MARINE SCOTLAND - SCIENCE LABORATORY MANUAL	SOPFL 1010 Issue No Issued By Date of this Issue:	Page 1 of 3 4.00 12/12/2019
External Calibration of Reference Loggers		

1. Introduction and scope

This document describes the external calibration of reference dataloggers by an accredited calibration laboratory.

2. Principle of the method

Two dataloggers will be sent to an external UKAS accredited calibration laboratory for calibration against recognised international standards for temperature measurements. The two reference loggers were chosen from batches of loggers purchased as they were closest to the median value for bias (at temperature range 0-30^{o}C) when cross calibrated. Currently the preferred laboratory is Electronic Temperature Instruments (ETI) Ltd, (UKAS laboratory 0601).

3. Reference materials

Secondary-Standard Platinum Resistance Thermometers.

4. Reagents

N/A

5. Equipment

Secondary -Standard Platinum Resistance Thermometers.
Waterbath
Externally calibrated “Reference Loggers”: Tinytag Aquatic 2 (Cal 2) and

Tinytag Aquatic 2 (Cal 3) Serial numbers:

1. 733784 (Named Cal 2)

2. 865626 (Named Cal 3)

6. Environmental control

N/A

7. Interferences

N/A

8. Sampling and sample preparation

Contained in a waterproof sheath and immersed in a stirred water bath.

9. Analytical procedure

9.1 Calibration Method

The reference loggers were stabilised at ambient temperature, contained in a waterproof sheath and calibrated by comparison with two Secondary Standard Platinum Resistance Thermometers in a stirred water bath at 7 points in the range of 0°C to +30°C.
The loggers were fully immersed in the liquid and set to log at 6 second intervals for a minimum of 1 hour to ensure a stable reading, a further reading is taken at 1 hour 10 minutes to confirm stability has been achieved. The test takes the mean of the temperatures at nominal time points of 1 hour, and at 1 hour 10 minutes for each of the 2 probes.
The mean values of the logged data produced by the Gemini Tinytag Explorer software at 1 hour and 1 hour 10 minutes minus the mean values measured by the Secondary-Standard Platinum Resistance Thermometers at the same time points were are used to estimate logger bias and uncertainty.

The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor K=2, providing a level of confidence of approximately 95%.

9.2 Calibration intervals

The reference loggers should be returned for calibration once a year.

9.3 Maintenance

Reference loggers should have the batteries and seals changed once a year and then sent for external calibration as per 9.1

9.4 Calibration Certificates

Calibration certificates should be stored in FL room 25

9.5 Data storage

9.5.1 Results of the calibration as reported in the certificate of calibration should be saved in a comma separated file and stored in a new folder dated as per the certificate of calibration at the following address:

[redacted]

The file for each calibration should be named **"UKASCalibration_[Serial number].csv"**. An example file following the required format is:

S/N, 319151
"Mean Established Temperature", "Mean Logged Temperature", "Error", "Time", "Uncertainty"
19.996, 19.946, -0.050, 00:30:00, 0.025
25.013, 24.975, -0.038, 00:30:00, 0.025
29.993, 29.954, -0.039, 00:30:00, 0.025
5.025, 4.929, -0.096, 00:30:00, 0.025
-0.002, -0.118, -0.116, 00:30:00, 0.025
9.993, 9.912, -0.081, 00:30:00, 0.025
14.988, 14.926, -0.062, 00:30:00, 0.025
19.983, 19.932, -0.051, 00:30:00, 0.025

10. Calculation of results

Results are presented in the certificate of calibration.

11. Bias and Uncertainty

See individual certificate of calibration plus individual logger resolution currently +\- 0.041°C.

12. Reports

See individual certificate of calibration

13. Safety

Not applicable.

14. Literature references

Not applicable.