SLIM MERCURY TRIPLE POINT CELL MODEL 17724M

User Maintenance Manual/Handbook

Isothermal Technology Limited, Pine Grove, Southport, PR9 9AG, England
Tel: +44 (0)1704 543830 Fax: +44 (0)1704 544799 Internet: www.isotech.co.uk E-mail: info@isotech.co.uk

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GUARANTEE

This instrument has been manufactured to exacting standards and is guaranteed for twelve months against electrical break-down or mechanical failure caused through defective material or workmanship, provided the failure is not the result of misuse. In the event of failure covered by this guarantee, the instrument must be returned, carriage paid, to the supplier for examination and will be replaced or repaired at our option.

FRAGILE CERAMIC AND/OR GLASS PARTS ARE NOT COVERED BY THIS GUARANTEE

INTERFERENCE WITH OR FAILURE TO PROPERLY MAINTAIN THIS INSTRUMENT MAY INVALIDATE THIS GUARANTEE

RECOMMENDATION

The life of your **ISOTECH** Instrument will be prolonged if regular maintenance and cleaning to remove general dust and debris is carried out.

ISOTHERMAL TECHNOLOGY LTD.
PINE GROVE, SOUTHPORT
PR9 9AG, ENGLAND

TEL: +44 (0) 1704 543830/544611
FAX: +44 (0)1704) 544799

The company is always willing to give technical advice and assistance where appropriate. Equally, because of the programme of continual development and improvement we reserve the right to amend or alter characteristics and design without prior notice. This publication is for information only.

INTRODUCTION

Isotech produce a range of Slim Cells whose physical size is smaller than ITS-90 optimal cells, which are designed to fit bench top sized apparatus.

The most recent slim cell to be designed together with a portable apparatus named Europa is a Slim Mercury Triple Point Cell. At -38.8344°C the cell and apparatus (which can also be used with Water and Gallium Cells) offer a complete breakthrough in ITS-90 Fixed Points.

WHAT ARE SLIM CELLS?

The special requirements of immersion depth, plateau duration, etc. required for the calibration of SPRT's may not be necessary in laboratories charged with calibrating industrial resistance thermometers, thermocouples and thermistors, but mobility and cost may be more important.

"Slim Cells" is a name given to another category of cell, being somewhat slimmer, slightly shorter and lower in price than the standard varieties. Slim cells are built using the same materials, techniques and purity of metal as the larger cells, but the uncertainties associated with them are somewhat larger, not because of the cells but precisely because their properties cannot be measured with SPRT's and transfer thermometers must be employed in qualifying them.

The Europa apparatus was specifically developed to accommodate and condition the Slim Mercury Triple Point Cell.

INSTALLATION

On arrival the Slim Mercury Cell should be inspected for damage. Because it is a triple point cell, it should click when shaken.

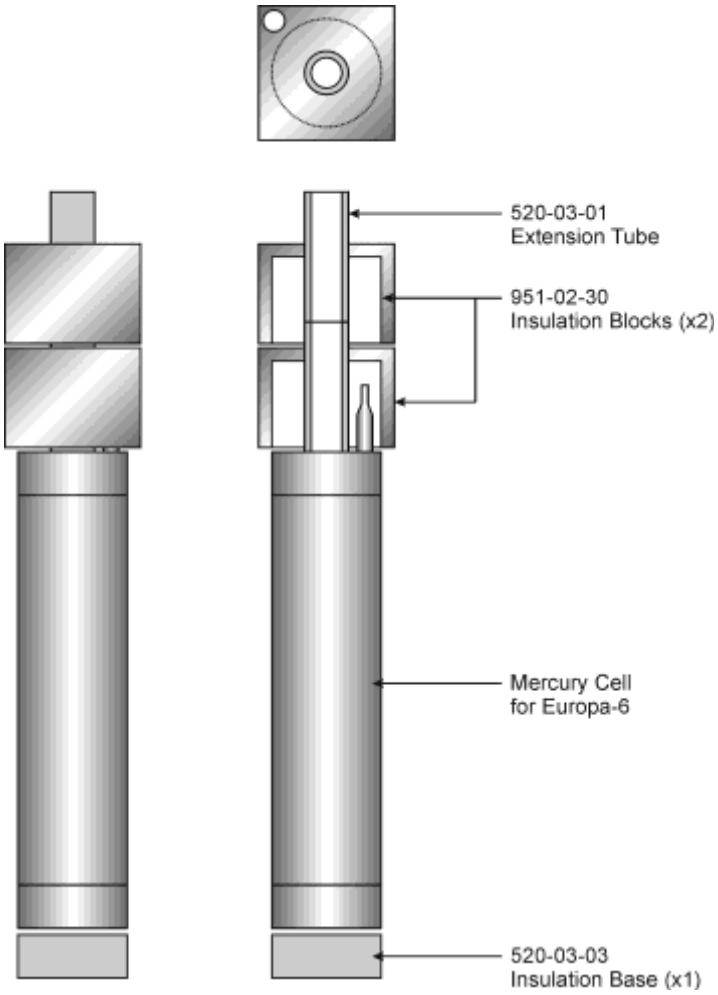
If the vacuum has been lost then please immediately contact Isotech.

The cell should be assembled into the Europa according to Figure 1 using the insulation provided.

TRANSPORTATION RESTRICTION

Due to its hazardous nature, Mercury must be packed and transported in accordance to IATA specification.

FIGURE 1: EUROPA-6 MERCURY CELL GENERAL ASSEMBLY



TO GET THE BEST RESULT FROM THE SLIM MERCURY CELL IN THE EUROPA

1. Keep the well in the Europa-6 dry.

2. Place the insulation base part number 520-03-03 under the cell and the 2 insulation caps part number 951-02-30 over the re-entrant tube.

3. Let the cell and well stabilise 1°C away from the transition temperature before use.

4. Keep methanol in the re-entrant tube of the cell.

5. Do not let it spill into the well of the Europa-6 - it will change the thermal conductivity from cell to well.

THE PERFORMANCE OF A SLIM MERCURY CELL IN THE EUROPA-6 APPARATUS

INTRODUCTION

The purpose of this evaluation is to assess the performance of a Slim Mercury Triple Point Cell in the Europa-6 compared to the Large Mercury Triple Point Cell in its larger apparatus (ITL-M-17725).

METHOD

A True Temperature Indicator 2 (TTI 2) with a resolution of 10uΩ together with a 670 Standard Platinum Resistance Thermometer (SPRT) serial number 080 was used for this evaluation.

The Slim Mercury Triple Point Cell was placed in the well of the Europa-6. A cushion of Insulating foam 1cm thick (520-03-03) was placed between the cell and the bottom of the well.

Above the cell were placed two blue insulation pieces (951-02-30) (these are provided with the cell).

The temperature of the Europa-6 was initially set to –37°C and the system was allowed to stabilise for 30 minutes. Next the controller temperature was set some 0.5°C below the freeze temperature. The cell's well temperature was monitored until it showed super-cool. At this point the thermometer was removed and a 6mm copper rod pre-cooled in liquid nitrogen was inserted into the well to initiate nucleation. After two minutes the thermometer, which had also been placed in liquid nitrogen, was returned to the re-entrant tube.

To aid thermal conduction the re-entrant well was filled with acetone to a level where the metal re-entrant tube meets the glass fibre extension tube (520-03-01).

Graph 1 shows the complete freeze.

The apparatus was left overnight and next morning the Europa-6's temperature was set to –45°C for 30 minutes, then to –37°C until the mercury began to melt, at which time the controller was set to 0.3°C above the melt temperature.

A melt of over three hours was obtained, see Graph 2. Longer or shorter plateaus can be obtained by setting the controller closer or further from the Triple Point Temperature.

Lastly the TTI 2 and 670/080 were calibrated in our Large Mercury Triple Point Cell and apparatus.

RESULTS

Summarising, all results were within 100uK.

In detail: setting a freeze 0.5°C lower than the Triple Point and initiating the freeze with a cold rod and the cold thermometer resulted in a 2 hour freeze. 50% of the freeze occurred within 100uK. The freeze will be extended if thermometers are calibrated during the freeze, since each thermometer will melt some of the frozen mercury, thus elongating the freeze time.

The freeze plateau can also be lengthened by setting the Europa-6 to, for instance, 0.25°C below its Triple Point which would double the plateau time.

Melting the cell: setting a temperature about 0.3°C above the melt resulted in a melt of three hours with a flatness of better than 100uK over 80% of the melt.

Calibrating thermometers during a melt will shorten the plateau time as each thermometer will melt some more of the solid mercury.

Table 1 below shows the actual resistance values of the 670/080 SPRT measured by the TTI 2.

Table 1: TTI 2 connected to the 670/080 SPRT

Ω	Comments
21.70097	Mean value during 50% of the Freeze of Slim Mercury Triple Point Cell in Europa-6
21.70098	Mean value during 80% of the Melt of Slim Mercury Triple Point Cell in Europa-6
21.70097	Value of resistance when calibrated in large reference Mercury Triple Point Cell on its melt plateau

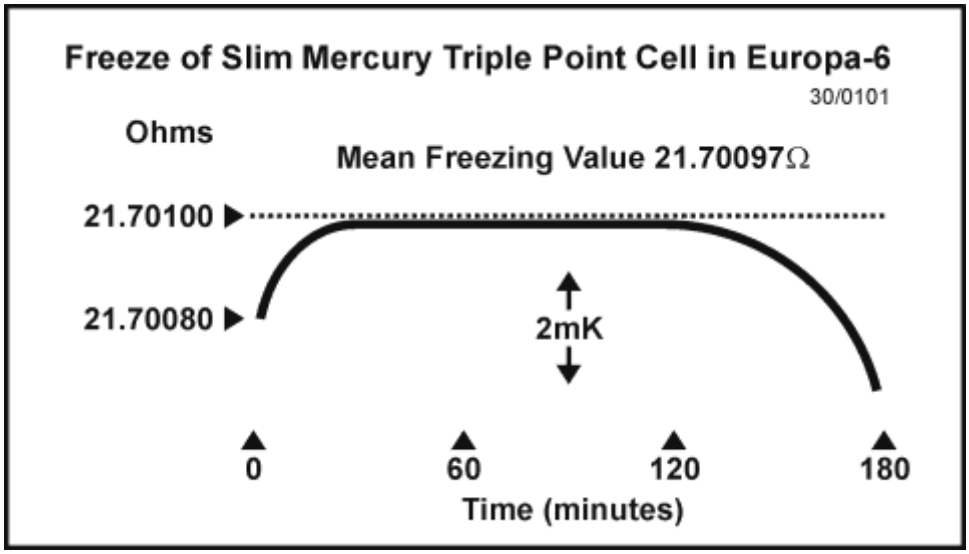
Notes:

1. *0.1Ω approximately 1°C, all results agree within 100uK.*
2. *Resistances above are compensated for Hydrostatic head.*

CONCLUSION

The Europa-6 and Slim Mercury Triple Point Cell give accurate realization of the ITS-90 value.

Graph 1:



Graph 2: