

SEA-BIRD ELECTRONICS, INC.

1808 136th Place N.E., Bellevue, Washington, 98005 USA
 Phone: (425) 643 - 9866 Fax (425) 643 - 9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 0794
 CALIBRATION DATE: 02-Nov-07

SBE 43 OXYGEN CALIBRATION DATA

COEFFICIENTS

Soc = 0.3796

Voffset = -0.4866

A = -2.5759e-003

B = 2.1869e-004

C = -4.2537e-006

E nominal = 0.036

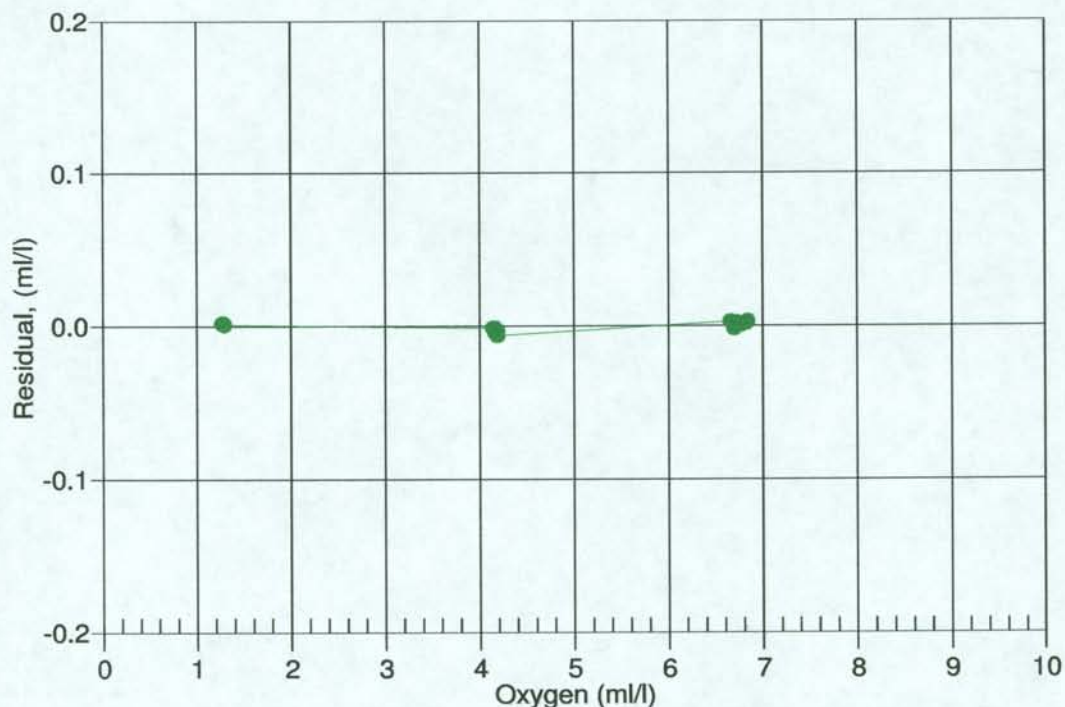
BATH OX (ml/l)	BATH TEMP ITS-90	BATH SAL PSU	INSTRUMENT OUTPUT(VOLTS)	INSTRUMENT OXYGEN(ml/l)	RESIDUAL (ml/l)
1.27	20.00	0.01	1.012	1.27	0.00
1.28	26.00	0.01	1.076	1.28	0.00
1.28	6.00	0.00	0.876	1.28	0.00
1.28	2.00	0.00	0.837	1.28	0.00
1.28	12.00	0.01	0.938	1.28	0.00
1.29	30.00	0.01	1.128	1.29	0.00
4.14	26.00	0.01	2.397	4.14	-0.00
4.15	20.00	0.01	2.200	4.15	-0.00
4.17	2.00	0.00	1.625	4.16	-0.00
4.17	12.00	0.01	1.953	4.17	-0.00
4.19	30.00	0.01	2.560	4.18	-0.00
4.19	6.00	0.00	1.762	4.18	-0.01
6.65	30.00	0.01	3.786	6.66	0.00
6.70	26.00	0.01	3.575	6.69	-0.00
6.73	20.00	0.01	3.268	6.73	0.00
6.77	12.00	0.01	2.870	6.78	0.00
6.82	6.00	0.00	2.569	6.83	0.00
6.83	2.00	0.00	2.356	6.84	0.00

Oxygen (ml/l) = Soc * (V + Voffset) * (1.0 + A * T + B * T² + C * T³) * OxSol(T,S) * exp(E * P / K)

V = voltage output from SBE43, T = temperature [deg C], S = salinity [PSU] K = temperature [deg K]

OxSol(T,S) = oxygen saturation [ml/l], P = pressure [dbar], Residual = instrument oxygen - bath oxygen

Date, Delta Ox (ml/l)



02-Nov-07 1.0000



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1808 - 136th Place Northeast, Bellevue, Washington 98005 USA

Phone: (425) 643-9866 Fax: (425) 643-9954 www.seabird.com

Temperature Calibration Report

Customer:	Woods Hole Oceanographic Institute		
Job Number:	43897	Date of Report:	10/6/2006
Model Number:	SBE 03Plus	Serial Number:	03P2265

Temperature sensors are normally calibrated 'as received', without adjustments, allowing a determination sensor drift. If the calibration identifies a problem, then a second calibration is performed after work is completed. The 'as received' calibration is not performed if the sensor is damaged or non-functional, or by customer request.

An 'as received' calibration certificate is provided, listing coefficients to convert sensor frequency to temperature. Users must choose whether the 'as received' calibration or the previous calibration better represents the sensor condition during deployment. In SEASOFT enter the chosen coefficients using the program SEACON. The coefficient 'offset' allows a small correction for drift between calibrations (consult the SEASOFT manual). Calibration coefficients obtained after a repair apply only to subsequent data.

'AS RECEIVED CALIBRATION'

☒ Performed ☐ Not Performed

Date: 10/6/2006

Drift since last cal: +.00075 Degrees Celsius/year

Comments:

'CALIBRATION AFTER REPAIR'

☐ Performed ☒ Not Performed

Date:

Drift since Last cal: Degrees Celsius/year

Comments:

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SENSOR SERIAL NUMBER: 2265
CALIBRATION DATE: 06-Oct-06

SBE3 TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

ITS-90 COEFFICIENTS

g = 4.33165443e-003
h = 6.43447458e-004
i = 2.32971332e-005
j = 2.16640116e-006
f0 = 1000.0

ITS-68 COEFFICIENTS

a = 3.68121140e-003
b = 6.01944145e-004
c = 1.65221542e-005
d = 2.16797427e-006
f0 = 2848.194

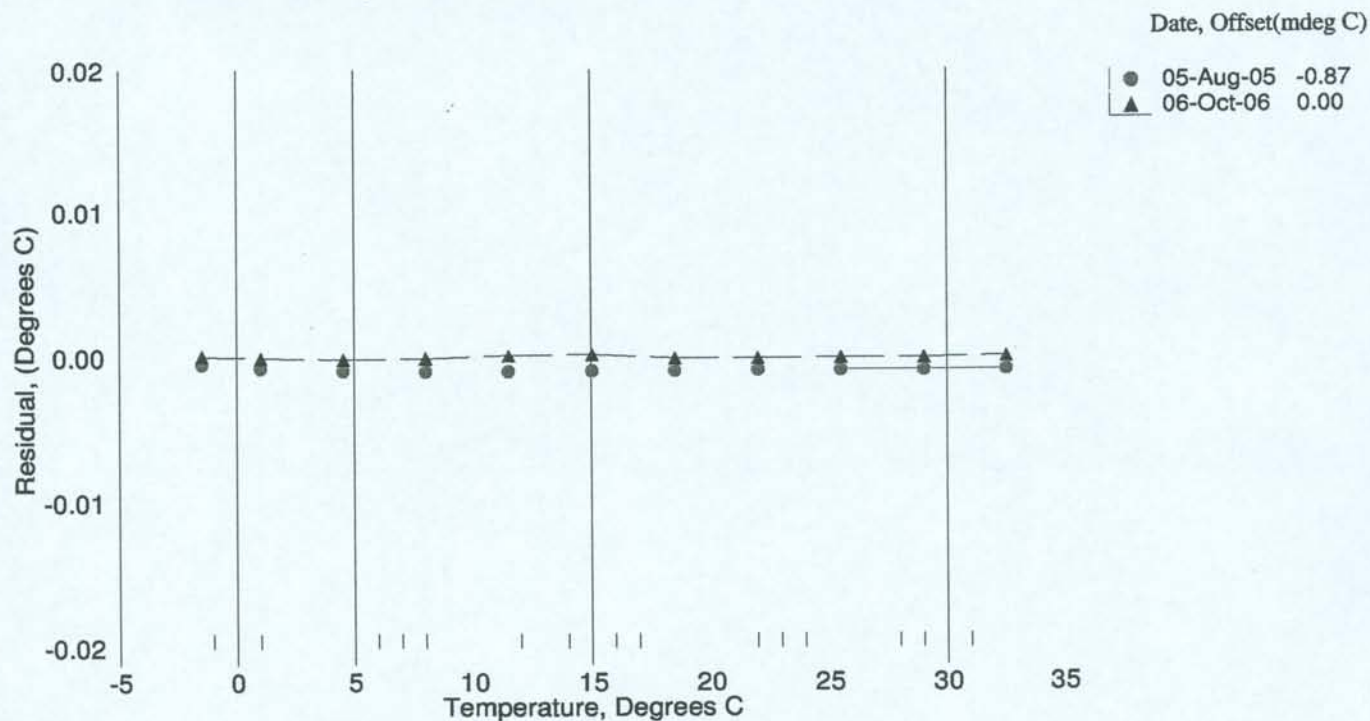
BATH TEMP (ITS-90)	INSTRUMENT FREQ (Hz)	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
-1.5000	2848.194	-1.4999	0.00007
1.0000	3011.834	1.0000	-0.00004
4.5000	3252.239	4.4999	-0.00010
8.0000	3506.178	7.9999	-0.00006
11.5000	3774.025	11.5001	0.00013
15.0000	4056.113	15.0002	0.00016
18.5000	4352.777	18.4999	-0.00009
22.0000	4664.398	21.9999	-0.00009
25.5000	4991.288	25.5000	-0.00001
29.0000	5333.744	29.0000	-0.00001
32.5000	5692.080	32.5000	0.00004

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

Temperature ITS-68 = $1/[a + b[\ln(f_0/f)] + c[\ln^2(f_0/f)] + d[\ln^3(f_0/f)]] - 273.15$ (°C)

Following the recommendation of JPOTS: T_{68} is assumed to be $1.00024 * T_{90}$ (-2 to 35 °C)

Residual = instrument temperature - bath temperature





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Temperature Calibration Report

Customer:	Woods Hole Oceanographic Institute		
Job Number:	43897	Date of Report:	10/12/2006
Model Number:	SBE 03Plus	Serial Number:	03P2271

Temperature sensors are normally calibrated 'as received', without adjustments, allowing a determination sensor drift. If the calibration identifies a problem, then a second calibration is performed after work is completed. The 'as received' calibration is not performed if the sensor is damaged or non-functional, or by customer request.

An 'as received' calibration certificate is provided, listing coefficients to convert sensor frequency to temperature. Users must choose whether the 'as received' calibration or the previous calibration better represents the sensor condition during deployment. In SEASOFT enter the chosen coefficients using the program SEACON. The coefficient 'offset' allows a small correction for drift between calibrations (consult the SEASOFT manual). Calibration coefficients obtained after a repair apply only to subsequent data.

'AS RECEIVED CALIBRATION'

☒ Performed ☐ Not Performed

Date: 10/12/2006

Drift since last cal: -.00086 Degrees Celsius/year

Comments:

'CALIBRATION AFTER REPAIR'

☐ Performed ☒ Not Performed

Date:

Drift since Last cal: Degrees Celsius/year

Comments:

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SENSOR SERIAL NUMBER: 2271
CALIBRATION DATE: 12-Oct-06

SBE3 TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

ITS-90 COEFFICIENTS

g = 4.33370733e-003
h = 6.41122555e-004
i = 2.32335643e-005
j = 2.16890382e-006
f0 = 1000.0

ITS-68 COEFFICIENTS

a = 3.68121213e-003
b = 5.99518512e-004
c = 1.64026069e-005
d = 2.17046175e-006
f0 = 2869.238

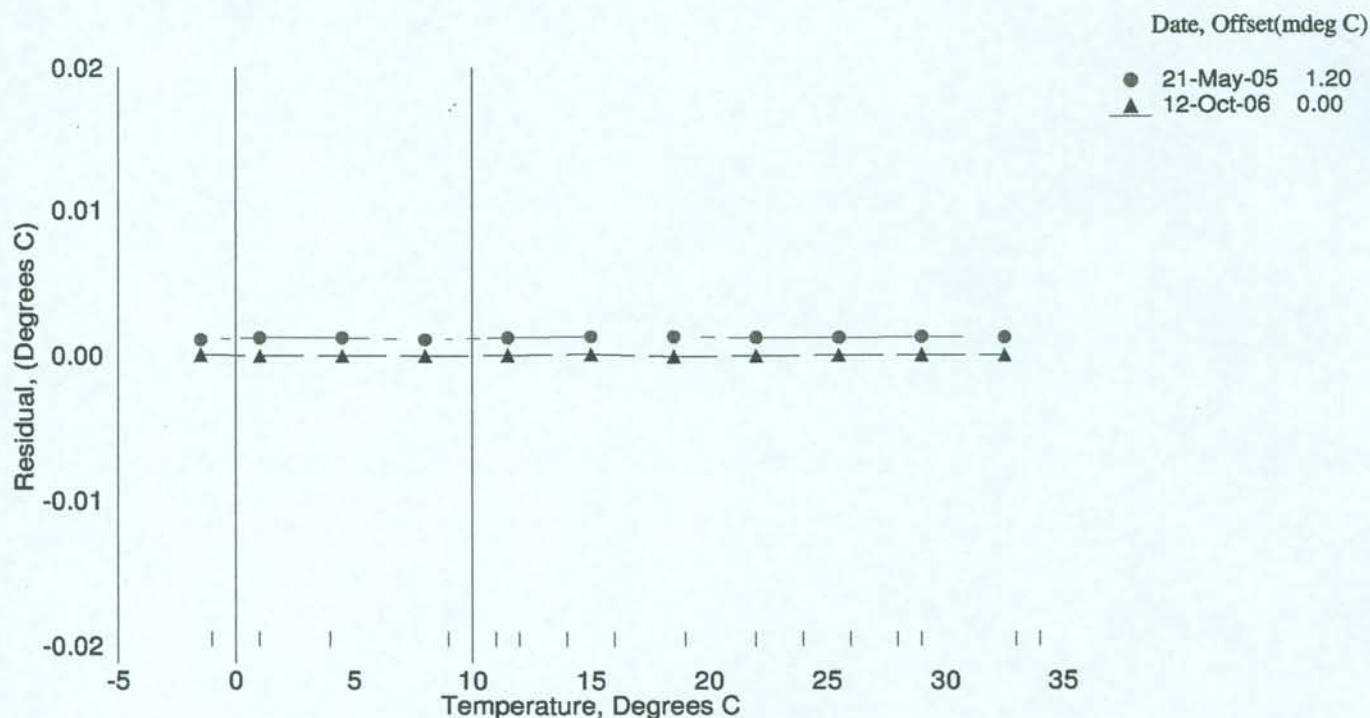
BATH TEMP (ITS-90)	INSTRUMENT FREQ (Hz)	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
-1.5000	2869.238	-1.5000	0.00001
1.0000	3034.779	1.0000	-0.00001
4.5000	3278.038	4.5000	-0.00002
8.0000	3535.065	8.0000	-0.00001
11.5000	3806.240	11.5000	0.00002
15.0000	4091.931	15.0001	0.00007
18.5000	4392.478	18.4999	-0.00006
22.0000	4708.258	22.0000	-0.00003
25.5000	5039.593	25.5000	0.00001
29.0000	5386.802	29.0000	0.00002
32.5000	5750.193	32.5000	-0.00001

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

Temperature ITS-68 = $1/[a + b[\ln(f_0/f)] + c[\ln^2(f_0/f)] + d[\ln^3(f_0/f)]] - 273.15$ (°C)

Following the recommendation of JPOTS: T_{68} is assumed to be $1.00024 * T_{90}$ (-2 to 35 °C)

Residual = instrument temperature - bath temperature



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SENSOR SERIAL NUMBER: 2304
 CALIBRATION DATE: 06-Oct-06

SBE4 CONDUCTIVITY CALIBRATION DATA
 PSS 1978: C(35,15,0) = 4.2914 Siemens/meter

GHIJ COEFFICIENTS

g = -1.04548869e+001
 h = 1.57935431e+000
 i = -2.67396492e-003
 j = 2.94457926e-004
 CPcor = -9.5700e-008 (nominal)
 CTcor = 3.2500e-006 (nominal)

ABCDM COEFFICIENTS

a = 2.57509131e-007
 b = 1.57231007e+000
 c = -1.04409917e+001
 d = -8.62470142e-005
 m = 6.7
 CPcor = -9.5700e-008 (nominal)

BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (kHz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
0.0000	0.0000	0.00000	2.57691	0.00000	0.00000
-1.0001	34.9099	2.81140	4.95116	2.81138	-0.00002
1.0670	34.9105	2.98907	5.06389	2.98907	0.00000
15.0000	34.9107	4.28197	5.81835	4.28199	0.00003
18.5000	34.9098	4.62943	6.00483	4.62946	0.00003
29.0000	34.9073	5.71554	6.55318	5.71543	-0.00012
32.5000	34.9003	6.08898	6.73138	6.08905	0.00008

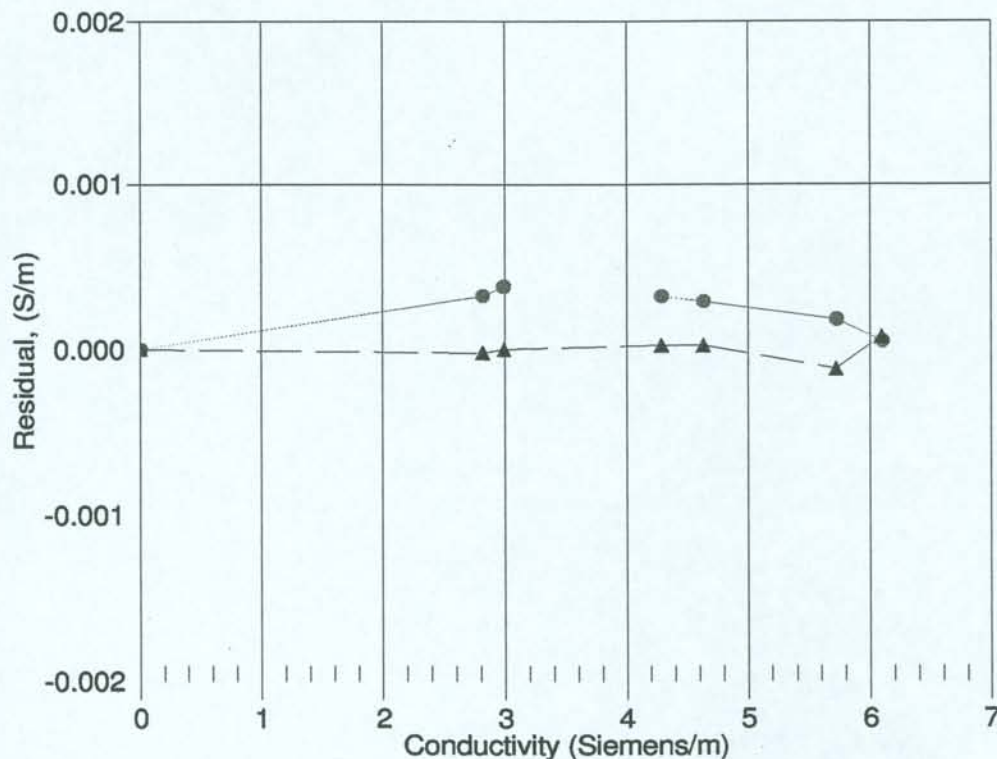
Conductivity = $(g + hf^2 + if^3 + jf^4) / 10(1 + \delta t + \epsilon p)$ Siemens/meter

Conductivity = $(af^m + bf^2 + c + dt) / [10(1 + \epsilon p)]$ Siemens/meter

t = temperature[°C]; p = pressure[decibars]; δ = CTcor; ϵ = CPcor;

Residual = (instrument conductivity - bath conductivity) using g, h, i, j coefficients

Date, Slope Correction



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SENSOR SERIAL NUMBER: 2645
CALIBRATION DATE: 06-Oct-06

SBE4 CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Siemens/meter

GHJ COEFFICIENTS

g = -1.02299770e+001
h = 1.41205850e+000
i = -5.54115246e-004
j = 1.12946050e-004
CPcor = -9.5700e-008 (nominal)
CTcor = 3.2500e-006 (nominal)

ABCDM COEFFICIENTS

a = 1.69581382e-005
b = 1.41095147e+000
c = -1.02285657e+001
d = -8.91380453e-005
m = 4.6
CPcor = -9.5700e-008 (nominal)

BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (kHz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
0.0000	0.0000	0.00000	2.69225	0.00000	0.00000
-1.0001	34.9099	2.81140	5.21067	2.81140	-0.00001
1.0670	34.9105	2.98907	5.32989	2.98906	-0.00001
15.0000	34.9107	4.28197	6.12765	4.28199	0.00002
18.5000	34.9098	4.62943	6.32481	4.62946	0.00003
29.0000	34.9073	5.71554	6.90448	5.71544	-0.00010
32.5000	34.9003	6.08898	7.09286	6.08904	0.00007

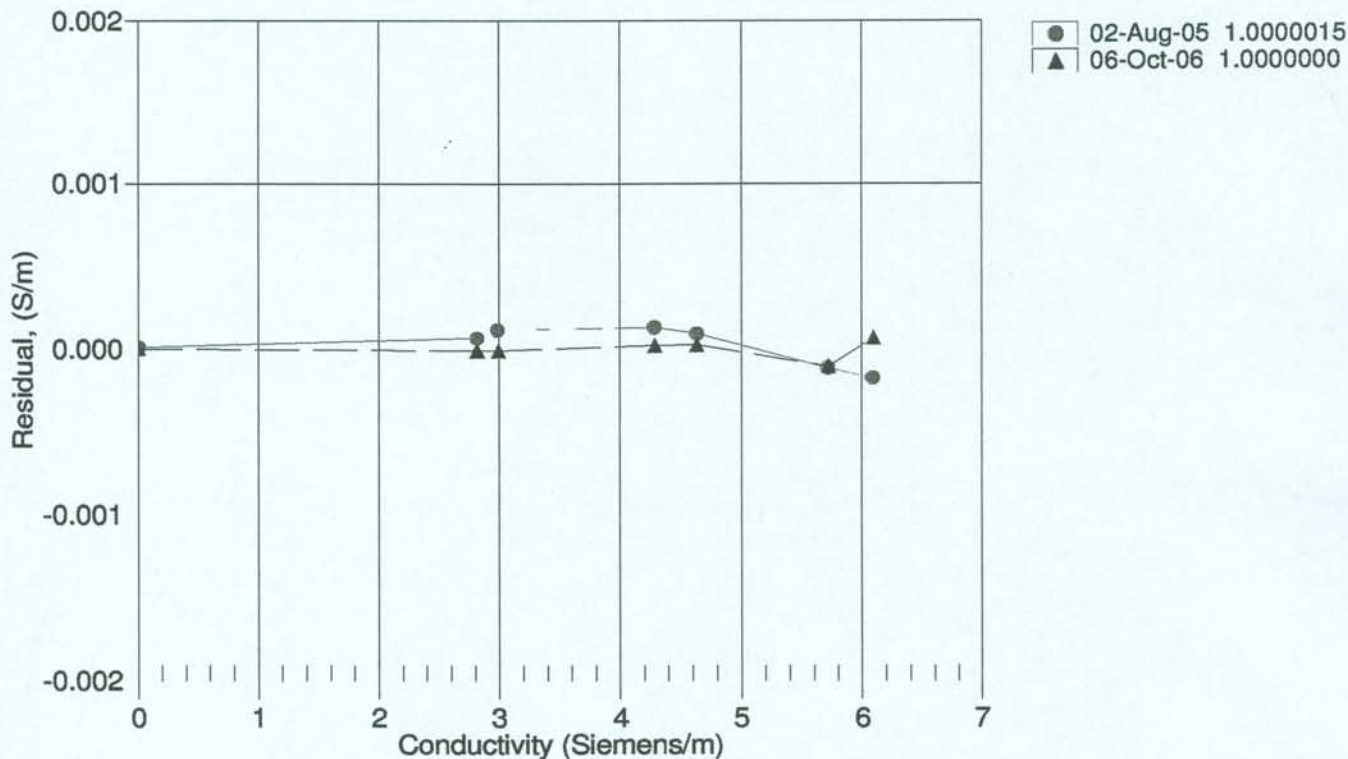
Conductivity = $(g + hf^2 + if^3 + jf^4) / 10(1 + \delta t + \epsilon p)$ Siemens/meter

Conductivity = $(af^m + bf^2 + c + dt) / [10(1 + \epsilon p)]$ Siemens/meter

t = temperature[°C]; p = pressure[decibars]; δ = CTcor; ϵ = CPcor;

Residual = (instrument conductivity - bath conductivity) using g, h, i, j coefficients

Date, Slope Correction



PO Box 518
620 Applegate St.
Philomath, OR 97370



(541) 929-5650
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ECO Chlorophyll Fluorometer Characterization Sheet

Date: 6/27/2005

Customer: WHOI

Job #: 506023

S/N#: FLRTD-297

Chlorophyll concentration expressed in $\mu\text{g/l}$ can be derived using the equation:

$$\text{CHL } (\mu\text{g/l}) = \text{Scale Factor} * (\text{Output} - \text{Dark Counts})$$

	Analog Range 1	Analog Range 2 (default)	Analog Range 4	Digital
Dark Counts <i>5-10/100K</i>	0.107	0.059	0.033 V	81 counts
Chl. Equivalent Concentration (CEC)	4.0	2.0	1.0 V	3285 counts
Scale Factor (SF)	6	13	26 $\mu\text{g/V}$	0.0078 $\mu\text{g/count}$
Maximum Output	4.94	4.94	4.94 V	16338 counts
Resolution	1.8	1.8	1.8 mV	1.1 counts

Ambient temperature during characterization

0.0 °C

Analog Range: 1 (most sensitive, 0–4,000 counts), 2 (midrange, 0–8,000 counts), 4 (entire range, 0–16,000 counts).

Dark Counts: Signal output of the meter in clean water with black tape over detector.

CEC Signal output of the fluorometer when using a fluorescent proxy that has been determined to be approximately equivalent to 25 $\mu\text{g/l}$ of a *Thalassiosira weissflogii* phytoplankton culture.

SF: Used to derive chlorophyll concentration from the signal output of the fluorometer. The scale factor is determined using the following equation: $\text{SF} = 25 \div (\text{CEC} - \text{dark counts})$. For example: $25 \div (2865 - 43.5) = 0.00886$.

Maximum Output: Maximum signal output the fluorometer is capable of.

Resolution: Standard deviation of 1 minute of collected data.

The relationship between fluorescence and chlorophyll-a concentrations *in-situ* is highly variable. The scale factor listed on this document was determined using a mono-culture of phytoplankton (*Thalassiosira weissflogii*). The population was assumed to be reasonably healthy and the concentration was determined by using the absorption method. To accurately determine chlorophyll concentration using a fluorometer, you must perform secondary measurements on the populations of interest. This is typically done using extraction-based measurement techniques on discrete samples. For additional information on determining chlorophyll concentration see "Standard Methods for the Examination of Water and Wastewater" part 10200 H, published jointly by the American Public Health Association, American Water Works Association, and the Water Environment Federation.