Sea-Bird Electronics, Inc.

13431 NE 20th Street, Bellevue, WA 98005-2010 USA
Phone: (+1) 425-643-9866 Fax (+1) 425-643-9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 0073
CALIBRATION DATE: 17-Jan-12

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

GHIJ COEFFICIENTS

```
g = -1.00323449e+001
h =  1.11123469e+000
i =  3.61200369e-003
j = -1.79789474e-004
CPcor = -9.5700e-008 (nominal)
CTcor =  3.2500e-006 (nominal)
```

ABCDM COEFFICIENTS

```
a =  6.04161592e-002
b =  1.05451057e+000
c = -1.00454157e+001
d = -1.46307051e-004
m =  2.1
CPcor = -9.5700e-008 (nominal)
```

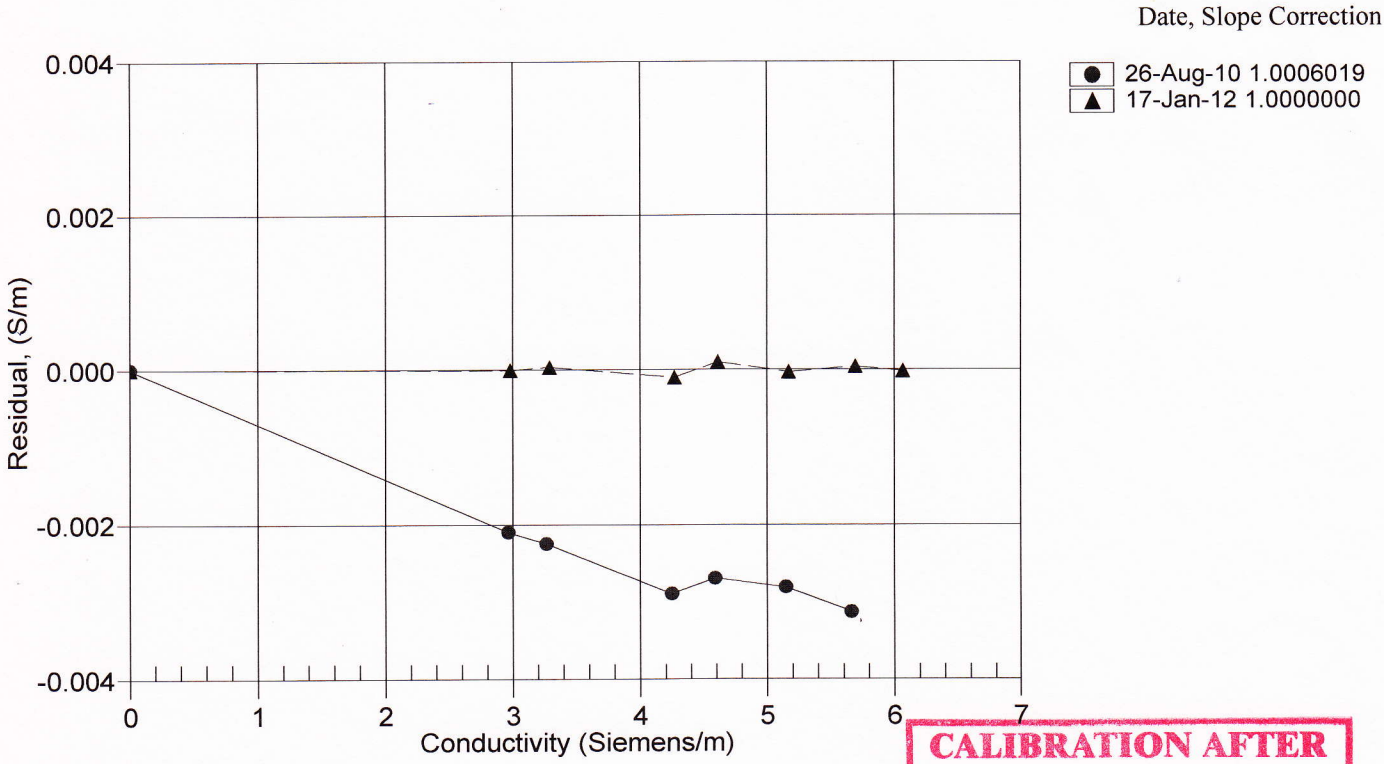
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (kHz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
22.0000	0.0000	0.00000	2.99232	0.00000	0.00000
1.0000	34.8420	2.97795	5.94523	2.97794	-0.00001
4.5000	34.8215	3.28517	6.16953	3.28520	0.00003
15.0000	34.7781	4.26742	6.83713	4.26732	-0.00010
18.5000	34.7689	4.61276	7.05696	4.61286	0.00010
24.0000	34.7586	5.17099	7.39822	5.17096	-0.00003
29.0000	34.7527	5.69307	7.70383	5.69311	0.00004
32.5000	34.7493	6.06563	7.91465	6.06561	-0.00002

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

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

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

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



CALIBRATION AFTER CLEANING AND REPLATINIZING CELL

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SENSOR SERIAL NUMBER: 0073
CALIBRATION DATE: 17-Jan-12

GliderAPL TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

ITS-90 COEFFICIENTS

```
g =  4.29404793e-003
h =  6.27893850e-004
i =  2.28773646e-005
j =  2.33829927e-006
f0 = 1000.0
```

IPTS-68 COEFFICIENTS

```
a =  3.64763514e-003
b =  5.87218046e-004
c =  1.54227902e-005
d =  2.33978906e-006
f0 = 2904.924
```

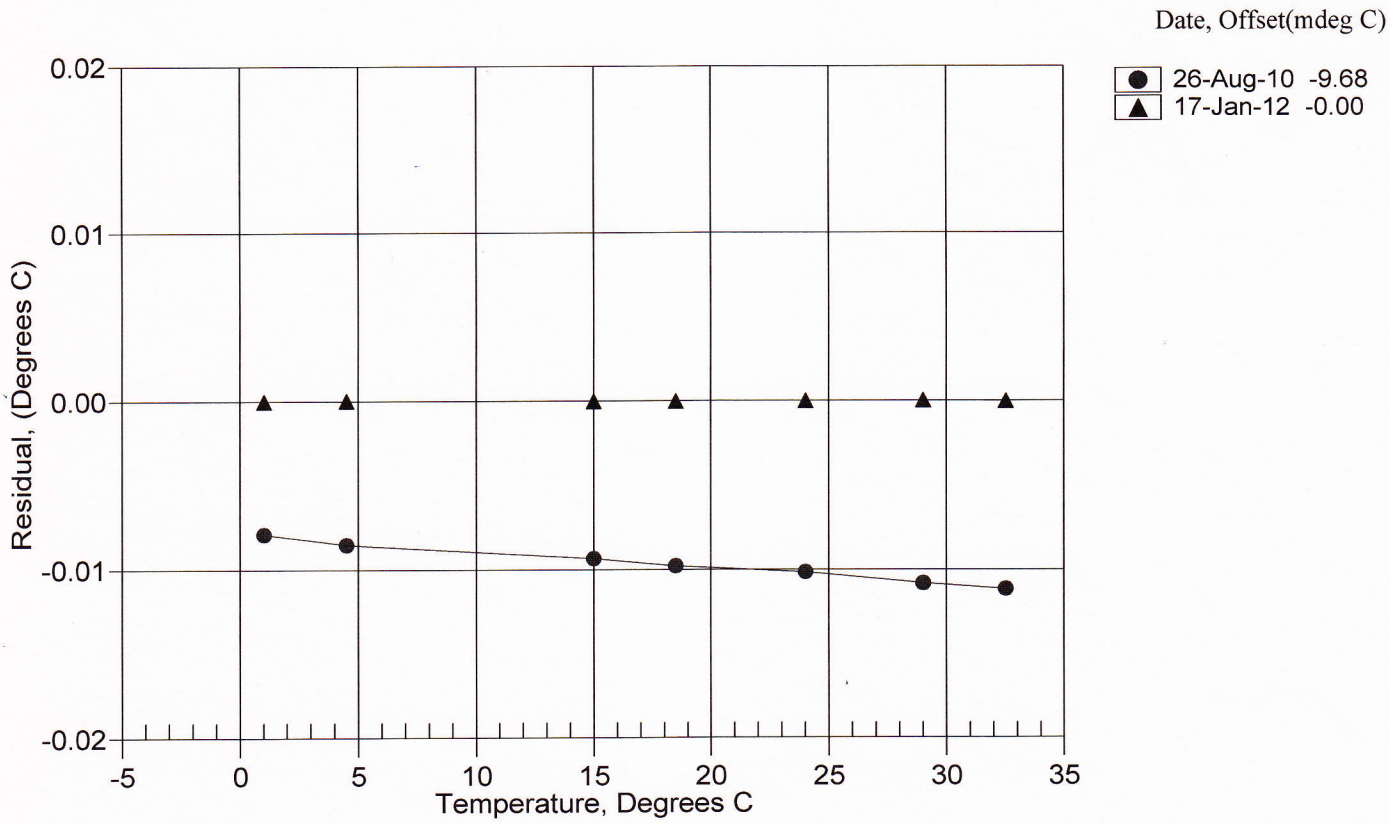
BATH TEMP (ITS-90)	INSTRUMENT FREQ (Hz)	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
1.0000	2904.924	1.0000	-0.00001
4.5000	3142.096	4.5000	0.00002
15.0000	3937.695	15.0000	-0.00001
18.5000	4232.203	18.5000	-0.00001
24.0000	4725.978	24.0000	0.00000
29.0000	5208.699	29.0000	0.00003
32.5000	5566.299	32.5000	-0.00002

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 IPTS-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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Service Report

RMA Number 66944

Customer Information:

Company	SEAGLIDER FABRICATION CENTER	**Date**	1/20/2012
Contact	Karl Kunkle		
PO Number	100902		

Serial Number	0073 Glider T/C Assembly
Model Number	Glider

Services Requested:

1. Evaluate/Repair Instrumentation.
2. Perform Routine Calibration Service.

Problems Found:

1. The conductivity cell was found to require cleaning and re-platinization.

Services Performed:

1. Performed initial diagnostic evaluation.
2. Performed "Post Cruise" calibration of the temperature & conductivity sensors.
3. Cleaned and replatinized the conductivity cell.
4. Performed "Final" calibration of the temperature & conductivity sensors.
5. Performed complete system check and full diagnostic evaluation.

Special Notes:

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Temperature Calibration Report

Customer:	SEAGLIDER FABRICATION CENTER		
Job Number:	66944	**Date of Report:**	1/17/2012
Model Number	Glider	**Serial Number:**	0073 Glider T/C Assembly

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. 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: 12/14/2011 Drift since last cal: -0.00059 Degrees Celsius/year

Comments:

'FINAL CALIBRATION' ☑ Performed ☐ Not Performed

Date: 1/17/2012 Drift since 26 Aug 10 +0.00694 Degrees Celsius/year

Comments:

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Conductivity Calibration Report

Customer:	SEAGLIDER FABRICATION CENTER		
Job Number:	66944	**Date of Report:**	1/17/2012
Model Number	Glider	**Serial Number:**	0073 Glider T/C Assembly

Conductivity sensors are normally calibrated 'as received', without cleaning or adjustments, allowing a determination of sensor drift. If the calibration identifies a problem or indicates cell cleaning is necessary, 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 the coefficients used to convert sensor frequency to conductivity. 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. The coefficient 'slope' allows small corrections for drift between calibrations (consult the SEASOFT manual). Calibration coefficients obtained after a repair or cleaning apply only to subsequent data.

'AS RECEIVED CALIBRATION' ☑ Performed ☐ Not Performed

Date: 12/14/2011 Drift since last cal: +0.00050 PSU/month*

Comments:

'CALIBRATION AFTER CLEANING & REPLATINIZING' ☑ Performed ☐ Not Performed

Date: 1/17/2012 Drift since 26 Aug 10 +0.00110 PSU/month*

Comments:

**Measured at 3.0 S/m*

Cell cleaning and electrode replatinizing tend to 'reset' the conductivity sensor to its original condition. Lack of drift in post-cleaning-calibration indicates geometric stability of the cell and electrical stability of the sensor circuit.

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SENSOR SERIAL NUMBER: 0073
CALIBRATION DATE: 14-Dec-11

GliderAPL TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

ITS-90 COEFFICIENTS

g = 4.29439011e-003
h = 6.28898787e-004
i = 2.35966481e-005
j = 2.50899119e-006
f0 = 1000.0

IPTS-68 COEFFICIENTS

a = 3.64763568e-003
b = 5.87277557e-004
c = 1.55975558e-005
d = 2.51051588e-006
f0 = 2904.335

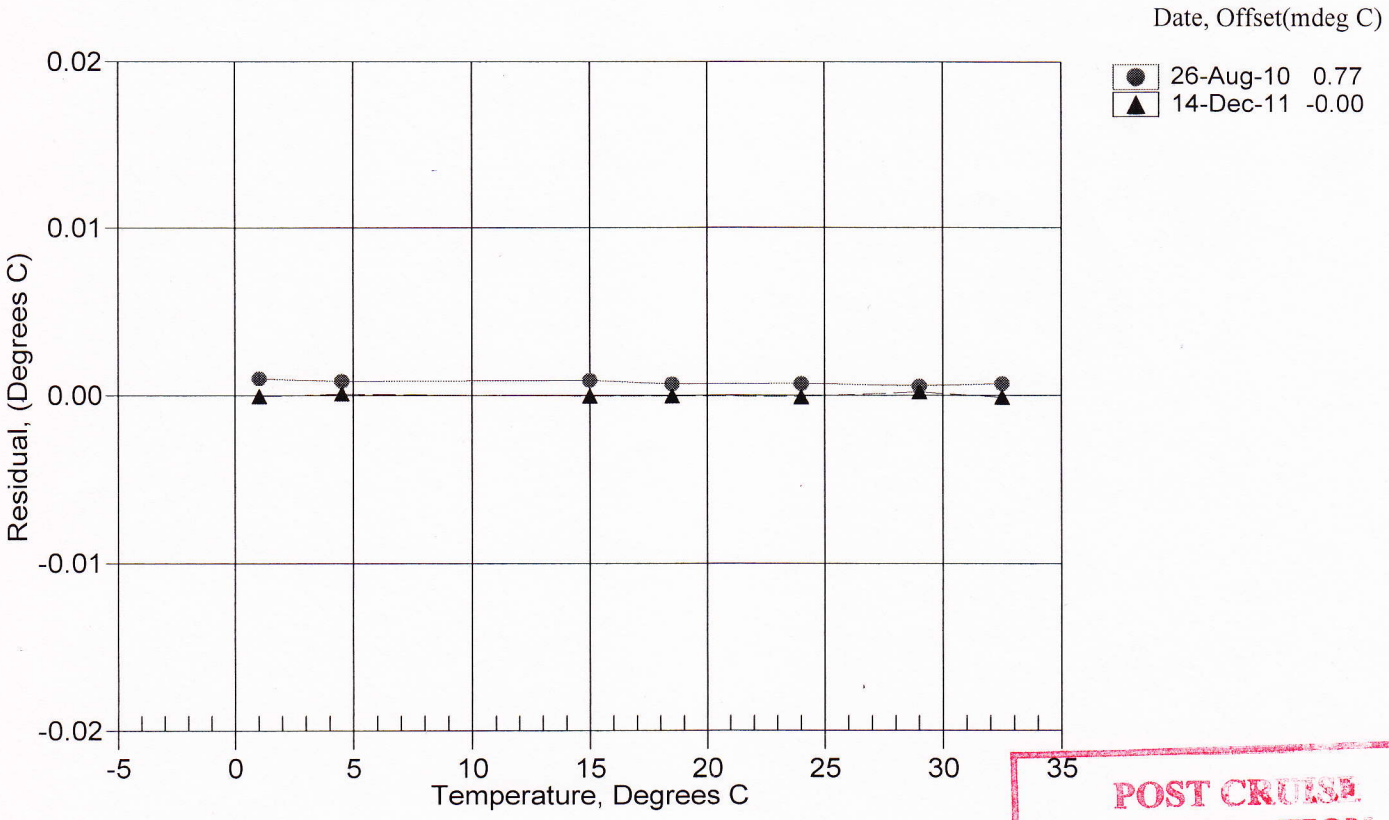
BATH TEMP (ITS-90)	INSTRUMENT FREQ (Hz)	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
1.0000	2904.335	0.9999	-0.00005
4.5000	3141.447	4.5001	0.00009
14.9999	3936.844	14.9999	-0.00004
18.4999	4231.289	18.4999	-0.00003
23.9999	4724.949	23.9998	-0.00006
29.0000	5207.583	29.0002	0.00021
32.5001	5565.061	32.5000	-0.00012

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 IPTS-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



POST CRUISE CALIBRATION

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SENSOR SERIAL NUMBER: 0073
CALIBRATION DATE: 14-Dec-11

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

GHIJ COEFFICIENTS

```
g = -1.00029083e+001
h =  1.10211456e+000
i =  6.21241092e-003
j = -3.70027174e-004
CPcor = -9.5700e-008 (nominal)
CTcor =  3.2500e-006 (nominal)
```

ABCDM COEFFICIENTS

```
a =  4.91294092e-002
b =  1.06879259e+000
c = -1.00577670e+001
d = -3.46092865e-004
m =  2.1
CPcor = -9.5700e-008 (nominal)
```

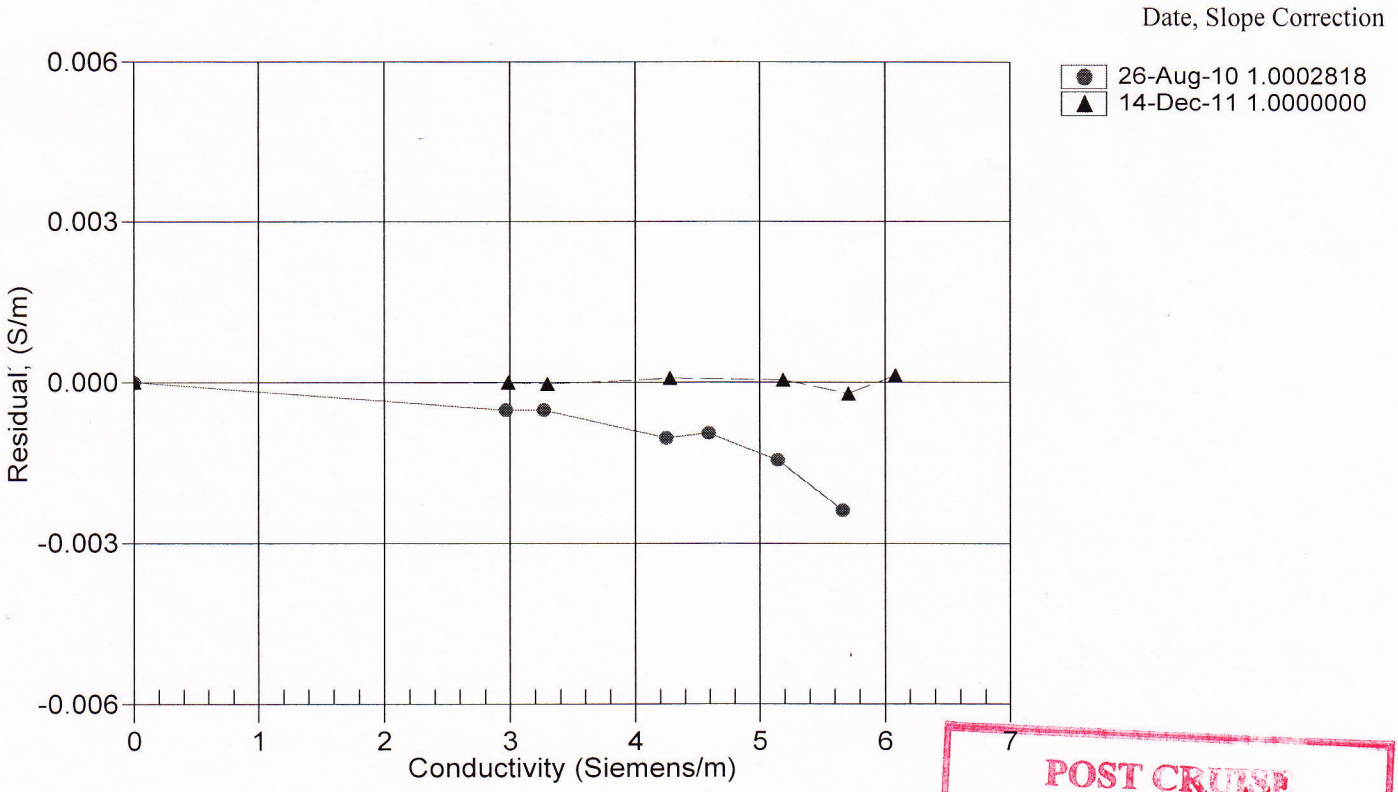
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (kHz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
22.0000	0.0000	0.00000	2.99200	0.00000	0.00000
1.0000	34.9392	2.98547	5.94964	2.98546	-0.00001
4.5000	34.9188	3.29344	6.17417	3.29341	-0.00003
14.9999	34.8744	4.27798	6.84286	4.27805	0.00008
23.9999	34.8529	5.18346	7.40492	5.18350	0.00004
29.0000	34.8441	5.70636	7.71091	5.70615	-0.00021
32.5001	34.8370	6.07920	7.92227	6.07933	0.00013

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

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

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

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



POST CRUISE CALIBRATION