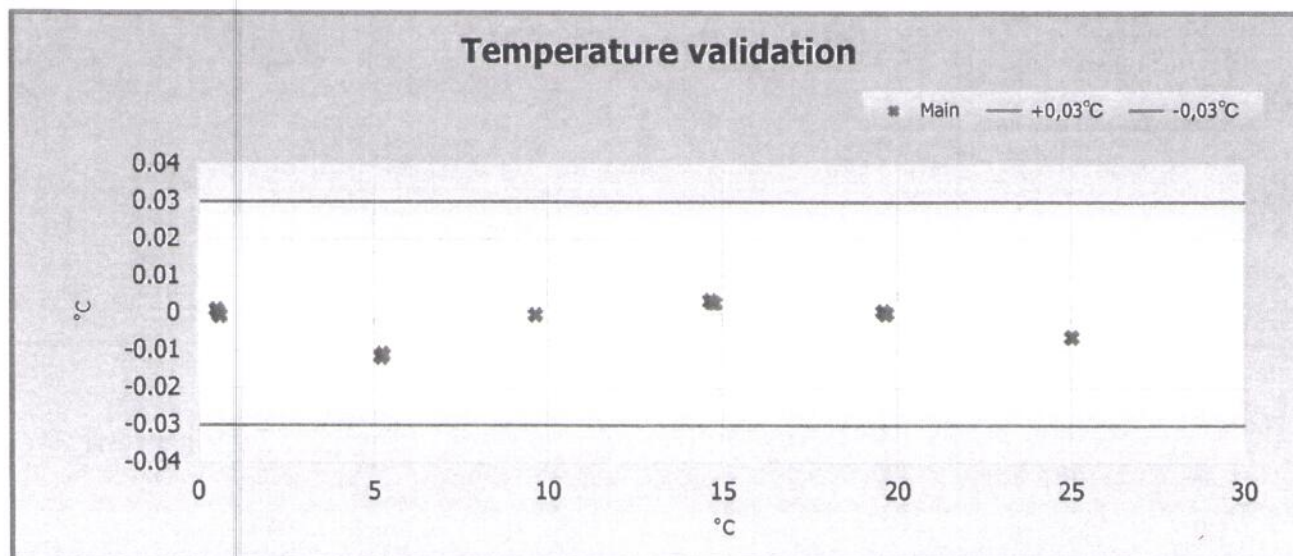
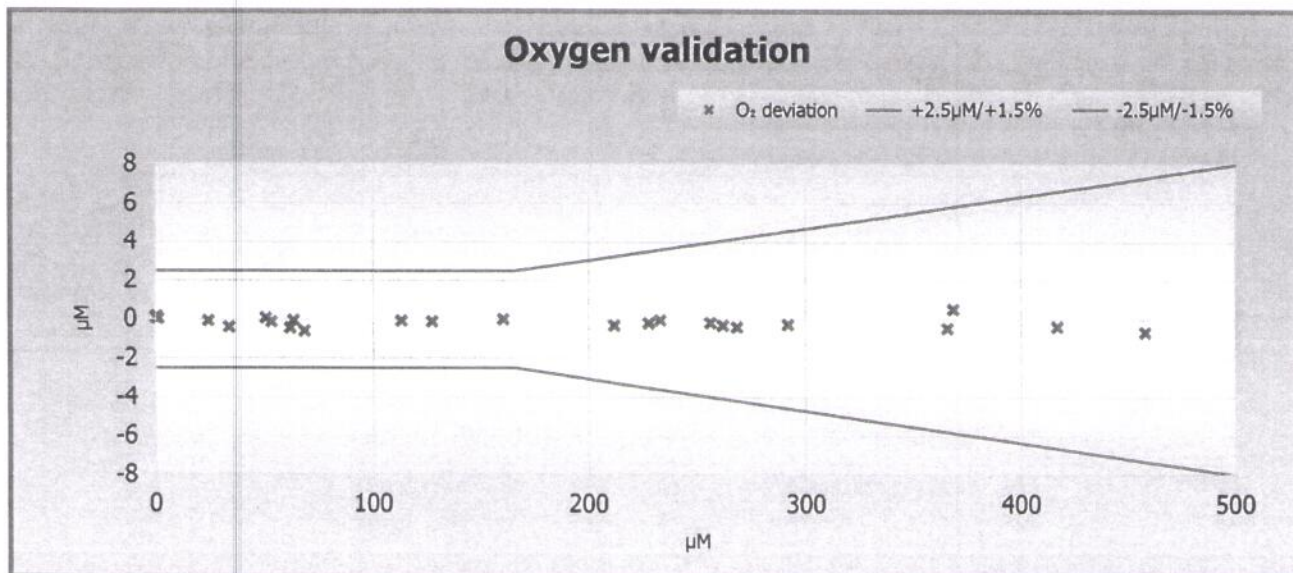


Certificate no: 4831_677_00128386
Foil batch no: 1517M

Product: 4831
Calibration date: 15.03.2017

Serial no: 677
Page 2 of 2

Index	0	1	2	3	4	5	6
SVUFoilCoef	2.69559E-03	1.13684E-04	2.34191E-06	2.31356E02	-3.71636E-01	-4.95064E01	4.61861E00
TempCoef	2.54141E01	-3.14991E-02	3.03130E-06	-4.43282E-09	0.00000E00	0.00000E00	



Date:15.03.2017

Tor-Ove Kvalvaag

Tor-Ove Kvalvaag, Calibration Engineer



PRESSURE TRANSDUCER CALIBRATION DATA

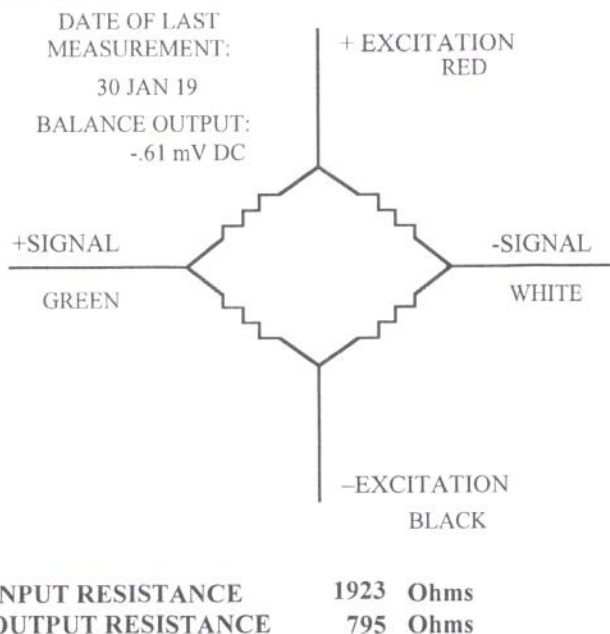
<i>Customer</i>	<i>Date</i>
TELEDYNE BENTHOS	30 JUL 19
<i>Model Number</i>	<i>Serial Number</i>
141698-2000A	92758

<i>Diaphragm Materials</i>	<i>Excitation</i>	<i>Pressure Range</i>	<i>Excitation Type</i>
TITANIUM	5 VDC	2000 PSIA	Constant Voltage

Pressure Calibration Data all readings are in mV DC						Date of Pressure Calibration
						28 JAN 19
Pressure	Increase	Decrease	Ideal	Linearity (%FS)	Hysteresis (%FS)	STATIC ERROR BAND ± .11% FS BFUL
0 PSIA	-.04	-.12	-.04		.08%	
1000 PSIA	48.31	48.19	48.53	.23%	.12%	
2000 PSIA	97.10		97.10			
SENSITIVITY	97.14					

Thermal Calibration Data all readings are in mV DC						Date of Thermal Calibration
						28 JAN 19
	Low Temp.	Ambient	High Temp	Temperature Range	Thermal Balance Shift	Thermal Sensitivity Shift
Temperature	30°F	75°F	130°F			
0 PSIA	-.19	-.10	0.00	30°F to 75°F	.09%FS	0.00%FS
2000 PSIA	97.00	97.09	96.74	75°F to 130°F	.10%FS	-.46%FS
Sensitivity	97.19	97.19	96.74	AVERAGE	± .001% FS/°F	± .002% FS/°F

Notes



<i>Data Entered and Reviewed By</i>	<i>Date Data Entered</i>
Tharin Thav	30 January 2019

Certificate no: 4831_677_00128386
Foil batch no: 1517M

Product: 4831
Calibration date: 15.03.2017

Serial no: 677
Page 1 of 2

Index	Temperature reference(°C)	[O2] Reference(µM)	Temperature raw data(mV)	Phase reading(°)
0	30.276	0.30	-151.660	60.48
1	19.743	0.19	182.405	61.38
2	9.708	0.39	505.055	62.17
3	0.532	1.29	781.530	62.81
4	0.549	20.04	781.045	60.36
5	0.562	42.73	780.700	57.71
6	0.561	63.42	780.700	55.54
7	0.583	102.52	780.080	51.95
8	0.586	141.57	779.995	48.92
9	0.574	210.70	780.325	44.58
10	0.581	310.77	780.105	39.88
11	0.589	412.16	779.900	36.35
12	0.586	518.33	779.970	33.53
13	10.051	13.17	494.245	59.78
14	9.983	31.69	496.395	56.66
15	9.923	48.53	498.280	54.17
16	9.883	80.05	499.535	50.20
17	9.847	110.93	500.665	47.00
18	9.817	164.71	501.615	42.56
19	9.805	243.87	501.980	37.80
20	9.807	323.57	501.900	34.33
21	9.808	405.48	501.900	31.65
22	19.859	9.79	178.650	58.82
23	19.787	24.24	180.975	55.45
24	19.726	37.08	182.950	52.83
25	19.678	62.01	184.475	48.58
26	19.642	87.29	185.685	45.10
27	19.608	129.96	186.755	40.57
28	19.595	194.65	187.185	35.69
29	19.588	258.58	187.400	32.31
30	19.586	324.07	187.500	29.75
31	29.997	7.38	-143.100	57.82
32	29.998	18.93	-143.155	54.15
33	30.005	29.64	-143.365	51.25
34	30.014	49.60	-143.620	46.79
35	30.021	70.62	-143.805	43.10
36	30.030	105.39	-144.115	38.49
37	30.059	158.30	-145.000	33.66
38	30.063	210.15	-145.105	30.42
39	30.060	265.35	-145.060	27.94

Program Version: 04.09.2001

Product: Oxygen Optode 4831

Serial No: 677

Visual and Mechanical Checks:

- 1.1 Soldering quality
- 1.2 Visual surface
- 1.3 Galvanic isolation between housing and electronics

Current Drain and Voltages:

2.1	Average current drain at 0.5 Hz sampling (Max.: 33 mA)	22.9	mA
2.2	CANBus Current drain at 0.5 Hz sampling (Max.: 33 mA)		mA
2.3	Current drain in sleep (Max.: 180 μ A)	247	μ A
2.4	CANBus Current drain in sleep (Max.: 180 μ A)		μ A
2.5	DSP IO voltage, J4.18 (3.3 ± 0.15 V)		V
2.6	DSP Core voltage, J4.17 (1.8 ± 0.05 V)	1.82	V
2.7	Excitation driver voltage, C4 Analog Board (4.5 ± 0.15 V)	4.33	V

Performance test:

	Channel:	Blue	Red
3.1	Average of Receiver readings (0 ± 150 mV)	-15.4 mV	-6.9 mV
3.2	Standard Deviation of Receiver readings (Max.: 45mV/10mV)	2.70 mV	0.35 mV
3.3	Amplitude measm. with non-fluorescence foil (<60mV/650-1200mV)	15.2 mV	1059.3 mV
3.4	CANBus Output test		

Function test from 0 to 40°C:

	Channel:	Blue	Red
4.1	Minimum amplitude measurement (Blue: >550 mV, Red >650 mV)	655.3 mV	781.7 mV
4.2	Maximum amplitude measurement (Blue: <1600 mV, Red <1400 mV)	992.8 mV	1227.2 mV
4.3	Minimum phase measurement (Blue: >24°, Red: >1°)	34.85 °	7.44 °
4.4	Maximum phase measurement (Blue: <34°, Red: <5°)	40.27 °	8.47 °
4.5	Maximum standard deviation of Phase measurement: (< 0.02°)	0.05 °	0.05 °
4.6	Minimum temperature raw data measurement: (<-200 mV)		-452.1 mV
4.7	Maximum temperature raw data measurement: (>450 mV)		632.8 mV

Pressure test :

5.1	Pressure (IW version: 20MPa, DW version 60MPa)	60MPa
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Date: 23 Mar 2017

Sign:



Vidar Selsvik, Production Engineer



a xylem brand

PRESSURE CERTIFICATE

Form No. 667, Sept 2009

Product: Oxygen Optode 4831

Serial No: 677

Date: 06,03,2017

Certificate No: 128755260677

This is to certify that this product has been pressure tested with the following instrument, and we confirm that no irregularities were found during the test:

Autoklav 800 bar – sn: 0210005

Pressure readings:

Pressure (Bar)	Pressure time (hour)
600	1

Date: 23 Mar 2017

Sign:

Vidar Selsvik, Production Engineer

Pressure Calibration Certificate

RBRlegato³ C.T.D, Teledyne Webb Slocum, 1000dbar, dry bay s/n: 202590

Sensor rating: 1000 dbar s/n: L061043

Nominal accuracy: 0.05%FS (0.5 dbar)

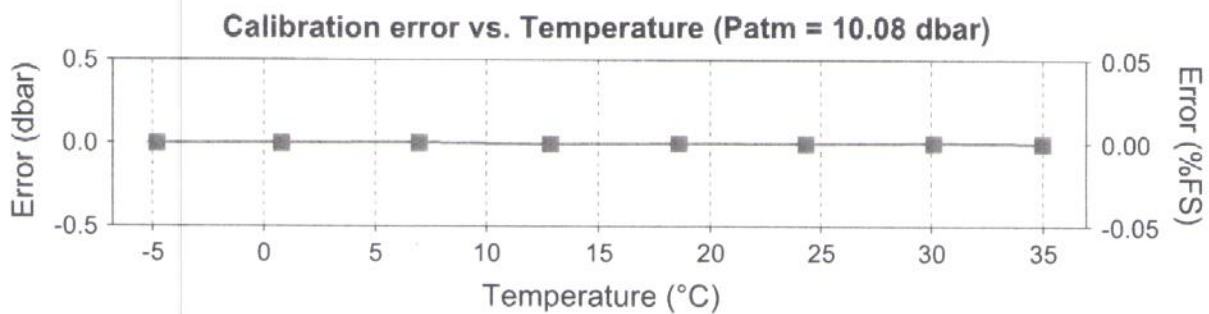
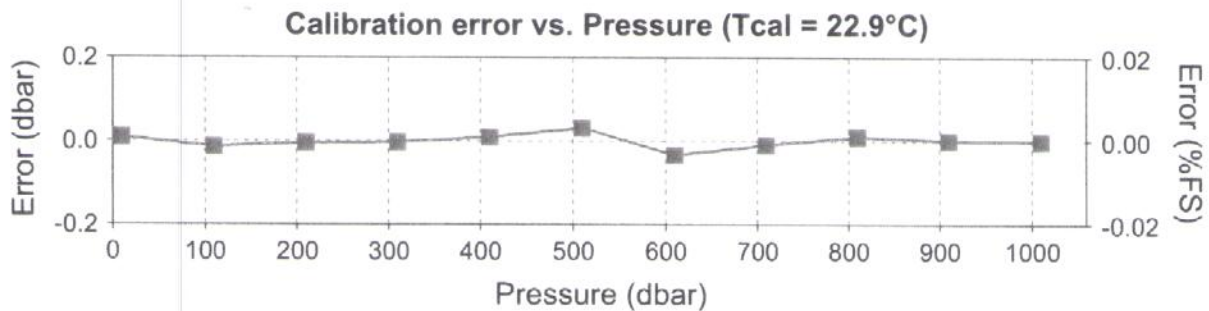
Reference instrument: Mensor CPC6050 s/n: 41000CAM

Applied pressure, P _{app} (dbar)	Voltage ratio, V	Measured pressure, P _{meas} (dbar)	Calibration error (dbar)	Coefficients
10.0564	-0.038955	10.0657	0.0093	C0: 97.43308
110.0000	0.005700	109.9860	-0.0140	C1: 2.2419001E3
209.9970	0.050167	209.9928	-0.0042	C2: 128.04764
309.9970	0.094416	309.9947	-0.0023	C3: -25.603596
410.0000	0.138462	410.0093	0.0093	X0: 10.0598
510.0000	0.182313	510.0320	0.0320	X1: -196.72062E-3
609.9990	0.225934	609.9663	-0.0327	X2: -472.29527E-6
710.0060	0.269415	709.9976	-0.0084	X3: 2.2949243E-6
810.0030	0.312713	810.0136	0.0106	X4: -121.21931E-6
910.0020	0.355832	910.0030	0.0010	X5: 22.9
1010.0000	0.398794	1009.9993	-0.0007	

$$P_{meas} = C_0 + C_1 \cdot V + C_2 \cdot V^2 + C_3 \cdot V^3$$

$$P_{cor} = X_0 + \frac{P_{meas} \cdot X_0 \cdot X_1 (T \cdot X_5) - X_2 (T \cdot X_5)^2 - X_3 (T \cdot X_5)^3}{1 + X_4 (T \cdot X_5)}$$

Head (mm) = 229



Calibration Date: 6/Sep/2019

Issue Date: 6/Sep/2019

File Name: 202590_20190906_1408P.rsk

Operator: 
dluong

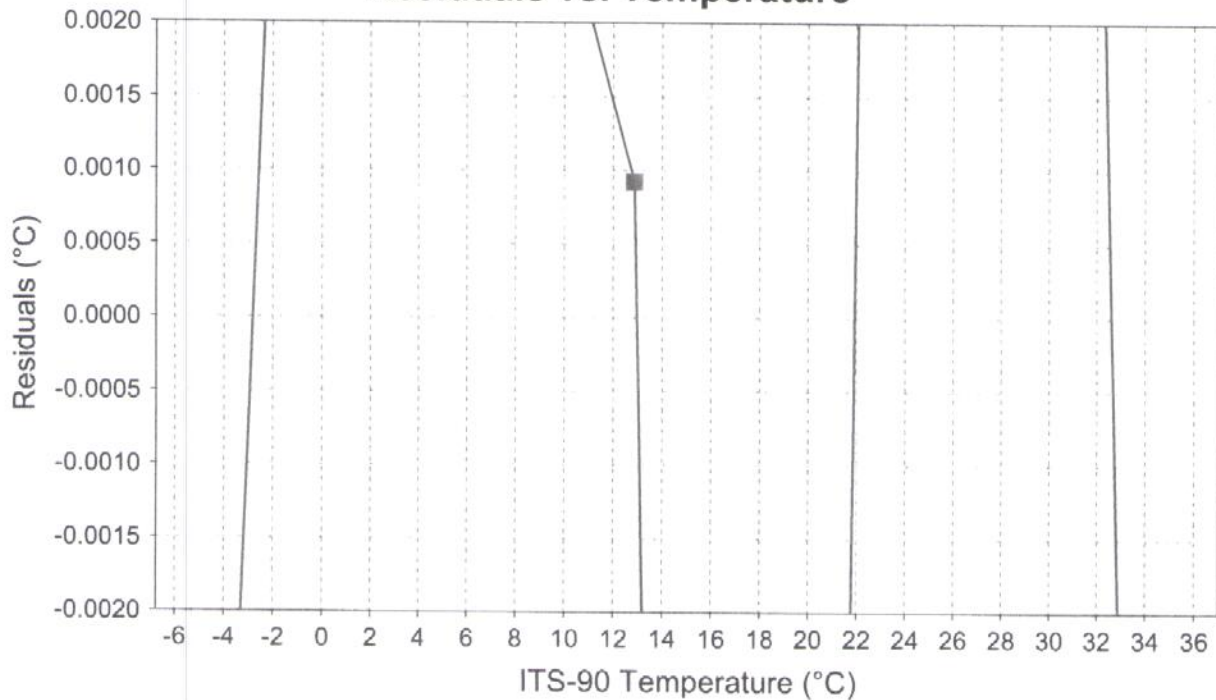
Approver: 
kmalorny

Temperature Calibration Certificate

Logger ID: RBRlegato³ Serial No: 202590 Channel No: 8

Reference Temperature, ITS-90	Voltage ratio, V	Measured Temperature, ITS-90	Calibration error	Coefficients
-4.79479	0.888572	-4.80295	-0.00816	C0: 3.1254499E-3
0.80052	0.860522	0.81554	0.01503	C1: -276.16372E-6
6.98587	0.824631	6.99048	0.00460	C2: 8.525147E-6
12.86249	0.785659	12.86342	0.00092	C3: 1.0125979E-6
18.60780	0.743691	18.55834	-0.04945	
24.33424	0.697202	24.37025	0.03601	
30.11644	0.648237	30.13549	0.01905	
34.99300	0.605654	34.97498	-0.01802	

Residuals vs. Temperature



Calibration Date: 5/Sep/2019
 Issue Date: 6/Sep/2019
 Calibration ID: 35079

Operator: *Danny*
 dluong

Approver: _____

Conductivity Calibration Certificate

RBRlegato³ C.T.D, Teledyne Webb Slocum, 1000dbar, dry bay s/n: 202590

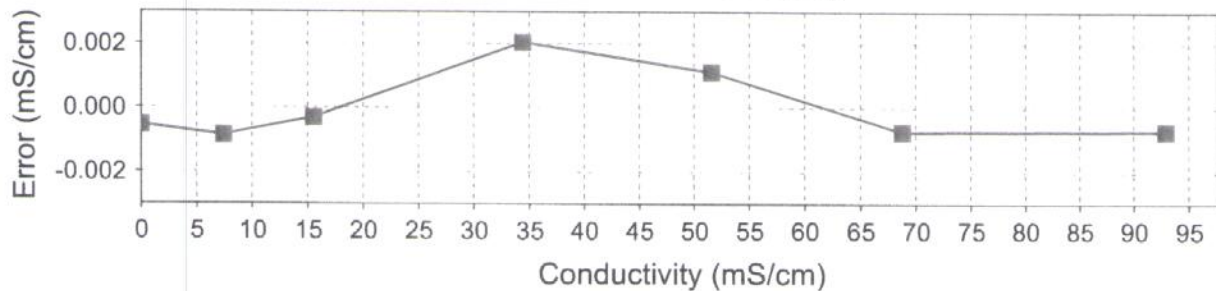
References: Autosal8400B#66289, MS-315#15506, SSW P160, RC#002

Reference Resistance (ohm)	Reference Conductivity (mS/cm)	Voltage Ratio, V	Measured Conductivity (mS/cm)	Calibration Error (mS/cm)	Coefficients
open	0.0000	-0.000209	-0.0005	-0.0005	C0: 39.082505E-3
694.035	7.4343	0.039026	7.4335	-0.0009	C1: 189.47263
331.927	15.5447	0.081834	15.5444	-0.0003	C2: 1.001942
150.017	34.3941	0.181330	34.3961	0.0020	X0: 1.0313833E-3
100.015	51.5892	0.272078	51.5903	0.0011	X1: -23.998244E-6
75.018	68.7794	0.362794	68.7787	-0.0007	X2: 0.0
55.516	92.9410	0.490315	92.9403	-0.0007	X3: 0.0
					X4: 0.0
					X5: 14.934426
					X6: 10
Bath	Voltage Ratio	Temperature (ITS-90)	Salinity (PSS-78)	Conductivity (mS/cm)	
T15S35	0.2259779	14.93443	35.0024	42.8557	
T25S35	0.2853087	25.98823	34.9959	54.1002	

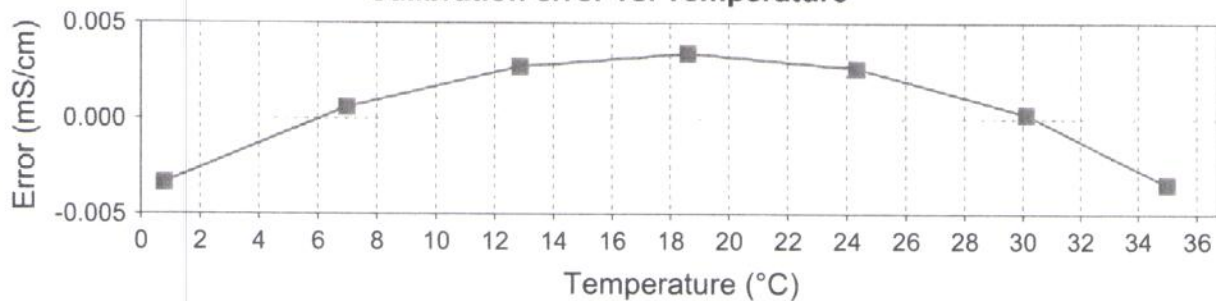
Cell Constant @T15S35 = 5.15970 1/cm

$$C_c = \frac{C_0 + C_1 * C_2 * V - X_0 * (T - X_5)}{1 + X_1 * (T - X_5) + X_2 * (P - X_6) + X_3 * (P - X_6)^2 + X_4 * (P - X_6)^3}$$

Calibration error vs. Conductivity



Calibration error vs. Temperature



Calibration Date: 9/Sep/2019

Issue Date: 9/Sep/2019

File Name: 202590_20190909_1302C.rsk

Operator:

T. Akweth
takuetteh

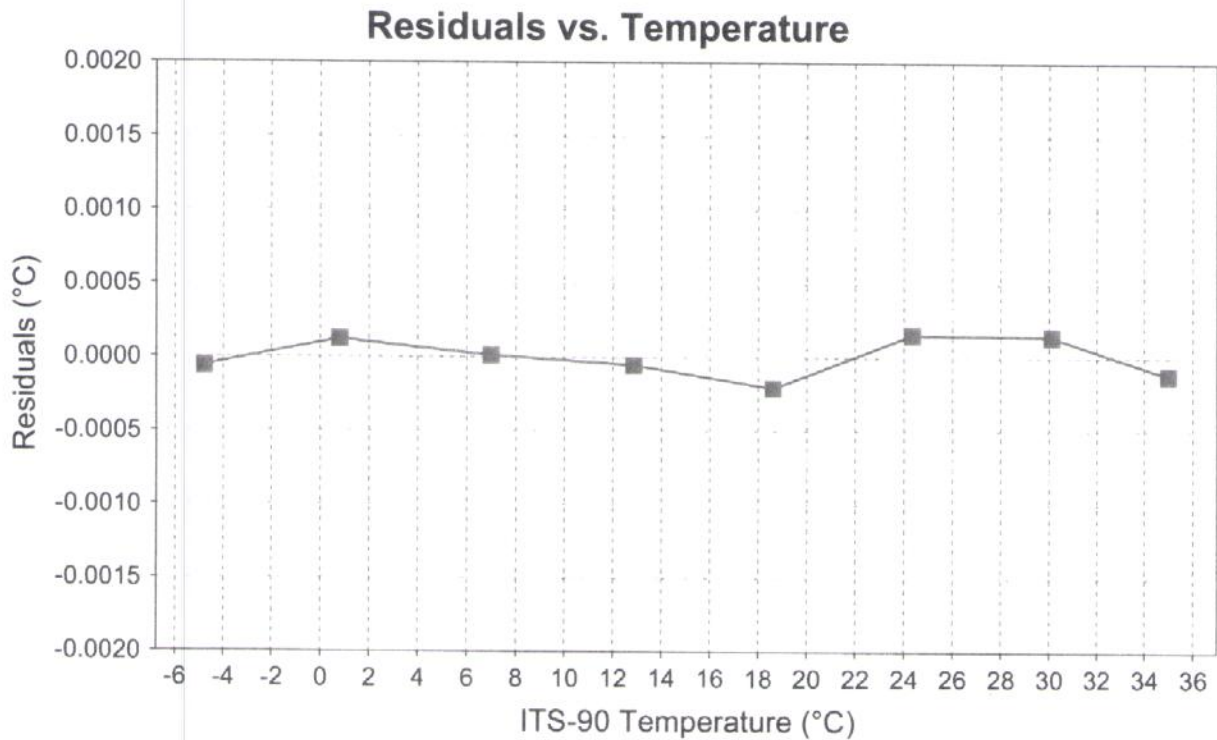
Approver:

[Signature]
kmalorny

Temperature Calibration Certificate

Logger ID: RBRlegato³ Serial No: 202590 Channel No: 2

Reference Temperature, ITS-90	Voltage ratio, V	Measured Temperature, ITS-90	Calibration error	Coefficients	
-4.79479	0.725194	-4.79485	-0.00006	C0:	3.477563E-3
0.80052	0.662754	0.80064	0.00012	C1:	-253.96122E-6
6.98587	0.589402	6.98588	0.00001	C2:	2.481635E-6
12.86248	0.518474	12.86243	-0.00005	C3:	-74.479075E-9
18.60767	0.450787	18.60746	-0.00021		
24.33419	0.387233	24.33435	0.00016		
30.11644	0.328677	30.11659	0.00014		
34.99301	0.284376	34.99289	-0.00012		



Calibration Date: 5/Sep/2019
 Issue Date: 6/Sep/2019
 Calibration ID: 35080

Operator: 
 dluong

Approver: 
 kmalorny