Isothermal Technology

Model 580: Oceanus 6

Evaluation Report

The Oceanus-6^{PLUS} has all the advantages of the Isocal-6 models but with a substantially larger calibration volume, 52mm diameter by 300mm deep. The Oceanus-6 can be used as a Dry Block, a Liquid Bath, a Blackbody Source for infra red thermometers, a Surface Sensor Calibrator and for performance to a few mK (0.001°C) ITS-90 Fixed Points. The Oceanus-6^{PLUS} is available in two models, the BASIC (B) and the SITE (S). The B model includes a sophisticated temperature controller with a dual display for Set Temperature and Dry Block Temperature
This evaluation report describes the performance of this bath, the intent is to provide a guide to the performance that can be expected in the calibration laboratory. When comparing uncertainties and bath performance it is important to check that the specifications being compared are like for like, if in doubt please contact Isotech for advice. The S model includes a built in digital thermometer to which an external standard thermometer can be connected, for Dry Block use this will give greater accuracy eliminating temperature gradient and loading errors.

For Liquid Bath, Surface Sensor or Blackbody use an external thermometer should always be used - either with the S model or the B model and a separate stand-alone indicator. For Lab use the Oceanus-6^{PLUS} can be used with a laboratory performance temperature indicator such as the Isotech TTI 5 and TTI 6 with performance, for similar sensors, down to hundredths of a degree.

This evaluation report is for the Dry Block mode of operation, temperature uniformity is better when used in liquid bath mode.

Performance Detail: Stability

On occasions, for sensors whose length or mass is dissimilar to the reference standard, the bath's absolute stability and thermal profile are needed.

Stability or *absolute stability*, we define as the variation in temperature, with time, of the calibration volume.

The Oceanus has a very wide operating range and it is not feasible to record the stability at every temperature, with every accessory and liquid combination.

The stability is reported for the following combinations,

Set Temperature	Volume	Stability
-20°C	Standard Metal Insert	+/- 0.01°C*
50°C	Standard Metal Insert	+/- 0.01°C*
110°C	Standard Metal Insert	+/- 0.05°C*

Recorded with model 935-14-61 (see Databook 3) probe over 30 minute period

Performance Detail: Vertical Temperature Gradient

Reported for the standard insert (Dry Block),

Two Model 935-14-61 probes were placed at the bottom of the two pockets in the insert. The difference between the two probes was recorded as one probe was withdrawn in 10mm steps from the insert. The variation was recorded over an 80mm zone

Set Temperature	Vertical Temp. Distribution (Lower 80mm) +/-°C
-20°C	0.010
50°C	0.016
110°C	0.013

This includes the measurement error, the immersion or stem conduction error will increase as the PRT is withdrawn.

Performance Detail: Radial Temperature Gradient

Two 935-14-61 thermometers were placed at the bottom of two insert pockets, 5mL of oil was added for heat transfer. After reaching stability the probes were interchanged between the pockets and the temperature differences between the pockets calculated.

Set Temperature	Temperature Difference
-20°C	0.000°C
50°C	+/-0.013°C
110°C	+/-0.036°C

Performance Detail: Loading

The Oceanus was set to its maximum operating temperature of 110°C with the top insulated with 10mm of ceramic fiber blanket. The temperature was recorded with a 25Ohm SPRT, stainless steel sheaths were added to the 4 empty pockets the sheaths extending 200mm. The variation in temperature as read from the *controller* was found to be 0.12°C. The S model indicator has resolution of 0.1°C and monitors the temperature change due to loading, and hence compensating for the error.

Performance Detail: Hysteresis

The Oceanus was set to 30°C, a temperature of 30.0158°C was recorded with a Model 909/SPRT, the temperature was increased to 110°C before a repeat measurement of 29.9951°C was recorded, a difference of 0.021°C.

Uncertainty Calculations

With reference to EA10/13

At –20°C

TYPE A UNCERTAINTY	Uncert	Sens	Dist	Deg	Div	STD Uncert	Variance
Standard incl measur. with	0.025	1	Norm	>100	2	0.0125	1.5625E-04

TYPE B UNCERTAINTY	Uncert	Sens	Dist	Deg	Div	STD Uncert	Variance
dt i Indic resolution	0.01	1	Rec	>100	1.732	5.7737E-03	3.3336E-05
dt r tempdiff borings radial	0	1	Rec	>100	1.732	0	0
dt h hysteresis	0.021	1	Rec	>100	1.732	1.2125E-02	1.4702E-04
dt b Axial Inhomog.	0.01	1	Rec	>100	1.732	5.7737E-03	3.3336E-05
dt l Block Loading	0.02	1	Rec	>100	1.732	1.1547E-02	1.3333E-04
dt v Stability	0.01	1	Rec	>100	1.732	5.7737E-03	3.3336E-05

COMBINED RESULTS	Uncert	STD Uncert	Variance
TYPE A	0.025	0.0125	1.5625E-04
TYPE B	3.3779E-02	1.9503E-02	3.8036E-04
TYPE AB	4.2024E-02	2.3165E-02	5.3661E-04

EFFECTIVE DEG. OF FREEDOM	>100
COVERAGE FACTOR (k)	2.000
EXPANDED UNCERTAINTY	0.0463

At 50°C

TYPE A UNCERTAINTY	Uncert	Sens	Dist	Deg	Div	STD Uncert	Variance
Standard incl measur. with	0.025	1	Norm	>100	2	0.0125	1.5625E-04

TYPE B UNCERTAINTY	Uncert	Sens	Dist	Deg	Div	STD Uncert	Variance
dt i Indic resolution	0.01	1	Rec	>100	1.732	5.7737E-03	3.3336E-05
dt r tempdiff borings radial	0.013	1	Rec	>100	1.732	7.5058E-03	5.6337E-05
dt h hysteresis	0.021	1	Rec	>100	1.732	1.2125E-02	1.4702E-04
dt b Axial Inhomog.	0.016	1	Rec	>100	1.732	9.2379E-03	8.5339E-05
dt l Block Loading	0.02	1	Rec	>100	1.732	1.1547E-02	1.3333E-04
dt v Stability	0.01	1	Rec	>100	1.732	5.7737E-03	3.3336E-05

COMBINED RESULTS	Uncert	STD Uncert	Variance
TYPE A	0.025	0.0125	1.5625E-04
TYPE B	3.8288E-02	2.2106E-02	4.8870E-04
TYPE AB	4.5727E-02	2.5396E-02	6.4495E-04

EFFECTIVE DEG. OF FREEDOM	>100
COVERAGE FACTOR (k)	2.000
EXPANDED UNCERTAINTY	0.0508

110

TYPE A UNCERTAINTY	Uncert	Sens	Dist	Deg	Div	STD Uncert	Variance
Standard incl measur. with	0.025	1	Norm	>100	2	0.0125	1.5625E-04

TYPE B UNCERTAINTY	Uncert	Sens	Dist	Deg	Div	STD Uncert	Variance
dt i Indic resolution	0.01	1	Rec	>100	1.732	5.7737E-03	3.3336E-05
dt r tempdiff borings radial	0.036	1	Rec	>100	1.732	2.0785E-02	4.3202E-04
dt h hysteresis	0.021	1	Rec	>100	1.732	1.2125E-02	1.4702E-04
dt b Axial Inhomog.	0.013	1	Rec	>100	1.732	7.5058E-03	5.6337E-05
dt l Block Loading	0.02	1	Rec	>100	1.732	1.1547E-02	1.3333E-04
dt v Stability	0.05	1	Rec	>100	1.732	2.8868E-02	8.3336E-04

COMBINED RESULTS	Uncert	STD Uncert	Variance
TYPE A	0.025	0.0125	1.5625E-04
TYPE B	7.0043E-02	4.0440E-02	1.6354E-03
TYPE AB	7.4371E-02	4.2328E-02	1.7916E-03

EFFECTIVE DEG. OF FREEDOM	>100
COVERAGE FACTOR (k)	2.000
EXPANDED UNCERTAINTY	0.0847

Conditions of Test

Measuring Equipment:
Isotech TTI 2 Thermometer, resolution 0.01mK (Statistics Mode)
Data recorded with CalNotePad Software, sampling rate 5 seconds and chart recorder
Thermometers Used: Isotech Model 935-14-61 Semi Standard Platinum Resistance Thermometers.

Environmental:
Ambient Temperature 23°C variation better than +/-2°C
Supply Voltage 230VAC (Stable)

Results shown are typical for the above conditions and do not constitute a formal specification

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