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ISOTECH

The Source for Calibration Professionals

THE QUEEN'S AWARDS FOR ENTERPRISE: INNOVATION 2017

Solutions for Primary & Secondary Laboratories

Temperature Calibration Equipment & Services

Isotech Catalogues...

Temperature Calibration Equipment and Services

This volume of our catalogue includes our calibration solutions intended for Primary and Secondary Laboratories. Volume 2 is also available with a range of equipment that includes portable calibrators for industrial temperature sensors, precision thermometers, blackbody sources and thermocouple referencing equipment.



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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.

Products in this catalogue are all CE Compliant

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 ±0.05ppm.

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

Hg	±0.2mK
Ga	±0.1mK
In	±0.5mK
Sn	±0.3mK
Zn	±0.5mK
Al	±0.7mK
Ag	±1.1mK

For SPRTs ±0.5mK (non-uniqueness of ITS-90 between fixed point of water and gallium), ±0.5mK (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 70 is the ideal solution, it contributes just 0.07ppm 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]

microsKanners 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 complement 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 then 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
- Sealed quartz
- Open metal clad
- 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, H20, 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.

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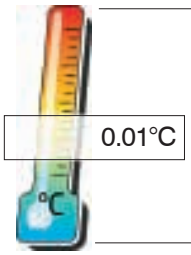


The Jarrett-Isotech **Water Triple Point Cells**

- Uncertainty to <0.0001°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 μK 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 ^{2}H per mol ^{1}H
0.0003799	mol ^{17}O per mol ^{16}O
0.0020052	mol ^{18}O per mol ^{16}O

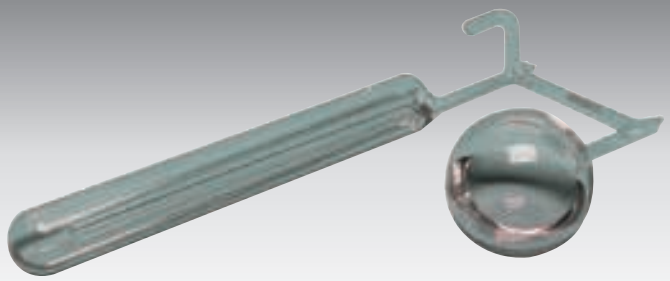
** Technical annex for the International Temperature Scale of 1990 (ITS-90) Adopted by the CCT on 10 June 2005*

Since early in 2000 Jarrett-Isotech Cells have been made to this definition and our cells have been within +10 and -40μK 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 ±20μK of the above definition.

We can provide Isotopic Analysis of the water in our triple point cells; recommended for NMIs. 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 < ±0.1mK, 2 Sigma. This will benefit the most demanding of NMIs and users.

More cost effective calibration options to uncertainties of ±0.1 and ±0.5mK are also available. Regardless of calibration the Jarrett-Isotech cells are reproducible to ±0.000020°C and after equilibrium has been reached the inner melt of the ice mantle will give stability of ±0.00001°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 <+/-0.0001°C (0.1mK)

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 ±0.0001°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 ±0.0005°C (0.5mK)

Performance

Accuracy

The equilibrium temperature of the Jarrett-Isotech Triple Point of Water Cell is within ±20μK of the 2005 definition as described in CCT/05-07/rev(2). We can provide Isotopic Analysis of the water in our triple point cells; recommended for NMIs.

Reproducibility

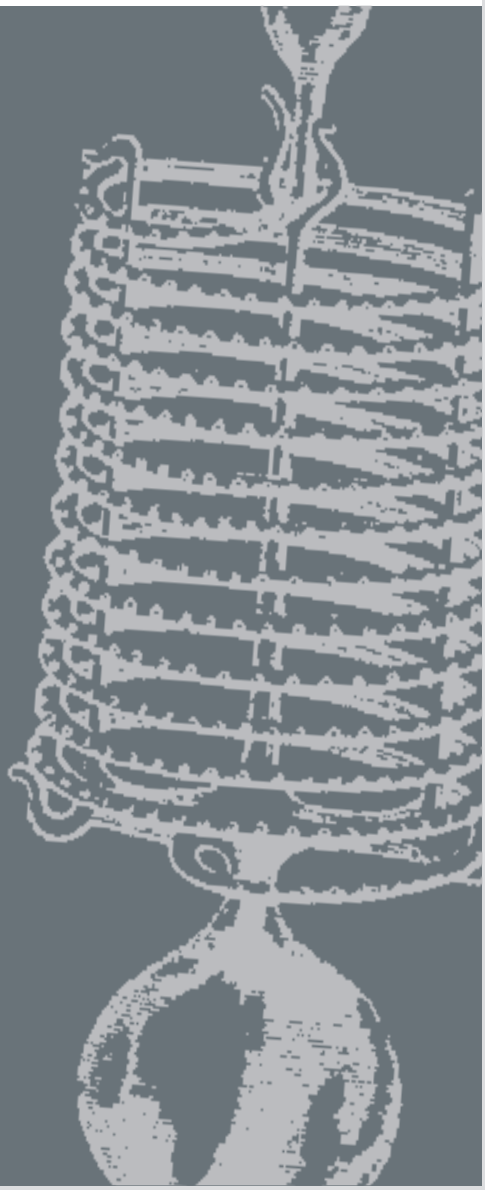
The equilibrium temperature of a cell will repeat to within ±0.000,02°C of the mean equilibrium temperature.

Stability

After equilibrium is reached, the temperature of the inner melt of an ice mantle will remain constant to within ±0.000,01°C for as long as the mantle can be preserved (up to 90 days in some instances).

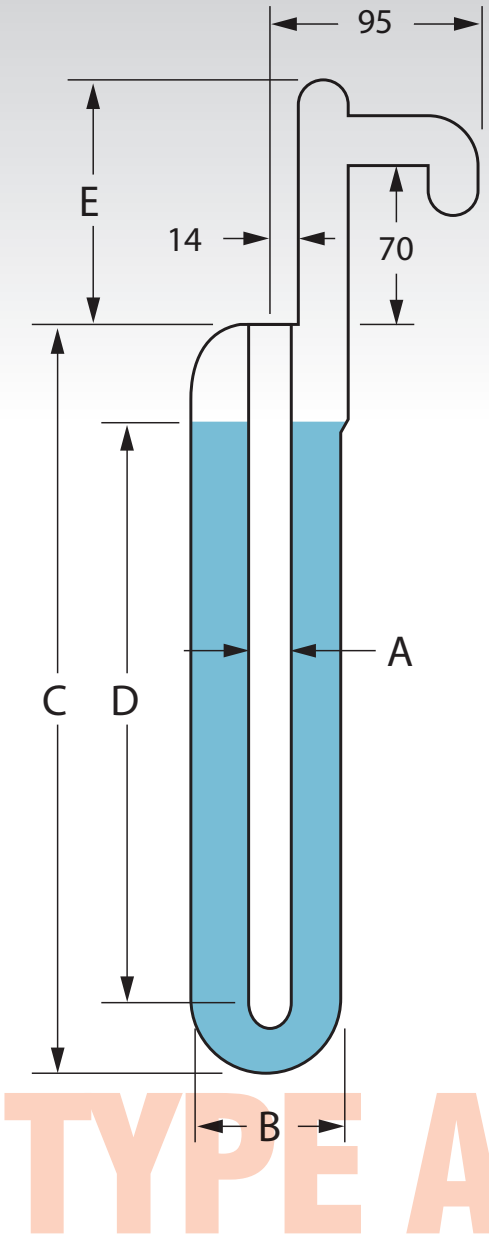
Life

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.

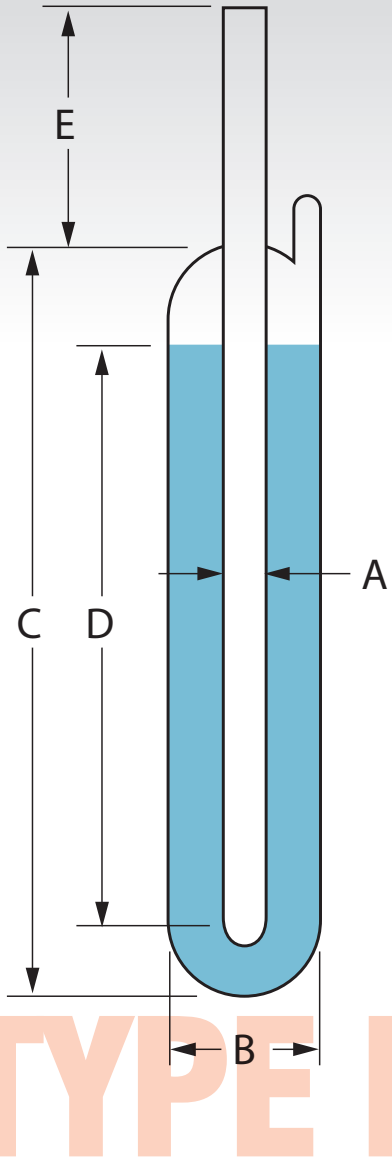


Physical Features

Type A cells were designed by Dr. H. F. Stimson at NBS. A tubular glass extension at the top of the cell serves as an indicator of partial presence of air.



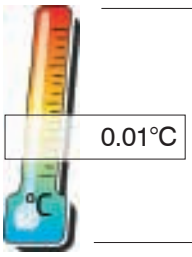
Type B cells were designed at NRC of Canada. The thermometer well extends 100mm above the top of the cell. Heat transfer to the ice mantle may be essentially eliminated by keeping these cells packed in ice to the top of the well extension, or by immersing them sufficiently in a Water Triple Point Maintenance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



	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

- Maintains Four WTP Cells
- Proven Use in Many NMIs
- Safe and Convenient Operation

This dedicated apparatus has more than 35 years of proven use and is widely used by the worlds' leading NMIs. In a recent International study cells from 21 of the world's leading laboratories were inter-compared; the study used two Isotech 18233 Baths to maintain the cells during the inter-comparisons.

The Isotech Model 18233 Water Triple Point Maintenance Bath is not an adaptation of general-purpose equipment, but is specifically designed to maintain and safeguard one to four Water Triple Point Cells.

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.

Safety is provided by both electrical safety circuits and passively 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.

Compared to general purpose baths with mechanical cooling it has advantage of

- Safer Operating Range -0.3 to +0.3C
- Solid State Vibration Free Cooling - Quieter Operation
- Holds up to Four Cells
- Lower Energy Consumption / Operating Costs



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



Updated Control System

The control system has been updated and now features a large colour display with crystal clear graphics. An Ethernet interface allows the bath temperature to be remotely monitored. Other features include data logging of the bath temperature along with the air intake temperature - the data can be exported to a USB drive.

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.

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
Interfaces	Ethernet and USB Host
Resolution	0.001°C
Power	150 Watts typical, 100-130 or 208-40 Vac* 50/60Hz (*fields changeable)
Dimensions	Height - 910mm Width - 635mm Depth - 710mm Weight - 66kg

Options
Triple point of water cells

How to order
ITL-M-18233 Water triple point maintenance bath. Please specify which types 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

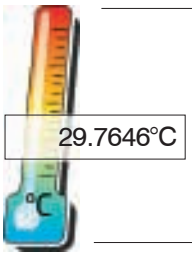
Additional Ice Bridge Prevention Collar

How to order

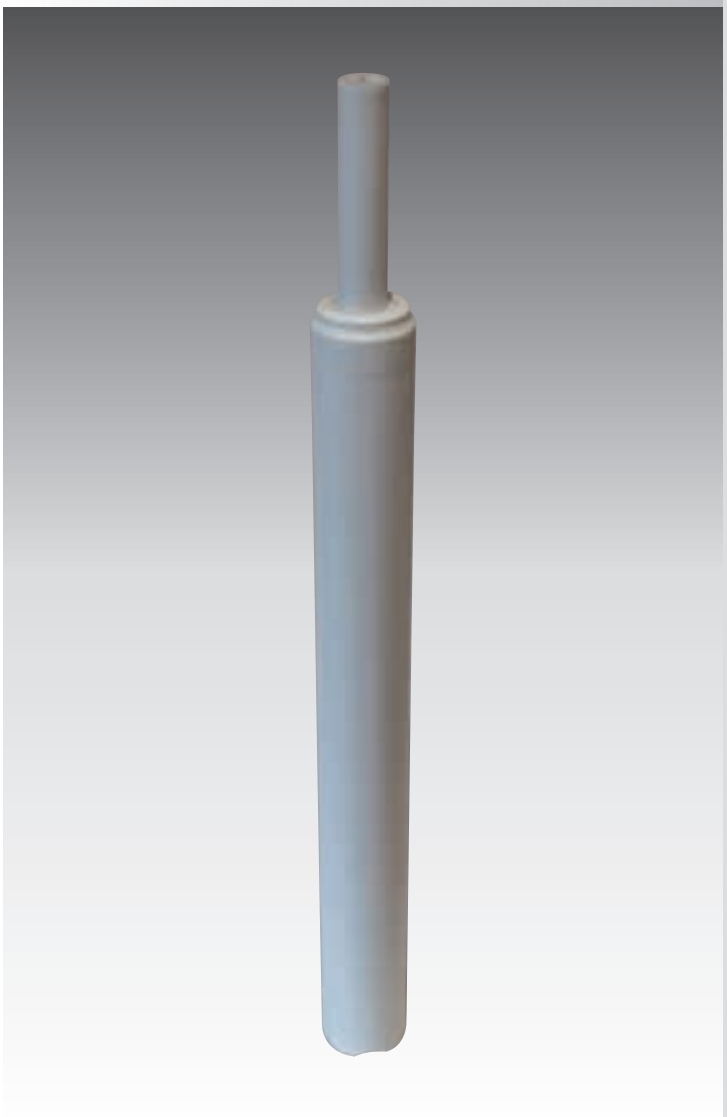
452 Ice Mantle Maker and one ice bridge prevention collar

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)
D) Outside Diameter of the re-entrant tube



Sostmann - Isotech
Gallium Cell



- World Leading Uncertainties
- 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 to 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	< 0.1mK

How to order

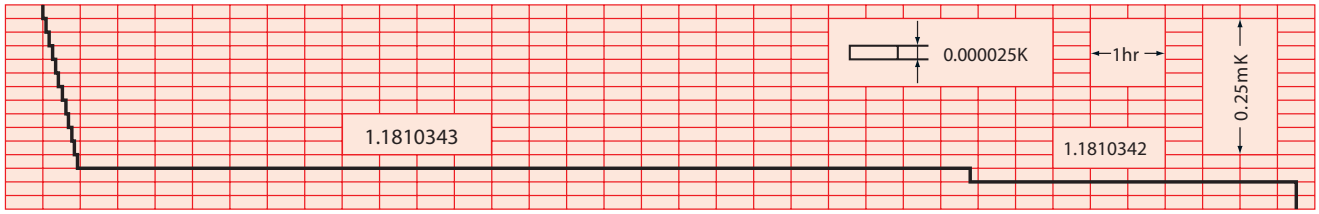
ITL-M-17401 Gallium Cell - (Specify sealed or open)

The Cell is supplied with a Certificate of Metal Purity

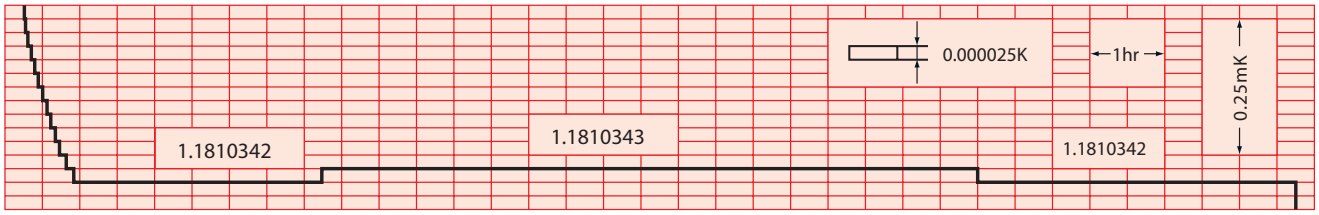
*We have a choice of UKAS calibration Services, the stated uncertainty figure is for our Premium UKAS Calibration Service

The Perfect Gallium Point

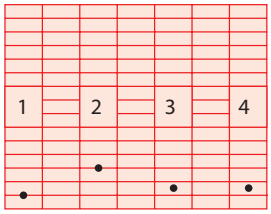
Melt 1 Day1



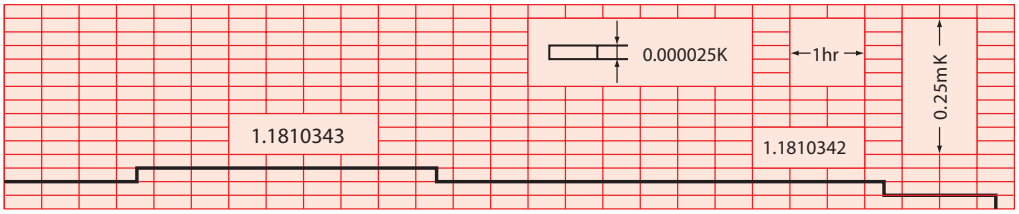
Melt 2 Day2



Shown on the same scale



Melt 3 Day3

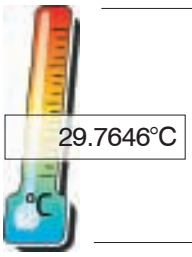


1 Value of 10 years old Cell
2 Value of N.P.L.'s Cell
3 Value of I.M.G.C.'s Cell
4 Value of Cell open for over 3 years

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


The Resealable Gallium Cell

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_2	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

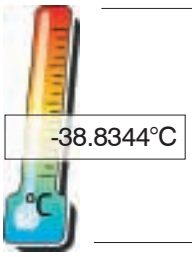
Model 17402B Gallium Apparatus is not an adaptation from general purpose equipment, but is designed specifically to realize and maintain the Gallium Cell on the melt plateau, for calibration of thermometers on the International Temperature Scale of 1990.

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



The Isotech **Mercury Cell**



- Uncertainty 0.000200°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

Model	ITL-M-17724
Temperature	-38.8344°C
Metal Purity	> 99.99999 7N
Dimensions	
Outside Diameter	40mm
Inside Diameter	8mm
Total Height	475mm
Metal Depth	200mm
Uncertainty *	0.2mK

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 apparatus is a self-contained, mechanically-refrigerated, system with a main well to house one mercury cell and two auxiliary wells for pre-chilling of thermometers. The cryostat temperature is adjustable from -36°C to -42°C. It makes the operation of mercury cells simple and safe.

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 avoid 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.

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

The apparatus has a long and successful history and has been relied on by many National Laboratories throughout the world for over 35 years.

The control system has been updated with the latest technology and now features a large colour display with crystal clear graphics. An Ethernet interface allows the bath temperature to be remotely monitored. Other features include a program option to allow switching between melt and freeze temperatures. A USB Interface allows programs to be copied or for apparatus heat up and cool down history to be exported.

Model	ITL-M-17725 Apparatus
Uncertainty	0.2mK (with cell)
Temperature Range	-36°C to -42°C
Control	0.01°C Resolution
Interfaces	Ethernet and USB Host
Ambient Limits	18°C to 28°C
Plateau Duration	8-12 hour plateau
Power	750 Watts typical. 208-240Vac, 50/60Hz
Dimensions	Height - 960mm Width - 600mm Depth - 560mm Weight - 96kg

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



471 Simple Argon **Triple Point Apparatus**

PROVISIONAL DATA*

The Isotech Argon Triple Point Apparatus has been upgraded for greater automation, efficiency, and ease of use in realising the argon triple point.

Many laboratories use liquid nitrogen comparators, a low-cost but imperfect method. Liquid nitrogen's boiling point is not on the ITS-90 scale and is below the argon triple point. This presents challenges, as standard platinum resistance thermometers (SPRTs) often contain a mix of argon and oxygen. At -195°C, the gas inside the SPRT can be under partial vacuum, affecting self-heating and increasing calibration uncertainties.

Previously, the high cost and complexity of argon triple point systems were barriers for many laboratories. Isotech has changed that with a simpler, more affordable solution featuring automated temperature control for easier operation.

What's New?

- Automated Pressure Control - Replaces the manual weight system for precise, stable temperature regulation.
- Additional Pre-Cooling Pocket - Improves efficiency and speeds stabilisation.
- Faster Time to Fixed Point Plateau - Reduces wait time for calibration.
- Allows LN_2 Replenishment During Use - Extends the calibration period without disruption.
- Faster Filling Time - Speeds up setup and operation.

Inside the apparatus, 6N pure argon is sealed in a pressure vessel, and liquid nitrogen cools the volume to approximately -195°C. A pressure controller then regulates the nitrogen's boiling temperature to just above the argon triple point, maintaining stable conditions. The argon settles into its triple point for around four hours, providing an accurate, stable reference for SPRT calibration. The temperature is adjustable via a PC-controlled electronic pressure controller (PC not supplied), allowing precise regulation and enhanced flexibility in operation.

With automation, faster setup, and improved usability, the updated Isotech Argon Triple Point Apparatus makes SPRT calibration at the argon triple point more accessible than ever, ensuring greater efficiency and control for calibration laboratories.



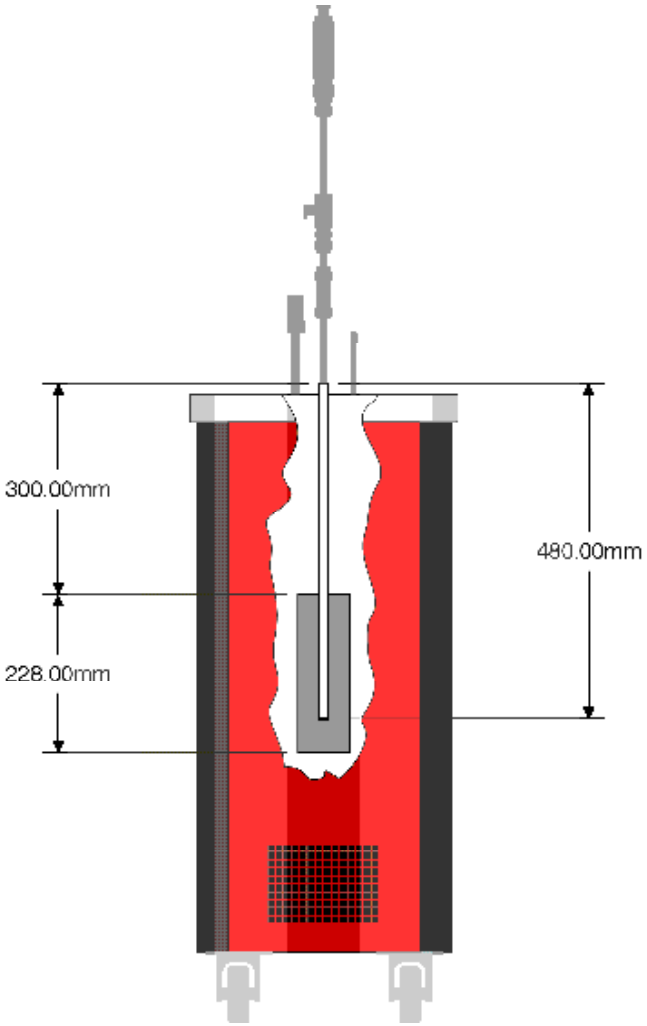
http://www.isotech.co.uk/argon

Why Choose the 471 Argon Apparatus

- No need for high-pressure gas handling or complex vacuum setups
- Practical and cost effective compared to other systems
- Electronic pressure control eases operation
- ITS-90 defines the argon triple point — not liquid nitrogen — as the standard at –189.3442°C

Experience repeatable, traceable argon triple point calibrations - with convenience and confidence.

This self-contained system offers true realisation of the argon triple point, with automated pressure control and reliable plateau performance — without the cost, complexity or risks associated with traditional systems.



What is the Argon Triple Point?

The argon triple point (−189.3442 °C) is a defining fixed point on the ITS-90 temperature scale, representing the precise temperature at which argon coexists in solid, liquid, and gas phases under equilibrium.

Used primarily in calibrating Standard Platinum Resistance Thermometers (SPRTs). It is especially valuable in national metrology institutes and accredited calibration centres where the lowest uncertainties are required.

Technical Feature	Value
Model	471
Temperature Range	-189.3442°C
Plateau Duration	4 Hours
Uncertainty (Calibration Options: k=2)	±0.8mK
Dimensions	Width - 380mm Depth - 615mm Height - 1500mm

For More Data and the Latest Information:
www.isotech.co.uk/argon

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

Comparison of 160 Isotech UKAS Certified Cells to CCT/2000-13

	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	0.20
H_2O	0.07
Ga	0.07
In	0.40
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)*

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 may be 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.

UKAS Calibration Service for SPRTs

SPRT Calibration with ITS-90 Fixed Points: Premium Service
ISOTECH UKAS Calibration Uncertainties (*k*=2)

Suitable only for Isotech 670SQ Models or other Primary Standard SPRTS of similar stability

Fixed Point	°C	Range 1	Range 2	Range 3	Range 4	Range 5	Range 6	Range 7[1]
				Typical Uncertainties ±				
TP Argon [2]	-189.3442	0.5mK		0.5mK	0.5mK	0.5mK	0.5mK	
TP Mercury	-38.8344	0.3mK	0.3mK	0.3mK	0.3mK	0.3mK	0.3mK	
TP Water	0.01	0.1mK	0.1mK	0.1mK	0.1mK	0.1mK	0.1mK	0.2mK
MP Gallium	29.7646		0.2mK					
FP Indium	156.5985			1mK	1mK			
FP Tin	231.928				1mK	1mK	1mK	1mK
FP Zinc	419.527					1.2mK	1.2mK	1.2mK
FP Aluminium	660.323						2mK	2mK
FP Silver	961.78							7mK

SPRT Calibration with ITS-90 Fixed Points: Standard Service
ISOTECH UKAS Calibration Uncertainties (*k*=2)

Suitable for Primary and Working SPRTS - Isotech 670 & 909 families and other SPRTS of similar stability

FIXED POINT Fixed Point	°C	Range 1	Range 2	Range 3	Range 4	Range 5	Range 6	Range 7[1]
				Typical Uncertainties ±				
BP Nitrogen	-195.798	5mK		5mK	5mK	5mK	5mK	
TP Mercury	-38.8344	1mK	1mK	1mK	1mK	1mK	1mK	
TP Water	0.01	0.5mK	0.5mK	0.5mK	0.5mK	0.5mK	0.5mK	1mK
MP Gallium	29.7646		1mK					
FP Indium	156.5985			2mK	2mK			
FP Tin	231.928				2.5mK	2.5mK	2.5mK	2.5mK
FP Zinc	419.527					3mK	3mK	3mK
FP Aluminium	660.323						6mK	6mK
FP Silver	961.78							10mK

Note 1: Model 96178 or other HTSPRTS of similar stability

Note 2: Alternatively in place of TP Argon the BP Nitrogen point can be used, the uncertainty increases to 2mK for Ranges 1, 3, 4, 5 & 6

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

The latest schedule can be found on the Isotech website or at www.ukas.org.

0175



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 ±0.07mK at 0.01°C to ±2mK at 961.78°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	+/-0.20mK	+/-1mK
Gallium	+/-0.07mK	+/-1mK
Indium	+/-0.40mK	+/-2mK
Tin	+/-0.60mK	+/-2mK
Zinc	+/-0.90mK	+/-2mK
Aluminium	+/-1.1mK	+/-6mK
Silver	+/-2mK	+/-10mK

The latest schedule can be found on the Isotech website or at www.ukas.org.

UKAS CALIBRATION
0175

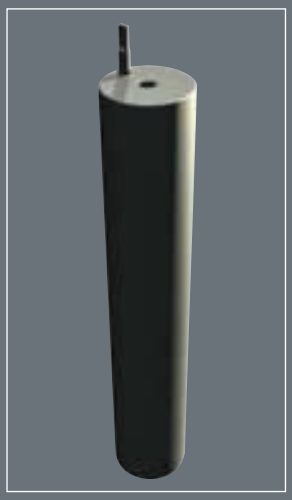
Available Types

Cells		Uncertainty	Sealed Cells		Open Cells	
			Metal Clad	Quartz Clad	Metal Clad	Quartz Clad
Indium	156.5985°C	+/-0.40mk	17668MO	17668	17668MCO	17668QCO
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.

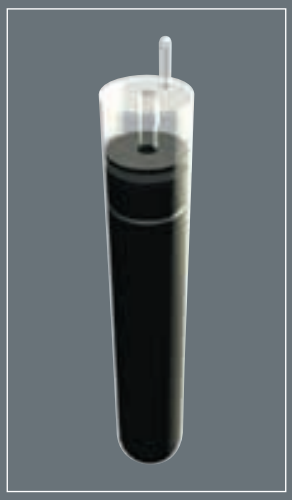
Isotech cells are of the highest purity available. Open cells conform to CCT/2000-13. Sealed cells are sealed to one atmosphere with 6N pure argon at the freeze temperature.

Sealed Metal



- Convenience
- Protected Against Contamination and Ambient Pressure Effects
- Easily Transportable Between Labs
- Robust

Sealed Quartz



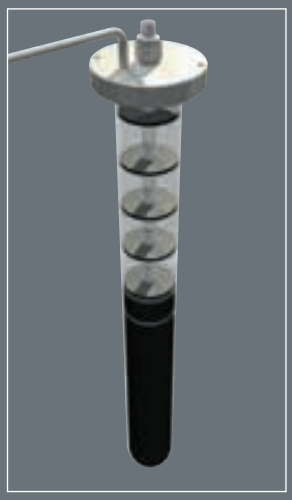
- Convenience
- Protected Against Contamination and Ambient Pressure Effects

Resealable Metal



- Pressure can be set by user
- Requires vacuum and gas flow system
- Easily Transportable Between Labs
- Robust
- Thermally Closer to ITS-90 temperature
- Sealed Construction with open port for gas supply

Open Quartz



- Pressure can be set by user
- Requires vacuum and gas flow system
- Transportable Between Labs
- Can be disassembled

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

Nominal Dimensions

Sealed Metal		Sealed Quartz		Resealable Metal		Open Quartz	
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 - 460 or 520mm Al - 480, 520 or 620mm Ag, Cu - 520 or 620mm
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 17025:2017. 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**



CERTIFICATE OF CALIBRATION

ISSUED BY: ISOTHERMAL TECHNOLOGY LIMITED.

DATE OF ISSUE:

CERTIFICATE NO:

ISOTECH

Page 1 of 5

Approved Signatory
Name:
Signature:

CUSTOMER:

CUSTOMER ORDER: ITL REFERENCE:

DESCRIPTION: Isotech Model 17401 Optimal Gallium Fixed Point Cell.

IDENTIFICATION: Ga XXX

DATE OF CALIBRATION: From 23rd September 2024 to 27th September 2024.

BASIS OF CALIBRATION: The cell has been inter-compared to one of the Laboratory Reference cells. The temperature scale in use in this Laboratory is the International Temperature Scale of 1990 (ITS-90). This laboratory is accredited in accordance with the recognised International Standard ISO/IEC 17025 2017. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer joint ISO-ILAC-IAF Communique). The Joint Communique is available on the ILAC website at www.ilac.org on the publications and resources page.

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 requirements 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 heat-pipe 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.

Heatpipe Furnaces

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

The length of the cell plateau is dictated mainly by how close the set point of the apparatus is to the fixed point being realized.

The controller resolution of our furnaces allow plateau lengths at the silver point of over 70 hours. From a practical point we operate with plateaus that last an entire day, remelting the cell overnight ready for a new freeze the next day.



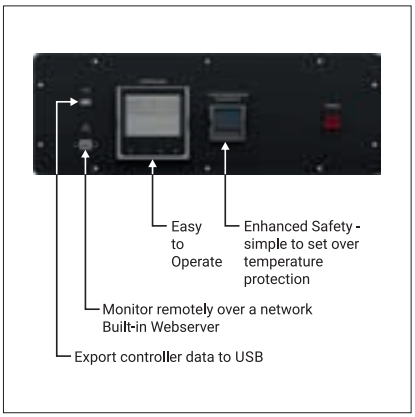
Isotech ITS-90 Fixed Point System have been in use around the world since 1990.

Re-Designed for Convenience

From our own ongoing experience and customer feedback, we have updated the Isotech Furnace Range to deliver the same proven performance and advanced features but with a number of convenience upgrades to make your life easier.

1 Repositioned Controllers

With the most featured and up to date controllers we have repositioned them to make them easier to view.



2 Thermometer Stand Included

Metrologists realise how important it is to safely support SPRTs, especially so at high temperatures.

Our furnaces includes a fully adjustable support to hold your SPRTs.



3 Adjustable Accessories

Our furnaces now feature and include “Accessory Pods” and “Cable Tidies”

Avoid the clutter on top of furnaces and tidy SPRT cables to reduce the risk of a cable getting pulled or caught. Each furnace includes two Accessory Pods and two Cable Tidies (they can be positioned anywhere the user sees fit by way of multi point mountings on either side of the furnace).





Why Isotech Furnaces?

- Isothermal Environments for Long Plateaus
- Safe Convenient Operation
- Four Decades of Proven Operation



Heatpipe Furnaces

Isotech Metrology Furnaces have been in use in world leading National Measurement Institutes, (NMI) since the late 1980's with the widest range of heatpipes covering Indium freeze point (156.5985°C) to Copper freeze point (1084.62°C). Many nations rely on Isotech technology to provide their national standards for temperature.

Dual Furnaces

The no compromise approach, Realise Fixed Points and Maintain Thermometers.
Two furnaces in one, as well as the heatpipe to realise the fixed points there is a separate furnace for annealing SPRTs. A further innovation from Isotech.

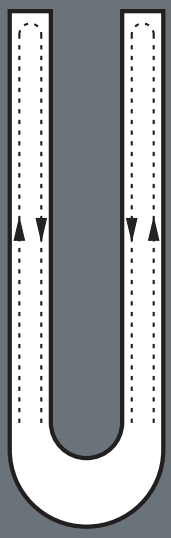
Three Zone Furnaces

Heatpipes provide best performance and operation but have limited temperature ranges, our Three Zone Furnaces have wider temperature ranges and are more cost effective. We use guard heaters at the top and bottom to minimise gradients. Our control systems offer enhanced performance and flexibility.

Why Heatpipes?

" A heatpipe is a self-contained structure which achieves very high thermal conductance by means of two-phase fluid flow with capillary circulation "

- Lower portion of the heatpipe is heated
- Liquid turns to a vapour and travels up the heatpipe
- Vapour condenses and travels down the heatpipe
- Latent heat created a volume of very uniform temperature, radially and axially
- Ideal conditions to realise ITS-90 Fixed Points



TEMPERATURE CONTROL SYSTEMS

Isotech furnaces have the most sophisticated Temperature Control Systems.

In 2016 we updated the control systems to the latest technology with crystal clear colour displays. Advanced gain scheduling that automatically optimizes the stability at each fixed point temperature. Save time with the included programmer - set the furnace to melt or freeze the cells at specific times. An eight point correction curve ensures high accuracy across the fixed point temperatures. Connect via ethernet to allow multiple furnaces to be monitored - export heat up and cool down times to a USB Drive.





- Crystal clear, easy to read display



- Optimise stability and accuracy at each fixed point



- Automatic temperature stepping



- Export to USB



- Remote control and monitoring over a network



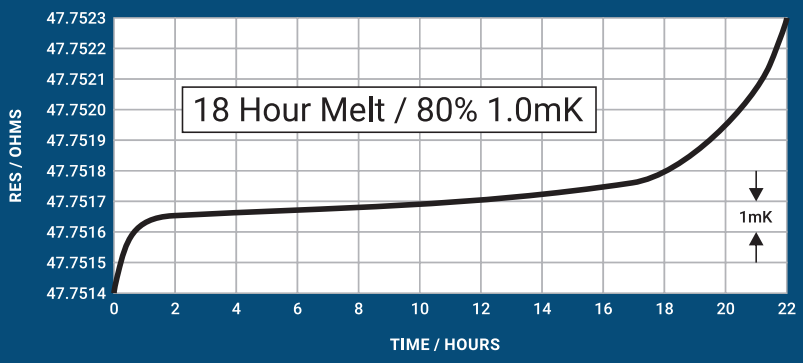
Isotech Furnaces for Optimal Plateaus

Why it matters...

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 a 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.

Long Plateau - Plateau lengths at the silver point of over 70 hours have been achieved using our furnaces



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, re-melting the cell overnight ready for a new freeze the next day.

Isotech for...

- **Heatpipes operating from 150°C to 1100°C to suit Indium to Copper Cells**
- **'Dual' combined Annealing and Fixed Point Furnaces**
- **Ethernet Built in Temperature Programmer**

The world's leading National Metrology Institutes choose Isotech...
Shouldn't you?



Furnaces
Dual



- Essentially Gradient Free
- Heatpipe Operation from Indium to Copper
- Simple Use - no zone offsets to adjust

Isotech metrology furnaces have more than 35 years of proven use and are widely used by the worlds' leading NMIs. For the optimal use of fixed point cells the temperature uniformity should be less than 10mK over the length of the fixed point sample CCT/2000-13, "Optimal Realization of the Defining Points of the ITS-90..."

Isotech heatpipe furnaces offer essentially gradient free operation; heatpipes provide the ideal conditions for the creation and maintenance of ITS-90 fixed point cells. Unlike some other companies Isotech can provide heatpipe furnaces to suit Indium, Tin, Zinc, Aluminum, Silver and Copper fixed points.

Plateau length is determined by the difference in temperature between the heatpipe and cell - this can be adjusted to give a plateau of any length of up to tens of hours. Our controllers offer extra resolution and allow adjustment to 0.1°C right up to 1090°C. 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.

A pre-warming tube with a temperature approximately equal to that of the heatpipe made of a unique and gas-tight material, is provided to heat the SPRT prior to it being placed in a cell.

The furnaces feature an adjustable independent and adjustable over temperature device to protect expensive cells and SPRTs as well as a second internal over temperature safety device.

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

There is also a separate storage enclosure for up to four thermometers with adequate support for the thermometer head.

With the Dual Furnace the thermometers are removed from their storage enclosure and placed in the preconditioning 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 when the thermometer can safely be removed into room temperature.

Isotech Dual Furnaces

Model	Temperature Range	Heatpipe Type	Cells
17707	125°C to 250°C	Water	Indium Tin
17706	400°C to 1000°C	Potassium	Zinc Aluminium Silver
17705	500°C to 1100°C	Sodium	Aluminium Silver Copper

Accessories

Accessories include equalizing blocks, a fan assembly to keep thermometer handles cool and a thermometer holder. With an equalizing block it is possible to use the furnace for comparison calibration.

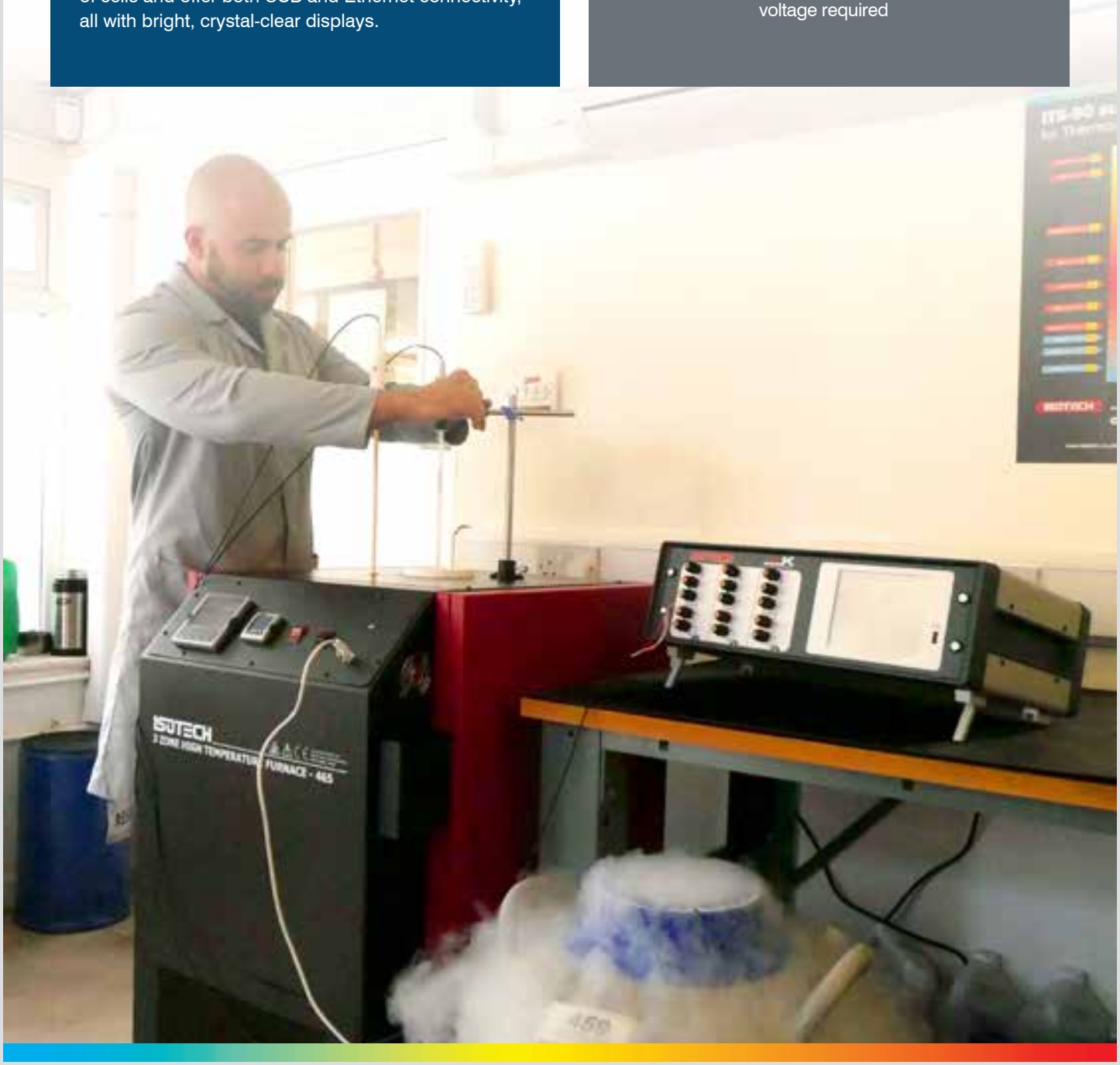
Enhanced Furnace Design

Developed with user feedback and hands-on experience, the Isotech Furnace Range combines trusted performance with a range of practical features designed to improve usability.

Controllers are positioned at the top for easier access, an SPRT Stand is included for secure thermometer support, and Cable Tides and Accessory Pods help maintain a tidy, efficient workspace. The furnaces are programmable to automate the melting and freezing of cells and offer both USB and Ethernet connectivity, all with bright, crystal-clear displays.

Specification

Uncertainty	<1mk (with cells)
Uniformity	<10mk over length of fixed point sample
Control	0.1°C Resolution: Gain Scheduling Action and Power Feedback
Interfaces	Ethernet and USB Host
Core Size	52 x 432mm
Dimensions	Height - 960mm Width - 600mm Depth - 560mm
Weight	119kg
How to order	Please specify model and voltage required





Furnaces
Heatpipe



- Essentially Gradient Free
- Heatpipe Operation from Indium to Copper
- Simple Use - no zone offsets to adjust

Isotech metrology furnaces have more than 35 years of proven use and are widely used by the worlds' leading NMIs. For the optimal use of fixed point cells the temperature uniformity should be less than 10mK over the length of the fixed point sample CCT/2000-13, "Optimal Realization of the Defining Points of the ITS-90..."

Isotech heatpipe furnaces offer essentially gradient free operation; heatpipes provide the ideal conditions for the creation and maintenance of ITS-90 fixed point cells. Unlike some other companies Isotech can provide heatpipe furnaces to suit Indium, Tin, Zinc, Aluminum, Silver and Copper fixed points.

Plateau length is determined by the difference in temperature between the heatpipe and cell - this can be adjusted to give a plateau of any length of up to tens of hours. Our controllers offer extra resolution and allow adjustment to 0.1°C right up to 1090°C. 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.

A pre warming tube with a temperature approximately equal to that of the heatpipe made of a unique and gas-tight material, is provided to heat the SPRT prior to it being placed in a cell.

The furnaces feature an adjustable independent and adjustable over temperature device to protect expensive cells and SPRTs as well as a second internal over temperature safety device.



Isotech Heatpipe Furnaces

Model	Temperature Range	Heatpipe Type	Cells
17702W	125°C to 250°C	Water	Indium Tin
17702P	400°C to 1000°C	Potassium	Zinc Aluminium Silver
17702S	500°C to 1100°C	Sodium	Aluminium Silver Copper

Accessories

Accessories include equalizing blocks, a fan assembly to keep thermometer handles cool and a thermometer holder. With an equalizing block it is possible to use the furnace for comparison calibration.

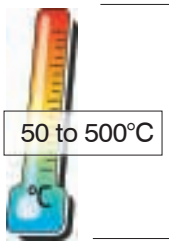


Specification	
Uncertainty	<1mk (with cells)
Uniformity	<10mk over length of fixed point sample
Control	0.1°C Resolution: Gain Scheduling Action and Power Feedback
Interfaces	Ethernet and USB Host
Core Size	52 x 432mm
Dimensions	Height - 960mm Width - 600mm Depth - 560mm
Weight	115kg
How to order	Please specify model and voltage required

Enhanced Furnace Design

Developed with user feedback and hands-on experience, the Isotech Furnace Range combines trusted performance with a range of practical features designed to improve usability.

Controllers are positioned at the top for easier access, an SPRT Stand is included for secure thermometer support, and Cable Tides and Accessory Pods help maintain a tidy, efficient workspace. The furnaces are programmable to automate the melting and freezing of cells and offer both USB and Ethernet connectivity, all with bright, crystal-clear displays.



Furnaces
Low Temperature



- Affordable Single Zone Furnace
- Simple Operation
- For Indium, Tin and Zinc Cells

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 plateau, essentially automatically, for a period of 10 to 12 hours.

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.

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.

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



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

Enhanced Furnace Design

Developed with user feedback and hands-on experience, the Isotech Furnace Range combines trusted performance with a range of practical features designed to improve usability.

Controllers are positioned at the top for easier access, an SPRT Stand is included for secure thermometer support, and Cable Tides and Accessory Pods help maintain a tidy, efficient workspace. The furnaces are programmable to automate the melting and freezing of cells and offer both USB and Ethernet connectivity, all with bright, crystal-clear displays.

Specification

Model	ITL-M-17701
Temperature Range	50°C to 500°C
Uncertainty	< 1mK (with cells)
Control	0.1°C Resolution, Gain Scheduling Action and Power Feedback
Interfaces	Ethernet and USB Host
Core Size	54.7mm x 420mm
Dimensions	Height - 960mm Width - 600mm Depth - 690mm
Weight	115kg
Power	1.5kW, 108-130 or 208-240Vac, 50/60Hz
Accessories	411-01-11 Annealing Adaptor 824-01-00 Fan Assembly
How to order	ITL-M-17701 Please specify voltage required



Furnaces
Medium Temperature



- Wide Operating Range
- For Indium, Tin, Zinc and Aluminium Cells
- Three Zone Design

Whilst heatpipe furnaces offer the ideal environment to melt and freeze ITS-90 Fixed Points the temperature range is limited by fluid that flows inside the pipe. Three zone furnaces can offer wider operating ranges and still meet the requirements for "Optimal Realization of the Defining Points of the ITS-90..." CCT/2000-13. In place of a heatpipe the Model 17703 Medium Temperature furnace uses top and bottom guard heaters to minimise temperature gradients.

The Model 17703 Furnace can be used with Indium, Tin, Zinc and Aluminium Cells. The substantial furnace core is machined from aluminium bronze.



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

Enhanced Furnace Design

Developed with user feedback and hands-on experience, the Isotech Furnace Range combines trusted performance with a range of practical features designed to improve usability.

Controllers are positioned at the top for easier access, an SPRT Stand is included for secure thermometer support, and Cable Tides and Accessory Pods help maintain a tidy, efficient workspace. The furnaces are programmable to automate the melting and freezing of cells and offer both USB and Ethernet connectivity, all with bright, crystal-clear displays.

Specification

Model	ITL-M-17703
Temperature Range	50°C to 700°C
Uncertainty	< 1mK (with cells)
Control	0.1°C Resolution, Gain Scheduling Action and Power Feedback
Interfaces	Ethernet and USB Host
Core Size	54.7mm x 420mm
Dimensions	Height - 960mm Width - 600mm Depth - 690mm
Weight	115kg
Power	2.6kW, 108-130 or 208-240Vac, 50/60Hz
Accessories	420-02-18 Aluminium Bronze Equalising Block 824-01-00 Fan Assembly 411-01-11B Annealing Adaptor
How to order	ITL-M-17703 Please specify voltage required



Furnaces
3 Zone High Temperature



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

Whilst heatpipe furnaces offer the ideal environment to melt and freeze ITS-90 Fixed Points the temperature range is limited by fluid that flows inside the pipe. Three zone furnaces can offer wider operating ranges and still meet the requirements for "Optimal Realization of the Defining Points of the ITS-90..." CCT/2000-13. In place of a heatpipe the Model 465 3 Zone High Temperature Furnace uses top and bottom guard heaters to minimise temperature gradients.

This more recent addition to our long-established range of metrology furnaces offers an alternative for those who prefer three zone furnaces to heatpipe technology and need high temperature operation. The three zones create a controlled volume of constant temperature within the furnace in which High Temperature Fixed Points such as Aluminium, Silver and Copper can be frozen and melted. Because High Temperature thermometers can be easily contaminated by metallic vapours, great care has been taken to eliminate the use of metals throughout the calibration volume.

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.

This 3 Zone Furnace can be used for the realizations of Zinc, Aluminium, 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 performace 3 zones controlled to compensate for end loss to give a perfect profile

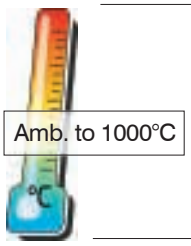
Enhanced Furnace Design

Developed with user feedback and hands-on experience, the Isotech Furnace Range combines trusted performance with a range of practical features designed to improve usability.

Controllers are positioned at the top for easier access, an SPRT Stand is included for secure thermometer support, and Cable Tides and Accessory Pods help maintain a tidy, efficient workspace. The furnaces are programmable to automate the melting and freezing of cells and offer both USB and Ethernet connectivity, all with bright, crystal-clear displays.

Specification

Model	465
Temperature Range	250°C to 1200°C
Uncertainty	< 1to 2mK (with cells)
Control	0.1°C Resolution, Gain Scheduling Action and Power Feedback
Interfaces	Ethernet and USB Host
Core Size	100mm x 500mm
Dimensions	Height - 960mm Width - 600mm Depth - 690mm
Weight	115kg
Power	3kW, 108-130 or 208-240Vac, 50/60Hz
Accessories	465-04-00 Cell holder assembly 465-02-06 ceramic equalising block Four pockets 10mm ID
How to order	465 Please specify voltage required



Furnaces
Annealing



- Designed to pre-warm and anneal Standard Platinum Resistance Thermometers
- Maintenance Free Use
- Automatic Temperature Cycling

The Annealing Furnace, model 414, is designed to heat, anneal and cool Standard Platinum Resistance Thermometers (SPRTs) 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 over the SPRTs being annealed. A comprehensive handbook accompanies the Furnace.

The furnace has been upgraded to benefit from the latest technology. Fitted with a crystal clear colour display the furnace is now fully programmable. Programs can be created for the cycling of SPRTs - with the ability to set the dwell time at the annealing temperature and heat up and cool down rates along with the number of temperature cycles. Multiple programs can be stored - each with up to 25 segments. The furnace heat up cool down history is logged and can be exported to a USB drive. The PID control parameters are now dynamically optimised at different temperatures optimizing furnace stability.

This Furnace is installed easily and requires no maintenance.

Model	414
Temperature Range	Ambient to 1000°C
Control	0.1°C Resolution. Gain Scheduling Action and Power Feedback
Furnace Depth	450mm
Diameter	50mm
Interfaces	Ethernet and USB Host
Power	110Vac 50/60Hz 2kW or 230Vac 50/60Hz 2kW
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:

$W(29{,}7646°C) \geq 1{,}118\ 07$ (8a)

$W(-38{,}8344°C) \leq 0{,}844\ 235$ (8b)

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

$W(961{,}78°C) \geq 4{,}2844$ (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 Ro to ITS-90.

The **909L** works from -200°C to 165°C and also is available with Ro 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 935 series of semi-standard PRTs.
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

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.

NPL Platinum / Palladium Thermocouple

This model manufactured by the National Physical Laboratory (NPL) was developed to operate reliably and accurately to 1500°C and offers superior stability to conventional platinum / platinum rhodium thermocouples. They now can be purchased from Isotech.

http://www.isotech.co.uk

SPRT Uncertainties - Refer to page 19 for details of calibration uncertainties



Primary SPRT
670 Family



Super Stable Standard Platinum Resistance Thermometer

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

The 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 SPRT result in exceptional performance. 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 Wga are routinely provided with the 670SQ.

The 670SQ can be supplied with R_{TPW} and Wga 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 is 1mA for the 25.5Ω (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, and has superior 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.

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

How to Order

Model 670SQ, 670SH, 670SL / 25.5

State “with UKAS Calibration” or “without UKAS Calibration”.

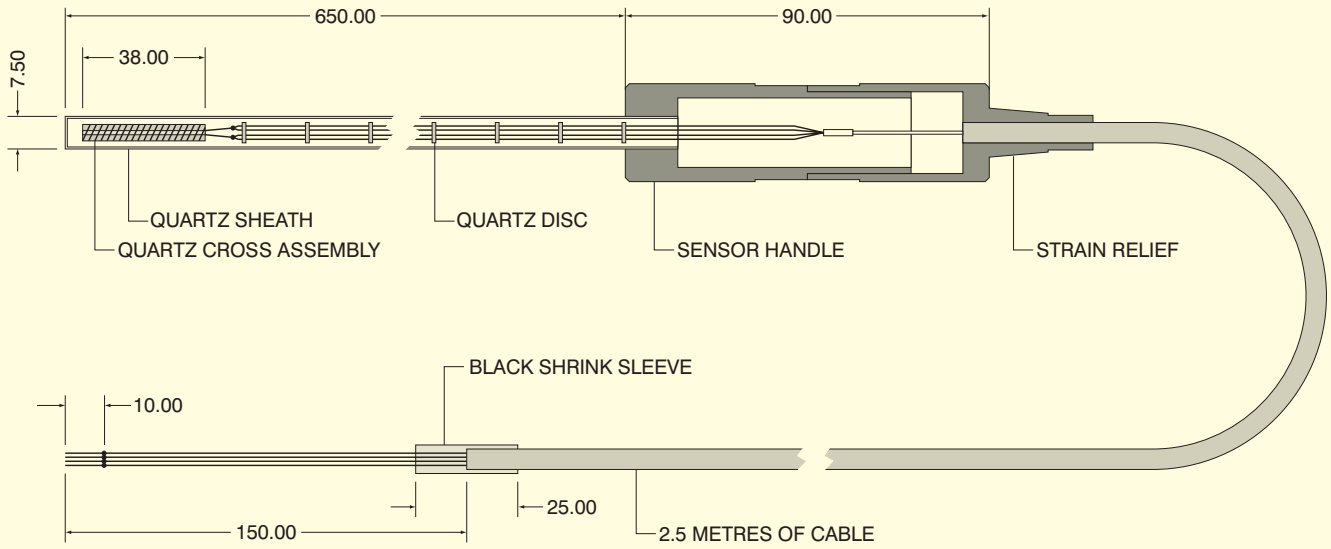
Whilst metal sheathed thermometers appear more robust than the quartz glass models it should be noted that ALL SPRTs are fragile devices and must be handled with care. Quartz glass thermometers have the advantage that the internal components are visible and can be inspected and continue to be our recommended 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
670SH	-80 to 670	25.5	Metal	6mm	650mm or 480mm	35mm	Metal sheathed high temperature model
670SL	-200 to 165	25.5	Metal	6mm	480mm	35mm	Metal sheathed low temperature model

SPRT Calibration with ITS-90 Fixed Points: Premium Service
ISOTECH UKAS Calibration Uncertainties (*k*=2)

Suitable only for Isotech 670SQ Models or other Primary Standard SPRTS of similar stability

Fixed Point	°C	Range 1	Range 2	Range 3	Range 4	Range 5	Range 6
				Typical Uncertainties ±			
TP Argon [1]	-189.3442	0.5mK		0.5mK	0.5mK	0.5mK	0.5mK
TP Mercury	-38.8344	0.3mK	0.3mK	0.3mK	0.3mK	0.3mK	0.3mK
TP Water	0.01	0.1mK	0.1mK	0.1mK	0.1mK	0.1mK	0.1mK
MP Gallium	29.7646		0.2mK				
FP Indium	156.5985			1mK	1mK		
FP Tin	231.928				1mK	1mK	1mK
FP Zinc	419.527					1.2mK	1.2mK
FP Aluminium	660.323						2mK

Note 1: Alternatively in place of TP Argon the BP Nitrogen point can be used, the uncertainty increases to 2mK for Ranges 1, 3, 4, 5 & 6

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

Table shows Premium Calibration Service, Standard Service is also available, see page 19.





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	Ro = 0.25Ω (others to special request)
Resistance Ratio	Wga>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?

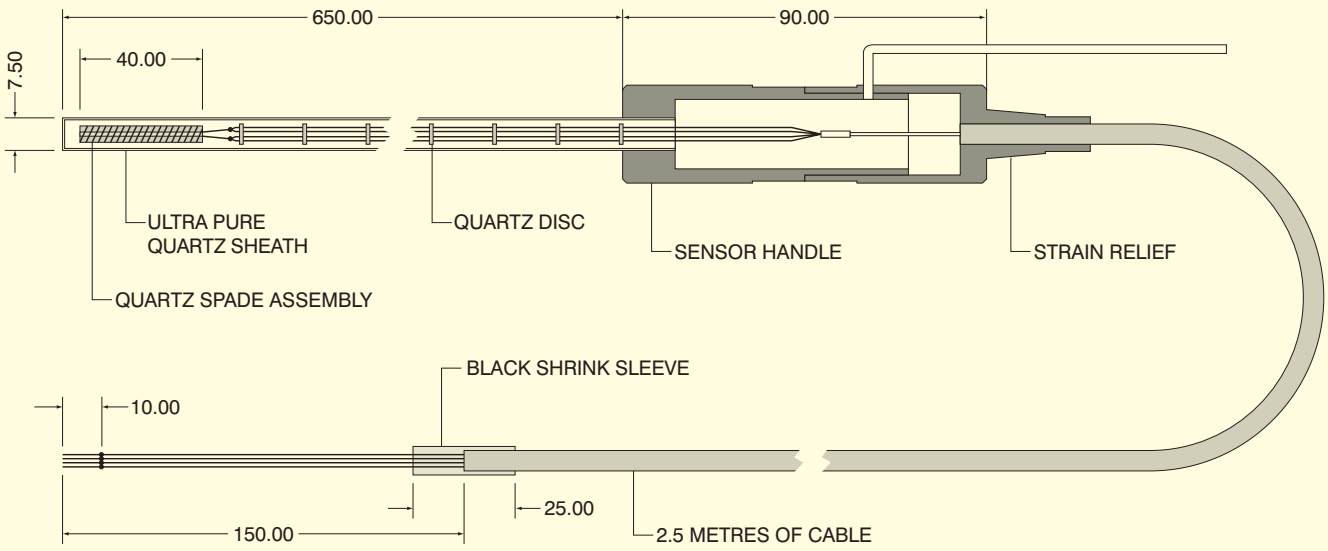
Note1: It is necessary to make the former on which the platinum is wound of high-purity quartz. Even quartz does not provide absolute isolation at the high temperature end of the range. The former, or mandrel, is thus a shunt resistance across the platinum winding, and because of the uncertainty of the 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.

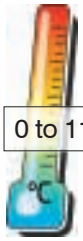
Note2: Gases, like Iron, Chromium, Nickel under reducing conditions, can penetrate the quartz sheath and poison the platinum.

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.





Copper Point SPRT
Model 108462

- Novel Design
- Sapphire Mandrel
- Pressurized Sheath



The ITS-90 specifies the SPRT to the freezing point of silver, 961.78°C. Thermocouples can be used beyond this temperature but it is difficult to see small changes in temperature. For a Type R thermocouple the voltage sensitivity at the copper point is 14μV/°C; a change of 1 μV is equivalent to a voltage change of 71mK. When using thermocouples electrical noise limits the ability to follow small changes in the copper freezing plateau and so attention was turned to the development of a new resistance thermometer allowing better measurements to be made.

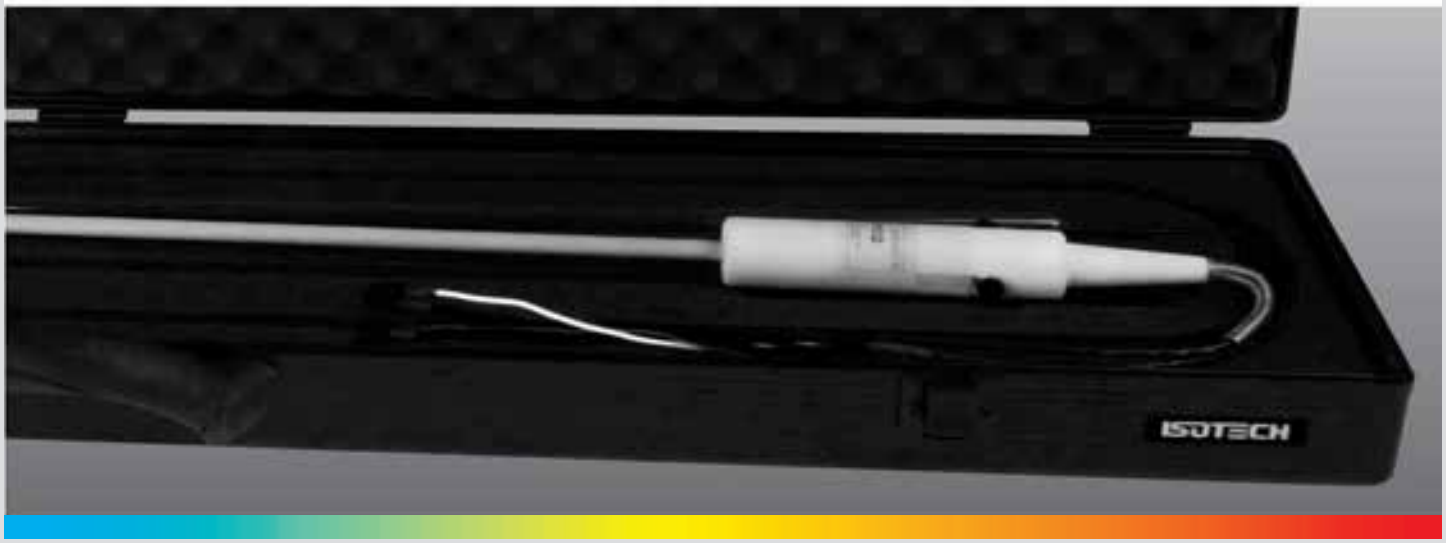
Isotech has a long history of making SPRTs to the Silver point (Model 96178) and this experience was combined with new research to produce the new copper point SPRT (Model 108462).

Ro is nominally 0.25Ω the same as the silver point SPRT but the platinum winding is held in place on a new type of synthetic sapphire mandrel. The platinum 'loves' oxidising but 'hates' reducing atmospheres. The thermometer sheath is made of alumina. It is air filled and hence surrounded by 20% oxygen. Uniquely the sheath is connected to a small air pump to pressurise the 108462 with air so that any leakage is outwards, whilst maintaining an oxygen rich atmosphere around the winding. This is what gives the thermometer its stability.

The four platinum lead wires are separated with tubes of quartz glass and passed through four bores. In use the winding is biased to +9V DC with the included ioniser.

Following around 30 years of research, with earlier results formally presented at TEMPMEKO & ISHM 2010 and at the 9th International Temperature Symposium (ITS9) Isotech have commercialised the design to allow other researchers to benefit from the technology and novel design.

http://www.isotech.co.uk



Specification

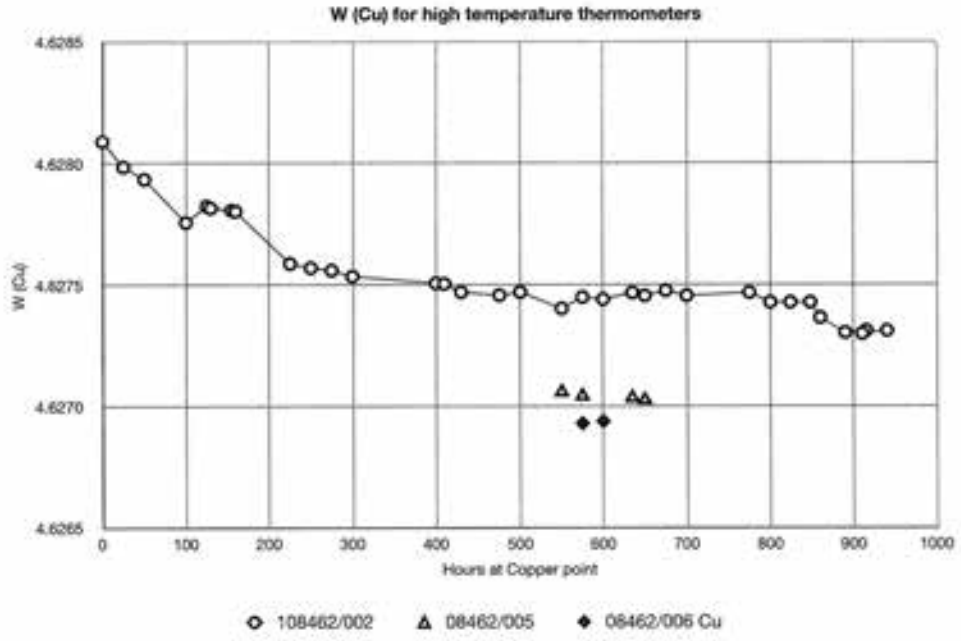
Model	**108462**
Measuring Range	0°C to 1100°C
Ro	0.25Ω
Length	650mm
Diameter	7.5mm

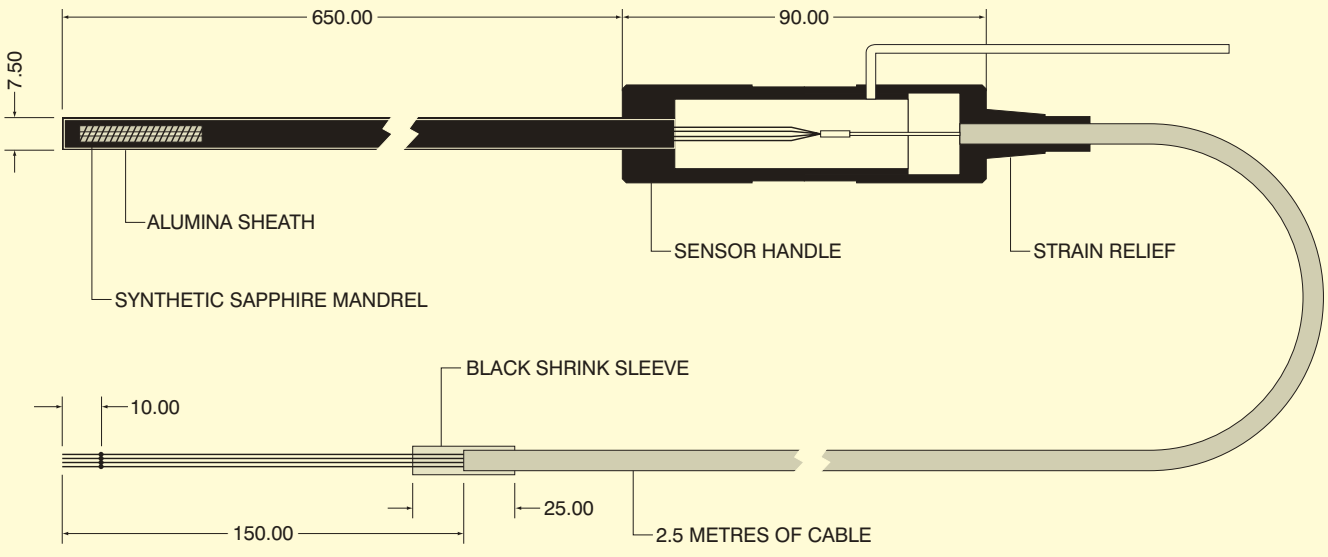
Performance

These devices are offered as research thermometers and the performance is described in the paper available on the Isotech website.

"Investigations into the performance of copper point standard resistance thermometer"

J.P. Tavener







Working SPRTs
909 Family



- 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 Wga. 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.

Model	909	
R_{TPW}	25.5Ω	100Ω
Nominal Resistance	25.5Ω at 0°C	100Ω
Recommended Max. Current mA	1	0.5
Nominal Sensitivity	0.1 Ω/°C	0.4 Ω/°C
Resistance Ratio	Wga>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.

SPRT Calibration with ITS-90 Fixed Points: Standard Service
ISOTECH UKAS Calibration Uncertainties (*k*=2)

Suitable for Primary and Working SPRTS - Isotech 670 & 909 families and other SPRTS of similar stability

FIXED POINT **Fixed Point**	°C	Range 1	Range 2	Range 3	Range 4	Range 5	Range 6
				Typical Uncertainties ±			
BP Nitrogen	-195.798	5mK		5mK	5mK	5mK	5mK
TP Mercury	-38.8344	1mK	1mK	1mK	1mK	1mK	1mK
TP Water	0.01	0.5mK	0.5mK	0.5mK	0.5mK	0.5mK	0.5mK
MP Gallium	29.7646		1mK				
FP Indium	156.5985			2mK	2mK		
FP Tin	231.928				2.5mK	2.5mK	2.5mK
FP Zinc	419.527					3mK	3mK
FP Aluminium	660.323						6mK

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 6. Please contact Isotech if calibration is required above Zinc.

The latest schedule can be found on the Isotech website or at www.ukas.org.

0175

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

Introduction to Standard Thermocouples

■ Thermocouples

Isotech 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.

Isotech Gold / Platinum Thermocouple
This model offers smaller uncertainties than Type R or S using only pure metals in the construction and can be considered as an alternative to HTSPRTs.

NPL Platinum / Palladium Thermocouple
This model manufactured by the National Physical Laboratory (NPL) was developed to operate reliably and accurately to 1500°C and offers superior stability to conventional platinum / platinum rhodium thermocouples. They now can be purchased from Isotech, with NPL calibration (UKAS) with an uncertainty of ±0.2°C, from 0°C to 1100°C rising linearly to ±0.55°C at 1330°C or ±0.7°C at 1500°C.

Fixed Point Calibration at the National Physical Laboratory (NPL)

NPL National Physical Laboratory

For lower uncertainty calibration Isotech can supply the Model 1600 with ISO 17025 (UKAS) accredited fixed point calibration up to 1330°C or even 1500°C benefiting from NPL's newly developed high temperature metal-carbon eutectic fixed points. The uncertainty is then ±0.3°C to 1100°C rising to ±0.55°C at 1330°C or ±0.7°C at 1492°C. The fixed points used are Zinc, Silver and the eutectic point of either Cobalt-Carbon or Palladium-Carbon alloys.

The Platinum/Gold Thermocouple can be supplied calibrated with uncertainties of ±0.07°C from 0°C to 400°C and ±0.05°C from 400°C to 1000°C using the fixed points of Zinc, Aluminium and Silver.

These calibrations are performed by NPL who established the world-first ISO 17025 (UKAS) accredited calibration services using metal-carbon eutectic fixed-point cells.

www.npl.co.uk/temperature-humidity

■ Calibration Options

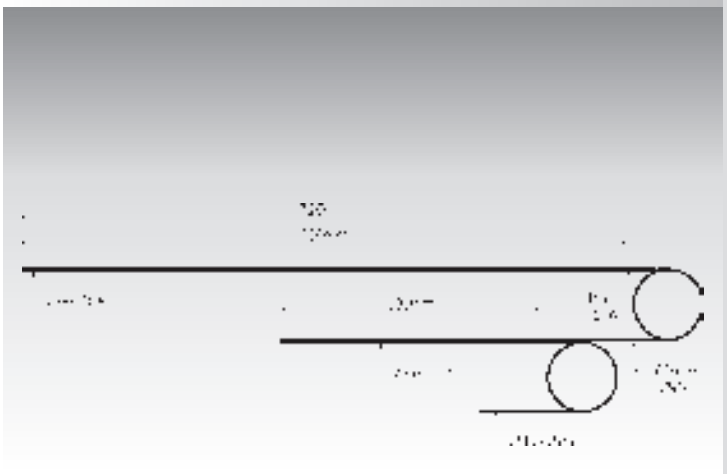
Comparison Calibration
The Model 1600 includes UKAS calibration to 1100°C, with options to extend this to 1200°C or 1300°C. The thermocouples are calibrated using comparison techniques in the Isotech 877 Furnace. Uncertainties for models with a cold junction (recommended) are ±0.7°C to 1100°C.



http://www.isotech.co.uk



Thermocouple Standards
Platinum / Palladium



- Superior stability to Platinum / Platinum Rhodium
- Very Low Uncertainties
- Use to 1500°C

These Platinum / Palladium Thermocouples (Pt/Pd) are manufactured by the National Physical Laboratory (NPL) who have developed a novel physical mechanism which mitigates the mechanical stresses caused by the different thermal expansion of Pt and Pd wires. This dispenses with the fragile coil conventionally used with this type of thermocouple.

Platinum / Palladium thermocouples are more costly than Platinum / Platinum Rhodium types but benefit from superior performance, both in terms of stability (less de-calibration) and accuracy.

Gold / Platinum Thermocouples (Au/Pt) offer the best performance but are limited to a maximum temperature of 1000°C.

These Pt/Pd thermocouples offer lower drift than Platinum / Platinum Rhodium (Pt/Pt-Rh)and with higher operating temperatures than Au/Pt. They are suitable for a range of applications including transfer standards.

In addition to developing the novel structural design along with new annealing and construction procedures NPL have established the world's first ISO 17025 (UKAS) accredited calibration services using metal-carbon eutectic fixed point cells.

We are pleased to be able to offer the NPL Pt/Pd thermocouple with calibration alongside our own Pt/Pt-Rh and Au/Pt Standards.

Temperature Range	0 to 1500°C
Sheath Materials Measuring Junction	4mm x 710mm, fits into a removable 7mm x 700 mm protective outer ceramic sheath
Reference Junction	Enclosed in a Quartz Sheath
Applicable Standard	IEC 62460 Edition 1.0

How To Order

Model Type: NPL Pt/Pd Thermocouple

Includes UKAS Calibration, specify range from either:

0°C to 1100°C Uncertainty of ±0.2°C
Calibrated at Fixed Points Zn, Ag and Cu

0°C to 1330°C Uncertainty of ±0.2°C from 0°C to 1100°C rising linearly to ±0.55°C at 1330°C
Calibrated at Fixed Points Zn, Ag and Co-C

0°C to 1500°C Uncertainty of ±0.2°C from 0°C to 1100°C rising linearly to ±0.7°C at 1500°C
Calibrated at Fixed Points Zn, Ag and Pd-C



Thermocouple Standards
Platinum / Platinum Rhodium

- Premium-grade noble metal wire, thermally aged for stability
- Gas-tight alumina sheath for contamination resistance
- Removable inner assembly for flexibility and ease of maintenance

Isotech Model 1600 Platinum/Platinum-Rhodium Thermocouple

High-Accuracy Reference Thermocouple for Calibration Labs and High-Temperature Applications

The Isotech Model 1600 is a premium Type R or Type S thermocouple standard, designed for calibration laboratories and high-temperature environments up to 1600 °C. It is ideal for laboratories calibrating with compliance to AMS 2750 and ASTM E2750, including aerospace, automotive, and energy sectors.

Manufactured using ultra-high purity Platinum/Platinum-Rhodium wire (Pt/13%Rh for Type R, Pt/10%Rh for Type S), the Model 1600 ensures excellent long-term stability and low drift. A continuous noble metal conductor runs from the hot junction to the cold junction with no intermediate splices, preserving measurement integrity.

The measuring junction is protected inside a gas-tight 7 mm recrystallized alumina ceramic sheath. Inside is a removable 2.5 mm twin-bore insert housing the thermocouple wires. This removable assembly enables independent calibration or replacement without disturbing the outer sheath.

At the cold end, a 250 mm stainless steel sheath provides a stable 0 °C reference junction, connected via 2 m low-EMF copper leads. For systems with internal referencing, a “No Cold Junction” (NCJ) option is available.

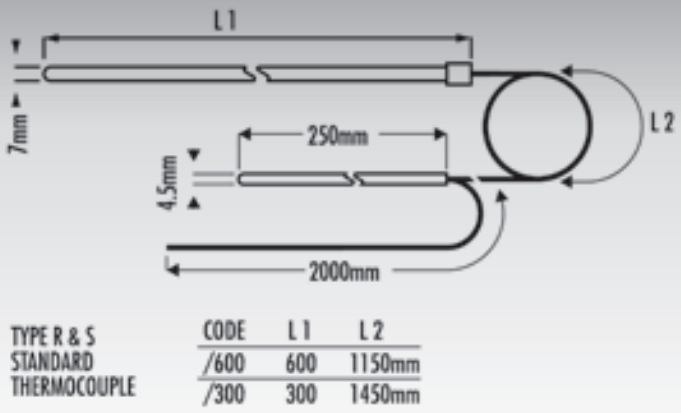
Supplied with a UKAS-accredited ISO 17025 calibration certificate to 1100 °C (uncertainty ±0.8 °C), with optional extension to 1300 °C (uncertainty ±1.8 °C).

For even lower uncertainties, fixed-point calibration can be provided at extra cost, delivering world-leading uncertainties as low as ±0.3 °C to 1100 °C, rising to ±0.55 °C at higher temperatures.

Key Features:

The Model 1600 offers trusted performance for the comparison calibrations of thermocouples in laboratories. Its robust design, wide temperature range, and proven stability make it the reliable choice for high-accuracy temperature standards.

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



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 Standards
Platinum/Gold

- Pure Metal Construction
- Best Homogeneity
- Alternative to HTSPRTs

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

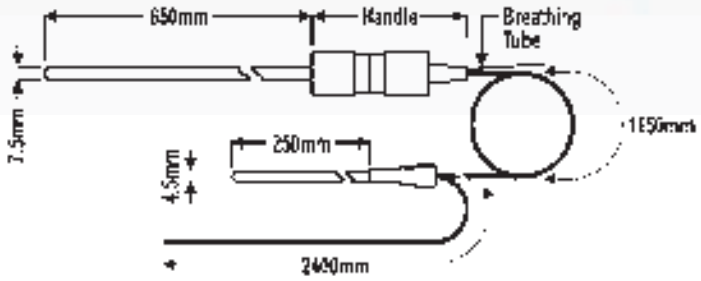
All wires are 99.999+% pure and are fully annealed according to the recommendations of McLaren. Assembly also follows his prescriptions which have never been bettered.

After final assembly and annealing the Au/Pt thermocouples will conform to IEC 62460, Edition 1 2008-07.

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



Alternative to HTSPRTs
Construction allows for differential expansion
Accuracy of up to ±0.05°C



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 ice point reference.
7. An article describing in detail the construction, handling and operation of the thermocouple is provided free with each unit.

Temperature Range	0°C to 1000°C
Sheath materials	
Measuring Junction	Quartz
Reference Junction	Stainless Steel
Thermo-element Purities	
Platinum	99.999% Pure
Gold	99.999% Pure
Calibration Options	Isotech Traceable Calibration at Zinc, Aluminium and Silver Fixed Points. NPL: Fixed Point Calibration: Calibrated at Fixed Points of Zn, Al and Ag (UKAS) Uncertainty: 0 - 400°C ±0.07°C 400 - 1000°C ±0.05°C
Dimensions	Refer to diagram
Carrying Case	Included as standard

How to order

Model type: Au/Pt Thermocouple

Including emf vs. temperature traceable calibration certificate and carrying case.

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.

Precision Thermometry Bridges

The microK 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.

Precision Thermometers

This range includes two high accuracy bench top thermometers. The TTI-22 offer performance to 1mK at a ground breaking new price. The milliK can be used with SPRTs, PRTs, Thermistors, Thermocouples and Current Transmitters.



Selection Guide

Model	SPRTs	PRTs	Thermistors	Thermocouples	Accuracy at 0°C	Application	Features
Precision Thermometry Bridges							
microK 70	■	■	■	■	0.017ppm	Primary	Three Input Channels Touch Screen
microK 125	■	■	■	■	0.03ppm	Primary	Adjustable Current Source
microK 250	■	■	■	■	0.06ppm	Secondary	Keep Warm Currents Touch Screen
microK 500	■	■	■	■	0.125ppm	Secondary	
microK^2 Elite	■	■	■	■	0.125ppm	Secondary	Enhanced Model
microK^2 60	■	■	■	■	0.125ppm	Secondary	Ultimate Performance
milliK	■	■	■	■	0.003°C	Secondary	Current Input
TTI-22	■	■			0.001°C	Secondary	Sets new Standard for Price to Performance
Scanners							
microsKanner							Add up to 90 Channels to microK family, Plug and Play Operation
millisKanner							Add up to 32 Channels to milliK family, Plug and Play Operation

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

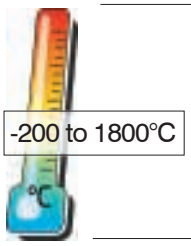
Model	SRA & SRB	456	455
			
Values	SRA: 1, 10, 25 and 100 Ohm 400 Ohm to special order SRB: 1000 and 10,000 Ohms	10, 25, 100, 1000, 10,000 Ohm	Standard Resistor Maintenance Bath
Application	Primary and Secondary Lab microK	Affordable Resistors with inbuilt temperature control	Precisely Maintains SRA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

RBC: Resistance Bridge Calibrator

The RBC is designed for quick and simple, in-house calibrations of AC and DC thermometry bridges, with an accuracy of better than 0.1 ppm at 100 Ω. The calibrators are supported by software for analysis of the results.



http://www.isotech.co.uk



Precision Thermometer
microK

- Ratio Accuracy to <0.02ppm (20ppb) with Zero Drift
- SPRTs, PRTs, RTDs, Thermistors and Thermocouples
- Reliable 21st Century 100% Solid State Design

The microK family of precision thermometry bridges use a completely new measurement technique to achieve accuracies to better than 0.02ppm.

There are models to suit all levels of temperature metrology from National Measurement Institutes to those wanting a solution to make low uncertainty temperature measurements in a range of applications.

In addition to making the best resistance measurements, the microK makes high accuracy thermocouple measurements with a voltage uncertainty of <0.25μV. The microK can be used with all standard thermometer types including SPRTs, Standard Thermocouples, Industrial PRTS and thermistors.

First introduced in 2006 the microK has become the instrument of choice at the world's leading NMIs and many commercial laboratories. All microK models now include IEEE-488 General Purpose Interface Bus as well as RS232 and USB. The microK 70 and microK 125 also feature an Ethernet port and can be monitored and controlled across a LAN.

Performance by Design - Drift Free

"Performance by Design" was the mantra and passion behind the development of the microK. On Day 1 a decision was made, "no tweak pots" (such as used on AC Bridges to correct for flux leakage), no software adjustment, no "self-calibration" but performance by design. The microK achieves its resistance ratio accuracy by design, not adjustment and is uniquely drift free.



Unequalled combination of accuracy, stability and versatility.

To be clear, as a ratio bridge the microK is drift free. This is a benefit of the substitution topology used and provides one of the microK's most exciting features, it is inherently drift free.

It doesn't have compensation or adjustment circuits, it doesn't have software offsets, it doesn't self-calibrate, it never needs adjusting, never needs a service engineer, in ratio measurement it is drift free by design.

For more details read, "Using a Substitution Measurement Topology to Eliminate the Effect of Common Mode Errors in Resistance Measurements used in Temperature Metrology" available on the Isotech Website which also explains why the performance of the microK is superior to DC potentiometric instruments.

Accuracy

Model	Ratio Accuracy	Accuracy (Whole Range)
	ppm*	ppm
microK 70	0.017	0.07
microK 125	0.03	0.125
microK 250	0.06	0.25
microK 500	0.125	0.5

** At Ratio: 0.95 to 1.05*

Key Features

- **Resistance Thermometry**
  - 0.1Ω, 0.25Ω, 1Ω, 10Ω, 25.5Ω, 100Ω SPRTs
  - Industrial PRTs
  - Thermistors
- **Voltage Measurement**
  - Laboratory Standards: Platinum / Rhodium, Platinum / Gold and Base Metal, Accuracy to 0.25μV
- **Display Modes**
  - Numeric and Graphical
  - Ratio, Resistance, Voltage, °C, °F, K
- **Stable**
  - ZERO drift in ratio measurement
- **Three Input Channels**
  Best Practice Ready
  - Expandable to 92
- **Ease of Use**
  - Intuitive Touch Screen Operation, Store all Standard Thermometer and Standard Resistors internally
  - Log to internal memory or USB Memory Drive
- **Reliable**
  - 21st Century Solid State Design, no moving parts

Performance by Design - More Advantages

In making ratio measurements other benefits by design include:-

- **Zero Hysteresis**
  There is no hysteresis effect by design
- **Zero Channel to Channel Variation**
  Even with a microsKanner, as the channel expander duplicates the front end of the microK for each input rather than just being a switch box
- **Zero Temperature Coefficient**
  Temperature Coefficient is 0ppm/°C, another benefit of the substitution technique. No need for warm up or stabilisation periods.
- **Complete Line Frequency Rejection**
  Total rejection of 50 and 60Hz line frequency

Thermocouple Measurements

When used with an external 0°C cold junction reference unit (or by measuring the junction temperature with a PRT on another channel) the microK can be used for low uncertainty precision thermocouple measurements. The microK is designed for ALL the thermometer types used in a laboratory including Standard Thermocouples. The voltage uncertainty is 0.25μV, equivalent to 0.01°C for a Platinum / Gold thermocouple at 1000°C.

Keep Warm Currents

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. Each channel, whether on the microK or a microsKanner can be individually programmed.

Zero Current Resistance

The microK was the first Bridge to have the ability to automatically compute and display the zero current resistance with no manual correction, this feature is available on the microK 70 and 125 models.

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.

Parallel Processing Technology

The microK 70 and 125 incorporate additional technology (compared to the micro 250 and 500) to deliver superior performance for the Primary Laboratory. A new technique of Analogue Parallel Processing is used to lower noise to a level that previously could only be achieved by the best AC Bridges. These models also feature an Ethernet port

ADC

The microK realises its superior linearity and low noise through a number of novel approaches, including a new noise reduction technique, new solid state switching, new guarding arrangements and a sophisticated substitution topology to achieve zero drift.

NPL National Physical Laboratory

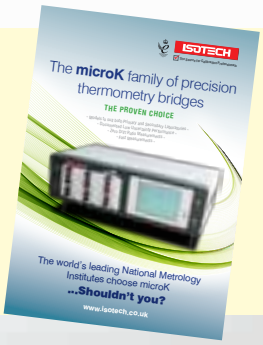
Technology Applied

In 2017 Isotech was awarded the Queen's Award for Enterprise in the Innovation category for the co-development of the microK

Learn more

Download the
16 page brochure at

www.isotech.co.uk/microk



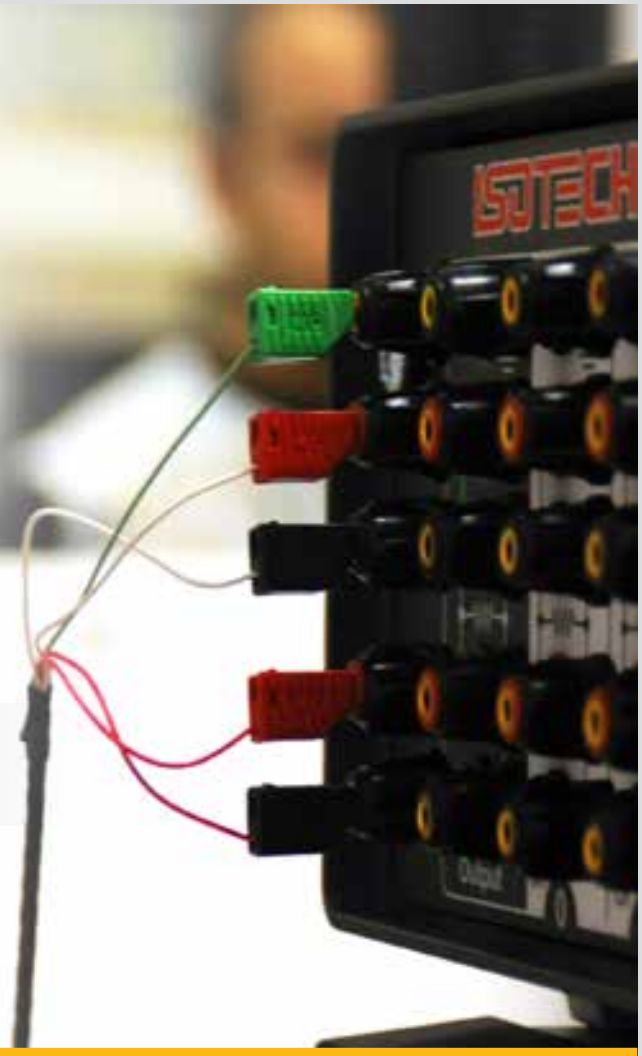


microK with microsKanner

microK GOLD

We are now able to offer a microK with enhanced performance to <30ppb (whole range, 0 to unity) and an unmatched performance promise and warranty...

This unique package is called “microK GOLD”.



Unique Promise - Performance Guaranteed

We guarantee the 30ppb performance and provide evidence by calibrating the microK with an Automatic Ratio Bridge Calibrator, A-RBC. What is more you can choose to return the bridge for calibration of the ratio accuracy in year two and three with no charge for calibration, you pay only for the carriage.

No other company makes this commitment - we challenge you to find any other company to report ratio accuracy, measured with the RBC and who guarantee that for three years.

Confidence

As well as the performance promise we are including an extended three year warranty. Thermometry bridges at this level require a large investment; choose Isotech for the best performance and confidence.

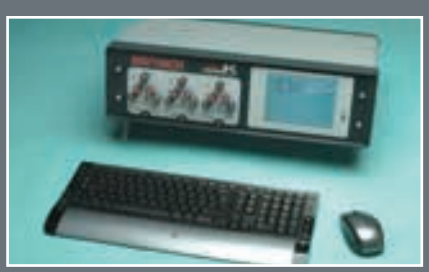
microK Specifications *(Specifications are subject to change without prior notice)*



Parameter	microK GOLD
Accuracy Whole Range (SPRT Ro ≥ 2.5Ω)[1]	0.03ppm / 30ppb
Resolution	0.001mK
Resolution Voltage	10nV
Stability	0ppm/yr [3]
TC (resistance ratio)[4]	0ppm/°C [3]
Resistance Range	0 - 100 kΩ
Voltage Range (Thermocouple)	±125mV
Internal Resistance Standards	25, 100, 400Ω
Internal Standard Resistor Stability	TCR <0.05ppm/°C Annual Stability <2ppm/year
Interfaces	RS232, GPIB & USB & Ethernet
Power	25W maximum, 1.5A (RMS) maximum
Weight	13.3kg







microK Universal Specifications

Accuracy - Thermocouples	Voltage uncertainty: Range 0-20mV 250nV. Equivalent to 0.01°C for Gold Platinum thermocouples at 1000 °C
Measurement Time (Per Channel)	Resistance: <2s (1s using the RS232 or GPIB interface) Voltage: <1s (0.5s using the RS232 or GPIB interface)
Temperature Conversions	PRTs: ITS-90, Callendar-van Dusen. Thermocouples: IEC584-1 1995 (B, E, J, K, N, R, S, T), L and gold-platinum. Thermistors: Steinhart-Hart
Cable Length	Limited to 10Ω per core and 10nF shunt capacitance (equivalent to 100m of RG58 coaxial cable)
Input Connectors	Cable Pod™ connector accepting: 4mm plugs, spades or bare wires Contact material: gold plated tellurium copper
Interfaces	RS232 (9600 baud), USB (1.1) - host, IEEE-488 GPIB
Ratio Range	Unlimited
Display	163mm / 6.4" VGA (640 x 480) Colour TFT LCD
Channels	3
Cold Junction Mode	External and Remote with PRT
Expandable	Add up to 90 expansion channels
Probes Supported	PRT's, Thermistors & Thermocouples
Units	Ratio, V, Ω, °C, °F, K
Switching Technology	Solid state
Sensor Current	0 – 10mA in 3 Ranges 0 – 0.1mA ±0.4% Value ±70nA (Resolution 28 nA) 0.1 – 1mA ±0.4% Value ±0.7μA (Resolution 280nA) 1– 10mA ±0.4% Value ±7μA (Resolution 2.8 μA)
Keep Warm Current	Adjustable 0-10mA Each Channel Adjustable 0-10mA ±0.4% Value ±7μA (Resolution 2.8 μA)
Internal Data Storage	2Gb: For > 4 years storage (Timed Stamped Measurements)
Operating Conditions	For Full Specification: 15 - 30°C 10 - 80% RH Operational: 0 - 40°C 0 - 95% RH
Supply	88-264 Vac, 47-63Hz
Size W x D x H	520mm x 166mm x 300mm / 20.5" x 6.6" x 11.9" (19" Rack Mountable)

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

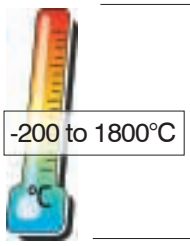




Parameter	microK 70	microK 125	microK 250	microK 500
Accuracy Whole Range (SPRT Ro ≥ 2.5Ω)[1]	0.07ppm	0.125ppm	0.25ppm	0.5ppm
Accuracy Ratio 0.95 to 1.05[2]	0.017ppm	0.03ppm	0.06ppm	0.125ppm
Equivalent Temperature Accuracy[2]	0.017mK	0.03mK	0.06mK	0.125mK
Resolution	0.001mK	0.001mK	0.01mK	0.01mK
Resolution Voltage	10nV	10nV	10nV	10nV
Stability	0ppm/yr [3]	0ppm/yr [3]	0ppm/yr [3]	0ppm/yr [3]
TC (resistance ratio)[4]	0ppm/°C [3]	0ppm/°C [3]	0ppm/°C [3]	0ppm/°C [3]
Resistance Range	0 - 100 kΩ	0 - 100 kΩ	0 - 500 kΩ	0 - 500 kΩ
Voltage Range (Thermocouple)	±125mV	±125mV	±125mV	±125mV
Internal Resistance Standards	25, 100, 400Ω	25, 100, 400Ω	1, 10, 25, 100, 400Ω	1, 10, 25, 100, 400Ω
Internal Standard Resistor Stability	TCR <0.05ppm/°C Annual Stability <2ppm/year		1, 10Ω <0.6ppm/°C <5ppm/year 25,100,400 <0.3ppm/°C <5ppm/year	
Interfaces	RS232, GPIB & USB & Ethernet		RS232, GPIB, USB	
Power	25W maximum, 1.5A (RMS) maximum		20W maximum, 1.5A (RMS) maximum	
Weight	13.3kg	13.3kg	12.4kg	12.4kg

Notes:

1. *Over whole range of SPRT, -200°C to 962°C. For Ro=0.25Ω increased by a factor of 2.5*
2. *E.g.: 25Ω SPRT with 25Ω standard resistor at water triple point or with direct comparison of similar SPRTs.*
3. *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.*
4. *Using external reference resistors.*



Channel Expander
microsKanner



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

The microsKanner 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 microsKanner. 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 microsKanner and immediately gain the benefit of the additional channels, making this the easiest channel expansion system of its type.

Accurate: The microsKanner replicates the input system of the microK bridge for all 10 of its input channels Measurements made with a microsKanner 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 microsKanner works with PRTs, thermocouples and thermistors giving you unparalleled flexibility.

Keep-Warm Currents: The micosKanner 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 ¾" 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.

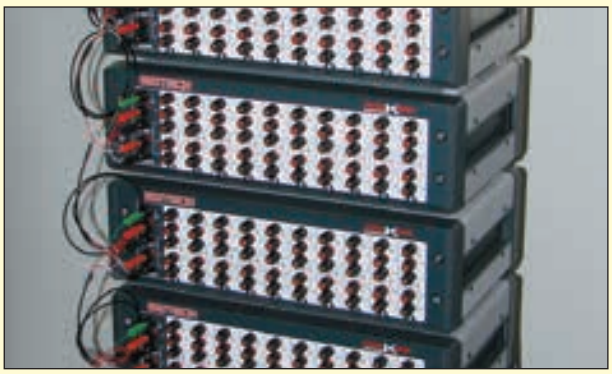
Reliable: Like the microK, the microsKanner uses the latest semiconductor technology for channel selection and signal routing. This completely solid-state design therefore provides the highest possible reliability.

Model	913 microsKanner
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

microsKanner

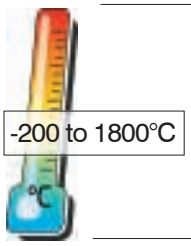
- **Performance** - zero uncertainty contribution
- **Flexibility** - supports all sensor types (PRTs, thermocouples & thermistors)
- **Keep-warm currents for PRTs** - individually programmable
- **Ease of use** - plug-and-play… new channels added by the microsKanner just appear in the existing operator interface on the microK
- **Input channels** - up to 90 expansion channels
- **Reliability** - completely solid-state (no relays)





< Expandable

The microK has three input channels, to allow best practice of having two standard thermometers and still have a channel free for the thermometer under test. Additional expansion channels can be added in blocks of 10 to a maximum of 90 expansion channels. The microsKanner adds no additional uncertainty and each channel is individually programmable from the touch screen. Any channel can be set for any thermometer type or for an external resistor.



Precision Thermometer

NEW microK²



Unequalled combination of accuracy, stability and versatility.

- **Accuracy and Stability:** Superior resistance ratio accuracy and zero drift to ensure long-term stability
- **Trusted by NMIs:** Widely recognised by leading NMIs with independant reports validating its exceptional performance
- **Second Generation:** Improved performance with new features and a 10.1-inch high-resolution touchscreen for clear visualisation of measurements and data.

The microK² builds on the success of the original microK models that were quickly adopted by the world's leading National Metrology Institutes and commercial laboratories. Retaining Isotech's innovative technology and operating mode to achieve accuracies as low as 7.5μK, microK² remains first choice to measure with SPRTs and supports all standard thermometer types including Standard Thermocouples, Industrial PRTs and Thermistors.

NEW: The microK² introduces several new features designed to enhance usability, accuracy, and versatility. A notable addition is the new fourth channel, which accepts SPRTs, reference resistors, or the channel expander, offering greater flexibility in measurement systems. The touchscreen has been upgraded to a 10.1-inch high-resolution display with improved capacitive touch technology, ensuring a more responsive and intuitive user interface, input terminals are now more robust and easier to use. Enhanced connectivity options now include Ethernet, two RS232 serial ports, three USB ports and a IEEE 488 Port with new software features.

Performance by Design - Inherently Drift-Free

The microK was developed with a clear design philosophy: to ensure genuine, long-term performance without relying on "tweak pots," software adjustments, or self-calibration. This innovative approach has resulted in a resistance ratio accuracy the is uniquely drift-free, ensuring unparalleled accuracy and stability.

As a ratio bridge, the microK leverages a substitution topology that inherently eliminates drift. With no need for compensation circuits, software offsets, or routine calibration, the microK maintains its performance without requiring adjustments or service interventions, delivering consistent, reliable measurements year after year, thereby reducing operating costs.

Since its introduction in 2006, the microK has been rigorously studied and validated by temperature metrologists worldwide, confirming its superior performance and reliability.

For an in-depth understanding of the microK's technology and performance, visit our website. You'll find a range of technical papers, including those presented at conferences, academic studies, and more general articles, all providing solid evidence of the microK's exceptional capabilities,

www.isotech.co.uk/evidence.

Accuracy

Model	Ratio Accuracy	Equivalent Temperature Accuracy at Water Triple Point [2]
microK² ELITE	30 ppb	7.5μk
microK² 60	60 ppb	15μK

Key Features

- **Resistance Thermometry**
  - 0.1Ω, 0.25Ω, 1Ω, 10W, 25.5Ω, 100Ω SPRTS
  - Industrial PRTs
  - Thermistors
  - Rhodium-Iron (Resistance only)
- **Voltage Measurement**
  - Laboratory Standards: Platinum / Rhodium, Gold / Platinum and Base Metal, Accuracy to 0.15μV
- **Accurate**
  - World-Leading Accuracy for Primary & Secondary Laboratories
- **Stable**
  - ZERO drift in ratio measurement
- **Four Input Channels**
  - Best Practice Ready
  - Expandable to 93
  - Allows for future-proof scalability, accomodating growing laboratory needs
- **Ease of Use**
  - Upgraded Touch Screen Operation, Store all Standard Thermometer and Standard Resistors Internally
  - Log to internal memory or USB Memory Drive
- **Trusted**
  - Documented Performance with Acceptance by the World's Leading NMIs
- **microK²**
  - New & Improved Performance, Upgraded with New Features

microK Benefits

NEW

- **Unmatched Accuracy**
  Documented ratio accuracy as low as 0.03 ppm
- **Extra Channel**
  Features a new fourth channel on the rear panel for invreased flexibility
- **Extensive Connectivity**
  Includes Ethernet, RS232, USB & IEEE 488 (GPIB)
- **Trusted by Experts**
  Chosen by leading National Metrology Institutes worldwide
- **Versatility**
  Suitable for all temperature metrology applications & budgets
- **Intuitive Operation**
  Faster, larger touchscreen interface for easy navigation provides a clear and responsive interface, even in bright environments, making it easier to read and navigate

Thermocouple Measurements

When used with an external 0°C cold junction reference unit (or by measuring the junction temperature with a PRT on another channel), the microK can be used for low uncertainty precision thermocouple measurements. The microK is designed for ALL the thermometer types used in a laboratory including Standard Thermocouples. The voltage uncertainty is 0.15 μV, equivalent to 0.006°C for a Platinum / Gold thermocouple at 1000°C.

Cryogenic Measurements

The microK supports Rhodium-Iron thermometers (RhFe or RIRTs) and SPRTs for measurements down to 4K in ratio and resistance modes (resistance only).

Keep Warm Currents

The keep warm current for each channel, whether on the microK or via the microsKanner channel expander, is automatically set to the last applied sense current. This feature not only simplifies the use of the microK but also ensures that measurements remain immune to power coefficient effects.

Zero Current Resistance

The microK was the first Bridge to have the ability to automatically compute and display the zero current resistance with no manual correction. Automatically computes and displays resistance with no manual correction needed, simplifying the process and reducing potential errors. Now available on all microK² models.

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.

Parallel Processing Technology

A key innovation developed specifically for the microK² is Parallel Analogue Processing, which reduces voltage noise to levels previously achievable only by the best AC resistance bridges. Each amplifier contributes linearly to the signal, while noise adds the root mean square (RMS), resulting in significantly lower overall noise. By using multiple parallel amplifiers, the microK² minimises voltage noise without compromising performance, making it a valuable feature in precision measurement.

ADC

The microK achieves unrivalled linearity and low noise through innovative techniques that include parallel analogue amplifiers, solid-state switching, advanced guarding and a zero-drift substitution topology. Its novel sigma-delta ADC employs a multi-bit, pulse-width modulation (PWM) DAC under NPL's "Technology Applied" scheme to achieve <0.03 ppm accuracy and low quantisation noise.

NPL National Physical Laboratory
Technology Applied



microK² with microsKanner

Extensive Testing and Validation

The microK² performance, rigorously tested by NMIs and leading research organisations, confirms its reliability and precision. Visit our website for a full brochure along with technical articles and papers highlighting the microK² unmatched capabilities.

Introducing the microK² ELITE Package

Unmatched Performance and Assurance

We are proud to offer the microK² ELITE package, a premium offering that combines enhanced performance with an exclusive set of benefits designed to provide you with the highest level of confidence and support.

Performance Guarantee - <30 ppb Accuracy

The microK² ELITE package includes a microK² instrument with superior performance, achieving ratio accuracy of <30 ppb across the entire range (0 to unity). This exceptional level of precision is guaranteed, with each unit calibrated using our Automatic Ratio Bridge Calibrator (RBC-A)

Exclusive Benefits - Extended Warranty and Free Recalibration

As part of the microK² ELITE package, you'll recieve an extended three-year warranty, ensuring long-term reliability and peace of mind. Additionally, we offer free ratio accuracy recalibration in years two and three you only cover the shipping costs.

A Commitment Like No Other

No other company matches our commitment to precision and reliability. We are the only provider offering guaranteed performance validated by the advanced RBC-A (Automatic Ratio Bridge Calibrator), developed by renowned metrologist Rod White. Backed by a three-year guarantee, the microK² ELITE package represents the pinnacle of performance, delivering assurance and protecting your investment for the long term.







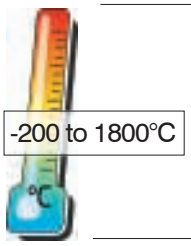
microK² Specifications *(Specifications are subject to change without prior notice)*

Parameter	microK² ELITE	microK² 60
Accuracy Whole Range *[1]*	30ppb	60ppb
Equivalent Temperature Accuracy Whole Range *[1]*	30 μK	60 μK
Equivalent Temperature Accuracy Water Triple Point *[2]*	7.5 μK	15 μK

Common Specifications

Weight	13.2kg
Resolution, Temperature	0.001 mK 0.000001°C
Input Channels NEW	Four - three front and one rear
Ratio Range	Unlimited
Ratio Accuracy Stability *[3]*	Zero Drift
Ratio Accuracy Temperature Coefficient *[4]*	Zero
Resistance Range	0 - 500 kΩ
Keep Warm Current	Each Channel Individually Programmable
Voltage Range (Thermocouple)	125 mV
Voltage Accuracy 0 - 20 mV	0.15 μV Equivalent to 0.006°C for a Platinum / Gold thermocouple at 1000°C
Resolution Voltage	10 nV
Cold Junction Mode	External and Remote with PRT
Sensor Current NEW	Each Channel Adjustable 0 - 14.2 mA
Cable Length	Limited to 10Ω per core and 10nF shunt capacitance (equivalent to 100m of RG58 coaxial cable)
Temperature Conversions NEW	PRTs: ITS-90, Callendar-van Dusen. Thermocouples: IEC 60584-1 Ed. 3.0 2013 (B, E, J, K, N, R, S, T), L, Pt/Pd and Au/Pt, Thermistors: Steinhart-Hart, Polynomial
Internal Resistance Standards	25, 100, 400Ω
Optional Internal Values	1, 10, 10KΩ, Custom
Internal Standard Resistor Stability	TCR < 0.5 ppm/°C and stability < 2 ppm/year
Input Connectors	Upgraded: Gold Plated 4mm binding posts for plugs, spades, or bare wires, material tellurium-copper alloy for low thermal EMF
Interfaces	Ethernet 3 x USB Host, 2 x RS232, IEEE
Store Calibration Coefficients	Unlimited
Datalogger	32 GB Storage
Expandable NEW	Add up to 90 expansion channels
Switching Technology	Solid State
Units	Ratio, V, Ω, °C, °F, K
Display	10.1-inch high-resolution touchscreen with anti glare treatment
Operating Conditions	Full Specification: 15 - 30°C 10 - 80% RH Operational: 0 - 40°C 0 - 95% RH
Power	85 - 264 Vac 50/60 Hz 20 watts maximum
Dimensions	539mm x 200mm x 300mm (19" Rck Mountable)

[1] Over whole range of SPRT, -200°C to 962°C. For Ro=0.25Ω increased by a factor of 2.5
[2] E.g. With 25.5Ω SPRT and 25Ω Reference Resistor or Direct Comparison of SPRTs with Ro > 2.5Ω
[3] The microK2 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.
[4] Using External reference resistors



Channel Expander
microsKanner



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

The microsKanner can be used with any member of the microK family to add further channels, up to a maximum of 90 expansion channels, 913-HC is styled to suit the microK².

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 microsKanner. 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 microsKanner and immediately gain the benefit of the additional channels, making this the easiest channel expansion system of its type.

Accurate: The microsKanner replicates the input system of the microK bridge for all 10 of its input channels Measurements made with a microsKanner 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 microsKanner works with PRTs, thermocouples and thermistors giving you unparalleled flexibility.

Keep-Warm Currents: The micosKanner 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 ¾" 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 microsKanner uses the latest semiconductor technology for channel selection and signal routing. This completely solid-state design therefore provides the highest possible reliability.

Model	913-HC microsKanner
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

microsKanner

- **Performance** - zero uncertainty contribution
- **Flexibility** - supports all sensor types (PRTs, thermocouples & thermistors)
- **Keep-warm currents for PRTs** - individually programmable
- **Ease of use** - plug-and-play… new channels added by the microsKanner just appear in the existing operator interface on the microK
- **Input channels** - up to 90 expansion channels
- **Reliability** - completely solid-state (no relays)





< Expandable

The microK has three input channels, to allow best practice of having two standard thermometers and still have a channel free for the thermometer under test. Additional expansion channels can be added in blocks of 10 to a maximum of 90 expansion channels. The microsKanner adds no additional uncertainty and each channel is individually programmable from the touch screen. Any channel can be set for any thermometer type or for an external resistor.

Resistance Bridge Calibrators
RBC100A/M & RBC400A/M



Manual

Automatic

Calibrate thermometry bridges quickly, simply and in-house

- Calibrate ac and dc thermometry bridges
- High accuracy - better than 0.01 ppm at 100 Ohms (RBC100A)
- Patented design licensed from IRL
- Windows application for full analysis and reporting

Operating principles

The problem: Temperature measurement is one of the most demanding applications of resistance measurement. It requires the measurement of resistance ratios to accuracies of 1 part in 10^7 or better. While dc resistance standards are sometimes available at this level, ac resistance standards are generally not. So how can we show our bridges are accurate at this level, and that our resistance and temperature measurements are traceable?

The linearity check:

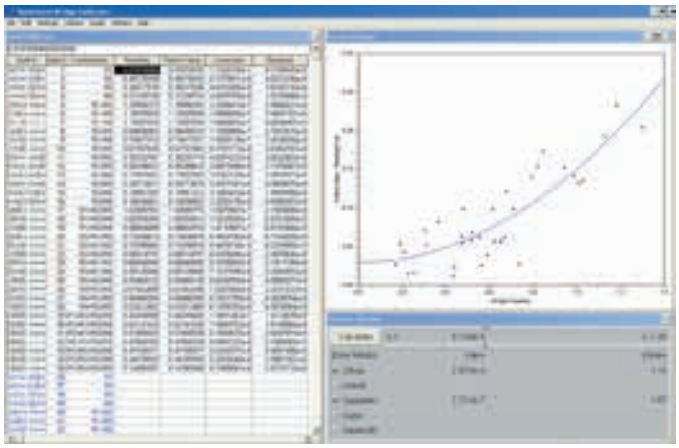
One simple method for checking a resistance bridge is to measure a pair of resistors separately, and then measure the two in series. Ideally the series measurement should equal the sum of the two individual measurements. If not, then the measurements give us a little bit of information about the errors in the bridge readings. Note that we do not need to know the values of the resistors to make this test work.

The complement check:

Another check is to measure the ratio of two resistances, say R_1/R_2, then swap the resistors and measure the reciprocal ratio (or complement), R_2/R_1. Ideally the product of the two measurements should equal 1.0 exactly, if not, the measurements give us more information on the bridge errors. Once again, we do not need to know the values of the resistors to make this test work.

The combinatorial method:

The RBC exploits the same principles as the linearity and complement check. It uses a network of four stable four-terminal resistors that can be connected in 35 different series and parallel combinations. By measuring each RBC combination in the two different ways (as with the complement check) up to 70 different measurements can be made. Since the RBC has just four unknown resistance values, we have up to 66 independent measurements containing information about the errors in the bridge readings.



The combinatorial calibration method is particularly powerful because it is not necessary to know the actual values of the four resistors, or their frequency dependence. This means we can calibrate any ac or dc bridge to any accuracy, so long as the various resistance combinations are accurate.

The patented RBC Calibrators are a result of research carried out by Rod White at the Measurement Standards Laboratory of New Zealand, which operates within Industrial Research Ltd (IRL). Isothermal Technology Ltd has an exclusive license from IRL to develop, sell and produce the RBC.

Automatic vs Manual

The manual model is operated from switches, and the data manually entered into the software for analysis and reporting.

The new automatic model is operated from a PC via a USB connection. There are drivers for the Isotech milliK and AC and DC bridges from other manufactures that allow for fully automatic and unattended calibration of commonly used thermometry bridges. The software design allows for new drivers to be created as DLLs and we expect to support a growing number of bridges, check the website for full details.

The RBC 100A / 400A benefits not only from automatic operation but with changes to the internal circuitry to increase the accuracy and they can be immersed in oil to allow for temperature control.

For further information, see our website http://www.isotech.co.uk/rbc

Manual Specifications

Accuracy:	<0.1ppm at 100Ω (For DC and AC to 400 Hz)	
Temperature Coefficient:	< ±0.3 ppm/ °C.	
Maximum Sensing current:	RBC100M:	10mA
	RBC400M:	5mA
Resistance range:	RBC100M:	16Ω to 127Ω
	RBC400M:	43Ω to 346Ω
Power supply:	None - the RBC is completely passive	
Connections:	Four-terminal coaxial using separate BNC for the current and voltage leads	
Case Dimensions:	Width 215mm Height 105mm Depth 200mm (2U height by half rack width)	
Weight:	2.5 kg	

Automatic Specifications

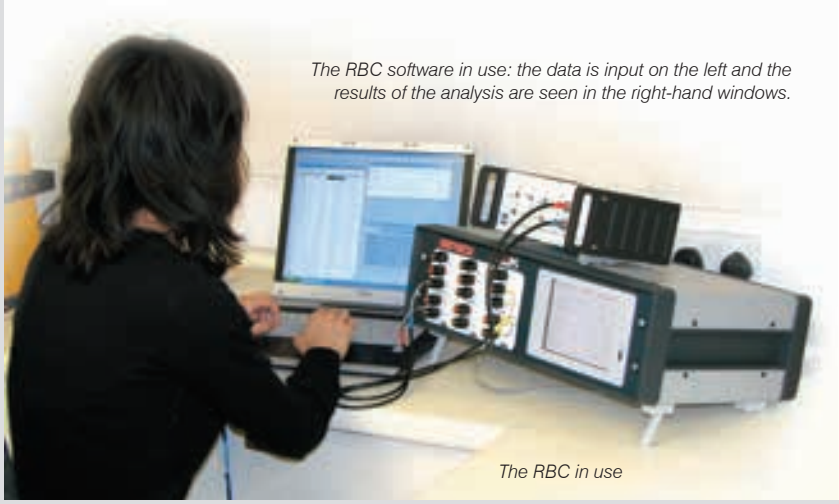
Accuracy:	<0.01ppm at 100Ω (For DC and AC to 400 Hz. When RBC is temperature controlled)	
Temperature Coefficient:	< ±0.3 ppm/ °C	
Maximum Sensing current:	RBC100A:	5mA
	RBC400A:	3mA
Resistance range:	RBC100A:	16Ω to 127Ω
	RBC400A:	43Ω to 346Ω
Power supply:	5V, via the USB cable. Idle current typically less than 5mA, switching currents less than 200mA.	
Connections:	Signal: Five-terminal guarded dc spade lugs.	
Digital control:	USB.	
Case Dimensions:	Diameter 88mm Height 140mm Identical to Tinsley type standard resistors.	
Weight:	1.25 kg	

Software

Tabular and graphical representation of data
Least-squares fit to determine model of bridge error
Tabular summary of data and results
Print calibration report

Minimal hardware requirements:

486/66 PC
8 Mb RAM (16 Mb for NT)
SVGA (800 x 600) monitor
Compatible with Microsoft Windows platforms



The RBC software in use: the data is input on the left and the results of the analysis are seen in the right-hand windows.

The RBC in use

Can you trust your bridge?

In the paper "A Method for Calibrating Resistance Thermometry Bridges" Rod White evaluated 38 Bridges, small but significant faults were found with 15% of those tested, but "like the walking wounded" they continued to provide a plausible reading.

The RBC allows easy verification and calibration of your bridge ensuring measurements are accurate and traceable, use it to Restore Bridge Confidence



True Temperature Indicator
TTI - 22



Simple to use
High Accuracy
High Resolution

- 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.

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 *Instrument only, uncertainty with sensor dependant on range and sensor type.*
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 ±1.3mK (5ppm x 100Ω = 0.5mΩ / 1.3mK).

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 0.3ppm / °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.

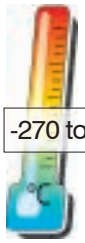
The overall uncertainty of the instrument and probe together will be determined by the model of probe and the temperature range. For the majority of applications the contribution of the instrument uncertainty will be negligible compared to the uncertainty of the calibrated probe.

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



Precision Thermometer
milliK



The Isotech milliK
High Accuracy Measurement
Controls Calibration Baths
Logs Data

- Wide Range of Sensors, SPRTs, PRTs, Thermistors, Thermocouples and 4-20mA Transmitters
- High Accuracy, < ±5ppm for PRTs, ±2μV for Thermocouples and ±1μA for Transmitters
- Logs and Controls Isotech Temperature Sources Massive logging capacity - supports Dry Blocks and Liquid Baths

The milliK Precision Thermometer from Isotech sets a new standard for the high accuracy measurement and calibration of Platinum Resistance Thermometers, Thermistors, Thermocouples and Process Instrumentation (4-20mA) over the range -270°C to 1820°C.

In addition to low uncertainty measurements from Reference Standards and Industrial sensors, the milliK can control Isotech temperature sources, sequencing through a programmable list of temperature set points and log data to internal memory or a USB drive.

The milliK has two input channels for sensors and a third channel for current. It can be expanded to become a measuring system with up to 33 channels reading SPRTs, RTDs, Thermistors, or Thermocouples with the option to control calibration baths and log readings accurately.

Benefiting You

The milliK sets a new standard for value, versatility and accuracy - < ±5ppm over range for PRTs, ±2μV for Thermocouples and ±1μA for current transmitters, see table.

Supporting a wide range of sensors and functions it replaces individual devices making it a cost effective calibration solution.

A robust design and operation from AC or DC power allows the milliK to be used in the laboratory, test room or out in the field.

The milliK can display in °C, °F, K, Ohms, mV and mA with numeric and graphical display modes. The large back lit display makes configuring the instrument and setting the scrolling strip charts intuitive. The USB port allows for the use of a mouse, keyboard or USB Drive.

Built on World Leading Technology

In 2006 Isotech launched the microK range of thermometry bridges which quickly established themselves as the instrument of choice for National Metrology Institutes and Primary Laboratories with innovative features, accuracy and versatility.

In response to industry demands for greater accuracy, the milliK now brings the same design philosophy used in the microK to those outside the Primary Laboratory. Users calibrating industrial sensors in the laboratory, pharmaceutical plants, food and beverage plants, aerospace, power industries and service companies will welcome the milliK as a solution to increase measurement confidence, ensure high accuracy traceable calibration, improve quality as well as ensure safety and lower energy consumption.

No Compromise Design

The design team have considered industrial users and applications in order to avoid measurement errors and problems encountered in some instruments from other manufacturers:

- **Eliminates Thermal EMF Errors in PRTS**
  Fast current reversal technology and solid state switching eliminate thermal EMF effects avoiding the errors that occur with fixed DC instruments.
- **Lead Wire Correction**
  PRT lead wire errors are eliminated for up to 30m of four core screened cable. Also supports lead wire correction for three wire PRTs.
- **Galvanic Isolation**
  Not only are the two sensor channels galvanically isolated, the 4 - 20mA input is also separately isolated. The benefits of the advanced design are no ground loops, improved safety and noise immunity.

High Resolution

The display resolution is 0.0001°C (0.1mK) made possible by using a powerful Sigma Delta Analogue to Digital converter to achieve a true measuring resolution of just 28μΩ equivalent to 0.00007°C (0.07mK) for PRT inputs.

Expandable

The millisKanner adds eight channels, and each can be configured individually as a SPRT, PRT, Thermistor or Thermocouple input. A maximum of four millisKanners can be added, providing up to 32 channels - all controlled from the milliK touch screen or an RS232 connection.

Reliable
Like the award winning microK range, the milliK is all solid state. There are no mechanical relays, switches or potentiometers which would reduce reliability.

Input Connectors
No compromise design ruled out lower cost problematic connectors and the SPRT / PRT inputs are via the highest quality gold plated push / pull self latching circular connectors overcoming the problems seen elsewhere where thermometers have been designed to a budget.

Outstanding CJC Performance and Flexibility
Again, the no compromise design philosophy led to a specially developed rugged thermocouple connector made from alumina and incorporating a digital temperature sensor for optimal cold junction accuracy.

Three CJC modes allow thermocouple operation with internal automatic compensations, external 0°C reference systems or the milliK can measure the junction with a probe on an unused channel, useful for automated systems.

21st Century Design
Utilising a powerful internal operating system and fast 32 Bit processor the milliK has the power and capacity to overcome the memory limitations of older instruments.

Store Probe Data
There is sufficient memory for an almost unlimited number of standard probes, allowing the storing of calibration data for both resistance thermometers and thermocouples. The digital matching of probe data allows the instrument to show the true temperature. The instrument will warn if a probes calibration time has expired.

Data Logging
Older instruments are limited to a maximum number of logged data points, the milliK is limited only by storage space. The internal memory can store more than six months of data, and with a low cost USB Memory stick the milliK can log continuously for a lifetime

Data Management
Probe data and logged measurements can be exported to a USB Memory drive at the push of a button. Additionally, the instrument is future proof with future software updates applied from a USB drive.

Connectivity and Communications
With USB host, two serial interfaces and Ethernet it is easy to communicate with the milliK whether it is on the bench next to a PC or remotely using a LAN or WAN connection. These interfaces are fitted as standard.

The milliK includes a PC lead and software.

Open Calibration
The milliK is readily calibrated against resistance and voltage standards. There are no internal adjustments and the calibration commands are simply sent via RS232 or from the front panel (password protected). The procedure is open and fully documented unlike some other instruments where there is no choice but to return to the manufacturer.



1 *The milliK can connect to Isotech temperature sources*

Dry Blocks (Basic & Site only), Liquid Baths and Furnaces

Can cycle the bath through a series of temperatures logging the data - all without a PC.



2 *Wide range of sensors*

The milliK can use Standard Reference probes and read from industrial sensors being calibrated, including 4 - 20mA transmitters - all to high accuracy.



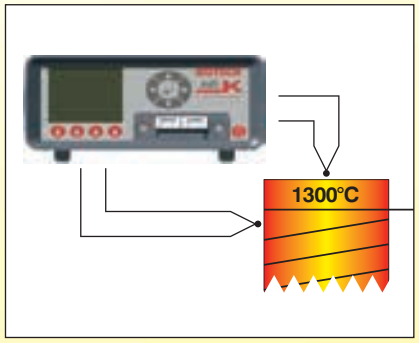
3 *Expandable*

The milliK can be expanded to have a maximum of 33 high accuracy channels. The millisKanner has eight expansion channels, with each channel configurable for SPRT, PRT, Thermistor or Thermocouple input type.



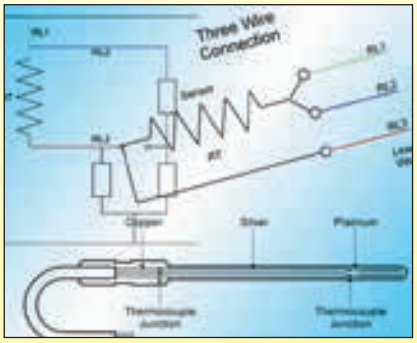
4 *Logs*

The milliK can record time stamped data to internal memory or a USB Memory Drive.



5 *Safety*

The milliK inputs are galvanically isolated, with the 4 - 20mA input separately isolated avoiding problems with high voltage pick up common when using thermocouples in high temperature furnaces.



6 *Designed to eliminate and protect against real world problems*

The milliK eliminates thermal EMF errors, compensates for lead wire resistance and warns if a probe is out of calibration.

Specifications

Input Channels	3	
Channels 1+2	SPRTs, PRTs, Thermistor and Thermocouples	
Channel 3	Process Inputs 4 - 20mA Isolated 24VDC Power Supply Included	
Ranges	SPRTs:	0-115Ω
	PRTs:	0-460Ω
	Thermistors:	0-500kΩ
	Thermocouples:	±115mV
	4-20mA:	0-30mA
Display Units	°C, °F, K, Ω, mV, mA	

Accuracy	Initial	Over 1 year
SPRTs/PRTs:	5ppm	7ppm
Thermistors:	50ppm	150ppm
Thermocouples:	2μV	4μV
4-20mA:	0.01%	0.02%

Temperature Accuracy	Initial	Over 1 year
SPRTs/PRTs (at 0°C):	3mK	4mK
(over full range):	5mK	7mK
Thermistors:	50ppm	150ppm

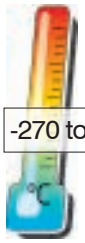
Thermocouples:	Ice Point Ref		Internal CJC	
	Initial	1 Year	Initial	1 Year
Type B @ 1000°C	±0.12°C	±0.14°C	±0.12°C	±0.14°C
Type E @ 600°C	±0.02°C	±0.05°C	±0.10°C	±0.20°C
Type J @ 600°C	±0.03°C	±0.05°C	±0.12°C	±0.23°C
Type K @ 600°C	±0.04°C	±0.06°C	±0.13°C	±0.25°C
Type L @ 600°C	±0.03°C	±0.05°C	±0.12°C	±0.23°C
Type N @ 600°C	±0.04°C	±0.06°C	±0.10°C	±0.19°C
Type R @ 1000°C	±0.09°C	±0.12°C	±0.14°C	±0.21°C
Type S @ 1000°C	±0.10°C	±0.14°C	±0.16°C	±0.24°C
Type T @ 200°C	±0.02°C	±0.03°C	±0.10°C	±0.18°C
Au-Pt @ 600°C	±0.06°C	±0.08°C	±0.10°C	±0.15°C

Resolution	Resistance (PRTs):	0.00001Ω
	(Thermistors):	0.001Ω
	Voltage:	0.00001mV
	Current:	0.001mA
	Temperature:	0.0001°
Temperature Conversions	PRTs:	IEC60751(2008), Callendar-van Dusen, ITS90
	Thermocouples:	IEC584-1 1995 (B,E,J,K,N,R,S,T), L, Au-Pt
	Thermistors:	Steinhart-Hart, polynomial
Sensor Currents	SPRTs/PRTs:	1mA and 1.428mA ±0.4% (reversing)
	Thermistors:	5μA (reversing)
Keep-Warm Current	SPRTs/PRTs:	1mA and 1.428mA

Input Connectors	SPRTs/PRTs:	LemoEPG.1B.306.HLN 6-pin gold plated contacts
	Thermocouples:	Miniature Thermocouple socket (ASTM E 1684-05)
	4-20mA:	4mm sockets
Interfaces	10/100MBit Ethernet (RJ45 socket) USB (2.0) host 2 x RS232 (9-pin D-type plug, 9600 Baud)	
Display	89mm / 3.5" QVGA (320 x 240) colour TFT LCD with LED backlight	
Operating Conditions	Operating:	0-45°C / 32-113°F, 0-99% humidity
	Full Specification:	15-30°C / 50-85 °F, 10-90% humidity
Statistics	In Addition to Instantaneous Display user can select mean of 2 - 100 measurements with Standard Deviation	
Measurement Time	PRTs (4-wire): 0.4s (3-wire): 0.7s Thermistors: 0.4s Thermocouples (ice point): 0.4s (internal CJC): 0.7s (external CJC): 1.0s	
Cable Length	Limited to 10Ω per core and 10nF shunt capacitance (equivalent to 100m of typical 4-core screened PTFE cable)	
Logging	Capacity to store > 180 Days of time stamped measurements to internal memory	
Recommended Probes	Isotech Semi Standard PRTs Isotech Model 909 SPRT	
Power	88-264V (RMS), 47-63Hz (universal), 6W maximum or 4 x AA cells	
Dimensions	255mm x 255mm x 114mm / 10" x 10" x 4.5" (W x D x H)	
Weight	2.25kg	
Optional Carring Case	931-22-102	



***NOTE**: Due to our program of continual development and improvement, we reserve the right to amend or alter characteristics and design without prior notice.*



Channel Expander
millisKanner



- Expands milliK to a maximum of 33 Channels
- Supports SPRTs, PRTs, Thermistors and Thermocouples
- Universal Inputs for Flexibility

The millisKanner channel expander has eight input channels, and each can be configured individually for SPRT, PRT, Thermistor or Thermocouple input. This gives ultimate flexibility with no need for separate devices for resistance or thermocouple inputs. A maximum of four devices can be added to the milliK providing 33 sensor inputs as well as the 4 - 20mA Process Input.

With no loss of accuracy and total flexibility a milliK system can be configured to suit a wide range of reference thermometers and units under test. This adaptable system saves on cost with no need for separate dedicated expansion modules and the flexibility maximises the usefulness of each channel.

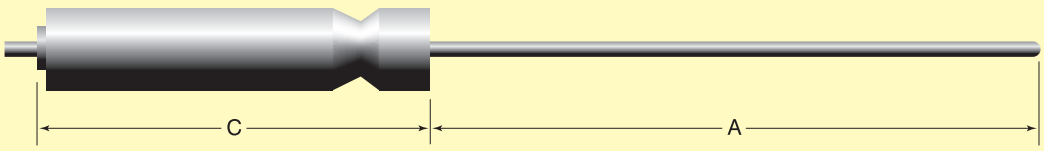
A solid state design avoids mechanical relays and provides high reliability. The inputs are isolated with galvanic isolation between the contacts and the PSU and also from the control circuitry which allows for better measurements and lower noise.

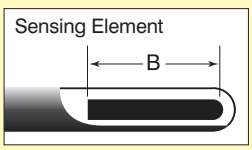
The millisKanner is controlled from the milliK with plug and play operation.

For use as a standalone switch for PRTs, the device has UP / DOWN touch buttons or can be operated via RS232. The temperature of the input thermocouple connectors can be read directly over RS232 to facilitate reference junction compensation.

Model	millisKanner	Max devices per milliK	4
Channels	8	Power	5V DC at 100mA (mains power supply provided)
Channel Indication	LED	CJC Sensor	Digital
Input Connectors	Terminal Post, accepts 4mm plugs, spades and bare wires	Size	255 x 255 x 80mm
	Miniature Thermocouple Sockets	Weight	2.3kg
Control	Automatic: Plug and Play from the milliK		
	Manual: UP / DOWN buttons or RS232		

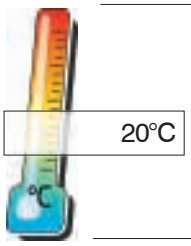
■ **Recommended** Probes (Fit milliK Case)





Model	Maximum Range	Diameter	Length (A)	Sensing Length (B)	Handle (C)	Cable	Application
935-14-61/TTI	-50°C to 250°C	4mm	300mm	6mm	19 x 120mm	2m PTFE	Fast Response, Low Stem Conduction
935-14-116/TTI	-100°C to 450°C	6mm	350mm	25mm	19 x 120mm	2m PTFE	General Purpose

For further options and details, see Reference Probes - Semi Standards, in Isotech catalogue Volume 2 or online.
For laboratory standard thermometers we recommend for SPRTs the Isotech Model 909Q and for thermocouples the Model 1600 Type R, see Catalogue 1: Solutions from Primary & Secondary Laboratories.



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.

Isotech are pleased to be able to offer this design of resistor and we can calibrate the SRA values in our laboratory to the following uncertainties.

Value Ω	Uncertainty, $k=2$
1	< 0.09 ppm
10, 25, 100	< 0.08 ppm
400	< 0.15 ppm

Other details including calibration at NPL, UK on request.

TYPE SRA Values	1, 10, 25 and 100 Ohms 400 Ohms to special order
TYPE SRB Values	1000, 10,000 Ohms
Accuracy of adjustment	±20ppm
Stability	2ppm/year (0.5ppm/year to special order)
Temperature coefficient of resistance	2ppm/°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 10Ω - 10kΩ 5ppm 1Ω

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





- Proven Use
- ±0.005°C stability and gradients
- Will House Several Resistors

This bath is the result of many years of development and is used to maintain the temperature of standard resistors used with thermometry bridges. It can also be used with the Automatic Resistance Bridge Calibrator, A-RBC.

Heating and cooling is accomplished by efficient solid-state Peltier chilling modules giving optimal control around ambient. Solid state cooling ensures minimal power consumption, silent operation and no vibration.

Stability and temperature differences total less than ±0.015°C when measured directly in the oil of the bath and ±0.003°C 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.

Updated Control System

The control system has been updated and now features a large colour display with crystal clear graphics. An Ethernet interface allows the bath temperature to be remotely monitored. For applications where it is necessary to change the bath temperature to determine the resistor temperature coefficient the bath can be programmed to step through a series of temperatures at a controlled ramp rate. Other features include data logging of the bath temperature along with the air intake temperature - the data can be exported to a USB drive.



Internal Assembly

Model	455
Temperature Range	Dew point to 40°C
Accuracy	±0.005°C stability and gradients
Control	0.01°C Resolution.
Interfaces	Ethernet and USB Host
Power	150 W typical, 100-130 or 208-240Vac*, 50/60Hz (*field changeable)
Dimensions	Height - 910mm Width - 635mm Depth - 710mm Weight - 66kgs

Accessories

935-19-72	35 litres of special oil

How to order

455 Standard Resistor Maintenance Bath.
Please specify voltage required.
Please specify number and type of resistors.

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
- 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.

For the highest quality traceability we recommend that the 456 be UKAS Certified. The 10, 25 & 100Ω models can be provided with a DC calibration to ±2ppm; the uncertainty for the 1000 and 10,000Ω versions is 12ppm; other options on request.

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.

The Best Comparison Calibration Equipment

Isotech have a range of professionally engineered comparison calibration equipment covering the temperature range -200°C to 1300°C. Isotech have equipment to match the requirements of National Metrology Institutes, Accredited Calibration Laboratories and in house calibration labs.

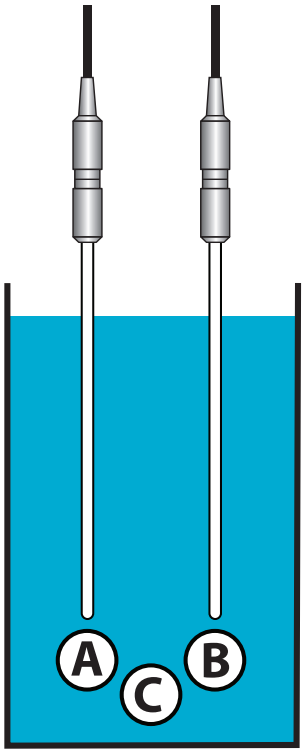
Comparison Calibration

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.

UKAS CALIBRATION
0175

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°C. The Model 459 Cryostat employs Liquid Nitrogen to operate over the range -180C to -80C

Low Temperature Range -80°C to 250°C



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

Medium Temperature Range 50°C to 700°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°C without hazard. The sealed design ensures no powder loss into the laboratory.

High Temperature Range 150°C to 1300°C

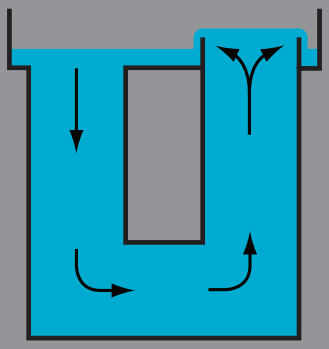


The concentric design of the Isotech 877 Thermocouple Calibration Furnace avoids the large temperature gradients present in simple tube furnaces.

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

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

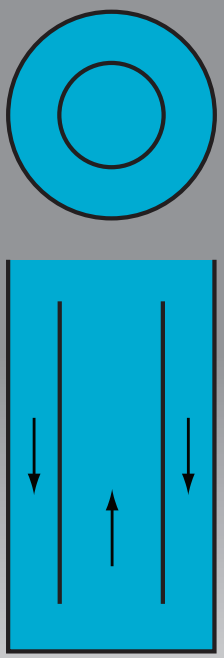
Parallel Tube Design



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



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.

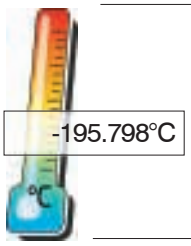


Boiling point of Liquid Nitrogen, -195.798°C
High Accuracy ±0.002K,
Handbook/Tutorial supplied
Self-contained, Bench mounted

Model	ITL-M-18205
Temperature Range	-185°C or -196°C nominal
Uncertainty	±0.002°C
	The temperature distrbution 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.
Power	NA
Dimensions	Below flange 430mm Diameter below flange 127mm Flange diameter 165mm Weight 14kgs

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_2 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 ±0.002°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 equilibriate.

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:

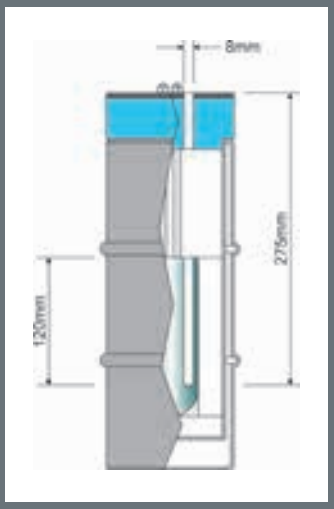
The Simple Liquid Nitrogen Apparatus, because there is air access will slowly condense oxygen from the atmosphere increasing the temperature of the Boiling Point.

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°C Nominal
Uncertainty	±0.002°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 ID Calibration Block Depth 120mm - total immersion depth 275mm

How to order
461 Simple Liquid N2 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 apparatus should be immersed into the Model 459-01-03 Container which must be ordered separately.
The cryostat can then be used in different ways

A: Without being vacuumed: benefit here is no vacuum pump is required

B: Connecting a vacuum pump to the vacuum flange: evacuating the apparatus after reaching temperature will minimise temperature gradients and give optimal performance. A vacuum pump is needed and periodically used to maintain the vacuum.

C: The apparatus can be vacuumed and then back filled with dry nitrogen. This eliminates any moisture and improves thermal conductivity. A vacuum pump, manifold and source of dry nitrogen is required.

Isotech can offer both a hand operate and an electrically operated vacuum pump.



The Cryostat includes an external temperature control system that connects via 2M leads to the Cryostat Assembly.

Recommended Container for Cryostat

Model	459
Cryostat Temperature:	-80°C to -180°C
Stability (30 mins)	±0.005°C

(as measured by one of the 670 thermometers in the bottom of one of the pockets of the cryostat)

Calibration Tubes: Three x 7.5mm Diameter: 466mm Deep

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	460mm
Neck Diameter	120mm
Compatibility	Liquid Nitrogen Containers
Nitrogen Capacity	35 litres

How to Order
459 Cryostat

Accessories
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



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	98mm diameter, 400mm deep (7 litres) **or** 98mm 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

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.

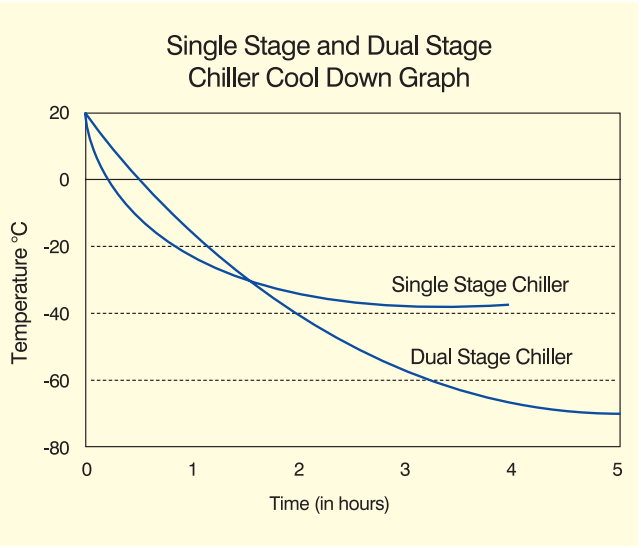
Controller Note:
The standard and enhanced controllers include features custom designed for Isotech by a world-leader in temperature control technology. Power feedback is used to stabilise against supply voltage changes, leading to greater stability. A digital filter circuit ensures high integrity of 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.

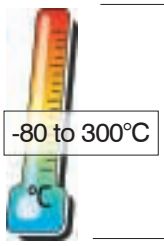
Health and Safety Notice
Rooms in which high temperature liquids are used should be ventilated or have extraction facilities. Although the overall temperature range of the bath is -65°C to 300°C the practical temperature range which can be achieved is dictated by the liquid being used and the ambient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

Refer to 'Liquid Selection Guide' on page 81.





See page 72



Stirred Liquid Baths
785 Parallel Tube



- Uncertainties to <1mK
- Physical separation of heating from Calibration Volume
- Three models covering -80 to 300°C

Isotech calibration baths employ sophisticated designs to ensure calibration to the smallest of uncertainties. In 1986 Isotech purchased the interests of H N Irving & Sons Temperature division which had specialised in providing high quality baths to NPL and other international laboratories.

The knowledge and concepts from this scientific instrument manufacturer were used in the development of the Isotech 815 and 915 Parallel Tube Liquid Baths. Whilst there is a higher cost compared to simple designs the quality and pedigree is unmatched.

The key feature is the physical separation of the chamber in which the liquid is heated or cooled from the chamber that contains the calibration volume in which the thermometers are placed.

The geometry of parallel tube is also important, with the shape and angle of the curves optimised for temperature uniformity.

The new Libra Model 785 achieves this with the same parallel tube assembly as used in the 915 packaged into a different case and now with internal refrigeration can be used to lower temperatures.

The cooling power varies dynamically with the benefit of giving greater stability at lower temperatures.

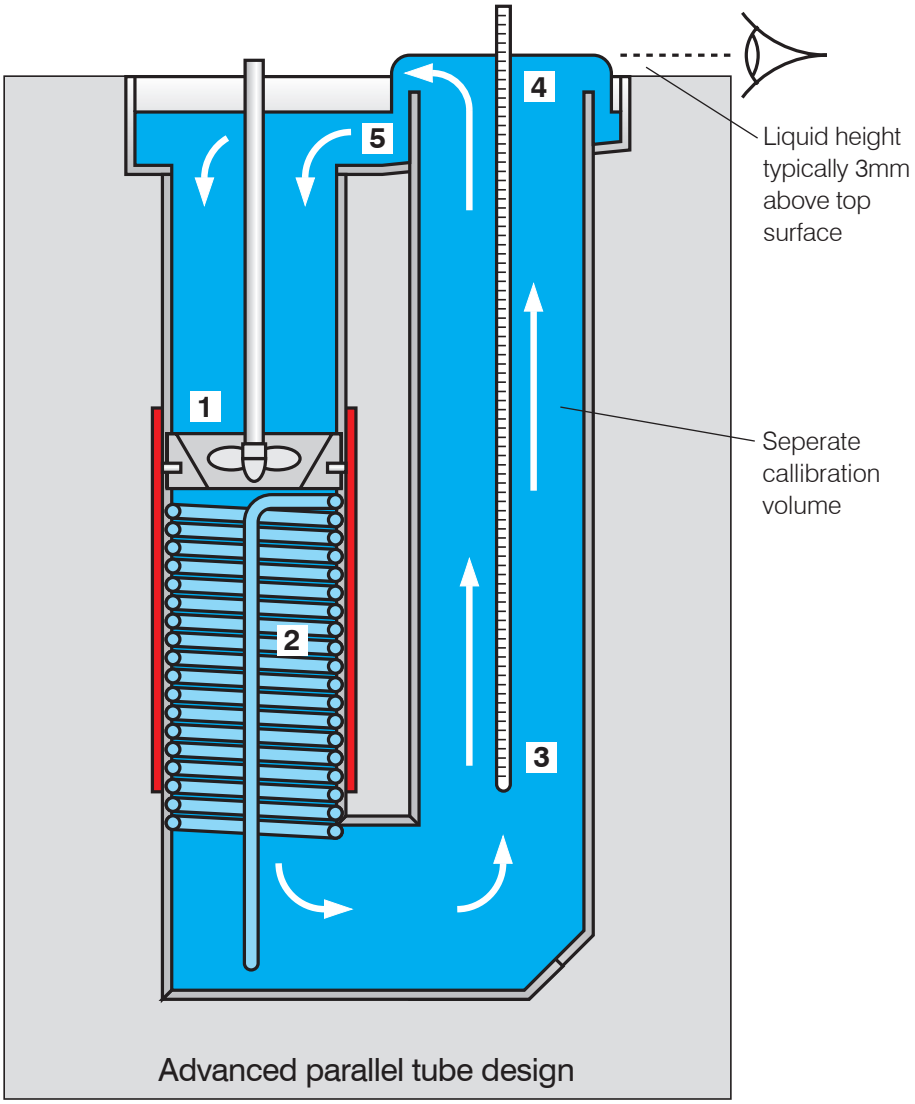
Whilst the bath has a maximum immersion of 485mm the fluid requirement is just 8.5 litres. This helps to lower operating costs as many other baths require a much larger volume of fluid, which in turn can be costly.

Model	All Models	785L	785M	785H
Temp Range		-80°C - 125°C	-40°C - 125°C	30°C - 300°C
Volume			98mm Diameter, 485mm Deep	
Absolute Stability Direct in Liquid	±0.0025°C (Water, 50°C)	±0.006°C (Ethanol, -80°C)	±0.006°C (Ethanol, -40°C)	±0.006°C (C10 Oil, 125°C)
Vertical Uniformity		From <1mK - See evaluation report		
Heating time		25°C to 125°C < 50 mins (C10 Oil)		30°C to 250°C < 150 mins (VH Oil)
Cooling time		0°C to -80°C < 300 mins (Ethanol)	10°C to -40°C < 180 mins (Ethanol)	-
Display Resolution (Whole Range):		0.01°C	0.01°C	0.01°C
Liquid Height (Above Surface)		3mm	3mm	3mm
Design		Parallel Tube: Separate Calibration and Mixing Chambers		
Communications		Includes Serial Interface, PC Cable and Software		
Dimensions		485mm wide, 525mm deep, 1150mm high		
Weight		78kg	68kg	48kg
Safety		Compliant to CE Regulations		
Power		2.8kW	1kW 108-130 or 208-240V, 50/60Hz	800W
How to Order		785L	785M	785H

Refer to Evaluation Report for Full Details

785 Operation

1. The Liquid Flows Down into the Mixing Chamber through an orifice plate, the flow rate of which is adjustable from the front panel.
2. Cooling / Heating Chamber, circular design for optimum flow and uniformity.
3. The calibration chamber is separate from the cooling / heating chamber.
4. The Liquid flows over a weir a little higher than the bath lid suiting total immersion liquid in glass thermometers.
5. The Liquid flows into a large volume liquid tray which caters for the expansion of the liquid as it is heated. The liquid re-circulates around the bath.
6. High Efficiency Thermal Insulation.



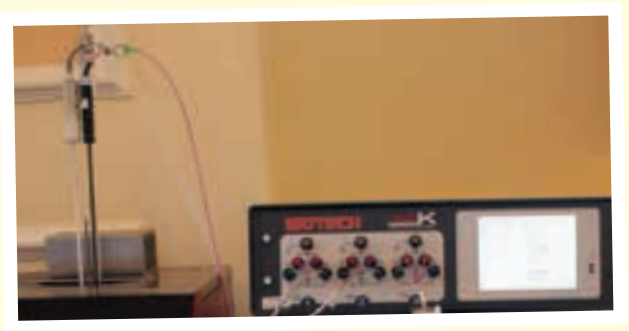
Advanced parallel tube design

Lowest Comparison Calibration Uncertainties

Isotech best practise for comparison calibration of resistance thermometers is to determine the resistance of the thermometer under test by directly comparing it to a Standard Platinum Resistance Thermometer.

The comparison is made using a thermometry bridge, such as the microK, to measure the resistance ratio of the two thermometers. An advantage of this approach is that if both thermometers are of the same type both will follow the same temperature fluctuations and the resistance ratio will remain very stable. This method can largely eliminate the effects of the bath stability, what is needed is temperature uniformity in the calibration volume, it needs to be isothermal.

The physical separation of the calibration chamber from the heating and cooling chamber along with the attention to the segments and contours provide an isothermal volume that is superior to other baths. The result a comparison bath providing the lowest comparison calibration uncertainties, reflected in our UKAS schedule.



Accessories for 785 & 915

These baths can be supplied with a range of accessories including equalising blocks, a support assembly for up 12 LIG thermometers and a monocular to aid reading the scale of a L.I.G. Thermometer.

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.

Refer to 'Liquid Selection Guide' on page 81 for information on liquids and important Health and Safety Information.

915/01a



Variable depth aluminium equalising block containing four drilled pockets 8mm diameter by 160mm 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

(915 only)

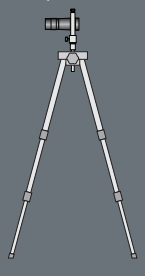
Increased depth Calibration Tube Assembly. Working volume is 100mm diameter by 530mm deep. This variant allows for the calibration of very long thermometers, typically the calibration of long liquid in glass thermometers.

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 thermometer types.

796/03



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.

796-05-03



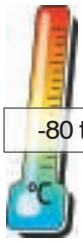
Thermometer Stand Kit

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





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 two models with built in refrigeration (-40°C to 125°C) and (-80°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.

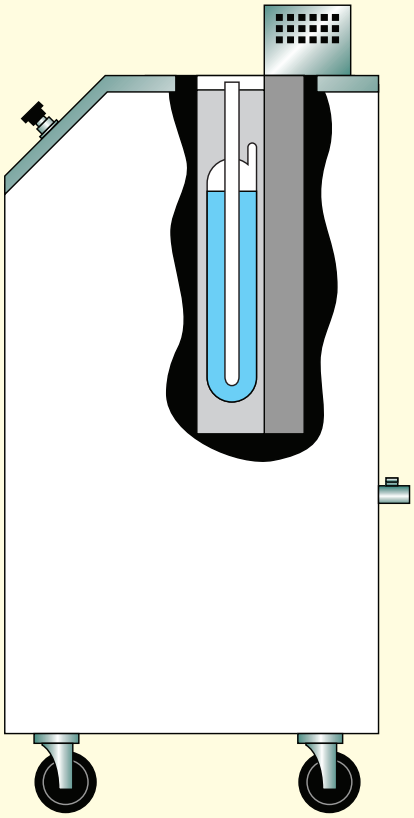
Isotech baths have always been designed for thermometer calibration, setting the standard for immersion depth versus filling costs. As the Orion requires just 8.5L of fluid it offers significant cost savings, both initial and the on going running costs, when compared to other larger volume baths.

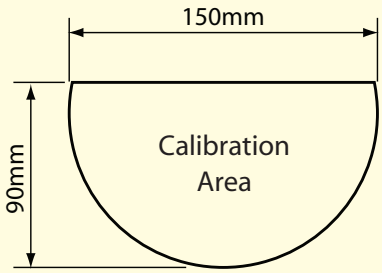
In operation the liquid level is within 10mm of the top lid allowing calibration of liquid in glass thermometers without the need for complicated accessories.

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	796L	796M	796H
Temp Range	-80°C - 125°C	-40°C - 125°C	30°C - 300°C
Volume	150mm Diameter, 470mm Deep (8.5 litres)		
Absolute Stability	±0.006°C (Ethanol, -80°C)	±0.006°C (Ethanol, -40°C)	±0.006°C (C10 Oil, 125°C)
Vertical Uniformity	±0.005°C (Ethanol, 0°C)	0.005°C (Ethanol, 0°C)	±0.007°C (C10 Oil, 125°C)
Heating time	25°C to 125°C < 50 mins (C10 Oil)		30°C to 300°C < 120 mins (VH Oil)
Cooling time	0°C to -80°C < 240 mins (Methanol)	10°C to -40°C < 180 mins (Methanol)	-
Communications	Includes Serial Interface, PC Cable and Software		
Dimensions	485mm wide, 525mm deep, 1150mm high		
Weight	78kg	68kg	48kg
Safety	Compliant to CE Regulations		
Power	2.8kW	1.5kW 108-130 or 208-240V, 50/60Hz	800W
How to Order	796L	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 it's better corrosion resistance, is recommended for oils, alcohol and water.

Refer to 'Liquid Selection Guide' on page 81 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.

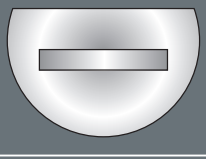
The liquid level is typically within only 10mm of the lid, so complicated fluid level adaptors are not essential.

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

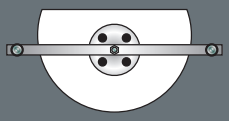
Accesories - Refer to 'Liquid Selection Guide' on page 81 for information on liquids and important Health and Safety Information

Lid



796-05-02 Liquid Volume Lid
Included

Equalizing Block



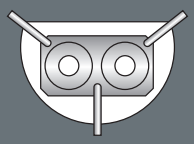
798-05-02A Aluminium Equalizing Block, 4 pockets, 8mm diameter, 160mm deep

798-05-02B Copper Equalizing Block, 4 pockets, 8mm diameter, 160mm deep

798-05-02C Special Aluminium Equalizing Block
To suit customer requirements.

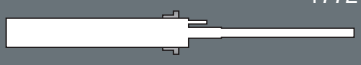
798-05-02D Special Copper Equalizing Block
To suit customer requirements.

Dual Cell Holder



796-05-01 Standard Dual Cell Holder
Includes interchangeable Cell adaptors

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

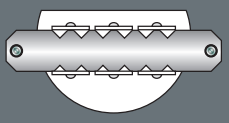


17401M Slim Gallium Melt Point Cell
29.7646°C



17668ML Indium Freeze Point Cell
156.5985°C

Sensor Holder



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

Overflow Adapter

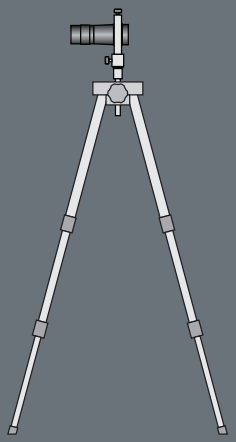


796-02-10 The Orion liquid level is within 10mm of the top lid allowing most liquid in glass thermometers to be calibrated.

For applications where the liquid level needs to be higher than the lid the Overflow Adapter can be be fitted to the Orion L and M
This assembly includes a motor to pump the liquid and raises the liquid level 20mm above the top lid

Includes Power Supply

Monocular and Support

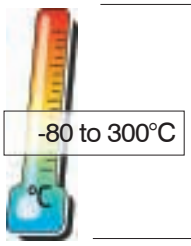


796-03 Monocular with x8 magnification to ease reading liquid in glass thermometers
Includes Tripod

Blackbody Accessory



798-05-02 This accessory allows the calibration of infrared (IR) thermometers



Stirred Liquid Baths
Hydra 798



- Three 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 features 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.

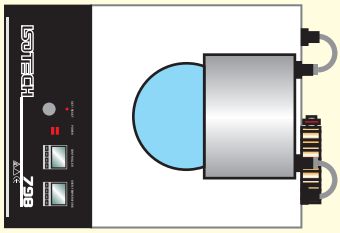
Cooling...
The cooling is built-in and also surrounds the calibration volume creating a low temperature ambient in which the heater can function efficiently.

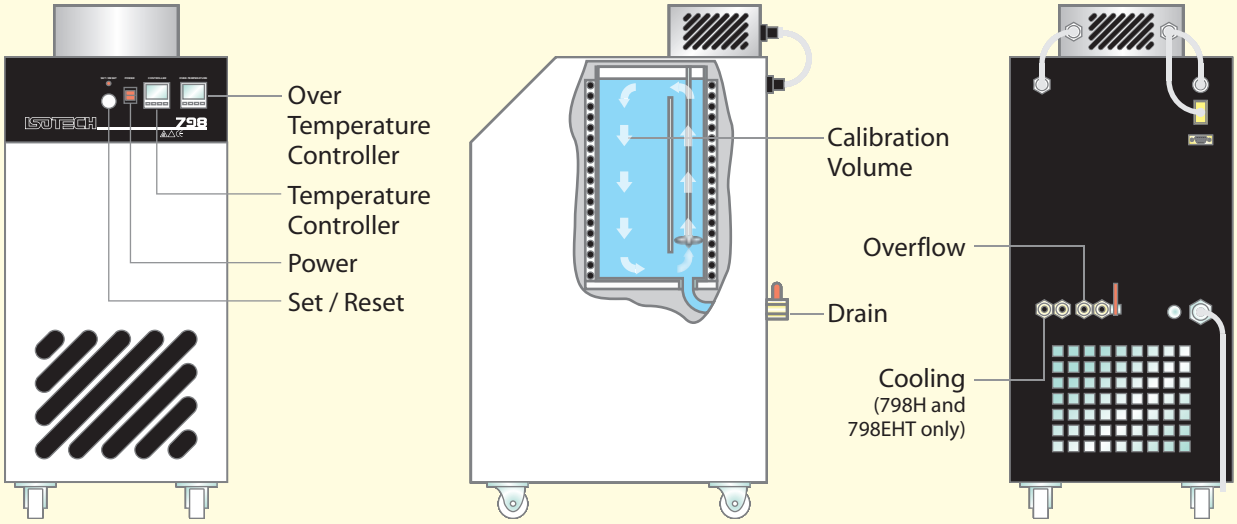
Wider Temperature Range...
A unique cooling system cools the unit as well as enabling the bath to heat up to 125°C (121°C is a key sterilization temperature).

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
Temp Range	-80°C - 125°C	-40°C - 125°C	30°C - 300°C
Volume	150mm Diameter, 300mm Deep (5 litres)		
Absolute Stability	±0.030°C (Ethanol, -80°C)	±0.017°C (Ethanol, -40°C)	±0.015°C (Oil, 250°C)
Vertical Uniformity	±0.002°C (Oil, 50°C)	±0.002°C (Oil, 50°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, 980mm High (870mm to Top Panel)		
Weight	59kg	46kg	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
How to Order	798L	798M	798H

Refer to Evaluation Report for Full Details



Stirred Liquid Baths
798O

- Calibrate a larger number of probes simultaneously
- Specialised for Oceanographic Sensor Calibration
- Option for salt water tanks

The Isotech 798O Stirred Liquid Bath is an evolution in precision calibration that builds upon the legacy of the Isotech 798 series. This comparison bath is designed to meet the growing demands for high-volume and specialized calibration, including oceanographic sensors, with its expanded calibration volume.

Compared to Isotech's other baths, the large volume of the 798O allows the calibration of more thermometers and sensors simultaneously. This capability significantly enhances workflow efficiency, especially in environments where high-volume calibration is required.

The 798O stands out with its precise oceanographic sensor calibration capabilities, enhanced by specialized accessories and additional tanks for saltwater calibration, "Oceanographic Calibration Reservoirs, (OCR)". This adaptability highlights the 798O's versatility in meeting a wide variety of needs. Its energy-efficient design ensures operational cost savings and minimizes environmental impact, aligning with the eco-conscious principles.

Designed to surpass traditional large volume saltwater baths, the 798O offers faster calibration cycles, essential for time-sensitive processes. This highlights Isotech's commitment to innovation. Supported by Isotech's renowned quality assurance and comprehensive after-sales support, the 798O delivers reliability, durability, and accuracy, making it a trusted solution for precise temperature control and calibration needs.

Capable of handling a wide range of calibration tasks, the 798O's versatility makes it an invaluable device in laboratories, research institutions, and industries requiring precise temperature calibration.



Its operational efficiency and advanced features solidify its status as a future-proof solution that integrates seamlessly into calibration workflows, providing unmatched performance and reliability. The Isotech 798O Stirred Liquid Bath sets new standards in calibration technology, offering precision, speed, and an eco-friendly approach to modern calibration challenges.

Enhanced Calibration Volume
The 798O version features a larger calibration volume, accommodating more thermometers simultaneously. This improvement addresses customer requests for greater capacity, making the bath ideal for high-volume calibration tasks.

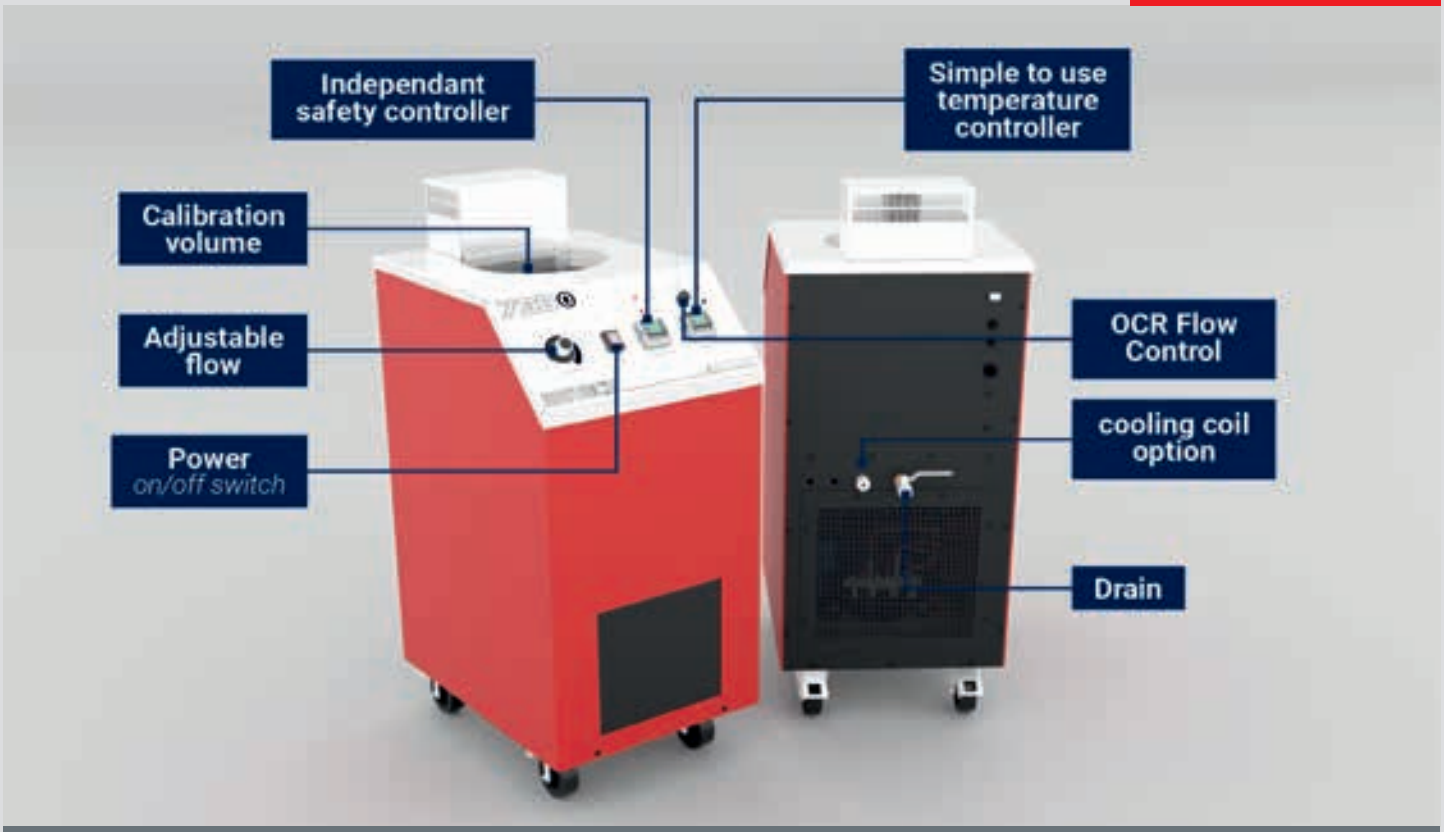
Isotech Quality and Support
Renowned for quality and reliability, Isotech ensures precise control and stability in temperature calibration, supported by superior after-sales service for a complete calibration solution.

Oceanographic Sensor Calibration
Specifically designed accessories enable the calibration of oceanographic sensors.

Faster Calibration
The bath can be equipped with accessories for saltwater calibration, catering to the unique needs of marine science instrumentation, ideal for urgent calibration tasks.

Versatile Calibration Solutions
The bath's design and accessories support a wide range of calibration options, including those for temperature sensors, oceanographic instruments, and more, providing a versatile tool for diverse calibration needs.

Enhanced Efficiency Over Large Volume Saltwater Baths
The 798O significantly accelerates calibration cycles compared to traditional large volume salt water baths. Benefit from reduced energy costs without sacrificing performance.



Model	798O
Temp Range	-40°C to 125°C
Volume	798O: 240mm Diameter, 310mm Deep (15 Litres)
	OCR Salt Water Tank: 226mm Diameter, 250mm Deep (6 Litres)

Thermal Performance

798O Calibration Volume

	Stability	Uniformity	
		Axial	Radial
-40°C	±0.01°C	0.016	0.004
-20°C	±0.008°C	0.004	0.009
0°C	±0.008°C	0.011	0.005
20°C	±0.008°C	0.011	0.004
50°C	±0.003°C	0.002	0.004
125°C	±0.008°C	0.014	0.005

Oceanographic Calibration Reservoir

	Stability	Uniformity	
		Axial	Radial
0°C	±0.003°C	0.007	0.006
50°C	±0.002°C	0.002	0.005
Extended Range			
-40°C	±0.007°C	0.015	0.003
-20°C	±0.007°C	0.017	0.003

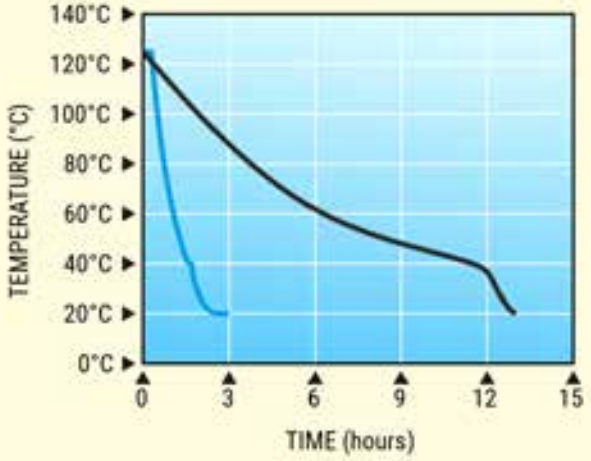
Heating Time	20°C to 125°C < 75 mins
Cooling Time	125°C to 40°C < 12 hours
	20°C to 0°C < 120 minutes
	20°C to -30°C < 300 minutes
Cooling Time (using Internal Cooling Coil)	125°C to 40°C < 3 hours
Communications	Includes Serial Interface, PC Cable and Software
Dimensions	405mm Wide, 610mm Deep,
	980mm High (870mm to Top Panel)
Weight	59kg
Power	1.5kW
	110V 50/60Hz or
	230V 50/60Hz
How to Order	Model 547

Cool Down Graph (125°C to 20°C)

In the Calibration Volume

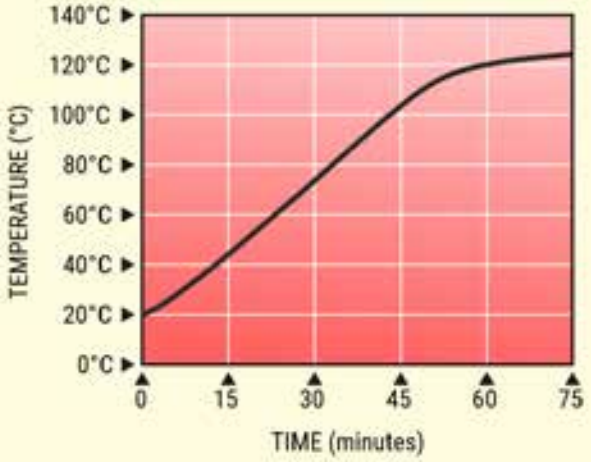
using internal cooling coil ■ without

The high efficiency of the insulating foam extends the cooling time from 125°C to ambient temperature. To cool more quickly, water can be passed through a cooling coil, enhancing heat dissipation and speeding up the process.



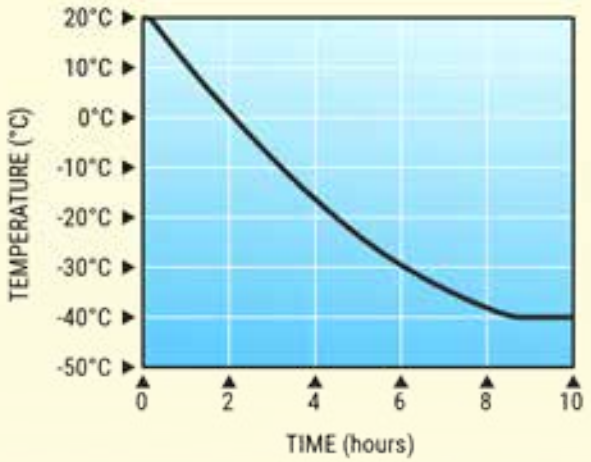
Heat Up Graph (20°C to 125°C)

In the Calibration Volume



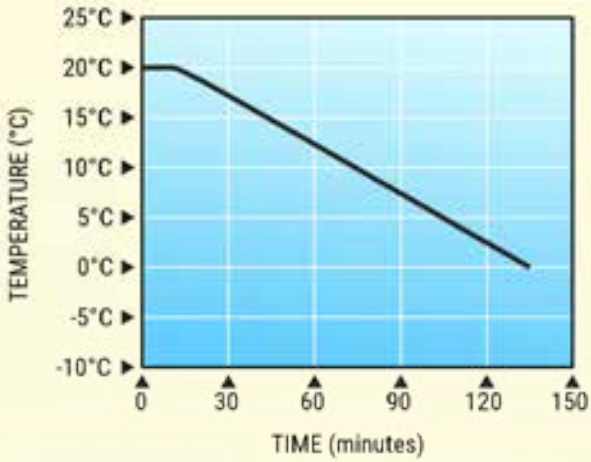
Cool Down Graph (20°C to -40°C)

In the Calibration Volume

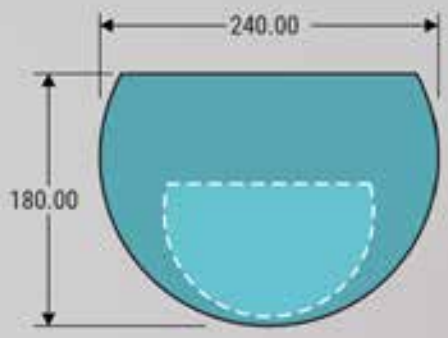


Cool Down Graph (20°C to 0°C)

In the Oceanographic Calibration Reservoir



Volume Comparison with the 798M



798O Calibration Area *(volume 14 litres)*

798M Standard Calibration Area *(volume 5 litres)*



Oceanographic Calibration Reservoirs

Introducing the Oceanographic Calibration Reservoirs (OCRs) - a pioneering addition to the Isotech 798O Stirred Liquid Bath, designed to revolutionise oceanographic sensor calibration. These smaller reservoirs fit into the main calibration volume and can contain salt water for precise probe calibration. The design allows the smaller tank with salt water to sit within the Larger volume, enabling it to be quickly cooled to 0°C without ice formation. This benefits the User with fast cooldown times and significant energy and cost savings compared to using large-volume saltwater tanks.

Seawater Compatability
Designed with seawater-compatible materials, the OCRs ensure durability and corrosion resistance, offering a realistic calibration environment for accurately simulating marine conditions, providing a realistic calibration environment for marine sensors.

Precision Calibration
Designed to integrate seamlessly with the Isotech 798O, the OCRs offer a controlled calibration space that enhances the precision of temperature measurements for oceanographic sensors.

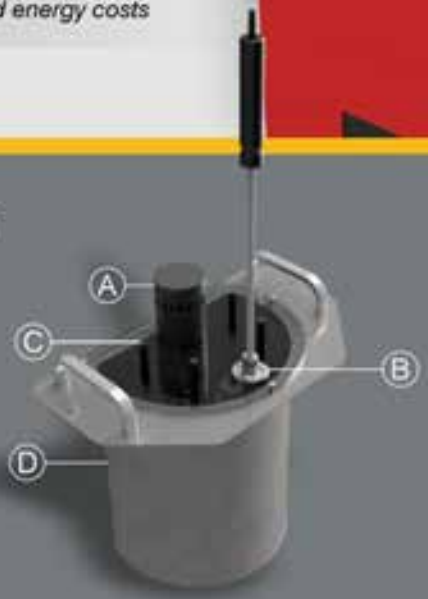
Speed
Using the smaller OCR in the 798O allows for rapid cooling without ice formation and also fast heating with reduced energy costs.



Using the smaller OCR in the 798O allows for rapid cooling without ice formation and fast heating with reduced energy costs

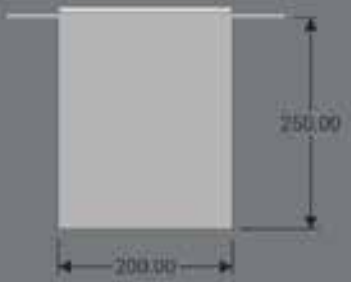
Oceanographic Calibration Reservoirs Specifications

The standard OCR is designed for up to four oceanographic probes (maximum diameter 40mm) to be suspended from the lid. Alternatively special OCRs can be designed to suit your specific probe(s), please contact Isotech for more details.



A: OCR Stirrer Motor
B: Reference Probe Clamp
C: Oceanographic Sensor
D: Saltwater Reservoir





Parameter	OCR
Model	798-OCR-A *(Up to 4 probes of up to 40mm diameter)* 798-OCR-S *(Special, contact Isotech for more details)*
Temperature Range	0°C to 50°C
Volume	5.3 Litres



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 ±0.01°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 81 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	±0.003°C (Direct in water, 50°C) ±0.020°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

Refer to Evaluation Report for Full Details

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

Liquid Selection Guide

When selecting a liquid for a calibration bath a number for 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. Care needs to be taken as alcohols can be toxic and flammable. There are nontoxic alternatives, including Florinert™ from 3M™ and Halocarbon 0.8 from Halocarbon. The disadvantage is that these fluids can be expensive compared to alcohol and can also evaporate quickly, see www.3m.com and 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 dew point, and then above 100°C

Isotech do not recommend the use of corrosive liquids such as saline solutions and others as any spillage or dripping can cause damage to other parts of the baths.

Isotech Oils for Hydra, Orion, 785 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.





Fluidised Calibration Bath
Model 875



- Wide Temperature Range, Deep Immersion & High Accuracy
- Clean & Safe: No salt, no powder loss
- Ideal for Comparison Calibration of Thermometers

The Isotech Model 875 Fluidised Calibration Bath is a high-precision solution for thermometer calibration across a broad temperature range. It outperforms traditional salt baths by offering safer operation, excellent thermal stability, and reduced maintenance. Developed over more than 20 years of research into powder flow, fluidisation, and filtration, the 875 is trusted by national laboratories, ISO 17025 accredited facilities, and demanding industrial users. It is particularly well-suited for the temperature calibration of long-stem MIMS thermocouples.

Designed to deliver consistent and repeatable results, the 875 excels in comparison calibration. Its fluidised powder medium provides exceptional temperature uniformity and thermal contact—without the risks associated with corrosive salt media.

A key advantage of the Model 875 is its deep immersion capability of up to 475 mm—significantly more than dry block calibrators. This reduces stem conduction errors which is critical for high-accuracy calibration. In our own ISO 17025 accredited laboratory, we use the 875 for comparison calibration of Platinum Resistance thermometers from 300°C to 700°C, achieving uncertainties as low as ±0.020°C at 300°C and ±0.035°C at 660°C.

The system uses high-purity aluminium oxide powder, fluidised by compressed air passing through a porous base plate. This creates a uniform, stable medium with excellent heat transfer properties. Unlike many fluidised baths that rely on metal blocks or collapsing the bed to improve stability, the 875 delivers full thermal performance with the powder in flow.

Model	875
Temp Range	50°C - 700°C
Volume (875/02)	67mm diameter, 475mm deep
Accuracy	Comparison Calibration: Uncertainties to ±0.035°C at 660°C See website for full details
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	No Salt. Blocked filter cut-out, low air flow indication, thermal fuse
Power	3kW (3 x 1kW heaters), 208-240V, 50/60Hz
How to Order	Model 875 Fluidized Calibration Bath

Refer to Evaluation Report for Full Details



The 875 now includes the 875/15 equalising block with eight pockets 8mm diameter by 240mm deep - which can set to different heights using a range of three spacing blocks.

Accessories

The following options are available:

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 875/06



The 875/15 shown in the calibration tube 875/02 - all included as standard

200 to 1200°C

Thermocouple Calibration Furnace
Model 547



- High Accuracy Thermocouple Calibration
- Calibrates both Laboratory & Industrial Thermocouples
- Options for Blackbody Calibration

The Model 547 is the professional solution for accurate and contamination-free temperature calibration, designed to meet the needs of professionals in a wide range of industries, from industrial to laboratory.

The furnace can be equipped with a blackbody target, making it ideal for calibrating infrared thermometers. For even higher accuracy, it also offers the option to use blackbody cells, ensuring ultimate precision and lowest calibration uncertainties.

The Model 547 is also designed to accommodate open-ended multi-zone thermocouples, making it an ideal choice for calibration professionals in the semiconductor industry.

With a focus on safety and convenience, the Model 547 has been “designed by metrologists for metrologists”.

When used in combination with our companion products for checking thermocouple homogeneity, laboratory standard thermocouples, cold/reference junction equipment, and software to automate thermocouple calibration, it is a complete solution for all your temperature calibration needs, that no other company can rival.

Invest in the Model 547 Thermocouple Calibration Furnace and experience the ultimate in temperature calibration accuracy and convenience.

- **Wide Temperature Range**
  Operates efficiently from 200°C to 1200°C with exceptional stability and uniformity.

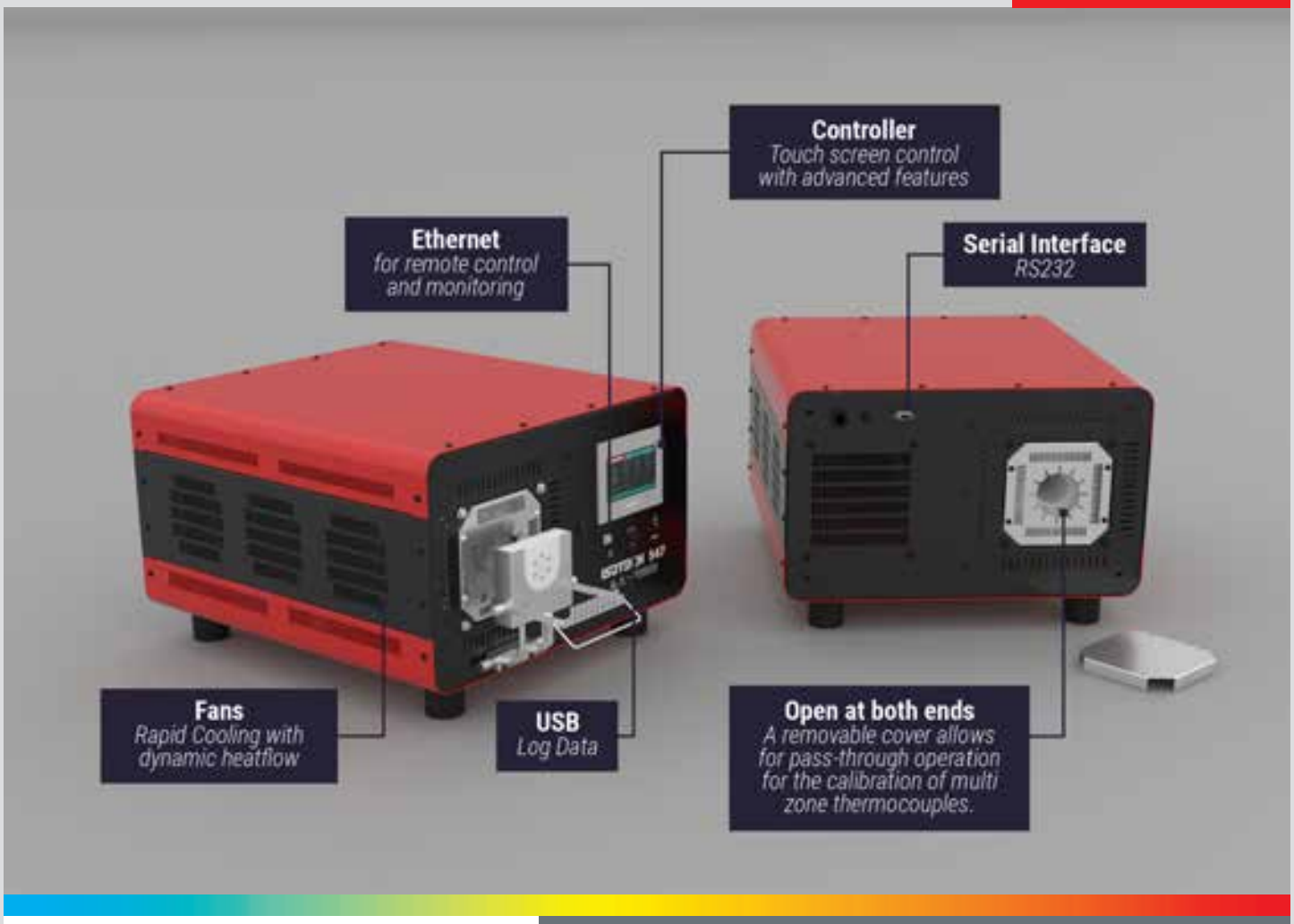
- **Versatile Calibration Options**
  Suitable for various thermocouple types, including laboratory standards and industrial sensors, with support for infrared thermometer calibration using blackbody targets.

- **Advanced Calibration Corrections**
  Switchable correction curves for deep and short immersion calibrations. Customise up to 16 correction points per immersion type, ensuring precise calibration across the full range. This feature improves accuracy and flexibility for all calibration requirements.

- **Rapid Heating and Cooling**
  Heats from 50°C to 1200°C in just 45 minutes and cools from 1200°C to 300°C in 90 minutes.

- **Automated Calibration Capability**
  Expandable for automated processes with software integration, allowing for efficient and precise calibration management.

- **User-Friendly Interface**
  Features a 4.5” touchscreen display for easy control and advanced three-zone temperature regulation.





Model	547
Temp Range	200°C to 1200°C
Stability	<0.08°C over the entire range
Uniformity	@200°C ±0.2°C @1200°C ±0.3°C
Display	4.5” Touchscreen
Display Resolution	0.1°
Heating Time	50°C to 1200°C in 45 minutes
Cooling Time	1200°C to 300°C in 90 minutes
Calibration Volume	46mm diameter x 450mm deep
Minimum Immersion	180mm
Interface	Ethernet, Serial (RS232), USB Host
Power	3kW
Dimensions	W510mm x H325mm x L660mm
Weight	55kg

Model 547 - Accessories (Inserts)

Choice of Alumina or Metallic Inserts

Alumina: metal free inserts - avoid contaminating laboratory standard thermocouples

Metal: high temperature alloy inserts for high capacity industrial sensor calibration

Inserts with Sensor Pockets or Through Holes

Drilled with Sensor Pockets: for calibrating laboratory standard and industrial sensors

Drilled with Through Holes: for calibrating multi zone thermocouples



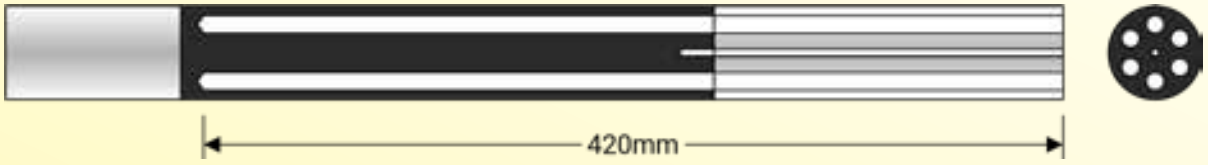
Metallic Insert	547-07A	547-07B	547-07C	547-07D
Insert Diameter	45mm	45mm	45mm	Custom Insert Please Specify
Insert Length	130mm	260mm	260mm	
Insert Type	Sensor Pockets	Sensor Pockets	Through Holes	
Holes	6 x 8mm holes	6 x 8mm holes	6 x 8mm holes	

Ceramic Insert	547-07E	547-07F	547-07G	547-07H
Insert Diameter	45mm	45mm	45mm	Custom Insert Please Specify
Insert Length	130mm	260mm	260mm	
Insert Type	Sensor Pockets	Sensor Pockets	Through Holes	
Holes	6 x 8mm holes	6 x 8mm holes	6 x 8mm holes	

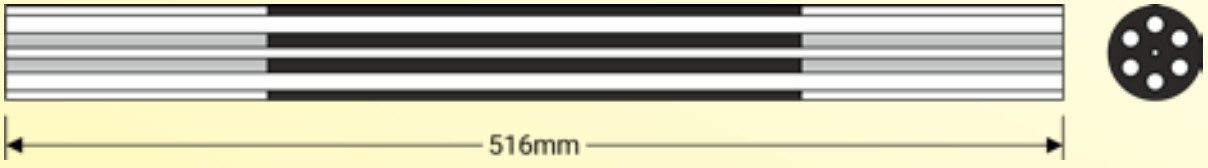
Short Insert



Long Insert



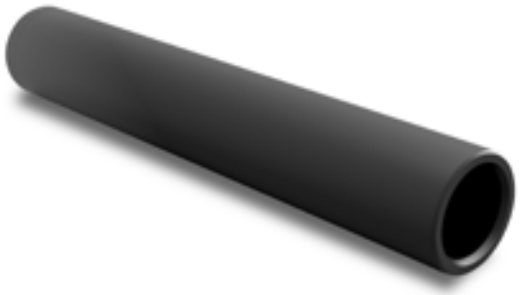
Drilled Through Insert



Model 547 - Accessories (Blackbody)

Infrared Thermometer Calibration

Calibrate Infrared Thermometers using the options of Blackbody Target or Blackbody Fixed Point Cells



Blackbody Target	547-07I
Target Diameter	45mm
Target Length	273mm
Aperture	Standard

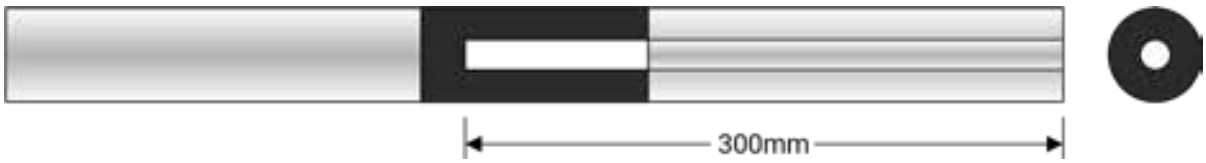
Blackbody Target



Blackbody Cell	547-07J	547-07K	547-07L
Cell Type	Zinc	Aluminium*	Silver*
Temperature	419.527°C	660.323°C	961.780°C
Aperture	10mm	10mm	10mm

* These cells are required to be surrounded by gas for protection at higher temperatures, see Model 984

Blackbody Cell (Zinc / Aluminium / Silver)







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 ±0.25°C and ±0.1°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 Thermometer Pockets	8 as standard 16 to special requirements
Diameter of Sensors	4 x 6mm + 4 x 8mm
Depth of immersion	180mm
Accuracy	±0.25°C to ±0.1°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 ±0.25°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.*

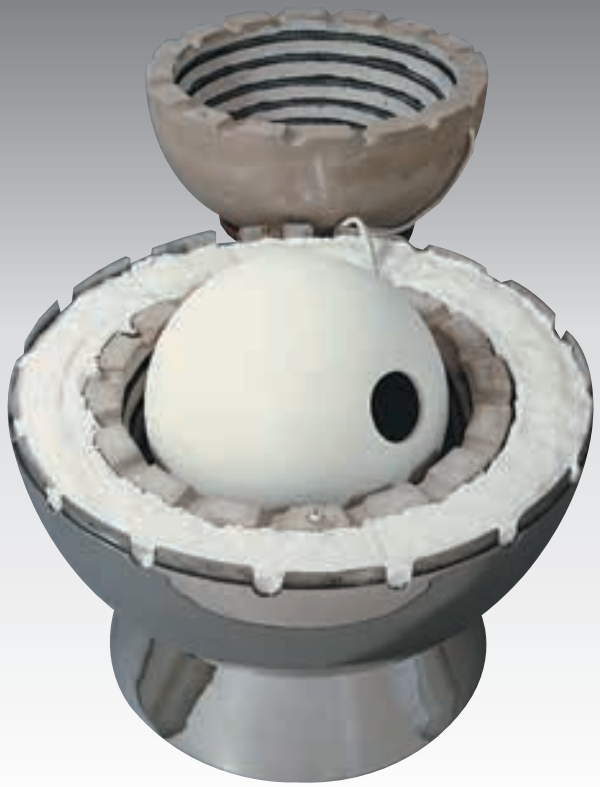
Accessories

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).

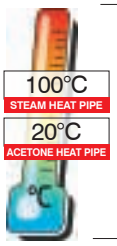
4 Blackbody Option.

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.

The external control system uses power feedback to stabilise against supply voltage changes providing greater stability. A digital filter circuit ensures high integrity of measurement, correcting for drift and noise





Thermocouple Homogeneity Scanner

Model 881



- Determine Uncertainty Due to Inhomogeneity
- Identify Contaminated Sections of Thermocouple Wire
- Assess Quality of Thermocouple Wires

Dual Heat Pipe Thermocouple Homogeneity Scanner

The 'Isotech Model 881 Dual Heat Pipe Thermocouple Homogeneity Scanner' provides a fully automated solution to the problem of measuring thermocouple homogeneity.

The operation of a thermocouple relies on the Seebeck effect which causes an emf to be generated in any region of a thermo element that is exposed to a temperature gradient. Undesirably, nearly all thermocouples develop non-uniformities (inhomogeneities) in their thermoelements during normal use.

If one is to assess the accuracy of a thermocouple, then the inhomogeneity of the thermocouple is a major concern. Increasingly users and laboratories are wanting to be able to measure thermocouple inhomogeneity.

The scanner can be used to determine:

- The uncertainty due to inhomogeneity
- The location of damaged regions that should be avoided
- Whether an annealing procedure has been successful
- If wire/cable manufacturing processes meet quality standards or tolerances
- Whether a thermocouple is damaged or faulty and unfit for use or calibration

Specification

Model	**881**
Operating Temp.	100°C
Max. Immersion Depth (Steam Heat Pipe)	1000mm
Recommended T/C Diameter	1.5mm to 4.0mm
Scanning Time	<20 minutes
Scanning Resolution	2 - 5mm
Dimensions	Height 2,685mm Width 210mm Depth 212mm
Weight	25kg
Power	175 watts
How to Order	881 Thermocouple Homogeneity Scanner

Homogeneity Scanner Basics

A homogeneity scanner is a device used to interrogate the Seebeck coefficient of thermocouples. The Model 881 uses a single narrow temperature gradient. By moving the test thermocouple through this gradient, only the region exposed to the temperature gradient will generate an emf as demonstrated in Figure 1. Any deviations in this emf from the reference function will indicate the presence of an inhomogeneity. Clearly, the width of the temperature gradient will determine the scanners resolving potential and its ability to detect inhomogeneities. The Model 881 has a scanning resolution of 2 - 5mm depending on the diameter of the thermocouple.

This high resolution is achieved by using two closely spaced heat pipes operating at different temperatures, T1 and T2. The bottom, high-temperature heat pipe uses steam whereas the top low-temperature heat pipe uses acetone. The speed of the scanning operation is chosen to match the speed of thermal conduction occurring within the thermocouple, allowing effective scanning of both ceramic sheathed and metal sheathed thermocouples.

A benefit of using steam is that it is non-contaminating. Therefore, the thermocouple can be in direct contact with the heating medium allowing the thermocouple temperature to be rapidly raised to that of the steam temperature. Consequently, thermocouples can be scanned at far higher speeds than traditional oil-bath based scanners. Oil-bath scanners will often employ a re-entrant tube, used to prevent contamination, but which inherently limits heat transfer.

Development of the Model 881

The device was developed at the Measurement Standards Laboratory of New Zealand and the manufacture and commercial sale has been licensed to Isothermal Technology Ltd, UK (Isotech). The scanner has been in development for more than 10 years and is based on world leading research [1].

Compared to previous work, this design offers faster operation and higher resolution from a single gradient scan. In this new version the hardware, electronics and software have been optimised and integrated to create an easy-to-use high-accuracy thermocouple scanner that is suitable for measuring inhomogeneities in both base and rare metal thermocouples.

Benefit from the Scanner

As well as the rapid and accurate scanning system, the user benefits from the unique software that takes the results and processes the data into information that the user needs to assess the acceptability of the thermocouple being investigated. The software also makes it easy for the user to calculate an uncertainty component due to inhomogeneity when calibrating thermocouples.

Digital Volt Meter

The 881 Thermocouple Homogoneity Scanner requires the use of a DVM (Digital Volt Meter) which is not supplied as standard. Isotech recommends the Keithley 2182A Nanovoltmeter.

Mounting the Scanner

The scanner is not self-supporting and it is essential that the scanner is attached to a wall in order to support it and prevent it from toppling over.

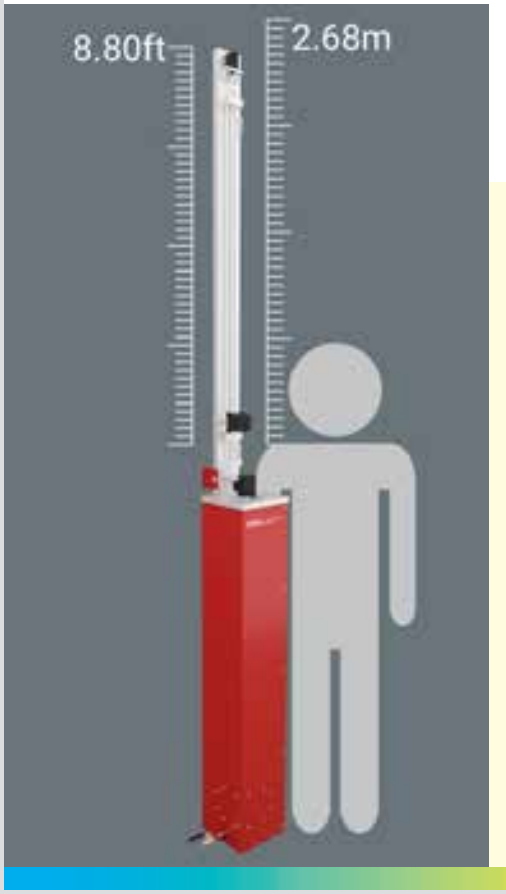
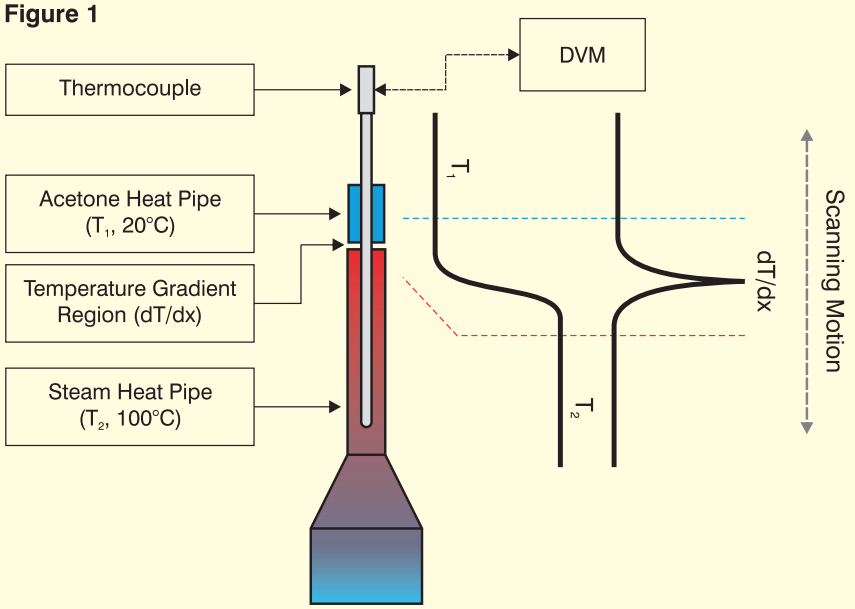


Figure 1



Introducing Absolute Calibration with **ITS-90 Fixed Point Cells**

For calibration to the smallest of uncertainties thermometers are calibrated by placing them into a series of Fixed Point Cells. For example pure aluminum freezes at 660.323°C so by first melting a cell containing pure aluminum, then placing a thermometer into it as the metal changes state, from a liquid to a solid, a very precise calibration point is realized.

This absolute or fixed point calibration is performed by National Metrology Institutes providing primary standards and directly realizing the International Temperature Scale, ITS-90. Isotech's solutions for Primary Standards are found in a separate publication, *"Volume 1: Solutions for Primary & Secondary Laboratories."*

Isotech also offer a range of ITS-90 Fixed Point systems that are less expensive, easier to use and more robust than the larger cells used by the international NMIs.

For some countries, where the local industry needs are less demanding Slim Cells are used by NMIs and Isotech can offer UKAS calibration with uncertainties from 0.5mk to 2mK over the range -38°C to 660°C.

Users in industrial and secondary laboratories benefit from using Slim Cells to calibrate to smaller uncertainties than is possible with dry blocks or liquid baths. The Isotech Slim Water Triple Point Cell is comparable in cost to a specially drilled metal insert, putting it in the reach of all calibration engineers. Using a Water Triple Point Cell allows cost effective checking of standards between calibrations, and to help determine when a thermometer needs recalibration. Water triple point cells have uncertainties less than 0.001°C at a very modest cost.

In order to use an ITS-90 Fixed Point Cell, apparatus is needed, it must create a zone of constant temperature around the cell so that the cell can melt of freeze uniformly. Isotech equipment uses multi zone heating or for optimal performance a heat pipe or heat siphon. To calibrate a thermometer it must be sufficiently immersed that further immersion would make no temperature change to the thermometer.

A new innovation from Isotech is the Isothermal Tower, which combines apparatus, a heat siphon, fixed point cell and an immersion compensation device.* The Isothermal Towers are simple to use integrated devices providing optimal performance.

There are also ranges of apparatus that can accept a range of cells, see table opposite. These models can also be used without cells, including use as Dry Blocks for immersion depths of up to 300mm - ideal for larger sensors.

** Patents applied for*



Fixed Point	State	Temperature °C
Argon	Triple Point	-189.3442
Mercury	Triple Point	-38.8344
Water	Triple Point	0.010
Gallium	Melt Point	29.7646
Indium	Freeze Point	156.5985
Tin	Freeze Point	231.928
Zinc	Freeze Point	419.527
Aluminium	Freeze Point	660.323
Silver	Freeze Point	961.78

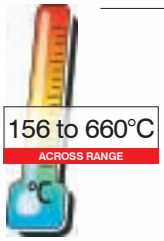
Equipment

The ITS-90 Cell needs equipment in order to melt, freeze or maintain it. Many combinations of Isotech equipment can be used; liquid baths, dry blocks and furnaces.

Isotech have a range of Dry Blocks that allow the fixed points to be easily realized at an affordable price.
The combination allows you to calibrate at a "Point On The Temperature Scale" hence the name POTTS.

Point	Temperature	Suitable Apparatus	
Mercury	-38.8344°C	Europa	
B8 Water Triple Point	0.01°C	Europa Venus	
B12 Water Triple Point	0.01°C	Oceanus	
Gallium	29.7646°C	Europa Venus Calisto	
Indium	156.5985°C	Medusa 510 Medusa 511 ISOTower 490	 
Tin	213.928°C	Medusa 510 Medusa 511 ISOTower 491	 
Zinc	419.527°C	Medusa 510 Medusa 511 ISOTower 492	 
Aluminium	660.323°C	Medusa 510 Medusa 511 ISOTower 493	 
Silver	961.78°C	Oberon	
Copper	1084.62°C	Oberon	

ISOTowers are intergrated devices including the ITS-90 Fixed Point Cell



ITS-90 Isothermal Towers
ISOTower

- High accuracy
- Fast to temperature
- Simple to use

The most accurately defined temperatures are those defining points (fixed points) of ITS-90.

The leading Primary Laboratories use large fixed point cells in deep calibration furnaces that utilise Heat Pipes to eliminate temperature gradients. This combination of cell and furnace gives the smallest of uncertainties.

In Isothermal Towers the fixed point cell and heat pipe (or heat siphon) have been combined (patent applied for) to produce the ideal realisations for calibrating standard thermometers.

Thermometers can only be calibrated accurately if they are immersed sufficiently.

In Isothermal Towers a heated block (Immersion Compensator, patent applied for) sits on top the heat siphon/cell to fully compensate for the immersion characteristics of the unit under test.

The Isothermal Towers performance has been fully evaluated against the most detailed and demanding requirements ever written: CCT/2000-13.

All Isothermal Towers; Indium, Tin, Zinc and Aluminium meet all the requirements of CCT/2000-13 allowing laboratories to realise the smallest uncertainties, at a fraction of the cost of conventional Metrology Furnaces with Primary Standard Cells

You can purchase three Isothermal Towers; Tin, Zinc and Aluminium for a similar price as one conventional cell and heat pipe apparatus!



Isothermal Towers are simple to use, and very robust. Operation is risk free, as a combined apparatus there is no need to handle a fragile cell. No need for specialist training courses. Isothermal Towers remove the mystery from fixed point calibration.

Easily set to provide a melt or freeze of 24 hours or more, lending themselves for automatic calibration and providing your lab with an all day long plateau.



Perfect Audit Item

As an audit item, an accreditation authority can send the device to laboratories for intercomparison.

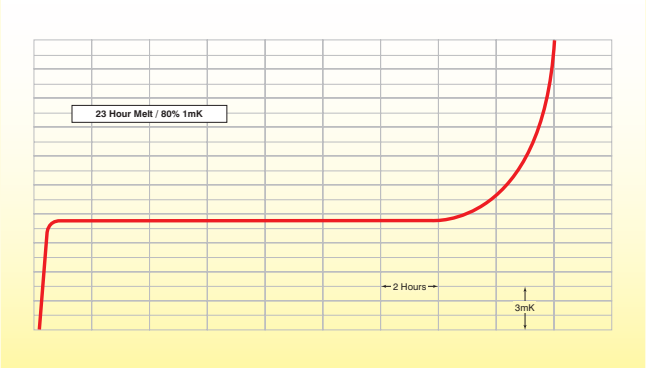
Because the cell, apparatus and immersion compensator are a single entity, the performance is unambiguous unlike existing systems where cell and apparatus are often separated during intercomparison. Accreditation authorities love them.

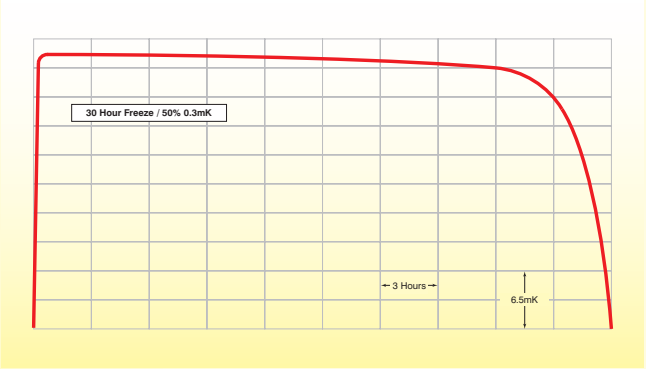
Available to Hire

Additionally Isothermal Towers are available to hire from Isotech and a growing number of Isotech Distributors to allow laboratories to audit themselves by intercomparing their cells and standard thermometers to a UKAS calibrated Isothermal Tower.

Transportable

ITS-90 Isothermal Towers are transportable by carrier; there are no fragile glass parts!



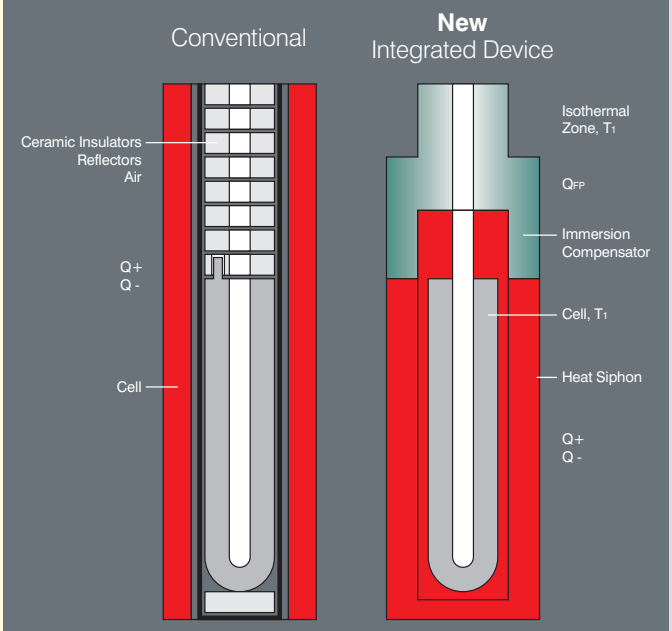


- Isothermal Towers include a traceable calibration certificate.

  This includes a graph of one freeze, one melt plateau and a certificate of purity for the metal inside the siphonic cell.

  As an option, UKAS calibration is available to one of two services, see table over for the uncertainties.

  Full data available at www.isotech.co.uk/isotower



A fixed point cell is not long enough to eliminate heat conductance along the thermometer calibrated in it. Currently, using long furnaces, heat shunts and reflective baffles an attempt is made to reduce these losses.

The ISOTower uses a combined metal clad fixed point cell and heat siphon, which when heated provides an isothermal environment for the metal within to change state. The outer wall of the cell becomes the inner wall of the heat siphon with cost as well as performance benefits.

Additionally an Immersion Compensator is used to compensate for the stem conduction problems caused when a thermometer under test is not sufficiently immersed into a fixed point cell.

Benefits of the ISOTower over a conventional Quartz Cell and Apparatus

ISOTower

- Robust - no glass parts
- Easily Transported
- Integrated Device - known immersion characteristics
- Uniquely integrated cell, apparatus and correction for thermometer stem conduction
- Simple and safe to use with increased confidence in results

Conventional Quartz Cell and Apparatus

- Fragile and Risk of Breakage
- Difficult and expensive to Transport
- Cell certified separate from apparatus, stem conduction unknown

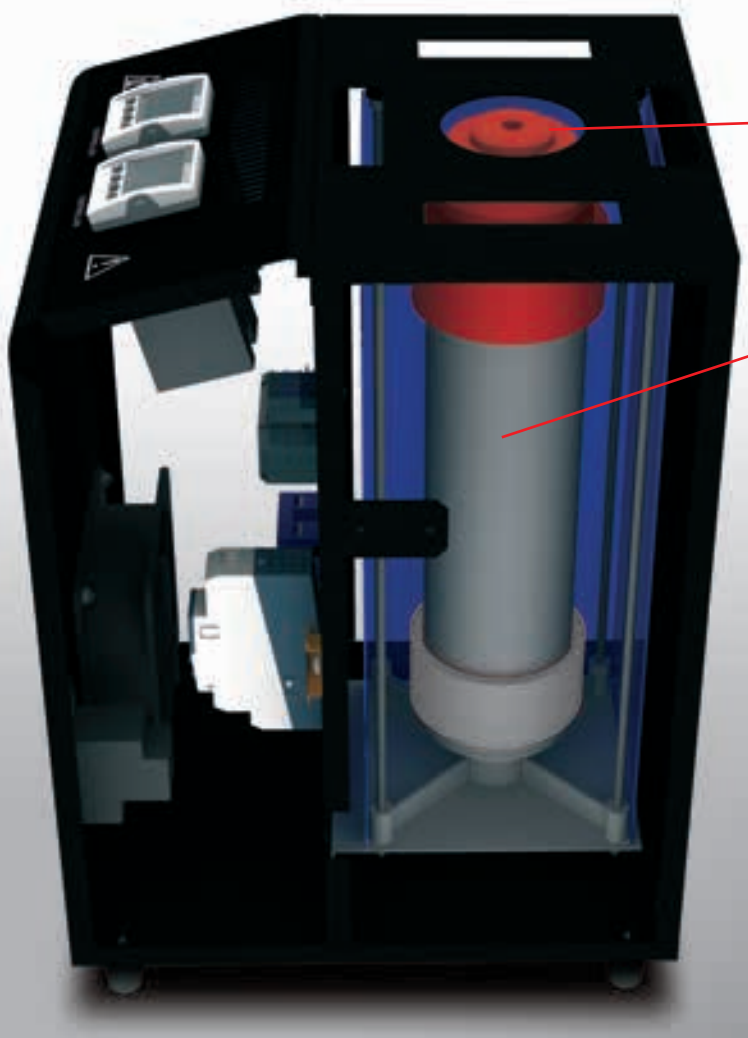
Specification

Model	490	491	492	493
ITS-90 Point	Indium	Tin	Zinc	Aluminium
Temperature	156.5985°C	231.928°C	419.527°C	660.323°C
Metal Purity	6N	6N	6N	6N
Plateau Duration	Up to 30 hrs			
UKAS Uncertainty: Premium Service*	±0.6mK	±0.8mK	±1mK	±2mK
UKAS Uncertainty: Standard Service*	±2mK	±2mK	±2mK	±6mK
Heating Time	2 hrs	2 hrs	2 hrs	2 hrs
Pocket Diameter	8 mm			
Total Immersion Depth	290 mm			
Depth of metal surface to bottom of reentrant tube	180 mm			
PC Interface	Supplied with PC Cable and Software			
Power	900 Watts			
Voltage	110 Vac or 230 Vac 50/60Hz			
Dimensions	H 430 mm x W 310 mm x D 300 mm			
Weight	15kg			

** UKAS Calibration is Optional, Uncertainties apply to whole system*

Patented

ISOTowers are unique to Isotech and protected by two patents - the first relates to the immersion compensator and the second to the Siphonic Cell with the integration of a heat pipe and fixed point cell.



Immersion Compensator

Fully compensates for the immersion characteristics of the thermometer under test.

Siphonic Cell

A combined Fixed Point Cell and Heat Pipe

The outer wall of the fixed point cell is the inner wall of the heat pipe or siphon, thus integrating the cell and its apparatus, giving a guaranteed performance from the cell.



Patented

The Siphonic Cell and Immersion Compensator are both patented

ISOTECH
The Source for Calibration Professionals

ISOTowers – International Acceptance and Intellectual Property Update

The innovative ITS-90 Isothermal Towers (ISOTowers) were first conceived in 2007 offering improvements to the fixed point calibration of thermometers. ISOTowers allow a robust, simple to use desktop cell apparatus to deliver the low uncertainties previously associated only with the Primary Laboratory.



ISOTowers combine the ITS-90 Fixed Point with a heat siphon forming a 'siphonic cell' and feature an 'Immersion Compensator' to compensate for stem conductance problems.

The resulting calibration solution is a desktop device, capable of the smallest of calibration uncertainties for SPRTs; rather than a large expensive furnace housing a fragile cell.

John Tavener says, *"The ISOTower range is now proven to be the most innovative product range in decades and brings a no compromise user friendly fixed point calibration to a wide audience at an affordable price... the novelty of the ISOTower has been accepted by the Intellectual Property Office."*

The patent applications around the siphonic cell and immersion compensator have now been granted. Adding to this excitement in the same week that the patents were awarded KlasmeierKalibrier- und Messtechnik (KK) achieved formal accreditation from DAkkS (the national accreditation body for Germany, formerly DKD). With uncertainties for the calibration of SPRTS:-

ISOTower	Temperature °C	Uncertainty °C *k*=2	Uncertainty mK *k*=2
ISOTower 491 Tin	231.928	0.003	3
ISOTower 492 Zinc	419.527	0.003	3
ISOTower 493 Aluminium	660.323	0.005	5

Commenting Peter Klasmeier says, *"after the effort of gaining accreditation we can now benefit with very efficient calibration of SPRTs to the smallest of uncertainties."*

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Directors: J. P. Tavener C.Eng., MSc., M.I.E.E., I. F. Tavener, W. H. Peck **Company Registration No:** 1530620



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 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	±0.6mK	±2mK
Tin	±0.8mK	±2mK
Zinc	±1mK	±2mK
Aluminium	±2mK	±6mK

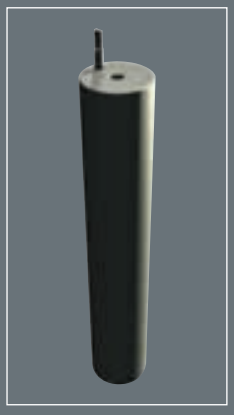
UKAS CALIBRATION
0175

The latest schedule can be found on the Isotech website or at www.ukas.org

Available Types Cells	Temperature	Uncertainty[1]	Additional Uncertainty[2]	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	±0.6mk	±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	±15mk		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



- Robust
- Protected Against Contamination and Ambient Pressure Effects
- Easily Transportable Between Labs

Quartz



- Silver and Copper points available

Slim Gallium



- Robust
- Fits in Isotech Dry Blocks

Slim Mercury



- Robust
- Fits in Europa-6

Water Triple



- Low cost
- Fits in Dry Blocks

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**

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

1. *The uncertainty applies when the cells are sufficiently immersed in deep apparatus.*
2. *When these cells are used in bench-top apparatus the additional uncertainty should be included for stem conduction effects. The value is typical for the 670 SPRT, others SPRTs may give different results depending on the stem conduction properties.*



POTTS
Europa-6



- Use with Mercury, Water or Gallium Cells
- Multi-Function Calibration Device
- Portable

The Isotech Europa covers the temperature range from -45°C to 140°C (at an ambient of 20°C) and can be used to realise the Slim Mercury (-38.8344°C), Water (0.01°C) and Gallium Cells (29.7646°C). The cells can be realised to an accuracy of 0.001°C (2 Sigma). For a small portable device this is unprecedented. The Europa can also be used without cells as a portable calibrator. With a metal insert it can be used to calibrate several sensors at once by comparison.

Other accessories are available to convert to a stirred liquid bath, for surface sensor calibration, to calibrate infrared thermometers and even to use as an ITS-90 Fixed Point System with calibration uncertainties as small as 0.0005°C. The Europa has excellent stability and distributed heating / cooling zones for good uniformity. These calibrators offer proven thermal performance.

The SITE model is a good choice for use with cells; as well as the temperature controller it has a separate indicator and with the 935-14-82DB probe can be used to monitor the cells as they come onto the plateau.

As well as the SITE model there is a Basic version, and an ADVANCED model which has inputs for reference and test thermometers with a further range of sophisticated features including automatic temperature cycling, secure data logging and full colour high resolution display. For more details see catalogue volume 2, Calibration Solutions for Temperature - Sensors - Infrared Thermometers and Thermocouple Referencing Systems.

Model	4520 Site POTTS
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 - 384mm Width - 212mm Depth - 312mm Weight - 14kg

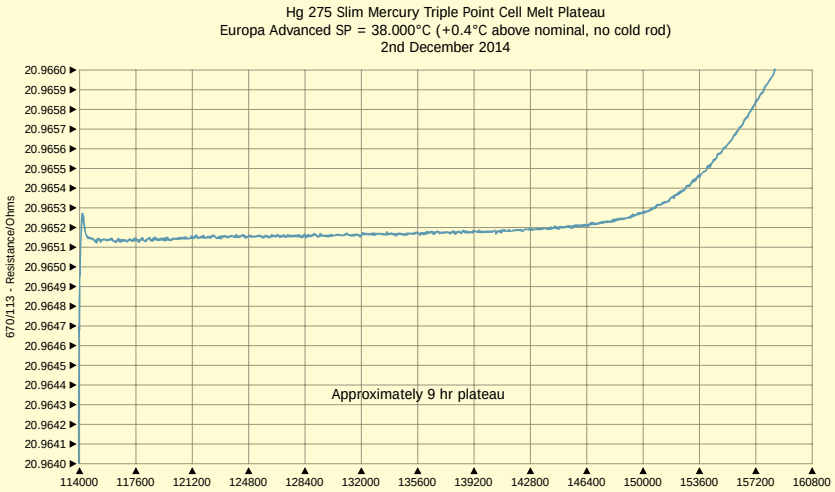
How to order
Europa 4520 Site POTTS
Please specify voltage required

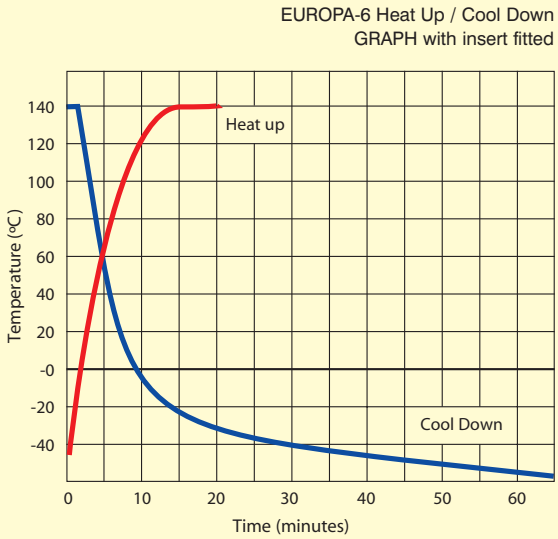
POTTS: POINTS ON THE TEMPERATURE SCALE

POTTS
POINTS ON THE TEMPERATURE SCALE

Slim Gallium Cell







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) C10 Oil (-35°C +140°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 / DB
Carrying Case	931-22-111

UKAS 5 Point Comparison Calibration



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



- 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 ±0.0002°C (2 Sigma) at the Water triple point and the Gallium melt temperature of 29.7646°C and up to ±0.005°C in the stirred liquid bath option (by comparison).

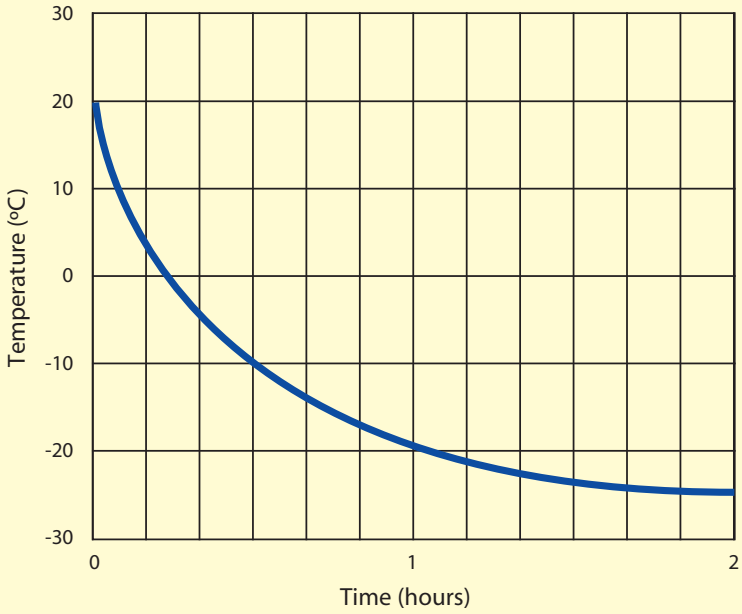
POINTS ON THE TEMPERATURE SCALE

Model	580
Temperature Range	45°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	±0.0002°C
Heating / Cooling	See Graph
Stabilisation Times	10 minutes
Calibration Volume	52mm x 300mm 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 208-240 VAC, 50/60Hz
Dimensions	Height 430mm Width 310mm Depth 300mm Weight 17kg

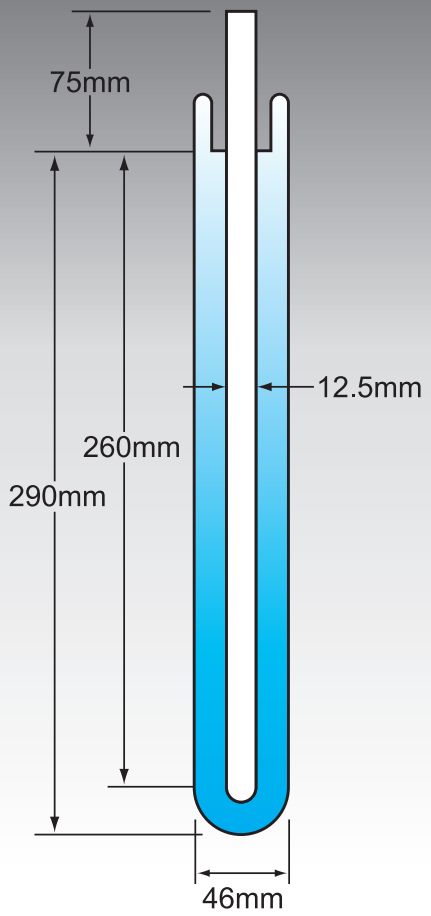
How to order
580 Oceanus-6 POTTS
Please specify voltage required

POINTS ON THE TEMPERATURE 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) C10 Oil (-35°C to 140°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	



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 ±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.



P POINTS O ON T THE T TEMPERATURE S SCALE

Fixed Point Cells Available

Material	Temperature	Uncertainty
Gallium	29.7646°C	±0.0005°C
Indium	156.5985°C	±0.0007°C
Tin	231.928°C	±0.0008°C
Zinc	419.527°C	±0.001°C
Aluminium	660.323°C	±0.002°C

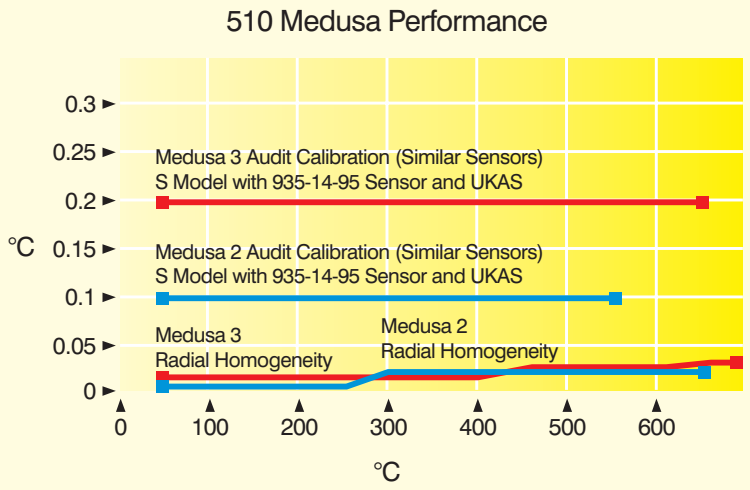
Premium calibration service uncertainties shown.

510 Metal Block Insert	510-06-01	Standard Insert
	510-06-02	Blank Insert Insert without pockets for local machining
	510-06-03	Special Insert Contact Isotech with your requirements
	510-06-04	Adjustable Equalising Block
511 Metal Block Insert	511-06-01	Standard Insert
	511-06-02	Blank Insert Insert without pockets for local machining
	511-06-03	Special Insert Contact Isotech with your requirements
	511-06-04	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
	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."



Model	510 MEDUSA	511 MEDUSA 3
Temperature Range	30°C to 550°C	50°C to 700°C
Absolute stability over 30 minutes	Metal Block Bath	±0.03°C
	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	

Indicator units	°C, °F, K	
Power	108 to 130V or 208 to 240V 50 / 60Hz	
	510: 1000 Watts	511: 1800 Watts
Overall dimensions	Height 430mm Width 310mm Depth 300mm	
	Weight 510: 17kg	511: 25kg

How to Order

510 Medusa or 511 Medusa
Please specify model type, voltage and options required



POTTS
Oberon

- Compact Heatpipe Furnace
- Suits Aluminium, Silver 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.

The Oberon has been upgraded to benefit from the latest technology. Fitted with a crystal clear colour display the furnace is now fully programmable. Programs can be created for the furnace to switch between set temperatures, for example to bring the furnace to the melt or freeze temperature at a desired time, or to lower the furnace temperature after a predetermined time. The PID control parameters are now dynamically optimised at different temperatures optimizing furnace stability. An Ethernet interface allows the furnace temperature to be monitored across a network whilst a USB Interface allows programs to be copied or for the furnace heat up and cool down history to be exported.



Oberon for Aluminium 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
Interfaces	Eithernet and USB Host
Power	110 Vac, 1.5kW, 50/60Hz (230 Vac Transformer available)
Dimensions	Height 410mm Width 415mm Depth 280mm Weight 30.5kg

Accessories

Metal Block Bath	426-06-05 Adjustable Equalising Block. Six pockets 8mm x 160mm deep.
ITS-90 Fixed Point	ITL M 17672QS Aluminium Quartz Clad Slim Cell
Apparatus	ITL M 17673QS Silver Quartz Clad Slim Cell
	ITL M 17674QS 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	ΔT	Uncertainties
Hg 137	0	±1.5mK
In 125	-1.4	±2mK
Sn 132	+1.4	±2mK
Zn 64	+0.3	±3.5mK
Al 160	+1	±5mK

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 250, 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 70 bridge as well as the resistors and temperature controlled environment.

P POINTS O ON T THE T TEMPERATURE S SCALE



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.

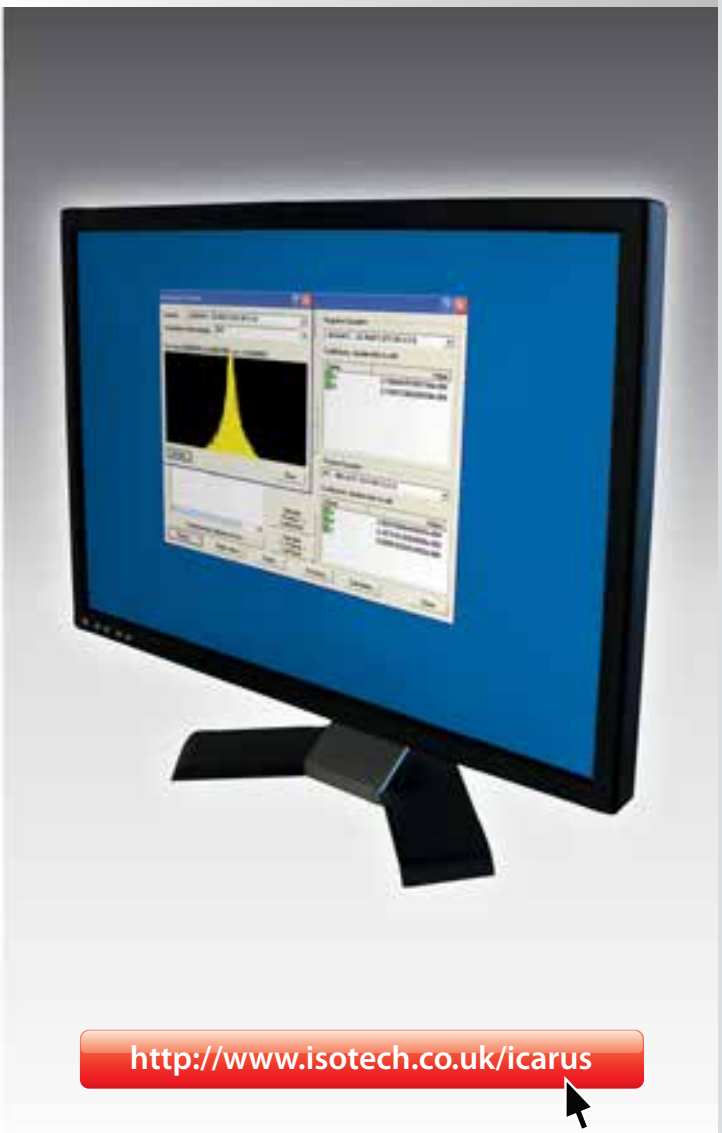


Demonstration versions of our software are available to download for evaluation:

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.

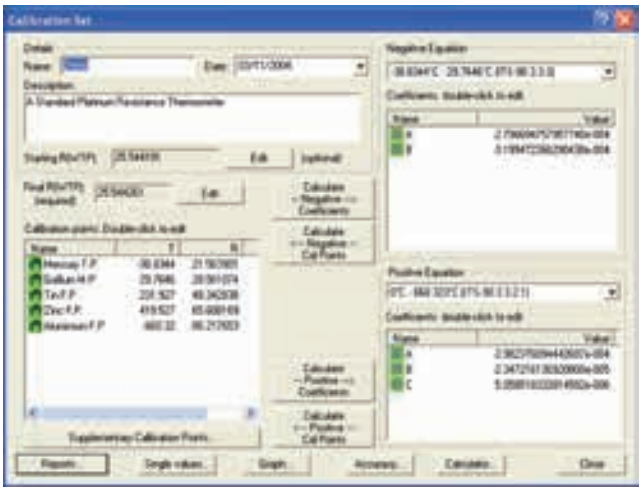
Check the calibration quality
Fit extra calibration points to the curve.
Create a distributable "Calculator" for any individual SPRT.

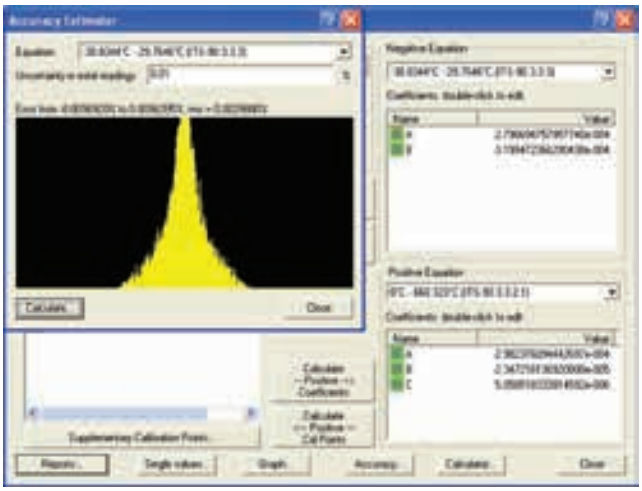
Accuracy Estimator

See Graphical Representation of data
Icarus is used at NTPL, 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

- 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.

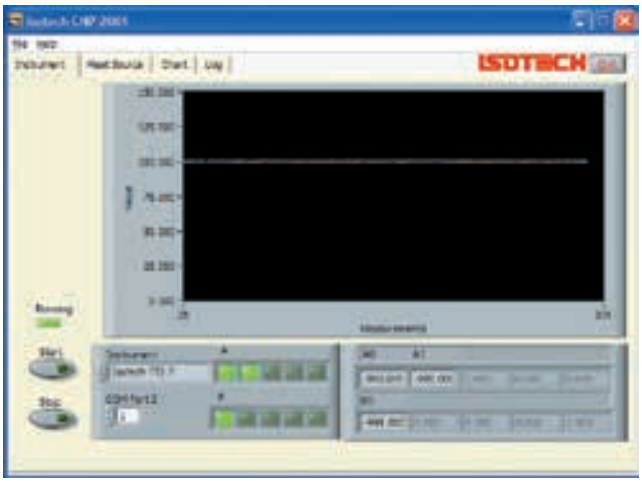
Then the manually entered data is combined with that gathered automatically and the resultant file can be opened in an external application such as Excel for the preparation of reports, certificates etc.

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
Laptop or Desktop
Windows 10/11
Serial Ports: RS232 or Adapaters

CNP is compatible with the following Isotech calibration equipment:-
Calibration Baths, Furnaces, Dry Block and POTT models with a serial interface.

Temperature Indicators:
Isotech milliK, TTI-1, TTI-2, TTI-5, TTI-6, TTI-7, TTI-10 and TTI 22

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

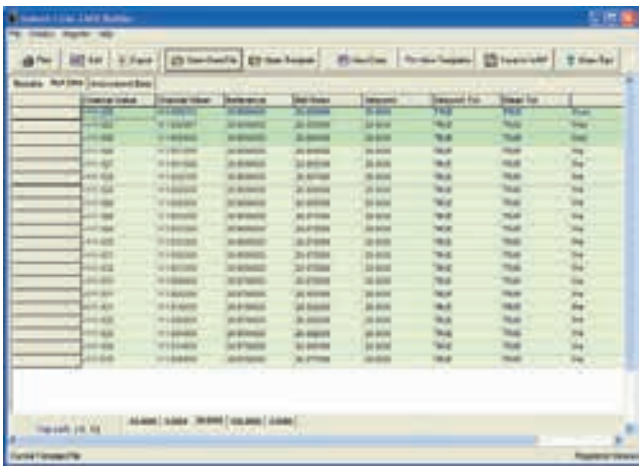


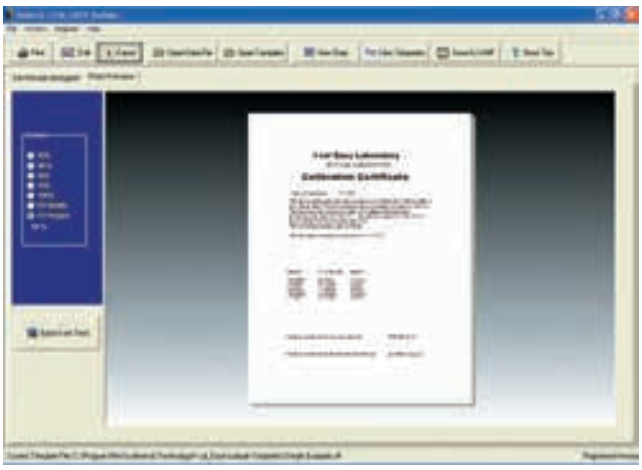
Use I-Cal Easy to automate sensor calibration, enter up to 20 calibration points and let the software set the bath, wait for stability and log the data automatically. Choose the stability criteria and how many points to record at each calibration temperature. Automatic temperature calibration the easy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





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.

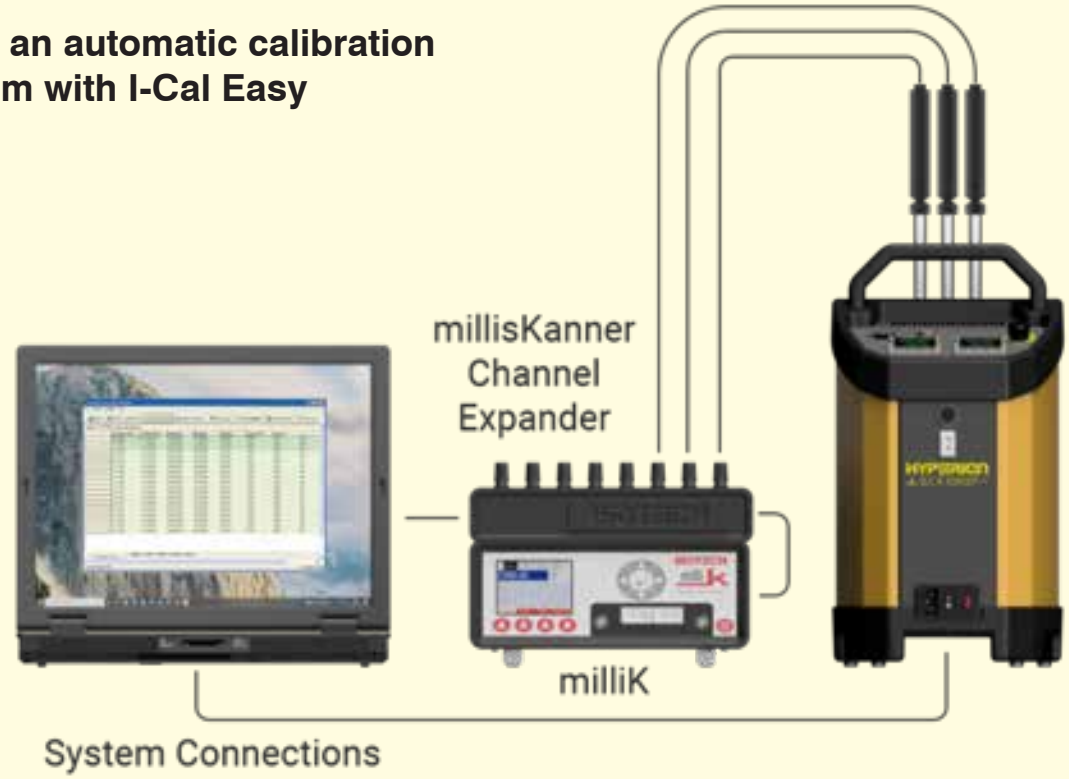
I-Cal Easy provides a powerful but easy to use automatic calibration system. A graphical setup lets you drag and drop instruments and equipment onto the appropriate PC port - no need to create config files. In addition to the comprehensive manual balloon tips guide you as to the operation of each control.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



System Requirements

Computer	Laptop or Desktop
Operating System	Windows 10/11
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

Isothermal Technology Ltd is proud to be recognised as the world's leading supplier of temperature calibration equipment—a position we hold with both pride and deep responsibility.

Our UKAS-accredited calibration laboratory (ISO/IEC 17025:2017), established in 1980, has developed into a world-class facility, delivering calibrations with the smallest of uncertainties. This not only ensures our customers receive best-in-class calibration services but also reinforces Isotech's standing as a global authority in temperature metrology.

Our UKAS schedule demonstrates these exceptional uncertainties—among the lowest available, even when compared to National Metrology Institutes.

Isotech offers the most comprehensive range of solutions, from primary metrology standards to industrial calibration equipment.



Extracts from the Schedule 42

Isotech UKAS Calibration Uncertainties (k=2)

Calibration of SPRTs at Fixed Points

	Temperature	Uncertainty
BP Nitrogen	-195.798°C	2mK
TP Argon	-189.3442°C	0.5mK
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

Calibration of ITS-90 Fixed Point Cells

	Temperature	Uncertainty
TP Mercury	-38.8344°C	0.20mK
TP Water	0.01°C	0.07mK
MP Gallium	29.7646°C	0.07mK
FP Indium	156.5985°C	0.40mK
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.isotech.co.uk/lab



Isotech Training – Global Experts in Calibration

Gain expert knowledge in temperature metrology with Isotech's trusted training programs. From on-site support to online courses and tailored sessions, we help professionals worldwide operate with confidence and precision.

Learn more at isotech.co.uk/training

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