



SEA-BIRD ELECTRONICS, INC.

13431 NE 20th Street Bellevue, Washington 98005 USA

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

Conductivity Calibration Report

Customer:	EMS/VOS Nippon		
Job Number:	84008	Date of Report:	4/17/2015
Model Number	SBE 45	Serial Number:	4528682-0050

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: 4/10/2015

Drift since last cal: +0.00350 PSU/month*

Comments:

'CALIBRATION AFTER CLEANING & REPLATINIZING'

☒ Performed ☐ Not Performed

Date: 4/16/2015

Drift since 12 Apr 13 +0.00400 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.

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: 0050

CALIBRATION DATE: 10-Apr-15

SBE 45 CONDUCTIVITY CALIBRATION DATA

PSS 1978: C(35,15,0) = 4.2914 Siemens/meter

COEFFICIENTS:

g = -9.635945e-001

h = 1.324764e-001

i = -1.270257e-004

j = 3.043565e-005

CPcor = -9.5700e-008

CTcor = 3.2500e-006

WBOTC = 1.3500e-005

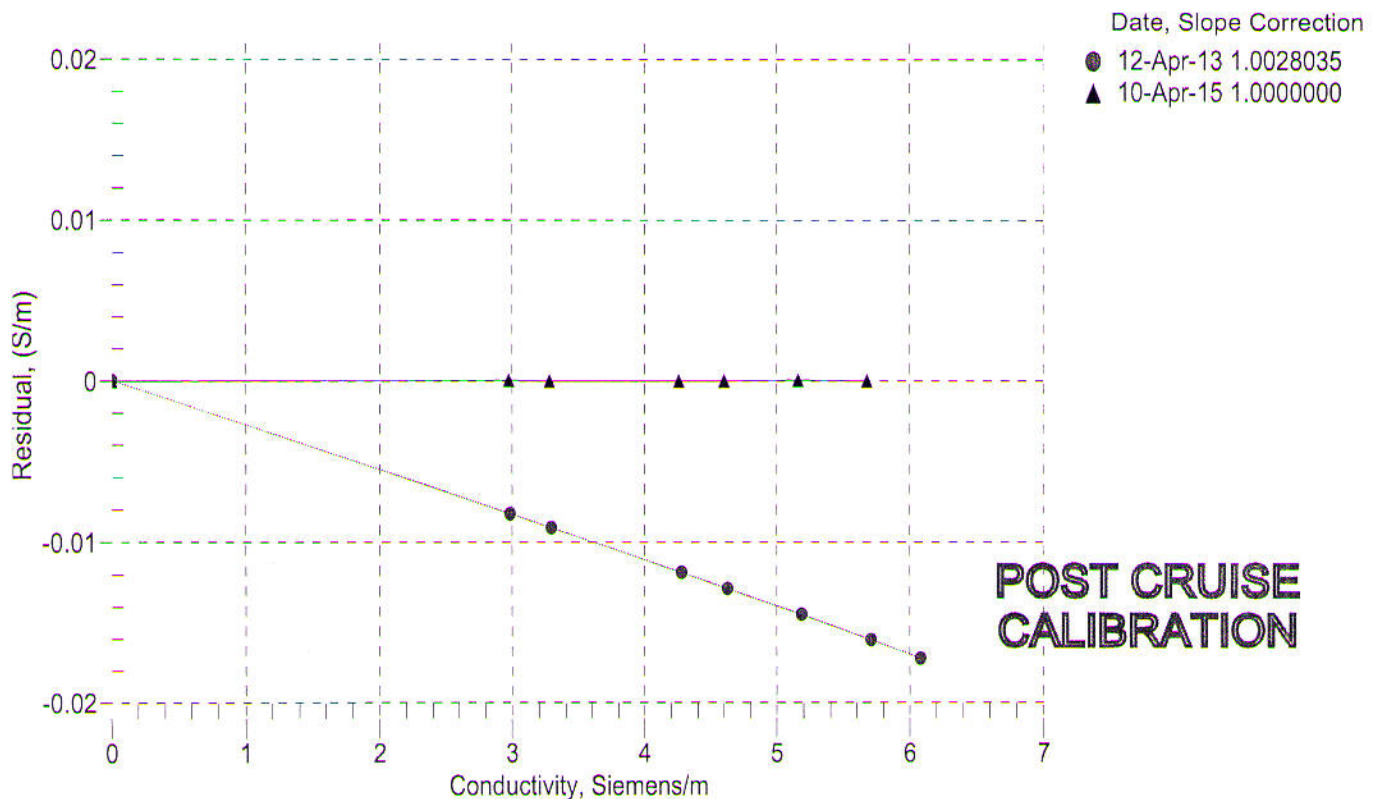
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (Hz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
22.0000	0.0000	0.00000	2697.81	0.00000	0.00000
1.0000	34.7316	2.96941	5444.35	2.96942	0.00001
4.5000	34.7115	3.27581	5651.40	3.27581	-0.00000
15.0000	34.6692	4.25547	6266.69	4.25547	-0.00001
18.5000	34.6601	4.59988	6468.74	4.59985	-0.00003
24.0000	34.6490	5.15648	6782.24	5.15653	0.00005
29.0000	34.6430	5.67712	7062.43	5.67710	-0.00002
32.5000	34.6386	6.04850	7255.49	6.04854	0.00005

$f = \text{INST FREQ} * \text{sqrt}(1.0 + \text{WBOTC} * t) / 1000.0$

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

t = temperature[°C]; p = pressure[decibars]; $\delta = \text{CTcor}$; $\epsilon = \text{CPcor}$;

Residual = instrument conductivity - bath conductivity





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Conductivity Calibration Report

Customer:	EMS/VOS Nippon		
Job Number:	73720	Date of Report:	4/19/2013
Model Number:	SBE 45	Serial Number:	4528682-0050

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: 4/3/2013

Drift since last cal: +0.00320 PSU/month*

Comments:

'CALIBRATION AFTER CLEANING & REPLATINIZING'

☒ Performed ☐ Not Performed

Date: 4/12/2013

Drift since 23 Sep 10 +0.00340 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: 0050
CALIBRATION DATE: 12-Apr-13

SBE 45 CONDUCTIVITY CALIBRATION DATA
PSS 1978: $C(35,15,0) = 4.2914$ Siemens/meter

COEFFICIENTS:

$g = -9.669767e-001$
 $h = 1.330902e-001$
 $i = -1.973394e-004$
 $j = 3.587396e-005$

$CPcor = -9.5700e-008$
 $CTcor = 3.2500e-006$
 $WBOTC = 1.3500e-005$

BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (Hz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
22.0000	0.0000	0.00000	2697.82	0.00000	0.00000
0.9999	34.9241	2.98429	5448.91	2.98430	0.00001
4.5000	34.9029	3.29209	5656.16	3.29209	-0.00000
15.0000	34.8576	4.27614	6271.95	4.27613	-0.00001
18.5000	34.8489	4.62223	6474.25	4.62222	-0.00000
24.0000	34.8393	5.18167	6788.12	5.18167	0.00001
29.0000	34.8341	5.70491	7068.64	5.70492	0.00002
32.5000	34.8306	6.07820	7261.88	6.07819	-0.00001

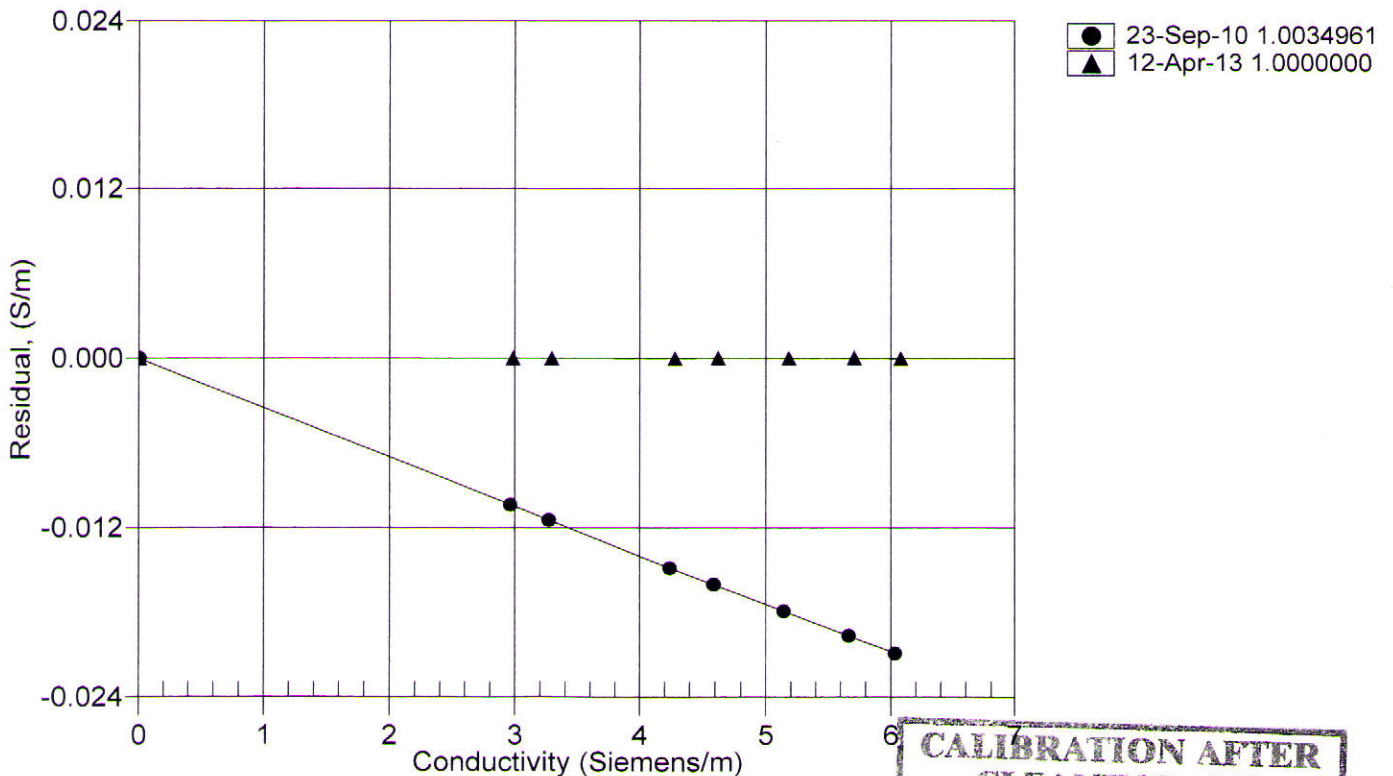
$$f = \text{INST FREQ} * \text{sqrt}(1.0 + \text{WBOTC} * t) / 1000.0$$

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

$$t = \text{temperature}[^{\circ}\text{C}]; p = \text{pressure}[\text{decibars}]; \delta = \text{CTcor}; \epsilon = \text{CPcor};$$

$$\text{Residual} = \text{instrument conductivity} - \text{bath conductivity}$$

Date, Slope Correction



**CALIBRATION AFTER
CLEANING AND
REPLATINIZING CELL**



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Conductivity Calibration Report

Customer:	EMS/VOS Nippon		
Job Number:	61029	Date of Report:	9/23/2010
Model Number:	SBE 45	Serial Number:	4528682-0050

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 using the program SEACON. 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: 9/23/2010

Drift since last cal: +0.00210 PSU/month*

Comments:

'CALIBRATION AFTER CLEANING & REPLATINIZING'

☐ Performed ☒ Not Performed

Date:

Drift since Last cal: PSU/month*

Comments:

**Measured at 3.0 S/m*

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SENSOR SERIAL NUMBER: 0050
CALIBRATION DATE: 23-Sep-10

SBE 45 CONDUCTIVITY CALIBRATION DATA
PSS 1978: $C(35,15,0) = 4.2914$ Siemens/meter

COEFFICIENTS:

$g = -9.696791e-001$
 $h = 1.333549e-001$
 $i = -1.425249e-004$
 $j = 3.186400e-005$

$CP_{cor} = -9.5700e-008$
 $CT_{cor} = 3.2500e-006$
 $WBOTC = 1.3500e-005$

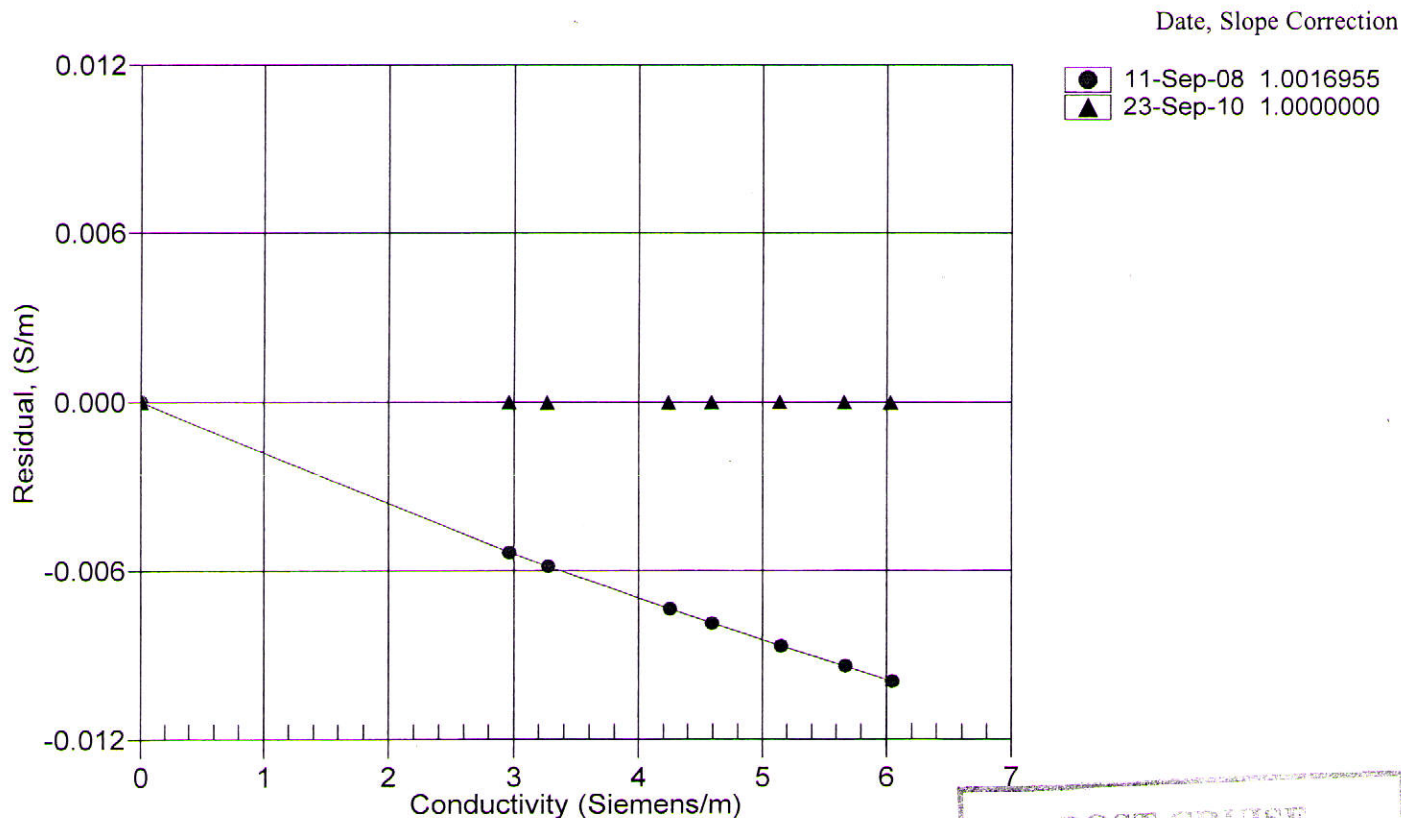
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (Hz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
22.0000	0.0000	0.00000	2697.70	0.00000	0.00000
1.0000	34.6076	2.95982	5424.93	2.95983	0.00001
4.5000	34.5877	3.26527	5630.81	3.26527	-0.00001
15.0000	34.5449	4.24183	6242.65	4.24182	-0.00001
18.5000	34.5357	4.58514	6443.61	4.58514	0.00000
24.0000	34.5255	5.14013	6755.45	5.14014	0.00001
29.0000	34.5192	5.65911	7034.15	5.65911	0.00000
32.5000	34.5155	6.02944	7226.22	6.02944	-0.00000

$$f = \text{INST FREQ} * \sqrt{1.0 + \text{WBOTC} * t} / 1000.0$$

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

$$t = \text{temperature}[^{\circ}\text{C}]; p = \text{pressure}[\text{decibars}]; \delta = CT_{cor}; \epsilon = CP_{cor};$$

$$\text{Residual} = \text{instrument conductivity} - \text{bath conductivity}$$





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Conductivity Calibration Report

Customer:	EMS/VOS Nippon		
Job Number:	51767	Date of Report:	9/11/2008
Model Number	SBE 45	Serial Number:	4528682-0050

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 using the program SEACON. 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: 8/29/2008

Drift since last cal: +0.00310 PSU/month

Comments:

The conductivity cell was found to have failed.

'CALIBRATION AFTER REPAIR'

☒ Performed ☐ Not Performed

Date: 9/11/2008

Drift since Last cal: N/A PSU/month

Comments:

The conductivity cell was replaced.

**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: 0050
CALIBRATION DATE: 29-Aug-08

SBE 45 CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Siemens/meter

COEFFICIENTS:

g = -9.942050e-001
h = 1.368271e-001
i = -1.853544e-004
j = 3.424183e-005

CPcor = -9.5700e-008
CTcor = 3.2500e-006
WBOTC = 1.3500e-005

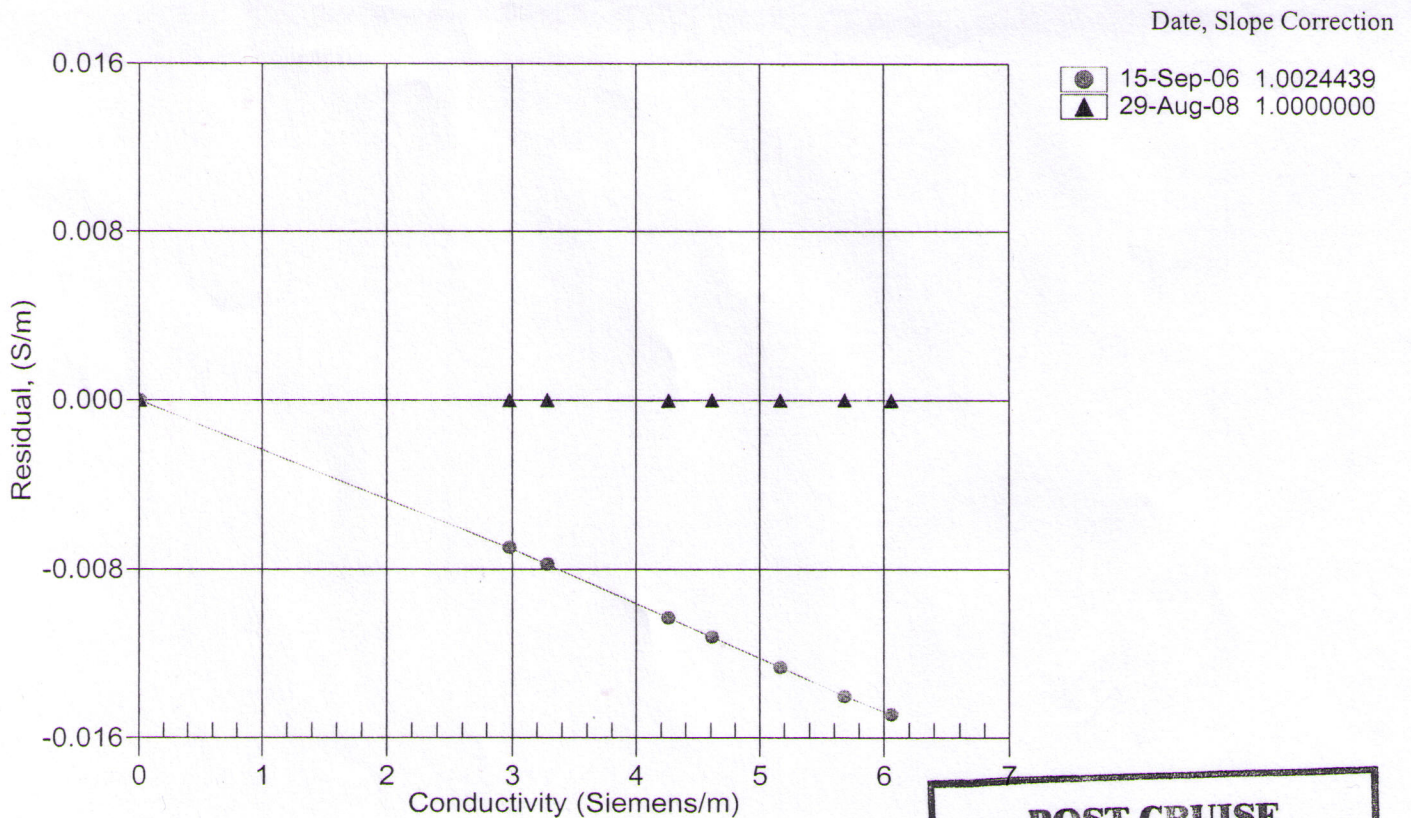
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (Hz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
22.0000	0.0000	0.00000	2697.65	0.00000	0.00000
1.0000	34.7844	2.97350	5385.04	2.97350	-0.00000
4.5000	34.7645	3.28032	5588.48	3.28032	0.00001
15.0000	34.7207	4.26113	6193.20	4.26111	-0.00001
18.5000	34.7119	4.60601	6391.94	4.60601	0.00000
24.0000	34.7026	5.16358	6700.41	5.16358	0.00000
29.0000	34.6977	5.68508	6976.20	5.68509	0.00001
32.5001	34.6952	6.05727	7166.31	6.05726	-0.00001

$f = \text{INST FREQ} * \sqrt{1.0 + \text{WBOTC} * t} / 1000.0$

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

t = temperature[°C]; p = pressure[decibars]; $\delta = \text{CTcor}$; $\epsilon = \text{CPcor}$;

Residual = instrument conductivity - bath conductivity



**POST CRUISE
CALIBRATION**



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Conductivity Calibration Report

Customer:	EMS/VOS Nippon		
Job Number:	44147	Date of Report:	9/15/2006
Model Number	SBE 45	Serial Number:	4528682-0050

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 using the program SEACON. 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: Drift since last cal: PSU/month*

Comments:

The conductivity cell was found to have failed.

'CALIBRATION AFTER REPAIR'

☒ Performed ☐ Not Performed

Date: Drift since Last cal: PSU/month*

Comments:

The conductivity cell was replaced.

**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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 Phone: (425) 643 - 9866 Fax (425) 643 - 9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 0050
 CALIBRATION DATE: 07-Sep

SBE 45 CONDUCTIVITY CALIBRATION DATA
 PSS 1978: C(35,15,0) = 4.2914 Siemens/meter

COEFFICIENTS:

g = -1.069411e+000	CPcor = -9.5700e-008
h = 1.471084e-001	CTcor = 3.2500e-006
i = -1.665794e-004	WBOTC = 1.3500e-005
j = 3.436092e-005	

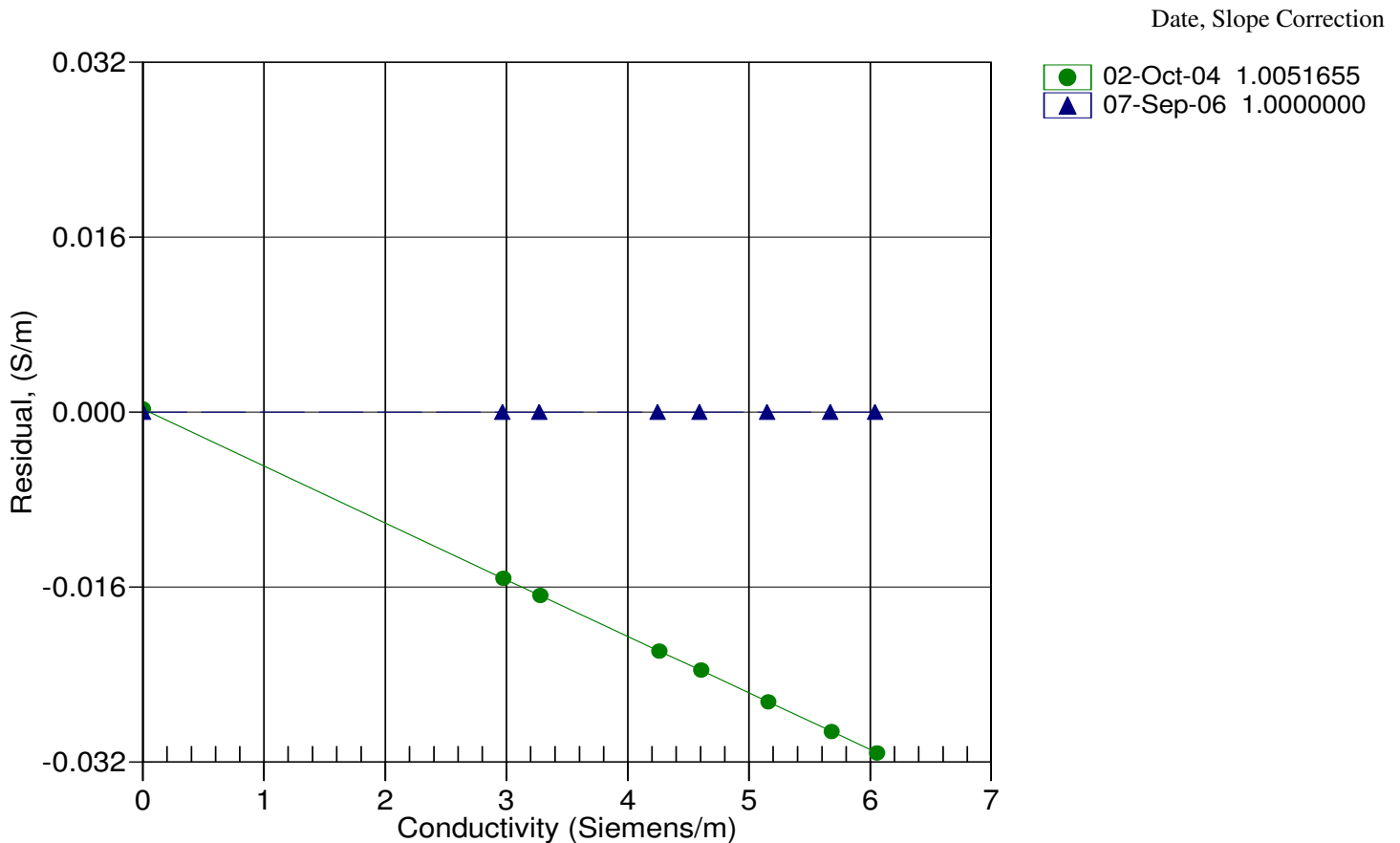
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (Hz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
22.0000	0.0000	0.00000	2697.64	0.00000	0.00000
1.0000	34.6513	2.96320	5234.43	2.96320	-0.00000
4.4999	34.6313	3.26898	5428.44	3.26898	0.00000
15.0000	34.5887	4.24664	6006.03	4.24663	-0.00000
18.4999	34.5798	4.59036	6196.03	4.59036	0.00000
23.9999	34.5701	5.14603	6491.13	5.14603	0.00000
29.0001	34.5651	5.66580	6755.17	5.66580	0.00000
32.5001	34.5624	6.03671	6937.25	6.03671	-0.00000

$$f = \text{INST FREQ} * \sqrt{1.0 + \text{WBOTC} * t} / 1000.0$$

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

$$t = \text{temperature}[^{\circ}\text{C}]; p = \text{pressure}[\text{decibars}]; \delta = \text{CTcor}; \epsilon = \text{CPcor};$$

$$\text{Residual} = \text{instrument conductivity} - \text{bath conductivity}$$





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Conductivity Calibration Report

Customer:	EMS/VOS Nippon		
Job Number:	37204	Date of Report:	10/4/2004
Model Number:	SBE 45	Serial Number:	4528682-0050

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.

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'AS RECEIVED CALIBRATION'

☒ Performed ☐ Not Performed

Date: 9/24/2004

Drift since last cal: +.00350 PSU/month*

Comments:

'CALIBRATION AFTER CLEANING & REPLATINIZING'

☒ Performed ☐ Not Performed

Date: 10/2/2004

Drift since Last cal: +.00400 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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Phone: (425) 643 - 9866 Fax (425) 643 - 9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 0050
CALIBRATION DATE: 24-Sep-04

SBE 45 CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Siemens/meter

COEFFICIENTS:

g = -1.075963e+000
h = 1.480757e-001
i = -2.126111e-004
j = 3.867241e-005

CPcor = -9.5700e-008
CTcor = 3.2500e-006
WBOTC = 1.3500e-005

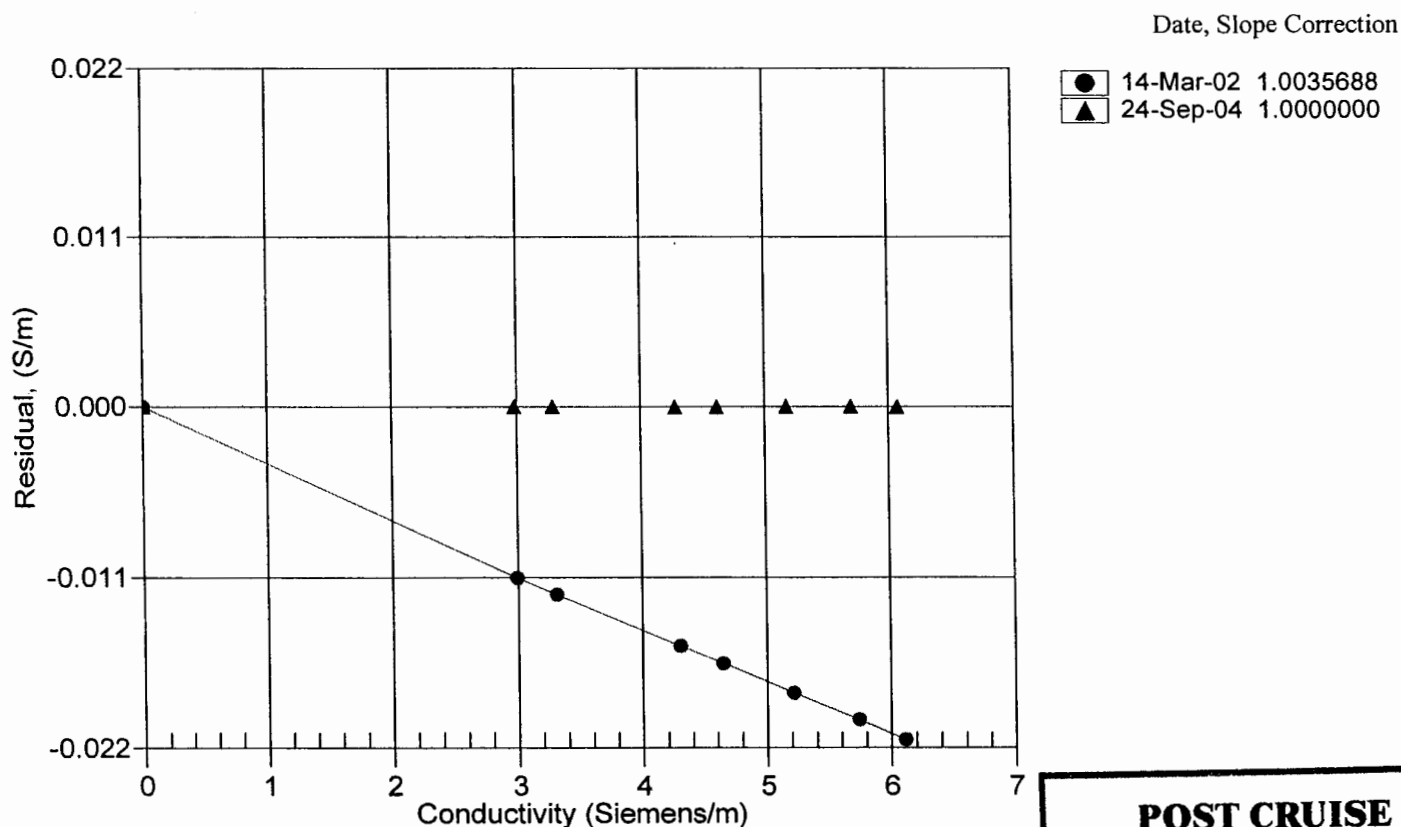
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (Hz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
22.0000	0.0000	0.00000	2697.87	0.00000	0.00000
1.0000	34.8638	2.97964	5234.34	2.97964	0.00000
4.5000	34.8433	3.28702	5428.26	3.28702	0.00000
15.0000	34.7996	4.26978	6005.56	4.26977	-0.00001
18.5000	34.7906	4.61533	6195.47	4.61532	-0.00001
24.0000	34.7810	5.17395	6490.44	5.17397	0.00001
29.0000	34.7765	5.69653	6754.35	5.69654	0.00001
32.5000	34.7752	6.06963	6936.42	6.06962	-0.00001

$$f = \text{INST FREQ} * \sqrt{1.0 + \text{WBOTC} * t} / 1000.0$$

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

$$t = \text{temperature}[^{\circ}\text{C}]; p = \text{pressure}[\text{decibars}]; \delta = \text{CTcor}; \epsilon = \text{CPcor};$$

$$\text{Residual} = \text{instrument conductivity} - \text{bath conductivity}$$



**POST CRUISE
CALIBRATION**