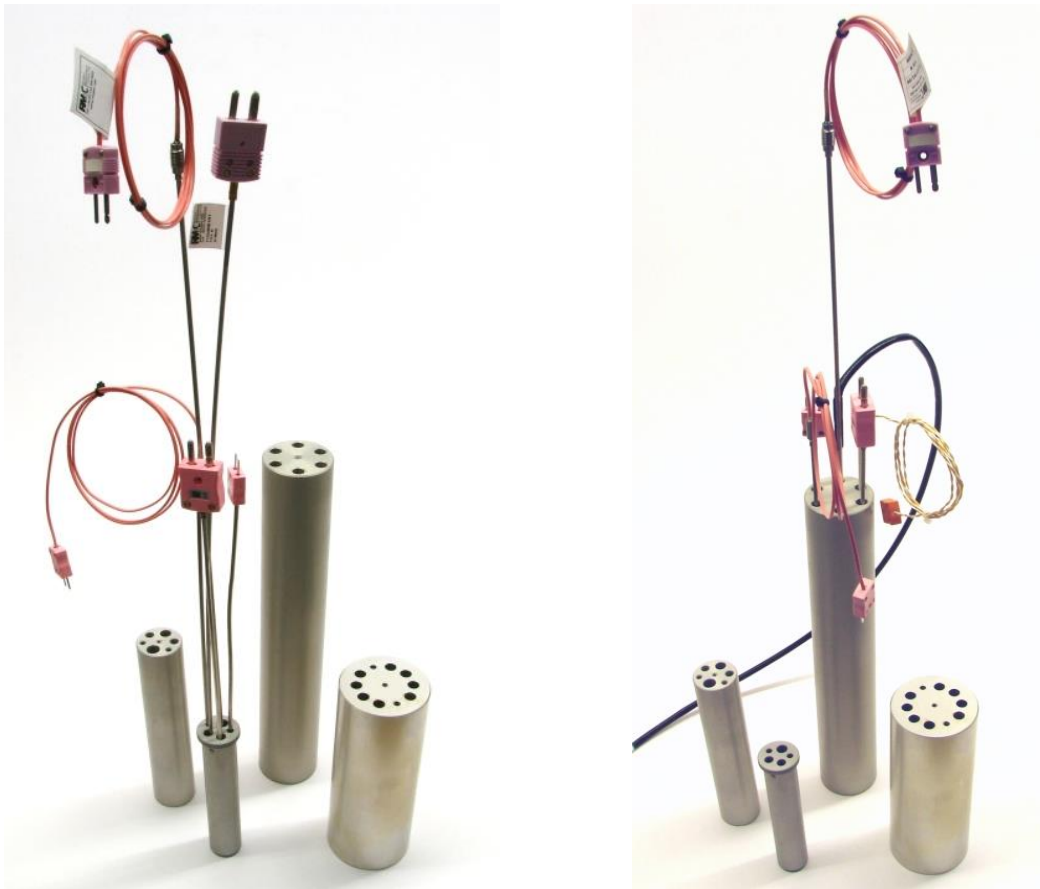


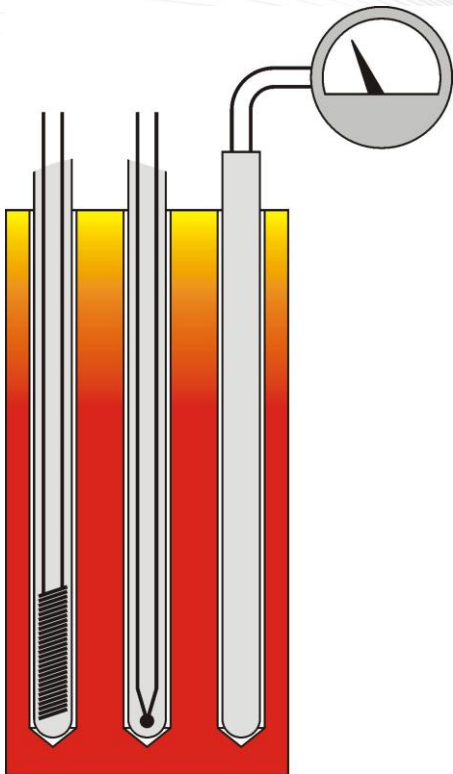
## HOW HOT IS YOUR BLOCK?

With temperature measurement we face a challenge. That is we can not measure temperature directly, we must use a temperature sensor or transducer. With a resistance thermometer we measure resistance which is proportional to the temperature that we wish to measure. With a thermocouple we measure voltage; with a liquid in glass thermometer we measure the length of a column of liquid.

A further challenge we face is that very often the temperature sensor will not be at the same temperature as the system we want to measure. Further the introduction of the sensor may even change the temperature of the system.



Small Blocks will be more affected by loading errors than larger volumes.  
Isotech have a range of insert sizes to suit all applications.



The diagram below shows a metal block, the block is a few degrees cooler at the top than at the bottom, there is a temperature gradient. In it are placed three different types of temperature sensor. One a platinum resistance thermometer which has a sensing length of 20mm, a thermocouple with a short sensing length and a dial thermometer with an extended sensing length.

All three thermometers will read differently, the resistance thermometer integrating the value over the length of its sensing coil, the thermocouple the temperature at the bottom of the pocket and the dial thermometer the temperature over the length of the bulb.

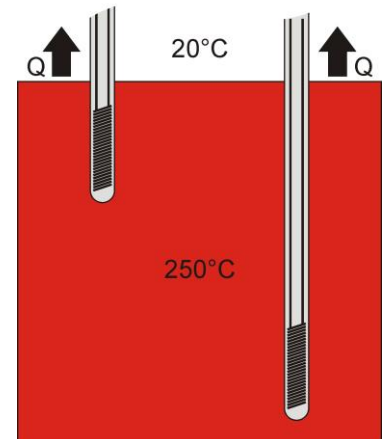
Even in a “perfect” block, with no temperature gradient, different thermometers might report different values for the same block or bath temperature.

The depth of immersion of the sensor is important. Often temperature sensors are simply not immersed deep enough, or made long enough for them to reach the same temperature as the system.

In the diagram a thermometer is immersed a short distance into a tank of oil at a uniform temperature of 250°C.

The first thermometer is not immersed deeply enough to allow it to reach the same temperature as the oil. It is not in thermal equilibrium. There is a flow of heat along the stem and the thermometer will be a different temperature than the oil due to stem conduction or immersion error. It will therefore report a lower value than a second thermometer immersed at a greater depth.

The minimum depth of immersion will depend on the thermometer type, the temperature difference between the oil and the environment and the desired uncertainty of the measurement. Isotech have a number of resources discussing stem conduction from a training course, online e-learning and technical articles.



Isotech Dry Blocks are designed to have good uniformity, and this is specified generally over the bottom 40mm of the pocket. Evaluations reports with thermal surveys are available from the Isotech website, [www.isotech.co.uk](http://www.isotech.co.uk).

Best practice is to place a calibrated probe in the block and compare the thermometers under test to the reference probe. On the Isotech SITE models a separate temperature indicator is provided for the reference probe.

When a Dry Block is calibrated, the controller and indicator are programmed with calibration data to digitally match the display to the measured temperature. The offset between the controller and the block temperature may vary depending upon the loading of the block. With a site model, or when using an external reference probe this will not affect the calibration as the probe alongside the test probe will show the effect of the loading. When a sensor being calibrated has similar immersion characteristics to the test probe, much of the immersion error is cancelled out.

When calibrating sensors in Dry Blocks the choice of when to use the controller value, or a reference probe must be made. This decision should be taken with regard to the application, the number and types of sensor, the temperature range and the required accuracy.

Isotech have a full range of portable and transportable Dry Blocks with immersion depths from 120 to 285mm, rely on our product range and experience to provide a calibration solution for all types of probe.

Related Article: [Temperature Calibration: Depths of Immersion](http://www.isotech.co.uk/pdfs/immersion.pdf)  
<http://www.isotech.co.uk/pdfs/immersion.pdf>