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**TEST REPORT**

M-DCM-24-261

**DELIVERED TO:** UPC  
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**CALIBRATED SENSOR**

(Probe // Sensor // Indicator)

Name: CTD // Conductivity 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

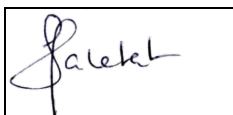

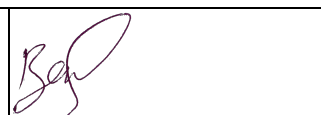
Date:

17/12/24

F. Salvetat

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K. Boukerma

		
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TR #M-DCM-24-261		Page 2/5
Test registration #MB031-24		eOTP #P204-0083-05
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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).

### *Reference salinity measurement*

- GUILDLINE Autosal 8400B s/n 70583 laboratory salinometer (Set temperature: 21°C).

The salinometer is calibrated with IAPSO Standard Seawater.

Salinity is calculated using the conductivity ratio measured by the salinometer and the equations recommended by UNESCO in "The Practical Salinity Scale 1978".

The estimated expanded uncertainty of the reference salinity is  $U = 1.10-2$ .

### *Reference conductivity measurement*

Reference conductivity is calculated using the reference salinity calculation, the sensor immersion, the reference temperature measurement of the bath and the iterative equation recommended by UNESCO in 1980 with  $C_{35, 15, 0} = 42.914$  mS/cm.

The estimated expanded uncertainty of the reference conductivity is  $U = 0.01$  mS/cm.

### *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 sensor is immersed in the temperature regulated bath. It is distant from the sides of the bath to prevent any effects on measurements. Its immersion is indicated with the calibration results.

The platinum resistance thermometer is placed near the sensor to be calibrated. The immersion of the platinum resistance thermometer is indicated with the calibration results.

The experiment is performed at atmospheric pressure. The pressure resulting from the immersion of the sensors is included in all calculations.

If needed, we perform measurements before and after removing bubbles from the sensors (shaking / brushing them) to check any potential influence of bubbles on the sensor.

For each measurement point, we sample 3 bottles of water. Their salinity is measured with the salinometer when their temperature is around the laboratory temperature.

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  $\pm 1.00E-03^{\circ}\text{C}$ .

The laboratory temperature during experiment is  $20.0^{\circ}\text{C} \pm 2.0^{\circ}\text{C}$ .

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

## 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 corresponding 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:	Conductivity Sensor // // // //
Indicator:	// // // //

**Reference temperature**

Ref. temperature sensor immersion (cm):	25
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**Calibrated conductivity sensor**

Data acquisition:	Computing	Continuous supply:	YES
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Manual adjustment:	-
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--> No manual adjustment      -      -      -

Modelling:	
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Sensor immersion (in cm):	13.75	Pressure at sensor level (bar):	0.01375
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Calculated reference salinity		Corresponding bath temperature		Calculated reference conductivity		No adjustment		
Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	Conductivity sensor indication		Measured correction
(BB)	No unit	°C	°C	(CC)	mS/Cm	Mean	Standard Deviation	(CC-J)
No unit	No unit			mS/Cm	mS/Cm	(J)	mS/cm	mS/cm
34.640	3.38E-04	34.984	1.05E-04	63.160	5.46E-04	63.201	7.85E-04	-0.042
34.646	2.28E-04	5.093	9.85E-05	33.234	1.97E-04	33.247	4.74E-04	-0.014
34.646	2.28E-04	5.093	3.46E-04	33.234	1.97E-04	33.246	4.51E-04	-0.013
34.645	2.28E-04	15.037	7.36E-05	42.564	2.51E-04	42.584	3.68E-04	-0.020
34.645	2.28E-04	15.037	1.05E-04	42.564	2.51E-04	42.584	3.69E-04	-0.020
34.675	3.36E-04	24.987	1.27E-04	52.620	4.53E-04	52.662	3.30E-04	-0.042
34.675	3.36E-04	24.988	2.70E-04	52.620	4.53E-04	52.665	4.60E-04	-0.044
34.905	4.71E-04	24.988	1.08E-04	52.931	6.34E-04	52.979	3.71E-04	-0.048
34.905	4.71E-04	24.988	8.58E-05	52.931	6.34E-04	52.982	3.24E-04	-0.051

**Remarks:**

During this experiment, the Sbe37 probe was equipped with a Sbe5T pump s/n 050874 1.3K (powered with 12V) to avoid constant decreasing of the conductivity measurement that was noticed in a first test. The pump was placed downstream the conductivity cell, the intake of the pump connected to the side of the conductivity cell opposed to the communication connector (see.photo).

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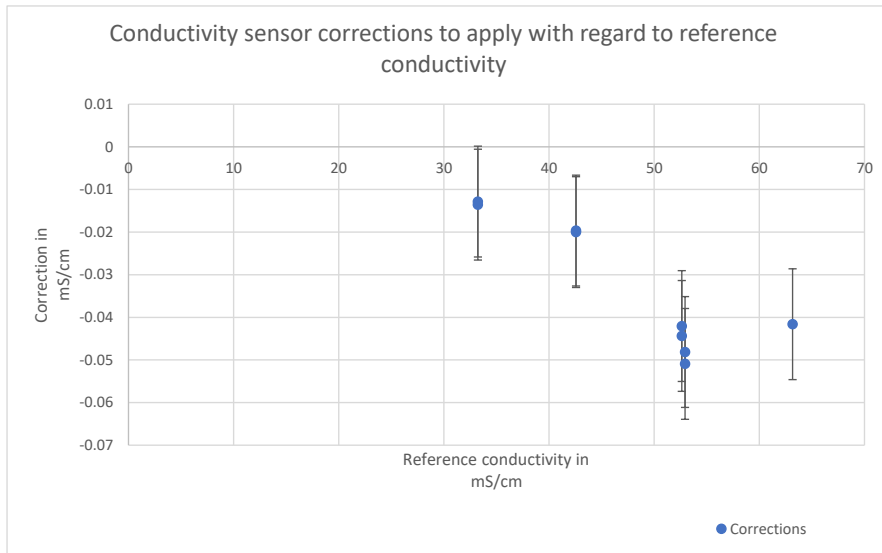


Fig: Photo of the set up (including pump)

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 = 0.013 mS/cm**

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.