EUROPA-6PLUS

EVALUATION REPORT
ISSUE 01

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Europa-6PLUS Evaluation Report

Product Data Issue Date: July 2003

An evaluation report of the Europa-6PLUS (Serial Number 23136/1) metal block bath manufactured by Isothermal Technology Ltd.

Introduction

The Europa-6PLUS is part of the ISOCAL-6 family of products. It can be used as a dry-block, liquid bath, ITS-90 fixed point device, black body and surface probe calibrator.

At Isotech it is our earnest desire to present for our customers consideration as much useful information as possible and to this end we have spent a substantial amount of time evaluating our products.

The results of the evaluation of a bath can be presented in many formats some of which will give an optimistic or indeed a pessimistic view of how the product operates. This evaluation report is based on the DKD-R5-4 document.

The evaluation based on the DKD document presents almost the worse case error that may occur within the bath.

With some care and proper procedures it is possible to improve considerably upon these uncertainties. We have therefore presented a second evaluation based on the best practice as an Appendix to the evaluation.

Summary of Performance

Metal Block Mode, Option 1, Site Model

TEMPERATURE °C	STABILITY ± ° C	RADIAL HOMOGENEITY	AXIAL HOMOGENEITY
-35.0	0.008	0.004	0.037
50.00	0.018	0.001	0.026
140.0	0.020	-0.001	0.054

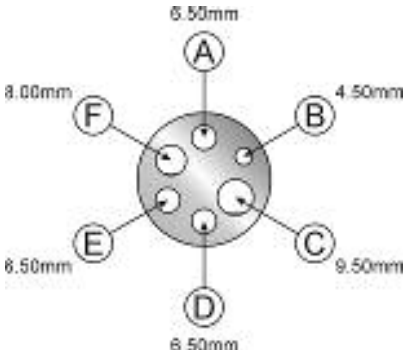
* Uncertainty is calculated, for the spread k = 2, which is the combined uncertainty x 2 and equivalent to a confidence level of approximately 95% (2 Sigma)

ITS-90 Fixed Point Mode, Option 6

Fixed Point	UNCERTAINTY
Gallium, 29.7646°C	0.001°C
Water, ±0.01°C	±0.001°C

Evaluation with Metal Insert

AXIAL TEMPERATURE HOMOGENEITY



Axial Temperature Homogeneity: The axial temperature distribution is measured at three different temperatures representative of the field of application and covering the extreme temperatures that may occur. A suitable thermometer is used, the sensor length not exceeding 5mm. At least six different measurements per bore are carried out in the calibration zone and adjoining parts of the bore, the distance between measurement points being 1cm.

TEST METHOD

A 935-14-12 probe (designed for small stem conduction) was placed in each of the 4.5mm holes. One probe was raised in 1cm steps (Pocket B) and the temperature difference between it and the static probe at the bottom of pocket D was recorded.

AXIAL TEMPERATURE HOMOGENEITY: -35°C

DISTANCE FROM BOTTOM OF INSERT POCKET, CM	TEMPERATURE DIFFERENCE Δ T=TD-TB °C
0	0.003
1	0.003
2	0.004
3	-0.002
4	-0.012
5	-0.033
6	-0.042
(0 Repeat)	0.003

At -35°C the Maximum Variation over 50mm Zone was 0.037°C
(This includes the measurement error and stem conduction)

AXIAL TEMPERATURE HOMOGENEITY: 50°C

DISTANCE FROM BOTTOM OF INSERT POCKET, CM POCKET D	TEMPERATURE DIFFERENCE Δ T=TD-TB °C
0	0.002
1	0.000
2	-0.001
3	-0.004
4	-0.012
5	-0.024
6	-0.040
(0 Repeat)	0.002

At 50°C the Maximum Variation over 50mm Zone was 0.026°C
(This includes the measurement error and stem conduction)

AXIAL TEMPERATURE HOMOGENEITY: 140°C

DISTANCE FROM BOTTOM OF INSERT POCKET, CM POCKET D	TEMPERATURE DIFFERENCE Δ T=TD-TB °C
0	0.006
1	0.010
2	0.019
3	0.019
4	-0.001
5	-0.035
6	-0.058
(0 Repeat)	0.003

At 140°C the Maximum Variation over 50mm Zone was 0.054°C
(This includes the measurement error and stem conduction)

RADIAL TEMPERATURE HOMOGENEITY

Radial Temperature Homogeneity: The temperature differences between the zones in the individual bores provided for the measurements are measured with a suitable thermometers at three different temperatures representative of the field of application and covering the extreme temperatures which may occur.

TEST METHOD
A 935-14-12 thermometer (designed for small stem conduction) was placed in each of the 4.5mm holes. Measurements were recorded and then the probes were moved between the two pockets and repeat measurements made. The temperature, Δt, was calculated to remove the small offsets between the two probes.

$\Delta t = ½ [(t_{AAB} - t_{AAD}) + (t_{ZZB} - t_{ZZD})]$

Temperature, °C	Δ t
-35	0.004°C
50	+0.001°C
140	-0.001°C

Loading Effects

Influence upon radial temperature homogeneity due to different loading: A suitable thermometer is placed into the bore located next to the largest bore. The change in temperature is measured which results when a solid metal rod is introduced into the largest bore which protrudes from the bore by at least 200mm. The measurement is to be carried out at three different temperatures representative of the field of application and covering the extreme temperatures that may occur.

TEST METHOD
Isothermal Technology recommends an external probe is used to determine the insert temperature. For this test the recommended probe model 935-14-82, is connected to the built in indicator of the site model. A second thermometer is introduced to measure the insert temperature independently. A metal rod 340mm long and 9mm diameter is placed in pocket C.

Insert Temperature, -35°C

	No Rod	Δ t	Rod Added	Δ t	Change
935-14-12-A02+TTI 2	-34.979°C		-34.972°C		
935-14-82+Site Indicator (In Built)	-35.0°C	-0.021	-35.0°C	-0.028	-0.007

Although the block temperature is influenced by loading the Europa's separate PRT and in built indicator compensates such that errors due to loading are eliminated.

Insert Temperature, 50°C

	No Rod	Δ t	Rod Added	Δ t	Change
935-14-12-A02+TTI 2	49.999 °C		49.990°C		
935-14-82+Site Indicator (In Built)	50.00°C	-0.001	50.00°C	-0.010	-0.009

Although the block temperature is influenced by loading the Europa's separate PRT and in built indicator compensates such that errors due to loading are eliminated.

Insert Temperature, 140°C

	No Rod	Δ t	Rod Added	Δ t	Change
935-14-12-A02+TTI 2	140.014 °C		139.990°C		
935-14-82+Site Indicator (In Built)	140.0°C	0.014	140.0°C	-0.010	0.024

Although the block temperature is influenced by loading the Europa's separate PRT and in built indicator compensates such that errors due to loading are eliminated.

Stability with Time

Stability with time: The variation of temperature with time in the zones in the individual bores provided for measurements must be sufficiently small. The temperature variations are considered to be sufficiently small when the greatest temperature difference occurring within 30 minutes is smaller than or, equal to, half the uncertainty of the measurement stated.

Stability at –35°C, 30 minute period, ±0.008°C
Stability at 50°C, 30 minute period, ±0.0018°C
Stability at 140°C, 30 minute period, ±0.02°C

TEST METHOD
A 935-14-12 thermometer was placed into one of the 4.5mm holes. The probe was connected to a TTI 2 precision temperature indicator and the variation in temperature was recorded for a 30-minute period. The ambient temperature was within 23°C ±3°C.

HYSTERESIS (REPEATABILITY)
The Europa was set to –35°C and the actual temperature along with the value for the in-built temperature indicator was recorded, then the temperature was raised to 140°C for two hours. The temperature was then reset to –35°C and repeat measurements made. The difference was within the resolution of the indicator: -0.1°C

TO ADD

HEAT UP TIME - Insert
-30°C to 140°C - 14 minutes.

COOL DOWN TIME – Insert
140°C to -30°C - 25 minutes.

Use with Fixed Points

Isocal Fixed Point Cells

Fixed Point Cells provide fixed point calibration. The International Temperature Scale, ITS-90, specifies for the range -38 to 962°C values for the melting, freezing or triple points of a metal (or water for the water triple point, 0.01°C). The freezing point of a metal can be defined with great accuracy. The accuracy comes not from the precision of electronic or other artificial means but from the purity of a metal and the physics of latent heat.

Using a fixed point cell with the Europa is simple. The cell is placed into the well and thermometers to be calibrated are then placed in turn into the cell. As the cell changes state, from a solid to a liquid the temperature remains constant and known - a fundamental constant of nature.

Isocal-6 Fixed Point Cells are built with the same materials and techniques as the larger cells that Isotech manufactures for Primary Standards Laboratories but the smaller size of the cells make them more affordable and practical for the industrial laboratory. For the industrial laboratory Isocal-6 cells provide fixed point reference standards, useful for checking the labs reference thermometers.