

# 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.

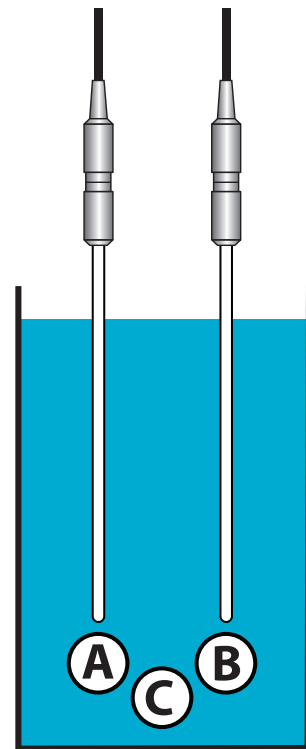
## Comparison Calibration

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](http://www.ukas.org).



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

## Types of Equipment

### Cryogenic

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



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

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



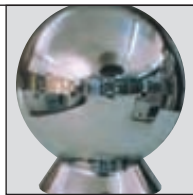
### Medium Temperature Range $50^{\circ}\text{C}$ to $700^{\circ}\text{C}$

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



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

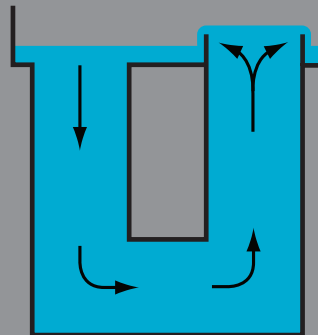
The concentric design of the Isotech 877 Thermocouple Calibration Furnace avoids the large temperature gradients present in simple tube furnaces.



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

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

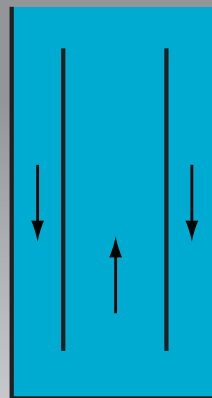
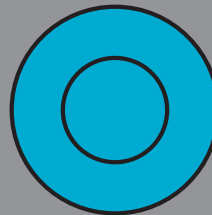
### Parallel Tube Design



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

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

### Concentric Tube Baths



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



Photograph by kind permission of ThyssenKrupp Steel AG - Werkstoffkompetenzzentrum

# Immersion Depth

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

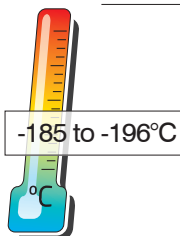
The “Supplementary Information for the ITS-90, BIPM” states conduction down the sheath is usually such as to require deeper immersion.

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



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

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



# Boiling Point Apparatus Nitrogen

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

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

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

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

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

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

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

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

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



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

Model	ITL-M-18205
Temperature Range	-185°C or -196°C nominal
Uncertainty	$\pm 0.002^\circ\text{C}$

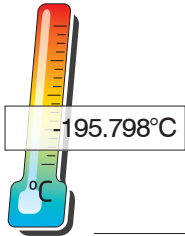
The temperature distribution across the copper block is less than 2mK. To this must be added the uncertainty issued with the calibration certificate from the National Laboratory.

Extra uncertainties will also exist if dissimilar probes are compared.

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<sub>2</sub> Apparatus

## Model 461

- Safe to use
- Economical

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

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

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

### Method of Operation

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

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

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

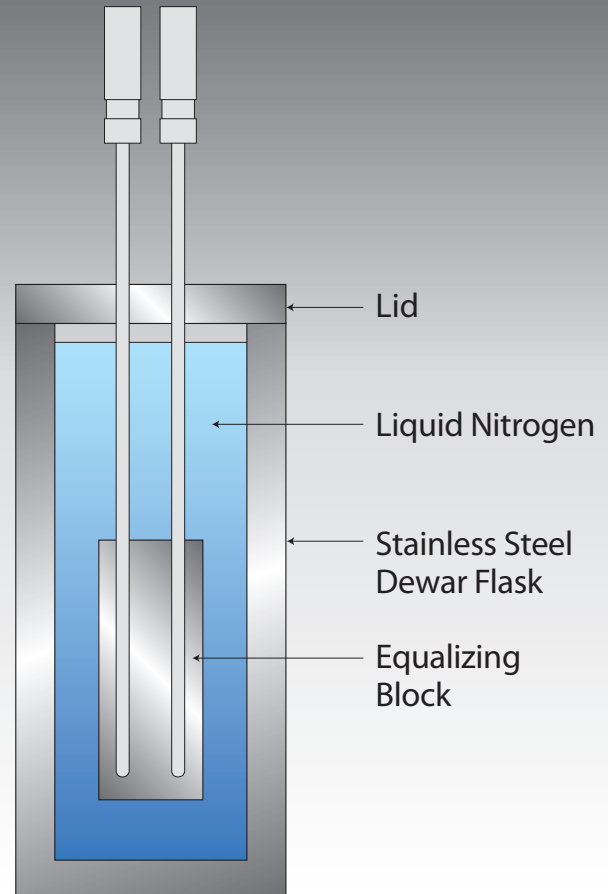
A comprehensive handbook accompanies the apparatus which includes an article by Henry E. Sostmann on the corrections required to convert the calibration to the ITS-90 value of the Argon Triple Point.

### Technical Note:

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

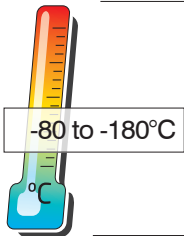
This is of small importance provided a calibrated SPRT is being used as the reference and simultaneous ratios of SPRT and unknown thermometers are being recorded, with a bridge such as the Isotech microK.

Liquid Nitrogen is not supplied with the apparatus.



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

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



# Cryostat Model 459

- Extreme Low Temperature Calibration
- High Stability

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

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

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

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

### Evaluation

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

### Method

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

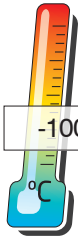


Optional Container for Cryostat

Model	459
Cryostat Temperature:	-80°C to -180°C
Absolute Stability (over 30 minutes)	±0.005°C at -80°C ±0.0015°C at -150°C
<i>(as measured by one of the 670 thermometers in the bottom of one of the pockets of the cryostat)</i>	
Homogeneity pocket to pocket	±0.005°C
Vertical Profile (over bottom 50mm)	±0.005°C at -80°C ±0.01°C at -150°C
Immersion Depth	560mm
Neck Diameter	120mm
Compatibility	Liquid Nitrogen Containers
Nitrogen Capacity	35 litres

### 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



-100 to 40°C

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

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

### Portability and Safety

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

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

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

### Cooling Technology

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

### Operating Life

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

# -100°C Dry Block Isis



### Benefits

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

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

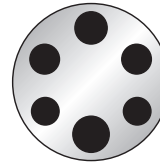
<http://www.isotech.co.uk>



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

## METAL BLOCK INSERTS

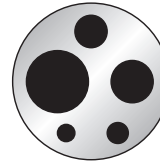
### Standard Insert A



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

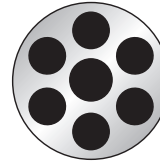
## ALTERNATIVE INSERTS

### Standard Insert B



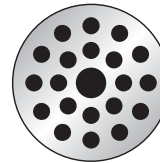
13mm, 10mm,  
8mm, 5mm  
and 3.5mm  
All 157 deep

### Standard Insert C



8mm and  
6 x 6.5mm  
All 157 deep

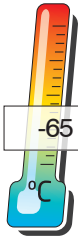
### Validation Insert



6.5mm and  
20 x 3.5mm  
All 157 deep

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





-65 to 300°C

# Stirred Liquid Baths

## 915 Parallel Tube

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

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

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

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

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

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

Liquids are circulated by a propeller which mixes and forces the liquid through a specially designed orifice in the rear of the two parallel tubes. A variable speed motor optimizes the flow as the viscosity of the liquid changes. Below the orifice plate liquid is circulated over a mineral insulated heater and temperature sensors which control the temperature of the bath. The liquid flows up the calibration tube and weirs over the tube into a collection tray where it returns to the rear tube for recirculation. An angled side entry tube enables a refrigeration cooling probe to be inserted in the rear of the two parallel tubes.



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

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

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

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

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

Refer to Evaluation Report for Full Details

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

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

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

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

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

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

**Controller Note:**

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

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

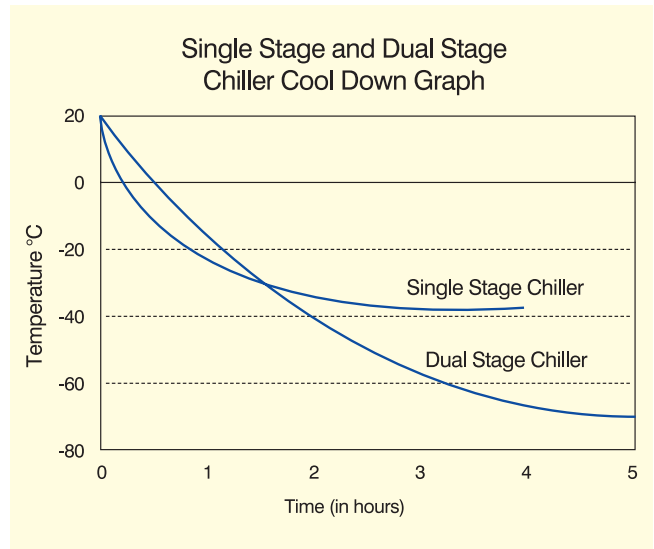
**Important**

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

**Health and Safety Notice**

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

Refer to 'Liquid Selection Guide' on page 73.



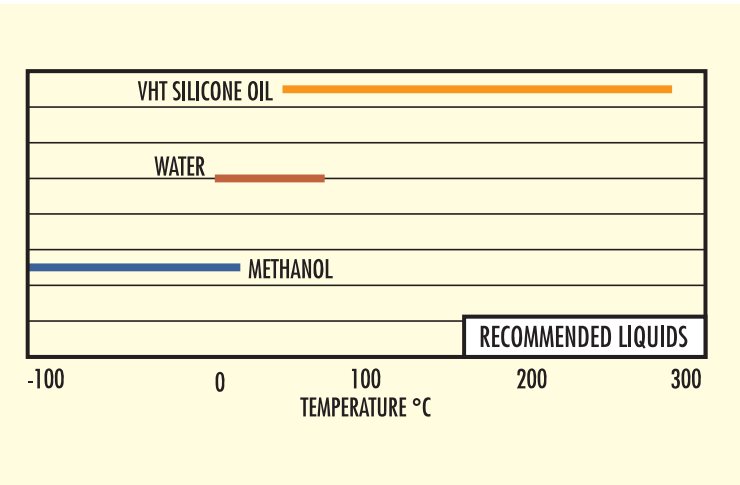
**Accessories**

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

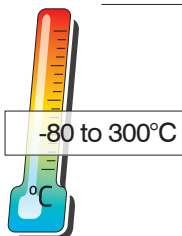
**NOTE:** Read all safety information concerning liquids which you intend to use in the bath and use only approved liquids.

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

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



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



# 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.

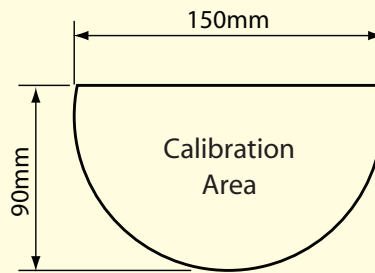
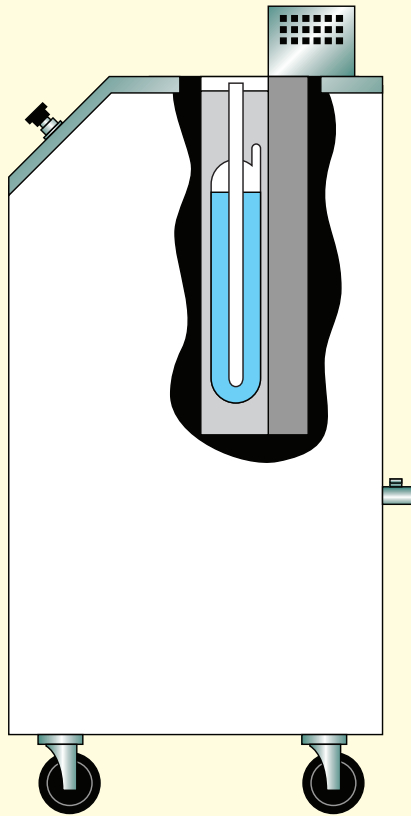
In operation the liquid level is within 10mm of the top lid allowing calibration of liquid in glass thermometers without the need for complicated accessories.

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 (Methanol, -80°C)	±0.006°C (Methanol, -40°C)	±0.006°C (C10 Oil, 125°C)
Vertical Uniformity	±0.005°C (Methanol, 0°C)	0.005°C (Methanol, 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	1kW 108-130 or 208-240V, 50/60Hz	800W
<b>How to Order</b>	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 its better corrosion resistance, is recommended for oils, alcohol and water.

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

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

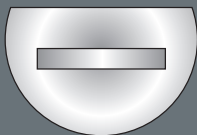
The liquid level is typically within only 10mm of the lid, so complicated fluid level adaptors are not essential.

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

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

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

**Lid**                      798-05-01    Liquid Volume Lid  
*Included*

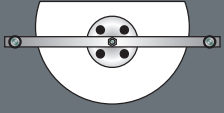


**Equalizing Block**      798-05-02A    Aluminium Equalizing Block, 4 pockets, 8mm diameter, 160mm deep


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

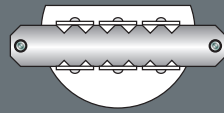
17401    Gallium Melt Point Cell  
29.7646°C

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*



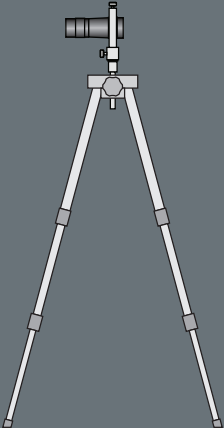
**Overflow Adapter**                      796-02-10    The Orion liquid level is within 10mm of the top lid allowing most liquid in glass thermometers to be calibrated.

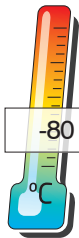
For applications where the liquid level needs to be higher than the lid the Overflow Adapter can be fitted to the Orion L and M. This assembly includes a motor to pump the liquid and raises the liquid level 20mm above the top lid.

Includes Power Supply



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





-80 to 300°C

# Stirred Liquid Baths

## Hydra 798

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

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

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

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

Hydra benefits from Isotech's experience, it drains faster, is easier to use, is safer, and is more convenient.

Accessories allow a wide range of thermometers, for example, to be readily clamped by the Sensor Support and ITS-90 fixed points cells are accommodated with the adjustable cell holder.



### ■ Parallel Tube Action...

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

### ■ Heating...

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

### ■ Fast Cool Down...

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

### ■ Cooling...

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

### ■ Wider Temperature Range...

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

### ■ Commercial Grade Chillers...

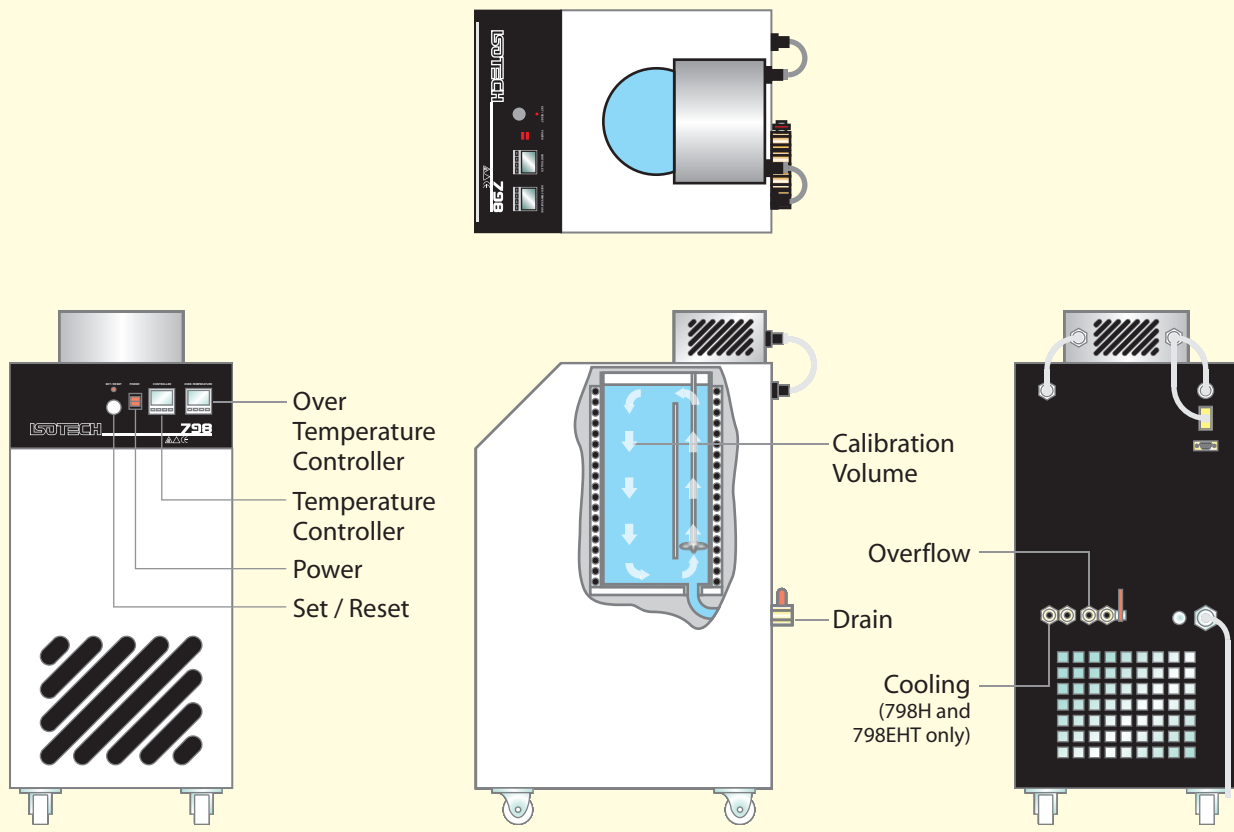
The chillers are one third horse power commercial grade units, not cheaper domestic grade as used by some manufacturers.

### ■ Calibration Depth...

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

### ■ Circular Design...

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

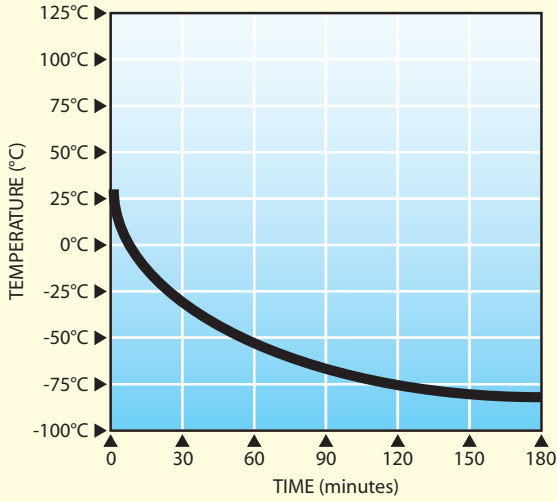


Model	798L	798M	798H	798EHT
Temp Range	-80°C – 125°C	-40°C – 125°C	30°C – 200°C	30°C – 300°C
Volume	150mm Diameter, 300mm Deep (5 litres)			
Absolute Stability	±0.030°C (Methanol, -80°C)	±0.017°C (Methanol, -40°C)	±0.015°C (Oil, 125°C)	±0.015°C (Oil, 250°C)
Vertical Uniformity	±0.002°C (Oil, 50°C)	±0.002°C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

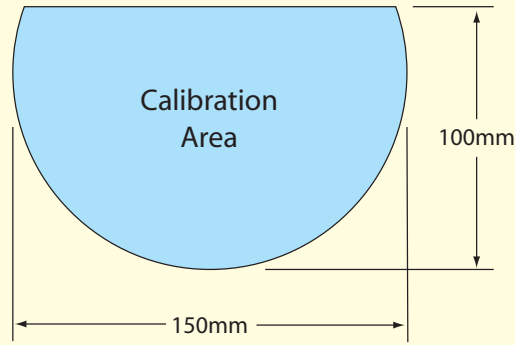
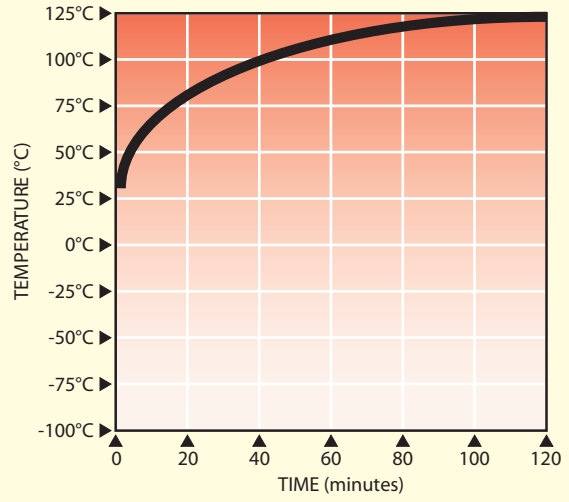
Refer to Evaluation Report for Full Details



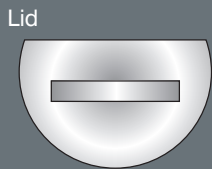
### Cool Down Graph



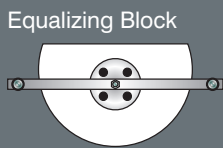
### Heat Up Graph



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



798-05-01 Liquid Volume Lid  
*Included*

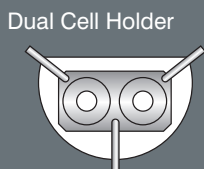


798-05-02A Aluminium Equalizing Block, 4 pockets, 8mm diameter, 160mm deep

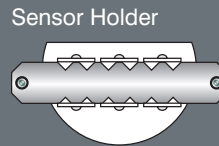
798-05-02B Copper Equalizing Block, 4 pockets, 8mm diameter, 160mm deep

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

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



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



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

#### Fixed Point Cells

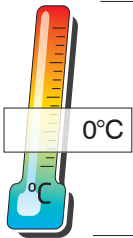
17724 Mercury Triple Point Cell  
-38.8344°C

B12 Water Triple Point Cell  
0.01°C

17401 Gallium Melt Point Cell  
29.7646°C

17401M Slim Gallium Melt Point Cell  
29.7646°C

17668ML Indium Freeze Point Cell  
156.5985°C



# Stirred Ice / Water Bath

## 813

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

The most used temperature for calibration is 0°C.

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

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

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

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

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

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

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



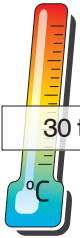
Model	813
Accuracy using Demineralised water	0°C $\pm 0.005K$
Capacity	8 litres (approx.)
Depth of immersion	350 mm
Accuracy using comparison techniques	$\pm 0.001^\circ C$
Power	50W, 108-130 or 208-240VAC, 50/60Hz
Dimensions	Height 580 mm Width 420 mm (including handle) Depth 250 mm Weight 15 kgs

#### Options

- 814/01b Copper Equalising Block
- 814/02 Mercury Thermometer Support Kit
- 814-06-02 Small Water Triple Point Cell Kit
- 814-06-04 Large Water Triple Point Cell Kit

#### How to Order

813 Stirred Ice Bath  
Please specify voltage required



30 to 200°C

# Large Volume Calibration Bath

## Model 820

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

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

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

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

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

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



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

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

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

Refer to Evaluation Report for Full Details

# Liquid Selection Guide

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

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

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

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

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

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

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

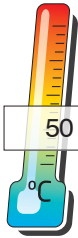
## Isotech Oils for Hydra, Orion and 915

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

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

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





# Fluidized Calibration Bath

## Model 875

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

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

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

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



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

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

*Refer to Evaluation Report for Full Details*



### Accessories

The following options are available:

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

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



# Thermocouple Calibration Furnace

## Model 877

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

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

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

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

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

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

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

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

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



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

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

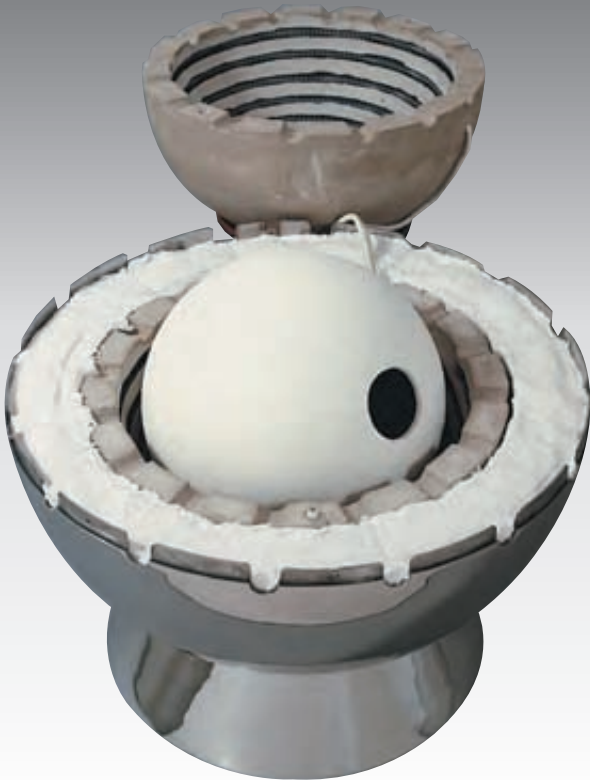
#### Accessories

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

#### How to Order

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

Blackbody Option



Thermocouple Calibration



**Note:**

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

**OPTIONS**

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

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

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

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

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

