<u>The Performance of a Slim Mercury Cell In the Europa-6 Apparatus</u>

<u>Introduction</u>

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).

<u>Method</u>

A **True Temperature Indicator 2** (TTI 2) with a resolution of 10μΩ, 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 was placed between the cell and the bottom of the well.

Above the cell were placed two blue insulation pieces (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 well was filled with acetone to a level where the metal re-entrant tube meets the glass fibre extension tube.

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 100µK.

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 100µK. 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 100µK 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

W	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.

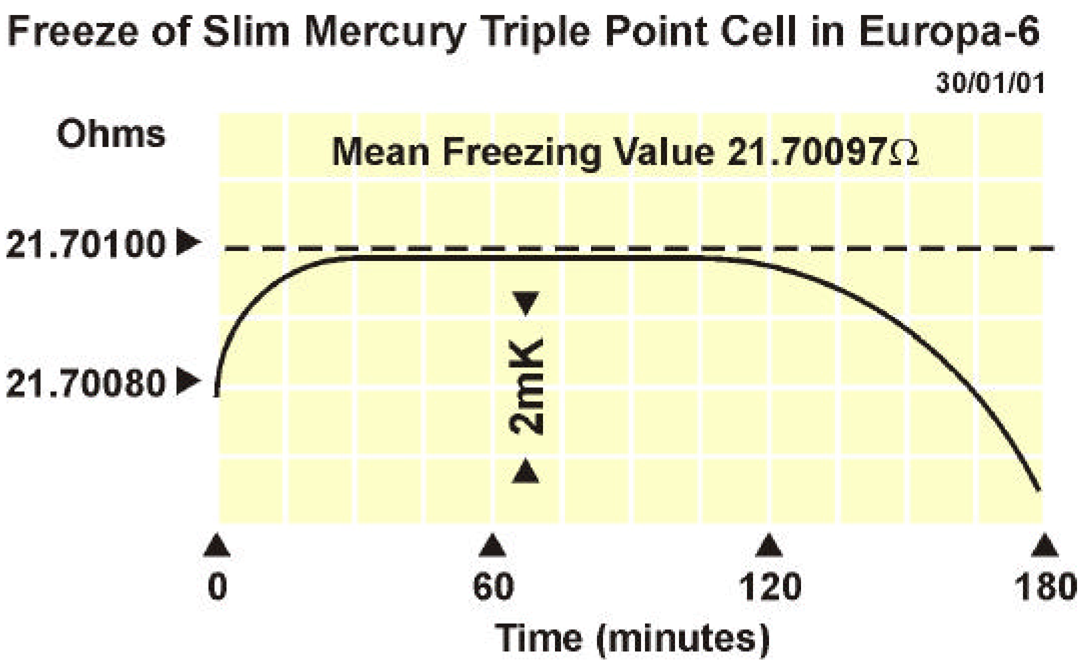
Notes:

1. *0.1W approximately 1°C, all results agree within 100mK.*
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