Integrity in Temperature Calibration

Triple Point of Water Cells

SIMPLY THE BEST AVAILABLE

Accuracy • Reproducibility • Stability • Confidence

www.isotechna.com
Isotech's unique K. T. Water triple point cell

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.

The Jarrett-Isotech Range of Water Triple Point Cells

Why the Jarrett-Isotech Cell is the best standard
The Jarrett-Isotech range of Water Triple Point Cells is unique. Unique in being in production for over 45 years. Unique in having 12 steps in the water purification process. Unique in having the most comprehensive evaluations ever made on Water Triple Point Cells performed on it.

One assumes that every Water Triple Point Cell, no matter from which source will be the same. This is not so. Each manufacturer employs his own design of distillation plant to produce the pure water that goes into the Cell, and cleans the Cell in different ways. The Jarrett Instrument Company and in particular its proprietor James L. Cross devoted 45 years with no other product in his range, to the understanding and perfection of the Water Triple Point Cell.

As improvements became possible, or research showed that additional precautions were necessary, additional steps were placed in the distillation process until, for the past 20 or more years the design as it is currently produced has been available as the World’s Temperature Standard. In 1980 a full evaluation of over 20 Jarrett Cells was undertaken and the results showed the high reproducibility of the Jarrett production over a very long period of time. It will keep its value for between 10 and 20 years, no other manufacture has sufficient data to justify this claim. In 1997 the late Henry Sostmann wrote a report summarising a number of important International and National Comparisons on Water Triple Point Cells. The Jarrett-Isotech Cells in many cases formed the reference to which other cells were compared, and in the other intercomparisons our cells were always the best. Before you choose a Water Triple Point Cell ask for a copy of Henry's summary report.

Three fundamentally different designs of Cells are available from Isotech, the type A Cell design with a McLeod gauge which enables the vacuum to be assessed, or the type B in which the reentrant tube is longer and hence sticks out of the apparatus and our unique K. T. Cell. For optimal realisations we use, and recommend the type A11. Isotech offers the following range of Cells, the A11 and B11 are the preferred models. You can purchase the cells with a certificate of conformity, or preferably a UKAS certification to an uncertainty of ±0.000070°C (2 sigma).

Temperature
The temperature of the Triple Point of Water is the temperature of pure water, ice and vapour in thermal equilibrium. It is the fundamental defining fixed point of the International Temperature Scale of 1990 (ITS-90) and the one defining fixed point of the Kelvin thermodynamic temperature-scale. This temperature has been assigned a value of +0.01°C on the ITS-90 and a value of 273.16°K on the Kelvin thermodynamic scale.

Use
Triple Point of Water Cells are used in the calibration of thermometers. Although most commonly used for the determination of the \( R_m \) of platinum resistance thermometers, they are also used for calibration of quartz thermometers, thermistors, liquid in glass thermometers and as a reference temperature for thermocouples. They are also used to establish the zero, and evaluate the stability of other temperature sensing devices.

Construction
The Jarrett-Isotech Triple Point of Water Cell is a cylindrical borosilicate glass container with a precision bore re-entrant tube which serves as a thermometer well. The cell is thoroughly cleaned, filled with high-purity gas-free water, and sealed.

Preparation
A mantle of ice 4 to 10mm thick is frozen on the outside of the thermometer well by refrigerating the inside of the well with dry ice or by other means. A thin layer of ice next to the well is melted by inserting a rod or glass tube, containing water at room temperature, into the cell. This ice-water interface next to the well provides an isothermal envelope surrounding the thermometer well. The Triple Point of Water Cell is then packed in ice to preserve the mantle and to shield the thermometer from thermal radiation, or placed in a Water Triple Point Maintenance Bath.

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 cells are carefully cleaned and aged by a special procedure. They are then filled with water that has been purified by an elaborate process designed to eliminate the possibility of contamination while avoiding change in isotope proportions.

Confidence
Since the triple-point-of-water cell is sealed, there is no risk of accidental contamination as there is with an ice bath. The uncertainty of the temperature of a well prepared ice bath is 50 to 200 times larger than that of a Jarret-Isotech Triple Point of Water Cell.
PHYSICAL FEATURES

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

Type 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

<table>
<thead>
<tr>
<th>Model</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>Comments</th>
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<tbody>
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<td>A11-50-270</td>
<td>11</td>
<td>50</td>
<td>350</td>
<td>270</td>
<td>100</td>
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<td>A13-50-270</td>
<td>13</td>
<td>50</td>
<td>350</td>
<td>270</td>
<td>100</td>
<td>Large re-entrant tube</td>
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<td>160</td>
<td>130</td>
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<td>290</td>
<td>210</td>
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<td>Replacement NPL type 32</td>
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<td>B12-46-210</td>
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<td>290</td>
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<td>75</td>
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<tr>
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<td>350</td>
<td>270</td>
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<td>100</td>
<td>Large re-entrant tube</td>
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<tr>
<td>B16-65-270</td>
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<td>65</td>
<td>350</td>
<td>270</td>
<td>100</td>
<td>Larger re-entrant tube</td>
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PERFORMANCE

Accuracy

The equilibrium of the Jarrett Triple Point of Water Cell is guaranteed to be within +0.000,00 and -0.000,04°C of the triple-point of pure water which has a natural isotopic composition.

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

Soluble impurities in glass slowly diffuse to the surface, are dissolved in the water of a Triple Point of Water Cell and eventually cause a lowering of equilibrium temperature. The glass used in Jarrett cells is subjected to an accelerated ageing process before filling, which increases the effective life of the cell. No detectable change in equilibrium temperature should be expected for the first 8 to 10 years of life. The equilibrium temperature of cells over 12 years old, may lower by 0.0001°C or more.

(1) Isotopic Analysis is available.

(2) Available in Quartz Glass.

(3) Any Cell described can be supplied with a UKAS Certificate.

(4) A range of apparatus is available to create and maintain the cells.
OTHER PRODUCTS:
Isothermal Technology Limited can supply Temperature Calibration Equipment, Indicators, Thermocouples and Platinum Resistance Thermometers for your most exacting needs and we offer the widest range of calibration equipment in the world. We also offer training courses and have technical articles to help you. A visit to our web-site is well worth while. If in doubt why not phone us.

If you require any of our databooks please tick the relevant box below or visit our website at www.isotech.co.uk

<table>
<thead>
<tr>
<th>databook one</th>
<th>databook two</th>
<th>databook three</th>
<th>databook four</th>
<th>databook five</th>
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<tr>
<td>Realizing ITS-90</td>
<td>Secondary Laboratory Equipment</td>
<td>Industrial Laboratory Equipment</td>
<td>Blackbody and Thermocouple Referencing</td>
<td>Calibration Services and Information</td>
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If you require more information or a quote for a Triple Point of Water Cell please tick the relevant boxes below and fax to Isotech.

**TYPE A**
- A11-50-270*
- A13-50-270
- UKAS Calibration
- "UKAS Calibration with Isotopic Analysis"

**TYPE B**
- B8-30-130
- B12-40-210
- B12-46-210
- B11-50-270*
- B11-65-270
- B13-65-270
- B16-65-270
- UKAS Calibration
- "UKAS Calibration with Isotopic Analysis"

Isotech is always willing to give technical advice and assistance where appropriate. This publication is for information only. Because of the program of continual development and improvement we reserve the right to amend or alter characteristics without prior notice.