Glider Prep and Deployment Checklists

Glider - deployment	ud_476-20230113T1454	Project	Moffat Antarctica Career
Deployment dates	1/13/23 - 1/22/23	Location/notes	Near Adelaide Island, Antarctica

- tear from aft, likely at ~~fin~~ fin connection
- glide did not return to RU after deployment - went straight to UDel, no RU check in

	Extant	Notes
1) Glider check-out sheet	☑	☐
2) Ballasting/dunk sheets	☑	☐
3) Deployment checklists (on boat, shore side)	☐	☐
4) Glider check-in sheet	☐	☐
5) Misc. (science, etc.)	☐	☐
	☑ CTD ☑ Optode	☐ LISST
6) Other	☐ Compass	☐
	✓ AQD compass	

GLIDER	UD-476
PREPARER	Nicole
PREP DATE	8/23/2022
LOCATION / MISSION	MOFFAT / ANTARCTICA
DENSITY @ TEMP	1026.8 @ 0° C
INSURED?	

SCIENCE BAY SERIAL NUMBERS		Calibration Date (user/factory)
1)	CTD 9537	11/12/2020
2)	FLBB SLC 5499	11/14/2020
3)	PAR 50283	11/17/2020
4)	Oxy4831 sln 334	Factory 10/12/2020 in-house cal 8/24/2022
5)	AQD 11619, head 6483	
6)		

PRE-SEAL

TAKE PICTURES OF CONNECTORS AT EACH SEALING JOINT ✓

FORE CHECK

Check pump & pitch threaded rods (clean and grease) ✓

Grounded nose? ✓

Dessicant Exposed? ✓

Leak detect in place, batteries secure, grab & wiggle pitch battery to check secure, white guides free, no metal shavings, bottles installed ✓ ✓

PAYLOAD CHECK

Special Sensors / Additional Sensors? Aquadopp

Grounded? Fore Sci Ring No CTD ✓

Corrosion? Aft Sci Ring No Other? —

CTD cable clear, no leak at CTD joint, no leak at pucks ✓

AFT CHECK

Iridium Card Installed (SIM #) (if not standard) ✓ DOD 8988 169 763 060 258 654

Flash Card Check (remove old files, backed up? See **Software** section) ✓

Inspect strain on connectors/worn connectors ✓

Battery secured ✓

Ballast bottle present ✓

Aft cap clean/clear of leak ✓

Ejection weight stem grounded? Should it be? (Version specific) No

Thruster greased? N/A

Ensure safety of ballast pump prior to powering glider

Battery check: G2/G1 turn glider on with only 1 battery connected; G3 use BMS current

Aft Pack Voltage ✓ TURNS ON

Pitch Pack Voltage ✓ TURNS ON

Nose Packs Voltage —

Emer (if possible) Voltage —

Cabling/connectors - lithium vs. alkaline circuit correct? ✓

POST-SEAL, pre-ballast

GENERAL

Pick Point Present? No

Special Cargo? No

HARDWARE

Nose cone and pump bladder inspection ✓

Anode grounded? ✓

Anode size / remainder New

Pressure Sensor Check (corrosion, clear)

Aft sensor ✓

Payload sensor ✓

Ejection weight assembly ok/not seized? ✓

** Do a logging on for all these checks, take note of log and transfer before deployment*

SENSOR RETURN 0194.0000 // 234-0-0

put c_science_send_all 1	✓
put c_science_all_on 8	✓
put c_science_on 3	✓
All sensors reporting values?	✓ * only PUBB - verify that is correct.

CTD 0193.0000 // 233-0-0

Tank static comparison OK?	✓
Pumped CTD operational?	✓
Plot ballast *BD log, sci_water_pressure non-noisy and near < .5 m	✓

OPTODE

Check in completed?	✓
Saturation reading in air	101.601

OPTICS 0195.0000 // 235-0-0

Check max return using fluoro sticks	✓ 4130 both
Check dark counts with sensor covered	bb=48 chl=42
Optics file name	0195.0000

LISST

Clean LISST and perform ZSCAT	N/A

OTHER

Aquadopp Set-up
Aqd Compass Cal 8/24/2022

OUTSIDE

GPS Alamanc/firmeware updated? ✓

GPS check Latitude	40 28.749 N	Longitude	-74 26.222 E
Iridium connect	✓	Alternate number	✓
zero_pressure	✓	Get m_pressure	-0.013 bar
Air bladder shutoff (time)?	✓ 2:38	Sync_time (proper date?)	✓
Compass calibration	✓	Compass check	✓

toginexp.0 put on slide for DOD sim

For deep gliders, put c_de_oil_vol -1000 to fully retract oil inside reservoir —

ADDITIONAL

I ***WARNING: Advanced knowledge required to avoid damage/injury**

Check burn wire - disconnect, then put c_weight_drop 1, confirm 12 V ✓

Fore leakdetect — Science — Aft leakdetect —

THRUSTER

Report ++ m_thruster_current	N/A
Put c_thruster_on 20	
Verify thruster spins clockwise and current value updates regularly	
Put c_thruster_on 0 to turn off	

POWERED

Put m_coulomb_amphr_total accordingly (0 = new batteries) ✓
Put f_coulomb_battery_capacity (Alk=155, LiIon=200, li=450,625) ✓ 450
Vacuum @ T @ ballast ~~5.89 @ 24.6C~~ 5.93 @ 23.3C @ Ballast — Stabilized m_battery 14.97 volts
Get m_tot_num_inflections. Verify relative < 20000 or sufficient ✓ 9813
Get m_leakdetect_voltage, science, forward (>2.3) ✓ 2.47, 2.49
Get m_digifin_leakdetect_reading (less than 1019 requires service) ✓ 1023
Altimeter test - put c_alt_time 0, verify chirp, note m_altimeter_voltage ✓ 2.465 volts
Verify Argos ping ✓ — Wiggle for 5 minutes ✓

SOFTWARE

(paths are RU specific)

GENERAL

Backup Glider and Science Cards ✓
COOL//gliderData/glider_CS_backups/"glider name"
Format both CF cards - FAT Format ✓
Apply new copy of latest TWR Software Image ✓
For Glider: COOL/gliderData/gliderDos_releases/archived/"version"/target-glider
For Science: COOL/gliderData/gliderDos_releases/archived/"version"/target-science

Copy/overwrite STATE and CONFIG Folders ✓
FW Transfer latest RU Software Image .cur put into to-glide on docserver ✓
COOL/Gliders/Glider Software Image/"use most recent image"
Software Version 8.3 — Configure TBDlist ✓
Date OK? ✓ — Configure NBDlist ✓

\CONFIG

simul.sim deleted ✓

\MAFILES

goto_l10.ma (set x_last_...) ✓
yo*.ma, surfac*.ma pertinent for each glider and test missions ✓

\MISSIONS

b_arg: undervolts: 10.75V alkaline, 9-10 V Li3S, 13.5V Li4S, 12.75V LiIon ✓
Remove unused sample behaviors in missions ✓

AUTOEXEC.MI

Iridium: Numbers may vary. Listed: Main - Rutgers Alternate - TWR
Irid Main: 88160000592 8816000500 — Irid Alt: 17818711614 0677 8187 1161 4 DOD #s
u_iridium_failover_retries = 10 ✓ — Ver 7.15 u_iridium_idle -1? —
sci timestamp sensors (ctd41cp) ✓ — Calibration coefficients ✓
Reset the glider, observe any errors ✓ — get f_max_working_depth 206

CACHE MANAGEMENT

del ..\state\cache*.* ✓
after *bdlist.dat are set (exit reset): ✓
logging on; logging off ✓
send ..\state\cache*.cac ✓
send *.mbd *.sbd *.tbd *.nbd ✓

DOCKSERVER

Version 8.5.0-1
Check script

TWR BACKUP

Confirm to-glider folder clear
Confirm correct script running

* **Software Burning Tips :** if using Procomm or local folder, copy all the files from the software image locally. Then proceed to edit them for the glider and do a mass freewave transfer of the files. Save these files or prepare the to-glider with these files

NOTES

burnapp to 8.3

- removed m_pump_stress_remaining_cycles + m_pump_stress_track from longterm.dat

tested strobe - works

Adjusted Pitch-motor cal-b value, battery was a little far back, shifted battpos forward 0.38 inches

Sci cal values verified (PAR, FLBB)

pump cal verified

* Need to check on pressure sensor cal values!
  - using typed min + max values on cal sheet - confirmed these values are in autoexec.mi
    ↳ not hand written values

CTD pump works - but sounds a little strange in lab.

AQD head pointed forward

AQD test: 1 sec rate
App A checklist
compass test, pressure test
ping in air: 20-30 counts sig
ping in water → sig strength up
on-line → range check
pressure offset in tank

UD-476 8/19/2022

Pitch motor

- moved to ballast ∅ fine
- moved 0 to 0.2 fine
- moved 0.2 to 0.5 fine
- tried 0.5 to 1 and didn't move, pitch motor got taken out of service.
  - tried to put pitch-motor back into service a couple times and it wouldn't go.

Front 1/2 inch back 1/4" thread left

m1 .89
M2 -.88

glider 1.74 1.77 ✓

m stacker : 1.962
b -1.743

Changing b to -1.743 changed batt pos by .38
- more negative b = shift forward battery

Deployment			MASS (g)	COMMENTS
Moffat Antarctica	GLIDER	FORE STEM (minus FBB1,2)		
		FORE HULL		Adjust trim
		AFT STEM (red plug, card)		removed 44g from aft ballast bottle
Glider		AFT HULL		add 44g to STBD Front ballast bottle (try to fix roll)
UD_476		COWLING		
		SCREWS (vacuum, cowling, aft battery)		
Date	PAYLOAD	PAYLOAD BAY		
8/25/2022		WINGS		
		OTHER - Aquadopp		
Preparer	BATTERIES	AFT BATTERY		
Nicole		PITCH BATTERY		
		FORE BATTERY 1, 2, EMER		
Final	WEIGHT BOTTLES	AFT BOTTLE	24.3	
Dunk for Roll only		FORE BOTTLE 1 (stbd) (FBB1)	325	
		FORE BOTTLE 2 (port) (FBB2)	239.1	
		OTHER		

ENTIRE VEHICLE (Ohaus Scale)	

Tank Specifics		Glider Specifics	
Tank Density (kg/m^3)	1020.35	Glider Volume (L)	60.475
Tank Temperature (C)	22.10	Total Mass (kg)	0.588
Weight in Tank (g)	280.00	Glider Density (in air)	9.73
Target Specifics		**Volume Change (temperature induced)**	
Target Density (kg/m^3)	1026.00	Volume Change (target) (mL)	-60.2
Target Temperature (C)	0.00	Coeffcient of Thermal Expansion	4.50E-05
		Carbon hulls	4.50E-05
Glider Volume (at lab temp) (L)		Aluminum hulls	7.50E-05

Ballasting Using Volume		Ballasting Using Mass	
Should Hang (in tank) (g)	280.0	Adjust Glider Mass (entered volume) (g)	61397.2
Adjust by (g)	0.0	Glider Density (target water, using mass)	**9.7**
Weight Change (no dunk) (g)			
Glider Density (target)	**1026.0**		

H MOMENT (rad)		(deg)	
Angle of Rotation (before)	-0	-2.6	
Angle of Rotation (after)		0.0	
Angle of Rotation	-0	-2.6	
Weight on Spring (after)			
Weight added			
Radius of Hull	125		125 for G2+, deeps
H-distance	**0.0**		

MISC MASSES & VOLUMES	
Pick point - 40 mL - 107 g air - 66 g water	
Wing Rail Weights - 1.8 mL @ 15.4 g each ~ 13.5 g in water	
VMT Transceiver - 173 mL - 162 g water	
FIRE Shroud SN02 (ru01) - 266 mL - 112 g water	
Optode - 130 mL - 92 or 190 g (plastic or titanium)	
LISST Bay - roughly 6.55 L	
Carbon Fiber wing Air -> Water Ratio	0.437209
Plastic Wing Air --> Water ratio	0.487603
2k syntactic foam 100 g gives you 155 buoyancy	

Deployment			MASS (g)	COMMENTS
Moffat Antarctica	GLIDER	FORE STEM (minus FBB1,2) 9926.4	~~9926.4~~	w/ 4-unit dessicant + battery — Dessicant = 125.2 g initial
Glider		FORE HULL	4558.4	
UD-476		AFT STEM (red plug, card)	6713.4	w/ optode
Date		AFT HULL	4566.0	
8/19/2022		COWLING	1725.0	
		SCREWS (vacuum, cowling, aft battery)	24.5	
Preparer	PAYLOAD	PAYLOAD BAY 11594.1	~~1259.7~~	w/ battery mounting bracket. 3 pucks front, 2 pucks back, wing rails = 5 each
Nicole		WINGS	446.7	
		OTHER - Aquadopp + mounts	3453.9	alkaline batteries ☆ swap to 2x Lithium after 1st dunk, -75g
initial	BATTERIES	AFT BATTERY	10083.0	
		PITCH BATTERY	8960.4	
		FORE BATTERY 1, 2, EMER	~~204.6~~	included in nose.
	WEIGHT BOTTLES	AFT BOTTLE	120.0	
copper shot.		FORE BOTTLE 1 (stbd) (FBB1)	~~[illegible]~~	231.2
		FORE BOTTLE 2 (port) (FBB2)	~~[illegible]~~	207.3
		OTHER ~~FBB3~~	~~[illegible]~~	
		~~FBB4~~	~~[illegible]~~	
	ENTIRE VEHICLE (Ohaus Scale)			

Tank Specifics		Glider Specifics	
Tank Density (kg/m^3)	1023.00	Glider Volume (L)	57.000
Tank Temperature (C)	23.00	Total Mass (kg)	0.000
Weight in Tank (g)	0.00	Glider Density (in air)	0.00
Target Specifics		**Volume Change (temperature induced)**	
Target Density (kg/m^3)	1023.00	Volume Change (target) (mL)	0.0
Target Temperature (C)	23.00	Coeffcient of Thermal Expansion	4.50E-05
		Carbon hulls	4.50E-05
Glider Volume (at lab temp) (L)	**0.000**	Aluminum hulls	7.50E-05

Ballasting Using Volume		Ballasting Using Mass	
Should Hang (in tank) (g)	0.0	Adjust Glider Mass (entered volume) (g)	58311.0
Adjust by (g)	0.0	Glider Density (target water, using mass)	0.0
Weight Change (no dunk) (g)			
Glider Density (target)	**1023.0**		

H MOMENT (rad)		(deg)	
Angle of Rotation (before)		0.0	
Angle of Rotation (after)		0.0	
Angle of Rotation	0	0.0	
Weight on Spring (after)			
Weight added	290		
Radius of Hull	107		125 for G2+, deeps
H-distance	**####**		

MISC MASSES & VOLUMES	
Pick point - 40 mL - 107 g air - 66 g water	
Wing Rail Weights - 1.8 mL @ 15.4 g each ~ 13.5 g in water	
VMT Transceiver - 173 mL - 162 g water	
FIRE Shroud SN02 (ru01) - 266 mL - 112 g water	
Optode - 130 mL - 92 or 190 g (plastic or titanium)	
LISST Bay - roughly 6.55 L	
Carbon Fiber wing Air -> Water Ratio	0.437209
Plastic Wing Air --> Water ratio	0.487603
2k syntactic foam 100 g gives you 155 buoyancy	

GLIDER: UD-476

Iteration 1 **Log File** 0192.0000 230-0-0 **Date / Location** RU / 8/19/2022

476

FORE | EB | SB | AFT

Front Scale 78 **Aft Scale** 506

Instrument: 1581 **Instrument:**

T = 22.017 T =

C = 4.311 C =

D = 1020.17 D =

Ballast

FBB1 stbd 231.2

FBB2 Port 207.3

Aft BB 120

Roll

Ballast 1.06cc

Battery 0.008 in

Notes Ver 8.2

● = 168g

pitch motor taken out of service...

Iteration 2 **Log File** 0193.0000 233-0-0 **Date / Location** 8/22/2022 RU

UD

FORE | EB | SB | AFT

Front Scale 178 **Aft Scale** 110

Instrument: 1581 **Instrument:** glider

T = 21.946 T = 21.948

C = 4.335 C = 4.331

D = 1020.35 D =

Ballast

FBB1 stbd 280.0

FBB2 Port 257.3

Aft BB 57.3

-3.1°

Roll -0.054 rad

Ballast 1.065cc

Battery 0.020 in

Notes

F	A	
-90	506	
+75	-75	ptch batt wrong
-15	431	VS
+223	-223	trim
-60	-60	ballast
~~+163~~	~~-283~~	
+20	-20	
+183	-303	

Dunk 2 notes continued below

Iteration **Log File** **Date / Location**

FORE | EB | SB | AFT

Front Scale **Aft Scale**

Dunk 2 H-Monet scale w/ mass: 516

Instrument: **Instrument:**

T = roll w/ mass: -0.387 rad T =

C = mass: C = 294g

D = D =

H = 4.8

Ballast

FBB1 stbd

FBB2 Port

Aft BB

Roll

Ballast

Battery

Notes

+183	-303	Sml -120
-160	-240	-2 SBA pic
~~+343~~	~~-63~~	
+343	-63	+ -400 = -120

Add 317g metal rod front, bottom

Change AQD batteries to lithium -75.2g

↳ add 100.2g to front BBs

↳ 50g each side

OHAUS Scale: Glider + cart = 76.10 kg. cart 14.1

GLIDER: UD-476

Iteration 3 **Log File** 0196.0000 235-1-0 **Date / Location** RU 8/24/2022

FORE | EB | SB | AFT

Front Scale 158 **Aft Scale** 132

Instrument: 1581 **Instrument:**

T = 22.145 T =

C = 4.317 C =

D = 1020.10 D =

Ballast

FBB1 stbd 280.0 (NC)

FBB2 Port 239.1

Aft BB ~~23~~ 67.4

Roll 0.042 rad = 2.4°

Ballast 1.065cc

Battery 0.014 in

Notes

F	A	
178	110	
+34	+34	Baku trim
+20	-20	make nose heavy
-4	-4	remove 8g
-18	+10	

Iteration 4 **Log File** **Date / Location** RU 8/25/2022

FORE | EB | SB | AFT

Front Scale 116 **Aft Scale** 164

Instrument: 1581 **Instrument:**

T = 22.104 T =

C = 4.354 C =

D = 1020.35 D =

Ballast

FBB1 stbd 280.0 (NC)

FBB2 Port 239.1 (NC)

Aft BB 67.4 (NC)

Roll -0.068 rad = -3.9°

Ballast 0.026in

Battery 1.065cc

Notes Add pickpoint aft SB

remove 2 wraps port, 3 wraps stbd

reverse direction of AQD

to remove yellow core

Iteration 5 **Log File** **Date / Location** 8/25/2022

FORE | EB | SB | AFT

Front Scale No Ballast dunk only roll check **Aft Scale**

Instrument: **Instrument:**

T = T =

C = C =

D = D =

Ballast

FBB1 stbd 325.0

FBB2 Port 239.1 (NC)

Aft BB 24.3

Roll -0.045 rad = -2.58°

Ballast

Battery

Notes

F	A	
116	164	
+24	-24	Trim
+20	-20	40g nose heavy
+44	-44	

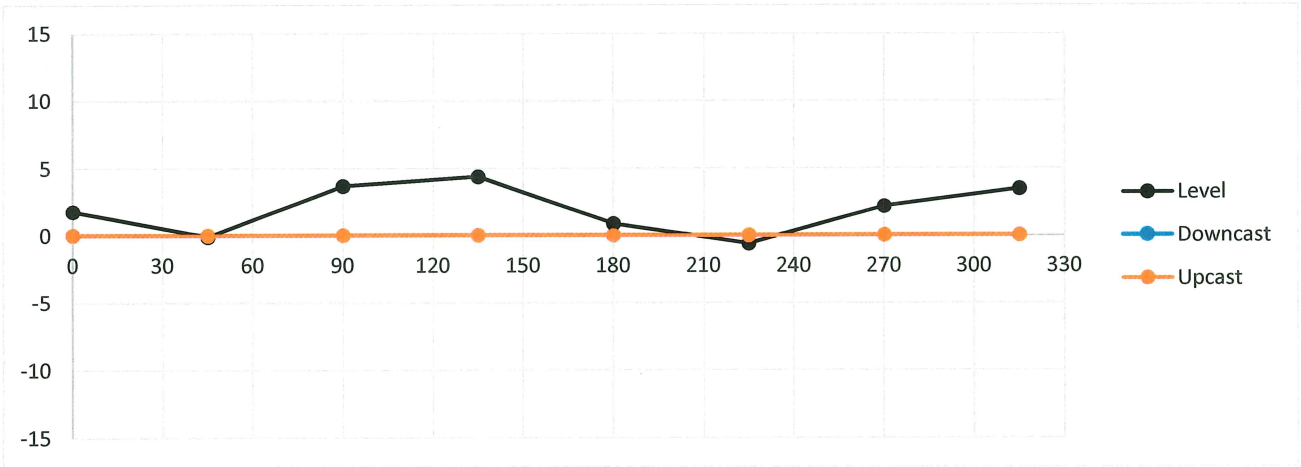
Glider / Mission: *UD476 AQD* **Cal Location** *DMCS cart* **Date** *8/25/2022* **Operator** *Nicole, Brian*

** AQD compass re-calibrated with glider attached

	LEVEL		
	HAND	GLIDER	ERROR
0	0	1.8	**1.8**
45	51	50.9	**-0.1**
90	90	93.7	**3.7**
135	133	137.4	**4.4**
180	177	177.9	**0.9**
225	220	219.4	**-0.6**
270	258	260.2	**2.2**
315	307	310.5	**3.5**
			0
			0
			0
			0

	DOWNCAST		
	HAND	GLIDER	ERROR
0			**0**
30			**0**
60			**0**
90			**0**
120			**0**
150			**0**
180			**0**
210			**0**
240			**0**
270			**0**
300			**0**
330			**0**

	UPCAST		
	HAND	GLIDER	ERROR
0			**0**
30			**0**
60			**0**
90			**0**
120			**0**
150			**0**
180			**0**
210			**0**
240			**0**
270			**0**
300			**0**
330			**0**



RUTGERS
Center for Ocean Observing Leadership

Slocum CTD Comparison Check

GLIDER: UD-476 **SB:** PAR Bay 9537p **DEPLOYMENT:** Moffat Antarctica

Pre-Deployment

Date: 8/22/2022

SBE19 s/n: 1581	Glider: 9537p
Temperature: 21.946	**Temperature:** 21.948
Conductivity: 4.335	**Conductivity:** 4.331

Notes:
8/22/22 Could not feel glider CTD pump running in tank, but did observe ripples, so appeared to be working.

Post-Deployment

Date: _____

SBE19 s/n:	Glider:
Temperature:	**Temperature:**
Conductivity:	**Conductivity:**

Notes:

*** CTD Maintenance if comparison is not acceptable (reference SeaBird Application Note 2D)

1. Perform CTD backward/forward flush with 1% Triton X-100 solution
2. Perform CTD backward/forward flush with 500 – 1000 ppm bleach solution
3. Perform the same on a pumped unit, just different approach
4. Repeat comparison test if above results not within T < .01 C, C < .005 S/m

Oxygen Optode Check & Calibration pre UD_476 Moffat Antarctica

OPTODE SN	334	DATE	8/24/2022
FOIL ID	1206 EM	AIR PRESSURE (hPa)	29.82 inHg = 1009.82 hPa = 757.428 mmHg
PRE SALINITY	35	CALIBRATED?	YES

* *REMEMBER TO ISSUE THE SAVE COMMAND AFTER CHANGING VALUES*

pre - interval = 2

100% SOLUBILITY	267.38 µM = 8.56 ppm	TITRATION	7.8 ppm, 7.8 ppm
	* µM = ppm * 1000 / 32	EPA Na2S2O3 Check	2.14 mL
		Sodium Sulfite / mL	16g / 800mL %

PRE-CHECK			
100%		0%	
Conc (µM) =	251.953	Conc (µM) =	1.484
Saturation (%) =	95.842	Saturation (%) =	0.545
Temp (°C) =	23.978	Temp (°C) =	22.147
Phase =	30.407	Phase =	60.426

POST-CAL			
100%		0%	
262.004 Conc (µM) =	~~[illegible]~~	Conc (µM) =	-0.052
99.455 Saturation (%) =	~~[illegible]~~	Saturation (%) =	-0.019
23.866 Temp (°C) =		Temp (°C) =	22.476
30.649 Phase =		Phase =	60.442

GLIDER CONFIG	
POST SALINITY	34
TEXT OUTPUT OFF	✓

Post Interval = 2

* *REMEMBER TO ISSUE THE SAVE COMMAND AFTER CHANGING VALUES*

PRESSURE TRANSDUCER CALIBRATION (PSI)

Date:	10-Dec-2020
Glider:	476

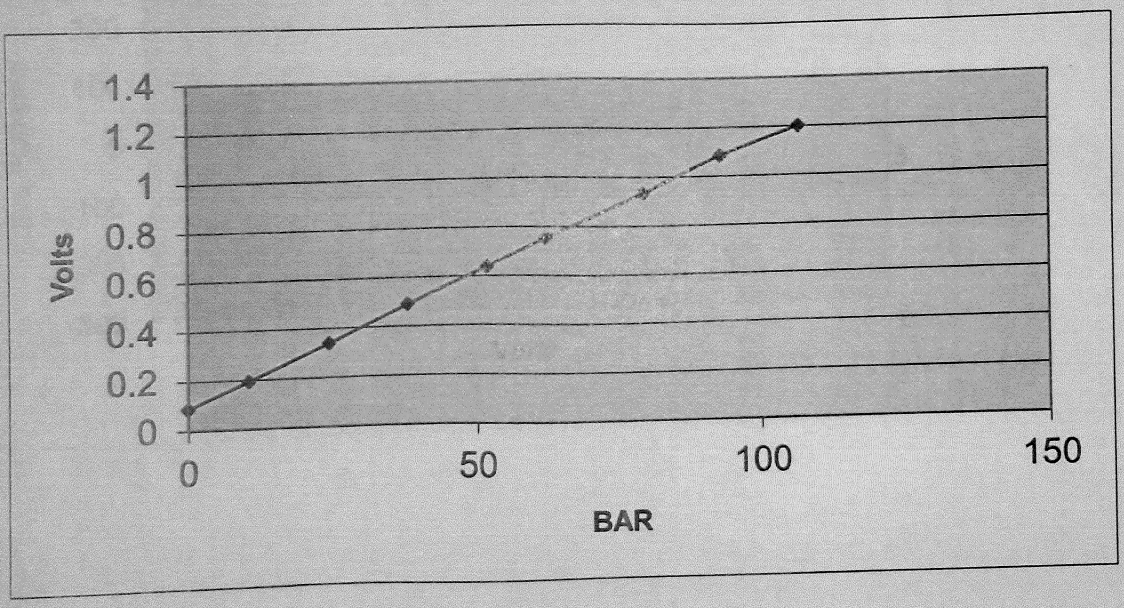
Dead Weight		AD1, 1
Kg/cm^2	Bar	Volts
0	0	0.087
150	10.34	0.194
350	24.13	0.34
550	37.92	0.491
750	51.71	0.639
900	62.05	0.752
1150	79.29	0.934
1350	93.08	1.084
1550	106.87	1.201

m=	94.454 BAR's per Volt
b=	-8.341 BAR

VOLTS @ 0 BAR=	0.088
VOLTS @ 140 BAR=	1.571

T_ocean_pressure_min .087 V
_____max 1.201

A number: 58.298



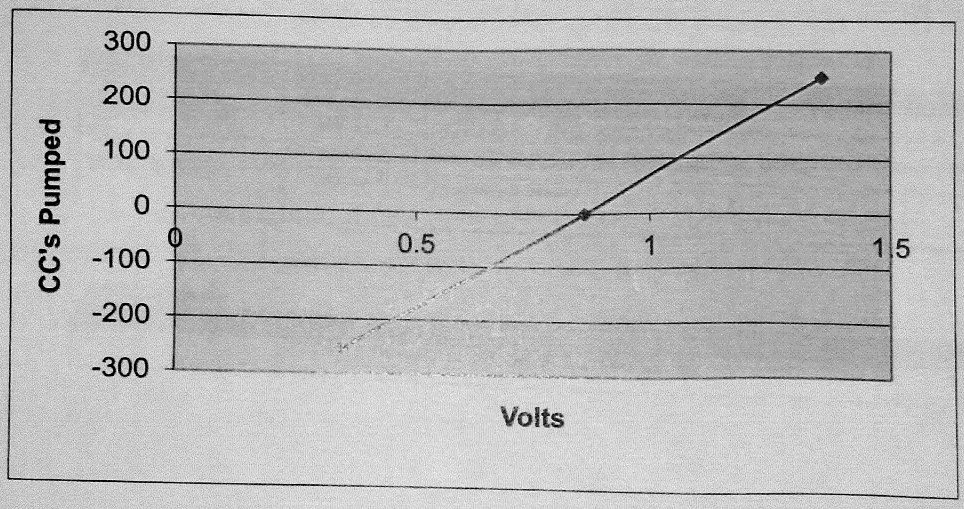
PUMP MOTOR

Date: 12/21/20
FWD: 218

Pump position in inches	AD2,0 CC's	Pot. reading in Volts
0.0	-252	0.345
1.6	0	0.861
3.2	252	1.359

m=	496.989 CC's per Volt
b=	-424.926 CC's

Number: 20.252



Biospherical Instruments Inc.

CALIBRATION CERTIFICATE

Calibration Date	11/17/20		
Model Number	QSP2155	Firmware Version	v 1.2
Serial Number	50283		
Operator	TPC		
Standard Lamp	V-040(11/12/20)		
Sensor Operating Voltage Range:	6 to 15	VDC (+)	
Output Polarity:	Positive		

A=125

Sensor Output Voltage:

Sensor Illuminated	129.1	mV
Sensor Dark	9.9	mV
Sensor Net Response	119.2	mV
RG780	10.0	mV

Corrected Lamp Output:

Output In Air (same condition as calibration):

1.558E-02 uE/cm²sec

Output Corrected for Immersion in Water: Using Immersion Coefficient of:

2.751E-02 uE/cm²sec 0.5664 (Collector Type: SC-3)

Calibration Scale Factor:

(To calculate irradiance, divide the net voltage reading in Volts by this value.)

Dry:	7.646E+00 Volts/(**uE/cm²sec**)
Wet:	4.331E+00 Volts/(**uE/cm²sec**)
Dry:	7.646E-04 Volts/(**uE/m²sec**)
Wet:	4.331E-04 Volts/(**uE/m²sec**)

Notes:

1. Annual calibration is recommended.
2. Calibration is performed using a Standard of Spectral Irradiance traceable to the National Institute of Standards and Technology (NIST).
3. To approximate the sensor's saturating irradiance, multiply the calibration factor by the sensor power supply voltage, minus one volt.
4. The collector should be cleaned frequently with alcohol.

PO Box 518
620 Applegate St.
Philomath, OR 97370

WET Labs

(541) 929-5650
Fax (541) 929-5277
www.wetlabs.com

ECO Chlorophyll Fluorometer Characterization Sheet

Date: 11/14/2020

S/N: FLBBSLC-5499

Chlorophyll concentration expressed in µg/l can be derived using the equation:

CHL (µg/l) = Scale Factor * (Output - Dark counts)

	Digital
Dark counts	38 counts
Scale Factor (SF)	0.0071 µg/l/count
Maximum Output	4130 counts
Resolution	1.0 counts
Ambient temperature during characterization	22.0 °C

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

SF: Determined using the following equation: SF = x ÷ (output - dark counts), where x is the concentration of the solution used during instrument characterization. SF is used to derive instrument output concentration from the raw signal output of the fluorometer.

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.

PO Box 518
620 Applegate St.
Philomath, OR 97370

WET Labs

www.wetlabs.com

Scattering Meter Calibration Sheet

11/14/2020
Wavelength: 700

S/N FLBBSLC-5499

Use the following equation to obtain "scaled" output values:

$$\beta(\theta_c)\ m^{-1}\ sr^{-1} = \text{Scale Factor} \times (\text{Output} - \text{Dark Counts})$$

• Scale Factor for	=	1.799E-06	$(m^{-1}sr^{-1})$/counts	
• Output	=	meter reading	counts	
• Dark Counts	=	31	counts	
Instrument Resolution	=	1.0	counts	1.89E-06 $(m^{-1}sr^{-1})$

Definitions:

- **Scale Factor:** Calibration scale factor, $\beta(\theta_c)$/counts. Refer to User's Guide for derivation.
- **Output:** Measured signal output of the scattering meter.
- **Dark Counts:** Signal obtained by covering detector with black tape and submersing sensor in water.

Instrument Resolution: Standard deviation of 1 minute of collected data.

WET Labs

(541) 929-5650
Fax (541) 929-5277
www.wetlabs.com

ECO Chlorophyll Fluorometer Characterization Sheet

Date: 7/23/2020

S/N: FLBBSLC-5499

Chlorophyll concentration expressed in µg/l can be derived using the equation:

CHL (µg/l) = Scale Factor * (Output - Dark counts)

	Digital
Dark counts	38 counts
Scale Factor (SF)	0.0071 µg/l/count
Maximum Output	4130 counts
Resolution	1.0 counts
Temperature during characterization	22.0 °C

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

SF: Calculated using the following equation: SF = x ÷ (output - dark counts), where x is the concentration of the solution used during characterization. SF is used to derive instrument output concentration from the raw signal output of the fluorometer.

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

Resolution: Standard deviation of a series of collected data.

Due to the variability in phytoplankton species and chlorophyll-a concentrations in-situ is highly variable. The scale factor listed on this calibration sheet was derived using a mono-culture of phytoplankton (Thalassiosira weissflogii). The population was assumed to be [illegible] method. To accurately determine chlorophyll concentration using this fluorometer, you must perform secondary measurements on the populations of interest. This is typically done using extraction measurement techniques on discrete samples. For additional information on determining chlorophyll concentrations 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 Water Environment Federation.

PO Box 518
620 Applegate St.
Philomath, OR 97370

(541) 929-5650
Fax (541) 929-5277
www.wetlabs.com

Scattering Meter Calibration Sheet

11/14/2020
Wavelength: 700

S/N FLBBSLC-5499

Use the following equation to obtain "scaled" output values:

$$\beta(\theta_c)\ m^{-1}\ sr^{-1} = \text{Scale Factor} \times (\text{Output} - \text{Dark Counts})$$

• Scale Factor for 700 nm	=	1.799E-06	$(m^{-1}sr^{-1})$/counts	
• Output	=	meter reading	counts	
• Dark Counts	=	31	counts	
Instrument Resolution	=	1.0	counts	1.89E-06 $(m^{-1}sr^{-1})$

Definitions:

- **Scale Factor**: Calibration scale factor, $\beta(\theta_c)$/counts. Refer to User's Guide for derivation.
- **Output**: Measured signal output of the scattering meter.
- **Dark Counts**: Signal obtained by covering detector with black tape and submersing sensor in water.

Instrument Resolution: Standard deviation of 1 minute of collected data.

AANDERAA
a xylem brand

CALIBRATION CERTIFICATE

Form No 854, May 5th 2020

Certificate no: Oxygen Optode 4831_334_179904
FoilID: 1206EM

Product: **Oxygen Optode 4831**
Serial no: 334
Calibration date: 10.12.2020

2-POINT RECALIBRATION, MULTIPOINT CALIBRATED OXYGEN OPTODE

This is to certify that this product has been calibrated and verified using the following reference equipment:

Reference Equipment	Serial
Calibration Bath Model Toho TM-005-P-A	12-K
Fluke 5615 PRT	Serial No. 802054 and Serial No. 849155
Fluke CHUB E-4	Serial No. A7C677
Reference sensor 4330	338

Specification

	O2 Concentration	Air Saturation	Temperature
Range	0-500 µM	0 - 120%	-5 to +40°C
Accuracy	< ±3µM or ±2% 1)	±2% 2)	±0.03°C 3)
Resolution	< 1 µM	< 0.4%	0.01°C
Settling Time (63%)	< 25 seconds	< 25 seconds	< 2 seconds

1) Requires salinity compensation for salinity variations > 1mS/cm, and pressure compensation for pressure > 100meter
2) Within calibrated range 0 - 120% / 0 - 30°C
3) Within calibrated range 0 - 36°C for standard version and 0 - 30°C for multipoint version

Calibration points and readings:

	Air Saturated Water	Zero Solution (Na2SO3)
Phase reading (°)	33.61	60.94
Temperature reading (°C)	10.05	21.51
Air Pressure (hPa)	957.00	

Giving these coefficients

Index	0 (Offset)	1 (Slope)
ConcCoef	-2.828391E+00	1.042126E+00

With following settings

Index	0	1	2	3	4	5	6
SVUFoilCoef	2.80983E-03	1.17557E-04	2.52472E-06	2.31705E+02	-3.27474E-01	-5.62698E+01	4.54625E+00
PhaseCoef	0.000000E+00	1.000000E+00	0.000000E+00	0.000000E+00			
TempCoef	2.679277E+01	-3.148383E-02	3.180070E-06	-4.607407E-09	0.000000E+00	0.000000E+00	
Salinity (mS/cm)	0.00						
Firmware Version	5.0.4						

Date: 10.12.2020

Sr. Repair Technician

SEA-BIRD SCIENTIFIC
Sea-Bird Scientific
13431 NE 20th Street
Bellevue, WA 98005
USA

+1 425-643-9866
seabird@seabird.com
www.seabird.com

SENSOR SERIAL NUMBER: 9537
CALIBRATION DATE: 29-Jan-19

Slocum Payload CTD PRESSURE CALIBRATION DATA
1450 psia S/N 11151147

COEFFICIENTS:

PA0 =	2.353944e-001	PTCA0 =	5.238874e+005
PA1 =	4.550810e-003	PTCA1 =	3.600658e+000
PA2 =	-1.271461e-011	PTCA2 =	-5.638615e-002
PTEMPA0 =	-6.574419e+001	PTCB0 =	2.503425e+001
PTEMPA1 =	5.181534e-002	PTCB1 =	-3.500000e-004
PTEMPA2 =	-4.337839e-007	PTCB2 =	0.000000e+000

PRESSURE SPAN CALIBRATION

PRESSURE (PSIA)	INSTRUMENT OUTPUT (counts)	THERMISTOR OUTPUT (volts)	COMPUTED PRESSURE (PSIA)	RESIDUAL (%FSR)
14.68	527111.8	1708.1	14.68	-0.00
301.70	590182.8	1709.6	301.73	0.00
588.73	653262.9	1710.0	588.73	-0.00
875.83	716385.3	1710.4	875.82	-0.00
1163.00	779550.4	1710.7	1163.00	-0.00
1450.09	842720.5	1711.0	1450.10	0.00
1162.95	779538.1	1710.9	1162.94	-0.00
875.83	716386.8	1710.2	875.82	-0.00
588.85	653290.4	1710.3	588.85	0.00
301.68	590173.3	1710.2	301.69	0.00
14.69	527109.2	1709.9	14.67	-0.00

THERMAL CORRECTION

TEMP (°C)	THERMISTOR OUTPUT (volts)	INSTRUMENT OUTPUT (counts)
32.50	1927	527141.80
29.00	1857	527161.10
24.00	1758	527140.80
18.50	1649	527137.50
15.00	1579	527131.60
4.50	1371	527108.60
1.00	1303	527094.00

TEMPERATURE (°C)	SPAN
-5.00	25.04
35.00	25.02

y = thermistor output (counts)

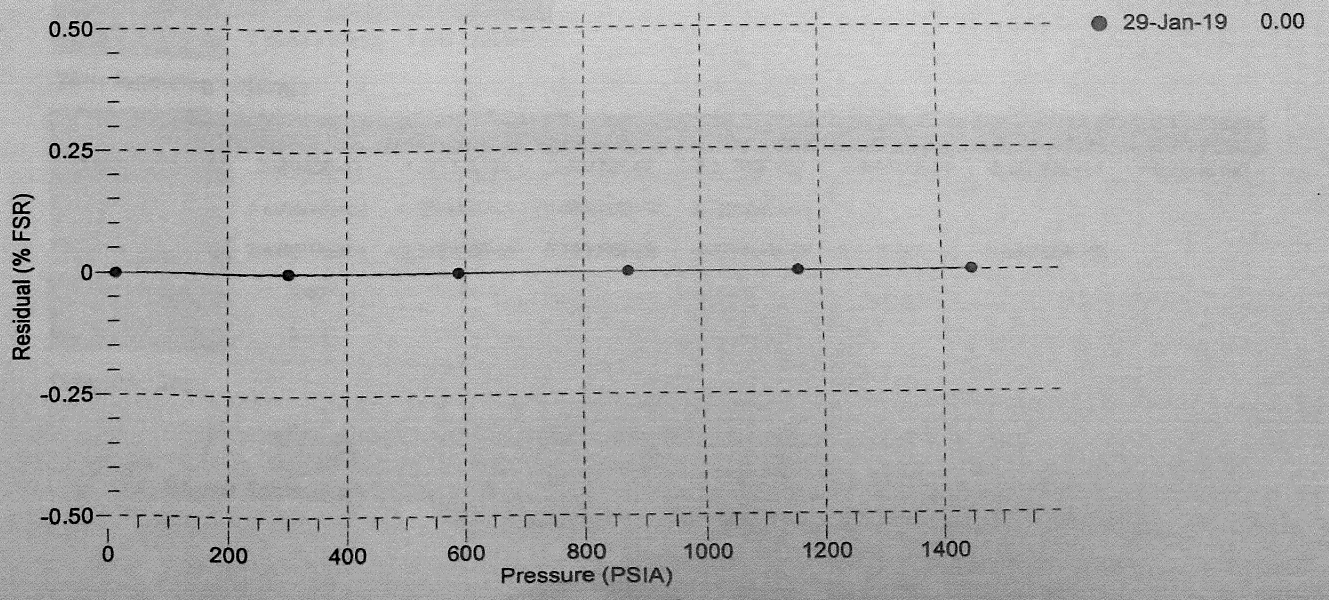
$t = PTEMPA0 + PTEMPA1 * y + PTEMPA2 * y^2$

$x = \text{instrument output} - PTCA0 - PTCA1 * t - PTCA2 * t^2$

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

$\text{pressure (PSIA)} = PA0 + PA1 * n + PA2 * n^2$

Residual (%FSR) = (computed pressure - true pressure) * 100 / Full Scale Range



SEA-BIRD SCIENTIFIC
Sea-Bird Scientific
13431 NE 20th Street
Bellevue, WA 98005
USA

+1 425-643-9866
seabird@seabird.com
www.seabird.com

SENSOR SERIAL NUMBER: 9537
CALIBRATION DATE: 12-Nov-20

Slocum Payload CTD TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

COEFFICIENTS:

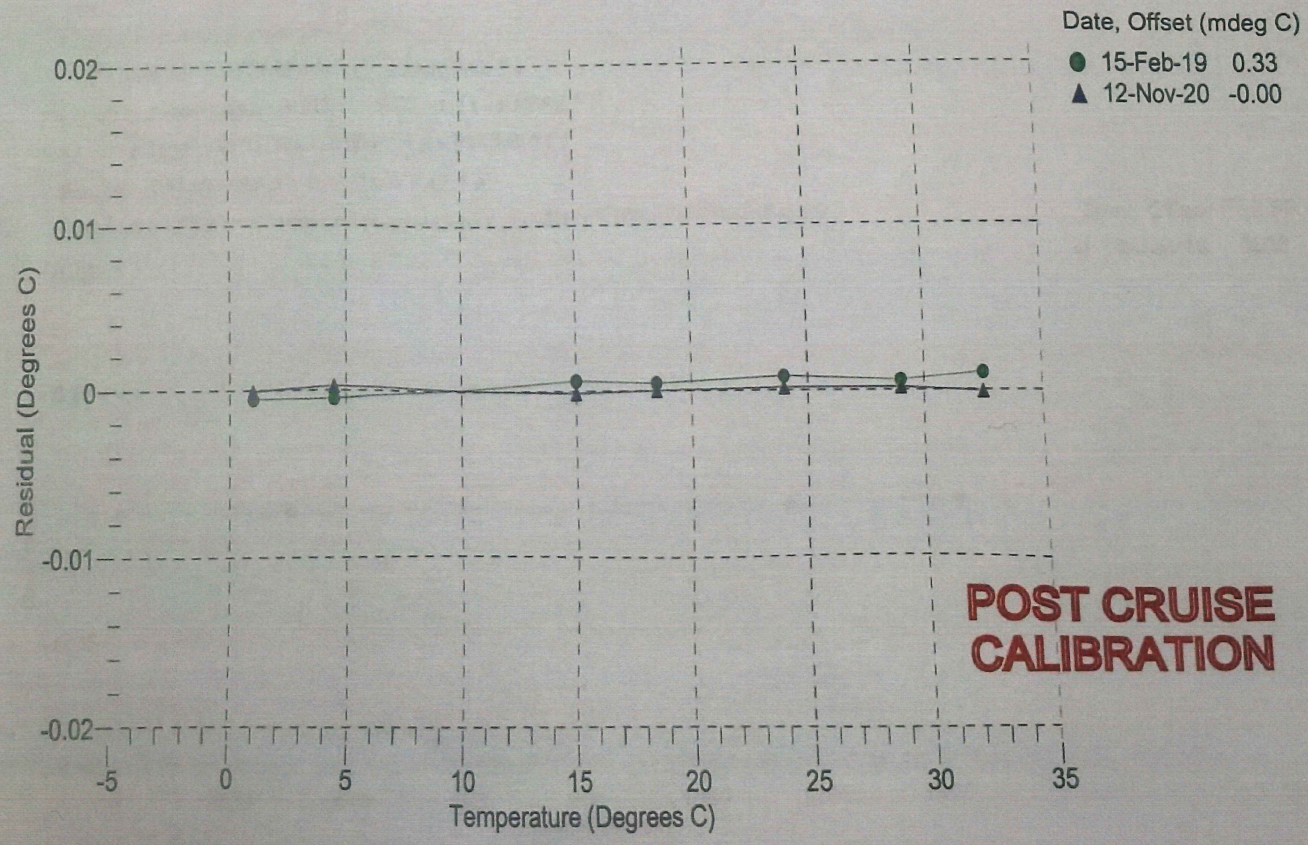
a0 = -1.729775e-004
a1 = 3.232566e-004
a2 = -5.802654e-006
a3 = 2.369666e-007

BATH TEMP (° C)	INSTRUMENT OUTPUT (counts)	INST TEMP (° C)	RESIDUAL (° C)
1.0000	577730.2	0.9999	-0.0001
4.4999	494041.3	4.5001	0.0002
15.0000	315074.1	14.9998	-0.0002
18.5000	272899.3	18.5000	-0.0000
23.9999	219045.0	24.0000	0.0001
29.0000	180469.5	29.0001	0.0001
32.5001	158114.1	32.5000	-0.0001

n = Instrument Output (counts)

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

Residual (°C) = instrument temperature - bath temperature



SEA-BIRD SCIENTIFIC
Sea-Bird Scientific
13431 NE 20th Street
Bellevue, WA 98005
USA

+1 425-643-9866
seabird@seabird.com
www.seabird.com

SENSOR SERIAL NUMBER: 9537
CALIBRATION DATE: 12-Nov-20

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

COEFFICIENTS:

```
g = -9.919848e-001
h =  1.343852e-001
i = -1.250621e-004
j =  2.786896e-005

CPcor = -9.5700e-008
CTcor =  3.2500e-006
WBOTC =  2.7588e-007
```

BATH TEMP (° C)	BATH SAL (PSU)	BATH COND (S/m)	INSTRUMENT OUTPUT (Hz)	INSTRUMENT COND (S/m)	RESIDUAL (S/m)
22.0000	0.0000	0.00000	2718.27	0.00000	0.00000
1.0000	34.6935	2.96647	5424.49	2.96647	0.00000
4.4999	34.6739	3.27260	5629.58	3.27261	0.00001
15.0000	34.6330	4.25150	6239.49	4.25147	-0.00003
18.5000	34.6240	4.59560	6439.91	4.59557	-0.00003
23.9999	34.6137	5.15180	6751.03	5.15186	0.00006
29.0000	34.6075	5.67196	7029.14	5.67194	-0.00001
32.5001	34.6015	6.04277	7220.70	6.04276	-0.00001

f = Instrument Output(Hz) * sqrt(1.0 + WBOTC * t) / 1000.0

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

Conductivity (S/m) = $(g + h * f^2 + i * f^3 + j * f^4) / (1 + \delta * t + \varepsilon * p)$

Residual (Siemens/meter) = instrument conductivity - bath conductivity