HIGH TEMPERATURE STANDARD PLATINIUM RESISTANCE THERMOMETER MODEL 96178

User Maintenance Manual/Handbook

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GUARANTEE

This instrument has been manufactured to exacting standards and is guaranteed for twelve months against electrical break-down or mechanical failure caused through defective material or workmanship, provided the failure is not the result of misuse. In the event of failure covered by this guarantee, the instrument must be returned, carriage paid, to the supplier for examination and will be replaced or repaired at our option.

FRAGILE CERAMIC AND/OR GLASS PARTS ARE NOT COVERED BY THIS GUARANTEE

INTERFERENCE WITH OR FAILURE TO PROPERLY MAINTAIN THIS INSTRUMENT MAY INVALIDATE THIS GUARANTEE

RECOMMENDATION

The life of your **ISOTECH** Instrument will be prolonged if regular maintenance and cleaning to remove general dust and debris is carried out.

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The company is always willing to give technical advice and assistance where appropriate. Equally, because of the programme of continual development and improvement we reserve the right to amend or alter characteristics and design without prior notice. This publication is for information only.

OPERATING INSTRUCTIONS

INTRODUCTION

You or your company has just paid a considerable sum of money to purchase this 96178.

Although the materials to make the 96178 are very costly, it has also taken up to 1000 hours to prepare the 96178 for your use.

It is not a product that can be assembled, tested and sold; it is produced, calibrated, aged and re-calibrated, until its characteristics are stable enough to meet the exacting needs of ITS 90.

The weeks of work that go into its production make each 96178 more than another product. Each 96178 already has a character and a history before it leaves us. Please look after it. Regard yourself as its custodian rather than its owner.

1. Always keep the 96178 in its case when not in use.

2. When in use, support the handle.

3. Cool and store the 96178 in the same place as you normally use it.

4. Each time before you use the 96178 clean off all traces of grease by using a chlorinated solvent.

5. Even go so far as using gloves to handle the 96178, and keep the gloves clean.

6. Quartz is glass. It is a supercooled liquid. At 800°C and above, your 96178 will bend and bow if you do not support it along its complete length. At high temperatures I recommend that the 96178 be housed inside a close fitting recrystallised Alumina closed ended tube, which has been pre-fired to 1000°C, or better still a silicon carbide tube.

7. Quartz is transparent in two senses of the word. At temperatures above 700°C metallic vapours can pass through the quartz and attack the pure platinum sensing element. Isotech have developed a product which can be attached to the 96178 to prevent this happening to a 960 Ioniser. A Model 960 Ioniser is provided free with each 96178.

8. If you have purchased the 'Open' version of the 96178, open the valve at high temperatures and close it before bringing the 96178 down to room temperature. This will ensure that no moisture builds up inside the thermometer.

RETURNING YOUR THERMOMETER TO ISOTECH

Due to the fragility of the 96178 we strongly recommend that this is not transported unless personally hand carried.

In the event that the unit must be shipped by courier then the following instructions must be adhered to and reference to diagram on page 12.

Preparing the box

Place the two foam blocks over the closed case and lower into inner box. Pad out ends with polystyrene chips to stop the unit from moving - seal the box, lower it into the outer box and fill with chips, then lift the inner box slightly so the polystyrene chips completely surround it. Place the protective sheath if supplied on top of the chips and seal the box.

Always remember to label the box thoroughly with “fragile” and “this way up” labels and arrange adequate insurance cover.

Your unit should now be ready to send.

STABILITY EVALUATION

INTRODUCTION

The 96178 is one of a new generation of thermometers designed at Isotech. It is a high temperature thermometer working up to 1000°C and being 0.25 ohms at 0°C.

Its main radical and new features are:

1. The 96178 can be supplied pre-sealed with an inert gas containing 10% oxygen or with a valve built into the handle so the user can allow the thermometer to breath.

2. The quartz used is a new and more pure material.

3. The internal construction is made of many small parts to eliminate stem conduction.

4. The internal structure contains a platinum light scattering disc to reflect radiant energy.

In this report the first production unit was cycled to the silver point to test the reproducibility of the W value at silver, and to check the stability of R_{TPW}.

METHOD

The 96178 thermometer, like all high temperature thermometers will change its characteristics if subjected to step changes of temperature. The way in which the thermometer is temperature cycled is therefore very important.

In this series of tests the following strategy was adopted:-

The thermometer was placed in a pre-warming/annealing furnace at 400°C. The furnace temperature was then slowly raised to 850°C (The apparatus used was the Isotech Dual Furnace which has been pre-programmed with ramp-rates suitable for pre-warming the High Temperature Thermometers). From this furnace, the thermometer was transferred to a heat pipe furnace in which was placed a silver cell. The silver had previously been melted and partially frozen.

After 30 minutes in the cell, during which time and after stabilisation 4 to 6 readings were recorded, the thermometer was transferred back to the annealing furnace, still at 850°C.

The annealing furnace was then cooled to 425°C overnight and R_{TPW} measured the next morning.

Other thermometers of proven good stability were cycled with the 96178 to add further confidence that the method gave stable results.

RESULTS

The following results were obtained during two temperature cycles to the silver point. Mean values are tabulated.

Serial No. 96178/1 is the new thermometer.

Serial No. 962/148 the best thermometer from my store of standards - it also "breathes" i.e. the air inside the stem is not sealed in.

Ohms or ratio	**962/148**	**96178/1**
Initial R_{TPW}	0.2362608	0.2100675
R Ag	1.0127804	0.9004547
R TPW	0.2362600	0.2100668
W Ag	4.2867197	4.2865160
W Ga	1.1181537	1.1181429
R Ag $_{(2)}$	1.0127804	0.9004532
R TPW $_{(2)}$	0.2362602	0.2100667
W Ag $_{(2)}$	4.2867160	4.2865109
W Ga $_{(2)}$	1.1181541	1.1181439

DISCUSSION OF RESULTS

High temperature thermometers take a long while - many hundred, if not thousands of hours - to stabilise completely. Thermometer 962/148 is some 3 to 4 years old and has proved to be our most stable thermometer.

96178/1 was stabilised only overnight after its arrival from manufacture; even so the stability of the new thermometer is remarkable.

There is always an initial shift in the characteristics of a high temperature thermometer during its first cycle to the silver point. In this instance, both thermometers became more fully annealed, and so the R_{TPW} was reduced by 0.7 & 0.8 mK; then, between the first and second calibrations the R_{TPW} remained stable at 0.1 and 0.2 mK.

Some high temperature thermometers exhibit better stability in the reproducibility of the resistance at the silver point, whilst others keep better W silver stability. In this evaluation we can look at both R silver and W silver.

The R silver reproducibility of Serial No. 962/148 was perfect -a very unusual - if not unique - situation.

96178/1 thermometer reproduced R silver by 1.5 mK, still exceptionally good.

962/148 reproduced W silver to within the equivalent of about 1 mK

96178/1 to within the equivalent of about 1.5 mK.

These are both exceptionally good results.

To put the above results into context; N.P.L. would permit a shift of up to 5 mK in R_{TPW} and a spread of 20 mK in W silver during a full calibration cycle.

CONCLUSION

The 96178/1 thermometer has shown itself to be as stable as our very best standard thermometer after only an overnight anneal.

FURTHER WORK

As more thermometers are produced and tested further reports will be issued to confirm the results above.

Uncertainties vary depending on the temperature range of calibration.

Isotech's Models 670H and 96178 Standard Platinum Resistance Thermometers (SPRT's) can be calibrated using procedural techniques aimed at achieving the uncertainties outlined in Issue 13 of our Schedule of Accreditation see page 11.

Alternatively, at an extra cost the SPRT's can be calibrated in line with a specific procedure aimed at achieving the uncertainties outlined in Issue 35 of our Schedule of Accreditation, see page 10.

Schedule of Accreditation

issued by

United Kingdom Accreditation Service

21 - 47 High Street, Feltham, Middlesex, TW13 4UN, UK

UKAS CALIBRATION

0175

Accredited to ISO/IEC 17025:1999

Isothermal Technology Ltd

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Calibration performed at the above address only

DETAIL OF ACCREDITATION

Measured Quantity Instrument or Gauge	Range	Best Measurement Capability Expressed as an Expanded Uncertainty (k=2)	Remarks
TEMPERATURE			
Platinum thermocouples Calibration by comparisons	-50 °C to 0 °C 0 °C to 50 °C 50 °C to 660 °C 660 °C to 1100 °C 1100 °C to 1300 °C	0.5 °C 0.45 °C 0.4 °C 0.7 °C 1.7 °C	
Calibrations at fixed points	232 °C up to 962 °C	0.4 °C	
Gold/Platinum thermocouples Calibration at fixed points	0 °C to 1000 °C 420, 660, 962 °C	0.1 °C 0.06 °C	
Other thermocouples	-196 °C -80 °C to 0 °C 0 °C to 50 °C 50 °C to 300 °C 300 °C to 420 °C 420 °C to 660 °C 660 °C to 1100 °C 1100 °C to 1300 °C	0.3 °C 0.25 °C 0.1 °C 0.25 °C 0.30 °C 0.4 °C 0.8 °C 2.2 °C	
Compensating and extension cables	-25 °C to 200 °C	1 °C	
4-wire platinum resistance thermometers			
Calibration at fixed points			
BP Nitrogen TP Mercury MP Gallium FP Indium FP Tin FP Zinc FP Aluminium FP Silver	-195.798 °C -38.8344 °C 29.7646 °C 156.5985 °C 231.928 °C 419.527 °C 660.323 °C 961.78 °C	5 mK 0.24 mK 0.15 mK 1.0 mK 1.0 mK 1.2 mK 4.0 mK 11 mK	Uncertainty in the determination of $W(t_{90})$ used to calculate ITS-90 coefficients Note: TP = Triple Point FP = Freezing Point MP = Melting Point BP = Boiling Point

ISOTECH

United Kingdom Accreditation Service

CALIBRATION LABORATORY
No. 0175

SCHEDULE

NAMAS
National Accreditation of Measurement And Sampling

Address of permanent laboratory	**Category 0** **Permanent Laboratory**
Isothermal Technology Ltd Pine Grove Southport Merseyside PR9 9AG Telephone : Southport (01704) 543830/544611 Fax : 01704 544799	Calibration performed on permanent laboratory premises APPROVED SIGNATORIES Head of Laboratory: Mr J P Tavener Deputy: Mr D J Ayres Mrs A S Blundell, Mr D Southworth, Mr N Davies, Mr A Orme Issue No: 13 Date: 24 February 1997

Measured Quantities for which UKAS has granted NAMAS Accreditation

Item	Measured Quantity Instrument or Gauge	Range	Best Measurement Capability Expressed as an Expanded Uncertainty (±)*
	TEMPERATURE		
1	Platinum thermocouples	0 to 1100 °C	1 K
		Above 1100 to 1300 °C	2 K
2	Other thermocouples	-196 °C	0.5 K
		-80 to 250 °C	0.3 K
		Above 250 to 660 °C	1 K
		Above 660 to 900 °C	2 K
		Above 900 to 1100 °C	3 K
		Above 1100 to 1300 °C	4 K
3	Compensating and extension cables	-25 to 200 °C	1 K
4	4-wire platinum resistance thermometer		

Uncertainty (±)

Temperature	(°C)	Range 1	Range 2	Range 3	Range 4	Range 5
BP Nitrogen	-196		10 mK	10 mK	10 mK	
TP Mercury	-38.8344	2 mK	2 mK	2 mK	5 mK	
TP Water	0.01	1mK	1 mK	2 mK	5 mK	10 mK
MP Gallium	29.7646	2 mK				
FP Indium	156.5985		3 mK			
FP Tin	231.928		3.5 mK	3.5 mK	5 mK	10 mK
FP Zinc	419.527			3.5 mK	5 mK	10 mK
FP Aluminium	660.323				10 mK	25 mK
FP Silver	961.78					40 mK

Note: TP = Triple Point, MP = Melting Point,
FP = Freezing Point, BP = Boiling Point

*The Expanded Uncertainty is given for k=2, providing a level of confidence of approximately 95%

GLOSSARY OF METROLOGICAL TERMS

ACCURACY OF MEASUREMENT

The closeness of the agreement between the result of a measurement and the (conventional) true value of the measurand*

REPRODUCIBILITY OF MEASUREMENTS

The closeness of the agreement between the results of measurements of the same measurand, where the individual measurements are carried out changing conditions such as:

- method of measurement
- oberserver
- measuring instrument
- location
- conditions of use
- time

NOTES:

1. A valid statement of reproducibility requires specification of the conditions changed.

2. Reproducibility may be expressed quantitatively in terms of the dispersion of the results.

UNCERTAINTY OF MEASUREMENT

An estimate characterising the range of values within which the true value of a measurand lies.

Note: Uncertainty of measurement comprises, in general, many components. Some of these components may be estimated on the basis of the statistical distribution of the results of series of measurements and can be characterised by experimental standard deviations. Estimates of other components can only be based on experience or other information.

STABILITY

The ability of a measuring instrument to maintain constant its metrological characteristics.

DRIFT

The slow variation with time of metrological characteristic of a measuring instrument.

*Measurand = a quantity subjected to measurement

PACKING INSTRUCTIONS FOR THE RETURN OF YOUR 96178