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 **The Source for Calibration Professionals**

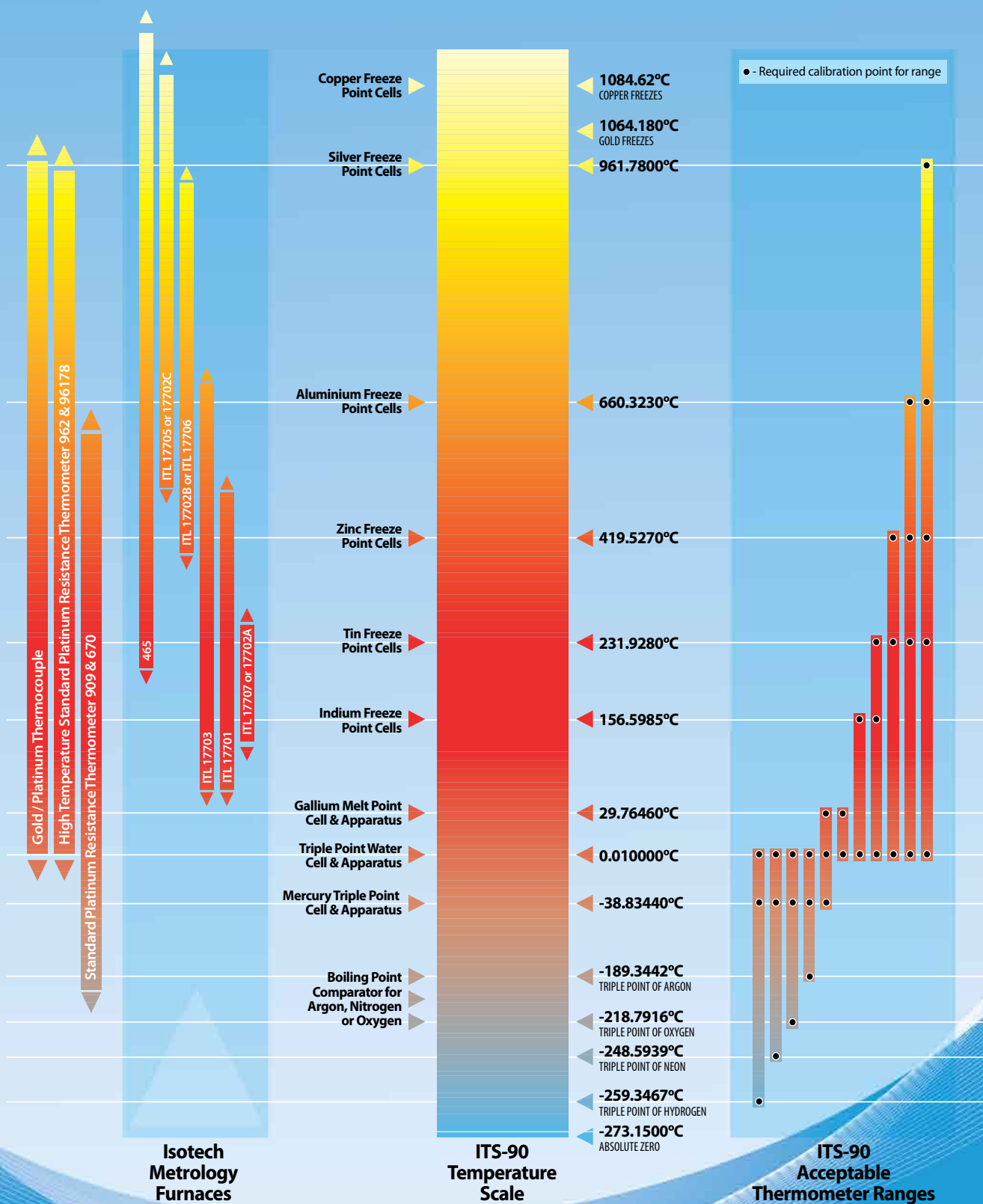


# **Solutions for Primary & Secondary Laboratories**

Temperature Calibration Equipment & Services



# METROLOGY INSTRUMENTS



# ISOTECH

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The company is always willing to give technical advice and assistance where appropriate.

Equally because of the program 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.

# Introduction

## Primary & Secondary Laboratory Equipment

...our knowledge, product quality and integrity are the reasons for buying from Isotech

In our catalogues, datasheets and website you will not find unsubstantiated claims by our own scientists (although they are as good as the best), you will find the results of independent international intercomparisons done by such organisations as BIPM and NIST.

Where we have to summarise we provide references to the appropriate document for you to download and read in full.

Our uncertainties of calibration and procedures have all been scrutinised and agreed with UKAS, who are party to the ILAC-MRA.

Each year we are audited by UKAS who check our electrical and thermal standards, examine and witness our procedures and question our uncertainty spread sheets.

This ensures a continuous improvement in our services to you, our customer.

Our electrical standards are certified by NPL, the UK's National Laboratory.

Our fixed points from argon through to silver have been intercompared at NIST in the US to their references.

Our UKAS certificates are presented in a form which makes them instantly useful. Our staff of experts are available to help with your enquiries and problems.

### Selecting the best equipment for a Primary Temperature Laboratory

#### The Purpose

The purpose of a primary laboratory realising part of ITS-90 is to calibrate SPRTs at fixed temperatures, by comparing their resistance to a fixed and known resistance.

#### Uncertainty Limits

For fixed resistors the limit is about  $\pm 0.05\text{ppm}$ .

For 6N purity metallic cells the limits are (ref CCT/2000-13 p.5)

Hg	$\pm 0.2\text{mK}$
Ga	$\pm 0.1\text{mK}$
In	$\pm 0.5\text{mK}$
Sn	$\pm 0.3\text{mK}$
Zn	$\pm 0.5\text{mK}$
Al	$\pm 0.7\text{mK}$
Ag	$\pm 1.1\text{mK}$

For SPRTs  $\pm 0.5\text{mK}$  (non-uniqueness of ITS-90 between fixed point of water and gallium),  $\pm 0.5\text{mK}$  (2 oxide state).

When selecting equipment the uncertainties should match the above. This is because uncertainties are combined using root sum of squares. So if an uncertainty is much larger than the above it will dominate the rest, if it is very small it becomes insignificant.

### Equipment Required

Can be grouped under four headings:

1. An accurate electrical measuring system.
2. A number of ITS-90 fixed point cells.
3. Apparatus to melt, freeze and maintain the cells.
4. Stable thermometers to monitor the cells.

When selecting the equipment for the laboratory look at performance, uncertainties and price.

### The Electrical Measuring System

#### The Bridges

A ratio bridge that compares a temperature controlled stable fixed resistor to the SPRT under test is ideal.

Bridge linearity, noise and stability are the main things to consider. The uncertainty should be of the order of 0.1ppm.

The Isotech microK 100 is the ideal solution, it contributes just 0.1ppm to the measurement uncertainties with noise and linearity and uniquely it is drift-free. It has input 3 channels extendable to over 90 with



<http://www.isotech.co.uk>

# Introduction [continued]

microKanners and with no mechanical switches, relays, potentiometers or moving parts is the most reliable product available.

## Fixed Resistors

The best resistors are made for us by Tinsley and we can UKAS certify them to 0.1ppm or better.

Even fixed resistors have a tempco and so we offer a maintenance bath.

The maintenance bath needs to be monitored using an SPRT. It can be connected to the one channel of the microK to save cost.

You now have a world-class measuring system. To maintain it the resistors will need regular recalibration (every year or two years).

The SPRT can be recalibrated in your own fixed point cells at water and gallium.

The microK can be rechecked by you using compliment checks with your fixed resistors.

## Fixed Point Cells

ITS-90 gives 7 optional ranges, check the graph on the inside front cover and select the range for your laboratory.

Every primary laboratory needs water triple point and the gallium melt point, because to qualify as an ITS-90 SPRT a

thermometer must have a W Gallium equal to or greater than 1.11807.

Mercury triple point is the next most useful temperature.

Isotech is unique in offering the other commonly used fixed points of Indium, Tin, Zinc and Aluminium in choice of 4 housings;

- Open quartz    ■ Open metal clad
- Sealed quartz    ■ Sealed metal clad

You will find full details on the following pages.

See Isotech's technical library on the website for a comparison of our UKAS results of quartz clad and metal clad cells compared to CCT/2000-13.

Silver, gold and copper require special handling and with many years of experience we can help you with the temperature points.

Isotech can UKAS certify any of these cells to the smallest uncertainties outside NIST.

## Selecting Furnaces

For indium through copper we have a choice of furnaces. The Isotech Dual Furnaces use heat pipes for best performance, and include a second independent furnace for annealing. For those with existing annealing furnaces we offer Heat Pipe only models. Three Zone furnaces can be used over very wide ranges. Our Furnace Selection Guide will help you select the appropriate models for your needs.

## Monitoring Thermometers

Ideally each fixed point cell should have its own designated SPRT. If this is unaffordable one SPRT can be used with a number of fixed point cells.

These SPRTs need to be very stable. We recommend model 670SQ/25.5/480 for use with Hg, H<sub>2</sub>O, Ga, In and Sn.

670SQ/25.5/650 for any cell from Hg to and including Al. and 96178/0.25 for Zn, Al and Ag.

The above monitor thermometers can be supplied with UKAS certificates or you can certify them in your own fixed point cells.

In the primary lab, only the resistors and the cells require external traceability.

## Procedures and Uncertainties

One of the great things about thermal metrology is that there is no approved way to calibrate. One of our staff was asked by a UKAS Auditor how long it took to calibrate an SPRT... "Oh!" she said without hesitation "until its right!". The auditor was so impressed he asked if he could use the saying elsewhere.

Your calibration procedures need to be unique to you to suit your equipment, your staff and your customers.

Likewise uncertainties, you will have a unique combination of equipment and procedures. These will dictate your uncertainty.

Although we cannot write your procedures and calculate your uncertainties, we want to help, and so if you go to our website you will find some examples that may help you develop your own budgets.

## More Information

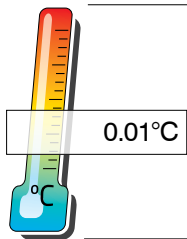
A list of our recommended books is available on the Isotech website and the Isotech journal of thermometry.

We have an e-learning course and we run occasional 2 or 3 day courses here in Southport.

World-wide, we have a network of 90 agencies to help you locally. Contact us for your nearest.



<http://www.isotech.co.uk>



# The Jarrett-Isotech Water Triple Point Cells

- Uncertainty 0.000070°C
- Fifty Years of Proven Use
- Quartz Glass and Isotopic Analysis Available

The Water Triple Point is the most important fixed point, the only point common to the ITS-90 and the Thermodynamic Temperature Scale. It is an essential reference point for every temperature laboratory.

The Jarrett-Isotech cells are the best standard, all cells are not the same, accept no inferior device.

## Total Confidence – The Internationally Proven Cells

The Jarrett-Isotech cells have been in production since 1958. A independent comparison\* in 1981 showed the first cell to be within 0.000006°C of the reference cell. The most recent international study organized by BIPM\*\* consistently shows labs using both recent and older Jarrett-Isotech cells tightly grouped, tens of  $\mu\text{K}$  around the BIPM reference value.

International comparisons prove the quality of the Jarrett-Isotech Cells and are unique in the number, and history of comprehensive evaluations.

\*\* Reproducibility of Some Triple Point of Water Cells\*By George T. Furukawa and William R. Bigge. Temperature - Its Measurement & Control in Science & Industry Vol. 5 1982.

\*\* Final Report on CCT-K7: Key comparison of water triple point cells. M Stock et al 2006 Metrologia 43 03001

## Quality

The capability of a triple point of water cell to provide an accurate, stable and reproducible temperature depends upon the purity of the water in the cell. Jarrett-Isotech cells are carefully cleaned and aged by a special procedure. They are then filled with water that has been purified by an elaborate 12 step process designed to eliminate the possibility of contamination while avoiding change in isotope proportions.

## Isotopic Content

Jarrett-Isotech Cells use water with an isotopic content essentially similar to Standard Mean Ocean Water. Following research by the international science community into the make up of Standard Mean Ocean Water, and V-SMOW the BIPM recommended in 2005\* that

“The triple point of water is now defined as the equilibrium temperature of vapour, liquid and solid water, with the liquid water having the isotopic composition defined by the following amount of substance ratios:



0.00015576	mol <sup>2</sup> H per mol <sup>1</sup> H
0.000379	mol <sup>17</sup> O per mol <sup>16</sup> O
0.002005	mol <sup>18</sup> O per mol <sup>16</sup> O”

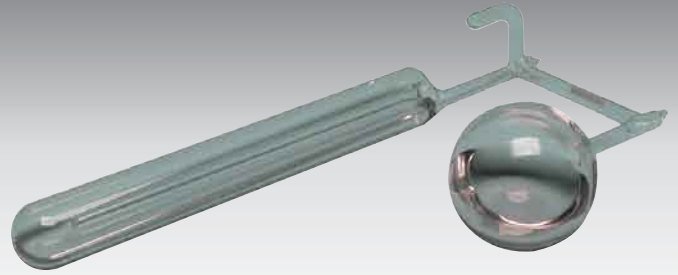
\* Technical annex for the International Temperature Scale of 1990 (ITS-90) Adopted by the CCT on 10 June 2005

Since early in 2000 Jarrett-Isotech Cells have been made to this definition and our cells have been within +10 and -40 $\mu\text{K}$  of it.

During 2005, subsequent to the CCT definition, the water in our triple point cells has been further enriched and our latest cells meet  $\pm 20\mu\text{K}$  of the above definition.

Further we can provide Isotopic Analysis giving the exact composition with an uncertainty of  $\pm 3\mu\text{K}$ . Samples of the actual water used in a particular cell can be supplied for purity analysis.

### Isotech's unique KT Water Triple Point Cell



#### Quartz vs Borosilicate Glass

The special cleaning and ageing of the usual borosilicate glass ensure, and the evaluations demonstrate, the long life of the cells. Selected cell types are available in quartz construction which are expected to last ten times longer.

#### Performance

The cells include a certificate of conformance.

A UKAS calibration service is available for all of our water triple point cells. The larger cells can be UKAS certified to  $\pm 0.000070^{\circ}\text{C}$ , 2 Sigma. This will benefit the most demanding of NMIs and users.

More cost effective calibration options to uncertainties of  $\pm 0.1$  and  $\pm 0.5\text{mK}$  are also available. Regardless of calibration the Jarrett-Isotech cells are reproducible to  $\pm 0.000020^{\circ}\text{C}$  and after equilibrium has been reached the inner melt of the ice mantle will give stability of  $\pm 0.00001^{\circ}\text{C}$

Reverting to the very first designs of water triple point cells, Isotech produce a cell with Isotopic analysis, a McLeod gauge to assess any trapped air and an attached flask where the cell's water can be transferred and redistilled. By accounting for these sources of uncertainty we claim that this cell represents the ultimate reference for those requiring cells as close to ITS-90 as possible. Please ask for a copy of a comprehensive report describing the cell, its operation and performance.

#### Model Types

##### Premium Water Triple Point Cells - Borosilicate Glass

These Premium Cells can be calibrated to an uncertainty of  $\pm 0.000070^{\circ}\text{C}$  (0.07mK)

- A11-50-270\*
- A13-50-270\*
- B11-50-270
- B11-65-270\*
- B13-65-270
- B16-65-270

*\*Also available in Quartz Glass*

##### Further Laboratory Water Triple Point Cells

These cells have shorter immersion depth and can be calibrated to an uncertainty of  $\pm 0.000100^{\circ}\text{C}$  (0.1mK)

- B12-40-210
- B12-46-210

##### Slim Water Triple Point Cell

- B8-30-130

This small cell fits into portable Dry Block Calibrators for use outside of the calibration laboratory. It can be calibrated to  $\pm 0.0005^{\circ}\text{C}$  (0.5mK)

#### Performance

##### Accuracy

The equilibrium temperature of the Jarrett-Isotech Triple Point of Water Cell is within  $\pm 20\mu\text{K}$  of the 2005 definition as described in CCT/05-07/rev(2). Isotopic Analysis can be provided to give the exact composition within  $\pm 3\mu\text{K}$ .

##### Reproducibility

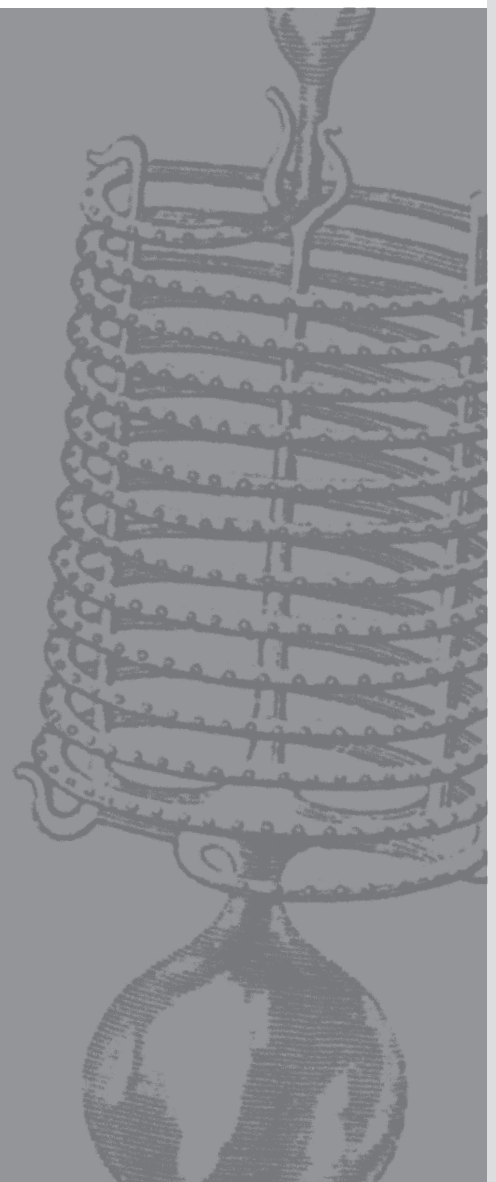
The equilibrium temperature of a cell will repeat to within  $\pm 0.000,02^{\circ}\text{C}$  of the mean equilibrium temperature.

##### Stability

After equilibrium is reached, the temperature of the inner melt of an ice mantle will remain constant to within  $\pm 0.000,01^{\circ}\text{C}$  for as long as the mantle can be preserved (up to 90 days in some instances).

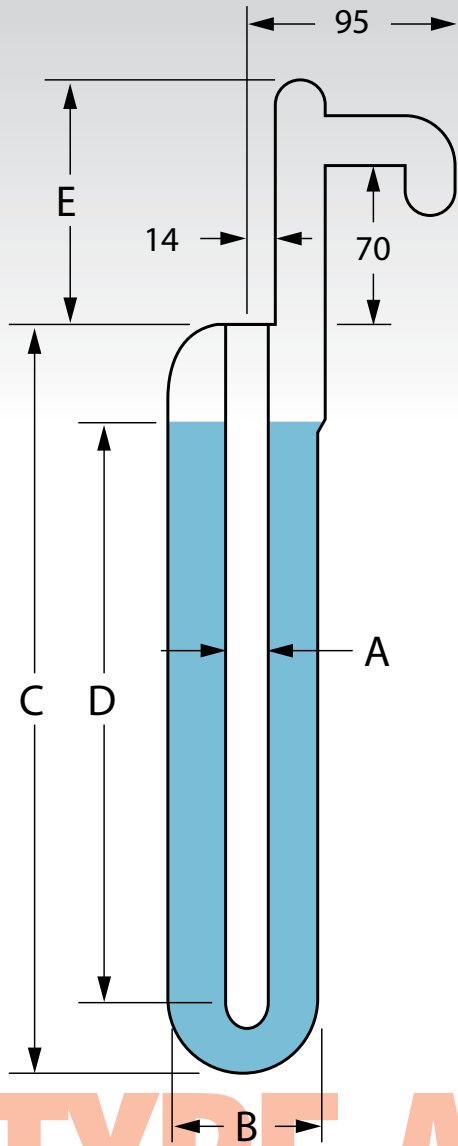
##### Life

Cells made from Borosilicate Glass may drift lower in temperature by up to 0.1mK after 10 to 20 years. Cells made from Quartz are expected to last 10 times longer.



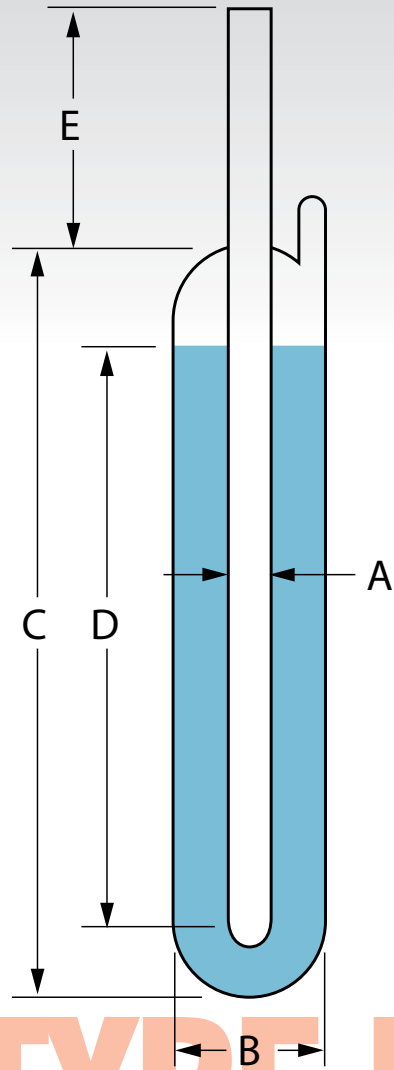
### Physical Features

**Type A cells** were designed by Dr. H. F. Stimson at NBS. A tubular glass extension at the top of the cell serves as a convenient handle for lifting and carrying the cell, as a hook for supporting it in an ice bath, and as an indicator of partial pressure of air in the cell.



# TYPE A

**Type B cells** were designed at NRC of Canada. The thermometer well extends 100mm above the top of the cell. Heat transfer to the ice mantle may be essentially eliminated by keeping these cells packed in ice to the top of the well extension, or by immersing them sufficiently in a Water Triple Point Maintenance Bath.

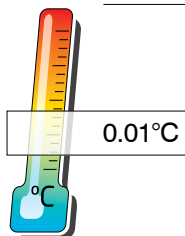


# TYPE B

Nominal Dimensions in mm

Model	A	B	C	D	E	Comments
A11-50-270	11	50	350	270	100	Highly recommended (1) (2)
A13-50-270	13	50	350	270	100	Large re-entrant tube (1)
B8-30-130	8	30	160	130	0	Slim Cell - Fits Isotech Dry Blocks
B12-40-210	12	40	290	210	75	Replacement for NPL, UK Type 32 Cells
B12-46-210	12	46	290	210	75	Recommended for Isotech Oceanus
B11-50-270	11	50	350	270	100	Highly recommended (1) (2)
B11-65-270	11	65	350	270	100	NRCC's favourite Cell (1) (2)
B13-65-270	13	65	350	270	100	Large re-entrant tube (1)
B16-65-270	16	65	350	270	100	Larger re-entrant tube (1)

(1) Isotopic Analysis is available.  
 (2) Available in Quartz Glass.



# Maintenance Bath Water Triple Point

The Isotech 18233 Water Triple Point Maintenance Bath is widely used by the worlds' leading NMLs. In a recent International study cells from 21 of the worlds leading laboratories were inter-compared, the study used two Isotech 18233 Baths to maintain the cells during the inter-comparisons.

It will maintain the water triple point for long periods of time (many months, with occasional attention) so that this fundamental fixed point of thermometry is continuously available.

The Bath ensures total safety of the cells with dual electrical safety circuits and the passive safety of the design, see below.

The Isotech Model 18233 Water Triple Point Maintenance Bath is not an adaptation of general-purpose commercial equipment, but is specifically designed to maintain and safeguard 1 to 4 Water Triple Point Cells, for the calibration of thermometers on the International Temperature Scale of 1990.

It will ensure the integrity of the cells against catastrophic freezing, which can break the glass envelope.

The case of the bath is made of special-quality double-skinned laminated wood for best thermal resistance and stability.

Cooling is accomplished by efficient solid-state Peltier chilling modules, powered so that the rate of temperature change is very small. Solid state cooling ensures minimal power consumption, silent operation and no vibration.

Two safety circuits are provided to prevent cell breakage by excessive ice formation. The controls can be set to a resolution of better than 0.001°C. If control fails in such a mode that the Peltier chillers are full on, a warning light is lit to give the operator 20 minutes in which to take appropriate action. If no action is taken, the apparatus is automatically switched off and the cells are allowed to warm slowly.

Passive safety is provided by the physics of ice. If the Peltier chillers become too cold, the first ice which forms is on the water tank surfaces directly in contact with the chillers, effectively inhibiting further rapid transfer of freezing to the bath water.

A specific stirring rate of bath fluid is provided by bubble agitation which prevents the water from stratifying.

The bath is extensively tested at Isotech for two weeks or more, during which use the control and alarm circuits are set and checked for optimum performance. It is released only when Isotech is entirely satisfied with its performance.

The bath has a long and successful history and is relied on by many National Laboratories throughout the world. This history of successful use is one of the most important reasons for choosing Isotech products.

No Ice required, Automatic, Vibration free,  
Electrical noise free, Solid state cooling,  
Double safety circuits



Model	ITL-M-18233
Temperature Range	+0.01°C ± 0.3°C
Accuracy	±0.001°C ±0.0001°C in Cell
Ambient Limits	18°C to 28°C
Time to temperature	na
Power	150W typical, 100-130 or 208-240VAC* 50/60Hz (*field changeable)
Dimensions	Height 910mm Width 635mm Depth 710mm Weight 66kgs

## Options

Triple Point of Water Cells

## How to order

ITL-M-18233 Water Triple Point Maintenance Bath

Please specify which type of cells will be used so that we can supply the correct cell holder.

# Ice Mantle Maker Water Triple Point

## Introduction

Are you fed up with cold wet hands, and hours of frustration when you produce an ice mantle in your Triple Point Cell?

Change your life and try the Isotech Ice Mantle Maker.

We developed it, like so many of our products, for our own use in our UKAS facility. It is so easy that we actually want to make more mantles. The days of dreading making ice mantles are gone with the Ice Mantle Maker.

It works by using a specially designed anti-gravity heat-pipe. The heat-pipe exits the cell and exchanges the heat/cool in a small container filled with solid carbon dioxide or preferably liquid nitrogen.

Because of the low temperature gradient along the heat-pipe the ice mantle is formed close to 0°C, and so beautiful strain free mantles are formed.

The Mantle Maker works equally well when you wish to increase the thickness of ice at the bottom of the cell. By keeping only a cc of alcohol in the cell the heat transfer is focused around the bottom of the cell.

## Background

In 1969 John Evans of N.B.S. America described a method of heat removal and ice mantle growth in a water triple point cell. His materials, liquids, etc. were adequate at the time and the idea has been considered as a novelty since.

Now, Isotech have brought the liquids and technology right up to date to effectively solve the problem of trouble free and strain free fast ice mantle manufacture.

## Ice Bridge Prevention Collar

In developing the heat pipe Ice Mantle Maker we worried that an ice bridge can form across the top of the cell.

We therefore developed a clever collar that sits around the cell and prevents ice formation at the water/vapour interface.

We include this free with the Mantle Maker provided you inform us of the cell diameter with the order.



Weight	250g
Typical time to create a mantle	20 to 30 minutes using a Jarrett-Isotech A11 Water Triple Point Cell.*

*\* Longer or shorter times for larger or smaller cells.*

## Options

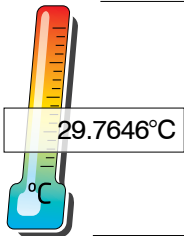
Additional Ice Bridge Prevention Collar

## How to order

452 Ice Mantle Maker and one ice bridge prevention collar

## Please specify

- A) Cell Type or
- B) Outside diameter of Water Triple Point Cell (mm)
- C) Depth from shoulder of Cell to water level (mm)



# Sostmann - Isotech Gallium Cell

- Uncertainty 0.000070°C
- Thirty Years of Proven Use
- Open and Sealed Models

Second only to the Water Triple Point and in many ways, because of its ease of use and purity, superior to it, is the Gallium Melt Point. At 29.7646°C this is a very convenient temperature.

### Total Confidence

Confidence is a major requirement in a standard. The Isotech Gallium Cell and Apparatus have a long history and have been successfully used in most National and Primary Laboratories world-wide.

International comparisons prove the quality of the Isotech Cells and are unique in the number, and history of comprehensive evaluations.

Calibration of Isotech's Reference Cell with the Standard at NIST showed an agreement of 4μK, 0.000004°C.

The Isotech Gallium Cells contain the highest purity metal, >99.99999% pure (7N) and giving a flat plateau. The cell has a day to day reproducibility of just +/-0.000025°C.

### Quality

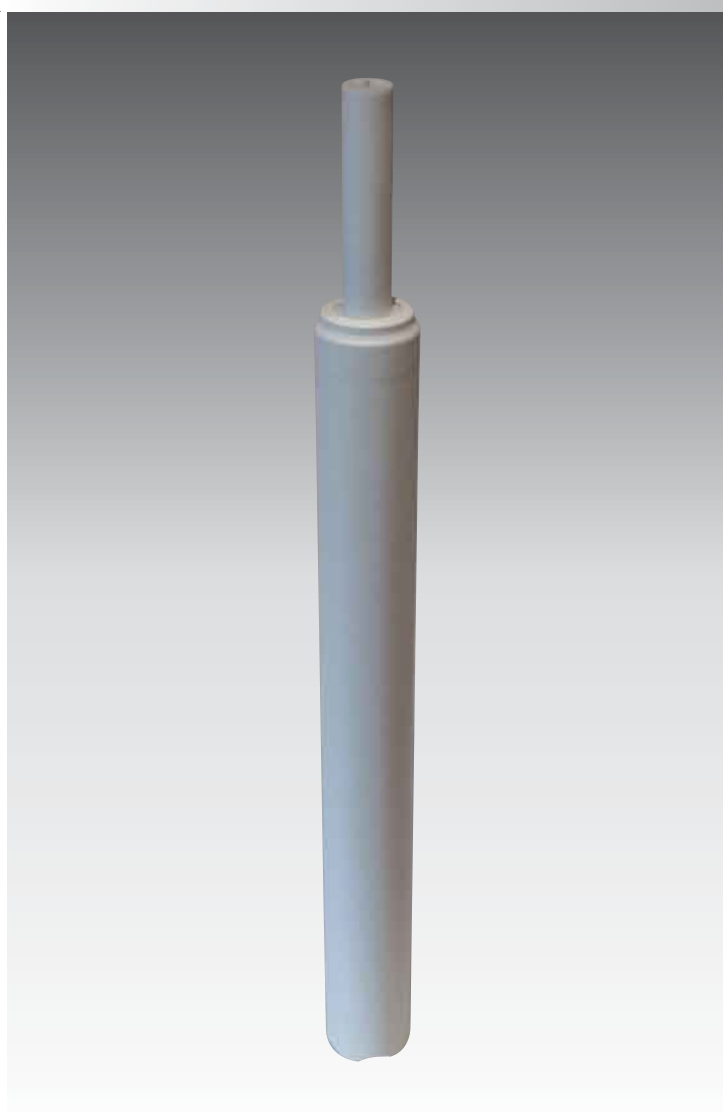
Developed in the 1970s by Henry Sostmann the design is of the highest standard. The metal is contained within a resilient inner housing that ensures no contamination or reaction with the Gallium. The surrounding outer metal sleeve provides longitudinal uniformity of temperature and further mechanical strength. With several hundred cells shipped to all parts of the world all have arrived without damage.

### Sealed Cell

In general we recommend the sealed cell, it has the convenience of the sealed construction along with the sub mK performance.

### Open Cell

A re-sealable or open cell is also available. The cell has a valve and a "Klein" flange fitted at the top allowing connection to a vacuum system and pure gas supply. This permits the pressure to be set to one bar at the melt temperature, or measured in accordance with "Optimal realization of the defining fixed points of the ITS-90... CCT/2000-13". With the Open Cell uncertainties of +/- 100 μK are achievable.



	Sealed Gallium	Open Gallium
Model	ITL-M-17401	ITL-M-17401(O)
Temperature	29.7646°C	29.7646°C
Metal Purity	> 99.99999 7N	> 99.99999 7N
Dimensions		
Outside Diameter	38mm	35mm
Inside Diameter	12mm	12mm
Total Height	420mm	425mm
Metal Depth	230mm	230mm
Uncertainty *	0.25mK	0.07mK

### How to order

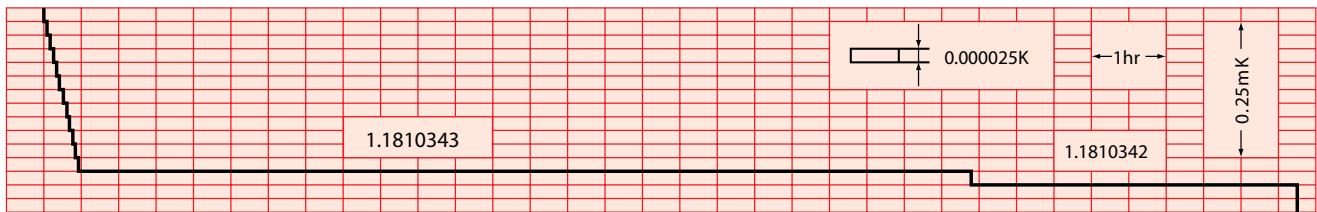
ITL-M-17401 Gallium Cell - (Specify sealed or open)

The Cell is supplied with a Certificate of Metal Purity

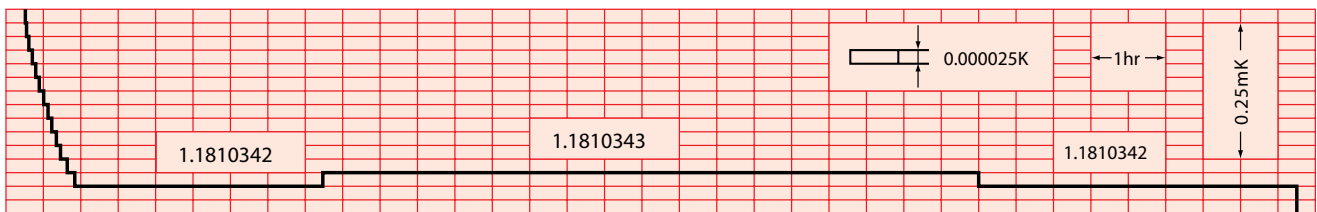
\*We have a choice of UKAS calibration Services, the stated uncertainty figure is for our Premium UKAS Calibration Service

# The Perfect Gallium Point

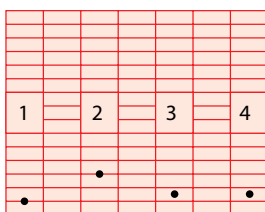
## Melt 1 Day1



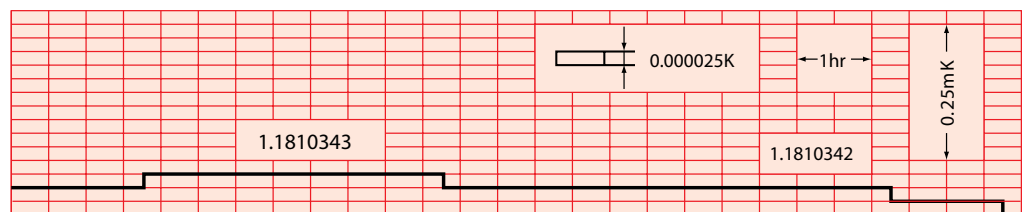
## Melt 2 Day2



Shown on the same scale



## Melt 3 Day3

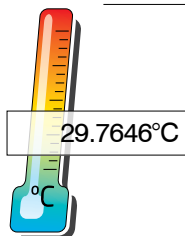


- 1 Value of 10 years old Cell
- 2 Value of N.P.L.'s Cell
- 3 Value of I.M.G.C.'s Cell
- 4 Value of Cell open for over 3 years

The information below is extracted from  
*The Gallium Point, An Alternative Reference Temperature to the Water Triple Point*  
 by John P. Tavener



Intercomparison of Water and Gallium	Water	Gallium
Impurities	Small	Small
Peritectics	None	None
Variation with Isotopes	Large	None Found
Interoperability	Good	Good
Practical Variation	40μK	40μK
H.H. Uncertainty	Small	10μK
Ruggedness	Poor	Good
Ease of Use	Difficult	Easy
Apparatus	Ice Bath & CO <sub>2</sub>	Warm Water
Price	Low	High
Drift with Time	4μK / year	None Detected
Time before Best Accuracy	10 days	1 to 2 hours



# Apparatus Gallium

- Simple to Use
- Automatic Operation
- Totally Safe Operation

Model 17402B Gallium Apparatus is not an adaptation from general purpose equipment, but is designed specifically to realize and maintain the Gallium Cell on the melt plateau, for calibration of thermometers on the International Temperature Scale of 1990.

The apparatus will permit the gallium to melt coaxially over 12 to 16 hours. It is uniquely designed to also freeze the cell from the bottom up, which eliminates the danger of damage due to the expansion of gallium during freezing.

1. Model 17401 Gallium Cell may be used, without the thermal environment provided by Model 17402B Gallium Apparatus, in a well controlled bath. However, the advantages of automatic operation, convenience and cell protection, recommend the use of the Model 17402B environment in most cases.
2. No external connections other than power are required.
3. A completely automatic electronic control system provides a precise means for realization and maintenance of the plateau. The Apparatus can be turned on by a timer an hour before the laboratory day begins, the plateau utilized throughout the working day and the system recycled overnight. A thermal sink is provided which forces the gallium to refreeze upwards from the bottom (gallium expands when it freezes, requiring a specific freeze orientation to avoid rupturing the cell).
4. Confidence is a major requirement in a standard. The Isothermal Gallium Cell and Apparatus have a long (20 year) history and have been successfully used in most National and Primary Laboratories world-wide. This is one of the main reasons for choosing the Isothermal Cell and Apparatus.
5. The Cell and Apparatus are manufactured to the strict requirements of BS 5750 and ISO 9000. Each finished unit becomes part of the Isotech UKAS working Calibration Laboratory for two weeks or more, during which use the control circuits are set and checked for optimum performance. It is released only when Isotech is entirely satisfied with its performance.



Model	ITL-M-17402B cell apparatus
Temperature Range	29.7646°C
Uncertainty	0.25mK (with cell)
Ambient Limits	15°C to 28°C
Cycle Time	With cell at 20°C, time to plateau is 1 hour maximum. Recycling, including freezing the cell is typically 3 to 4 hours
Plateau Duration	Not less than 12 hours under specified ambient conditions; 16 hours typical
Power	75 Watts typical 100-130 or 208-240Vac* 50/60Hz *Field Changeable
Dimensions	Height 429mm Width 259mm Depth 181mm Weight 8.4kg

#### How to order

Model ITL-M-17402B Gallium Apparatus (without cell)

Please specify voltage required.

Model ITL-M-17401 Gallium Cell



-38.8344°C

- Uncertainty 0.000220°C
- Rugged Stainless Steel Construction
- 7N Pure

The Isotech Mercury Cell is constructed in a rugged, sealed stainless steel enclosure allowing the triple point of -38.8344°C to be realized both easily and safely.

**Total Confidence**

The embodiment of the Mercury Triple Point Cell was originally developed in the US with a very close cooperation between Henry Sostmann and Dr. Furukawa of N. B. S. (now NIST) over twenty years ago. The physical size, materials and metal purity are identical to this original design. The Mercury is distilled four times leaving impurities of 10 to 15 parts per billion. The cells made by Isotech still use the original design, purity and supplier of Mercury.

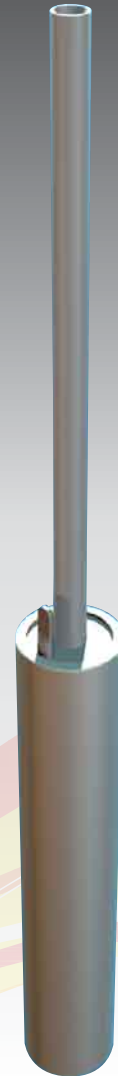
In international intercomparisons the cells made by Isotech have always been within the National Laboratories uncertainty of calibration and with over 20 years of successful use throughout the world the cell embodies the finest traditions of production and use.

After more than 20 years Dr. Furukawa opened some of the original cells and the Mercury was still above 99.99995% pure. A reflection of the long term performance of the design.

**Operation**

The cell can be realized in an Isotech stirred liquid bath such as the Hydra or 915 with plateau lengths of up to a week. For convenience, and to avoid the need to use a liquid, the dedicated Isotech Mercury Triple Point Apparatus can be used. This equipment is in use in many NMIs and commercial labs

# The Isotech Mercury Cell



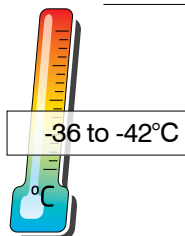
Model	ITL-M-17724
Temperature	-38.8344°C
Metal Purity	> 99.99999 7N
Dimensions	
Outside Diameter	40mm
Inside Diameter	9.5mm
Total Height	475mm
Metal Depth	200mm
Uncertainty *	0.22mK

**How to order**

ITL-M-17724 Mercury Cell

The Cell is supplied with a Certificate of Metal Purity

\*We have a choice of UKAS calibration Services, the stated uncertainty figure is for our Premium UKAS Calibration Service



# Apparatus Mercury Triple Point

- Purpose Designed for Isotech Mercury Cell
- Outstanding Convenience and Safety
- Liquid Free

The Isotech Model ITL -M-17725 Cryostat is a self-contained, mechanically-refrigerated, system with a main well to house one cell and two auxiliary wells for pre-chilling of thermometers. The cryostat temperature is steplessly adjustable from  $-36^{\circ}\text{C}$  to  $-42^{\circ}\text{C}$  with scale-divisions of  $0.1^{\circ}\text{C}$  (interpolation possible) and 24 hour stability better than  $\pm 0.05^{\circ}\text{C}$  measured by an SPRT in the well of a Mercury Cell inside the Cryostat.

The cryostat has several unique features providing outstanding convenience and safety. The refrigeration system has sufficient capacity to bring a cell to operating temperature in about one hour. At operating temperature, the cooling rate is about 1 Kelvin/minute and the heating rate is about 2 Kelvin/minute.

This permits rapid changes to be imposed on the temperature of the cell environment to a void excessive demands on the (low) heat-of-fusion energy of the mercury within the cell.

In addition, all temperature control is accomplished through control of refrigerant flow, providing inherently fail-safe operation. Indicators provided for the cryostat are "POWER ON" and "COOLING".

The cryostat provides convenient conditions for operating mercury fixed point cells both in heating and in cooling mode.



Model	ITL-M-17725 Apparatus
Temperature Range	$-36^{\circ}\text{C}$ to $-42^{\circ}\text{C}$
Uncertainty	0.22mK (with cell)
Ambient Limits	$18^{\circ}\text{C}$ to $28^{\circ}\text{C}$
Plateau Duration	8-12 hour Plateau
Power	750W typical. 208-240 VAC, 50/60Hz
Dimensions	Height 960mm Width 600mm Depth 560mm Weight 96kg

**How to order**  
ITL-M-17725 Mercury Triple Point Apparatus



# The Best Primary Standards for your Laboratory

The key factor is that of purity. ITS-90 specifies that the purity of the ITS-90 fixed points should be 99.9999% (6N).

The performance of an optimal 6N pure cell has been best described in CCT/2000-13 "Optimal Realization of the Defining Points of the ITS-90..."

All Isotech's cells for primary laboratories conform to the ideals set out in this document. To prove to ourselves, and you, our customer, that this is so we compared some 160 UKAS certificates over 10 years using a variety of metal samples to CCT/2000-13. The results tabulated below show that we equal or exceed the values given in that document.

## CCT/2000-13 Optimal Realizations of ITS-90

	CCT/2000-13	Large (Optimal) Cells mK
Hg	0.2mK	0.12
Ga	0.1mK	0.05
In	0.5mK	0.17
Sn	0.3mK	0.18
Zn	0.5mK	0.21
Al	0.7mK	0.66
		0.3*
Ag	1.1mK	1.1

\*6N5 pure

With each delivery of metal the supplier furnishes us with a certificate detailing the impurities detected in PPM.

At Isotech we go one step further, samples of the metal are sent to NRCC in Canada who analyse the sample to parts per billion and look for 60 elements rather than the 20 that the supplier analyses. This independent analysis increases confidence in the metal of the cell.

The metal of the cell is contained in a graphite crucible. Our graphite is the densest available having an average grain size of just 7 µm.

No metal has ever penetrated this graphite. It is supplied with a purity better than 99.9995% and at Isotech temperature and vacuum processing further reduced the impurities.

Whether you choose a sealed, or resealable cell we need pure argon to surround the cell, our argon is 99.9999% pure.

Before we make cells commercially with a new delivery of metal we make a cell for evaluation. It goes through the same 5 step process as is used by National Laboratories for international intercomparisons.

The cell is melted and frozen three times and the coincidence between melt and freeze point measured. The impurities are used to calculate the expected depression of the metal from ITS-90 and the cell is intercompared on 2 separate occasions with a reference cell directly traceable to NIST's realization. This process takes 15 working days.

ITS-90 specifies that the melting or freezing should take place at 101,325 Pa.

An Isotech sealed cell is filled with 6N pure argon to 101,325 Pa ±0.04% as certified by a UKAS certificate of the vacuum gauge.

Nothing is left to chance with an Isotech Primary Standard.

Because we supply most of the worlds primary laboratories we need to be able to certify what we have made. Working with UKAS and NIST we have reduced our uncertainties of measurement to the smallest outside NIST. They are tabulated below for your information.

UKAS k=2	Isotech ±mK Quartz & Metal Clad (*)
Hg	0.22
H <sub>2</sub> O	0.07
Ga	0.07
In	0.65
Sn	0.60
Zn	0.90
Al	1.10
Ag	2.00

(\*As November 2008 - The latest UKAS Schedule can be found from our website or at [www.ukas.org](http://www.ukas.org))

The above contains no fancy claims or unsubstantiated numbers, only independently verifiable facts.

Some 500 metrologists visit Isotech each year for discussions and training, you will be welcome.

The immersion of the cells from metal surface to the bottom of the re-entrant tube is 200mm ±5mm.

Each primary cell is accompanied by a conformity certificate which includes a copy of the impurities analysis, a copy of the metal of the cell evaluation freeze and melt curves.

At an extra cost we can issue a UKAS certificate to the uncertainty above. This takes 15 working days.

## Cell Containment

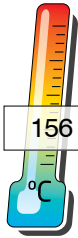
### ■ Resealable cells

Traditionally our optimal cells have been assembled into resealable quartz tubes or crucibles whereby the cell can be vacuumed and refilled with pure argon to 1 atmosphere.

More recently Isotech have pioneered metal clad cells replacing the more fragile quartz with a pre-aged metallic alternative. These cells have a small metal tube which can be used for vacuuming and refilling the cell and because of less conduction from the cell; the cell is closer thermally to its ITS-90 value.

### ■ Sealed Cells

It maybe more convenient to have sealed cells - cells with a cladding whose internal pressure is preset to 1 atmosphere at the freeze temperature and then sealed. Isotech offers both quartz and metal clad sealed cells.



156 to 1084°C

# Fixed Point Cells Sealed and Open

- Ultra Pure >99.9999% 6N
- 35 Year Plus History
- For Optimal Realisations

Isotech Ultra Pure-Metal Freezing Point Cells are designed specifically to realize the liquid-solid equilibrium temperatures of certain high-purity metal elements, for calibration of thermometers at the ITS-90 Fixed Points.

When you purchase an Isotech Sealed Freeze Cell you are not just purchasing a kilo of metal inside a graphite crucible sealed within a quartz shell, you are getting the fruits of more than 35 years of experience and learning of not only how to make such an artifact without introducing contamination but an Internationally accepted embodiment of an ITS-90 fixed point.

The Isotech cells have been further developed and refined from cells designed and manufactured by Henry Sostmann, with the first international inter comparison results being published in 1972.

In 2007 we combined 17 years experience of producing the best Metal Clad Slim Cells, with our experience of producing the most accurate Fixed Points sealed in quartz glass; to introduce Metal Clad Optimal Cells for the Primary Laboratory. These cells can be readily shipped between labs for intercomparisons, overcoming the difficulty of transporting Quartz Cells due to the increased airport security restrictions.

Isotech's accredited laboratory has the smallest uncertainties and can issue UKAS certificates with uncertainties as low as  $\pm 0.07\text{mK}$  at  $0.01^\circ\text{C}$  to  $\pm 2\text{mK}$  at  $961.78^\circ\text{C}$ ,  $k=2$ .

## Uncertainties

Optimal Cells include a conformity certificate which includes a copy of the impurities analysis, a copy of the metal of the cell evaluation freeze and melt curves. Where required we can also provide UKAS calibration.

The uncertainty mentioned in the table is that which can be offered with our optional UKAS Calibration service. Our Premium Calibration service involves realizing three melt plateau, three freeze plateau and two intercomparisons to



a reference cell. This takes a minimum of 15 days of laboratory time.

With our Standard Comparison service we perform one melt, one freeze and one intercomparison, the time to calibrate is less than the Premium Service and so the cost is lower. The uncertainties are still small, and suitable for all but the most demanding of Primary Laboratories.

## Isotech UKAS Calibration Uncertainties ( $k=2$ )

Cell	Premium Calibration Service UKAS Schedule Note 4	Standard Calibration Service UKAS Schedule Note 5
Mercury	$\pm 0.22\text{mK}$	$\pm 1\text{mK}$
Gallium	$\pm 0.07\text{mK}$	$\pm 1\text{mK}$
Indium	$\pm 0.65\text{mK}$	$\pm 2\text{mK}$
Tin	$\pm 0.60\text{mK}$	$\pm 2\text{mK}$
Zinc	$\pm 0.90\text{mK}$	$\pm 2\text{mK}$
Aluminium	$\pm 1.1\text{mK}$	$\pm 6\text{mK}$
Silver	$\pm 2\text{mK}$	$\pm 30\text{mK}$

The latest schedule can be found on the Isotech website or at [www.ukas.org](http://www.ukas.org).

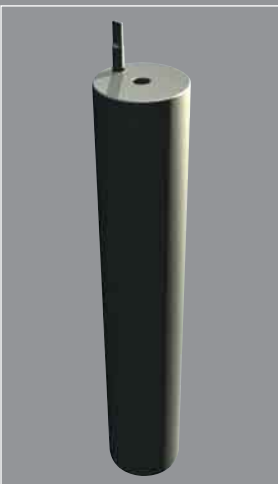

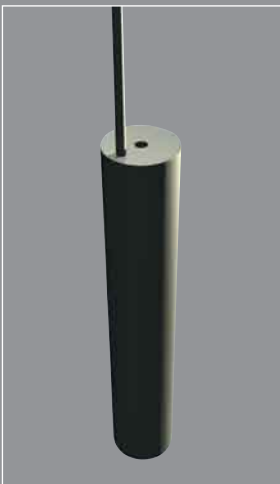



### Available Types

Cells		Uncertainty	Sealed Cells		Open Cells	
			Metal Clad	Quartz Clad	Metal Clad	Quartz Clad
Indium	156.5985°C	+/-0.65mk	17668MO	17668	17668MCO	176868QCO
Tin	231.928°C	+/-0.60mk	17669MO	17669	17669MCO	17669QCO
Zinc	419.527°C	+/-0.90mk	17671MO	17671	17671MCO	17671QCO
Aluminium	660.323°C	+/-1.1mk	17672MO	17672	17672MCO	17672QCO
Silver	961.78°C	+/-2mk	N/A	17673	N/A	17673QCO
Copper	1084.62°C		N/A	17674	N/A	17674QCO

*Other points such as Lead and Antimony available. Please ask for details.*

Isotech cells are of the highest purity available. Open cells conform to CCT/2000-13. Sealed cells are sealed to one atmosphere with 6N pure argon at the freeze temperature.

Sealed Metal	Sealed Quartz	Resealable Metal	Open Quartz
			
<ul style="list-style-type: none"> <li>■ Convenience</li> <li>■ Protected Against Contamination and Ambient Pressure Effects</li> <li>■ Easily Transportable Between Labs</li> <li>■ Robust</li> </ul>	<ul style="list-style-type: none"> <li>■ Convenience</li> <li>■ Protected Against Contamination and Ambient Pressure Effects</li> </ul>	<ul style="list-style-type: none"> <li>■ Pressure can be set by user</li> <li>■ Requires vacuum and gas flow system</li> <li>■ Easily Transportable Between Labs</li> <li>■ Robust</li> <li>■ Thermally Closer to ITS-90 temperature</li> <li>■ Sealed Construction with open port for gas supply</li> </ul>	<ul style="list-style-type: none"> <li>■ Pressure can be set by user</li> <li>■ Requires vacuum and gas flow system</li> <li>■ Transportable Between Labs</li> <li>■ Can be disassembled</li> </ul>

Cell baskets, complete with appropriate heat shunts and reflectors are available separately. A carry case is included with Sealed Cells.

### Nominal Dimensions

Outside Dia.	50mm	Outside Dia.	50mm	Outside Dia.	50mm	Outside Dia.	50mm
Inside Dia.	8mm	Inside Dia.	8mm	Inside Dia.	8mm	Inside Dia.	8mm
Height*	270mm	Height*	275mm	Height*	270mm (+350mm Tube)	Height*	In, Sn, Zn - 520mm Al, Ag, Cu - 610mm
Metal Depth	200mm	Metal Depth	200mm	Metal Depth	200mm	Metal Depth	200mm

\*The height is measured from the bottom of the flange wherever necessary, excludes sealing tip.

# International Traceability

Certificates issued by Isotech are legally recognized and accepted not just in the UK but in many countries throughout the world.

Isotech has always invested heavily in, and attached great importance to its calibration laboratory which was first accredited in 1985.

Today the laboratory, known as NTPL is formally accredited by UKAS to ISO / IEC 17025:2005. Since 2008 NTPL UKAS Certificates have been licensed to bear the ILAC MRA mark.

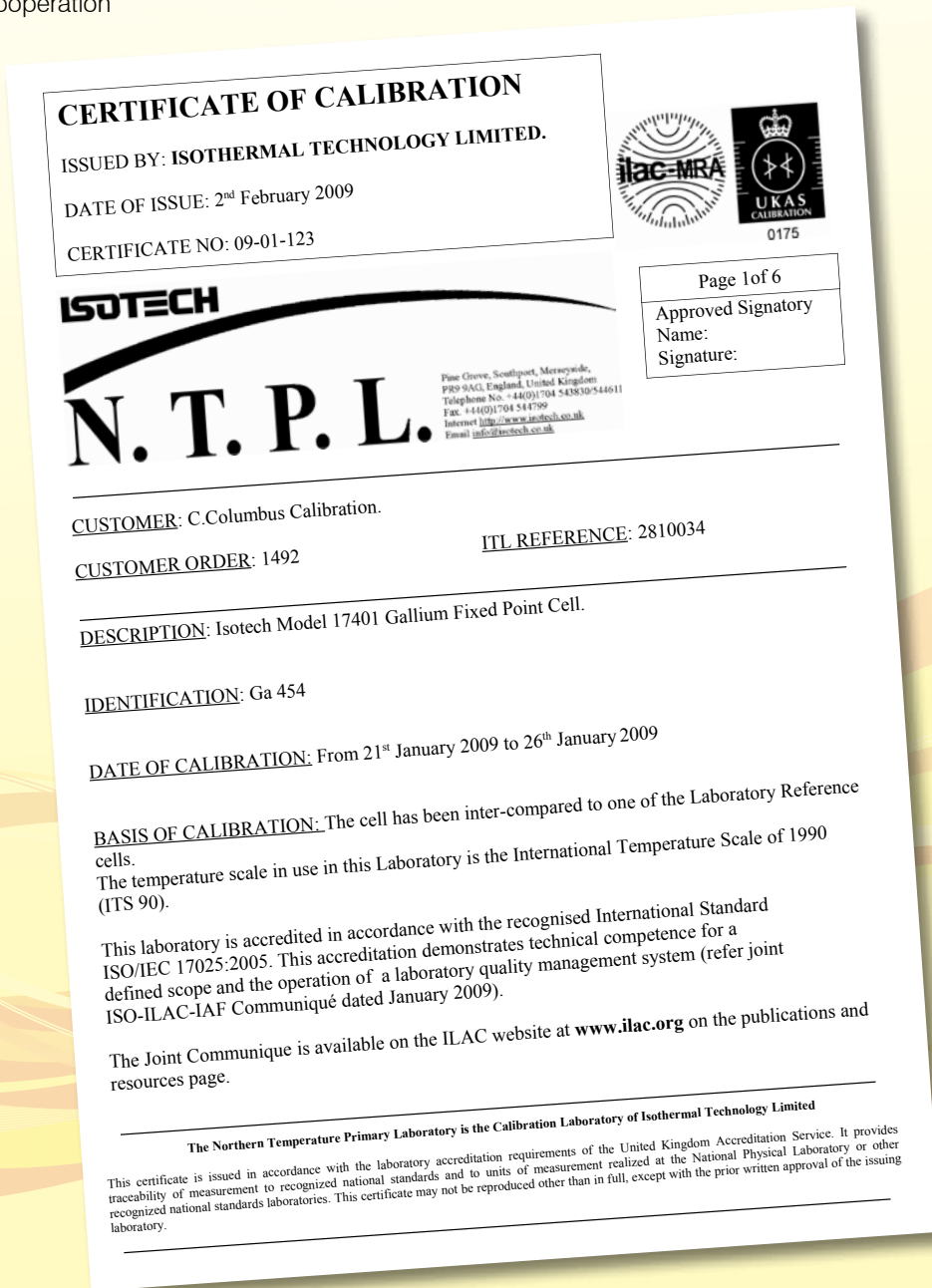
ILAC International Laboratory Accreditation Cooperation

ILAC was formed to harmonize technical issues between accreditation bodies worldwide with the goal of breaking down international barriers, resulting in increased global trade.

This was implemented through a network of Mutual Recognition Arrangements (MRA) amongst accreditation bodies throughout the world.

Under these MRA's UKAS calibration certificates are recognised and accepted in over 70 countries

For more information on ILAC visit [www.ilac.org](http://www.ilac.org)



# Furnace Selection Guide

Isotech offers the widest range of metrology furnaces for the realisation of ITS-90 Fixed Points. All models can give very long plateau, in excess of ten hours as suggested in CCT/2000-13, "Optimal Realization of the Defining Points of the ITS-90..."

## ■ Dual Furnaces - the no compromise choice

These furnaces use heatpipes to provide an essentially gradient free environment to melt and freeze the ITS-90 fixed points. These furnaces meet all the requirement of CCT/2000-13 and allow a uniformity of <10mK over the entire length of the fixed-point sample.

The second independent furnace is used to pre warm and anneal the thermometers being calibrated. This concept of heatpipe and second furnace for pre and post conditioning the thermometers in a single apparatus was developed from a concept of Dr Marcarino of IMGC, Italy.

## ■ Heat Pipe Furnaces

For those laboratories who already have furnaces for pre and post conditioning SPRTs we offer the range of furnaces in single, heatpipe only version.

## ■ Three Zone Furnaces

All heatpipes have a limited operating range, determined by fluid that flows inside the pipe. Furnaces without heatpipes can work over wider temperature ranges. Isotech offer two models of Three Zone Furnaces, one from 50°C to 700°C and one from 200°C to 1200°C. These furnaces use top and bottom guard heaters to minimise temperature gradients and also meet the requirement of "Optimal Realizations".

## ■ Single Zone Furnaces

Finally the range includes an economical single zone furnace for Indium, Tin and Zinc Cells and an Annealing Furnace for pre and post conditioning thermometers.

## ■ Plateau Lengths

CCT/2000-13 says that a plateau length of 10 or more hours is suitable for optimal realizations.

NIST in the US like to work with long plateaus whereas according to our UKAS procedure we should calibrate an SPRT 2 or 3 times using a new plateau each time.

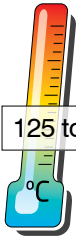
Our apparatus has sufficient performance that the length of the plateau is dictated mainly by how close the set point of the apparatus is to the fixed point being realized.

Plateau lengths at the silver point of over 70 hours (3 days) have been achieved using our furnaces. From a practical point we normally work with one working day long plateaus, remelting the cell overnight ready for a new freeze the next day.

## ■ High Temperature Furnaces

To eliminate problems with noise and electrical safety from high earth leakage currents our high temperature furnaces operate from 110VAC. For operation from 230VAC the furnace can be provided with an internally mounted isolating transformer.





125 to 1090°C

# Furnaces Dual and Heat Pipe

- Essentially Gradient Free
- Simple to use
- Long Plateau Length

### The Furnace Core

A heatpipe provides the ideal conditions for the creation and maintenance of freeze points from ITS-90. The core is essentially free from gradients meeting the recommendations of CCT/2000-13, "Optimal Realization of the Defining Points of the ITS-90..."

The heat pipe is designed so that the inner wall is not subject to thermal expansion stresses from the outer wall before the heat pipe reaches conduction temperature. The working fluid is permanently and safely sealed within the plasma-arc-welded enclosure.

Three temperature ranges are available

- Low Temperature 125°C to 250°C Water
- High Temperature 400°C to 1000°C Potassium
- Very High Temperature 500°C to 1090°C Sodium

An advanced proportional electronic control system with digital filtering controls the furnace temperature. Power feedback is used to stabilise against supply voltage changes.

Two entirely independent over-temperature safety circuits are provided.

### Dual Furnaces

In addition to heat pipes described above the Dual Furnaces incorporate a second furnace which, because of its unique design, will safely (and without contamination) pre- and post-condition the thermometers.

To complete the apparatus, a further pre-warming tube (with a temperature approximately equal to that of the heat-pipe) made of a unique and gas-tight material, is provided, together with a storage rack for 4 thermometers.



### Method of operation

The cell is melted, when melting is complete, the heat-pipe temperature is readjusted to be 0.5°C below the freeze temperature of the cell. A cold rod introduced into the cell's re-entrant tube initiates the freeze, to give a plateau that will last for between 12 and 24 hours.

With the Dual Furnace the thermometers are removed from their storage rack and placed in the pre-conditioning furnace. The furnace is slowly heated to the Cell temperature.

The thermometers are protected from contamination by a slow air flux around them.

One by one the thermometers are transferred into the cell for 20 to 30 minutes for calibration and thence back to the conditioning furnace.

When all the thermometers have been calibrated, the conditioning furnace is slowly cooled back to 400°C whence the thermometers can safely be removed into room temperature.

### Accessories

Accessories include equalizing blocks, a fan assembly to keep thermometer handles cool, a thermometer holder and internal and external isolating transformers.

### Cooling Coil

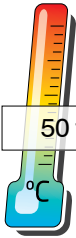
The Potassium and Sodium models have a cooling coil in the lid with connections to circulate tap water to keep the furnace lid cool protecting the SPRT and reducing heat load into the lab.

The Isotech Medium Temperature Furnace is designed specifically to realize and maintain the freeze plateaux of Isotech Indium, Tin, Zinc and Aluminium Cells, for the calibration of thermometers on ITS-90. It can also be used with an insert, as an annealing facility of the highest order for SPRTs or as a comparison calibration facility.



Model	Temperature Range	Heatpipe	Cells	Conditioning Furnace	Equalizing Block
17707	125°C - 250°C	Water	In and Sn	Included	410-02-18
17702W	125°C - 250°C	Water	In and Sn	Heatpipe Only	410-02-18
17706	400°C - 1000°C	Potassium	Zn, Sn, Al	Included	420-02-15
17702P	400°C - 1000°C	Potassium	Zn, Sn, Al	Heatpipe Only	420-02-15
17705	500°C - 1090°C	Sodium	Al, Ag Cu	Included	420-02-15
17702S	500°C - 1090°C	Sodium	Al, Ag Cu	Heatpipe Only	420-02-15

Uncertainty	< 1mk (with cells)	PC Interface	Included as standard
Uniformity	< 10mk over length of fixed point sample	Resolution	0.1 (Over Whole Range)
Control	0.1°C Resolution	Core Size	52 x 432mm
Communications	Included as standard	Dimensions	Height 960mm Width 600mm Depth 560mm Weight Dual 119kg / Heatpipe 115kg



50 to 500°C

# Furnaces

## Low Temperature

- Single Zone
- Aluminium Alloy Block
- Six to 12 Hour Plateau

The Isotech Low Temperature Fixed Point Furnace is designed specifically to realize and maintain the freeze plateaux of Isotech Indium, Tin and Zinc Fixed Point Cells, for calibration of thermometers on the International Temperature Scale of 1990.

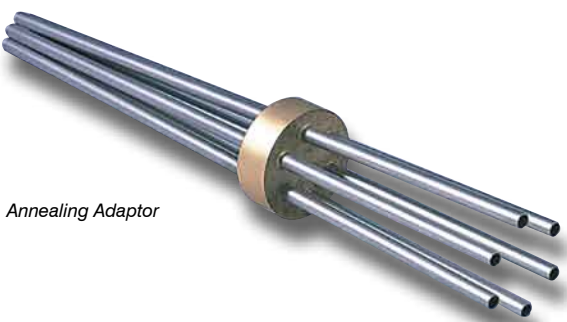
The Low Temperature Furnace is a single-zone furnace.

The recommended procedure for establishing a freeze plateau requires operator attention until the plateau is realized. Following that, the Model 17701 Furnace will maintain the indium or the tin plateau, essentially automatically, for a period of 10 to 12 hours and the zinc plateau for 6 to 8 hours.

1. The furnace core, into which the freeze-point cell is inserted, is of aluminium alloy, which provides a very low thermal gradient along the core length. The main furnace heater is of the parallel-tube design as used at NIST. A pre-warming tube is provided.
2. An advanced proportioning electronic control system regulates furnace temperature, using a platinum resistance thermometer as sensing element. The controller may be calibrated in-situ using Freeze Point Cells as references.

Two entirely independent over-temperature safety devices are included. A dedicated (on-off) over-temperature control circuit provides active safety. A fusible link in the main power circuit provides passive safety.

3. The Low Temperature Furnace is completely self-contained, castor mounted and requires no external supplies (except power).



Annealing Adaptor

*Fixed Points of:  
Indium 156.5985°C, Tin  
231.928°C, and Zinc  
419.527°C, 6 to 12 Hours  
Plateau Annealing Adaptor,  
Active and Passive  
Safety Circuits*



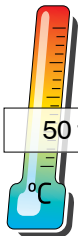
Model	ITL-M-17701
Temperature Range	50°C to 500°C
Uncertainty	<1mk (with cells)
Control	0.1°C Resolution
Communications	Included as standard
Power	1.5kW, 108-130 or 208-240VAC, 50/60Hz
Dimensions	Height 960mm Width 600mm Depth 560mm Weight 115kg

### Accessories

- 411-01-11 Annealing Adaptor
- 824-01-00 Fan Assembly

### How to order

ITL-M-17701 Low Temperature Furnace  
Please specify voltage required



50 to 700°C

# Furnaces

## Medium Temperature

- Wide Operating Range
- Three Zone Control
- Long Plateau Length

The Medium Temperature Furnace is of three zone design. In addition to the main temperature controlled zone there are guard heaters at the top and bottom of the block. These zones are controlled by differential temperature sensors which enable the furnace to operate with just small temperature differences along the whole length of the heated metal block. This is important when freezing cells, since the assumption made is that cells freeze in concentric shells. This is true only if there is a small temperature gradient along the furnace.

The substantial furnace core is machined from aluminum bronze.

The recommended procedure for establishing a freeze plateau requires operator attention until the plateau is realized. Following that, the Furnace will maintain the plateau essentially automatically for a period of 10 to 20 hours, (longer if the heat flux from the Cell minimised).



*Fixed Points of: Indium 156.5985°C, Tin 231.928°C, Zinc 419.527°C, and Aluminium 660.323°C Active and Passive Safety Circuits, Equalizing Block for Comparison Calibration*

Model	ITL-M-17703
Temperature Range	50°C to 700°C
Uncertainty	<1mk (with cells)
Control	0.1°C Resolution
Communications	Included as standard
Power	3kW, 108-130 or 208-240 VAC, 50/60Hz
Dimensions	Height 960mm Width 600mm Depth 560mm Weight 115kg

<b>Accessories</b>	
420-02-18	Aluminium Bronze Equalizing Block
824-01-00	Fan Assembly (to cool the thermometer handle)
411-01-01B	Annealing Adaptor

**How to order**  
ITL-M-17703 Medium Temperature Furnace

Please specify voltage required



200 to 1200°C

# Furnaces

## 3 Zone High Temperature

- Widest Operating Range
- Three Zone Control
- Long Plateau Length

This more recent addition to our long-established range of metrology furnaces offers an alternative for those who prefer 3-Zone furnaces to Heat-Pipe technology. The three zones create a controlled volume of constant temperature within the furnace in which High-Temperature Fixed Points such as Aluminum, Silver and Copper can be frozen and melted. Because High-Temperature thermometers can be easily contaminated by metallic vapors, great care has been taken to eliminate the use of metals throughout the calibration volume. The cell holder is made of alumina.

A ceramic equalizing block is available comprising a closed ended tube, alumina tubes to house the sensors being compared, and alumina powder to act as an equalizing media.

The sensor for the main controller is a mineral insulated type N thermocouple which has been found to be more stable than the type R thermocouple. In addition two slave controllers compensate for any temperature gradient along the furnace by eliminating any temperature difference that they sense.

There is a cooling coil in the lid with connections to circulate tap water to keep the furnace lid cool protecting the SPRT and reducing heat load into the lab. A flow of 0.5 to 1 litre per minute is required at temperatures above 700°C

This 3-Zone Furnace can be used for the realizations of the Indium, Tin, Zinc, Aluminum, Silver, Gold and Copper points, or with an optional equalizing block used for annealing or comparison calibration.



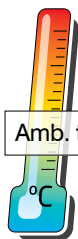
*Long plateaus from Fixed Point Cells  
Self-Tuning controller optimizes each Fixed Points performance  
3 zones controlled to compensate for end loss to give a perfect profile*

Model	465
Temperature Range	200°C to 1200°C
Uncertainty	<1 to 2mk (with cells)
Control	0.1°C Resolution
Furnace Depth	500mm
Diameter	100mm
Communications	Included as standard
Power	110VAC 50/60Hz 3kw or 230VAC 50/60Hz 3kw with internal transformer option

Dimensions	Height 960mm Width 600mm Depth 560mm Weight 115kg
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- Accessories**
- 465-04-00 Cell holder assembly
  - 465-02-06 Ceramic Equalizing Block

**How to order**  
465 3 Zone Metrological Furnace



- Designed to pre-warm and anneal Standard Platinum Resistance Thermometers
- Maintenance Free Use
- Available with programmable controller with communications

The Annealing Furnace, model 414, is designed to heat, anneal and cool SPRTs (Standard Platinum Resistance Thermometers) prior to calibration. The temperature range of the Furnace - from ambient to 1000°C enables all types of SPRTs to be annealed.

One of the duties of a calibration laboratory manager is to ensure that the SPRTs used in the Laboratory are fully annealed and still within specification.

Just using the thermometers within the laboratory will cause work-hardening to take place within the platinum coil of the SPRT.

Therefore regular annealing is required to ensure the SPRTs are in an ideal condition.

In 1990 the then new temperature scale ITS-90 specified the use of SPRTs up to the Silver point (961.78°C). At these temperatures quartz is very porous and in reducing atmospheres the SPRTs can quickly become contaminated.

The Isotech Annealing Furnace offers a safe solution for those who wish to anneal SPRTs up to 1000°C.

To prevent contamination at high temperatures a constant flux of pre-heated air passes the SPRTs being annealed.

A comprehensive handbook accompanies the Furnace.

This Furnace is installed simply and requires no maintenance.

# Furnaces Annealing



Model	414
Temperature Range	Ambient to 1000°C
Control	0.1°C Resolution
Furnace Depth	450mm
Diameter	50mm
Communications	Included as standard
Power	110VAC 50/60Hz 3kw or 230VAC 50/60Hz 3kw with internal transformer option

#### Dimensions

Height 800mm  
Width 400mm  
Depth 620mm  
Weight 40kg

#### How to order

414 Annealing Furnace



# Introduction to SPRTs and Standard Thermocouples

The **ITS-90** specifies the use of platinum resistance thermometers over the range -259°C to 962°C

*Between the triple point of equilibrium hydrogen (13,8033 K) and the freezing point of silver (961,78°C)  $T_{90}$  is defined by means of platinum resistance thermometers calibrated at specified sets of defining fixed points and using specified interpolation procedures.*

And

*An acceptable platinum resistance thermometer must be made from pure, strain-free platinum, and it must satisfy at least one of the following two relations:*

$$W(29,7646^{\circ}\text{C}) \leq 1,118\ 07 \quad (8a)$$

$$W(-38,8344^{\circ}\text{C}) \leq 0,844\ 235 \quad (8b)$$

*An acceptable platinum resistance thermometer that is to be used up to the freezing point of silver must also satisfy the relation:*

$$W(961,78^{\circ}\text{C}) \leq 4,2844 \quad (8c)$$

In practise Standard Platinum Resistance Thermometers, SPRTs, are constructed to cover sub ranges of the ITS-90 and SPRTs are available in different construction types.

Isotech offer the 670 family as SPRTs recommended for Primary Applications and the 909 Family for Secondary Laboratories.

These families span from -200°C to 670°C, for higher temperatures, up to 961.78°C the freezing point of Silver Isotech offer the 96178 HTSPRT.

## Standard Thermocouples

Whilst no longer a part of the temperature scale thermocouples are widely used in calibration laboratories. Isotech can supply Standard Thermocouples to 1600°C, either in platinum / platinum rhodium or platinum / gold materials.

## The 670 Family

### Ultra Stable SPRTs - The 670SQ Range

This new quartz sheathed SPRT range from Isotech is the ultimate SPRT for the most exacting measurements over the range of -200°C to 670°C. The same ultra stable element is now available in metal sheaths.

The Model 670SH covers -80°C to 670°C

The Model 670SL covers -200°C to 165°C

## 909 Family

Working Standards - The 909 Range

In addition to our popular quartz sheathed 909 SPRT covering the temperature range -200°C to 670°C. Isotech have introduced two new metal sheathed versions for 2007.

The **909H** works from -80°C to 670°C and can be provided with either 25.5 Ohm or 100 Ohm  $R_0$  to ITS-90.

The **909L** works from -200°C to 165°C and also is available with  $R_0$  25.5 or 100 Ohms to ITS-90.

## UKAS Calibration Options

All of the SPRTs described on this datasheet can be accompanied by one of three UKAS Calibration options.

1. **By comparison**, accuracies of just a few milliKelvins, ideal for the 95 Range.
2. **Standard Fixed Point Calibration**, suitable for most SPRTs including the 909 Range.
3. **Premium Fixed Point Calibration**, suitable only for most stable SPRTs such as the 670 Range and the 96178

## Isotech UKAS Calibration Uncertainties ( $k=2$ )

### Fixed Point Calibration

	Standard $\pm u/c$	Premium $\pm u/c$
Mercury	2	0.6
Gallium	2	0.6
Indium	3	1
Tin	3.5	1
Zinc	3.5	1.2
Aluminium	10	2
Silver	40	7

## Thermocouples

Model 1600 Platinum / Platinum Rhodium

Available as Type R or Type S these thermocouples are housed in a 99.7% recrystallized alumina sheath, 300 or 600 mm long and can be used to 1600°C

## Platinum / Gold Thermocouple

This model offers smaller uncertainties than Type R or S using only pure metals in the construction. An economical alternative to HTSPRTs.

<http://www.isotech.co.uk>



-200 to 670°C

- Useable Range -200°C to 670 °C
- 25.5 Ohm SPRT
- Outstanding Performance

This 670SQ is our latest thermometer, to be specifically designed to give optimum performance up to the aluminium point. Its construction permits the four internal platinum lead wires to expand and contract in the same manner as those of silver-point thermometers. The all-quartz construction of the support members gives the most stable performance with minimal drift, and a unique platinum radiation shield prevents heat radiating up the inside of the sheath.

The temperature range and design of this new unit means that we can now offer 25.5 Ohm (Ro) and 100 Ohm (Ro). The construction, including the coiled sensing element, heat-shunt baffles and light scattering barriers, creates a thermometer of unsurpassed stability.

Because the 670SQ goes beyond the temperature range of oxide growth to the level at which the oxide dissociates, the 670 is filled with a unique argon/oxygen mixture. A 2.5 metre length of low thermal EMF, high temperature, screened cable is connected in the handle, via a strain-relieving transition, to the all pure platinum construction of the thermometer.

Gold-plated U-shaped terminals complete the cable construction, and the 670SQ is delivered in an elegant soft lined carry-case of our own design. A 670SQ is supplied only after a stabilising process which is complete when the reproducibility of  $R_{TPW}$  is within 0.0005°C after excursions to the extremes of its temperature range. Values of  $R_{TPW}$  and  $W_{ga}$  are routinely provided with the 670SQ.

The 670SQ can be supplied with  $R_{TPW}$  and  $W_{ga}$  only or with full UKAS calibration. "With calibration" means that you will get an Internationally accepted Fixed Point calibration. For best accuracy, recommended maximum measuring currents for the 670SQ are 1mA for the 25.5Ω (Ro) and 0.5mA for the 100Ω (Ro).

A comprehensive handbook and tutorial will help you get the very best performance and stability from your 670SQ.

The 670SQ 650mm long is our recommended SPRT offering ultra stability, vibration, shock, immersion and self heating characteristics. From the success of the original Model 670 SPRTs we have introduced new models into the 670 range offering metal sheathed and low temperature models.

# Primary SPRT 670 Family



*Super Stable Standard Platinum  
Resistance Thermometer*

Models	670SQ, 670SH, 670SL
Measuring Range	-200°C to 670°C
Nominal Resistance	25.5Ω Ro or 100Ω Ro
Resistance Ratio	$W_{ga} > 1.11807$ as required by ITS-90
Sensitivity	0.1Ω / °C (25.5Ω) 0.4Ω / °C (100Ω)
Long term drift	from 0.001°C / year depending on use

### How to Order

Model 670SQ, 670SH, 670SL / 25.5 or  
Model 670SQ, 670SH / 100

State "with UKAS Calibration" or "without UKAS  
Calibration".

Refer to introduction for Calibration Uncertainties.

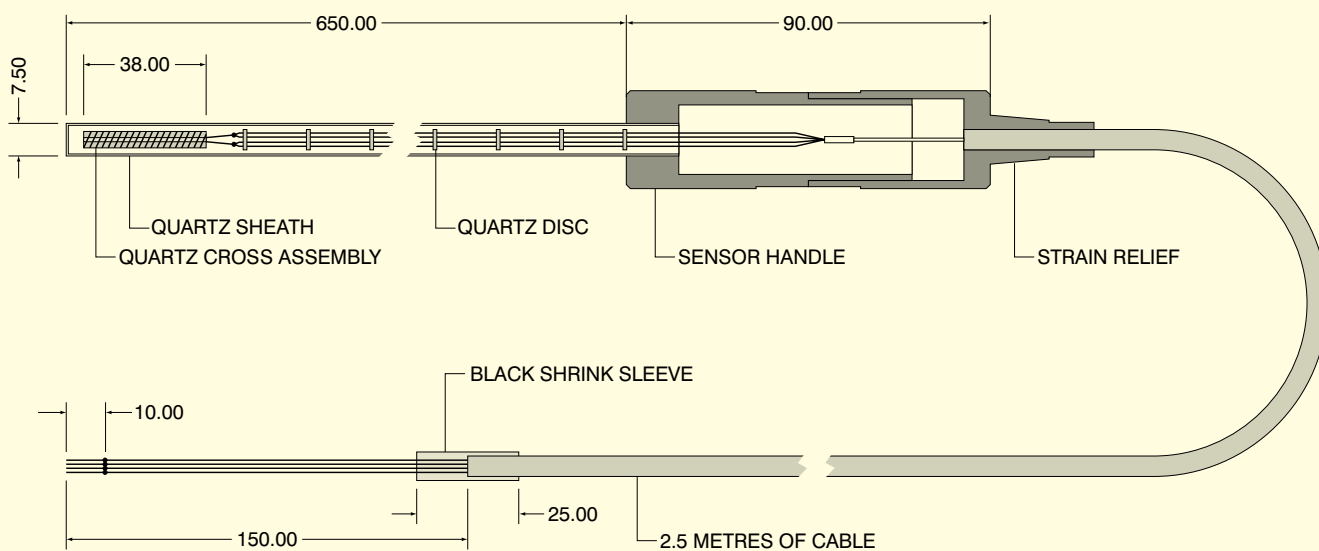
Whilst metal sheathed thermometers appear more robust than the quartz glass models it should be noted that ALL SPRTs are fragile devices and must be handled with care. Quartz glass thermometers have the advantage that the internal components are visible and can be inspected and continue to be our recommended models.

The low temperature models have excellent immersion characteristics and a significant cost saving when compared to the higher temperature models.

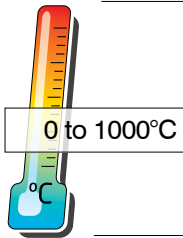
Having selected the finest cells and apparatus select Isotech SPRTs, with over thirty years experience of manufacturing platinum resistance thermometers it is not surprising we have developed the finest standard thermometers.

Our preferred standards in our UKAS lab are the 670SQ for up to 660°C and the 96178/0.25 for use up to the silver point, 962°C.

Benefits to your laboratory, ultra stability, best SPRT vibration and shock resistance, best immersion characteristics, low self heating, longer life and less contamination.



Model	Range (°C)	Ro (Ohms)	Sheath	Diameter	Length	Sensing Length	Comments
670SQ	-200 to 670	25.5	Quartz	7.5mm	650mm or 480mm	35mm	Recommended for wide range use in the Primary Laboratory
670SQ	-200 to 550	100	Quartz	7.5mm	650mm or 480mm	35mm	100 Ohm version
670SH	-80 to 670	25.5	Metal	6mm	650mm or 480mm	35mm	Metal sheathed high temperature model
670SH	-80 to 550	100	Metal	6mm	650mm or 480mm	35mm	100 Ohm version
670SL	-200 to 165	25.5	Metal	6mm	480mm	35mm	Metal sheathed low temperature model



# Silver Point SPRT Model 96178

- Unique Aspirated Design
- High Stability
- Ultra High Purity Quartz

Isotech has produced over 200 high temperature thermometers which have been sold world-wide for use up to the silver point. As a consequence of our pre-delivery testing alone we have probably made more silver point calibrations than anyone else in the world.

No one fully appreciates all the mechanisms at work when a coil of pure platinum wire inside a quartz envelope is taken to 1000°C and back. However, endless hours of study at National and International level, plus our own significant work at Isotech, have enabled us to design, build and test a superior Silver-Point Thermometer. This, we feel, is a significant contribution to better high temperature calibration.

First, the 96178 can breathe, a valve in the handle can be opened to allow oxygen depleted or moist air to escape from inside the sheath and replacement by fresh air containing 20% oxygen. The valve is normally opened at elevated temperatures and closed to prevent moisture ingress before water triple point measurements are performed.

Second, the 96178 is the only thermometer ever designed with platinum heat radiation shields built into the sheath, to prevent heat radiating up inside the sheath.

Third, a new ultra pure quartz, developed for the semiconductor industry at a cost of between 20 and 30 million pounds, has been adopted for use in the construction of the 96178. This new thermometer exemplifies our commitment to achieve the highest possible quality and minimum of contamination.

How the thermometer is handled is most important for its stability and a purchaser will receive a comprehensive manual and tutorial with each 96178.

Under some circumstances, provided the interior of the thermometer is undamaged we can replace the outer quartz sheath. Please consult us if a replacement is required.

To exploit fully the accuracy of the 96178, a user will need a furnace for warming and annealing the thermometer as well as one to house the silver-point/aluminum-point cells.

A Dual Calibration Furnace from Isotech combines these two features together with all the special accessories and handling know-how we have discovered.



Model No	96178
Temperature Range	0°C to 1000°C
Resistance Value	$R_0 = 0.25\Omega$ (others to special request)
Resistance Ratio	$W_{ga} > 1.11807$
Dimensions	Length 650mm Diameter 7.5mm
Drift during use	
a. Smallest	When taken to 970°C slowly over 1 to 2 hours and cooled slowly again (overnight) to 450°C, the triple point of water resistance will repeat to better than a temperature equivalent of 0.0005°C.
b. Largest	When thermally shocked from 970°C to 20°C the triple point of water resistance will increase by a temperature-equivalent of up to 35mK; this is mostly recoverable upon annealing at 650°C for a few hours and then cooling slowly (overnight) to 450°C.
Long term drift	Most changes occur during heating and cooling. If this process is done carefully, long term stabilities of a few mK per year can be expected, with reproducibility at the silver point of 3 to 5 mK.

#### How to order

Model 96178/0.25

State "with UKAS calibration" or "without UKAS calibration".

Refer to introduction for Calibration Uncertainties.

# Isotech Note

## Why choose 0.25Ω for HTSPRTs?

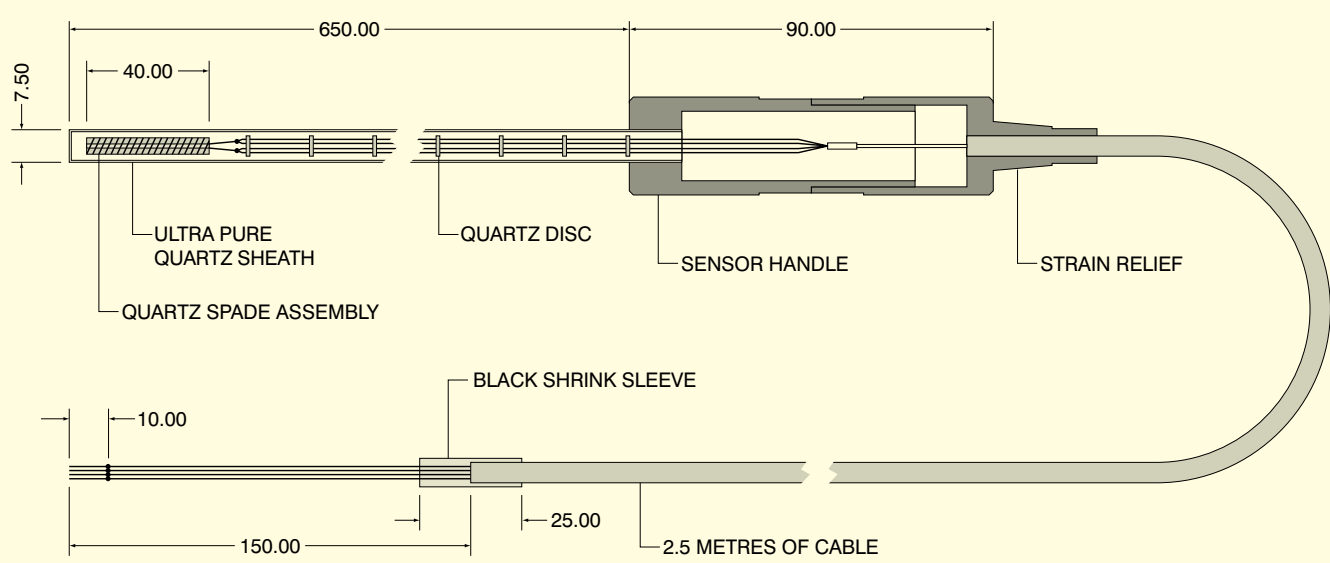
**Note1:** It is necessary to make the former on which the platinum is wound of high-purity quartz. Even quartz does not provide absolute isolation at the high temperature end of the range. The former, or mandrel, is thus a shunt resistance across the platinum winding, and because of the uncertainty of the contacts between platinum and quartz, it is uncertain and unstable in magnitude. The practical solution is to reduce the element resistance so that the shunt resistance produces a smaller network effect. For example, for a 25.5Ω thermometer, suppose that the shunt resistance were 20 MΩ. Then the network resistance is 25.499967Ω. But we require measurement assurance of better than 1 part per million, so this won't do, even if the shunt were a constant (calibratable) value, which it is not. For a 0.25Ω thermometer, a 20 MΩ shunt gives a network resistance of 0.24999997Ω, which is tolerable. The cost, and there is a cost, is increased difficulty on the electrical measurement side, particularly in the face of noise, which is present at high temperatures.

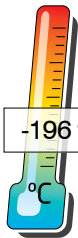
**Note2:** Gases, like Iron, Chromium, Nickel under reducing conditions, can penetrate the quartz sheath and poison the platinum.

It is necessary to purchase not only the 96178, but items such as the Dual Furnace to ensure that your high temperature thermometer does not become contaminated.

Only Isotech offers a comprehensive solution to the measurement and use High Temperature Thermometry.

**Note3:** Our know-how and expertise in the field of High Temperature Thermometry has been written down and is available in the Isotech Journal of Thermometry.





-196 to 670°C

- Three Stem Lengths
- Wide Operating Range
- Proven Design

This economically-priced Standard Platinum Resistance Thermometer, Model 909, is the workhorse of calibration laboratories all over the world. During 2007 we reviewed our range of SPRTs and now have new models in the 909 family, the 909L and 909H. The wide temperature ranges and economic pricing make this thermometer ideal for the secondary laboratory. For smaller uncertainties to suit the Primary Laboratory refer to the Model 670 SPRTs.

The resistance element is of pure platinum, coiled and mounted in a strain free construction. The former is of pure alumina material and all parts have been pre-aged to eliminate contamination and strain. All joints are welded to minimize resistance changes. The leads are brought to a handle assembly where they are connected to a low loss cable, 2M long and screened.

The 909Q has a quartz sheath while the 909L and 909H have metal sheaths. Whilst metal sheathed thermometers appear more robust than the quartz glass models it should be noted that ALL SPRTs are fragile devices and must be handled with care.

Three thermometer lengths are available, standard length 480mm, extra length 550mm or maximum length 600mm.

Quartz glass thermometers have the advantage that the internal components are visible and can be inspected and continue to be our recommended models. The low temperature models have excellent immersion characteristics and a significant cost saving when compared to the higher temperature models.

The Model 909 is supplied with a calibration certificate giving  $R_{TPW}$  and  $W_{ga}$ . Alternatively we can provide a complete UKAS calibration certificate, see table opposite. For transportation and storage the Model 909 is supplied in its own attractive carrying case.

# Working SPRTs 909 Family



Model	909	
$R_{TPW}$	25.5Ω	100Ω
Nominal Resistance	25.5Ω at 0°C	
Recommended Max. Current mA	1	0.5
Nominal Sensitivity	0.1 Ω/°C	0.4 Ω/°C
Resistance Ratio	$W_{ga} > 1.11807$ as required by ITS-90	
Self-heating	1mK / 25 microwatts	
Stability	Depends upon the temperature range of use. Typical annual stability, see the table on the next page.	
Internal leads	4 wire-platinum	
External Leads	Silver-plated multi-strand wires in a low-loss insulation cable terminating in gold-plated terminals.	

### How to Order

Model 909 Specify model, resistance and length. State with UKAS Calibration or without UKAS Calibration. at Fixed Points or by Comparison.

**Isotech UKAS Calibration Uncertainties (k=2)**

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

The latest schedule can be found on the Isotech website or at [www.ukas.org](http://www.ukas.org).

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

**Note:** The 100Ω 909 has a maximum temperature of 550°C and so cannot be UKAS certified over Range 4. Please contact Isotech if calibration is required above Zinc.

Model	Range (°C)	Ratio Wga	Outer Sheath	Construction	Nominal Diameter	Stem Length	Sensor Length	Notes
909Q 25.5Ω	-200 to 670	>1.11807	Quartz	Sealed with dry oxygen / argon mix	7.5mm	480mm 550mm 600mm	65mm	Isotech recommended secondary standard SPRT
909Q 100Ω	-200 to 550	>1.11807	Quartz	Sealed with dry oxygen / argon mix	7.5mm	480mm 550mm 600mm	65mm	100 Ohm secondary standard SPRT
909H 25.5Ω	-80 to 670	>1.11807	Metal	Sealed	6mm	480mm 550mm 600mm	65mm	Internal alumina tube protects sensor from contamination
909H 100Ω	-80 to 550	>1.11807	Metal	Sealed	6mm	480mm 550mm 600mm	65mm	Internal alumina tube protects sensor from contamination
909L 25.5Ω	-200 to 165	>1.11807	Metal	Sealed with dry oxygen / argon mix	6mm	480mm 550mm 600mm	65mm	Optimised for low temperatures, less stem conduction due to internal construction
909L 100Ω	-200 to 165	>1.11807	Metal	Sealed with dry oxygen / argon mix	6mm	480mm 550mm 600mm	65mm	Optimised for low temperatures, less stem conduction due to internal construction



0 to 1600°C

- Type R and Type S
- Gas Tight Assembly
- Premium Grade Wire

The Isothermal range of Thermocouple Standards are the result of many years development. The type R and S standards will cover the range from 0°C to 1600°C.

The measuring assembly comprises a 7mm x 300mm or 600mm gas tight 99.7% recrystallized alumina sheath inside which is a 2.5mm diameter twin bore tube holding the thermocouple.

The inner 2.5mm assembly is removable since some calibration laboratories will only accept fine bore tubed thermocouples and some applications require fine bore tubing.

The covered noble metal thermocouple wire connects the measuring sheath to the reference sheath which is a 4.5mm x 250mm stainless steel sheath suitable for referencing in a 0°C reference system. Two thermo electrically free multistrand copper wires (teflon coated) connect the thermocouple to the voltage measuring device.

The thermocouple material is continuous from the hot or measuring junction to the cold, or referencing junction.

**Calibration**

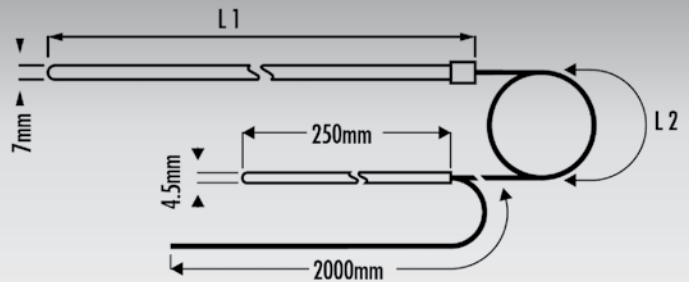
The 1600 is supplied with a certificate giving the error between the ideal value and the actual emf of the thermocouple at the gold point. For types R and S thermocouples, manufacturing tolerances are small and, therefore, the use of a standard reference table is particularly apt. A few calibration points, only, are required to determine the small differences between the characteristics of an individual thermocouple and the standard reference table. As an example of consistency, 48 Isotech thermocouples calibrated at NPL, had a standard deviation of the differences from the reference table value at the gold point (11, 364µV) of only 7µV, equivalent to about 0.5°C.

Thermocouple characteristics are sufficiently smooth to allow interpolation of deviations from the reference table to be carried out over fairly wide temperature spans without introducing unacceptable errors. Isotech can offer a 4-point UKAS calibration for temperatures up to 1100°C (supplied as standard), a 6 point UKAS calibration up to 1300°C with the option of a table of millivolts to degrees Celsius in 10°C steps or, alternatively, arrange for an NPL calibration for temperatures up to 1600°C.

Please contact Isotech to obtain current prices for calibration.

# Thermocouple Standard

*Type R & S Standard Thermocouple, Model 1600, Premium grade wire, gas tight assembly, No intermediate junctions.*



TYPE R & S STANDARD THERMOCOUPLE	CODE	L 1	L 2
	/600	600	1150mm
	/300	300	1450mm

*Also available without the physical cold junction - Specify No Cold Junction (NCJ).*

Model	1600
Hot Sheath Temperature Range	0°C to 1600°C (R or S)
Emf Vs Temperature	According to relevant document
Response Time	5 minutes
Hot Junction Dimensions	see diagram
Connecting Cable	see diagram
Cold Junction	250mm long x 4.5 diameter
Copper Extension Wires	2000mm
Immersion	100mm min.
Case Dimensions	Height 65mm Width 710mm Depth 165mm Gross Weight 900g
Feature	Removeable inner assembly

The standard thermocouple described can be supplied in the following noble metal combinations

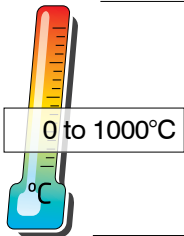
- TYPE R: Platinum vs Platinum 13% Rhodium
- TYPE S: Platinum vs Platinum 10% Rhodium

**How to order**

- Model 1600 Type R/300
- Model 1600 Type R/600
- Model 1600 Type S/300
- Model 1600 Type S/600

If cold junction not required, specify NCJ.

UKAS calibration is included



# Thermocouple Platinum/Gold

- Pure Metal Construction
- Best Homogeneity
- Economic Attention to HTSPRTs

Since 1995 Isotech have been producing various designs of special Pt/Au, Pt/Pd, Pd/Au thermocouples for researchers. From our experience we can now offer the most popular of these, the Pt/Au thermocouple in a standard form.

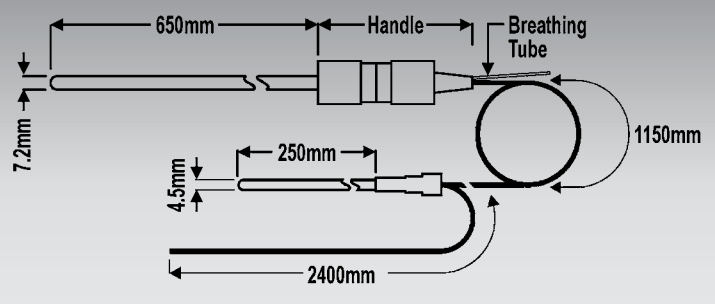
All wires are 99.999+% pure and are fully annealed according to the recommendations of McLaren. Assembly also follows his prescriptions which have never been bettered.

After final assembly and annealing the Pt/Au thermocouples will conform to IEC 26460, Edition 1 2008-07.

For the smallest uncertainties we calibrate the thermocouple at the Zinc, Aluminium and Silver Fixed Points.

**We achieve these results because:**

1. All materials are selected for their purity and high quality.
2. All parts are pre-aged and annealed prior to construction.
3. The construction allows for differential expansion of the Gold and the Platinum by having a coil of platinum bridge the two thermo elements at their measuring junction.
4. There are no joins between the measuring and reference junctions.
5. The reference junction is also researched and we use thermally pure copper wire of selected diameter which has been pre-annealed in inert gas to maintain the accuracy of the measuring junction.
6. The reference junction needs to be placed in an accurate reference system such as a Water Triple Point Cell or an Isotech Zeref.
7. An article describing in detail the construction, handling and operation of the thermocouple is provided free with each unit.



*Economic alternative to HTSPRTs  
Construction allows for differential expansion  
Accuracy of ±0.05°C over the whole temperature range*

Temperature Range	0°C to 1000°C	
Sheath materials	Quartz	
Measuring Junction	Stainless Steel	
Reference Junction	Stainless Steel	
Thermo-element Purities		
Platinum	99.999% Pure	
Gold	99.999% Pure	
Calibration	Zinc	0.05°C
Uncertainties	Aluminium	0.05°C
	Silver	0.05°C
	0-1000°C	0.10°C
	Including uncertainty of interpolation / extraction	
Dimensions	Refer to drawing	
Carrying Case	Included as standard	

**How to order**

Model type: Pt/Au Thermocouple  
Including emf vs. temperature traceable calibration certificate and carrying case.  
UKAS Calibration optional.

# Precision Thermometry Bridges

Isotech have a range of innovative precision thermometers to match the calibration requirements of all labs, from most demanding of National Metrology Institutes through to the needs of those calibrating industrial sensors.

## microK Family

These instruments and the matching microK channel expander can be used with the best of Standard Platinum Resistance Thermometers, Thermistors and Thermocouples with uncertainties of better than 0.0001°C.

The microK family has unrivalled convenience and flexibility with performance that was previously only attainable with the best of the AC Resistance Bridges.

## TTI Family

The True Temperature Indicator family includes the TTI-22 and TTI-7 PLUS. The TTI-22 offers performance to 1mK at a ground breaking new price. The TTI-7 can be used with SPRTs, PRTs and all the major thermocouple types.



## Thermometer Selection Guide

Model	SPRTs	PRTs	Thermistors	Thermocouples	Accuracy at 0°C	Application	Features
microK 100	■	■	■	■	0.000025°C	Primary	Three Input Channels Touch Screen
microK 200	■	■	■	■	0.000050°C	Primary	Adjustable Current Source Keep Warm Currents Touch Screen
microK 400	■	■	■	■	0.000100°C	Secondary	
microK 800	■	■	■	■	0.000200°C	Secondary	
TTI-22	■	■			0.001°C	Secondary	Sets new Standard for Price to Performance
TTI-7	■	■		■	0.01°C	Secondary/ Industrial	SPRTs, PRTs and Thermocouples
<b>Scanners</b>							
microKanner							Add up to 90 Channels to microK family Plug and Play Operation
Model 954							8 Channel PRT Switch for TTI-22 and TTI-7 PLUS
Model 958							8 Channel Thermocouple Switch for TTI-22 and TTI-7 PLUS

## Resistors

To enable the smallest of measurements Standard Resistors are used, and in the Primary Lab these resistors require to be kept at a precise and constant temperature. Isotech can supply and calibrate Standard Resistors to uncertainties less than 0.08ppm.

Resistor Selection Guide			
Model	SRA & SRB	456	455
			
<b>Values</b>	SRA: 1, 10, 25 and 100 Ohm 400 Ohm to special order  SRB: 1000 and 10,000 Ohms	10, 25, 100, 1000, 10,000 Ohm	Standard Resistor Maintenance Bath
<b>Application</b>	Primary and Secondary Lab microK	Affordable Resistors with inbuilt temperature control	Precisely Maintains SRA Primary Resistors at Fixed Temperature

<http://www.isotech.co.uk>





-200 to 1800°C

- Accuracy  $\pm 0.1$  ppm
- Zero drift for PRTs
- PRT, thermocouple and thermistor sensing
- <2 second measurement time
- Keep-warm currents
- 0-10mA sensor current
- Touch screen

The new microK family of precision thermometers set new world standards for accuracy and stability. Designed for a wide range of high accuracy industrial and scientific calibration applications, the instrument uses a completely new measurement technique to achieve accuracies better than 0.1 parts per million (ppm) - equivalent to 0.0001°C - when used with a standard platinum resistance thermometer (SPRT).

When used with a 0°C cold junction reference unit, or by measuring the junction temperature with a PRT on another channel the instrument is capable of low uncertainty precision thermocouple measurements, with a voltage uncertainty of just 0.25 $\mu$ V, equivalent to 0.01°C with a Platinum / Gold Thermocouple at 1000°C.

The microK range consists of four instruments offering a choice of measurement uncertainty from 0.1 to 0.8ppm, equivalent to 0.1mK to 0.8mK over the whole range of an SPRT with an  $R_0 > 2.5\Omega$ .

The instruments in the microK range offer performance characteristics and features which are simply not available elsewhere. Comparable instruments available internationally do not achieve the same accuracy or stability (zero drift characteristics with SPRT measurements are not obtainable in any other instrument), other instruments do not support the same variety of sensors, and offer considerably less operational features. The microK family uses solid state construction with no potentiometers or relays which ensures long term reliability and low cost of ownership, a feature of growing international importance.

**Stable:** The inherently stable 'substitution technique' used in the microK means that it achieves zero drift for resistance measurements and only 3ppm/year for voltage measurements so you can be confident in your measurements between calibrations.

**Versatile:** This is the only instrument of its type that works with PRTs, thermocouples and thermistors, so you only need to purchase one product for your thermometry application rather than two or more instruments.

**Easy to Use:** The microK includes a comprehensive range of features, including direct reading in temperature for all sensor types, data logging, easy export of data to Excel™ and graphing facilities. Despite its sophistication

# Precision Thermometer microK



microk 100

*Unequalled combination of accuracy, stability and versatility.*

the microK is very easy to use. The built in 6.4" full VGA colour touch screen, powered by the Window CE operating system provides a familiar and powerful operator interface so you can get on with making measurements rather than learning how to control the instrument.

**Best Practice Ready:** Best practice guidelines recommend the use of two reference thermometers for calibrations. That is why we have included three channels in the microK, enabling you to achieve best practice without having to buy additional and costly multiplexers.

**Cable Pod™ Connector System:** The connectors accept 4mm plugs, spades or bare wires. The 3/4" separation is compatible with standard 4mm to BNC adaptors, so you can use thermometers with any normal termination type. The Cable Pod™ connector system uses gold-plated, tellurium-copper to give the lowest possible thermal EMF and the best measurement uncertainty. The connectors have a clamping arrangement that does not rotate as the terminal is screwed down, thereby protecting the wire from mechanical damage.

**Low Noise:** The new ADC, together with the low noise pre-amplifiers used in the microK, means you achieve a lower measurement uncertainty in a shorter time.

**Keep-Warm Current:** The microK includes keep-warm current sources to maintain the power in a PRT when it is not being measured, eliminating uncertainty resulting from power coefficients.

# The microK Family

## microK 400 and 800

These models were first introduced in 2006 and set a new standard for temperature measuring instruments. With innovative features and performance of 0.4 and 0.8ppm these are the instruments of choice for secondary laboratories. All the microK family have three input channels. PRT, Thermistor and Thermocouple Support, Touch Screen, Zero Drift, Data Logging and reliable solid state construction

## microK 100 and 200

Retaining the features and innovation of the original microK these models introduced in 2009 incorporate a measurement engine with improved linearity and advanced Parallel Analogue Processing giving Primary Laboratory performance of better than 0.1ppm and 0.2ppm. A further innovation is the ability to automatically compute and display the zero current resistance with no manual correction, another microK first.

## microKanner

The microKanner replicates the input system of the microK for all 10 of its input channels. Measurements made with a microKanner are therefore to the same uncertainty as the microK itself. A microK system can be expanded to a maximum of 92 channels without losing measurement performance.

The use of plug-and-play technology means that the extra channels appear automatically on the microK when you connect it to a microKanner. The new channels are configured in exactly same way as any of the microK's existing inputs, through the microK's existing inputs, through the microK's touch screen or via the PC Interface.

**Parallel Analogue Processing - microK 100 or microK 200**

When working at 0.1ppm uncertainty the noise of the instrument is an important performance parameter. In developing the microK 100 and 200 a new technology, that of parallel analogue processing has been used to lower the noise to a level which could previously only be achieved by the best of AC bridges. To learn more visit the Isotech website.



microK 400 with microKanner

# microK Universal Specifications

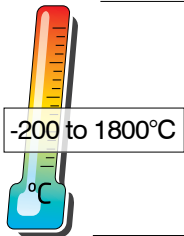
<b>Accuracy - Thermocouples</b>	Voltage uncertainty: Range 0-20mV 250nV Equivalent to 0.01°C for Gold Platinum thermocouples at 1000 °C	<b>Interfaces</b>	RS232 (9600 baud) USB (1.1) - host
<b>Measurement Time</b>	<2 seconds per channel	<b>Display</b>	163mm / 6.4" VGA (640 x 480) Colour TFT LCD
<b>Temperature Conversions</b>	PRTs: ITS-90, Callendar-van Dusen Thermocouples: IEC584-1 1995 (B, E, J, N, R, S, T), L and gold-platinum Thermistors: Steinhart-Hart	<b>Channels</b>	3
<b>Cable Length</b>	Limited to 10Ω per core or 10nF shunt capacitance (equivalent to 100m of RG58 coaxial cable)	<b>Cold Junction Mode</b>	External and Remote with PRT
<b>Input Connectors</b>	Cable Pod™ connector accepting: 4mm plugs, spades or bare wires Contact material: gold plated tellurium copper	<b>Expandable</b>	Add up to 90 expansion channels
		<b>Probes Supported</b>	PRT's, Thermistors & Thermocouples
		<b>Units</b>	Ratio, V, Ω, °C, °F, K
		<b>Switching Technology</b>	Solid state
		<b>Keep Warm Current</b>	Adjustable 0-10mA

## microK Specifications (Specifications are subject to change without prior notice)

Parameter	microK 100	microK 200	microK 400	microK 800
Accuracy PPM (Whole range)	0.1	0.2	0.4	0.8
Accuracy (at 0.01C) (mk)	0.025	0.05	0.1	0.2
Accuracy (SPRT Ro ≥ 25Ω) <sup>[1]</sup> (mk)	0.1	0.2	0.4	0.8
Accuracy (SPRT Ro ≥ 0.25Ω) <sup>[1]</sup> (mk)	0.25	0.5	1	2
Sensor Current	0-10mA in 3 ranges: 0 - 0.1mA ±0.4% of value, ±70nA, resolution 28nA 0.1 - 1mA ±0.4% of value, ±0.7µA, resolution 280nA 1-10mA ±0.4% of value, ±7µA, resolution 2.8µA			
Resolution (mK)	0.001	0.001	0.01	0.01
Stability (ppm/yr)	0 <sup>[2]</sup>	0 <sup>[2]</sup>	0 <sup>[2]</sup>	0 <sup>[2]</sup>
TC (resistance ratio) <sup>[3]</sup> (ppm/°C)	0 <sup>[2]</sup>	0 <sup>[2]</sup>	0 <sup>[2]</sup>	0 <sup>[2]</sup>
Resistance Range (kΩ)	0 - 100	0 - 100	0 - 500	0 - 500
Internal Resistance Standards (Ω)	25, 100, 400	25, 100, 400	1, 10, 25, 100, 400	1, 10, 25, 100, 400
Internal Standard Resistor Stability	TCR <0.05ppm/°C Annual Stability <2ppm/year		1Ω <10ppm/°C <25ppm/year 10Ω <0.6ppm/°C <5ppm/year 25,100,400 <0.3ppm/°C <5ppm/year	
Keep Warm Current	0-10mA ±0.4% of value, ±7µA, resolution 2.8µA			
Operating Conditions	15-30°C / 50-85°F, 10-90% RH (for full spec) 0-50°C / 32-120°F, 0-99% RH (operational)			
Supply	88-264V (RMS), 47-63Hz (Universal)			
Power	25W maximum, 1.5A (RMS) maximum		20W maximum, 1.5A (RMS) maximum	
Size W x D x H (mm)	520mm x 166mm x 300mm / 20.5" x 6.6" x 11.9"			
Weight (kg)	13.3	13.3	12.4	12.4

**Notes:**

- Over whole range of SPRT, -200°C to 962°C.
- The microK uses a "substitution technique" in which the Device-Under-Test and the Reference are successively switched into the same position in the measuring circuit. This means that the stability of resistance ratio measurements is immeasurably small.
- Using external reference resistors.



# Channel Expander microKanner

- Expandable to 90 channels
- Supports PRTs, thermocouples & thermistors
- Plug-and-play operation

The microKanner can be used with any member of the microK family to add further channels, up to a maximum of 90 expansion channels.

**Easy to Use:** The use of plug-and-play technology means that the extra channels appear automatically on your microK bridge when connected to a microKanner. You can configure the new input channels in exactly same way as any of the microK's existing inputs (through the microK's touch screen or a PC, via an RS232 connection). You just plug in a microKanner and immediately gain the benefit of the additional channels, making this the easiest channel expansion system of its type.

**Accurate:** The microKanner replicates the input system of the microK bridge for all 10 of its input channels. Measurements made with a microKanner are therefore to the same accuracy as the microK bridge it is connected to. By adding further scanners the microK system can be expanded to 92 channels without losing measurement performance.

**Versatile:** Like the microK bridge, the microKanner works with PRTs, thermocouples and thermistors giving you unparalleled flexibility.

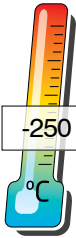
**Keep-Warm Currents:** The microKanner has 10 individually programmable keep-warm current sources to maintain the power in PRTs when they are not being measured, eliminating uncertainty caused by power coefficients.

**Cable Pod™ Connector System:** The connectors accept 4mm plugs, spades or bare wires. The standard 3/4" separation is compatible with standard 4mm to BNC adaptors, so you can use thermometers with any standard termination type. The Cable Pod™ connector system uses gold-plated, tellurium-copper to give the lowest possible thermal EMF and the best measurement uncertainty.

**Reliable:** Like the microK, the microKanner uses the latest semiconductor technology for channel selection and signal routing. This completely solid-state design therefore provides the highest possible reliability.



Model	microKanner
Channels	10
Keep-Warm Currents	0-10mA ±0.4% of value, ±7µA, resolution 2.5µA
Input connectors	Cable Pod™ connector accepting: 4mm plugs, spades or bare wires
Contact material	Gold plated tellurium copper
Interface	RS232 (9600 baud)
Operating conditions	15-30°C / 50-85°F, 10-90% RH (for full specification) 0-50°C / 32-120°C, 0-99% RH (operational)
Power	88-264V (RMS), 47-63Hz (Universal) 10W maximum, 1.2A (RMS) maximum
Size	520mm x 166mm x 300mm / 20.5" x 6.6" x 11.9" (W x D x H)
Weight	12.6kg / 28lb



-250 to 962°C

# True Temperature Indicator

## TTI - 22

- No mechanical relays, long life
- Warns if calibration due date exceeded
- Accuracy to 0.001°C, 1mK

Quite simply the Isotech TTI-22 High Accuracy Thermometer sets new standards in the price to performance ratio for industrial and secondary resistance thermometry. If you need high accuracy at an affordable price you have to look at the TTI-22.

The TTI-22 has an accuracy of 0.001°C and a resolution of 0.0001°C (0.00004 Ohms). It has two input channels, is lightweight (1.8kg) and will operate for more than 10 hours from two small AA cells. It has both RS232 and Ethernet ports.

Simple to use, supporting both Industrial 100 Ohm probe and SPRTs to ITS-90, 25.5 and 100 Ohm. Up to 30 probe calibrations can be stored along with the calibration expiry date so the instrument can warn when the calibration time has been exceeded.

Built in statistics calculation can show you both the measured and average values along with the standard deviation over previous measurements.

The Isotech TTI-22 is ideal as a reference standard alongside liquid calibration baths, for the smallest uncertainty calibration with Dry Blocks or for demanding stand alone measurement applications.

Previously this level of performance was confined to specialist laboratories with expensive thermometry bridges; TTI-22 delivers 5 to 10 times the performance of comparably priced instruments.

- The TTI-22 uses the same patented measurement technique as the earlier TTI-2.
- Each measurement performs a zero point and gain correction.
- The switched polarity DC measuring current (0.4mA) eliminates thermal EMFs.
- Surface mount construction ensures long term reliability.



Simple to use  
High Accuracy  
High Resolution

Model	TTI-22
Inputs	2 channel Pt100 (BS EN 60751 / IEC 751) or 25.5/100Ω SPRT to ITS-90
Measuring Current	0.41mA
Self Heating Test Current	0.29mA (0.41mA / √2)
Measuring Time	1.44 seconds for both channels
Measuring Range	-250 to 960°C (0 to 440 Ohm)
Resolution	Temperature: 0.0001°C, 0.1mK Resistance: 0.00004Ω, 40 μΩ
Uncertainty of Measurement	Temperature: 0.001°C, 1mK 100 Ohm PRT Resistance: 0.4mΩ @ 20°C <i>Instrument only, uncertainty with sensor dependant on range and sensor type.</i>
Reference Resistor	Internal 380Ω TCR ±0.3ppm / °C Stability ±5ppm / year
Interface	RS232, Ethernet, built-in web server provides simple temperature display
Ambient Temp. Range	10°C to 30°C
Power Supply	7.5VDC, 250mA power adaptor or 2 x AA batteries (typically >10 hours operating time)
Case Dimensions	Width: 190mm Height: 112mm Depth: 240mm Weight: 1.8kg

The TTI-22 continually compares the connected sensor to a highly stable precision internal reference resistor. For a Pt100 at 0°C the annual stability for absolute measurement is typically  $\pm 1.3\text{mK}$  ( $5\text{ppm} \times 100\Omega = 0.5\text{m}\Omega / 1.3\text{mK}$ ).

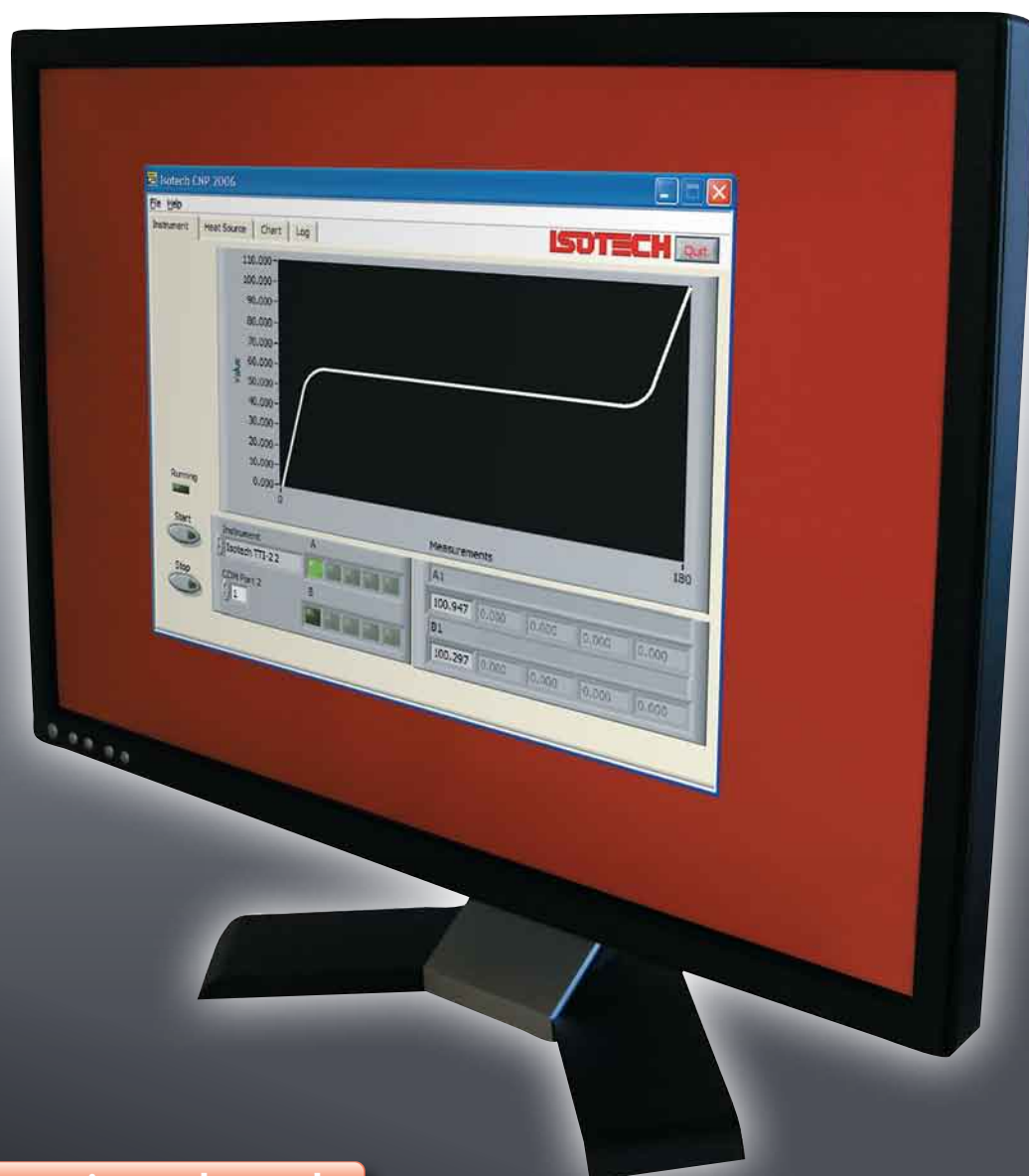
For comparison calibration, when a reference probe is compared to a calibrated standard, the long term stability is not important as any change of value is cancelled in the comparison. The temperature coefficient is  $0.3\text{ppm} / ^\circ\text{C}$  and the measuring time, for both channels, is just 1.44 seconds.

The instrument can be configured to measure ratio of the measured resistance of the two input channels, a technique familiar to users of older style thermometry bridges.

The overall uncertainty of the instrument and probe together will be determined by the model of probe and the temperature range. For the majority of applications the contribution of the instrument uncertainty will be negligible compared to the uncertainty of the calibrated probe.

Recommended probes include the Isotech 909/100 and 670SQ /100, 935-14-16, 935-14-95L and H.

The TTI-22 includes Cal Notepad software for easy monitoring and logging of data. It is fully compatible with Isotech I-Cal Easy which can automate comparison calibration.



<http://www.isotech.co.uk>





-200 to 2315°C

# PRT and Thermocouple Thermometer

## TTI - 7 PLUS

- Now accepts 25 and 100 Ohm Resistance Thermometers - Conversion to ITS-90 and IEC 751
- Eliminate unwanted thermal EMFs with current reversal
- Expandable to have 10 input channels
- Inbuilt data logger stores up to 4000 measurements
- Portable - 10 hours use from internal battery

The TTI-7 PLUS is a very high accuracy multi purpose digital thermometer for both platinum resistance thermometers and thermocouples. Laboratory users will welcome the features to eliminate Thermal EMF Errors and Self Heating Errors along with provision to store the calibration data of up to 20 PRT probes. The rugged aluminum case, internal battery pack and integrated power supply ensure reliable portable field use for demanding measurement applications all at great value for money.

Dual Channel input allows a probe on Channel B to be calibrated against a standard on Channel A - directly compare any combination of PRT and Thermocouple. The TTI-7 PLUS now supports thirteen thermocouple types, B, C, D, E, J, K, L, N, R, S, T, U, Au/Pt along with 25 and 100 Ohm platinum resistance thermometers.

### Data Logging and Statistical Analysis

The TTI-7 PLUS includes an inbuilt data logger internally storing up to 4,000 date and time stamped readings. Recall the data from the front panel or send to a PC or Printer via the PC interface which is included as standard. The powerful math function enables statistical analysis of the captured data, mean, max, min, peak and standard deviation. The TTI-7 PLUS now also includes a real time rolling display.

### Usability

Ease of use, password protected digital calibration and a large clear backlit LCD graphics panel ensure the TTI-7 PLUS is a delight to use. Resistance thermometer connections are via LEMO connectors. Both sub miniature thermocouple and standard thermocouple plugs are accepted directly into the thermocouple inputs with no need for further adapters.

### Why the TTI-7 PLUS ?

The TTI-7 PLUS has the features you need for high accuracy temperature measurement. With resistance thermometers used at high temperatures unwanted thermal EMFs are generated, the TTI-7 PLUS can take two measurements switching the polarity then computing the average to eliminate this error source. Many other instruments lack the ability to eliminate thermal EMFs. The thermal EMF error can be greater than the quoted



accuracy of an instrument, if you need small measurement uncertainty for high temperature PRT work you need this feature. Add the internal scanner to expand the instrument to have up to 10 channels - any or all can be scanned and lodged with the internal data logger.

### High Accuracy

Highest accuracy is for Pt100 inputs, the TTI-7 PLUS Uncertainty of Measurement (1 Year) in the range -100°C to 500°C is 0.01°C. Watch for specifications that quote the value at -100°C and then get larger as the temperature rises. The TTI-7 PLUS is optimized over the most frequently used and useful temperature range. For thermocouple measurements the automatic CJC is far better than 0.1°C at 20°C. Great design care was taken, both thermocouple inputs are measured with separate Pt100 sensors. This approach gives outstanding CJC performance, again a point to check against other instruments which can have significantly less performance.

Sensor	Range (°C)	Resistance (Ohm)	Current	Resolution °C °F K	Uncertainty 1 year @ 20 ±5°C
Pt25	-200 to -100	2.5 to 15	1mA	0.001	0.02°C
Pt25	-100 to +500	15 to 75	1mA	0.001	0.01°C
Pt25	+500 to +670	75 to 115	1mA	0.001	0.02°C
Pt100	-200 to -100	10 to 60	0.5mA	0.001	0.02°C
Pt100	-100 to +500	60 to 280	0.5mA	0.001	0.01°C
Pt100	+500 to +670	280 to 460	0.5mA	0.001	0.02°C

Type	Range °C	Common Name	Resolution °C °F K	Standard	Uncertainty @20°C ±5°C 1 Year	Uncertainty @20°C ±5°C 60 Days
B	+250°C to +1820	Platinum / Rhodium	0.01	NIST 175	±(0.025% Rdg + 0.006%FS)*	±(0.02% Rdg + 0.006%FS)*
C	0 to +2315	Tungsten / Rhenium	0.01	ASTM E988	±(0.075% Rdg + 0.005%FS)	±(0.05% Rdg + 0.005%FS)
D	0 to +2315	Tungsten / Rhenium	0.01	ASTM E988	±(0.075% Rdg + 0.005%FS)	±(0.05% Rdg + 0.005%FS)
E	-200 to +1000	Chromel / Constantan	0.01	NIST 175	±(0.026% Rdg + 0.004%FS)	±(0.01% Rdg + 0.004%FS)
J	-210 to +1200	Iron / Constantan (SAMA)	0.01	NIST 175	±(0.03% Rdg + 0.005%FS)	±(0.008% Rdg + 0.005%FS)
K	-200 to +1372	Chromel / Alumel	0.01	NIST 175	±(0.035% Rdg + 0.006%FS)	±(0.01% Rdg + 0.006%FS)
N	-200 to +1300	Nicrosil / Nisil	0.01	NIST 175	±(0.035% Rdg + 0.005%FS)	±(0.01% Rdg + 0.005%FS)
R	-50 to +1768	Platinum / Rhodium	0.01	NIST 175	±(0.02% Rdg + 0.015%FS)	±(0.005% Rdg + 0.015%FS)
S	-50 to +1768	Platinum / Rhodium	0.01	NIST 175	±(0.02% Rdg + 0.015%FS)	±(0.005% Rdg + 0.015%FS)
T	-200 to +400	Copper / Constantan	0.01	NIST 175	±(0.025% Rdg + 0.015%FS)	±(0.005% Rdg + 0.015%FS)
U	-200 to +600	Copper / Constantan	0.01	DIN 43710	±(0.025% Rdg + 0.015%FS)	±(0.005% Rdg + 0.015%FS)
L	-200 to +500	Iron / Constantan	0.01	DIN 43710	±(0.03% Rdg + 0.005%FS)	±(0.008% Rdg + 0.005%FS)
Au/Pt	0 to +1000	Gold / Platinum	0.01	NIST - Burns	±(0.02% Rdg + 0.015%FS)	±(0.005% Rdg + 0.015%FS)

*TC input for external CJC, automatic CJC is better than 0.1°C at 20°C, typically 0.01°C / °C over the range 0°C to 100°C*  
*\*Apply to readings above 600°C*

Model	TTI-7 PLUS	Working Temperature	0°C to 40°C rel. humidity
Temperature Range	Depending on Sensor	Storage Temp.	80% max non condensing
Indicator units	-200 to 2315°C	Main Supply	-20°C to +50°C.
Display	°C, °F, K	Dimensions	100/120/220/240 Volts +10% -13% 47 to 63Hz max. 40VA
Maths	LCD Graphics Panel, 240 x 64 Dot with LED backlight contrast control via keyboard	Battery	Height 110mm Width 219mm Depth 315mm Weight 8kg
PC Interface	Display Min / Max, Peak to Peak and Standard Deviation	Scanner Option	Sealed lead acid, rechargeable cell giving approximately 10 hours continuous operation. Internal battery charger.
Data Logging	RS232 and Software Included		With the scanner option fitted, scanner cards may be inserted into slots on the rear panel, cards for thermocouples and Platinum Resistance Thermometers are available, giving a maximum of 10 measuring channels. Each scanner card has 4 channels and up to 2 cards may be fitted, either thermocouple or PRT in any combination.
Inputs	Includes a data logging function, enabling up to 4000 single channel (2000 dual channel) readings to be stored together with a date and time stamp.		
	The stored values can be recalled to the instrument display, downloaded to a PC file or printer.		
	Thermocouples via sub miniature and standard connectors. Reference Junction Compensation - Automatic with internal sensor, or with external Pt100 probe. PRTs Lemo Socket.		

# Selector Switch 8 Way

- Eight Channel - Local and RS232 Control
- PRT and Thermocouple Models
- Use with Isotech TTIs and Automation Software

Isotech produces two eight way selector switches, one for resistance thermometers Model 954 and Model 958 for thermocouples.

These switches have been designed for use in conjunction with our TTI range. The switches allow easy selection of connected sensors. They can be operated from either the front panel switch or from an RS232 interface that is provided as standard. Channel status is indicated via front panel LEDs. The Selector switches can be located adjacent to the sensors being calibrated, giving more flexibility than a permanently connected or stacked system.

The PRT Switch has 4mm terminal posts that can accept bare wires or 4mm plugs. The thermocouple switch has eight miniature thermocouple connectors. These thermocouple connectors are thermally bonded to a platinum resistance thermometer that measures the temperature of the connector and hence the “cold junction”.

The TTI range temperature indicators feature the ability to measure a remote cold junction and this permits a mixture of thermocouple types to be connected through the box. The I-Cal software supports Switchbox models 954 and 958 and, for automatic operation, two boxes can be connected together with a “master / slave” lead allowing them to be controlled from a single RS232 port and up to 16 sensors to be switched.

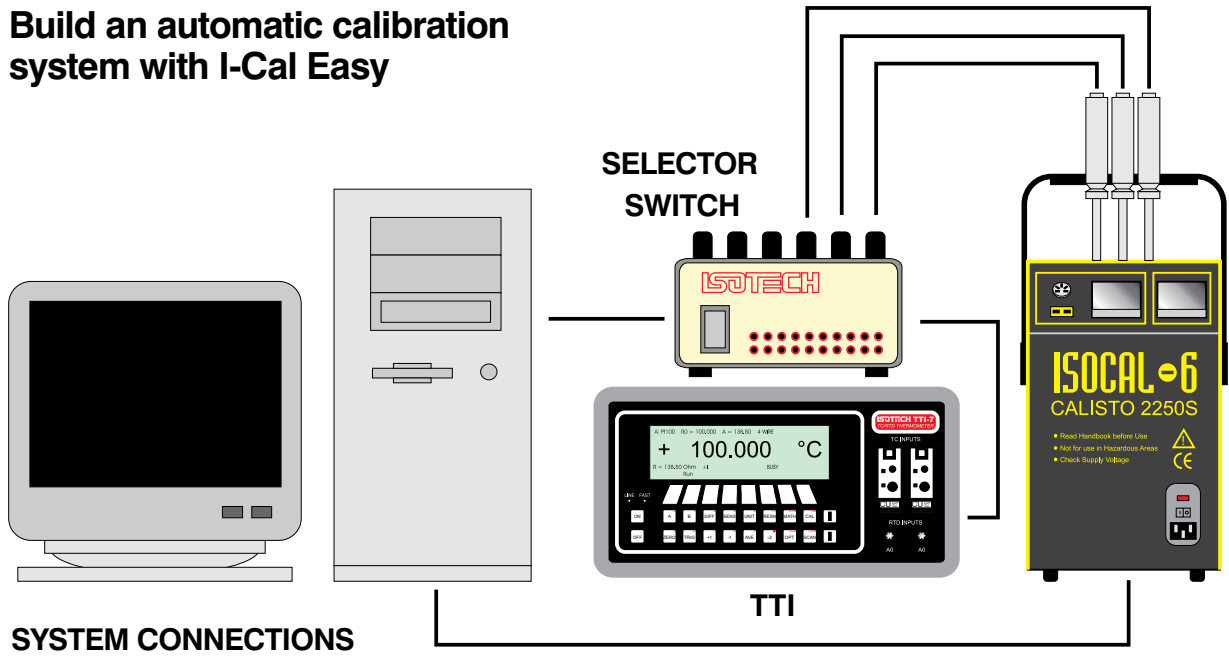
The software can automatically switch between the boxes and connect the appropriate output to the TTI. This 16 channel operation is not convenient without the software and manual operation of two boxes together is not recommended.

### Advantages

- Use with TTI-6 and TTI-7 PLUS easily switch up to eight sensors manually or with RS232.
- RTD and Thermocouple Models.
- Use with I-Cal Software for automatic switching and temperature calibration, add a second box (either type) to calibrate up to 16 sensors.
- Switches are stand-alone allowing them to be positioned anywhere in a laboratory for most efficient operation.



# Build an automatic calibration system with I-Cal Easy



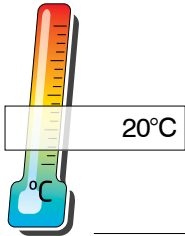
**SYSTEM CONNECTIONS**

Model	954 RTD Selector Switch
Channels	Eight - four wire (four pole)
Control	Front panel switch And RS232
Connectors	4mm Terminal post
Internal Circuit Resistance	<250mΩ
Thermal EMF, typical	2μV after 1 minute of channel set 6μV after 30 minutes of channel set
Power	5 VDC 100-250 VAC, 50 / 60Hz Power Supply Included
Dimensions	Height 91mm Width 141mm Depth 165mm Weight 1kg

**How to Order**  
954 RTD Selector Switch

Model	958 TC Selector Switch
Channels	Eight - two wire (two pole)
Control	Front panel switch And RS232 (Also compatible with Isotech VLT system)
Connectors	Miniature Thermocouple Connectors
Internal Circuit Resistance	<250mΩ
Thermal EMF, typical	2μV after 1 minute of channel set 6μV after 30 minutes of channel set
Reference Junction Measuring Device	100Ω 1/10 Din Pt100
Thermal Coupling	<0.2°C* *Basis of test. At ambient 20°C ±2°C the internal Pt100 agreed with the connected thermocouples to ±0.2°C (including all measurement errors) using IEC584-1995 and IEC751-1995. The uncertainty of this test was ±0.3°C which includes the reproducibility of the test thermocouples.
Power	5 VDC 100-250 VAC, 50 / 60Hz Power Supply Included
Dimensions	Height 64mm Width 141mm Depth 165mm Weight 1kg

**How to Order**  
958 TC Selector Switch



# AC/DC Standard Resistors

## Models SRA & SRB

Eventually all resistance thermometry refers back to one or more fixed resistors. These are a key element in any laboratory which measures temperature. The resistors need to be very stable with time, temperature and transportation, and they need to have negligible inductance and capacitance.

They also need to have a long and successful history of use. Wilkins and Swan at our National Physical Laboratory (NPL) developed a resistor design flexible enough to allow windings with various resistance values to be made available and stable enough to be accepted world-wide as resistance standards. Particularly important is that the AC/DC characteristics are the same up to about 1000 Hz.

This design has been licensed to H. Tinsley & Co. who have been producing (and have made further improvements to) this product since 1970.

Isotech are pleased to be able to offer this design of resistor made for us by Tinsley with 1 of 2 calibration possibilities:

UKAS with an uncertainty of  $\pm 0.3$ ppm (SRA models).

NPL with an uncertainty of  $\pm 0.1$  ppm (dependant on resistance value).



TYPE SRA Values	1, 10, 25 and 100 Ohms 400 Ohms to special order
TYPE SRB Values	1000, 10,000 Ohms
Calibrated uncertainty	0.3ppm (see UKAS schedule)
Accuracy of adjustment	$\pm 20$ ppm
Stability	2ppm/year (0.5ppm/year to special order)
Temperature coefficient of resistance	2ppm/ $^{\circ}$ C 0.5ppm to special order
Recommended dissipation	10 mW
Maximum dissipation	1 Watt
Approximate load coefficient	6ppm/Watt
A.C./D.C. transfer error at 1kHz	1ppm 10 $\Omega$ - 10k $\Omega$ 5ppm 1 $\Omega$

### Construction

Element	Strain free, immersed in dry oil (No. 4 Kerosene)
Top panel	Bakelite with PTFE inserts and engraved lettering
Terminal - Current	0BA copper
Terminal - Potential	4BA copper
Earth	6BA brass
Dimensions	Container 114 x 76mm dia. Overall 140 x 83mm dia.
Weight	680g

### How to order

Standard Resistor  
Please specify type, resistance value and calibration option.



# Resistor Maintenance Bath

## Model 455

- Wide Temperature Range
- +/-0.005K Stability / Gradients
- Will House Several Standard Resistors

As a result of many years development, Isothermal are now able to offer a temperature controlled Standard Resistor Maintenance Bath. Using Peltier heating/cooling modules, temperatures 20°C either side of ambient temperature may be set to a resolution 0.01°C.

Stability and temperature differences total less than  $\pm 0.015K$  when measured directly in the oil of the bath and  $\pm 0.003K$  when measured inside a Fixed Standard Resistor.

The bath will house several Resistors depending on their size and is ideal for measuring the temperature coefficients of Fixed Resistors, as well as maintaining them at a selected temperature.

The oil used in the bath is very special, it has to be very high resistance and very low viscosity. Wrong choice of oil will cause larger temperature gradients and may cause the motor to burn out.



Model	455
Temperature Range	Dew point to 40°C
Accuracy	$\pm 0.005^\circ C$ stability and gradients
Control	0.01°C Resolution
Power	15w typical, 100-130 or 208-240VAC*, 50/60Hz * field changeable
Dimensions	Height 910mm Width 635mm Depth 710mm Weight 66kgs

**Accessories**  
932-19-72 35 litres of special oil

**How to order**  
455 Standard Resistor Maintenance Bath  
Please specify voltage required  
Please specify number and type of Resistors



Internal Assembly

# Temperature Controlled AC/DC Resistors

## Model 456

- Nominal Temperature Coefficient of Resistance: +0.02ppm/°C (with temperature control on) 18 to 25°C
- Power Rating: 0.5 Watt at +25°C
- Resistance Tolerance (Initial Resistance Accuracy): ±0.005%
- Standard models: 10, 25, 100, 1000 and 10,000Ω
- Current Noise: <0.010μV (RMS) / Volt of Applied Voltage.
- Thermal EMF: 0.1μV/°C Max; 0.05μV/°C Typical
- The most precise and stable resistors available.
- Impervious to harmful environments - oil filled.

By temperature controlling an otherwise very stable resistor a performance close to the very best available World-wide can be achieved at a surprisingly low price. The resistor itself is oil filled and hermetically sealed.

The function of hermetic sealing is to eliminate the ingress of moisture and oxygen both of which play a role in the long term degradation of unsealed resistors. A further enhancement in both short and long term stability is achieved by oil filling. The oil also acts as a thermal conductor allowing the device to accept short periods of overload without degradation.

With accuracies of ±0.005%, a wide resistance range and long term drift of less than 5ppm, these devices are virtually secondary standards that can be kept in a laboratory as references to calibrate other devices.

The Resistor is held in a temperature controlled environment heated to 30°C ±0.1°C other temperatures are available to special order. The heater requires 2 watts at 5V which can be supplied by a battery or an unregulated DC supply. In an ambient of 20°C the Resistor's heater will warm up in typically 30 minutes, and a LED shows when the temperature has been reached. A test pocket is provided so that the resistors' temperature can be monitored if required.

Stability of 0.1 ppm/month or better can be expected.

Standard models are: 10, 25, 100, 1000, 10,000Ω. For other values please contact Isotech.

For the highest quality traceability we recommend that the 456 be UKAS Certified. We can offer the 2 Sigma Uncertainties shown in the table.



Model	456
Rating	0.5 Watt
Stability	Typically 1ppm per year at 1mA
Traceability	A Traceable Certificate accompanies your 456 to the 2 sigma uncertainties shown.
Induction	0.08μH typical
Capacitance	0.5pF
Dimensions	144 x 110 x 96mm (in box)
Weight	1kg (including box) 550g (excluding box)

### How to Order

456 Temperature Controlled Fixed AC/DC Resistor  
Please specify ohmic value  
State with UKAS Calibration or without UKAS Calibration.

### Isotech UKAS Calibration Uncertainties (k=2)

Measured Quantity Instrument or Gauge	Range/ Frequency	Best measurement Capability expressed as an Expanded Uncertainty
<b>DC Resistance</b>		
0.1Ω to 1000Ω		±5ppm
1kΩ to 100kΩ		±12ppm
<b>AC Resistance</b>		
2.5Ω to 400Ω	75Hz	±15ppm
400Ω to 1000Ω	75Hz	±100ppm

The latest schedule can be found on the Isotech website or at [www.ukas.org](http://www.ukas.org).





# The Best Comparison Calibration Equipment

Isotech have a range of professionally engineered comparison calibration equipment covering the temperature range -200°C to 962°C. Isotech have equipment to match the requirements of National Metrology Institutes, Accredited Calibration Laboratories and in house calibration labs.

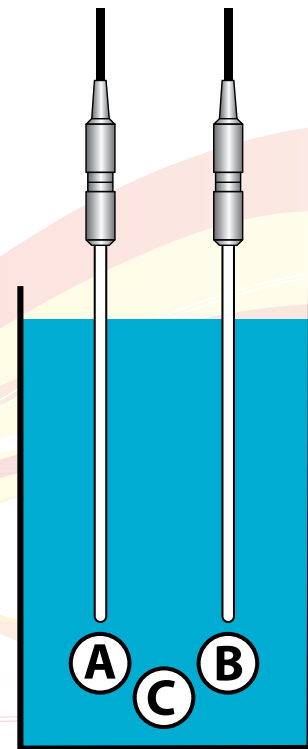
## Comparison Calibration

With comparison calibration a thermometer with known characteristics is compared to the thermometer we want to calibrate. Relying on the “Zeroth Law of Thermodynamics”.

There are four “Laws of Thermodynamics”, the Zeroth Law was only formulated in 1931 by Fowler - it is more fundamental than the other three existing laws so it became known not as the fourth law, but the “Zeroth” law.

It states, “If two systems are in thermal equilibrium, each having the same temperature as a third system, the two systems have the same temperature as each other”.

This can be rephrased to explain comparison calibration “if a calibrated thermometer is at the same temperature as a calibration bath, and a thermometer under test is at the same temperature as that calibration bath, then the calibrated thermometer and the thermometer under test are at the same temperature.”



## Isotech Comparison Equipment

Isotech products are designed to be deep enough, to be stable enough and to have sufficient uniformity to enable calibration to the smallest of uncertainties. The comparison

calibration schedule below is from Isotech’s UKAS accredited calibration laboratory. The performances are achieved using Isotech Baths and Reference Thermometers.

Evaluation reports describing the performance of Isotech equipment are freely available.

### Isotech UKAS Calibration Uncertainties (k=2)

#### Platinum Resistance Thermometers

Calibration by comparisons	-80 °C to -40 °C	7.0 mK
	-40 °C to +50 °C	4.0 mK
	50 °C to 156 °C	5.0 mK
	156 °C to 300 °C	6.5 mK
	300 °C to 420 °C	20 mK
	420 °C to 660 °C	35 mK

The latest schedule can be found on the Isotech website or at [www.ukas.org](http://www.ukas.org).



Evaluation reports describing the performance of Isotech equipment are freely available.

## Types of Equipment

### Cryogenic

A Liquid Nitrogen Comparator provides a convenient calibration point at a nominal  $-196^{\circ}\text{C}$ . The Model 459 Cryostat employs Liquid Nitrogen to operate over the range  $-180^{\circ}\text{C}$  to  $-80^{\circ}\text{C}$



### Low Temperature Range $-80^{\circ}\text{C}$ to $250^{\circ}\text{C}$

Over this range Isotech Stirred Liquid Baths of parallel tube design provide outstanding temperature uniformity with low filling costs.



### Medium Temperature Range $50^{\circ}\text{C}$ to $700^{\circ}\text{C}$

The Isotech Fluidized Furnace Model 875 is a concentric tube design that uses safe inert alumina oxide powder in place of oil or dangerous salt mixes and operates up to  $700^{\circ}\text{C}$  without hazard. The sealed design ensures no powder loss into the laboratory.



### High Temperature Range $150^{\circ}\text{C}$ to $1300^{\circ}\text{C}$

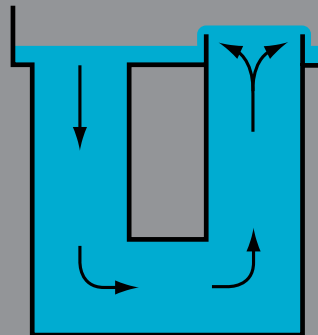
The concentric design of the Isotech 877 Thermocouple Calibration Furnace avoids the large temperature gradients present in simple tube furnaces.



■ The following pages describe the Isotech range of comparison equipment.

Isotech baths employ sophisticated designs to ensure calibration to the smallest of uncertainties

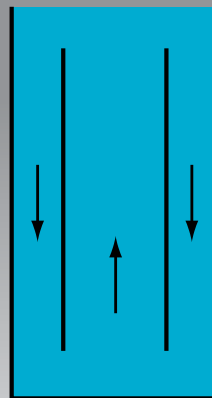
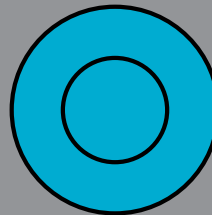
### Parallel Tube Design



Here the heating, cooling and mixing take place in one of two parallel tubes. The second tube is the calibration volume and again the excellent temperature uniformity gives small calibration uncertainties.

An added benefit of these tube design of bath over large square tank designs is that to fill the bath much less liquid is required. For high temperature work it is usual to use Silicone Oils which have both a high cost and finite life.

### Concentric Tube Baths

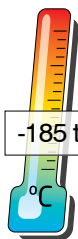


In this design liquid is forced down an outer tube and flows up an inner concentric tube. The heating and cooling takes place in the outer tube leaving the inner tube as the calibration volume into which the thermometers are immersed. This design gives very small vertical and axial temperature gradients



Photograph by kind permission of ThyssenKrupp Steel AG - Werkstoffkompetenzzentrum





-185 to -196°C

# Boiling Point Apparatus Nitrogen

- Boiling Point of Liquid Nitrogen
- Gas Manifold for Thermometers
- Self Contained - Bench Mounted

Isotech Nitrogen Boiling Point Apparatus is designed specifically to realize and maintain the liquid/vapour equilibrium (boiling point) of nitrogen or argon, for the calibration of thermometers on the International Temperature Scale of 1990.

The Boiling Point Apparatus is self-contained and refrigerated by liquid nitrogen or liquid argon, which must be supplied by the user. Either liquid is suitable for the purpose. Liquid nitrogen is generally less costly and more readily available than liquid argon. The Apparatus does not require electrical power for its operation.

The Boiling Point Apparatus will maintain the liquid-vapour equilibrium of nitrogen (-195.798°C) or of argon (-185.8468°C) indefinitely, provided boiled-off gas is replenished.

ITS-90 specifies the triple point of argon (-189.3442°C) as the low end of the long-stem Standard Platinum Resistance Thermometer range. As a practical matter, realization of this triple point is a costly (in equipment and time) and complicated process.

Most laboratories will choose to calibrate this end of the platinum range by comparison of the thermometer under test with a thermometer of known calibration. National Laboratories themselves will invariably calibrate thermometers submitted to them by comparison, realising the actual argon triple point only infrequently for calibration of their own reference thermometers. The National Physical Laboratory of England makes this statement:

*"Most thermometers (submitted for calibration) will involve measurements (by) ... comparison with NPL standards in a bath of liquid nitrogen (about -196°C)"*

Model 18205 Comparator is designed for precisely such comparison calibration. It comprises a stainless steel dewar, an inner equalizing block having wells for 3 thermometers, top connections for filling and monitoring the level of liquid coolant, a pressure safety blow-off and a manifold which may be used to thermally tie the thermometers under test to the equalizing block with helium gas (optional).

Since the slopes (dR/dT) of Standard Platinum Resistance Thermometers are very similar at any temperature, calibration uncertainties not larger than 0.002K can be obtained at a small fraction of the cost of an absolute calibration.



*Boiling point of  
Liquid Nitrogen, -195.798°C  
High Accuracy  $\pm 0.002K$ ,  
Handbook/Tutorial supplied  
Self-contained, Bench mounted*

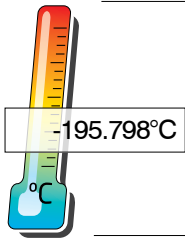
Model	ITL-M-18205
Temperature Range	-185°C or -196°C nominal
Uncertainty	$\pm 0.002^\circ\text{C}$
Power	NA
Dimensions	Below flange 430mm Diameter below flange 127mm Flange diameter 165mm Weight 14kgs

The temperature distribution across the copper block is less than 2mK. To this must be added the uncertainty issued with the calibration certificate from the National Laboratory.

Extra uncertainties will also exist if dissimilar probes are compared.

**How to order**  
ITL-M-18205 Nitrogen Boiling Point Apparatus

**Note**  
The Nitrogen Point Apparatus may be adapted for use with liquid argon. Please contact the factory for details



# Simple Liquid N<sub>2</sub> Apparatus

## Model 461

- Safe to use
- Economical

This model is a lower cost alternative to the ITL M 18205. This model is a simple apparatus open to the atmosphere comprising a stainless steel dewar flask filled with liquid Nitrogen, an insulating layer which houses a metallic equalising block and thermometer holder. Lastly a split insulated lid reduces evaporation and permits easy addition of liquid Nitrogen.

From time to time extra liquid Nitrogen must be added, approximately every 30 minutes, to keep the dewar flask full.

The dewar flask is 100mm inside diameter and 280mm deep. The standard equalizing block houses four SPRTs or industrial thermometers up to 8mm in diameter, giving  $\pm 0.002^{\circ}\text{C}$  temperature uniformity.

### Method of Operation

A standard calibrated SPRT is placed in the equalizing block together with the sensors to be calibrated. The whole is allowed equilibrate.

The level is checked and Nitrogen added as necessary and readings taken 10 minutes afterwards.

The Isotech Simple Liquid Nitrogen Apparatus is safe to use, having no glass dewar flask internally to explode.

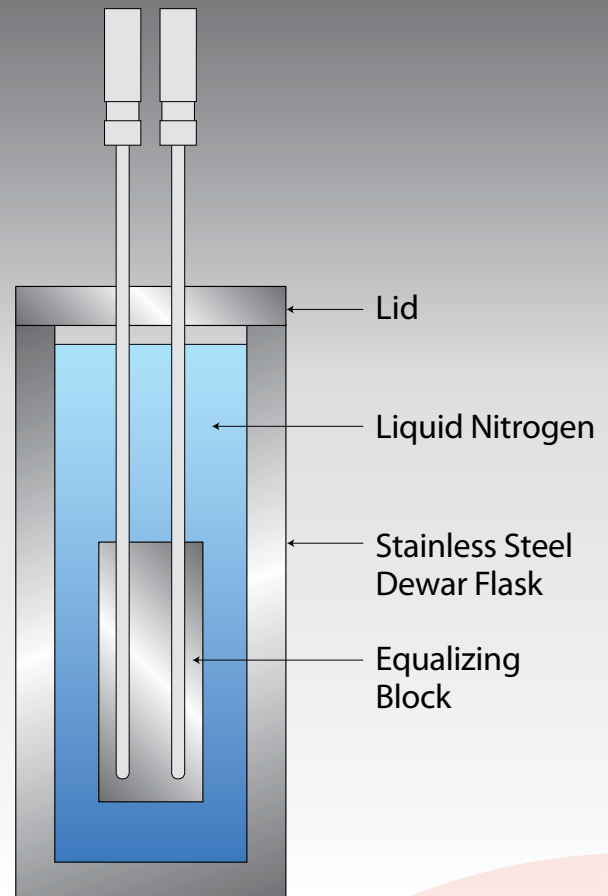
A comprehensive handbook accompanies the apparatus which includes an article by Henry E. Sostmann on the corrections required to convert the calibration to the ITS-90 value of the Argon Triple Point.

### Technical Note:

The Simple Liquid Nitrogen Apparatus, because there is air access will slowly condense oxygen from the atmosphere increasing the temperature of the Boiling Point.

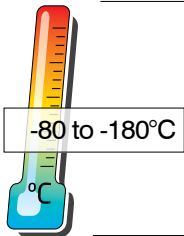
This is of small importance provided a calibrated SPRT is being used as the reference and simultaneous ratios of SPRT and unknown thermometers are being recorded, with a bridge such as the Isotech microK.

Liquid Nitrogen is not supplied with the apparatus.



Model	461 Simple Liquid Nitrogen Apparatus
Temperature Range	$-196^{\circ}\text{C}$ Nominal
Uncertainty	$\pm 0.002^{\circ}\text{C}$ The temperature distribution across the block is typically 2mK. To this must be added the uncertainty issued with the calibration certificate from the National Laboratory. Extra uncertainties will also exist if dissimilar probes are compared.
Power	NA
Dewar Dimensions	Inside diameter 100mm Depth 280mm Volume 3 litres
Thermometer wells	Four 8mm as standard, others to special orders

**How to order**  
461 Simple Liquid N<sub>2</sub> Apparatus



# Cryostat Model 459

- Extreme Low Temperature Calibration
- High Stability

When we considered low temperature comparison calibration, we had to take into account Health and Safety considerations, both of the liquids used in compressors to generate low temperatures and also the liquids used in the calibration volume itself. The cost of chillers increases considerably for very low temperatures. We concluded that using chillers for very low temperatures was expensive, unsafe and unreliable.

Our solution is a simple heated metal block design using a single, safe surrounding liquid, liquid nitrogen.

An apparatus immersed in liquid nitrogen will cool to approximately -195°C. Our design, using a controller and heater, permits the cryostat to be set at any temperature above liquid nitrogen temperature.

The Cryostat comprises an insulated machined copper equalizing block inside an 80mm diameter tube 480mm long, attached via a flange to a lid giving access for three thermometers, a vacuum port and a Lemo connector for the temperature sensor and heater. A cable runs to a controller which sets the temperature. An RS422 connector permits the calibration to be automated using one of our Software programs.

### Evaluation

The most used range for the Isotech Cryostat is between -80°C to -180°C. This temperature range is selected because Oxygen condenses at -186°C and if this is then accidentally boiled off it can cause a health and safety issue. The performance of the Cryostat actually improves as the temperature is lowered because the temperature difference between Cryostat and it's surrounding liquid nitrogen is smaller. The measurements were made with two model 670 thermometers.

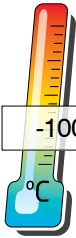
### Method

The Cryostat is connected to a vacuum pump. It is pumped for five minutes and then sealed. The Cryostat is connected to the controller, switched on to check the connections. The Cryostat is then lowered into the container of liquid nitrogen, which should come between 25mm and 75mm below the flange. Three thermometer tubes exit the Cryostat and have nylon compression fittings. The standard PRT and unknown thermometers to be calibrated are lowered into the wells and the nylon fittings are hand tightened until the nylon grips the thermometer without damage. The controller is set to the required temperature and the Cryostat left to stabilize before comparison readings are made.



Optional Container for Cryostat

Model	459
Cryostat Temperature:	-80°C to -180°C
Absolute Stability (over 30 minutes)	±0.005°C at -80°C ±0.0015°C at -150°C
<i>(as measured by one of the 670 thermometers in the bottom of one of the pockets of the cryostat)</i>	
Homogeneity pocket to pocket	±0.005°C
Vertical Profile (over bottom 50mm)	±0.005°C at -80°C ±0.01°C at -150°C
Immersion Depth	560mm
Neck Diameter	120mm
Compatibility	Liquid Nitrogen Containers
Nitrogen Capacity	35 litres
<b>How to Order</b>	
459 Cryostat	
<b>Accessories</b>	
459-01-01 Hand Vacuum Pump	
459-01-02 Electric Vacuum Pump	
459-01-03 35 Litre Cryostat Container	
459-01-04 25 Litre Container for topping up	



-100 to 40°C

**PROVISIONAL DATA**

# -100°C Dry Block Isis

- 20,000 hours testing, equal to 10 years use
- Minimum Temperature -100°C (-148°F)
- No expensive liquids

The Isis Dry Block offers operation to temperatures as low as -100°C, and is the only block bath working to such a low temperature. Now it is possible to calibrate temperature sensors such as PRTs, Thermocouples and Thermistors at ultra low temperatures without the need for a liquid bath.

### Portability and Safety

Unlike a liquid bath the Isis requires no costly, or hazardous fluids and offers greater portability. This will be of particular value to calibration engineers working on site with low temperature freezers as encountered in pharmaceutical, aeronautical and food environments.

The minimum operating temperature is less than stirred liquid laboratory calibration baths and users in laboratories will also benefit by avoiding the ongoing need for expensive fluids.

The maximum operating temperature is 40°C, a little higher than the minimum operating temperature of Isotech Hot Blocks. This permits covering the range from -100°C to 650°C or higher with just two Isotech blocks. By limiting the maximum temperature the reliability and operating life of the cooling engine is maximised, and has been agreed in consultation with the licensee of the cooling technology, see below.

### Cooling Technology

The Isis makes use of a Free Piston Stirling Cooler (FPSC) which provides a massive 80 Watts of cooling power to the calibration block. Specialist materials, patent applied for, are used for the heat transfer from the FPSC to the block.

### Operating Life

Reliability is a prime attribute of this revolutionary new product. Testing at 20,000 hours (nominally equivalent to 10 years at 40 hours use each week) shows that -100°C is still possible, with an increase in cooling time <10%.



### Benefits

Isotech can offer full support with options for UKAS / ILAC calibration, tutorial on getting the best calibration uncertainties and a full range of supporting reference thermometers, indicators and software.

The Isis has a large insert 35mm diameter by 160mm deep. This allows for calibration of multiple sensors. For thermal validation applications there is an insert with pockets for a reference probe (6.5mm) and 20 x 3.5mm pockets for thermocouples. This allows a single calibration cycle to validate up to 20 probes at a time.

<http://www.isotech.co.uk>



The Isis Dry Block Model 525  
The only Dry Block working to -100°C

### METAL BLOCK INSERTS

#### Standard Insert A

9.5mm, 8.0mm,  
6.4mm, 6.4mm,  
4.5mm, 4.5mm  
All 157 deep

### ALTERNATIVE INSERTS

#### Standard Insert B

13mm, 10mm,  
8mm, 5mm  
and 3.5mm  
All 157 deep

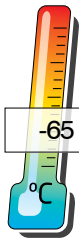
#### Standard Insert C

8mm and  
6 x 6mm  
All 157 deep

#### Validation Insert

6.5mm and  
20 x 3.5mm  
All 157 deep

Model	525 Isis	
Temperature Range	-100°C to +40°C	
Approximate time to Temperature from Ambient	-20°C	20 minutes
	-40°C	30 minutes
	-60°C	40 minutes
	-80°C	60 minutes
	-100°C	90 minutes
Absolute Stability	At 0°C ±0.03°C (30 minutes)	
	At -90°C ±0.02°C (30 minutes)	
Radial Homogeneity (similar pockets)	0.01°C	
Vertical gradients (over bottom 40mm)	0°C 0.1°C	
	-90°C 0.2°C	
Calibration Volume	35mm diameter x 160mm deep (Excludes Insulating Cap)	
Standard Insert	6 thermometer wells as standard (9.5mm, 8.0mm, 6.4mm, 6.4mm, 4.5mm and 4.5mm All 157 deep)	
Power	200W	
Voltage	100-240Vac, 50/60Hz	
Dimensions	215mm(W) x 420mm (D) x 640mm (H)	
Weight	22.7kg	



-65 to 300°C

# Stirred Liquid Baths

## 915 Parallel Tube

- Three Models Covering -65°C to 300°C
- Excellent Uniformity
- Uncertainties to 0.0005°C

The 915 is, no question, the finest stirred liquid parallel tube bath produced.

Using best practise ratio methods of comparison calibration uncertainties of less than 1mK can be obtained. The bath can also be used to realise ITS-90 Fixed Point Cells (Mercury to Tin Points) with absolute uncertainties to less than 1mK.

The Isotech Parallel Tube Liquid Bath is a development of the previous 815 model and has many features which enhance its performance and enable ease of operation. It is suitable for the calibration of Liquid in Glass Thermometers, Industrial Platinum Resistance thermometers, Standard Platinum Resistance Thermometers, Thermocouples and Industrial Temperature sensors. It can also be used with fixed point cells.

The temperature range of the standard 915 liquid calibration bath (915H) is 40°C to 300°C. When the 915 is used in conjunction with our external chiller the low temperature limit can be extended to -65°C.

The 915 has a wide temperature range using silicon oils and other suitable liquids. All components in contact with the liquid are of stainless steel and are insulated with materials which are completely safe in use. The 915 used in conjunction with a chiller, utilizes the latest ozone friendly gases.

Liquids are circulated by a propeller which mixes and forces the liquid through a specially designed orifice in the rear of the two parallel tubes. A variable speed motor optimizes the flow as the viscosity of the liquid changes. Below the orifice plate liquid is circulated over a mineral insulated heater and temperature sensors which control the temperature of the bath.

The liquid flows up the calibration tube and weirs over the tube into a collection tray where it returns to the rear tube for recirculation. An angled side entry tube enables a refrigeration cooling probe to be inserted in the rear of the two parallel tubes.



The standard temperature controller has resolution from 0.01°C to 0.1°C which auto scales to suit the four digit display (all digits can be read with the Cal NotePad Software).

The standard controller can be replaced with a model offering a display resolution of 0.01°C over the whole range. This High Stability controller (Option 915/E) also offers better short term temperature stability, see table.

With the high cost of some silicon oils the 915's seven litre capacity makes it relatively inexpensive to fill compared to many other baths.

The changing of liquid is easily enabled by using the fitted drain. The design also allows for the expansion of liquids when being raised to a particular calibration temperature.

Model	915LW	915MWE	915H
Temp Range	-65°C – 40°C	-30°C – 40°C	30°C – 300°C
Volume	100mm diameter, 400mm deep (7 litres) or 100mm 530mm deep (Option 915D)		
Absolute Stability:			
High Stability Controller	±0.0006°C (Water, 50°C)		±0.002°C (Oil, 100°C)
Standard Controller	±0.004°C (Water, 50°C)		±0.007°C (Oil, 100°C)
Vertical Uniformity	±0.0002°C (Water, 50°C)		
Communications	Includes Serial Interface, PC Cable and Software		
Dimensions	580mm wide, 640mm deep, 1020mm high		
Weight	90kg	75kg	45kg
Safety	Compliant to CE Regulations		
Power	1kW (excluding Chiller) 108-130 or 208-240V, 50/60Hz		
How to Order	915LW	915MWE	915H

Refer to Evaluation Report for Full Details

For customers who require lower temperatures the range of the 915 bath can be extended by the addition of a chiller unit, see photograph below and the chart of model types available.

The chiller unit's probe (203mm long by 32mm diameter) is inserted into the angled side entry tube, accessible from the top of the cabinet, leaving the calibration volume of the bath unchanged.

The following chiller options are available, we recommend and supply the following:

Order Code	Description	Temperature Range min/max
915/10	Single Stage Wide Range Chiller	-30°C 40°C
915/11	Dual Stage Wide Range Chiller	-65°C 40°C

These chillers have both good reliability and wide operating ranges. They contain safe, ozone friendly gases.

The temperatures stated above assume an ambient within the range of 20°C to 25°C.

**Controller Note:**

The standard and enhanced controllers include features custom designed for Isotech by a world-leader in temperature control technology. Power feedback is used to stabilise against supply voltage changes, leading to greater stability. A digital filter circuit ensures high integrity of measurement correcting for drift, rejecting 50/60Hz pick-up and filtering out other sources of input noise.

The High Stability Controller (Option 915/E) has a resolution of better than 0.25µV which combined with powerful filtering provides outstanding temperature stability.

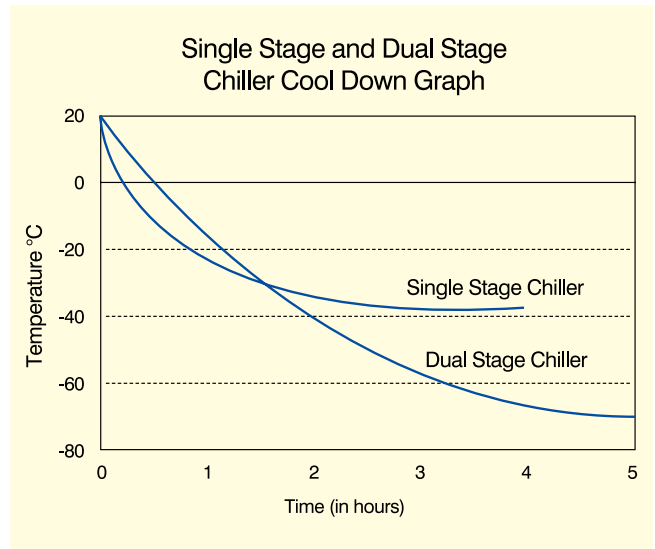
**Important**

Chiller probes must be removed from the Calibration Bath when used above their maximum temperature as stated above.

**Health and Safety Notice**

Rooms in which high temperature liquids are used should be ventilated or have extraction facilities. Although the overall temperature range of the bath is -65°C to 300°C the practical temperature range which can be achieved is dictated by the liquid being used and the ambient temperature.

Refer to 'Liquid Selection Guide' on page 73.



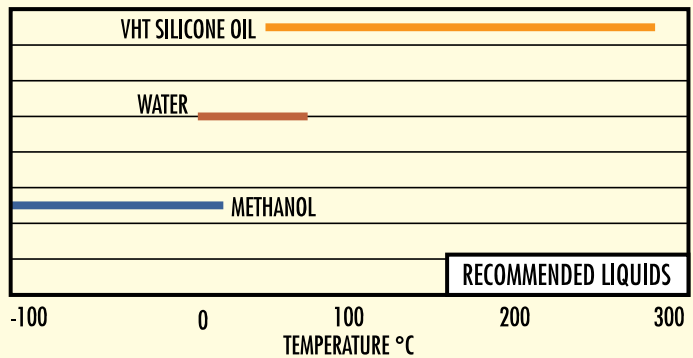
**Accessories**

- 915/01a Available for the Isotech Parallel Tube Bath is a variable depth aluminium equalising block containing four drilled pockets 8mm diameter by 120mm deep in which temperature sensors can be placed and is suitable for use with silicon oils.  
The equalising block is suspended centrally within the calibration tube and is easily removed.
- 915/01b As an alternative to the above a copper equalising block, dimensionally the same as 915/01a, may be supplied. This block is more suitable for use in water and other liquids.
- 915/D Increased depth Calibration Tube Assembly. Working volume is 100mm diameter by 530mm deep. This variant allows for the calibration of very long thermometers, typically the calibration of long liquid in glass thermometers. See also 915/02.
- 915/02 This assembly will hold up to 12 liquid in glass thermometers (maximum diameter 12.7mm) radially and a centre mounted standard sensor. The assembly may be rotated allowing systematic calibration. The assembly is designed for partial or full immersion of thermometers.
- 915/03 Monocular and Support. Useful for viewing and magnifying the liquid column within the thermometer being calibrated. This ancillary piece of equipment is used in conjunction with 915/02 Liquid in Glass Thermometer Support Kit.
- 915/05 Calibration Tube Cover. The cover consists of a square enclosure containing baffles and fits over the calibration tube area insulating the circulating liquid from ambient air. Access for temperature probes remains at the top of the enclosure. An equalising block may also be supported from this assembly. Maximum operating temperature 180°C.
- 915/07 Medium Temperature Silicon Oil. Temperature Range 40°C to 180°C.  
Flash Point 300°C.
- 915/08 High Temperature Silicon Oil. Temperature Range 150°C to 250°C.  
Flash Point 315°C.
- 915/09 Very High Temperature Silicon Oil. Temperature Range 40°C to 288°C.  
Flash Point 288°C.
- 915/E Controller provides 0.01°C resolution over the full temperature range with enhanced short term temperature stability.

**NOTE:** Read all safety information concerning liquids which you intend to use in the bath and use only approved liquids.

**Fixed Point Calibration ITS-90  
Cell Basket Assemblies  
(Excluding Cells)**

- 915-05-43 Small Mercury Cell Kit
- 915-05-44 Large Mercury Cell Kit
- 915-05-41 Small Water Triple Point Cell Kit
- 915-05-40 Large Water Triple Point Cell Kit
- 915-05-39 Small Gallium Cell Kit
- 915-05-38 Large Gallium Cell Kit
- 915-05-42 Slim Cell Kit



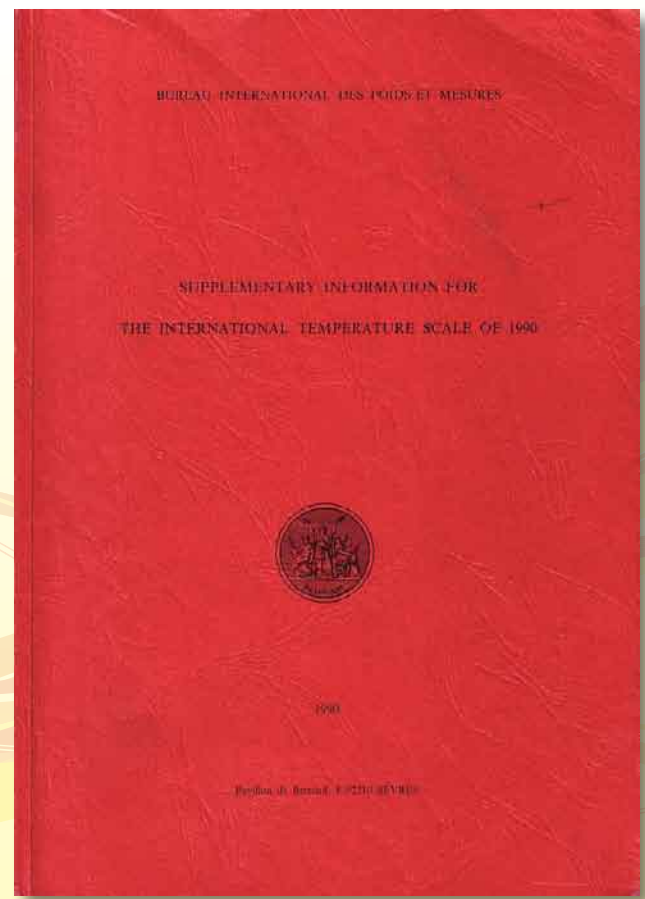
<http://www.isotech.co.uk>

# Immersion Depth

When selecting a liquid bath ensure that it is deep enough to provide low uncertainty calibration.

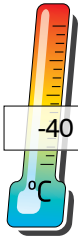
The “Supplementary Information for the ITS-90, BIPM” states conduction down the sheath is usually such as to require deeper immersion.

*Immerse the thermometer from 15cm to 20cm between -50°C and 50°C, and from 20cm to 27cm at 200°C and above.*



<http://www.isotech.co.uk/links>

Guide can be downloaded via the above link or directly from <http://www.bipm.org/en/publications/its-90.html>



-40 to 300°C

# Stirred Liquid Baths Orion 796

- Can accept large Water Triple Point Cells
- Variable Cooling Power
- Low Filling Cost

The Isotech Hydra range of calibration baths have proved very successful since their introduction in 2003. The Orion range has been introduced to fit alongside the Hydra models.

The Orion calibration baths offer deeper calibration volumes than the Isotech Hydra series with world class temperature stability. There is a high temperature model (30°C to 300°C) and a model with built in refrigeration (-40°C to 125°C).

These deep stirred liquid baths are suitable for the low uncertainty calibration of long thermometers including liquid in glass and extended length SPRTS.

The Orion unit has sufficient depth, 470mm (18.5"), to accommodate Isotech's largest Water Triple Point Cells providing a cost effective sub mK calibration system. There are accessories to hold Mercury, Water, Gallium and Indium ITS-90 Fixed Point Cells.

Isotech baths have always been designed for thermometer calibration, setting the standard for immersion depth versus filling costs. As the Orion requires just 8.5L of fluid it offers significant cost savings, both initial and the on going running costs, when compared to other larger volume baths.

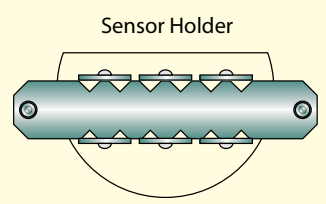
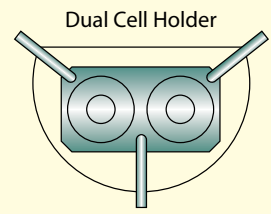
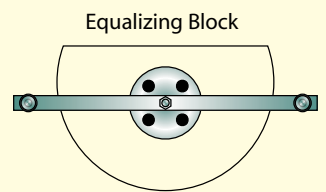
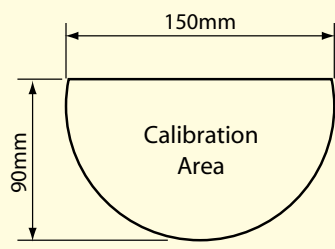
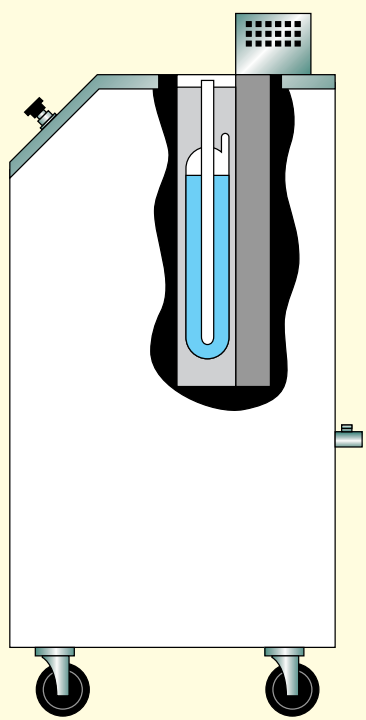
In operation the liquid level is within 10mm of the top lid allowing calibration of liquid in glass thermometers without the need for complicated accessories.

In addition to using a monocular to aid reading the scale I-Cal Easy automatic calibration software can capture images with low cost digital webcams.

The Isotech Orion range provides many features that laboratories need but which other manufacturers often cannot supply.



- Deep immersion depth (470mm / 18.5") with low filling costs
- Variable Speed Stirring - allowing optimum performance for a wide range of liquid viscosities
- Modular design for easier maintenance
- Over and Under Temperature Protection - protect expensive Water Triple Point Cells as well as over temperature conditions
- Connections for easy drain and overflow
- Automatic Power Up - no manual intervention needed - easier automation - energy saving
- Liquid Level to suit Liquid in Glass Thermometers - no level adaptors required



The diagram (left) shows a section view of the Orion showing its ability to house even the largest of cells

*The cell shown is a Jarrett-Isotech B-11, 450mm total length and 65mm diameter.*

Model	796M	796H
Temp Range	-40°C - 125°C	30°C - 300°C
Volume	150mm Diameter, 470mm Deep (8.5 litres)	
Absolute Stability	±0.006°C (Methanol, -40°C)	±0.006°C (C10 Oil, 125°C)
Vertical Uniformity	±0.005°C (Methanol, 0°C)	±0.007°C (C10 Oil, 125°C)
Heating time	25°C to 125°C < 120 minutes (C10 Oil)	
Cooling time	10°C to -40°C < 180 minutes (Methanol)	
Communications	Includes Serial Interface, PC Cable and Software	
Dimensions	485mm wide, 525mm deep, 1150mm high	
Weight	68kg	48kg
Safety	Compliant to CE Regulations	
Power	1kW 108-130 or 208-240V, 50/60Hz	800W 108-130 or 208-240V, 50/60Hz
How to Order	796M	796H

Refer to Evaluation Report for Full Details

**Accessories:**

The Orion can be supplied with both copper and aluminium equalising blocks. Aluminium is recommended for use only with oils. Copper, with its better corrosion resistance, is recommended for oils, alcohol and water.

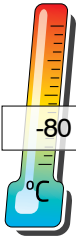
Refer to 'Liquid Selection Guide' on page 73 for information on liquids and important Health and Safety Information. The standard probe holder can support RTD's, Thermocouples and Liquid in Glass

Thermometers. A monocular is available to aid reading the scale of a L.I.G. Thermometer.

The liquid level is typically within only 10mm of the lid, so complicated fluid level adaptors are not essential.

There are a range of supports to hold various fixed point cells, Slim and Optimal, allowing the bath to realise ITS-90 fixed point cells to sub mK uncertainties.

Isotech has a full range of fixed point cells, for more details visit our web-site: [www.isotech.co.uk](http://www.isotech.co.uk)



-80 to 300°C

# Stirred Liquid Baths

## Hydra 798

- Four Models, -80°C to 300°C
- Stability 0.01°C
- Excellent Uniformity

Precision calibration of thermometers calls for the use of stirred liquid calibration baths. The Hydra models set new standards in terms of price to performance ratio. Now Calibration Engineers and Metrologists can choose from a range of baths that offer good immersion depth, parallel tube action, giving the best uniformity and smallest calibration uncertainties, and wide temperature ranges.

Hydra offers these features in a new price class, don't settle for a bath with shallow immersion or simple stirred action when with these Isotech baths provide good depth of immersion and good temperature uniformity along with the other benefits Isotech baths offer.

The immersion depth of 300mm allows the requirements of "Supplementary Information to the ITS-90" to be met. This publication from BIPM recommends immersion depths of 15 to 20cm from -50°C to 50°C, and from 20 to 27cm at 200°C. Many baths in this price range are simply not deep enough to meet this requirement. Rather than simply stirring a square tank of liquid the Hydra uses parallel tube action for superior temperature uniformity. Like other Isotech liquid baths the calibration volume is cylindrical to suit thermometers, not a large square tank. The bath is filled with just 5 litres of liquid reducing filling and ongoing cost of ownership as liquids are replenished. The 798H and 798EHT feature a cooling coil which can be attached to an external source of either cold water or gas to further reduce cool down times.

Hydra benefits from Isotech's experience, it drains faster, is easier to use, is safer, and is more convenient. Accessories allow a wide range of thermometers, for example, to be readily clamped by the Sensor Support and ITS-90 fixed points cells are accommodated with the adjustable cell holder.



### ■ Parallel Tube Action...

Liquid flows up the rear volume of the bath and down the working volume. This action creates very small vertical and axial gradients. This gives the smallest overall uncertainties.

### ■ Heating...

All heating is outside the container. By using a large area nickel foil heater the complete bath wall is heated uniformly.

### ■ Fast Cool Down...

The Hydra cools from ambient to -80°C in just 180 minutes.

### ■ Cooling...

The cooling is built-in and also surrounds the calibration volume creating a low temperature ambient in which the heater can function efficiently.

### ■ Wider Temperature Range...

A unique cooling system cools the unit as well as enabling the bath to heat up to 125°C (121°C is a key sterilization temperature).

### ■ Commercial Grade Chillers...

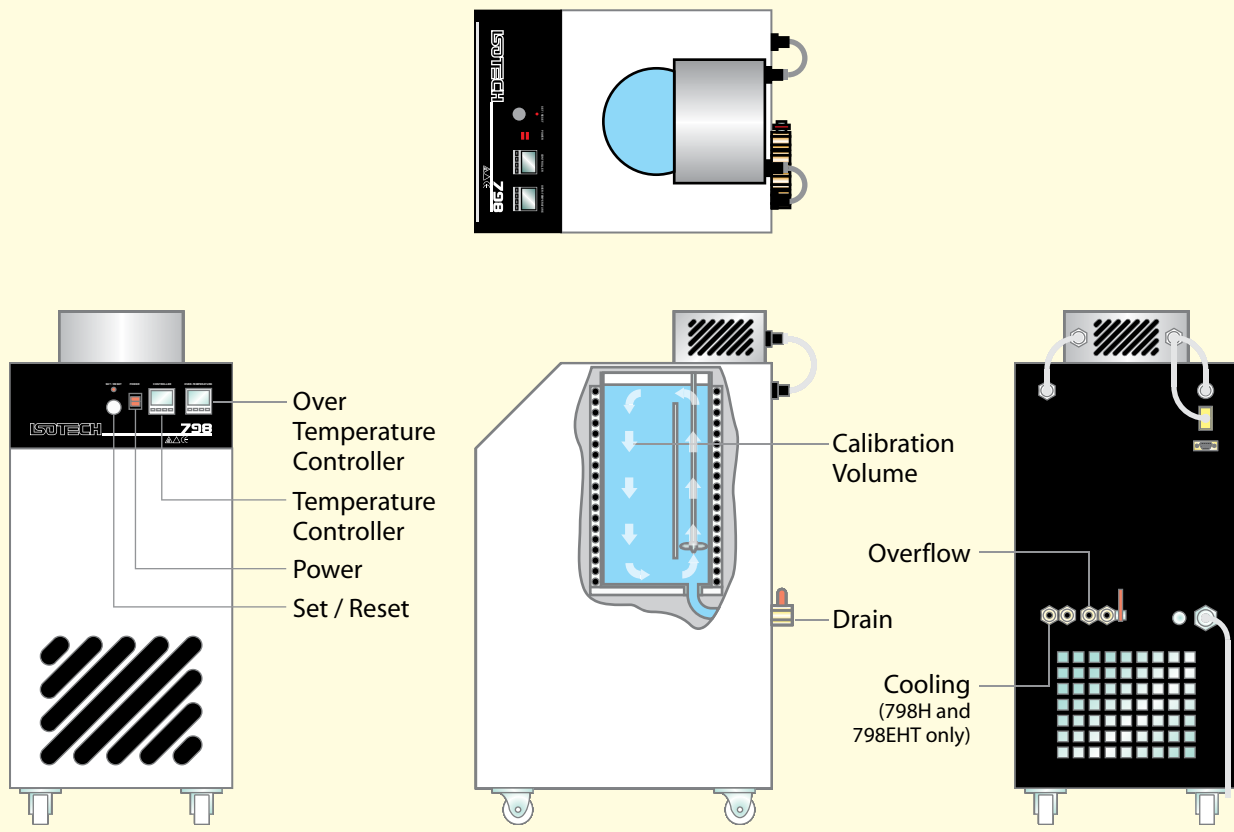
The chillers are one third horse power commercial grade units, not cheaper domestic grade as used by some manufacturers.

### ■ Calibration Depth...

Double the depth of some baths. The Hydra Range has up to 300mm depth of immersion.

### ■ Circular Design...

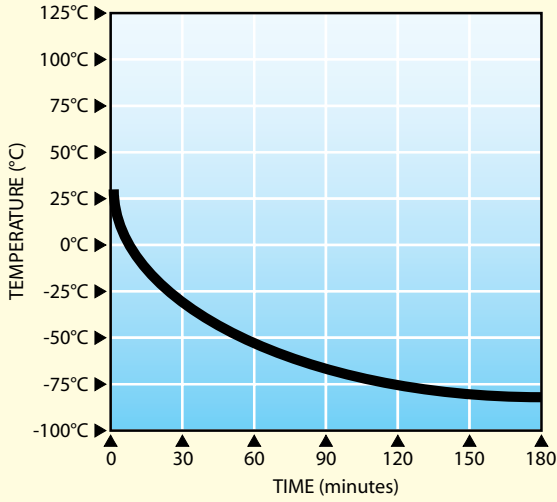
The circular design eliminates 'cold corners' found in tank shaped calibration baths.



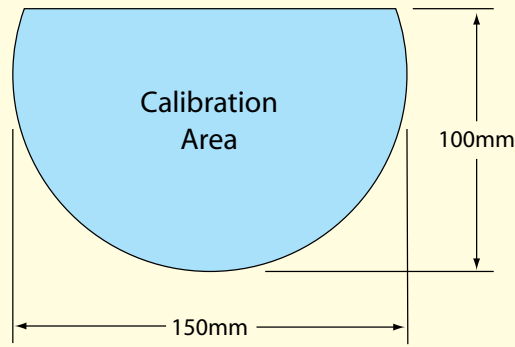
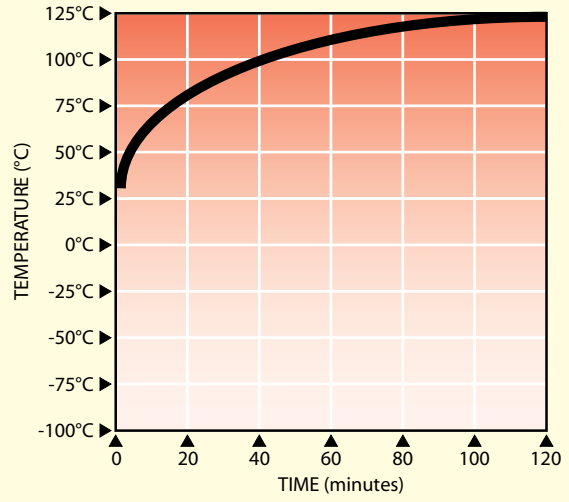
Model	798L	798M	798H	798EHT
Temp Range	-80°C – 125°C	-40°C – 125°C	30°C – 200°C	30°C – 300°C
Volume	150mm Diameter, 300mm Deep (5 litres)			
Absolute Stability	±0.030°C (Methanol, -80°C)	±0.017°C (Methanol, -40°C)	±0.015°C (Oil, 125°C)	±0.015°C (Oil, 250°C)
Vertical Uniformity	±0.002°C (Oil, 50°C)	±0.002°C (Oil, 50°C)	±0.002°C (Oil, 125°C)	±0.005°C (Oil, 200°C)
Heating time	25°C to 200°C < 60 minutes (C10 Oil)			
Cooling time	Ambient to -80°C < 130minutes (Methanol)			
Communications	Includes Serial Interface, PC Cable and Software			
Dimensions	405mm Wide, 610mm Deep, 940mm High (870mm to Top Panel)			
Weight	59kg	46kg	33kg	33kg
Safety	Compliant to CE Regulations			
Power	2.5kW 110V 50/60Hz or 230V 50/60Hz	1.5kW 110V 50/60Hz or 230V 50/60Hz	800W 110V 50/60Hz or 230V 50/60Hz	800W 110V 50/60Hz or 230V 50/60Hz
<b>How to Order</b>	798L	798M	798H	798EHT

Refer to Evaluation Report for Full Details

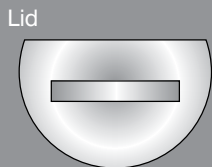
### Cool Down Graph



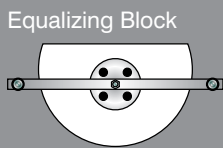
### Heat Up Graph



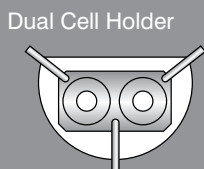
**Accessories** - Refer to 'Liquid Selection Guide' on page 73 for information on liquids and important Health and Safety Information



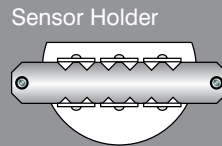
798-05-01 Liquid Volume Lid  
*Included*



798-05-02A Aluminium Equalizing Block, 4 pockets, 8mm diameter, 160mm deep  
798-05-02B Copper Equalizing Block, 4 pockets, 8mm diameter, 160mm deep  
798-05-02C Special Aluminium Equalizing Block *To suit customer requirements.*  
798-05-02D Special Copper Equalizing Block *To suit customer requirements.*



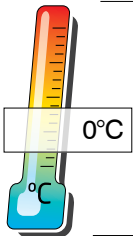
798-05-03 Standard Dual Cell Holder  
*Includes interchangeable Cell adaptors*



798-05-04 Thermometer Support Kit  
*Holds up to 12 sensors between 3mm diameter and 8mm diameter*

#### Fixed Point Cells

- 17724 Mercury Triple Point Cell -38.8344°C
- B12 Water Triple Point Cell 0.01°C
- 17401 Gallium Melt Point Cell 29.7646°C
- 17401M Slim Gallium Melt Point Cell 29.7646°C
- 17668ML Indium Freeze Point Cell 156.5985°C



# Stirred Ice / Water Bath

## 813

- 350mm Immersion Depth
- 8L Capacity
- 0°C created by stirred ice/water mixture

The most used temperature for calibration is 0°C.

The normal way of creating 0°C is via a mixture of ice and water in a Dewar Flask.

However, this can give errors of up to 4°C because water is densest at 4°C and so as the ice melts the temperatures at the bottom of the flask can rise to 4°C.

In the design of the ice flask offered by Isothermal Technology Ltd., these problems have been eliminated by stirring the water/ice mixture and segregating the ice from the water in the measuring zone.

This stirred ice/water bath is designed and built according to National Laboratory recommendations.

Using demineralised water, accuracies of  $\pm 0.005K$  are obtainable. Typically the bath will last for 4 hours before recharging with ice.

The ice is contained around and below the compartment where up to 4 probes can be placed for calibration or referencing purposes.

An option permits a water triple point cell to be maintained within the stirred ice bath.



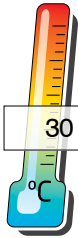
Model	813
Accuracy using Demineralised water	0°C $\pm 0.005K$
Capacity	8 litres (approx.)
Depth of immersion	350 mm
Accuracy using comparison techniques	$\pm 0.001^\circ C$
Power	50W, 108-130 or 208-240VAC, 50/60Hz
Dimensions	Height 580 mm Width 420 mm (including handle) Depth 250 mm Weight 15 kgs

#### Options

- 814/01b Copper Equalising Block
- 814/02 Mercury Thermometer Support Kit
- 814-06-02 Small Water Triple Point Cell Kit

#### How to Order

813 Stirred Ice Bath  
Please specify voltage required



# Large Volume Calibration Bath

## Model 820

- Large volume for calibration of a number of sensors,
- Wide temperature range 30°C to 200°C
- Good comparison accuracy  $\pm 0.01^\circ\text{C}$

If you have a large number of sensors to calibrate then this economically priced stirred liquid bath is the solution.

The 820 bath has been introduced to provide a liquid calibration bath with a large volume. This is to allow the bath to be used with many temperature probes simultaneously immersed in the bath or with accessories. It may also be used to maintain standard resistors at a constant temperature.

The liquid in the bath is heated to the set temperature and circulated by a propeller system.

The Aquarium is of robust construction and the liquid is contained in a stainless steel insulated enclosure which has a calibration volume 185mm long x 140mm wide x 300mm deep.

Refer to 'Liquid Selection Guide' on page 73 for information on liquids and important Health and Safety Information.



Model	820
Temp Range	30°C – 200°C
Volume	185 x 140 x 300mm (15 litres)
Absolute Stability	$\pm 0.003^\circ\text{C}$ (Direct in water, 50°C) $\pm 0.020^\circ\text{C}$ (Direct in VH Oil, 200°C)
Uniformity	0.005°C - between corners at 100mm depth
Heating time	50°C to 200°C < 145 minutes (VH Oil)
Communications	Includes Serial Interface, PC Cable and Software
Dimensions	240mm wide 378mm deep 645mm high overall
Weight	17kg
Safety	Compliant to CE Regulations
Power	1kW 108-130 or 208-240V, 50/60Hz

Accessories	
820/01	Standard Resistor Holder
820/02	Standard Aluminium Equalising Block
820/02S	Special Drilling Equalising Block
915/07	Medium Viscosity Oil 40°C to 180°C
915/08	High Viscosity Oil 150°C to 250°C
915/09	VH Temperature Oil 50°C to 288°C
932-19-72	Standard Resistor Oil

**How to Order** 820 Large Volume Liquid Calibration Bath  
Please specify voltage required

Refer to Evaluation Report for Full Details

# Liquid Selection Guide

When selecting a liquid for a calibration bath a number of factors need to be taken into account, temperature range, health and safety considerations, cost and operating life. For a specific fluid its properties such as boiling point, viscosity, specific heat and expansion coefficient need to be considered.

If calibrating over a limited range, say from 5°C to 90°C then water may be used with is ideal in many ways - low cost, safe and readily available.

For many labs though there will be a requirement to calibrate over much wider ranges.

For low temperature calibration alcohol or a mixture of alcohol and water can be used. Methanol is commonly chosen as it is easily obtained and relatively low cost. Methanol is both toxic and flammable and must be used with care.

There are non toxic alternatives to Methanol, including Florinert™ from 3M™ and Halocarbon 0.8 from Halocarbon. The disadvantage is that these fluids are expensive compared to Methanol see [www.3m.com](http://www.3m.com) and [www.halocarbon.com](http://www.halocarbon.com) for further information.

For high temperature calibration the choice is usually that of a silicone oil. Silicone oils can be used at low temperatures too but icing can be a problem, particularly if a bath is used for long periods at low temperatures.

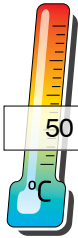
The practise at Isotech is to use one bath with a low temperature liquid, and a second with oil for higher temperatures and this is our recommendation. If an oil is used below the dew point water will condense into the open bath. If the bath is then used above 100°C the expansion of water present in the bath to steam can force the liquid from the bath creating a serious hazard. This is true for all open oil baths and the reason why Isotech do not recommend using an oil both below the dewpoint, and then above 100°C

Isotech Oils for Hydra, Orion and 915		Minimum Temperature	Maximum Temperature
915/07	Medium Silicon Oil	40°C	180°C
915/08	High Silicon Oil	150°C	250°C
915/09	Very High Silicon Oil	40°C	288°C
936-06-07	C10 Silicon Oil	-35°C	140°C
580-06-09	C20 Silicon Oil	20°C	200°C

■ Provision for adequate fume extraction needs to be made when using any open liquid bath.

The requirement will vary depending on the liquid used, and the temperature range.





# Fluidized Calibration Bath

## Model 875

- Wide Temperature Range, High Accuracy
- Safe, sealed no powder loss into laboratory
- Comparison Calibration or use with Fixed Points

The Isotech fluidized calibration bath out performs dangerous salt baths in all respects: wider temperature range, less hazardous and better uncertainties. The bath is the result of 20 years research and development into flow patterns, powder technology and filtration. Recent developments have enabled the baths facilities to be extended even further, it is now eminently suitable for Liquid in glass thermometer calibration. To achieve this the filter and exhaust system were re-designed to cope with the increased level of powder needed for Liquid In Glass thermometer calibration.

The result is a calibration system to National Standards. The performance is only matched by heat pipe technology. The profiles are so small that the bath has been used by National Laboratories for fixed points of Indium through Aluminum, with great success. In comparison mode 2 sigma uncertainties of  $\pm 0.020^{\circ}\text{C}$  at  $300^{\circ}\text{C}$  and  $\pm 0.035^{\circ}\text{C}$  at  $660^{\circ}\text{C}$  can be obtained.

This is the only product capable of covering a very wide temperature range without a change of thermal media. Like most fluidized bed baths, the 875 bath consists of a container of aluminum oxide powder with a porous base plate. Sufficient air is passed through the base plate to motivate the powder into a fluid like state so that it will flow, display buoyancy effects and have good heat transfer characteristics.



A disadvantage of many fluidized-bed baths is that good temperature stability and uniformity cannot be achieved in the fluidized medium itself. They are obtained by using large metal blocks or by inhibiting the fluidizing action in the powder around the work piece - either locally, or by completely collapsing the bed at the required temperature, this is not the case with the 875. A full evaluation report is available upon request.

Model	875
Temp Range	50°C - 700°C
Volume (875/02)	67mm diameter, 475mm deep
Absolute Stability: In Equalising Block (875/09a) 10 Minutes	$\pm 0.005^{\circ}\text{C}$ at $150^{\circ}\text{C}$ $\pm 0.005^{\circ}\text{C}$ at $450^{\circ}\text{C}$ $\pm 0.020^{\circ}\text{C}$ at $660^{\circ}\text{C}$
Vertical Uniformity	$\pm 0.005^{\circ}\text{C}$ at $350^{\circ}\text{C}$ $\pm 0.005^{\circ}\text{C}$ at $420^{\circ}\text{C}$ $\pm 0.026^{\circ}\text{C}$ at $660^{\circ}\text{C}$
Heating time	50°C to 700°C < 240 minutes
Compressed Air Supply	1 BAR, 30 litres/minute at 100°C (50 L max)
Communications	Includes Serial Interface, PC Cable and Software
Dimensions	580mm Wide, 640mm Deep, 1570mm High (880mm to Top Panel)
Weight	85kg (including 22Kg of Alumina Powder)
Safety	Compliant to CE Regulations
Power	3kW (3 x 1kW heaters), 208-240V, 50/60Hz
<b>How to Order</b>	<b>Model 875 Fluidized Calibration Bath</b>

Refer to Evaluation Report for Full Details



### Accessories

The following options are available:

- 875/09a** Adjustable height aluminium bronze equalising block. Eight 8mm pockets x 240mm deep.
- 875/02** Calibration Tube. As fitted as standard. This enables a calibration volume of 67mm inside diameter and 475mm deep. This calibration tube is supplied and fitted as standard.
- 875/03** Oil free compressor and connecting tube. Used to supply air to the fluidized bed where an independent air supply is not available within the laboratory.
- 875/04** Alumina powder specifically chosen for this application, supplied in a 25kg container.
- 875/06** Liquid in Glass Thermometer Support Gantry System consisting of a multi-tube probe holder with ten 10.80mm by 470mm deep pockets, four support pillars and an adjustable stainless steel gantry with holes corresponding to the probe holder, to locate up to ten thermometers simultaneously. Thermometer collars and 'O' rings (10 off) are included with the assembly.
- 875/07** The multi-tube probe holder, described under 875/06 is available separately upon request.
- 875/08** Monocular and Support. Useful for viewing and magnifying the liquid column within the thermometer being calibrated. This ancillary piece of equipment is used in conjunction with

*Note: The bath is fully commissioned, tested and charged with the correct amount of aluminium oxide powder before despatch.*



# Thermocouple Calibration Furnace

## Model 877

- Accuracy 0.25°C at 1000°C
- Central Zone of Zero Heat flux
- Range 100°C to 1300°C

The Saturn spherical furnace comprises a number of concentric shells. The outer shell of spun metal is for containment and support. Inside this is a layer of ceramic fibre. Within the fibre is a ceramic spherical mantle containing the heater windings. In the centre of the furnace is a solid cast ceramic sphere with 8 or 16 tubes, to be used for the thermocouples requiring calibration.

Isotech's calibration furnace is revolutionary from a number of aspects:

It is spherical, and its design ensures a central zone of constant temperature.

Thermocouples are inserted around the circumference of the furnace. When fully inserted the measuring junctions are within a few millimeters of each other at the centre of the sphere.

Up to 15 thermocouples can be calibrated simultaneously. The accuracy is between  $\pm 0.25^\circ\text{C}$  and  $\pm 0.1^\circ\text{C}$  at 1000°C.

Larger tube diameters will give larger gradients, as will larger numbers of tubes. The precision of this furnace has previously been achieved only by using heat pipes.

Because of the design the price is only one half to one third that of a bath with comparable accuracy and much smaller capacity of calibration.

The use of newly developed modern ceramic materials has enabled high accuracy, low mass and high stability to be obtained. The Saturn system will not contaminate your thermocouples unlike some furnaces that have metal equalizing blocks.



Model	877
Temperature Range	100°C to 1300°C
Number of Calibration Points	8 as standard 16 to special requirements
Diameter of Sensors	4 x 6mm + 4 x 8mm
Depth of immersion	180mm
Accuracy	$\pm 0.25^\circ\text{C}$ to $\pm 0.1^\circ\text{C}$ at 1000°C (using comparison techniques.)
Warm-up times*	1 hour to 700°C 3 hours to 1300°C
Stabilisation time*	1 hour to $\pm 0.25^\circ\text{C}$
Communications	Supplied as standard with serial interface. PC adaptor cable, and Cal NotePad.
Power	3kW, 208-240Vac, 50/60Hz 3kW, 115Vac, 50/60Hz
Dimensions	425 mm Diameter Weight 25 kgs

\* These times may increase as the windings age or if the supply voltage is low.

#### Accessories

877/01	Equalising Block 4 x 8mm + 4 x 6mm i.d. (standard)
877/01S	Equalising Block 16 x 6mm (special)
877/01E	Equalising Block - Other configurations (consult Isotech)
877/02	Platinum Foil Temperature Barrier

#### How to Order

877 Thermocouple Calibration Facility including Standard Equalising Block.  
Please specify voltage required

Blackbody Option



Thermocouple Calibration



**Note:**

Spherical furnaces are normally supplied 240 Volts, 50 Hz, 3 kW with 8 sensor insertion points, one of which is used to house the control thermocouple. Eight tubes with a nominal internal diameter of 6 mm have been found to give a very good and stable performance. It is the configuration around which the specification has been written.

**OPTIONS**

To special order, the following options are available, please contact Isotech for details.

- 1 16 Thermocouple Inserts. Because of the extra thermal mass involved in offering this option, an extra 30 minutes should be allowed for full stabilisation.
- 2 Larger Thermocouple Inserts. Inserts of up to 10mm (0.4 inches) diameter can be accommodated in the furnace. Please consult Isotech.
- 3 Platinum wrap can be fitted. Isotech wrap the insert of the Saturn in Platinum foil. Reducing the gradient at 1000°C to an unmeasurable value (less than 1µV difference from 2 type R Thermocouples).
- 4 Blackbody Option.

Each thermocouple is completely isolated in a gas tight closed end tube to prevent any contamination problems during calibration.

Normally the windings will require replacing after a few years of operating (dependent on work cycle) and so the furnace has been designed with ease of maintenance in mind. A spare set of windings is provided free with each furnace, as is a comprehensive handbook.



# Points on the Temperature Scale



Calibration of thermometers in ITS-90 Fixed Point Cells is not limited to NMIs or large scale Primary Laboratories.

Using Isotech POTTS (Points On The Temperature Scale) equipment fixed point calibration can be readily achieved with simple to use cost effective solutions.

POTTS are primarily designed for the maintenance of Slim Cells. Slim Cells

are slightly smaller than Isotech Primary or Optimal Cells which results in a large cost saving at only a small cost in performance.

Many of the POTTS models can be automated, with the apparatus automatically bringing the cell on to the plateau before the working day starts, and cycling it over night, giving the user the fixed point all day, every day, without attention.

## Flexibility

By removing the cell from the POTTS unit kits are available to allow the apparatus to be used in a variety of applications, making them the most flexible calibration baths available



**METAL BLOCK BATH**



**BLACK BODY SOURCE**



**STIRRED LIQUID BATH**



**SURFACE SENSOR**



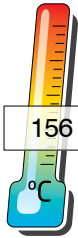
**STIRRED ICE / WATER**



**ITS-90 FIXED POINT**

Unit	Temperature Range	Cells	Internal Timer	Sensor Included
Europa-6	*-45°C to +140°C	Mercury, Water, Gallium	No	935-14-82
Oceanus-6	*-25°C to +110°C	Water, Gallium	Yes	935-14-85
Medusa	+30°C to +700°C	Gallium, Indium, Tin, Lead, Zinc	Yes	935-14-95
Oberon	+450°C to +1100°C	Aluminium, Silver, Copper	No	None

*\*In an ambient of 20°C*



156 to 1084°C

# Slim Fixed Point Cells Sealed

- Ultra Pure >99.9999% 6N
- 35 Year Plus History
- For Optimal Realisations

### Water

The Isotech B8 30 130 Cell is small enough to fit into portable Dry Blocks such as the Venus and Europa models. For the larger blocks like the Oceanus Isotech recommend the B 12 46 210 with its increased immersion depth

### Gallium and Mercury Cells

Like the B8 Cell the Slim Gallium Cell can be used in portable blocks like the Venus and Europa, or in stirred liquid baths. The Hydra and Orion have accessories available to support the cells.

### Indium to Copper

Isotech's Slim Cells have been in constant use since their introduction in 1990. The cells have always been made from the highest quality graphite and 6N (99.9999%) pure metals.

After further investment in the lab, and gaining smaller uncertainties from UKAS, we reviewed and further refined our range of metal clad cells to give better accuracy and performance. The new professional ranges of cells have more metal inside providing an active immersion depth in the metal of 160mm.

### Metal Clad

Isotech produced the first metal clad cells in 1990 and have much experience in the manufacture and calibration of high quality proven metal clad cells.

Metal clad cells are recommend for all points from Indium to Aluminium.

### Quartz Clad

These cells are recommended for Silver and Copper points, whilst available for the lower temperature points the metal clad versions are recommended as they are more robust, have the same performance and are more cost effective.

### Equipment for Slim Cells

The Slim Cells can be used in the same apparatus as the larger cells, and the greater immersion depth will give the lowest uncertainties.



Cost effective dedicated desktop apparatus like the POTTS, "Points on the Temperature Scale" can be used to automatically bring the cell to the plateau. These simple to use systems conveniently provide long flat plateau for low uncertainty calibration of thermometers.

### UKAS certification of our 2007 Slim Cells

The new, longer metal clad fixed point cells are intercompared to our reference cells for smallest uncertainties. Isotech now offer two UKAS services depending on the amount of measurements we make on the cell under test.

In our standard and recommended service we perform one melt, one freeze and one intercomparison. In our premium service, in order to reduce uncertainties we perform two or three melts, two or three freezes and two intercomparisons.

The two optional UKAS services with the uncertainties are tabulated below:

### Isotech UKAS Calibration Uncertainties ( $k=2$ )

Cell	Premium Service UKAS Schedule Note 4	Standard Service UKAS Schedule Note 5
Mercury	+/-0.5mK	+/-1mK
Water	+/-0.1mK (B12)	+/-0.5mK
Gallium	+/-0.5mK	+/-1mK
Indium	+/-0.7mK	+/-2mK
Tin	+/-0.8mK	+/-2mK
Zinc	+/-1mK	+/-2mK
Aluminium	+/-2mK	+/-6mK



The latest schedule can be found on the Isotech website or at [www.ukas.org](http://www.ukas.org)

### Additional Uncertainties

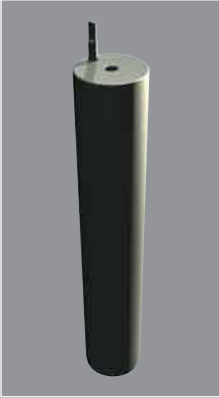




Mercury	+/-0.1mK
Water	+/-0.3mK
Gallium	+/-0.3mK
Indium	+/-0.7mK
Tin	+/-0.8mK
Zinc	+/-1.5mK
Aluminium	+/-3.0mK

### Additional Uncertainties

When these cells are used in bench-top apparatus such as Oceanus and Medusa 511 an extra uncertainty must be included for stem conduction effects.

Available Types					
Cells	Temperature	Uncertainty	Additional Uncertainty	Model Metal Clad	Model
Water	0.01°C	+/-0.5mk	+/-0.3mk	N/A	B8 30 130
Water	0.01°C	+/-0.1mk	+/-0.3mk	N/A	B12 40 210
Water	0.01°C	+/-0.1mk	+/-0.3mk	N/A	B12 46 210
Gallium	29.7646°C	+/-0.5mk	+/-0.3mk	17401M	N/A
Mercury	-38.8344°C	+/-0.5mk	+/-0.1mk	17724M	N/A
Higher Temperature					Quartz Clad
Indium	156.5985°C	+/-0.7mk	+/-0.7mk	17668ML	17668QS
Tin	231.928°C	+/-0.8mk	+/-0.8mk	17669ML	17669QS
Zinc	419.527°C	+/-1mk	+/-1.5mk	17671ML	17671QS
Aluminium	660.323°C	+/-2mk	+/-3mk	17672ML	17672QS
Silver	961.78°C	+/-30mk		N/A	17673QS
Copper	1084.62°C			N/A	17674QS

Isotech cells are of the highest purity available. Open cells conform to CCT/2000-13. Sealed cells are sealed to one atmosphere with 6N pure argon at the freeze temperature.

Metal	Quartz	Slim Gallium	Slim Mercury	Water Triple
				
<ul style="list-style-type: none"> <li>■ Robust</li> <li>■ Protected Against Contamination and Ambient Pressure Effects</li> <li>■ Easily Transportable Between Labs</li> </ul>	<ul style="list-style-type: none"> <li>■ Silver and Copper points available</li> </ul>	<ul style="list-style-type: none"> <li>■ Robust</li> <li>■ Fits in Dry Blocks</li> </ul>	<ul style="list-style-type: none"> <li>■ Robust</li> <li>■ Fits in Europa-6</li> </ul>	<ul style="list-style-type: none"> <li>■ Low cost</li> <li>■ Fits in Dry Blocks</li> </ul>

Nominal Dimensions				
Cell	Outside Dia.	Inside Dia.	Height	Material Depth
Slim Metal	37	8	220	160
Slim Quartz	38	8	226	160
Slim Mercury	36	9	235+140	130
Slim Gallium	35	10	200+45	140
Water B8 30 130	30	8	160	130
Water B12 40 210	40	12	365	210
Water B12 46 210	46	12	365	210

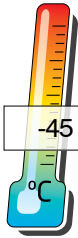
A free report is available, [www.isotech.co.uk/pdfs/SlimCells.pdf](http://www.isotech.co.uk/pdfs/SlimCells.pdf)

*N.B. Other SPRTs may give different results depending on the stem conduction properties.*

*Between aluminium metal clad slim cells and aluminium optimal cells.*

*We have fully certified more than 20 metal clad slim aluminium cells and 20 optimal aluminium cells. The table above compares the results, which shows how close the slim cell performance is to the optimal cells.*

*Note: 80% of the melt and 50% of the freeze slopes are internationally accepted method of assessing the purity of a cell.*



-45 to 140°C

- Use with Mercury, Water or Gallium Cells
- Multi Function Calibration Service
- Fast Response

The multi-functions of the Europa-6 is a unique award winning concept from Isotech.

The Europa-6 is a complete calibration laboratory working over the temperature range 65°C below ambient temperature to +140°C. It permits the calibration of temperature sensors absolutely (at fixed points of the ITS-90 scale) or by comparison to a reference standard.

It will calibrate both contact and non-contact thermometers such as optical pyrometers, surface sensors, as well as thermistors, thermocouples and resistance thermometers, whether they are short, long or odd shaped. Further it permits maintenance of reference standards by confirming the Water Triple Point at regular intervals.

The Europa-6 has a calibration volume of 35mm diameter by 160mm deep and is supplied with the very latest technology digital indicator and controller making the Europa-6 a complete self-contained calibration laboratory.

The Europa-6 offers unprecedented accuracies of 0.001°C (2 Sigma) at the Water Triple Point and the Gallium melt temperature of 29.7646°C and the Mercury Triple Point of -38.8344°C.

# POTTS Europa-6



Model	520
Temperature Range	65°C below ambient to +140°C
Absolute minimum temperature	-45°C
Absolute stabilities	over 30 minutes:
Metal Block Bath	±0.03°C
Stirred Liquid Bath	±0.025°C
Ice/Water Bath	±0.001°C
Black Body Source	±0.3°C
Surface Sensor	
Calibrator	±0.5°C
ITS-90 Fixed Point	±0.001°C
Heating / Cooling	See Graph (opposite)
Stabilisation Times	10 minutes
Calibration volume	35mm diameter x 160mm deep
Uniformity	±0.018°C
Controller Resolution	0.1 to 0.01 (4 digit display)
Indicator Resolution	0.1 to 0.01 (4 digit display)
Indicator Units	°C, °F, K
Communications	Supplied as standard with serial interface, PC adaptor cable and Cal Notepad.
Power	300W, 108-130 or 208-240VAC, 50/60Hz
Dimensions	Height 322mm Width 176mm Depth 262mm Weight 14kg

**How to order**  
520 Europa-6 POTTTS  
Please specify voltage required

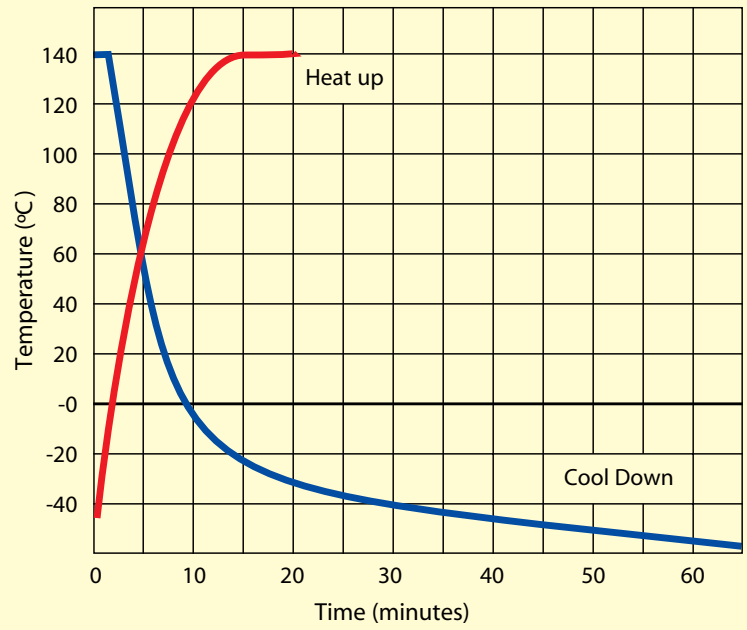


**P** POINTS  
**O** ON  
**T** THE  
**T** TEMPERATURE  
**S** SCALE

Slim Gallium Cell

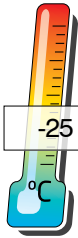


EUROPA-6 Heat Up / Cool Down GRAPH with insert fitted



**Accessories**

Metal Block Bath	Standard Insert 2 x 4.5 mm, 2 x 6.4 mm, 1 x 8 mm and 1 x 9.5 mm holes x 155 mm deep. Non-standard Insert - please consult Isotech
Stirred Liquid Bath	Stirred Liquid Container (For alcohols, water & oil) C20 Oil (ambient to +150°C) 0.1 litre required Liquid in Glass Thermometer Support kit
Stirred Ice/Water Bath	Stirred Liquid Container (For alcohols, water & oil) Liquid in Glass Thermometer Support kit
Blackbody Source	Blackbody Target
Surface Sensor Calibrator	Surface Sensor Calibrator Kit
ITS-90 Fixed Point	ITL M 17724M Slim Triple Point of Mercury Cell ITL M 17401M Slim Gallium Melting Point Cell B8 Slim Triple Point of Water Cell
Semi-Standard Probe	935-14-82
Carrying Case	931-22-27
UKAS 5 Point Comparison Calibration	



-25 to 140°C

- Use with Water and Gallium Fixed Points
- Can also be used as a Dry Block, Liquid Bath
- -25°C to 140°C

The multi-functions of the Oceanus-6 is a unique concept from Isotech, so unique that it is currently the subject of a patent application.

The Oceanus-6 is a complete calibration laboratory working over the temperature range 45°C below ambient temperature to +140°C. It permits the calibration of temperature sensors absolutely (at fixed points of the ITS-90 scale) or by comparison to a reference standard.

It will calibrate both contact and non-contact thermometers such as optical pyrometers, surface sensors, liquid in glass thermometers as well as thermistors, thermocouples and resistance thermometers, whether they are short, long or odd shaped. Further it permits maintenance of reference standards by confirming the Ice or Water triple point at regular intervals.

The Oceanus-6 has a calibration volume of 52mm diameter and 300mm deep and is supplied with the very latest technology digital indicator, timer and controller making the Oceanus-6 a complete self-contained calibration laboratory.

The Oceanus-6 offers unprecedented accuracies of  $\pm 0.0002^\circ\text{C}$  (2 Sigma) at the Water triple point and the Gallium melt temperature of  $29.7646^\circ\text{C}$  and up to  $\pm 0.005^\circ\text{C}$  in the stirred liquid bath option (by comparison).

# POTTS Oceanus-6

*Automated Calibration using Fixed Point Cells.  
Temperature range 45°C below ambient to +110°C.  
Calibrate absolutely at the fixed points of ITS-90 or by comparison*



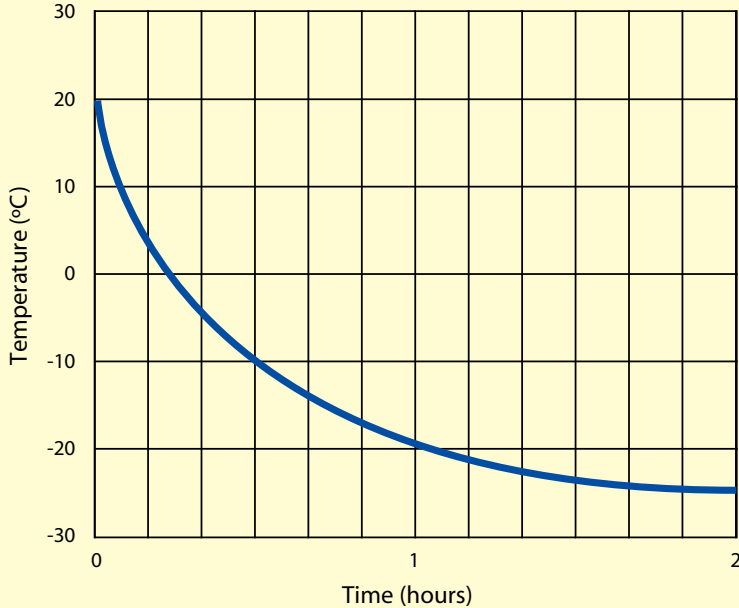
Model	580
Temperature Range	45°C below ambient to +140°C
Absolute minimum temperature	-45°C
Absolute stabilities over 30 minutes:	
Metal Block Bath	$\pm 0.03^\circ\text{C}$
Stirred Liquid Bath	$\pm 0.025^\circ\text{C}$
Ice/Water Bath	$\pm 0.001^\circ\text{C}$
Black Body Source	$\pm 0.3^\circ\text{C}$
Surface Sensor Calibrator	$\pm 0.5^\circ\text{C}$
ITS-90 Fixed Point	$\pm 0.0002^\circ\text{C}$
Heating / Cooling	See Graph
Stabilisation Times	10 minutes
Calibration Volume	52mm x 300mm deep

Uniformity	$\pm 0.018^\circ\text{C}$
Controller Resolution	0.1 to 0.01 (4 digit display)
Indicator Resolution	0.1 to 0.01 (4 digit display)
Indicator Units	$^\circ\text{C}$ , $^\circ\text{F}$ , K
Communications	Supplied as standard with serial interface, PC adaptor cable and Cal Notepad.
Power	300W, 108-130 or 208-240 VAC, 50/60Hz
Dimensions	Height 430mm Width 310mm Depth 300mm Weight 17kg

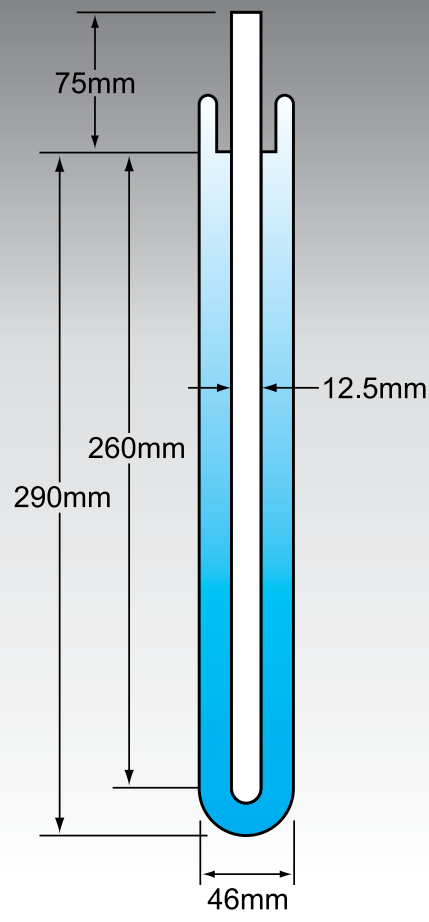
**How to order**  
580 Oceanus-6 POTTIS  
Please specify voltage required

**P** POINTS **O** ON **T** THE **T** TEMPERATURE **S** SCALE

Oceanus-6 Cool Down Graph



Type B-12 Water Triple Point Cell

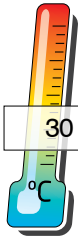


Gallium Cell



**Accessories**

Metal Block Bath	Standard Insert 6 x 8mm holes x 250mm deep. Adjustable Equalising Block Non-standard Insert - please consult Isotech
Stirred Liquid Bath	Stirred Liquid Container (For alcohols, water & oils) C20 Oil (ambient to +150°C) 1L required Liquid in Glass Thermometer Support kit
Stirred Ice/Water Bath	Stirred Liquid Container (For alcohols, water & oils) Liquid in Glass Thermometer Support kit
Blackbody Source	Blackbody Target
Surface Sensor Calibrator	Surface Sensor Calibrator Kit
ITS-90 Fixed Point	B12 Water Triple Point Cell ITL M 17401 Gallium Melting Point Cell
Semi-Standard Probe	935-14-85
Carrying Case	931-22-58
UKAS 5 Point Comparison Calibration	



30 to 700°C

# POTTS 510 Medusa & 511 Medusa

- High Capacity Deep Block
- Use for Comparison and Fixed Point Calibration
- Use with very long thermometers

Isotech have a wide range of Dry Blocks to suit probes requiring a large immersion depth. These products feature large and deep calibration volumes. As such they are less portable than the earlier Dry Blocks, but have higher capacities and retain outstanding temperature uniformity, this uniformity is so good that these larger products are also apparatus for Secondary Laboratories to realize the Fixed Points of ITS-90.

Medusa 510 has a maximum operating temperature of 550°C. The Medusa Model 511 can be used to 700°C and features three zone control. In addition to the main heating zone there are additional top and bottom heaters which compensate for the end losses creating a constant temperature zone across the well.

For Comparison Calibration the Medusa should be used with an insert, the standard insert has six 8mm pockets 250mm deep. Also available is an insert 44mm diameter x 170mm deep which is suspended from the top of the block so that the height is user adjustable. For flexibility the Medusa can also be used with accessories for infrared thermometers and surface sensors. The Medusa is available in two models, the BASIC (B) and the SITE (S). The B model includes a sophisticated temperature controller with a dual display for Set Temperature and Dry Block Temperature.

The S model includes a built-in digital thermometer to which an external standard thermometer can be connected giving greater accuracy, eliminating temperature gradient and loading errors. Also included in the site model is a timer which can set the bath between two temperatures, and automate ITS-90 fixed point operation. For Surface Sensor and Blackbody use an external thermometer is recommended. For laboratory accuracy the Medusa can be used with a high-end temperature indicator such as an Isotech TTI model.

Includes as standard: Windows Software, Computer Interface and a Ramp to Set Point Feature. Increased resolution of  $\pm 0.01$  available throughout the range via the PC interface and from 0.01 to +99.99 locally on the auto-ranging front display. The controller features multi-point block to display correction giving good absolute accuracy.

The S model has universal sensor input allowing Platinum Resistance Thermometers, Thermocouples (types K, N, R, S, L, B, PL2, T, J and E) along with Linear Process Inputs including 4-20mA current transmitters to be displayed on the in-built indicator. The indicator can be programmed with up to five calibration points to provide high accuracy digital probe matching. The indicator and controller are both addressable over the communications link.



### Fixed Point Cells Available

Material	Temperature	Uncertainty
Gallium	29.7646°C	$\pm 0.0005^\circ\text{C}$
Indium	156.5985°C	$\pm 0.0007^\circ\text{C}$
Tin	231.928°C	$\pm 0.0008^\circ\text{C}$
Zinc	419.527°C	$\pm 0.001^\circ\text{C}$
Aluminium	660.323°C	$\pm 0.002^\circ\text{C}$

Premium calibration service uncertainties shown.  
See page 80 for full details.

	510 Metal Block Insert	510-06-01	Standard Insert
		510-06-02	Blank Insert
		510-06-03	Insert without pockets for local machining
		510-06-04	Special Insert

Contact Isotech with your requirements

Adjustable Equalising Block

	511 Metal Block Insert	511-06-01	Standard Insert
		511-06-02	Blank Insert
		511-06-03	Insert without pockets for local machining
		511-06-04	Special Insert

Contact Isotech with your requirements

Adjustable Equalising Block

510 Blackbody Kit	510-06-05	Includes a Blackbody target and Sensor
511 Blackbody Kit	511-06-05	Includes a Blackbody target and Sensor
510 Surface Sensor Kit	510-06-06	Includes an insert and angled thermocouple

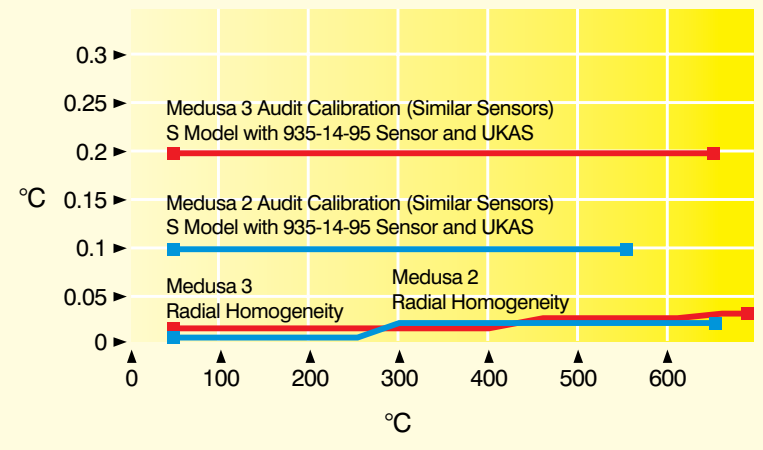
511 Surface Sensor Kit	511-06-06	Includes an insert and angled thermocouple
ITS-90 Fixed Points	ITL17401M	Gallium Slim Cell (510 only)
	ITL17668M	Indium Slim Cell
	ITL17669M	Tin Slim Cell
	ITL17670M	Lead Slim Cell
	ITL17671M	Zinc Slim Cell
	ITL17672M	Slim Aluminium Cell (511 only)
Slim Cell Holder		
UKAS Calibration	UKAS Calibration available to Order	
Standard Probe	935-14-95	Platinum Resistance Thermometer for use up to 650°C
Carrying Case	931-22-58	Sturdy case accommodates the unit with room for accessories

### Calibration and Uncertainty

A certificate, traceable to National Standards, is included as standard. Recommended is an optional UKAS five-point calibration.

The accuracy of the Medusa will depend very much on the mode of use, see the Uncertainty Graph for typical uncertainties. NTPL calculate the uncertainties to UKAS requirements. The Medusa meets the Calibration Capacity requirements of EA-10/13, "EA Guidelines on the Calibration of Temperature Block Calibrators."

### 510 Medusa Performance



Model	510 MEDUSA	511 MEDUSA 3	Indicator units	°C, °F, K	
Temperature Range	30°C to 550°C	50°C to 700°C	Power	108 to 130V or 208 to 240V 50 / 60Hz 510: 1000 Watts      511: 1800 Watts	
Absolute stability over 30 minutes	Metal Block Bath	±0.03°C	Overall dimensions	Height 430mm Width 310mm Depth 300mm Weight 510: 17kg      511: 25kg	
	Blackbody Source	±0.1°C			
	Surface Sensor Calibrator	±0.5°C			
	ITS-90 Fixed Point	±0.001°C			
Computer Interface	Included with Software				
Cools from	550°C to 30°C in 5 hours				
Heats from	30°C to 550°C in 90 minutes				
Uncertainties	Refer to Uncertainties Graph				
Calibration volume	45mm diameter by 285mm deep				
Standard Insert	Six 8mm pockets all 250mm deep				
Display Resolution	0.01 to 99.99 0.1 100.0 to 650.0 PC can display 0.01 across whole range with the software included				

**How to Order**  
510 Medusa or 511 Medusa  
Please specify model type, voltage and options required



450 to 1100°C

- Compact Heatpipe Furnace
- Suits Aluminium, Silver, Gold or Copper Fixed Points
- Can be used for comparison and infrared calibration

Model 426 is for Aluminium, Silver, Gold or Copper slim fixed point cells as well as for comparison calibration. Heatpipes provide the ideal conditions for the creation and maintenance of slim ITS-90 cells.

The furnace core is a specially-designed stress-free isothermal heat pipe, which provides a very low thermal gradient along the core working length.

The heatpipe is designed so that the inner wall is not subject to thermal expansion stresses from the outer wall before the heat pipe reaches conduction temperature. The working fluid is permanently and safely sealed within the plasma-arc welded enclosure.

The Oberon can be used with Blackbody Fixed Point Cells.

# POTTS Oberon



*Oberon for Aluminium, Gold or Copper Slim Fixed Point Cells*

Model	426
Temperature Range	450°C to 1100°C
Stability	±0.05°C
Display resolution	0.1°C
Cavity size	50mm diameter 300mm deep
Time to temperature	4 hours
Communications	Supplied as standard with serial interface, PC adaptor cable and Cal NotePad
Power	110 Vac, 1.5kW, 50/60Hz (230 Vac Transformer available)
Dimensions	Height 410mm Width 415mm Depth 280mm Weight 30.5kgs

<b>Accessories</b>	
Metal Block Bath	Standard Insert 6 x 8mm holes x 250mm deep Non-standard Insert - please consult Isotech
ITS-90 Fixed Point	ITL M 17672 Aluminium Quartz Clad Slim Cell
Apparatus	ITL M 17673 Silver Quartz Clad Slim Cell ITL M 17675 Gold Quartz Clad Slim Cell ITL M 17674 Copper Quartz Clad Slim Cell
Inconel Basket including insulators	426-04-00
230/110V Transformer	935-19-43

**How to order**  
426 Oberon High Temperature Furnace  
Please specify voltage required

# POTTS Ease of Use

Using the metal clad slim cells couldn't be easier!

## Long term stability

For the past seven years a set of metal clad slim cells have been part of our UKAS Secondary laboratory. An automated system puts the cells onto their melt plateau each day, every day of the year.

Complete melts and freezes are recorded each two years as part of our quality assurance program with the following results:

In	No change
Sn	No change
Zn	No change
Al	No change

## International Intercomparison

A set of metal clad slim cells from mercury through aluminium were tested at PTB by comparison to PTB's reference cells. All cells were within PTB's uncertainties.

Their results are summarised

Slim Cells	$\Delta T$	Uncertainties
Hg 137	0	$\pm 1.5\text{mK}$
In 125	-1.4	$\pm 2\text{mK}$
Sn 132	+1.4	$\pm 2\text{mK}$
Zn 64	+0.3	$\pm 3.5\text{mK}$
Al 160	+1	$\pm 5\text{mK}$

## An Example with a Medusa

Set the Medusa to a temperature 1°C above the cell's melt and wait!

Once the cell starts to melt you can use it all day to calibrate.

As you go home lower the Medusa temperature by 5°C and the cell will refreeze overnight ready for use again the next day.

Or like us, automate the process using a wall timer, to have cells melting all day every day.

With cells, apparatus and SPRT's you still need fixed resistors and an instrument. If you chose the standard recommended UKAS uncertainties you need a microK 400, two Standard Resistors with UKAS certificates and a temperature controlled environment to put them in.

If you chose the premier UKAS route then you need a microK 100 bridge as well as the resistors and temperature controlled environment.



# Introduction to Temperature Calibration Software

## Software

Isothermal Technology's range of calibration software saves you time, and lowers calibration costs. Isotech have a tested solution to calculate coefficients for Industrial Probes, for SPRTs, fit thermocouple error curves and fully automate the calibration of sensors.

## ITS-90 Software

Icarus is software for the ITS-90 Laboratory to calculate between resistance and temperature for SPRTs. It allows for the calculation of coefficients and the printing of charts and certificates.

## Cal NotePad

Isotech calibration equipment is supplied with Cal NotePad. This software allows equipment to be remotely controlled, monitored and the logging of data which can be imported into spreadsheet software. Cal NotePad supports the connection of both an Isotech Furnace, Bath, Block and an Isotech TTI Temperature Indicator.

## I-Cal Easy Software

I-Cal Easy allows for the automatic calibration of temperature sensors, from controlling the calibration run to printing certificates and calculating coefficients.



*Demonstration versions of our software are available to download for evaluation:*

<http://www.isotech.co.uk/software.html>

# Calibration Software Icarus

- Calculate SPRT Coefficients
- Print and Design Certificates
- Evaluation Version Available

## Software for the Primary Laboratory

Icarus is designed to calculate and display the relationship between resistance and temperature for Standard Platinum Resistance Thermometers between the triple point of Hydrogen and the freezing point of Silver. All calculations are performed using the equations and values defined in the International Scale of 1990 (ITS-90).

## Calculate ITS-90 Coefficients

Generate coefficients from data or data from coefficients

## Design and Print Certificates

Use built in layouts including R vs T, T vs R, W vs T etc. Design your own certificates using HTML. Use powerful keywords and additional statements.

## Check the calibration quality

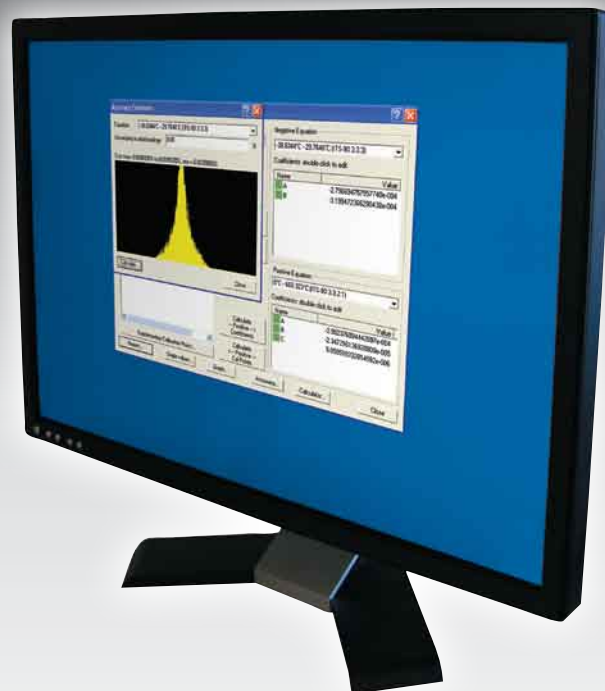
Fit extra calibration points to the curve. Create a distributable "Calculator" for any individual SPRT.

## Accuracy Estimator

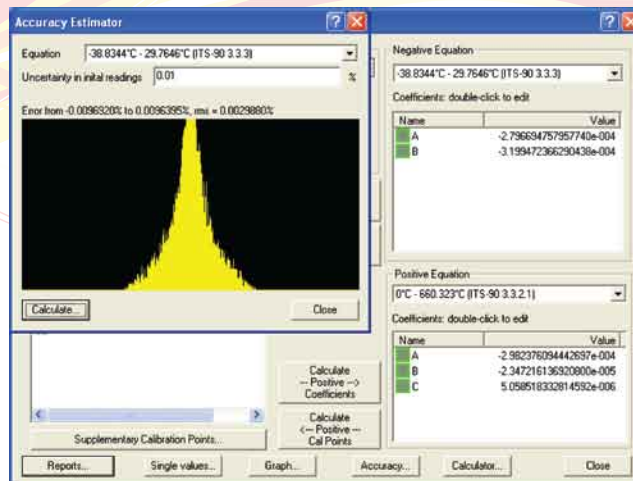
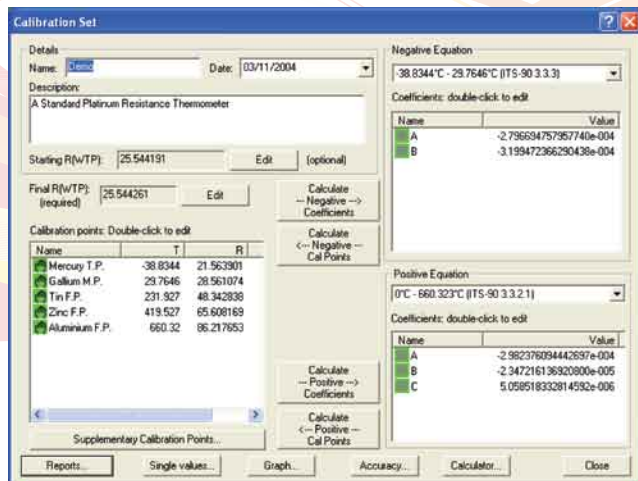
## See Graphical Representation of data

Icarus is used at NPL, if you have a recent certificate from Isotech for an SPRT it will have been created with Icarus.

Icarus has been tested and verified by Isotech and is available to save you lab time and increase confidence. The features of Icarus are as a result of requests made from Isotech Calibration Engineers. Quite simply if you calibrate SPRTs you need Icarus!



<http://www.isotech.co.uk/icarus>



# Calibration Software

## Cal NotePad

### CAL NotePad

- Easy to use Win98 - Win XP
- Interface to Isotech Block Baths & Temperature Indicators
- Log Chart and Export data - Control Calibration Bath - Read Standard

The purpose of Cal NotePad (CNP) is to automatically log and display the temperature of an Isotech calibration bath together with the unit under test. Cal NotePad can be used with baths (or indicators) without PC interfaces by the user typing in values from the keyboard. The Cal NotePad can be used to identify the operator and the unit under test. With the click of a button data is logged with time information, it is also possible to log continually.

The calibration bath temperature can be changed from the PC or from the calibration baths controller - Cal NotePad will display the temperature changes as they occur on the re-scalable chart display.

For traceable calibration the unit under test should be compared to a calibrated standard thermometer. Cal NotePad can record the actual temperature of the bath from either the in-built indicator of an Isotech SITE model or from a variety of external instruments see list. If the external instrument has two channels (e.g. Isotech TTI) then the unit under test may be connected to channel B for logging with CNP. Alternatively the value can be typed in from the keyboard. Similarly the calibration bath controller value, actual temperature, SITE indicator value or unit under test value may also be entered manually.

Then the manually entered data is combined with that gathered automatically and the resultant file can be opened in an external application such as Excel for the preparation of reports, certificates etc.

Cal NotePad is designed for ease of use, it will give a chart of the system. When the operator determines the system is stable - easily seen from the chart then clicking a button will record time, operator, serial numbers of unit under test along with controller and indicator values.

Cal NotePad can be used for semi-automatic calibration, see I-Cal Easy for a fully automated calibration solution.



<http://www.isotech.co.uk/calnotepad.html>



#### System Requirements

CNP requires a PC with Windows 98/2000/XP  
5Mb free hard drive space and a minimum of 8Mb RAM

#### CNP is compatible with the following Isotech calibration equipment:-

Calibration Baths, Furnaces, Dry Block and POTT models with a serial interface.

#### Temperature Indicators:

Isotech TTI-1, TTI-2, TTI-5, TTI-6, TTI-7 and-TTI 22

#### In addition the following third party instruments are supported:-

Labfacility Tempmaster, Labfacility Labcal +, Fluke 45 DVM, in built conversion for type K, J, E, R, S, T, N, B (external CJC required) or Volts/Ohms display, Cropico, 3000 Series, and similar models with the same command protocol, e.g. ASL F150, Tinsley 5885 etc.

#### Manual Entry:

Any instrument data can be typed into Cal NotePad.

I-CAL Easy

# Calibration Software

## I-Cal Easy

- Fully Automatic Calibration
- Design and Print Certificates
- Calculate Coefficients
- Prints PRT and TC tables
- Supports more equipment
- Try the full version free for 30 days

Use I-Cal Easy to automate sensor calibration, enter up to 20 calibration points and let the software set the bath, wait for stability and log the data automatically. Choose the stability criteria and how many points to record at each calibration temperature. Automatic temperature calibration the easy way.

I-Cal Easy lets you use a built-in template or design your own certificate. Add text, data fields and graphics on single or multiple pages, then publish the calibration data to the certificate. Do you want to include or calculate coefficients? Then drag your data to the ITS-90 or Calender Van Duesen calculators. For thermocouples use the powerful regression calculator to fit error curves.

Other systems have limited the user with a built-in template and the need to pay extra for any changes, with I-Cal Easy just build in your own certificate in minutes!



<http://www.isotech.co.uk/icaleasy>

Results	Run Date	Measurement Data	Channel	Stem	Reference	Bar Stem	Setpoint	Setpoint Tol	Status Tol	Pass
+111.828		111.825333	28.000000	28.000000	28.000000	28.0000	TRUE	TRUE	FALSE	Fail
+111.828		111.825967	28.000000	28.000000	28.000000	28.0000	TRUE	TRUE	FALSE	Fail
+111.828		111.830000	28.000000	28.000000	28.000000	28.0000	TRUE	TRUE	FALSE	Fail
+111.828		111.831000	28.000000	28.000000	28.000000	28.0000	TRUE	TRUE	FALSE	Fail
+111.827		111.831000	28.000000	28.000000	28.000000	28.0000	TRUE	TRUE	FALSE	Fail
+111.828		111.832100	28.000000	28.000000	28.000000	28.0000	TRUE	TRUE	FALSE	Fail
+111.828		111.832500	28.000000	28.000000	28.000000	28.0000	TRUE	TRUE	FALSE	Fail
+111.828		111.832900	28.000000	28.000000	28.000000	28.0000	TRUE	TRUE	FALSE	Fail
+111.828		111.833200	28.000000	28.000000	28.000000	28.0000	TRUE	TRUE	FALSE	Fail
+111.828		111.833500	28.000000	28.000000	28.000000	28.0000	TRUE	TRUE	FALSE	Fail
+111.827		111.832400	28.000000	28.000000	28.000000	28.0000	TRUE	TRUE	FALSE	Fail
+111.828		111.831000	28.000000	28.000000	28.000000	28.0000	TRUE	TRUE	FALSE	Fail
+111.827		111.828000	28.000000	28.000000	28.000000	28.0000	TRUE	TRUE	FALSE	Fail
+111.827		111.825200	28.000000	28.000000	28.000000	28.0000	TRUE	TRUE	FALSE	Fail
+111.827		111.818000	28.000000	28.000000	28.000000	28.0000	TRUE	TRUE	FALSE	Fail
+111.827		111.805000	28.000000	28.000000	28.000000	28.0000	TRUE	TRUE	FALSE	Fail
+111.827		111.794000	28.000000	28.000000	28.000000	28.0000	TRUE	TRUE	FALSE	Fail
+111.824		111.874800	28.000000	28.000000	28.000000	28.0000	TRUE	TRUE	FALSE	Fail
+111.828		111.840000	28.000000	28.000000	28.000000	28.0000	TRUE	TRUE	FALSE	Fail

Calibration Certificate

I-Cal Easy Laboratory

10%

Export as Text

I-Cal Easy supports the TTI-7 and Isotech Dry Blocks, Liquid Baths and Calibration Furnaces. Additional support for other and third party instruments is available, contact Isotech for details.

I-Cal Easy provides a powerful but easy to use automatic calibration system. A graphical setup lets you drag and drop instruments and equipment onto the appropriate PC port - no need to create config files. In addition to the comprehensive manual balloon tips guide you as to the operation of each control. Once familiar with the system this balloon help feature can be turned off.

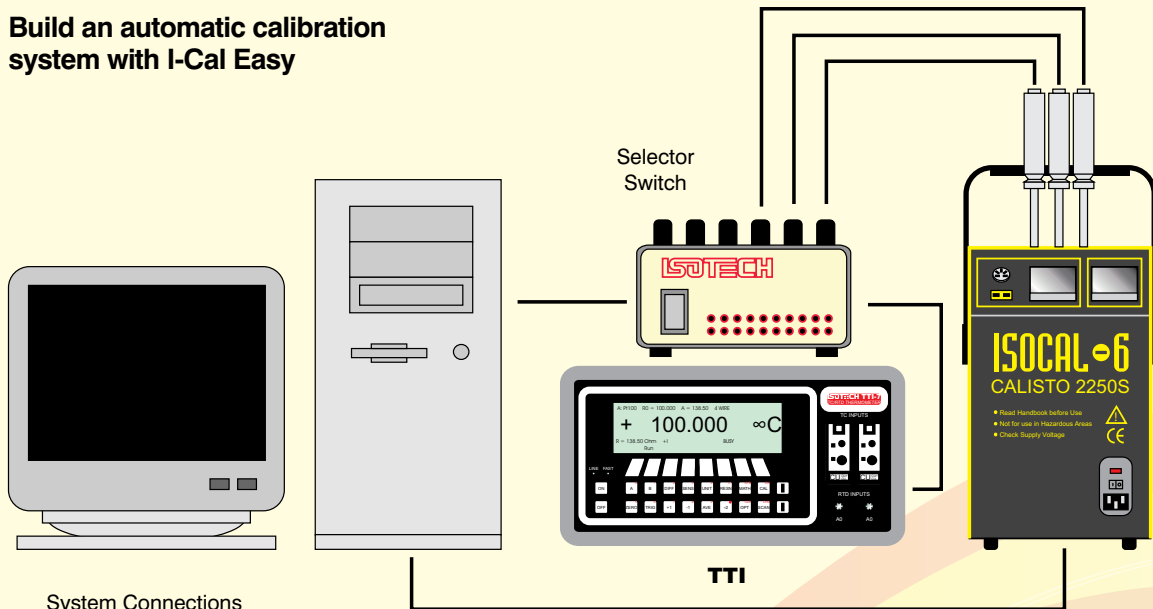
The criteria for stability can be set to suit all types of equipment; Dry Blocks, Liquid Baths and High Temperature Furnaces. Once the system is stable choose how many measurements to take at each calibration point and have the average value appear on the certificate. Create one or multiple page certificates, as many as required to suit different customers and different types of calibration, Thermocouple, Industrial PRTs and SPRTs. Drag and drop data and text fields onto the certificate, link to logos and other graphic elements.

The in-built calculator will calculate coefficients for both IEC 751, ITS-90

and for thermocouples you can choose what order of regression to fit an error curve. Try the demo version and see how easy it is to drag data to the calculator and export the results straight to a certificate.

Judge for yourself how this compares to any other software. The demonstration version will run without restriction for 30 days and enable you to learn how to use I-Cal Easy and save time by rapidly producing certificates to your own requirements. Try it and see why we are confident that I-Cal Easy is the market leader.

### Build an automatic calibration system with I-Cal Easy



*The number of sensors that can be calibrated depends upon the equipment used. Calibrate up to 16 sensors with two switch boxes, expandable to 32.*

#### System Requirements

Computer	Desktop or Notepad PC
Operating System	Windows 98/2000/XP
Display	800 X 600 / 16 bit display (1024 X 768 recommended)
I-Cal - Supported Camera	Check with Isotech for supported models
Serial Ports	A maximum of three ports are required, one for the dry block, one for the TTI and one for the Switchboxes (Two Switchboxes can be operated from a single port)

**Note:**  
Available in different languages -  
Spanish and Chinese currently available.

<http://www.isotech.co.uk/icaleasy>

# Calibration Services

Isotech's UKAS accredited calibration laboratory, Northern Temperature Primary Laboratory (NTPL), was established in 1980 and has grown to be a full scale laboratory providing calibration to the smallest of uncertainties. Isotech was the first UKAS laboratory to be accredited to calibrate ITS-90 Fixed Point Cells. Our accredited uncertainties are now smaller than many the scope of other accredited laboratories and smaller than most National Measurement Institutes.

NTPL comprises of three physically separate laboratories, A Primary Laboratory, A Secondary Laboratory and Calibration laboratory for Industrial products. Isotech can offer a tailored service to meet your needs be it a Dry Block calibration of the calibration of a standard for the primary lab.

NTPL is regularly visited by scientists from the the leading NIMs and provides a range of highly regarded training courses.

*Extracts from the Schedule 42*

Isotech UKAS Calibration Uncertainties (k=2)		
Calibration of SPRTs at Fixed Points		
	Temperature	Uncertainty
BP Nitrogen	-195.798°C	5mK
TP Mercury	-38.8344°C	0.24mK
TP Water	0.01°C	0.07mK
MP Gallium	29.7646°C	0.15mK
FP Indium	156.5985°C	1.0mK
FP Tin	231.928°C	1.0mK
FP Zinc	419.527°C	1.2mK
FP Aluminium	660.323°C	2.0mK
FP Silver	961.78°C	7mK

	Temperature	Uncertainty
TP Mercury	-38.8344°C	0.22mK
TP Water	0.01°C	0.07mK
MP Gallium	29.7646°C	0.07mK
FP Indium	156.5985°C	0.65mK
FP Tin	231.928°C	0.6mK
FP Zinc	419.527°C	0.9mK
FP Aluminium	660.323°C	1.1mK
FP Silver	961.78°C	2.0mK

*The latest schedule can be found on the Isotech website or at [www.ukas.org](http://www.ukas.org)*



<http://www.isotech.co.uk/lab>



## Training

Our training course, "From Industry to ITS-90" has been attended by several hundred delegates at venues across the world. Many more have completed the content via our E-Learning system. We also provide specialist courses relating to the use of Primary Standards

<http://www.isotech.co.uk/training.html>

## Journal of Thermometry

Published over ten years this remains a valuable resource for temperature metrologists.

<http://www.isotech.co.uk/journal.html>



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