

DOCUMENT

## Low-Temperature-Furnace

Isotech

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# 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  $\mu\text{m}$ .

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  $\pm 0.04\%$  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 $\pm\text{mK}$ Quartz & Metal Clad (*) |
|------------------|------------------------------------------------|
| Hg               | 0.20                                           |
| H <sub>2</sub> O | 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](http://www.ukas.org))

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

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

The immersion of the cells from metal surface to the bottom of the re-entrant tube is 200mm  $\pm 5\text{mm}$ .

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<br>1 | Range<br>2 | Range<br>3 | Range<br>4 | Range<br>5 | Range<br>6 | Range<br>7 <sup>1</sup> |
|-----------------------------|-----------|------------|------------|------------|------------|------------|------------|-------------------------|
| Typical Uncertainties $\pm$ |           |            |            |            |            |            |            |                         |
| TP Argon <sup>2</sup>       | -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<br>Fixed Point  | °C       | Range<br>1 | Range<br>2 | Range<br>3 | Range<br>4 | Range<br>5 | Range<br>6 | Range<br>7 <sup>1</sup> |
|-----------------------------|----------|------------|------------|------------|------------|------------|------------|-------------------------|
| Typical Uncertainties $\pm$ |          |            |            |            |            |            |            |                         |
| 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](http://www.ukas.org).



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