SBE 41CP CERTIFICATES

CTD Serial Number 41CP-2627

SEA-BIRD ELECTRONICS, INC.
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SBE 41CP Instrument Configuration

Model Number: SBE 41CP

Serial Number: 41CP-2627

Part Number: 90521.014

Description : APEX SBE 41CP-IDO Integrated Oxygen Configuration

Firmware Version: 2.0b

Pressure Type: Druck

Pressure Range: 2000 Dbar

Pressure Serial Number: 2824389

Oxygen Sensor Type: SBE 43i

Oxygen Serial Number: 0443

Document Date: Thursday , January 29, 2009

```
SBE 41CP-IDO-UW V 2.0b  SERIAL NO. 2627
temperature:  29-jan-09
    TA0 =  5.118936e-05
    TA1 =  2.729997e-04
    TA2 = -2.358077e-06
    TA3 =  1.485198e-07
conductivity:  29-jan-09
    G = -1.009600e+00
    H =  1.413981e-01
    I = -3.750932e-04
    J =  4.610097e-05
    CPCOR = -9.570001e-08
    CTCOR =  3.250000e-06
    WBOTC =  9.332357e-08
pressure S/N = 2824389, range = 2900 psia:  21-jan-09
    PA0 =  6.697752e-01
    PA1 =  1.400663e-01
    PA2 = -4.165425e-08
    PTCA0 =  1.483095e+01
    PTCA1 =  2.361235e-01
    PTCA2 = -6.211148e-04
    PTCB0 =  2.518500e+01
    PTCB1 = -6.000000e-04
    PTCB2 =  0.000000e+00
    PTHA0 = -7.057841e+01
    PTHA1 =  5.058793e-02
    PTHA2 = -4.424621e-07
    POFFSET =  0.000000e+00
oxygen S/N = 0443:  07-jan-09
    SOC =  1.346500e-04
    FOFFSET = -3.229010e+03
    A = -1.894200e-03
    B =  1.283400e-04
    C = -2.196700e-06
    E =  4.530000e-02
    TAU_20 =  4.410000e+00
```

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SENSOR SERIAL NUMBER: 2627
CALIBRATION DATE: 29-Jan-09

SBE 41cp TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

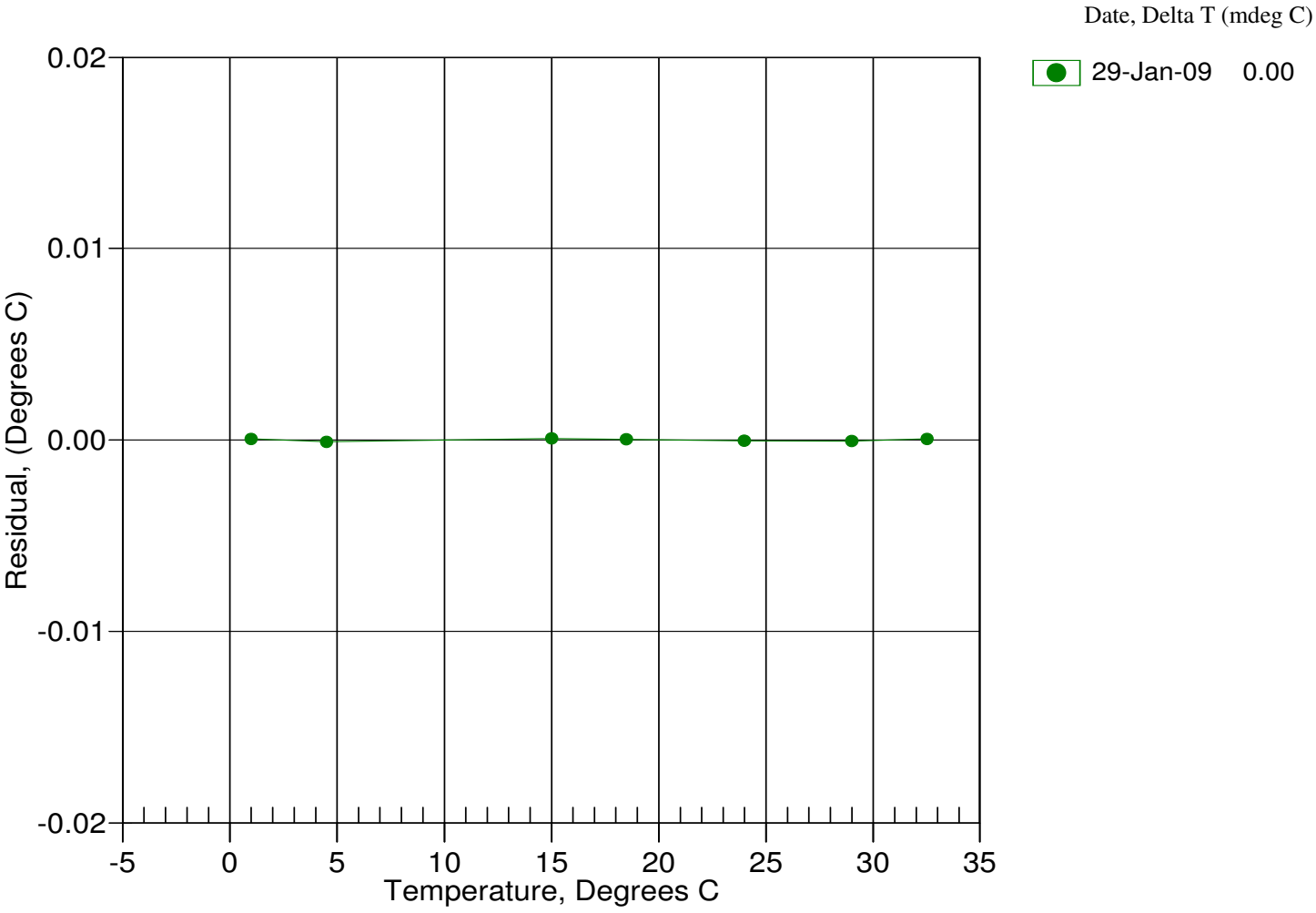
ITS-90 COEFFICIENTS

a0 = 5.118936e-005
a1 = 2.729997e-004
a2 = -2.358077e-006
a3 = 1.485198e-007

BATH TEMP (ITS-90)	INSTRUMENT OUTPUT	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
1.0000	669901.7	1.0001	0.0001
4.5000	571475.8	4.4999	-0.0001
15.0000	361846.9	15.0001	0.0001
18.5000	312675.0	18.5000	0.0000
23.9940	250107.7	23.9939	-0.0001
29.0000	205323.7	28.9999	-0.0001
32.5000	179465.7	32.5001	0.0001

Temperature ITS-90 = $1/\{a0 + a1[ln(n)] + a2[ln^2(n)] + a3[ln^3(n)]\} - 273.15$ (°C)

Residual = instrument temperature - bath temperature



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SENSOR SERIAL NUMBER: 2627
CALIBRATION DATE: 29-Jan-09

SBE 41cp CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Siemens/meter

COEFFICIENTS:

```
g = -1.009600e+000
h =  1.413981e-001
i = -3.750932e-004
j =  4.610097e-005

CPcor = -9.5700e-008
CTcor =  3.2500e-006
WBOTC =  9.3324e-008
```

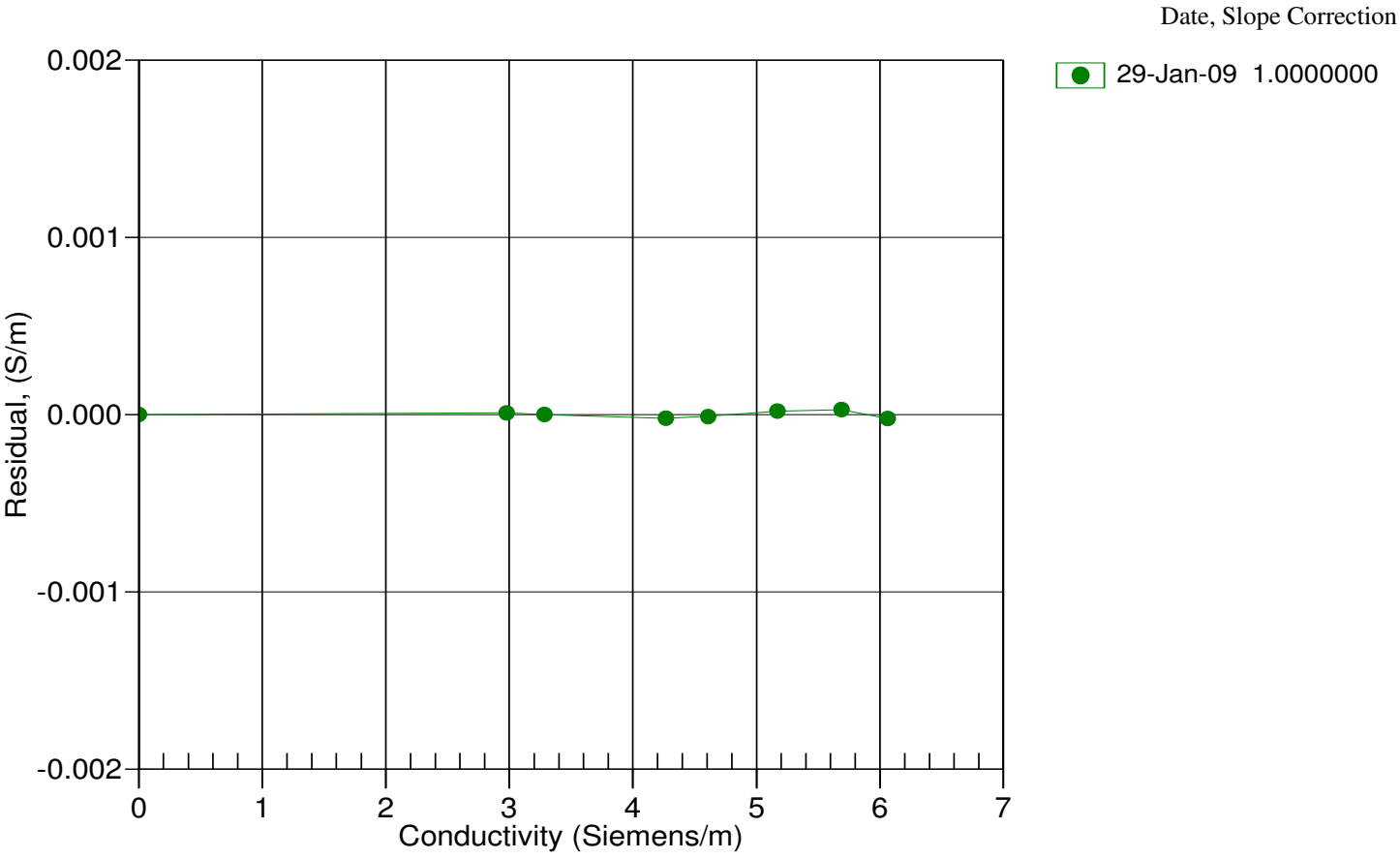
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (Hz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
22.0000	0.0000	0.00000	2678.49	0.00000	0.00000
1.0000	34.8209	2.97632	5322.39	2.97633	0.00001
4.5000	34.8007	3.28340	5523.13	3.28340	-0.00000
15.0000	34.7579	4.26521	6120.18	4.26519	-0.00002
18.5000	34.7488	4.61038	6316.42	4.61037	-0.00001
23.9940	34.7385	5.16771	6620.70	5.16773	0.00002
29.0000	34.7327	5.69017	6893.39	5.69019	0.00003
32.5000	34.7291	6.06250	7081.09	6.06248	-0.00002

f = INST FREQ * sqrt(1.0 + WBOTC * t) / 1000.0

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

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

Residual = instrument conductivity - bath conductivity



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SENSOR SERIAL NUMBER: 2627
CALIBRATION DATE: 21-Jan-09

SBE 41cp PRESSURE CALIBRATION DATA
2900 psia S/N 2824389

COEFFICIENTS:

PA0 =	6.697752e-001	PTCA0 =	1.483095e+001
PA1 =	1.400663e-001	PTCA1 =	2.361235e-001
PA2 =	-4.165425e-008	PTCA2 =	-6.211148e-004
PTHA0 =	-7.057841e+001	PTCB0 =	2.518500e+001
PTHA1 =	5.058793e-002	PTCB1 =	-6.000000e-004
PTHA2 =	-4.424621e-007	PTCB2 =	0.000000e+000

PRESSURE SPAN CALIBRATION

PRESSURE PSIA	INST OUTPUT	THERMISTOR OUTPUT	COMPUTED PRESSURE	ERROR %FSR
14.68	119.8	1849.1	14.71	0.00
592.59	4249.3	1852.6	592.66	0.00
1170.07	8387.4	1854.9	1170.39	0.01
1747.79	12534.7	1857.5	1747.98	0.01
2325.37	16691.7	1858.7	2325.48	0.00
2902.76	20857.4	1860.9	2902.75	-0.00
2325.44	16690.6	1860.6	2325.33	-0.00
1748.11	12534.4	1861.7	1747.94	-0.01
1170.42	8385.4	1862.1	1170.12	-0.01
592.52	4247.4	1862.5	592.39	-0.00
14.67	119.7	1865.2	14.67	0.00

THERMAL CORRECTION

TEMP ITS90	PRESS TEMP	INST OUTPUT
32.50	2075.00	128.49
29.00	2004.00	127.99
23.99	1901.00	126.86
18.50	1788.90	125.57
15.00	1717.10	124.93
4.50	1504.40	122.78
1.00	1432.60	121.65

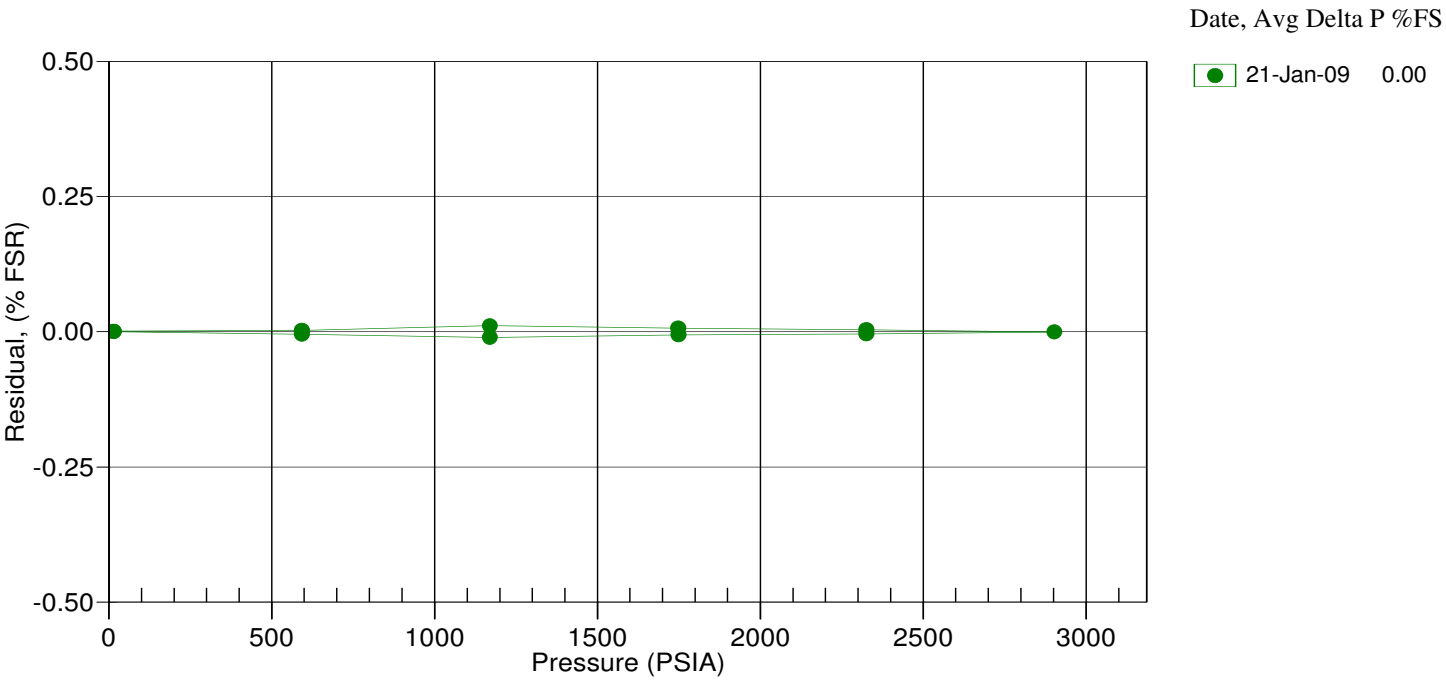
TEMP(ITS90)	SPAN(mV)
-5.00	25.19
35.00	25.16

y = thermistor output; $t = PTHA0 + PTHA1 * y + PTHA2 * y^2$

x = pressure output - $PTCA0 - PTCA1 * t - PTCA2 * t^2$

$n = x * PTCB0 / (PTCB0 + PTCB1 * t + PTCB2 * t^2)$

pressure (psia) = $PA0 + PA1 * n + PA2 * n^2$



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SENSOR SERIAL NUMBER: 0443
CALIBRATION DATE: 07-Jan-09p

SBE 43I OXYGEN CALIBRATION DATA

COEFFICIENTS

```
Soc =  1.3240e-004 (DI)
Foffset = -3229.01
Tau20 = 4.41
```

```
A = -1.8942e-003
B =  1.2834e-004
C = -2.1967e-006
E measured = 0.0453
```

NOMINAL DYNAMIC COEFFICIENTS

```
D1 =  1.92634e-4   H1 = -3.30000e-2
D2 = -4.64803e-2   H2 =  5.00000e+3
                   H3 =  1.45000e+3
```

BATH OX (ml/l)	BATH TEMP ITS-90	BATH SAL PSU	INSTRUMENT OUTPUT(Hz)	INSTRUMENT OXYGEN(ml/l)	RESIDUAL (ml/l)
1.27	12.00	0.00	4512.13	1.27	0.00
1.27	20.00	0.00	4747.01	1.27	0.00
1.27	2.00	0.00	4224.49	1.27	-0.00
1.27	6.00	0.00	4341.43	1.27	0.00
1.28	26.00	0.00	4933.91	1.28	0.00
1.29	30.00	0.00	5080.97	1.30	0.00
4.18	20.00	0.00	8208.05	4.18	-0.00
4.18	12.00	0.00	7445.70	4.18	-0.00
4.19	2.00	0.00	6501.36	4.18	-0.01
4.19	6.00	0.00	6881.18	4.18	-0.01
4.20	26.00	0.00	8815.28	4.19	-0.00
4.23	30.00	0.00	9270.27	4.23	0.00
6.18	30.00	0.00	12051.73	6.17	-0.00
6.24	26.00	0.00	11537.51	6.24	-0.00
6.27	20.00	0.00	10703.75	6.27	0.00
6.34	12.00	0.00	9633.05	6.34	0.00
6.36	6.00	0.00	8785.39	6.36	0.00
6.40	2.00	0.00	8242.97	6.40	0.01

Oxygen (ml/l) = Soc * (F + Foffset) * (1.0 + A * T + B * T^2 + C * T^3) * OxSol(T,S) * exp(E * P / K)

F = frequency output from SBE43I, 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