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CALIBRATION CERTIFICATE

M-DCM-24-260

DELIVERED TO: UPC

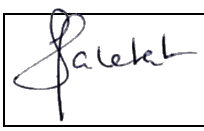
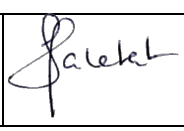
Rambla de l'Exposició 24 (edifici VGC)
08800 Vilanova i la Geltrú, Barcelona, Spain

CALIBRATED SENSOR

(Probe // Sensor // Indicator)

Name:	CTD // Temperature Sensor //
Manufacturer:	SEA-BIRD SCIENTIFIC // //
Type:	37SI 350m - 37SI.13200 // //
Serial no.:	37-24580 // //
Identification no.:	// //

This document has 5 pages.

WRITER	HEAD OF METROLOGY LABORATORY	HEAD OF LABORATORY
Date: 16/12/24	Date: 16/12/24	Date: 16/12/24
F. Salvetat	F. Salvetat	K. Boukerma
		

SOME CALIBRATIONS REPORTED IN THIS DOCUMENT ARE NOT IN THE SCOPE OF THE ACCREDITATION. THEY ARE IDENTIFIED BY THE SYMBOL *.

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Testing facilities

Thermostated Bath

Temperature regulated water bath HART 7BATH-045 s/n B7C058 (id. Felix) with stirred water to reduce temperature differences:
Effective bath capacity: 600 x 440 x 250 mm.
Regulation range: - 1,5°C to + 60°C.
Salinity can be changed from fresh water to seawater.

Reference temperature measurement

- Standard Platinum Resistance Thermometer ROSEMOUNT 162 CE s/n 5011 (id. R8).

- DC comparator resistance bridge MEASUREMENTS INTERNATIONAL 6010B s/n 1010914 (id. MI).

- Standard resistor 10 ohms GUILDLINE 9330 s/n 38551.

- Thermometer AOIP PN5207 s/n 59069 1 D5 (id 1) with the temperature sensor AN5850 s/n 068 (id Rt3A).

The platinum resistance thermometer is regularly calibrated at two fixed point cells of the ITS90: the water triple point and the gallium melting point. Then, a method developed by Ifremer allows the extrapolation of the use of this thermometer to -10°C and +60°C. This method were subjected to expertise and validation.

Sensor interface

- PC + "Pycharm Python3.12 (MINKE-MIDI) "software.

- Measurement frequency: 1 mes / 3 to 4 sec.

- Measurement period: 25 min.

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Operating protocol

The procedure MT017 is applied.

The sensor to be calibrated is immersed in the temperature regulated bath. The reference thermometer is placed near the temperature sensor to be calibrated. Their immersion is indicated with the calibration results.

The instrument is constantly powered up.

The laboratory staff handle the configuration of the instrument, the recovery and the post-processing of data.

During measurements, the stability and the drift of the bath are better than ±1.00E-03°C.

The laboratory temperature during experiment is 20.0°C ± 2.0°C.

This certificate is only valid for this sensor connected to this instrument.

This calibration certificate guarantees the compliance of the calibration results with the international system of units (SI) just for the calibrations in the scope of the accreditation (the calibrations out of scope are reported with an asterisk *).

Sensor adjustment

If the customer asked so:
- an adjustment of the sensor is performed using its interface and following the manufacturer instructions.
- an adjustment of the sensor is performed by modeling the data of the sensor with a least squares regression on the pairs (Sensor average, Reference average).

If this adjustment definitely changes the sensor response (no more traceability of the indication before adjustment), before adjustment, the indication of the sensor are collected on the calibration range.

If the sensor can deliver both non adjusted and adjusted data, and if the customer asked so, both indications are collected.

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Results

For each step, the following tables gives:
- the mean of the reference instrument indications,
- the mean and standard deviation of the sensor indications,
- the correponding correction of the sensor.

Calibration carried out from 27/11/2024 to 04/12/2024 by F. Salvetat.

	Name // Manufacturer // Type // Serial number // Identification number
Probe:	CTD // SEA-BIRD SCIENTIFIC // 37SI 350m - 37SI.13200 // 37-24580 //
Sensor:	Temperature Sensor // // // //
Indicator:	// // // //

Reference temperature

Ref. temperature sensor immersion (cm):	25

Calibrated temperature sensor

Data acquisition:	Computing	**Continuous supply:**	YES
Manual adjustment:	NO		
--> No manual adjustment	- -	- -	
Modelling:	-		
Immersion (complete, or manufacturer or value in cm):	complete		
Thermal dissipation:	Not Applicable	**Self heating:**	Not Applicable

Reference temperature		No adjustment		
		Temperature sensor indication		Measured correction
Mean (AA) °C	Standard Deviation °C	Mean (B) °C	Standard Deviation °C	(AA-B) °C
34.9841	1.05E-04	34.9849	5.06E-04	-0.0008
5.0931	9.85E-05	5.0964	2.04E-04	-0.0033
5.0929	3.46E-04	5.0962	3.10E-04	-0.0034
15.0371	7.36E-05	15.0380	2.22E-04	-0.0009
15.0370	1.05E-04	15.0378	2.70E-04	-0.0008
24.9874	1.27E-04	24.9886	4.13E-04	-0.0012
24.9876	2.70E-04	24.9888	4.62E-04	-0.0011
24.988	1.08E-04	24.989	3.75E-04	-0.0008
24.988	8.58E-05	24.989	4.01E-04	-0.0008

Remarks:

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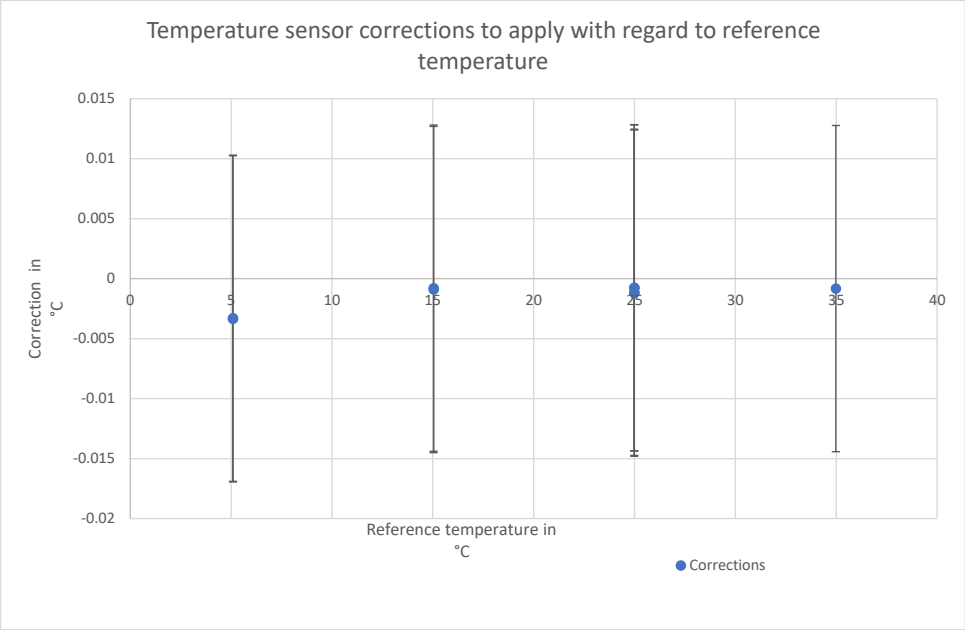

In the calibration conditions, the expanded uncertainty of the corrections to apply to the indications provided by the sensor (corrections not included in the uncertainty) is estimated to be:

U =	0.014	°C

The expanded measurement uncertainty is calculated as the product of the combined standard uncertainty and a coverage factor k, so that the coverage probability is approximately 95%. The combined standard uncertainty was calculated taking into account the different uncertainty sources, the reference standards, calibration instruments, environmental conditions, contribution of the calibrated instrument, repeatability, modelling of the response of the sensor.