ISOTECH

Whitepaper

ANNEALING:

- Annealing should be seen as part of the maintenance of a thermometer
- When using the SPRT with a programmable bridge you should always update the programmed data with a current R_{TPW} value

Standard Platinum Resistance Thermometers

Strain

A Standard Platinum Resistance Thermometer (SPRT) has a very fragile coil of Platinum Wire that may be supported on a mandrel or be unsupported in a Thermometer Assembly.

SPRTs are designed to allow the wire to expand and contract in a strain free manner – the benefit is the performance is superior to Industrial Platinum Resistance Thermometers but all SPRTs are more prone to damage and shift from handling. It has been said that if you can hear that you have put an SPRT down on a hard surface it may strained.

During transit it is inevitable there will be mechanical shock and vibration and that the SPRT coils will experience strain. This to be expected, there is no getting away from this.

When a thermometer is strained, the platinum is being stretched and thinned (like a strain gauge) and the resistance increases. By heating the thermometer (annealing) and then cooling it in a controlled way, the crystal lattice of the platinum returns to its original condition and the resistance of the thermometer reduces. Annealing should be seen as part of the maintenance of a thermometer rather than a last-ditch fix for any issues.

If the strain is introduced into the thermometer through a high energy impact, then in order to remove it, the thermometer needs to be taken to a high temperature. However, this temperature is limited by the construction of the thermometer itself. For a 25 Ohm SPRT such as the Isotech 909Q or a 670SQ, the highest temperature it can go to is 670°C, but this may not be enough to completely remove all of the strain. We see this with thermometers that have had severe knocks, and normal annealing at 670°C will not bring the strain out. In truth, the platinum needs to go to a much higher temperature (way beyond the capability of the thermometer construction) to remove this sort of strain and so there is a limit to what annealing can remove, dependent upon how the strain was first introduced.

In many instances, the ideal anneal cycle would be to hold the thermometer at 670°C for 2 hrs, then cooled slowly to 450°C where it should then be soaked for 30 minutes before being removed to ambient and then its resistance measured at the triple point of water (TPW). This can be repeated a number of times if required but the amount of resistance reduction will be much less after each additional cycle.

Regardless of whether the R_{TPW} returns to the original value or not, (for the reasons described above) the most important thing is that the *W* values for the SPRT remain the same. This is easily checked by calculating the ratio of the resistance at the gallium point (R_{Ga}) to the resistance at the water triple point, W_{GA} and comparing this value to that on the calibration certificate.

The Isotech Model 414 Annealing Furnace

A sharp decrease in W_{Ga} is a sign that the purity of the platinum has been affected and further investigation is required. Contact Isotech for guidance.

When using the SPRT with a programmable bridge you should always update the programmed data with a current R_{TPW} value, this keeps on top of any movement in the resistance of the thermometer and ensures that the error in displayed temperature is minimised.

If making the measurement using a ratio bridge then a current R_{TPW} value should always be used when calculating *W* value and then that new W value should be used to calculate the corresponding temperature.

Each SPRT supplied by Isotech is delivered with a traceable certificate stating the Resistance at TPW and Ga Melting Point and the W_{Ga} value for the thermometer.

This allows the user to reference this when performing repeat tests.

MEASURED TEMPERATURE °C	MEASURED VALUE OF THERMOMETER *W*	UNCERTAINTY OF MEASUREMENT ±°C
0.01	25.396591	0.001
29.7646	28.396286	0.002
W (29.7646 °C) = 1.1181141		

$$W_{Ga} = \frac{R_{Ga}}{R_{WTP}} = \frac{28.396286}{25.396591} = 1.1181141$$

Note: ITS-90 prescribes that the W_{Ga} value for an SPRT ≥1.11807.

Help and Advice

If you need low uncertainty measuring systems we can help, contact us for free advice and consultation. We have proven solutions at all levels in temperature metrology, from high accuracy cost effective industrial measurements systems to the lowest uncertainty systems for primary metrology used by the world's leading National Metrology Institutes.

If you have any questions, if you need any advice, if you would like a free consultation then please get in touch