

# MINI STD/CTD Calibration Certificate

Certificate no: **4829**

Instrument model: **SD204**

Serial number: **1546**

Owner: **AQUAGESTION**

Calibrated date: **2020-06-12** Certificate issued date: **2020-06-12** Env. temp (degr. C): **19**

Calibrated by: Sensordata a.s and **SAIV A/S** Bergen Norway

## Calibration procedure:

Conductivity and temperature are calibrated by setting the MINI STD/CTD instrument in raw data mode and keeping it in three 200 l stirred, temperature stabilised calibration baths. Raw conductivity and temperature data are recorded with bath temperature and bath conductivity as measured by reference temperature\* and conductivity\*\* instruments. Calibration coefficients A1, B1, C1 for temperature and A3, B3, C3, D3 for conductivity are calculated from least square equations included in the MINISOFT software packet. Output temperature and conductivity from calibrated instrument must correspond with reference readings within +/- 1/100 degr. C and +/- 1/100 mmho/cm. Pressure is calibrated by connecting to a reference DWT\*\*\* and successively generate 6 pressures from 1 bar to FS. Pressure coefficients A2, B2, C2, D2 are calculated from least squares equations included in the instruments software. Output CTD data must correspond to data from reference instruments within specified accuracy.

TEMPERATURE degr. C			CONDUCTIVITY mmho/cm			PRESSURE dbar		
Bef. cal.	After cal.	Reference	Bef. cal.	After cal.	Reference	Bef. cal.	After cal.	Reference
	19.61	19.611		50.48	50.482		10.02	10.01
	12.16	12.161		34.38	34.381		100.13	100.13
	0.41	0.411		9.47	9.472		200.26	200.26
							300.39	300.39
							400.52	400.52
							500.65	500.65

All calibration coefficients are shown on attached calibration sheet

## Working references:

Temperature\* Falmouth Scientific Model OTM S-112 S/N 1377-09JUL96 Accuracy +/- 2/1000 degr.C  
Conductivity\*\* Falmouth Scientific Model OCM S-112 S/N 1354-09JUL96 Accuracy +/- 2/1000 mmho/cm  
Pressure\*\*\* Budenberg DWT Model 280L S/N 9050 Accuracy 0.008% FS (600 bar)

## Traceable references:

### Temperature:

Subreference 1:  
General Oceanics ATB 1250 temp. bridge serial no 1235  
(Working ref. Is controlled by subref.1 four times per year)  
(Subref.1 is controlled by subref.2 twice per year)

### Subreference 2:

Distilled water tripple point cell at +0.010 degr.C  
Phenoxybenzene tripple point cell at +26.868 degr.C

### Conductivity:

Subreference 1:  
Neil Brown Cond./Temp. transfer standard mod. CT-2 serial no.3  
(Working reference is controlled by subref.1 four times per year)  
(Subref.1 is controlled by subref.2 four times per year)  
(Subref.2 is controlled by subref.3 four times per year)

### Subreference 2:

Guildline Portasal 8410 Portable Salinometer serial no.59

### Subreference 3:

Ocean Scientific International Standard Seawater

### Pressure:

Subreference:  
Pressure reference at FIMAS Coastal Base Calibration Center  
5363 Agotnes Norway  
Control frequency Calibration equipment: Once per year

Calibrated by  
Signature

**STEINAR VERJEN**  
S. Verjen

Date 20-06-12  
Time 09-18-58 GMT  
CALIBRATION SHEET SD204 Serial no.1546

Temperature (T) Deg.C:  
A1+1.4129885589E-03 B1+2.7085323678E-04  
C1-2.6296826297E-07 D1+2.0435053593E-07

Pressure (P) decibar:  
A2-2.9420410811E-01 B2+1.7562424838E-04  
C2+7.8872200754E-12 D2-2.2844518335E-17  
E2+3.4010437249E-23 F2-2.5024994175E-29  
G2+7.2058740626E-36

Conductivity (C) mmho/cm:  
A3-3.8099329203E-02 B3+1.0750969784E-04  
C3-1.0671746734E-12

Other sensor (0-2.5V) AO+0.0000000000E+00 BO+8.2348145128E-02  
CO+0.0000000000E+00 DO+0.0000000000E+00

Turbidity (0-62.5 FTU)  
AT-7.1622707765E-12 BT+2.5000000000E-02  
CT+6.9388939039E-18 DT-1.6940658945E-21

Oxygen (OX) in per cent:  
V +1.0131144422E+02

Pressure sensor mathem.comp.coeff.  
K0+1.85890178958E+01 K1-5.99148457490E-02  
K2+5.46651826585E-05 K3-1.64725698816E-08  
L0-2.30940586136E+00 L1+7.20416318808E-03  
L2-6.61151938587E-06 L3+2.01777837134E-09  
M0+1.13652043691E-01 M1-3.18436031704E-04  
M2+2.97097372088E-07 M3-9.22992146452E-11  
N0-2.48254465578E-03 N1+6.94751289174E-06  
N2-6.47439151245E-09 N3+2.00914873255E-12  
O0+2.58565284457E-05 O1-7.23337966152E-08  
O2+6.73791796642E-11 O3-2.09001207587E-14  
P0-1.26343434206E-07 P1+3.53404247142E-10  
P2-3.29160543896E-13 P3+1.02090551127E-16  
Q0+2.33084302832E-10 Q1-6.52025542247E-13  
Q2+6.07347598930E-16 Q3-1.88388424578E-19

X1-2.3463752756E-01 X2+1.0134161095E-04  
X3-2.7304502943E-12 X4+1.6463689532E-18  
S1+4.7625449317E-01 S2+4.0591980129E-03  
S3+1.8167286166E-11 Y4+2.5897649699E-01  
Y5+2.3755603506E-03 Y6+5.4963371014E-12  
Y7+2.4835481652E-19



# CALIBRATION CERTIFICATE

NAME	: RINKO III
MODEL	: ARO-CAV-SA-R
SERIAL No.	: 0383
Parameter	: Temperature Dissolved Oxygen



JFE Advantech Co., Ltd.

# Temperature Calibration Certificate

Model : ARO-CAV-SA-R  
Serial No. : 0383  
Date : June 28, 2019  
Location : Production Section  
Method : Calibration equation is determined from third order regression of samples of the reference temperature against instrument voltages. Samples are taken at approximately 3, 10, 17, 24, and 31 °C.

## 1. Equation

$$\text{Instrument temperature}[\text{°C}] = A + B \times V + C \times V^2 + D \times V^3 \quad V: \text{Instrument voltage}[\text{V}]$$

## 2. Coefficients

A = -1.189182e+01  
B = +2.146738e+01  
C = -3.622350e+00  
D = +6.808219e-01

## 3. Calibration results

Reference temperature [°C]	Instrument voltage [V]	Instrument temperature [°C]	Residual error [°C]	Acceptance [°C]	OK/NG
3.029	0.78339	3.030	0.001	±0.020	OK
10.358	1.23352	10.355	-0.003	±0.020	OK
17.116	1.67621	17.121	0.005	±0.020	OK
24.052	2.13458	24.049	-0.003	±0.020	OK
30.680	2.55591	30.681	0.001	±0.020	OK

## 4. Verification

Criteria of judgement : Residual error of the instrument temperature at arbitrary point is within the acceptance value.

Reference temperature [°C]	Instrument temperature [°C]	Residual error [°C]	Acceptance [°C]	Judgement
20.349	20.363	0.014	±0.020	Passed

Examined

*K. Shimotsu*

Approved

*M. Ujiiwaki*

JFE Advantech Co., Ltd.



# Dissolved Oxygen Calibration Certificate

Model : ARO-CAV-SA-R  
 Serial No. : 0383  
 Date : July 01, 2019  
 Location : Production Section  
 Method : Calibration is performed with the nitrogen gas (zero) and the oxygen saturated water (span) kept by air bubbling.  
 Film No. : 191625BA

## 1. Equation

$$DO[\%] = G + H \times P'$$

Here,  $P'[\%]$  consists of the coefficients A-F determined by the initial calibration.

## 2. Coefficients

A = -4.486336e+01      E = +4.000000e-03  
 B = +1.441385e+02      F = +5.620000e-05  
 C = -2.731262e-01      G = +0.000000e+00  
 D = +1.044900e-02      H = +1.000000e+00

## 3. Verification

Criteria of judgement : Residual error of the instrument DO at arbitrary point is within the acceptance value. The test is performed 3 times.

Acceptance:  $\pm 0.5\%$  of full scale

Test for DO 0 %

	Test condition		Instrument DO [%]	Residual error [%]	Acceptance [%]	Judgement
	Atm. pressure [hPa]	Reference DO [%]				
1st	1006.3	0.00	-0.06	-0.06	$\pm 1.00$	Passed
2nd	1006.3	0.00	-0.07	-0.07	$\pm 1.00$	Passed
3rd	1006.3	0.00	-0.07	-0.07	$\pm 1.00$	Passed

Test for DO 100 %

	Test condition			Instrument DO [%]	Residual error [%]	Acceptance [%]	Judgement
	Water T. [°C]	Atm. pressure [hPa]	Reference DO [%]				
1st	25.1	1006.1	99.27	98.83	-0.44	$\pm 1.00$	Passed
2nd	25.0	1006.2	99.28	99.10	-0.18	$\pm 1.00$	Passed
3rd	25.0	1006.1	99.27	98.88	-0.39	$\pm 1.00$	Passed

Examined M. TAKEISHI  
 Approved M. Ujinaki

JFE Advantech Co., Ltd.

# RINKO-III Custom-Made ARO-CAV-SA-R Verification

## 1. Description

ARO-CAV-SA-R outputs analog values as calculated DO.

## 2. Equation

$$\text{DO [\%]} = 80 \times \text{DO\_voltage [V]}$$

Output: 0 [%] at 0 [V], 100 [%] at 1.25 [V], and 200 [%] at 2.5 [V]

## 3. Pressure compensation

Pressure-compensated DO, DOp, is calculated by the following equation.

$$\text{DOp [\%]} = \text{DO [\%]} \times (1 + E \times p)$$

Here,  $E$  is the coefficient value written on the DO Calibration Certificate and  $p$  is the *in-situ* pressure (atmosphere + water pressure) in MPa.

## 4. Verification

Model: ARO-CAV-SA-R  
 S/No.: 383  
 Date: July 5, 2019  
 Location: Production Section  
 Method: Verification is performed with the nitrogen gas (Zero) and the oxygen saturated water (Span) kept by air bubbling.

Temperature [°C]		25.003	
Atmospheric pressure [hPa]		1001.8	
DO saturation [%]		98.83	
Result	Span output	Span output	Residual error
	[V]	[%]	
1st	1.229	98.34	0.49
2nd	1.230	98.41	0.43
3rd	1.231	98.49	0.35
Result	Zero output	Zero output	Residual error
	[V]	[%]	
1st	0.001	0.07	-0.07
2nd	0.001	0.05	-0.05
3rd	0.000	0.03	-0.03

Criteria of acceptability: All residual errors must be within the acceptance value.

Judgement: **Good**

Calibration Group,



JFE Advantech Co., Ltd.