



Sea-Bird Scientific  
 13431 NE 20<sup>th</sup> Street  
 Bellevue, WA 98005  
 USA

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 seabird@seabird.com  
 www.seabird.com

SENSOR SERIAL NUMBER: 1136  
 CALIBRATION DATE: 26-Jan-18

SBE 9plus PRESSURE CALIBRATION DATA  
 10000 psia S/N 127421

DIGIQUARTZ COEFFICIENTS:

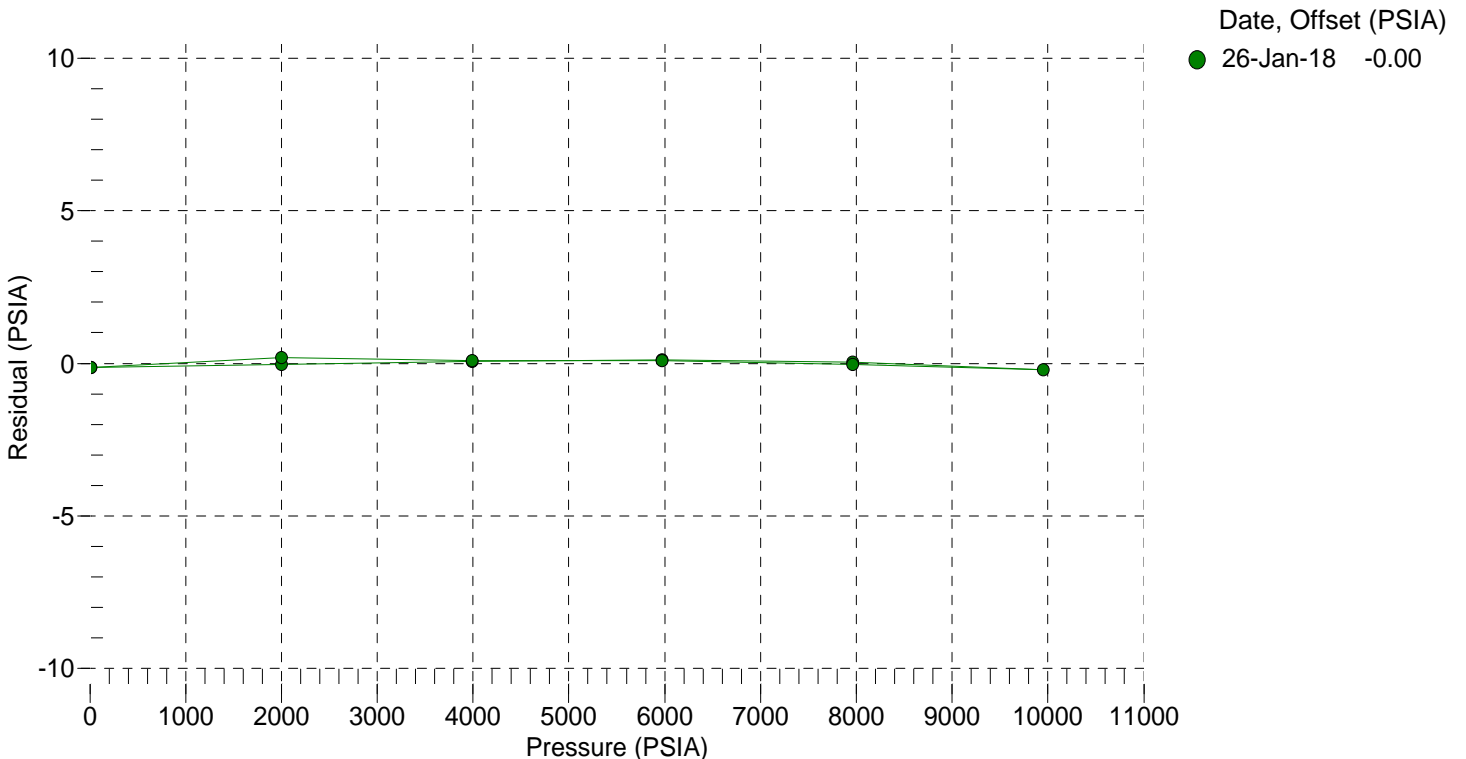
C1 = -4.373304e+004  
 C2 = 2.440268e-001  
 C3 = 1.442500e-002  
 D1 = 3.686900e-002  
 D2 = 0.000000e+000  
 T1 = 3.002769e+001  
 T2 = -1.951630e-004  
 T3 = 4.244630e-006  
 T4 = 2.954280e-009  
 T5 = 0.000000e+000

AD590M, AD590B, SLOPE AND OFFSET:

AD590M = 1.28120e-002  
 AD590B = -8.82994e+000  
 Slope = 0.99999  
 Offset = -2.0693 (dbars)

PRESSURE (PSIA)	INSTRUMENT OUTPUT (Hz)	INSTRUMENT TEMPERATURE (°C)	INSTRUMENT PRESSURE (PSIA)	CORRECTED PRESSURE (PSIA)	RESIDUAL (PSIA)
14.635	33311.70	21.0	17.502	14.500	-0.135
2001.252	34058.60	21.1	2004.255	2001.225	-0.027
3988.264	34787.20	21.1	3991.379	3988.321	0.057
5975.263	35498.50	21.1	5978.453	5975.366	0.103
7962.196	36193.50	21.2	7965.354	7962.239	0.043
9949.898	36873.40	21.2	9952.833	9949.689	-0.209
7962.265	36193.50	21.2	7965.347	7962.231	-0.034
5975.268	35498.50	21.2	5978.443	5975.356	0.088
3988.221	34787.20	21.2	3991.367	3988.309	0.088
2001.309	34058.70	21.2	2004.514	2001.484	0.175
14.640	33311.70	21.3	17.492	14.491	-0.149

Residual (PSIA) = corrected instrument pressure - reference pressure





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SENSOR SERIAL NUMBER: 5710  
 CALIBRATION DATE: 07-Jun-19

SBE 3 TEMPERATURE CALIBRATION DATA  
 ITS-90 TEMPERATURE SCALE

COEFFICIENTS:

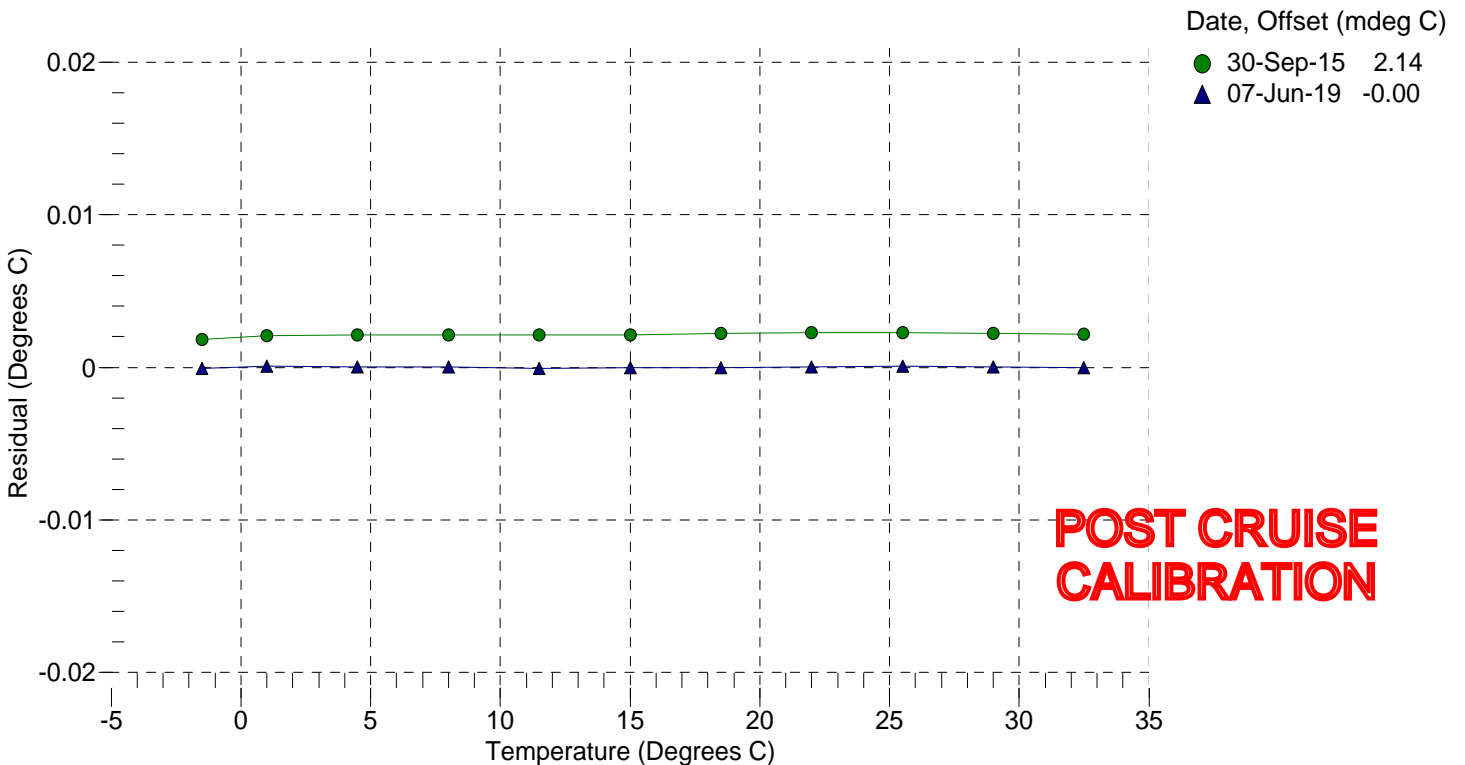
g = 4.35610405e-003  
 h = 6.30220061e-004  
 i = 1.93927951e-005  
 j = 1.29686869e-006  
 f0 = 1000.0

BATH TEMP (° C)	INSTRUMENT OUTPUT (Hz)	INST TEMP (° C)	RESIDUAL (° C)
-1.5000	3021.428	-1.5001	-0.00006
1.0000	3197.951	1.0001	0.00006
4.5000	3457.498	4.5000	0.00004
8.0000	3731.942	8.0000	0.00001
11.5000	4021.713	11.4999	-0.00006
15.0000	4327.248	15.0000	-0.00002
18.5000	4648.952	18.5000	-0.00002
22.0000	4987.235	22.0000	0.00000
25.5000	5342.496	25.5001	0.00005
29.0000	5715.112	29.0000	0.00004
32.5000	6105.455	32.5000	-0.00005

f = Instrument Output (Hz)

$$\text{Temperature ITS-90 (°C)} = 1 / \{g + h[\ln(f_0 / f)] + i[\ln^2(f_0 / f)] + j[\ln^3(f_0 / f)]\} - 273.15$$

$$\text{Residual (°C)} = \text{instrument temperature} - \text{bath temperature}$$





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SENSOR SERIAL NUMBER: 4107  
 CALIBRATION DATE: 12-Jul-18

SBE 4 CONDUCTIVITY CALIBRATION DATA  
 PSS 1978: C(35,15,0) = 4.2914 Siemens/meter

COEFFICIENTS:

g = -9.85627486e+000  
 h = 1.25228276e+000  
 i = -2.45192199e-003  
 j = 2.33072012e-004

CPcor = -9.5700e-008 (nominal)  
 CTcor = 3.2500e-006 (nominal)

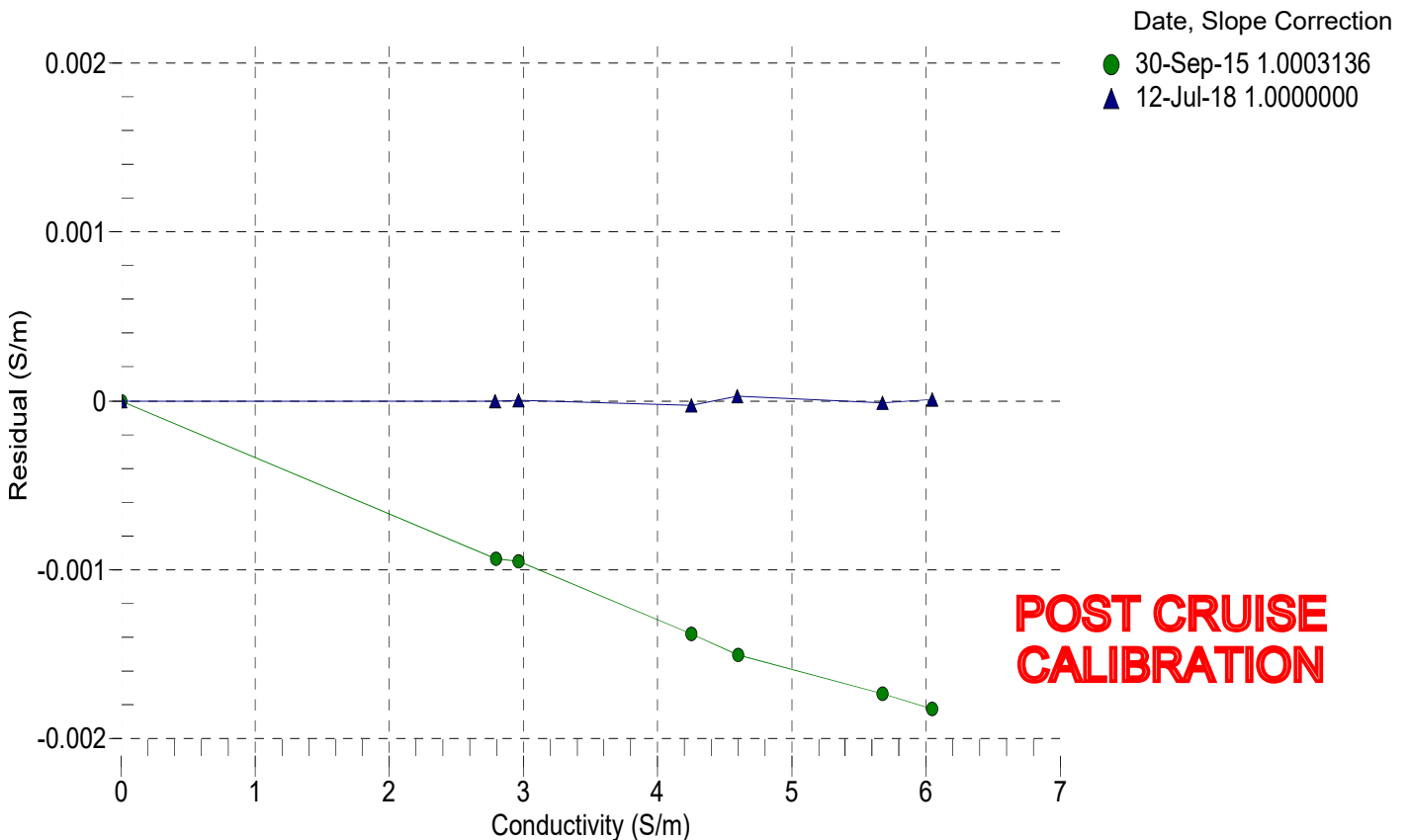
BATH TEMP (° C)	BATH SAL (PSU)	BATH COND (S/m)	INSTRUMENT OUTPUT (kHz)	INSTRUMENT COND (S/m)	RESIDUAL (S/m)
0.0000	0.0000	0.00000	2.81114	0.00000	0.00000
-0.9999	34.6423	2.79187	5.50641	2.79187	-0.00000
1.0001	34.6429	2.96256	5.62943	2.96257	0.00000
15.0001	34.6438	4.25270	6.48355	4.25267	-0.00003
18.5001	34.6427	4.59783	6.69345	4.59786	0.00003
29.0001	34.6369	5.67624	7.30995	5.67623	-0.00001
32.5001	34.6252	6.04643	7.50975	6.04644	0.00001

f = Instrument Output (kHz)

t = temperature (°C); p = pressure (decibars);  $\delta$  = CTcor;  $\epsilon$  = CPcor;

Conductivity (S/m) =  $(g + h * f^2 + i * f^3 + j * f^4) / 10 (1 + \delta * t + \epsilon * p)$

Residual (Siemens/meter) = instrument conductivity - bath conductivity





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SENSOR SERIAL NUMBER: 0460  
 CALIBRATION DATE: 11-Jul-19

SBE 43 OXYGEN CALIBRATION DATA

COEFFICIENTS:            A = -4.1528e-003  
 Soc = 0.4801                B = 1.6263e-004  
 Voffset = -0.4698         C = -2.2794e-006  
 Tau20 = 0.96               E nominal = 0.036

NOMINAL DYNAMIC COEFFICIENTS  
 D1 = 1.92634e-4         H1 = -3.300000e-2  
 D2 = -4.64803e-2        H2 = 5.00000e+3  
 H3 = 1.45000e+3

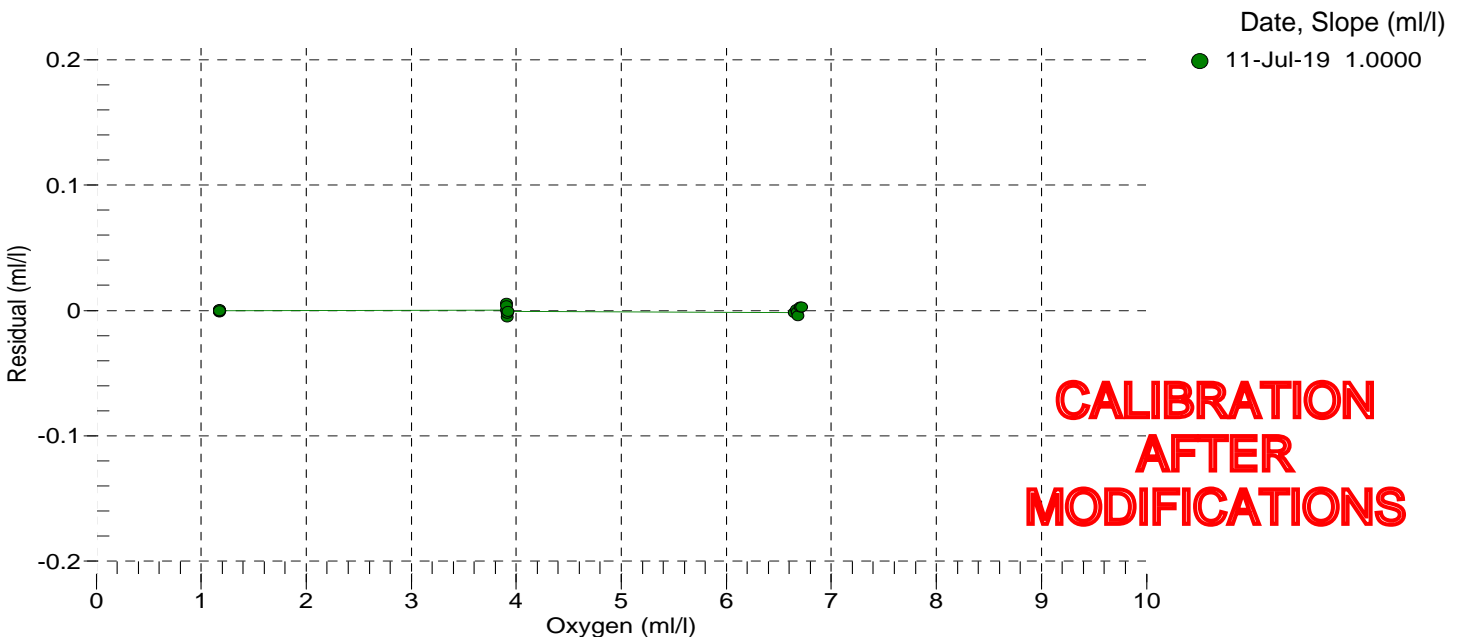
BATH OXYGEN (ml/l)	BATH TEMPERATURE (° C)	BATH SALINITY (PSU)	INSTRUMENT OUTPUT (volts)	INSTRUMENT OXYGEN (ml/l)	RESIDUAL (ml/l)
1.17	20.00	0.00	0.868	1.17	0.00
1.17	12.00	0.00	0.803	1.17	-0.00
1.17	26.00	0.00	0.916	1.17	-0.00
1.17	30.00	0.00	0.951	1.17	0.00
1.17	6.00	0.00	0.756	1.17	0.00
1.18	2.00	0.00	0.725	1.18	-0.00
3.91	2.00	0.00	1.317	3.91	0.00
3.91	26.00	0.00	1.962	3.91	0.01
3.91	6.00	0.00	1.424	3.91	0.00
3.91	12.00	0.00	1.583	3.91	-0.01
3.91	30.00	0.00	2.073	3.91	-0.00
3.92	20.00	0.00	1.801	3.92	-0.00
6.65	2.00	0.00	1.911	6.64	-0.00
6.67	6.00	0.00	2.096	6.67	0.00
6.67	30.00	0.00	3.205	6.67	-0.00
6.68	20.00	0.00	2.738	6.68	-0.00
6.71	26.00	0.00	3.029	6.71	0.00
6.72	12.01	0.00	2.384	6.72	0.00

V = instrument output (volts); T = temperature (°C); S = salinity (PSU); K = temperature (°K)

Oxsol(T,S) = oxygen saturation (ml/l); P = pressure (dbar)

Oxygen (ml/l) = Soc \* (V + Voffset) \* (1.0 + A \* T + B \* T<sup>2</sup> + C \* T<sup>3</sup>) \* Oxsol(T,S) \* exp(E \* P / K)

Residual (ml/l) = instrument oxygen - bath oxygen





## TEST REPORT

All test equipment and standards used are of known accuracy and traceable to national standards. Details of test equipment and standards relevant to this certificate are available upon request.

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Group Ltd

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sales@chelsea.co.uk  
www.chelsea.co.uk

Date of Issue: 19<sup>th</sup> June 2018  
Part Number: 0161-5552R  
WOT Number: WO180273  
Description: Alphatracka (25cm, 660nm)  
Serial Number: 09-7250-001

This is to certify that ALPHATRACKA MK II has been pressure tested for 1 hour at 60 Bar, with no apparent leakage.

The design of Alphatracka Mk II has previously been verified as suitable for continuous use at a maximum depth of 6000 metres

Equipment used during testing :-  
Pressure chamber Cil 219

Signed:

M.J.Nicholson

Date: 19<sup>th</sup> June 2018

**CERTIFICATE OF CALIBRATION**

All test equipment and standards used are of known accuracy and traceable to national standards. Details of test equipment and standards relevant to this certificate are available upon request.

Chelsea  
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Group Ltd

Date of Issue: 19<sup>th</sup> June 2018  
Part Number: 0161-5552R  
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Description: Alphatracka (25cm, 660nm)  
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**REPORT**

Alphatracka is a 25 cm transmissometer, measuring attenuation of light at 660 nm. It is designed for use at depths up to a maximum of 6000m.

**Results**

Readings from the transmissometer were taken, at a temperature of 20°C, +/- 1°C, in both air and purified water, and the following results were obtained:-

Reading in air	=	4.2576 Volts
Reading in purified water	=	4.2002 Volts
'Zero' reading	=	0.0106 Volts

**Notes**

The 'Zero' reading was obtained by mechanically obstructing the detection window.  
The purified water used was generated using a reverse-osmosis/ion exchange column. 'Purer' water (ie water with a higher transmission) may be found in clear deep ocean conditions.

**Equipment used during calibration:-**

Thurlby Dvm Cil 024  
Weir Psu Cil 098

Name: M.J.Nicholson

Signed: 

Date: 19<sup>th</sup> June 2018

Registration No: 00832429  
Registered at the above address





## TEST REPORT

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Date of Issue: 19<sup>th</sup> June 2018  
Part Number: 0088-3598C  
WOT Number: WO180272  
Description: AQUATRACKA MKIII  
Serial Number: 088-256

This is to certify that Aquatracka III (Titanium) has been pressure tested for 1 hour at 60 bars and is suitable for use to a maximum depth of 6000 Metres.

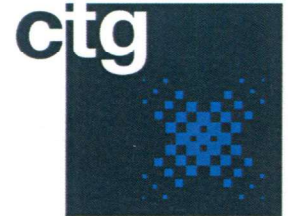
Equipment used during testing:-  
Pressure chamber Cil 219

Signed:

A handwritten signature in black ink, appearing to be 'M.J. Nicholson', written over a horizontal line.

M.J.Nicholson

Date: 19<sup>th</sup> June 2018



## CERTIFICATE OF CALIBRATION

All test equipment and standards used are of known accuracy and traceable to national standards. Details of test equipment and standards relevant to this certificate are available upon request.

Date of Issue: 19<sup>th</sup> June 2018

Part Number: 0088-3598C

WOT Number: WO180272

Description: AQUATRACKA MKIII

Serial Number: 088-256

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### REPORT

The fluorimeter was exposed to various concentrations of Chlorophyll-a dissolved in acetone in addition to pure water and pure acetone. The following formula was derived from the readings to relate instrument output to chlorophyll-a concentration.

$$\text{Conc.} = (0.008434 \times 10^{\text{Output}}) - 0.028910$$

Where:-

Conc. = fluorophor concentration in  $\mu\text{g/l}$

Output = Aquatracka output in volts

The above formula can be used in the range 0 - 100 microgrammes per litre to an uncertainty of 0.02 microgrammes per litre plus 3% of value.

#### Notes

The above formula has been derived using Chlorophyll-a dissolved in acetone. No guarantee is given as to the performance of the instrument to biologically active chlorophyll in sea-water.

The zero offset has been determined in the laboratory using purified water from a reverse osmosis/ion exchange column. It is possible that purer water may be found in clean deep ocean conditions. Under these conditions, the offset shown in the above formula should be replaced by the antilogarithm of the Aquatracka output in the purest water found, multiplied by the scale factor.



**Chelsea Technologies Group Ltd  
Certificate Of Calibration**

Fluorimeter calibration readings

Ambient temperature 20°C

Output for detector mechanically blanked 0.5340 Volts

Output for pure water 0.5350 Volts

chlorophyll concentration in acetone (µg/l)	Output (volts)
Acetone (pure)	0.5783
0.1	1.1847
0.3	1.5916
1.0	2.0847
3.0	2.5607
9.9	3.0735
29.1	3.5463
90.9	4.0371


The uncertainty of the chlorophyll concentration is estimated not to exceed 3%. The uncertainty of output voltage measurement is estimated not to exceed 2mV.

**Equipment used during calibration:-**

Thurlby Dvm Cil 024

Weir Psu Cil 098

Signed



Date 19<sup>th</sup> June 2018

**M.J.Nicholson**