

ภาคผนวก ง

ใบรับรองการสอบเทียบเครื่องมือ



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รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Stack	Carbon Monoxide	Console Control Unit	BKK_FS0556	13-Jul-23	13-Jan-24	6
Stack	Carbon Monoxide	Flue gas Analyzer	RYG_FS0565	28-Dec-22	28-Dec-23	12
Stack	Carbon Monoxide	CO Analyzer	RYG_EN0034	1-Sep-23	1-Sep-24	12
Stack	Oxides of Nitrogen	Console Control Unit	BKK_FS0556	13-Jul-23	13-Jan-24	6
Stack	Oxides of Nitrogen	Flue gas Analyzer	RYG_FS0565	28-Dec-22	28-Dec-23	12
Stack	Oxides of Nitrogen	Vacuum Gauge	BKK_FS0479	14-Feb-23	14-Aug-24	18
Stack	Oxides of Nitrogen	SPECTROPHOTOMETER	RYG_EN0179	27-Sep-22	27-Sep-23	12
Stack	Sulfur Dioxide	Console Control Unit	BKK_FS0556	13-Jul-23	13-Jan-24	6
Stack	Sulfur Dioxide	Flue Gas Analyzer	RYG_FS0565	28-Dec-22	28-Dec-23	12
Stack	Sulfur Dioxide	Dry Gas	BKK_FS0563	13-Jul-23	13-Jan-24	6
Stack	Total Suspended Particulate	Console Control Unit	BKK_FS0556	13-Jul-23	13-Jan-24	6
Stack	Total Suspended Particulate	Flue gas Analyzer	RYG_FS0565	28-Dec-22	28-Dec-23	12
Stack	Total Suspended Particulate	Digital Balance	RYG_EN0003	1-Mar-23	1-Mar-24	12
Ambient	Total Suspended Particulate	High Volume	RYG_FS0176	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RYG_FS0179	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RYG_FS0393	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RYG_FS0174	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RYG_FS0395	-	-	On site Calibration
Ambient	Total Suspended Particulate	Digital Balance	RYG_EN0001	1-Mar-23	1-Mar-24	12
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0397	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0192	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0185	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0295	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0398	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	Digital Balance	RYG_EN0001	1-Mar-23	1-Mar-24	12
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	RYG_FS0461	1-Jul-23	1-Jan-24	6
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	BKK_FS0735	1-Jul-23	1-Jan-24	6
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	RYG_FS0272	1-Jul-23	1-Jan-24	6
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	RYG_FS0535	1-Jul-23	1-Jan-24	6
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	RYG_FS0457	1-Jul-23	1-Jan-24	6
Ambient	Sulfur Dioxide	SO ₂ Analyzer	RYG_FS0460	2-Jul-23	2-Jan-24	6
Ambient	Sulfur Dioxide	SO ₂ Analyzer	RYG_FS0454	2-Jul-23	2-Jan-24	6
Ambient	Sulfur Dioxide	SO ₂ Analyzer	RYG_FS0271	2-Jul-23	2-Jan-24	6
Ambient	Sulfur Dioxide	SO ₂ Analyzer	RYG_FS0534	2-Jul-23	2-Jan-24	6
Ambient	Sulfur Dioxide	SO ₂ Analyzer	RYG_FS0456	2-Jul-23	2-Jan-24	6
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0411	10-Feb-23	10-Aug-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0545	21-Jul-23	21-Jan-25	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS0143	5-Jan-23	5-Jul-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0609	18-Nov-22	18-May-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0414	10-Feb-23	10-Aug-24	18
Noise	Leq 24 hrs	Sound Calibrator	RYG_FS0496	17-Jan-23	17-Jan-24	12
Noise	Leq 24 hrs	Sound Level Meter	RYG_FS0020	13-Jan-23	13-Jan-24	12
Noise	Leq 24 hrs	Sound Calibrator	RYG_FS0213	26-Jan-23	26-Jan-24	12
Noise	Leq 24 hrs	Sound Level Meter	RYG_FS0026	25-Jan-23	25-Jan-24	12
Noise	Noise Annoyance	Sound Calibrator	RYG_FS0213	26-Jan-23	26-Jan-24	12
Noise	Noise Annoyance	Sound Level Meter	RYG_FS0026	25-Jan-23	25-Jan-24	12
Noise	Leq 8 hrs	Sound Calibrator	RYG_FS0496	17-Jan-23	17-Jan-24	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0026	25-Jan-23	25-Jan-24	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0030	25-Jan-23	25-Jan-24	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0025	25-Jan-23	25-Jan-24	12
Noise	Leq 8 hrs	Sound Calibrator	RYG_FS0496	17-Jan-23	17-Jan-24	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0012	16-Dec-22	16-Dec-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0024	16-Dec-22	16-Dec-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0386	19-Oct-23	19-Oct-24	12
Heat	Heat Stress	Heat Stress Monitor	RYG_FS0357	02-Feb-23	2-Feb-24	12
Heat	Heat Stress	Heat Stress Monitor	RYG_FS0358	02-Feb-23	2-Feb-24	12



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รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Rayong Lab	pH at 25 °C	pH meter	RYG_EN0183	27-Feb-23	27-Feb-24	12
Rayong Lab	BOD	DO meter with Sensor	RYG_EN0032	24-Jul-23	24-Jan-25	18
Rayong Lab	BOD	Incubator	RYG_EN0154	29-May-23	29-Nov-24	18
Rayong Lab	COD	Spectrophotometer	RYG_EN0037	18-Sep-23	18-Mar-25	18
Rayong Lab	Total Suspended Solids	Electronic Balance	RYG_EN0002	1-Mar-23	1-Mar-24	12
Rayong Lab	Total Suspended Solids	Hot Air Oven	RYG_EN0010	20-Oct-22	20-Apr-24	18
Rayong Lab	Total Dissolved Solids 180°C	Electronic Balance	RYG_EN0002	1-Mar-23	1-Mar-24	12
Rayong Lab	Total Dissolved Solids 180°C	Hot Air Oven	RYG_EN0010	20-Oct-22	20-Apr-24	18
Rayong Lab	Oil & Grease	Electronic Balance	RYG_EN0002	1-Mar-23	1-Mar-24	12
Rayong Lab	Oil & Grease	Hot Air Oven	RYG_EN0006	20-Oct-22	20-Apr-24	18
Rayong Lab	Oil & Grease	Water Bath	RYG_EN0061	20-Oct-22	20-Apr-24	18
Rayong Lab	Temperature	Digital Thermometer	RYG_FS0570	12-Apr-23	12-Apr-24	12



CONSOLE CONTROL UNIT CALIBRATION TEST REPORT

Barometric Pressure (mmHg) 752
Relative Humidity (%) 55.0
Temperature (C°) 31.0

Calibration of Date 13-Jul-23
Next Cal. Date 13-Jan-24

Console Control Meter Data

Calibration No. C-130723-BKK_FS0556
Dry Gas Meter ID BKK_FS0556
Serial No. 1600041
Model No. XC-572-V
Reference Dry Gas Meter ID BKK_FS0629
Serial No. 1607069
Correction Factor (Y) 1.0000
Next Calibration Date 9 Dec 23

ΔH (mm.H ₂ O)	Θ Minutes	Reference Dry Gas Meter Calibration						Console Control Drygas Meter						Dry Gas Meter Correction Factor (Y)	Oxide Calibration Factor (Avg)
		Wt (Liters)			T _g (°C)	T _h (°C)			Avg. T _m (°C)						
		Final	Initial	Total		Final	Initial	Total		To					
15	1.35	150.00	0.00	150.00	31.0	150.00	31.0	203.8	147.8	146.00	30.0	30.0	30.0	1.0225	40.0024
25	8.78	150.00	0.00	150.00	31.0	150.00	31.0	447.5	393.0	347.50	30.0	30.0	30.0	1.0111	39.0001
50	6.16	150.00	0.00	150.00	32.0	150.00	32.0	745.8	593.3	547.50	32.0	32.0	32.0	1.0120	39.3546
80	5.01	150.00	0.00	150.00	32.0	150.00	32.0	1093.2	762.2	647.00	33.0	33.0	33.0	1.0158	41.2559
120	4.04	150.00	0.00	150.00	33.0	150.00	33.0	1693.0	936.4	846.00	34.0	34.0	34.0	1.0146	40.6372
														Avg.	40.3212

Y Rate of reading of reference dry gas meter: tolerance for make dual values ± 0.02 (from average).

ΔAvg Official pressure differential that exceeds 1671.24 liter of air @ 25 C and 760 mm of mercury, marked tolerance for individual values ± 5.00 (from average)

Procedure: 40 CFR 60.APP. A.M.E.T.H. SEC 5.3.8.7

Calibrated by: Saket Phaisangphut
(Mr. Saket Phaisangphut)
Field Scientist (4)

Approved by: Natthapong Jengwareewong
(Mr. Natthapong Jengwareewong)
Specialist (1)

FORM NO. F 05-027 REVISION NO. 1 ISSUE DATE 30 Jun 22



Pitot Tube Calibration Data

Pitot Tube Identification Number BKK_FS0560 Calibration Date 13 Jul 23
Lab test duct Number 258-1-13-01 Standard Pitot ID BKK_FS0441
Calibration Sheet No C-130723-BKK_FS0560 Cp Standard 0.99

Type S Pitot Tube Coefficient Data					
Test	Type s pitot tube Leg A,B	Standard pitot tube (ΔP, mm H ₂ O)	Type s pitot tube (ΔP, mm H ₂ O)	Cp (s) Leg A	Cp (s) Leg B
Test 1	A	12.00	17.00	0.840	-
	B	12.00	17.00	-	0.840
Test 2	A	12.00	17.00	0.840	-
	B	12.00	17.00	-	0.840
Test 3	A	12.00	16.80	0.845	-
	B	12.00	16.80	-	0.845
	Cp			0.842	0.842

$$Cp(S) = Cp = \sqrt{\frac{\Delta P(s)}{\Delta P(s)}}$$

$$[Cp(A) - Cp(B)] \text{ must } BE \leq 0.01$$

$$\text{Average deviation(A or B)} = \frac{\sum [Cp(s) - Cp(A \text{ or } B)]}{3} \text{ must } BE \leq 0.01$$

Calibrated by: Saket Phaisangphut
(Mr. Saket Phaisangphut)
Field Scientist (4)

Approved by: Natthapong Jengwareewong
(Mr. Natthapong Jengwareewong)
Specialist (1)

FORM NO. F 05-027 REVISION NO. 1 ISSUE DATE 30 Jun 22

Pitot Tube Calibration Data

Pitot Tube Identification Number BKK_FS0561 Calibration Date 13 Jul 23
Lab test duct Number 258-1-13-01 Standard Pitot ID BKK_FS0441
Calibration Sheet No C-130723-BKK_FS0561 Cp Standard 0.99

Type S Pitot Tube Coefficient Data					
Test	Type s pitot tube Leg A,B	Standard pitot tube (ΔP, mm H ₂ O)	Type s pitot tube (ΔP, mm H ₂ O)	Cp (s) Leg A	Cp (s) Leg B
Test 1	A	12.00	17.00	0.840	-
	B	12.00	17.00	-	0.840
Test 2	A	12.00	17.00	0.840	-
	B	12.00	17.00	-	0.840
Test 3	A	12.00	16.80	0.845	-
	B	12.00	16.80	-	0.845
	Cp			0.842	0.842

$$Cp(S) = Cp = \sqrt{\frac{\Delta P(s)}{\Delta P(s)}}$$

$$[Cp(A) - Cp(B)] \text{ must } BE \leq 0.01$$

$$\text{Average deviation(A or B)} = \frac{\sum [Cp(s) - Cp(A \text{ or } B)]}{3} \text{ must } BE \leq 0.01$$

Calibrated by: Saket Phaisangphut
(Mr. Saket Phaisangphut)
Field Scientist (4)

Approved by: Natthapong Jengwareewong
(Mr. Natthapong Jengwareewong)
Specialist (1)

FORM NO. F 05-027 REVISION NO. 1 ISSUE DATE 30 Jun 22



DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date 13 Jul 23 Ambient Temperature (C°) 29
Calibration sheet No C-130723-BKK_FS0567 Relative Humidity (%) 60
Digital Temperature ID BKK_FS0567 Reference Temperature ID BKK_FS1144
Serial No 1600041 Serial No 20100000013
Model XC-572-V Model Digicon-CC-VT-M5
Next Calibration 14 Aug 24

Location	Reference Temperature °C	Digital Temperature °C	Error °C	MPE	Pass / Fail
Stack	0	0	0	±3	Pass
	25	23	-2	±3	Pass
	50	48	-2	±3	Pass
	100	89	-1	±3	Pass
	150	149	-1	±3	Pass
	200	168	-2	±3	Pass
Probe	250	248	-2	±3	Pass
	300	298	-2	±3	Pass
	500	500	0	±3	Pass
	100	89	-1	±3	Pass
	120	119	-1	±3	Pass
	140	139	-1	±3	Pass
Oven	100	100	0	±3	Pass
	120	119	-1	±3	Pass
	140	139	-1	±3	Pass
Filter	100	100	0	±3	Pass
	120	120	0	±3	Pass
	140	140	0	±3	Pass
Exit	0	0	0	±3	Pass
	10	8	-1	±3	Pass
	20	16	-2	±3	Pass
Motor	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass
AUX	0	0	0	±3	Pass
	25	23	-2	±3	Pass
	50	48	-2	±3	Pass

MPE (Maximum permissible error of measurement) ค่าความผิดพลาดสูงสุดที่อนุญาตในการวัด

Calibrated by: Saket Phaisangphut
(Mr. Saket Phaisangphut)
Field Scientist (4)

Approved by: Natthapong Jengwareewong
(Mr. Natthapong Jengwareewong)
Specialist (1)

FORM NO. F 05-027 REVISION NO. 2 ISSUE DATE 9 Feb 23



PROBE NOZZLE DIAMETER
CALIBRATION DATA SHEET

Calibration Date : 13 Jul 23	Nozzle Set ID : BKK_FS0562
Calibration Sheet No. : C-139723-BKK_FS0562	Vernier Caliper ID : BKK_FS1123

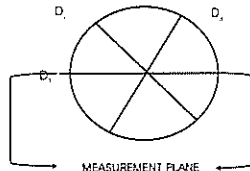
Nozzle ID #	Nozzle Diameter (cm)			Hi - Lo ΔD	ID - D ₁ - D ₂ : 3 D_{avg}
	D ₁	D ₂	D ₃		
1	0.300	0.302	0.302	0.002	0.301
2	0.480	0.475	0.480	0.005	0.478
3	0.625	0.630	0.630	0.005	0.628
4	0.755	0.750	0.755	0.005	0.753
5	0.975	0.980	0.970	0.010	0.975
6	1.082	1.081	1.080	0.002	1.081
7	1.275	1.275	1.270	0.005	1.273
8	1.610	1.610	1.610	0.000	1.610

Where

D₁, D₂, D₃ : Three different nozzle diameters at 60 degrees to each other, each measured the nearest 0.025 mm

ΔD : Maximum distance between any two diameters, must be ≤ 0.100 mm

D_{avg} : $(D_1 + D_2 + D_3) / 3$



Calibrated by Saksit Phasansaput
(Mr Saksit Phasansaput)
Field Scientist (4)

Approved by Nattapon Jengwareepong
(Mr Nattapon Jengwareepong)
Field Specialist (1)

Instrument description : Flue gas Analyzer
Instrument model : Testo 340
Instrument serial no. : 63119028
ID no. or control no. : RYG_FS0565
Manufacturer : Testo SE & Co. KGaA
Probe description :
Probe model :
Probe serial :
Customer name : ALS LABORATORY GROUP (THAILAND) CO., LTD.
Customer address : 104 Phatthanakan 40, Phatthanakan Road, Khwaeng Phatthanakan, Khet Suan Luang, Bangkok, 10250 Thailand
Total pages of certificate : 3 Pages
Receiving no. : L-230001
Receiving date : 26-Dec-22
Parameter of calibration : Gas Calibration (Oxygen 2.498, 10.04, 21.02 %Vol, Carbon Monoxide 80.14, 309.9, 1003 ppm, Nitric Oxide 30.03, 150.9, 320.6 ppm, Sulphur Dioxide 50.04, 100.8, 601.1 ppm)

REVIEW BY Nattapon J.
APPROVED BY Saksit P.
NEXT CAL DATE : 03/12/23

Condition of UUC : Used
Ambient condition : All of the Measurement were carried out the stabilized laboratory
Temperature : 23 ± 5 °C
Humidity : 55 ± 15 %RH
Calibration place : 17/121 Soi Niamwongwan 47 Yeak 48, Toongsonghong, Laksi, Bangkok 10210
Calibration procedure no. : WI-CL-28-C

The calibration certificate expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by coverage factor $k=2$, which for a normal distribution corresponds to a coverage probability of approximately 95%. This certificate is applied only to item under test Environmental condition. This Calibration Certificate may not be reproduced other than in full except with the permission of the issuing laboratory. Calibration certificates without signature and seal not valid. This calibration certificate documents are traceability to national standards, which realize measurement according to the International System of Units (SI).
Date of calibration : 29-Dec-22

Saksit P.
Mr Saksit Phasansaput
Calibration Technician

Nattapon J.
Mrs Nattapon Jengwareepong
Technical Manager

Entech Industrial Solution Co., Ltd.

17/121 Soi Niamwongwan 47 Yeak 48, Toongsonghong, Laksi, Bangkok 10210 THAILAND Tel: 0-2779-8888 Calibration@entech.co.th
Tax ID: 0105636035591 www.entech.co.th



Standard References (Table 1)

Standard	Certificate No.	Vendor	Due date
Oxygen (O ₂) 2.498 % Vol	4219/21	Linde	30-Sep-25
Oxygen (O ₂) 10.04 % Vol	CG-0153-21	Nirm	18-Nov-26
Oxygen (O ₂) 21.02 % Vol	CG-0041-22	Nirm	10-Feb-27
Carbon monoxide (CO) 80.14 ppm	CG-0049-22	Nirm	14-Feb-27
Carbon monoxide (CO) 309.9 ppm	2803/21	Linde	22-Jun-23
Carbon monoxide (CO) 1003 ppm	2553/22	Linde	09-Aug-24
Nitric Oxide (NO) 30.03 ppm	CG-0089-22	Nirm	13-Jun-24
Nitric Oxide (NO) 150.9 ppm	2057/21	Linde	27-Jun-23
Nitric Oxide (NO) 320.6 ppm	2944/21	Linde	02-Jul-23
Sulphur Dioxide (SO ₂) 50.04 ppm	3205/21	Linde	25-Jul-23
Sulphur Dioxide (SO ₂) 100.8 ppm	3507/22	Linde	09-Nov-24
Sulphur Dioxide (SO ₂) 601.1 ppm	3204/21	Linde	20-Jul-23

Measured room conditions

Temperature : 23.2 °C Humidity : 56.4 %RH Pressure : 1014.8 mbar

Calibration conditions

Gas Temperature : 23 °C Flow rate : 600 ml/min Gas pressure : 1018.6 mbar

Calibration Results Before Adjustment (Table 2)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O ₂ (%Vol)	2.498	2.47	-0.028	0.20
O ₂ (%Vol)	10.04	9.93	-0.11	0.40
O ₂ (%Vol)	21.02	21.09	0.07	0.80
CO (ppm)	80.14	83	2.86	3.0
CO (ppm)	309.9	319	9.1	6.0
CO (ppm)	1003	1038	35	12
NO (ppm)	30.03	26	-2.08	8.0
NO (ppm)	150.9	139	-11.9	8.0
NO (ppm)	320.6	299	-21.6	12
SO ₂ (ppm)	50.04	46	-4.04	6.0
SO ₂ (ppm)	100.8	96	-2.8	6.0
SO ₂ (ppm)	601.1	593	-8.1	12



Calibration Results After Adjustment (Table 3)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O ₂ (%Vol)	2.498	2.47	-0.028	0.20
O ₂ (%Vol)	10.04	9.93	-0.11	0.40
O ₂ (%Vol)	21.02	21.09	0.07	0.80
CO (ppm)	80.14	81	0.86	3.0
CO (ppm)	309.9	311	1.1	6.0
CO (ppm)	1003	1004	1	12
NO (ppm)	30.03	30	-0.08	8.0
NO (ppm)	150.9	154	3.1	8.0
NO (ppm)	320.6	322	1.4	12
SO ₂ (ppm)	50.04	49	-1.04	6.0
SO ₂ (ppm)	100.8	101	0.2	6.0
SO ₂ (ppm)	601.1	603	1.9	12

Remark : 1 cmol/mol = 1 %Vol., 1 μmol/mol = 1 ppm.

End of Report

Entech Industrial Solution Co., Ltd.

17/121 Soi Niamwongwan 47 Yeak 48, Toongsonghong, Laksi, Bangkok 10210 THAILAND Tel: 0-2779-8888 Calibration@entech.co.th
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Entech Industrial Solution Co., Ltd.

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Tax ID: 0105636035591 www.entech.co.th

MULTI-POINT CALIBRATION REPORT

CUSTOMER NAME : ALS Laboratory Group (Thailand) Co Ltd.			
EQUIPMENT NAME : CO Analyzer			
MANUFACTURER : Teledyne - API	MODEL : T300	SERIAL NO : 1215	
STANDARD GAS CONCENTRATION (PPM) : 888.8		CERTIFIED DATE : GC730072	
CYLINDER PRESSURE (psig) : 820		CERTIFIED DATE : Nov 05 2020	
CERTIFIED BY : AIRGAS SPECIALTY GASES		EXPIRED DATE : Nov 05 2028	

CALIBRATION RESULTS

POINT NO	CALIBRATION RESULTS			
	IDEAL (PPM)	ACTUAL CO (PPM)	ERROR CO (PPM)	% ERROR CO
ZERO	0.000	0.140	0.140	-
1	40.000	40.040	-0.020	-0.050
2	100.000	99.903	-0.097	-0.097
3	199.200	197.378	-1.822	-0.915
4	400.100	396.131	-3.969	-0.992
5	800.000	810.799	1.099	0.215
AVERAGE (%)				0.677

REVIEW BY : *Mr. Tull*
 APPROVED BY : *[Signature]*
 NEXT CAL DATE : 1 Sep 2024

Calibrated by : คุณหญิง นภัสวรรณ DATE : 1 Feb 2023
 ห้องปฏิบัติการมาตรฐานเคมีเพิ่มเติม คุณหญิง นภัสวรรณ โทร 02-515-6957

เลขที่ 308 ถนนรัชดาภิเษก แขวงจตุจักร เขตจตุจักร กรุงเทพฯ 10000 โทรศัพท์ 0-2515-8099 โทรสาร 0-2515-8088 E-Mail info@clc-lab.com



CALIBRATION LABORATORY Co., LTD.

210-11-14-55 Soi Praset Manuk 29 Yaek 4 Praset Manuk Rd. Ladphrae Bangkok 10230
 Tel: 02-578-0353-4 Fax: 02-578-2872 www.clc-lab.com E-mail: info@clc-lab.com



CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE : VACUUM GAUGE
 MANUFACTURER : DWYER
 MODEL / TYPE : DPGA-80
 SERIAL NO. : DVG06[BKK_FS0479]
 CLID. NO. : 212300278
 JOB CONTROL NO. : 230211016390

CUSTOMER : ALS LABORATORY GROUP (THAILAND) CO., LTD.
 104 PHATTHANAKAN 40, PHATTHANAKAN RD.,
 KHWAENG PHATTHANAKAN, KHET SUAN LUANG, BANGKOK 10250, THAILAND

DATE OF RECEIVED : 11 February 2023

DATE OF ISSUED : 16 February 2023

Report of calibration screening must not be taken in part. Except complete. Without the approval of the Calibration Laboratory Co., Ltd.

Calibrated By : Sitipong Pimdee
 Calibration Engineer

[Signature]



Approved By : Mongkol Yotsoontorn
 Authorized Signatory
 16 February 2023

This Calibration Certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI)

Certificate No. Q33016390

F3-011-0401-12

page 1 of 3



CALIBRATION LABORATORY Co., LTD.

210-11-14-55 Soi Praset Manuk 29 Yaek 4 Praset Manuk Rd. Ladphrae Bangkok 10230
 Tel: 02-578-0353-4 Fax: 02-578-2872 www.clc-lab.com E-mail: info@clc-lab.com



CALIBRATION LABORATORY Co., LTD.

210-11-14-55 Soi Praset Manuk 29 Yaek 4 Praset Manuk Rd. Ladphrae Bangkok 10230
 Tel: 02-578-0353-4 Fax: 02-578-2872 www.clc-lab.com E-mail: info@clc-lab.com



REPORT OF CALIBRATION

FOR

NOMENCLATURE : VACUUM GAUGE
 MANUFACTURER : DWYER
 MODEL / TYPE : DPGA-80
 SERIAL NO. : DVG06[BKK_FS0479]
 DATE OF CALIBRATION : 14 February 2023

ENVIRONMENT CONDITIONS :

Temperature : (23 ± 2) °C Relative Humidity : (55 ± 10) %RH

PROCEDURE USED :

This instrument was calibrated under procedure No. CLC-CPP-05 according to DKD-R 6-1 as calibration guidelines.
 The calibration was performed by direct measurement with Document Process Calibrator and Pressure Module which maintained by the Calibration Laboratory Co., Ltd.

REFERENCE STANDARD USED :

Document Process Calibrator Fluke Model 744 S/N 9226007 with Pressure Module Model 760PV4 S/N 19296401

TRACEABILITY :

The measurements are traceable to International System of Units (SI) through National Institute of Metrology (Thailand).
 Certificate No. MP-0195-22 Due Date 18 November 2023

UNCERTAINTY :

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor of k = 2. It has been evaluated according to the "Calibration of Pressure Gauges (DKD-R 6-1)" which provides a level of confidence approximately 95%.

Certificate No. Q33016390

F3-011-0401-12

page 2 of 3



CONDITION OF CALIBRATION ITEM : GOOD

MEASUREMENT RESULTS : (X) without adjustment () adjustment

The DUC was exercised by applying a known pressure from its zero to full scale 1 times. Then 2 series of known gauge pressure were applied. The STD reading were recorded and the means value were reported in the table below.

CALIBRATION DATA

CORRECTION OF PRESSURE

DUC Test point (inHg)	STD Reading (inHg)		Correction (inHg)	
	Up	Down	Up	Down
0.00	0.000	0.000	0.000	0.000
10.00	-9.985	-9.986	+0.015	+0.014
20.00	-19.979	-19.981	+0.021	+0.019
26.00	-25.976	-25.977	+0.024	+0.021
-27.00	-26.973	-26.974	+0.027	+0.026
28.00	-27.971	-27.971	+0.029	+0.029

Uncertainty of measurement = 0.007 inHg

Transmitting fluid : Air

Note: The Scope of Accredited ANAB Certificate No. ACDM-2814 Version 008 Page 16 of 54

This report is valid for the above stated instrument's only.

End of Certificate

Certificate No. Q33016390

F3-011-0401-12

page 3 of 3





Certificate of Calibration

Certificate No.: C06220465

Page 2 of 3

Equipment: SPECTROPHOTOMETER
Model: DR3900
Serial No. (or ID): 2021761 (RYG_EN0170)
Manufacturer: HACH
Condition: In Condition

Certificate No.: C06220465
Issued Date: 27 September 2022
Job No.: KSPR2212225
Page: 1 of 3

Customer: ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)
 616/10 Moo 5 T. Maenam Khu,
 A. Phukdaeng, Rayong 21140, Thailand.

Environment Condition: Temperature 22.6 °C ±
 Humidity 67.6 %RH ±

Calibration Place: ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch) (Wet Chemistry)
 616/10 Moo 5 T. Maenam Khu,
 A. Phukdaeng, Rayong 21140, Thailand.

Calibration By: Mr. Chutaphon Folthong
Calibration Date: 27 September 2022
The Method used: In house method, CAL-WI-24, base on ASTM E 275-06 and ASTM E 397-04
Traceability: This certificate is traceable to the CRM maintained by National Institute of Standards and Technology (NIST) through Sigma Scientific Limited.

The standard for Wavelength Certificate No. 91418 and 91435
 The standard for Photometric Certificate No. 91441
 The standard for Stray light Certificate No. 101040

REVIEW BY: N. Banjit
 APPROVED BY: D. Banjit
 METEORICAL DATE: 27/9/22

(Mr. Chutaphon Folthong)
 Person in charge

(Mr. Thalekiet Pongngam)
 Authorized signatory

This certificate is issued in the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognized national standard laboratories.
 The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).
 These results may be affected by deviations from specified conditions. The results relate only to the items tested, calibrated or sampled. The report shall not be reproduced except in full without approval of DKSH Technology Limited.
 DKSH Technology Limited
 2533 Sukhumvit Road, Bangkok, Prachinburi 10250
 2533 Sukhumvit Road, Bangkok, Prachinburi 10250
 Phone: +66 2658 7000 Email: info.asia@dksh.com Website: www.dksh.com/asia-thailand

Delivering Growth - In Asia and Beyond.

CAL-FM-C06-13: 20 Jul 2022

Calibration Results: Without Adjustment

Wavelength Accuracy (nm), The spectral bandwidth of Std of 5 nm and UUC of 5 nm				
Standard Wavelength	Unit Under Calibration	Correction	Uncertainty	
418.40	418	0.40	0.59	
537.00	538	1.00	0.59	
638.00	639	0.00	0.59	
747.61	748	-0.39	0.59	
807.04	807	0.04	0.59	

Photometric Accuracy (Absorbance)				
Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
420 nm	0.0000	0.000	0.0000	0.0045
	0.5005	0.502	-0.0015	0.0045
	0.7334	0.735	-0.0016	0.0045
440 nm	1.0534	1.054	-0.0009	0.0045
	0.0000	0.000	0.0000	0.0045
	0.5503	0.550	0.0003	0.0045
465 nm	0.7179	0.718	-0.0001	0.0045
	1.0312	1.031	0.0002	0.0045
	0.0000	0.000	0.0000	0.0045
546.1 nm	0.5024	0.505	-0.0026	0.0045
	0.6693	0.671	-0.0017	0.0045
	0.9804	0.984	-0.0038	0.0045
590 nm	0.0000	0.000	0.0000	0.0045
	0.5169	0.519	-0.0022	0.0045
	0.8903	0.891	-0.0007	0.0045
835 nm	0.5904	0.592	-0.0016	0.0045
	0.0000	0.000	0.0000	0.0045
	0.5525	0.553	-0.0005	0.0045
835 nm	0.7175	0.717	0.0005	0.0045
	1.0301	1.030	0.0001	0.0045
	0.0000	0.000	0.0000	0.0045
835 nm	0.5367	0.538	-0.0013	0.0045
	0.8647	0.865	-0.0003	0.0045
	0.8623	0.863	-0.0007	0.0045

DKSH Technology Limited
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 2533 Sukhumvit Road, Bangkok, Prachinburi 10250
 Phone: +66 2658 7000 Email: info.asia@dksh.com Website: www.dksh.com/asia-thailand

Delivering Growth - In Asia and Beyond.

CAL-FM-C06-13: 20 Jul 2022



ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

Certificate No.: C06220465

Page 3 of 3

Calibration Results: Without Adjustment

Stray light *	Standard: cut-off	UUC: Wavelength (nm)	UUC: Transmission (%)	Absorbance (A)
	391.04 ± 0.11 nm	392	4.1	1.387

* Calibration Marked * Not TISI Accredited * In this Certificate have been included for completeness.

The End of Certificate

เลขที่ใบงาน: KSPR2212225

ชนิดเครื่องมือ: SPECTROPHOTOMETER รุ่น: DR3900 หมายเลขเครื่อง: 2021761

ตรวจสอบ (ปี)	รายการตรวจวัด	ตรวจสอบ (ค่า)	หมายเหตุ
27 Sep 2022		27 Sep 2022	
ปกติ	ไม่ปกติ	ปกติ	ไม่ปกติ
General			
☒	☐	1. ความสมบูรณ์เครื่อง	☒
☒	☐	2. ความสะอาด (ช่องใส่ตัวอย่าง, ภายใน-นอกเครื่อง)	☒
☒	☐	3. สวิตช์ ปิด - เปิด เครื่อง (On-Off Switch)	☒
☒	☐	4. แผงกด (Keypad)	☒
☒	☐	5. หน้าจอ (Display, Screen Contrast)	☒
Spectrophotometer			
☐	☐	6. แบตเตอรี่สำรอง (Battery Backup) >= 2.5 VDC	☐
☐	☐	7. ควบคุมเลือกความยาวคลื่น (Wavelength Control)	☐
☒	☐	8. ความยาวคลื่น (Wavelength Check)	☒
☐	☐	9. แหล่งกำเนิดแสง (UV < 3,000 hour)	☐
☐	☐	10. แหล่งกำเนิดแสง (Visible < 5,000 hour)	☐
☐	☐	11. ช่องใส่ตัวอย่าง (Carousel Module)	☐
pH Meter and Conductivity Meter			
☐	☐	12. ขั้วไฟฟ้า (Electrode and Connection Cable)	☐
☐	☐	13. ระดับสารละลายใน Electrode (Level KCl)	☐
☐	☐	14. ฝาปิดกันฝุ่น Electrode (Dust Protection Hood)	☐
☐	☐	15. ขาจับขั้วไฟฟ้า (Stand)	☐
Turbidimeter			
☐	☐	16. ทำความสะอาดหัววัด (No Sample)	☐
☐	☐	17. ระดับการทำความสะอาด (≥ 2.5 ไม่นเกิน 3.0)	☐
Automatic titrator			
☐	☐	18. สภาพ Piston Burettes	☐
☐	☐	19. Function Rinsing and Dosing	☐
☐	☐	20. ระบบหล่อสารละลายและอุปกรณ์ประกอบ	☐

ผลการตรวจ:

Mr. Chutaphon Folthong
 Service Engineer

DKSH Technology Limited
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CAL-FM-C06-13: 20 Jul 2022

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CAL-FM-C06-13: 20 Jul 2022



DRY GAS METER CALIBRATION TEST REPORT

Calibration of Date 13 Jul 23 Barometric Pressure (mm.Hg) 751
 Next Calibration Date 13-Jan-24 Relative Humidity (%) 60.0
 Temperature (C) 29.0

Dry Gas Meter Data
 Calibration sheet No C-DDMMYY-BKK_FS0553
 Dry Gas Meter ID BKK_FS0553
 Serial No 1605011
 Model No XC-62-CV

Reference Dry Gas Meter Data
 Reference Dry Gas Meter ID BKK_FS0529
 Serial No 1607009
 Correction Factor (Y) 1.0000
 Next Calibration Date 9 Dec 23

Reference Dry Gas Meter Calibration			Dry Gas Meter							Dry Gas Meter Correction Factor
Vr (Liters)			Tr (° C)	Vm (Liters)			Ti (° C)	To (° C)	Avg. Tm (° C)	
Final	Initial	Total		Final	Initial	Total				
30.00	0.00	30.00	30.0	30.44	0.00	30.44	30.0	30.0	30.0	0.9855
30.00	0.00	30.00	31.0	30.60	0.00	30.60	30.0	30.0	27.0	0.9707
60.00	0.00	60.00	32.0	60.22	0.00	60.22	31.0	31.0	27.0	0.9600
60.00	0.00	60.00	33.0	60.22	0.00	60.22	32.0	32.0	27.0	0.9768
90.00	0.00	90.00	34.0	90.55	0.00	90.55	35.0	35.0	27.0	0.9713
90.00	0.00	90.00	35.0	90.55	0.00	90.55	35.0	35.0	27.0	0.9281
Avg									0.9764	

Y = Ratio of reading of reference dry gas meter to dry gas meter tolerance for individual ± 0.05 from average

Calibrate by Mr. Jitakorn Sriassak Approved by Mr. Nathaporn Jengwarewong
 Field Scientist (2) Field Specialist (1)

FORM NO. F-05-023 REVISION NO. 1 ISSUE DATE 30.6.22

RYG_EN0003

Sartorius (Thailand) Co., Ltd.
 129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
 Tel: +66 2543 8361-6 e-mail: service.thailand@sartorius.com



SARTORIUS

REVIEW BY Mr. Jitakorn Sriassak
 APPROVED BY Mr. Nathaporn Jengwarewong
 NEXT CAL DATE 01/05/24

Certificate of Calibration

Model Number MSE224S-100-DU Certificate No. 23BCI0115
 Description Analytical Balance Issued Date Friday, March 03, 2023
 Serial Number 0031709552 Reference No. 204833
 ID No RYG_EN0003
 Manufacturer Sartorius Page No. 1 of 2

Customer Name ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)
 616/10 Moo 5 T. Maenam Khu, A. Pluak Daeng, Rayong 21140, Thailand.

Calibrated Place ALS Laboratory Group (Thailand) Co., Ltd. (Balance Room)
 616/10 Moo 5 T. Maenam Khu, A. Pluak Daeng, Rayong 21140, Thailand.

Calibrated By Mr. Chonchai Inthana Calibration Procedure No. This calibration was conducted by
 Calibration Date Wednesday, March 01, 2023 Using in house calibration procedure number (V41-003)
 Based on UKAS LAB 14, 2019

Metrological data Ambient Conditions
 Capacity 220 g Readability 0.0001 g Temperature 23.0 °C $\pm$ 5.0 °C
 Humidity 55.0 % RH $\pm$ 10.0 % RH
 Pressure $\pm$ $\pm$

Reasons for calibration
☒ New Installation ☒ Service / Repair ☐ Re-calibration / Maintenance ☐ Equipment Condition ☐ Good Operation ☐ Fail

Measurement Method UKAS Publication Ref : Lab 14
 The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM). This calibration certificate documents the traceability to National Standards, which realise the unit of measurement according to the International Standard System of Units (SI). Report of Tolerance came from list of Sartorius Metrological Specifications.

Traceability:

Model Number	Description	Traceability	Certificate No.	Due Date
YCS011-522-00	Sartorius weight set 1mg 5000g E2 YCS011-522-00	SPC-RT	C02212655	14-Sep-2023
MHB-382SD	Humidity/Barometer/Temp. Luton MHB-382SD	DKSH	C19220444	5-Sep-2023

This certificate relate and apply this equipment only
 This certificate may not be reproduced other than in full except with the prior written approval of the Verification Operation Division
 Sartorius (Thailand) Co., Ltd.

Mr. Chonchai Inthana (Technical Manager)



DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date		13 Jul 23	Ambient Temperature (°C)		20
Calibration sheet No.		C-130123-BKK_FS0553	Relative Humidity (%)		60
Digital Temperature ID		BKK_FS0553	Reference Temperature ID		BKK_FS1144
Serial No		1605011	Serial No		201609006013
Model		XC-62-CV	Model		Digicon-CC-VT-MS
			Next Calibrate		14 Aug 24
Location	Reference Temperature °C	Digital Temperature °C	Error °C	MPE	Pass / Fail
Stack	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass
	100	100	0	±3	Pass
	150	150	0	±3	Pass
	200	200	0	±3	Pass
Probe	250	250	0	±3	Pass
	300	300	0	±3	Pass
	500	500	0	±3	Pass
	100	100	0	±3	Pass
	120	120	0	±3	Pass
	140	140	0	±3	Pass
Oven	100	-	-	±3	-
	120	-	-	±3	-
Fellow	140	-	-	±3	-
	100	100	0	±3	Pass
	120	120	0	±3	Pass
Exit	140	140	0	±3	Pass
	0	0	0	±3	Pass
	10	10	0	±3	Pass
Motor	20	20	0	±3	Pass
	0	0	0	±3	Pass
	25	25	0	±3	Pass
AUX	50	50	0	±3	Pass
	0	0	0	±3	Pass
	25	25	1	±3	Pass
	50	51	1	±3	Pass

MPE (Maximum permissible error of measurement) ค่าความคลาดเคลื่อนสูงสุดของเครื่องมือวัด

Calibrated by Mr. Jitakorn Sriassak Approved by Mr. Nathaporn Jengwarewong
 Field Scientist (2) Field Specialist (1)

FORM NO. F-05-022 REVISION NO. 2 ISSUE DATE 9 Feb 23

Sartorius (Thailand) Co., Ltd.
 129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
 Tel: +66 2543 8361-6 Fax: +66 2543 8367 e-mail: service.thailand@sartorius.com

SARTORIUS

Certificate of Calibration

Model Number MSE224S-100-DU Certificate No. 23BCI0115
 Description Analytical Balance Issued Date Friday, March 03, 2023
 Serial Number 0031709552 Reference No. 204833
 ID No RYG_EN0003
 Manufacturer Sartorius Page No. 2 of 2

Calibration Results : Without Adjustment

Repeatability	Eccentricity (Off-center loading error)
The reproducibility is the ability of a weighing instrument to display nearly identical readings under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.	The off-center loading error is yielded by the difference between the readout of the load (e.g. 1/3 or 1/4 of maximum capacity) placed in the middle of the weighing pan and between each of four additional measurement points (4 positions defined according to DIN EN 876).
Nominal Value (Low Load) 20 g Tolerance 0.0001 g	Nominal value 100 g Tolerance 0.0004 g
Nominal Value (High Load) 200 g Tolerance 0.0001 g	Difference 1 2 3 4 5 6
Standard Deviation 0.000004 0.000005	

Linearity				
The linearity, also called linearity error, describes the deviation of the characteristic curve of a weighing instrument from the linear slope.				
Tolerance		0.0002 g		
Nominal Value	Conventional Mass Value	Displayed Value	Deviation	Uncertainty
(g)	(g)	(g)	(g)	(g)
0.01	0.0100	0.0100	0.0000	0.00012
0.05	0.0500	0.0500	0.0000	0.00013
0.1	0.1000	0.1000	0.0000	0.00013
0.5	0.5000	0.5000	0.0000	0.00014
1	1.0000	1.0000	0.0000	0.00014
5	5.0000	5.0000	0.0000	0.00014
10	10.0000	10.0000	0.0000	0.00014
20	20.0000	20.0000	0.0000	0.00014
50	50.0000	50.0000	0.0000	0.00015
100	100.0000	100.0000	0.0000	0.00019
200	200.0000	200.0001	0.0001	0.00032

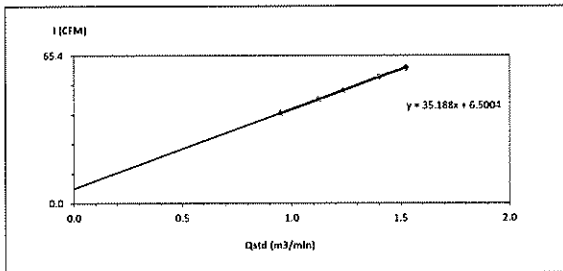
End of Report



High Volume Air Sampler Calibration Worksheet

Project Site : Amata B Grimm Power (Rayong) 1 Limited
 Calibrate Location : โรงเรือนเพาะเห็ดฟางสวนนกเขา
 Calibrate Date : 18-Sep-23
 CalibrationSheet No.: C-180923-RYG-FS0176
 Calibrator ID: RYG-FS0205
 Calibrator Model: TE-5028A
 Calibrator S/N: 1166
 Barometric Pressure (mm Hg): 758
 Temperature (°C): 28
 High Volume ID: RYG-FS0176
 High Volume Model: TE-5170D
 High Volume S/N: 4802
 Calibrator Slope: 1.50765
 Calibrator Intercept: -0.02043

Test No.	Delta H ₂ O (Inch)	Q _{std} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.0	0.9525	40	Slope: 35.1875 Intercept: 6.5004 Correlation Coefficient: 0.9999
2	2.6	1.1233	46	
3	3.4	1.2357	50	
4	4.4	1.4030	56	
5	5.2	1.5234	60	



Calibrated by: N. Noppong
 (Mr. Nontachai Uppathamp)
 Field Scientist(1)

Approved by: N. Noppong
 (Mr. Noppong Jantarupan)
 Enviro Field Coordinator Scientist (3)

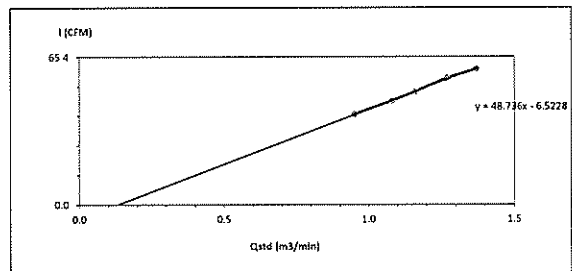
FORM NO.: F 06-073 REVISION NO.: ISSUE DATE: 14/03/16



High Volume Air Sampler Calibration Worksheet

Project Site : Amata B Grimm Power (Rayong) 1 Limited
 Calibrate Location : โรงเรือนเพาะเห็ดฟางสวนนกเขา
 Calibrate Date : 18-Sep-23
 CalibrationSheet No.: C-180923-RYG-FS0179
 Calibrator ID: RYG-FS0205
 Calibrator Model: TE-5028A
 Calibrator S/N: 1166
 Barometric Pressure (mm Hg): 758
 Temperature (°C): 28
 High Volume ID: RYG-FS0179
 High Volume Model: TE-5170D
 High Volume S/N: 4805
 Calibrator Slope: 1.50765
 Calibrator Intercept: -0.02043

Test No.	Delta H ₂ O (Inch)	Q _{std} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.0	0.9525	40	Slope: 48.7361 Intercept: -6.5228 Correlation Coefficient: 0.9990
2	2.6	1.0832	46	
3	3.0	1.1620	50	
4	3.6	1.2710	56	
5	4.2	1.3712	60	



Calibrated by: N. Noppong
 (Mr. Nontachai Uppathamp)
 Field Scientist(1)

Approved by: N. Noppong
 (Mr. Noppong Jantarupan)
 Enviro Field Coordinator Scientist (3)

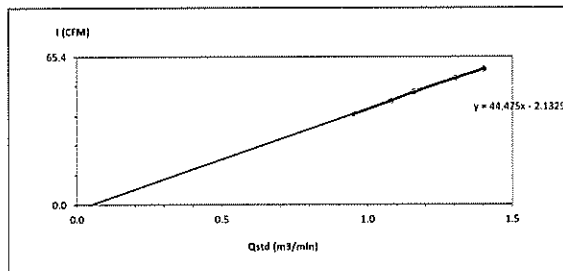
FORM NO.: F 06-073 REVISION NO.: ISSUE DATE: 14/03/16



High Volume Air Sampler Calibration Worksheet

Project Site : Amata B Grimm Power (Rayong) 1 Limited
 Calibrate Location : โรงเรือนเพาะเห็ดฟางสวนนกเขา
 Calibrate Date : 18-Sep-23
 CalibrationSheet No.: C-180923-RYG-FS0393
 Calibrator ID: RYG-FS0205
 Calibrator Model: TE-5028A
 Calibrator S/N: 1166
 Barometric Pressure (mm Hg): 758
 Temperature (°C): 28
 High Volume ID: RYG-FS0393
 High Volume Model: TE-5170D
 High Volume S/N: 5682
 Calibrator Slope: 1.50765
 Calibrator Intercept: -0.02043

Test No.	Delta H ₂ O (Inch)	Q _{std} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.0	0.9525	40	Slope: 44.4745 Intercept: -2.1329 Correlation Coefficient: 0.9993
2	2.6	1.0832	46	
3	3.0	1.1620	50	
4	3.8	1.3052	56	
5	4.4	1.4030	60	



Calibrated by: N. Noppong
 (Mr. Nontachai Uppathamp)
 Field Scientist(1)

Approved by: N. Noppong
 (Mr. Noppong Jantarupan)
 Enviro Field Coordinator Scientist (3)

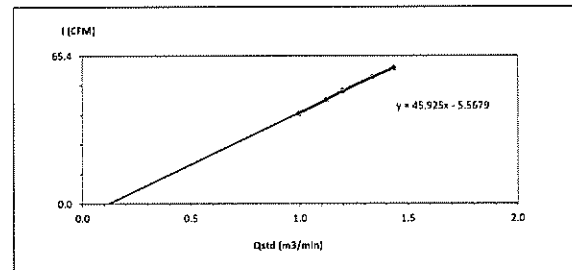
FORM NO.: F 06-073 REVISION NO.: ISSUE DATE: 14/03/16



High Volume Air Sampler Calibration Worksheet

Project Site : Amata B Grimm Power (Rayong) 1 Limited
 Calibrate Location : โรงเรือนเพาะเห็ดฟางสวนนกเขา
 Calibrate Date : 18-Sep-23
 CalibrationSheet No.: C-180923-RYG-FS0174
 Calibrator ID: RYG-FS0205
 Calibrator Model: TE-5028A
 Calibrator S/N: 1166
 Barometric Pressure (mm Hg): 758
 Temperature (°C): 28
 High Volume ID: RYG-FS0174
 High Volume Model: TE-5170D
 High Volume S/N: 4800
 Calibrator Slope: 1.50765
 Calibrator Intercept: -0.02043

Test No.	Delta H ₂ O (Inch)	Q _{std} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.2	0.9980	40	Slope: 45.9246 Intercept: -5.5679 Correlation Coefficient: 0.9992
2	2.8	1.1233	46	
3	3.2	1.1995	50	
4	4.0	1.3386	56	
5	4.6	1.4340	60	



Calibrated by: N. Noppong
 (Mr. Nontachai Uppathamp)
 Field Scientist(1)

Approved by: N. Noppong
 (Mr. Noppong Jantarupan)
 Enviro Field Coordinator Scientist (3)

FORM NO.: F 06-073 REVISION NO.: ISSUE DATE: 14/03/16



Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2543 8361-6 e-mail: service.thailand@sartorius.com



SARTORIUS

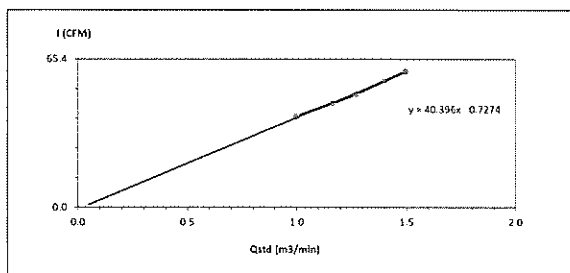
REVIEW BY: *P. Noppang*
APPROVED BY: *P. Noppang*
NEXT CAL DATE: 01/03/24

Certificate of Calibration

High Volume Air Sampler Calibration Worksheet

Project Site: Amata B Grimm Power (Rayong) 1 Limited
Calibrate Location: บ้านห้วยทราย (ห้วยทราย) (Ban Huay Trai)
Calibrate Date: 18-Sep-23
Calibration Sheet No.: C-180923-RYG-F50395
Calibrator ID: RYG_F50205
Calibrator Model: TE-S02RA
Calibrator S/N: 1166
Barometric Pressure (mm Hg): 758
Temperature (°C): 28
High Volume ID: RYG_F50395
High Volume Model: TE-S170D
High Volume S/N: 5692
Calibrator Slope: 1.50765
Calibrator Intercept: -0.02043

Test No.	Delta H ₂ O (inch)	Q _{act} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.2	0.9980	40	Slope: 40.3964
2	3.0	1.1620	46	Intercept: -0.7274
3	3.6	1.2710	50	Correlation Coefficient: 0.9985
4	4.4	1.4030	56	
5	5.0	1.4942	60	



Calibrated by: *P. Noppang*
(Mr. Nontchai Uppathaporn)
Field Scientist (1)

Approved by: *P. Noppang*
(Mr. Noppang Juntaruporn)
Enviro Field Coordinator Scientist (3)

FORM NO. F06-073 REVISION NO.: ISSUE DATE: 14/03/16

Model Number: LA130S-F
Description: Analytical Balance
Serial Number: 25409664
ID No.: RYG_EN0001
Manufacturer: Sartorius
Certificate No.: 23BCI0110
Issued Date: Friday, March 03, 2023
Reference No.: 204833
Page No.: 1 of 2

Customer Name: ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)
616/10 Moo 5 T. Maenam Khu. A. Pluak Daeng, Rayong 21140, Thailand

Calibrated Place: ALS Laboratory Group (Thailand) Co., Ltd. (Balance Room)
616/10 Moo 5 T. Maenam Khu. A. Pluak Daeng, Rayong 21140, Thailand

Calibrated By: Mr. Chonchal Inthana
Calibration Date: Wednesday, March 01, 2023
Calibration Procedure No.: This calibration was conducted by Using in-house calibration procedure number (WI-003) Based on UKAS LAB 14 : 2019

Metrological data
Capacity: 150 g Readability: 0.0001 g
Reasons for calibration
☒ New Installation ☐ Service / Repair ☐ Recalibration / Maintenance
Ambients Conditions
Temperature: 24.2 °C ± 5.0 °C
Humidity: 60.0 % RH ± 10.0 % RH
Pressure: ±
Equipment Condition: ☒ Good Operate ☐ Fair

Measurement Method UKAS Publication Ref :Lab 14

The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM). The calibration certificate documents the traceability to National Standards, which realise the unit of measurement according to the International Standard System of Units (SI). Report of Tolerance came form list of Sartorius Metrological Specifications.

Traceability:

Model Number	Description	Traceability	Certificate No.	Due Date
YCS011-522-00	Sartorius weight set 1mg - 5000g E2 YCS011-522-00	SPC-RT	C02212565	14-Sep-2023
MHB-302SD	Humidity/Balometer/Temp. Lukon MHB-302SD	DKSH	C19220444	5-Sep-2023

This certificate relate and apply this equipment only
This certificate may not be reproduced other than in full except with the prior written approval of the Verification Operation Division
Sartorius (Thailand) Co., Ltd.

Mr. Chonchal Inthana
(Mr. Chonchal Inthana) (Technical Manager)



SOP FM 33 03 February 2022

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2543 8361-6 Fax: +66 2543 8367 e-mail: service.thailand@sartorius.com

SARTORIUS

Certificate of Calibration

High Volume Air Sampler Calibration Worksheet

Model Number: LA130S-F
Description: Analytical Balance
Serial Number: 25409664
ID No.: RYG_EN0001
Manufacturer: Sartorius
Certificate No.: 23BCI0110
Issued Date: Friday, March 03, 2023
Reference No.: 204833
Page No.: 2 of 2

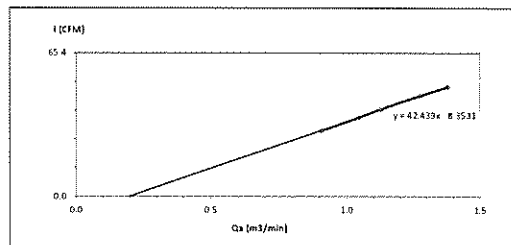
Calibration Results : Without Adjustment

Repeatability	Eccentricity (Off-center loading error)
The repeatability is the ability of a weighing instrument to display nearly identical readings under constant test conditions when the same load which a measurement device is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express repeatability quantitatively.	The off-center loading error is provided by the difference between the result of the load, i.e. 1/2 or 1/4 of maximum capacity, placed in the middle of the weighing pan and between each of four additional measurement points (positions defined according to OIML R110).
Nominal Value (Low Load) 10 g Tolerance 0.0001 g	Nominal value 50 g Tolerance 0.0004 g
Nominal Value (High Load) 100 g Tolerance 0.0001 g	Difference 1 2 3 4 5 6
Standard Deviation 0.00009 0.00006	

Linearity				
The linearity, also called linearity error, describes the deviation of the characteristic curve of a weighing instrument from the linear slope				
Tolerance		0.0002 g		
Nominal Value	Conventional Mass Value	Displayed Value	Deviation	Uncertainty
(g)	(g)	(g)	(g)	(g)
0.01	0.0100	0.0100	0.0000	0.00002
0.05	0.0500	0.0500	0.0000	0.00003
0.1	0.1000	0.1000	0.0000	0.00003
0.5	0.5000	0.5000	0.0000	0.00003
1	1.0000	1.0000	0.0000	0.00003
2	2.0000	2.0000	0.0000	0.00003
5	5.0000	5.0000	0.0000	0.00003
10	10.0000	10.0000	0.0000	0.00003
20	20.0000	20.0000	0.0000	0.00003
100	100.0000	100.0000	0.0000	0.00006

End of Report

Test No.	Delta H ₂ O (inch)	Q _{act} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	1.8	0.908	38	Slope: 42.4389
2	2.4	1.047	36	Intercept: -0.3531
3	2.8	1.130	40	Correlation Coefficient: 0.9995
4	3.6	1.279	46	
5	4.2	1.380	50	



Calibrated by: *P. Noppang*
(Mr. Nontchai Uppathaporn)
Field Scientist (1)

Approved by: *P. Noppang*
(Mr. Noppang Juntaruporn)
Enviro Field Coordinator Scientist (3)

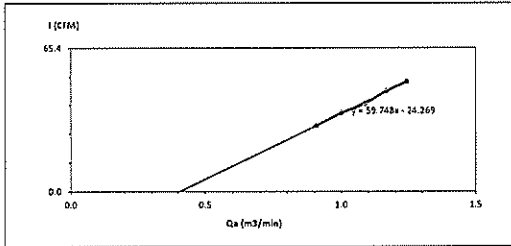
FORM NO. F06-074 REVISION NO.: ISSUE DATE: 14/03/16



High Volume Air Sampler Calibration Worksheet

Project Site: Amata B. Grimm Power (Rayong) 1 Limited
Calibrate Location: โรงไฟฟ้าถ่านหิน
Calibrate Date: 18-Sep-23
Calibration Sheet No.: C-180923-RYG-FS0192
Calibrator ID: RYG-FS0205
Calibrator Model: TE-5028A
Calibrator S/N: 1166
Barometric Pressure (mm Hg): 758
Temperature (°C): 28
High Volume ID: RYG-FS0192
High Volume Model: TE-5009X
High Volume S/N: 5331
Calibrator Slope: 0.94434
Calibrator Intercept: -0.01292

Test No.	Delta H ₂ O (Inch)	Q _a (m ³ /min)	I: Chart (CFM)	Linear Regression
1	1.8	0.908	30	Slope: 59.7477 Intercept: -24.2692 Correlation Coefficient: 0.9981
2	2.2	1.003	36	
3	2.6	1.089	40	
4	3.0	1.169	46	
5	3.4	1.243	50	



Calibrated by: Mr. Nontachai Uppathamp
(Mr. Nontachai Uppathamp)
Field Scientist (1)

Approved by: Mr. Noppong Juntarup
(Mr. Noppong Juntarup)
Enviro Field Coordinator Scientist (3)

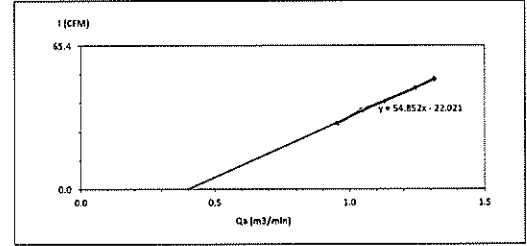
FORM NO. F-06-074 REVISION NO. - ISSUE DATE: 14/03/16



High Volume Air Sampler Calibration Worksheet

Project Site: Amata B. Grimm Power (Rayong) 1 Limited
Calibrate Location: โรงไฟฟ้าถ่านหิน
Calibrate Date: 18-Sep-23
Calibration Sheet No.: C-180923-RYG-FS0185
Calibrator ID: RYG-FS0205
Calibrator Model: TE-5028A
Calibrator S/N: 1166
Barometric Pressure (mm Hg): 758
Temperature (°C): 28
High Volume ID: RYG-FS0185
High Volume Model: TE-5009X
High Volume S/N: 4793
Calibrator Slope: 0.94434
Calibrator Intercept: -0.01292

Test No.	Delta H ₂ O (Inch)	Q _a (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.0	0.957	30	Slope: 54.8524 Intercept: -22.0212 Correlation Coefficient: 0.9988
2	2.4	1.047	36	
3	2.8	1.130	40	
4	3.4	1.243	46	
5	3.8	1.314	50	



Calibrated by: Mr. Nontachai Uppathamp
(Mr. Nontachai Uppathamp)
Field Scientist (1)

Approved by: Mr. Noppong Juntarup
(Mr. Noppong Juntarup)
Enviro Field Coordinator Scientist (3)

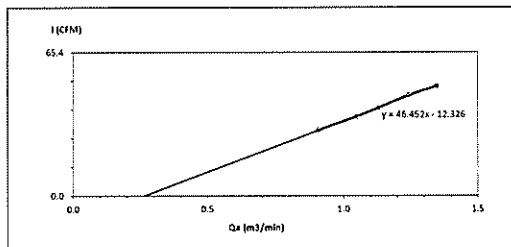
FORM NO. F-06-074 REVISION NO. - ISSUE DATE: 14/03/16



High Volume Air Sampler Calibration Worksheet

Project Site: Amata B. Grimm Power (Rayong) 1 Limited
Calibrate Location: โรงไฟฟ้าถ่านหิน
Calibrate Date: 18-Sep-23
Calibration Sheet No.: C-180923-RYG-FS0295
Calibrator ID: RYG-FS0205
Calibrator Model: TE-5028A
Calibrator S/N: 1166
Barometric Pressure (mm Hg): 758
Temperature (°C): 28
High Volume ID: RYG-FS0295
High Volume Model: TE-5009X
High Volume S/N: 5502
Calibrator Slope: 0.94434
Calibrator Intercept: -0.01292

Test No.	Delta H ₂ O (Inch)	Q _a (m ³ /min)	I: Chart (CFM)	Linear Regression
1	1.8	0.908	30	Slope: 46.4519 Intercept: -12.3256 Correlation Coefficient: 0.9990
2	2.4	1.047	36	
3	2.8	1.130	40	
4	3.4	1.243	46	
5	4.0	1.348	50	



Calibrated by: Mr. Nontachai Uppathamp
(Mr. Nontachai Uppathamp)
Field Scientist (1)

Approved by: Mr. Noppong Juntarup
(Mr. Noppong Juntarup)
Enviro Field Coordinator Scientist (3)

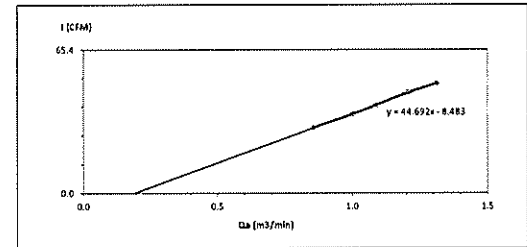
FORM NO. F-06-074 REVISION NO. - ISSUE DATE: 14/03/16



High Volume Air Sampler Calibration Worksheet

Project Site: Amata B. Grimm Power (Rayong) 1 Limited
Calibrate Location: โรงไฟฟ้าถ่านหิน (Udon Thani)
Calibrate Date: 18-Sep-23
Calibration Sheet No.: C-180923-RYG-FS0398
Calibrator ID: RYG-FS0205
Calibrator Model: TE-5028A
Calibrator S/N: 1166
Barometric Pressure (mm Hg): 758
Temperature (°C): 28
High Volume ID: RYG-FS0398
High Volume Model: TE-5009X
High Volume S/N: 5684
Calibrator Slope: 0.94434
Calibrator Intercept: -0.01292

Test No.	Delta H ₂ O (Inch)	Q _a (m ³ /min)	I: Chart (CFM)	Linear Regression
1	1.6	0.857	30	Slope: 44.6915 Intercept: -8.4830 Correlation Coefficient: 0.9989
2	2.2	1.003	36	
3	2.6	1.089	40	
4	3.2	1.207	46	
5	3.8	1.314	50	



Calibrated by: Mr. Nontachai Uppathamp
(Mr. Nontachai Uppathamp)
Field Scientist (1)

Approved by: Mr. Noppong Juntarup
(Mr. Noppong Juntarup)
Enviro Field Coordinator Scientist (3)

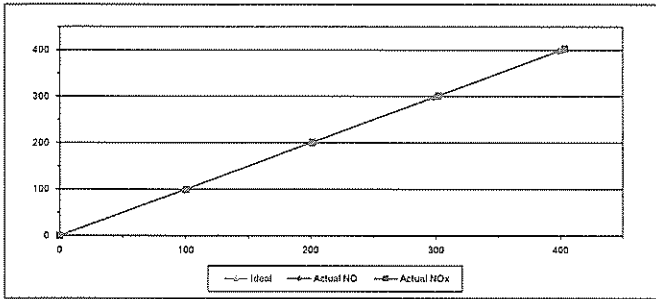
FORM NO. F-06-074 REVISION NO. - ISSUE DATE: 14/03/16



MULTIPOINT CALIBRATION REPORT

Calibration Date	1-Jul-23	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	T05HWM41	Equipment ID	RYG_FS0461
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	98.70	-1.30	-1.30	100.10	0.10	0.10
2	200.00	201.00	1.00	0.50	201.40	1.40	0.70
3	300.00	298.30	-1.70	-0.57	302.10	2.10	0.70
4	400.00	398.40	-1.60	-0.40	403.50	3.50	0.88
AVERAGE (%)				-0.33			0.50



Calibrated By

(Mr. Jirawut Sakam)
Field Environmental Scientist (3)

Approved By

(Mr. Sarayuth Jittrantorn)
Assistant General Manager

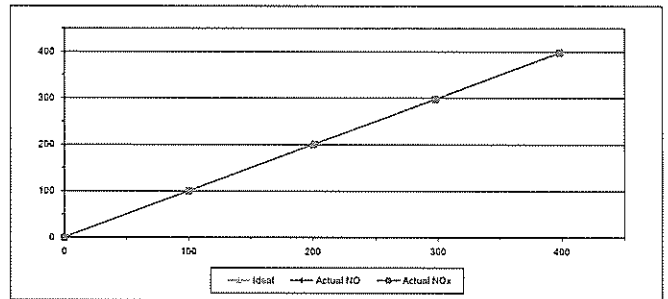
ALS Laboratory Group
FORM NO F 06-058 REVISION NO - ISSUE DATE 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	1-Jul-23	Equipment Name	NOx Analyzer
Manufacturer	Teledyne API	Model	200E
Serial No.	1578	Equipment ID	BKK_FS0735
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	99.20	-0.80	-0.80	100.30	0.30	0.30
2	200.00	199.30	-0.70	-0.35	201.00	1.00	0.50
3	300.00	298.50	-1.50	-0.50	298.00	-2.00	-0.67
4	400.00	398.50	-1.50	-0.38	398.10	-1.90	-0.47
AVERAGE (%)				-0.38			-0.05



Calibrated By

(Mr. Jirawut Sakam)
Field Environmental Scientist (3)

Approved By

(Mr. Sarayuth Jittrantorn)
Assistant General Manager

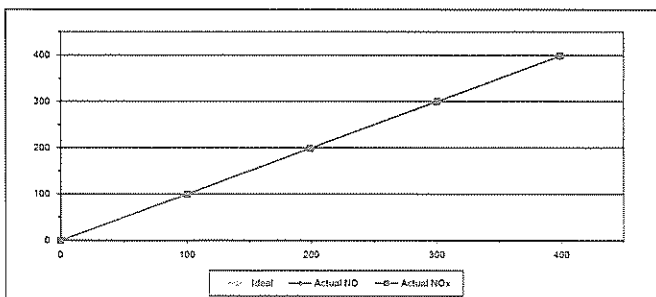
ALS Laboratory Group
FORM NO F 06-058 REVISION NO - ISSUE DATE 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	1-Jul-23	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	7AVB9544	Equipment ID	RYG_FS0272
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.05	0.05	0.05	0.10	0.10	0.10
1	100.00	99.10	-0.90	-0.90	100.10	0.10	0.10
2	200.00	198.60	-1.40	-0.70	199.00	-1.00	-0.50
3	300.00	298.70	-1.30	-0.43	300.50	0.50	0.17
4	400.00	398.00	-2.00	-0.50	398.70	-1.30	-0.33
AVERAGE (%)				-0.50			-0.09



Calibrated By

(Mr. Jirawut Sakam)
Field Environmental Scientist (3)

Approved By

(Mr. Sarayuth Jittrantorn)
Assistant General Manager

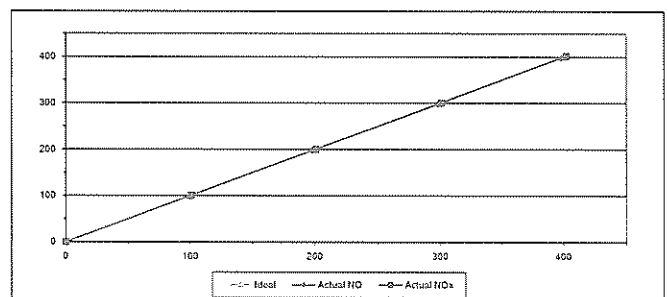
ALS Laboratory Group
FORM NO F 06-058 REVISION NO - ISSUE DATE 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	1-Jul-23	Equipment Name	NOx Analyzer
Manufacturer	Teledyne API	Model	T200
Serial No.	7238	Equipment ID	RYG_FS0535
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	99.60	-0.40	-0.40	101.00	1.00	1.00
2	200.00	198.30	-1.70	-0.85	201.10	1.10	0.55
3	300.00	298.60	-1.20	-0.40	301.50	1.50	0.50
4	400.00	398.20	-1.80	-0.45	402.30	2.30	0.58
AVERAGE (%)				-0.40			0.55



Calibrated By

(Mr. Jirawut Sakam)
Field Environmental Scientist (3)

Approved By

(Mr. Sarayuth Jittrantorn)
Assistant General Manager

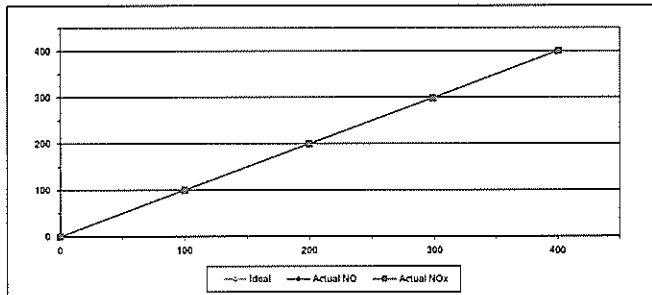
ALS Laboratory Group
FORM NO F 06-058 REVISION NO - ISSUE DATE 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	1-Jul-23	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	T27BYRL	Equipment ID	RYG_FS0457
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Algae Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	98.30	-1.70	-1.70	100.20	0.20	0.20
2	200.00	198.40	-1.60	-0.80	199.50	-0.40	-0.20
3	300.00	297.10	-2.90	-0.97	298.50	-1.50	-0.50
4	400.00	398.60	-1.40	-0.35	400.70	0.70	0.17
AVERAGE (%)				-0.74			-0.05



Calibrated By

(Mr. Jirawat Sakam)
Field Environmental Scientist (3)

Approved By

(Mr. Sarayuth Jitranont)
Assistant General Manager

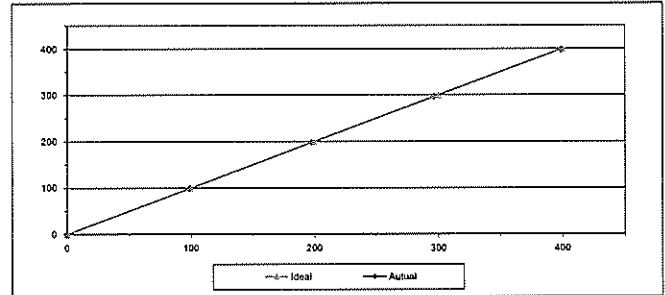
ALS Laboratory Group
FORM NO. F 06-056 REVISION NO. - ISSUE DATE 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	2-Jul-23	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	VABF9LSH	Equipment ID	RYG_FS0460
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	56.3	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Algae Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	98.70	-1.30	-1.30
2	200.00	197.80	-2.20	-1.10
3	300.00	296.50	-3.50	-1.17
4	400.00	398.30	-1.70	-0.42
AVERAGE (%)				-0.78



Calibrated By

(Mr. Jirawat Sakam)
Field Environmental Scientist (3)

Approved By

(Mr. Sarayuth Jitranont)
Assistant General Manager

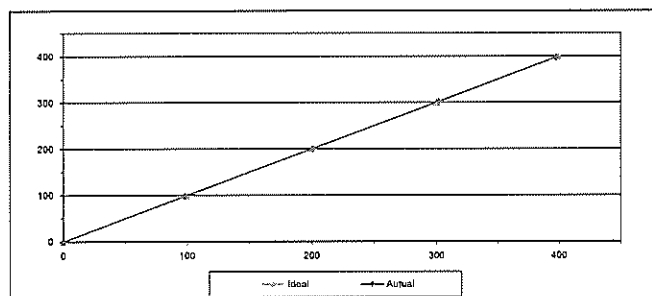
ALS Laboratory Group
FORM NO. F 06-056 REVISION NO. - ISSUE DATE 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	2-Jul-23	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	H08309FA	Equipment ID	RYG_FS0454
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	56.3	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Algae Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	98.30	-1.70	-1.70
2	200.00	200.80	0.80	0.40
3	300.00	301.90	1.90	0.63
4	400.00	397.50	-2.50	-0.63
AVERAGE (%)				-0.24



Calibrated By

(Mr. Jirawat Sakam)
Field Environmental Scientist (3)

Approved By

(Mr. Sarayuth Jitranont)
Assistant General Manager

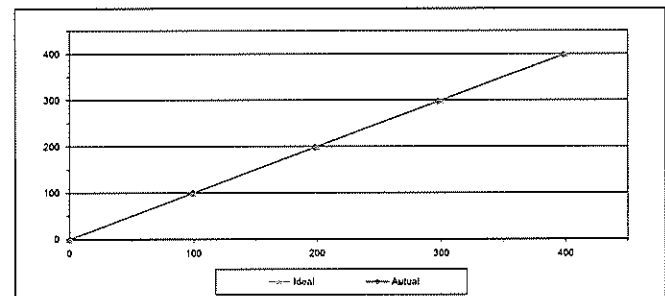
ALS Laboratory Group
FORM NO. F 06-056 REVISION NO. - ISSUE DATE 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	2-Jul-23	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	1092NYGM	Equipment ID	RYG_FS0271
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	56.3	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Algae Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	99.50	-0.50	-0.50
2	200.00	198.20	-1.80	-0.90
3	300.00	297.60	-2.40	-0.80
4	400.00	398.00	-2.00	-0.50
AVERAGE (%)				-0.52



Calibrated By

(Mr. Jirawat Sakam)
Field Environmental Scientist (3)

Approved By

(Mr. Sarayuth Jitranont)
Assistant General Manager

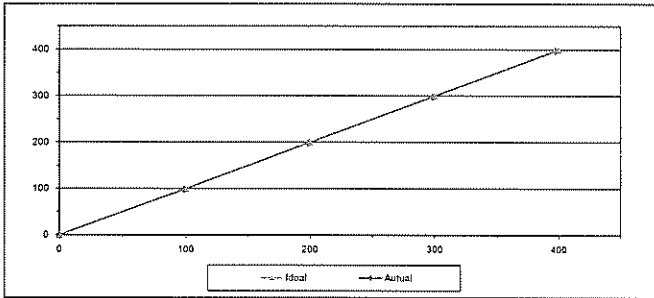
ALS Laboratory Group
FORM NO. F 06-056 REVISION NO. - ISSUE DATE 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	2-Jul-23	Equipment Name	SO2 Analyzer
Manufacturer	Teledyne API	Model	T100
Serial No.	8081	Equipment ID	RYG_FB0534
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	58.3	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Alngas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	99.80	-1.20	-1.20
2	200.00	198.70	-1.30	-0.65
3	300.00	298.30	-1.70	-0.57
4	400.00	397.30	-2.70	-0.67
AVERAGE (%)				-0.80



Calibrated By

Approved By

(Mr.) Jirawat Sakam
Field Environmental Scientist (3)

(Mr.) Sarayuth Jittrantong
Assistant General Manager

ALS Laboratory Group

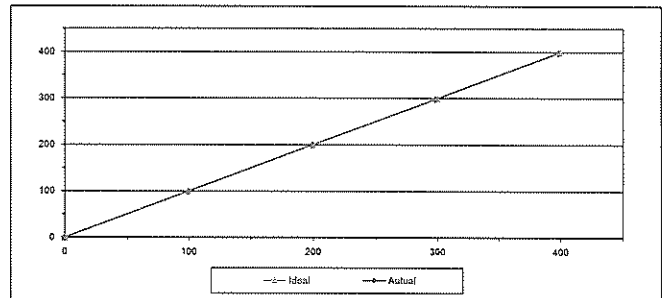
FORM NO. F-06-056 REVISION NO. - ISSUE DATE 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	2-Jul-23	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	RDHWYDWW	Equipment ID	RYG_FB0458
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	58.3	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Alngas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	99.70	-0.30	-0.30
2	200.00	199.50	-0.50	-0.25
3	300.00	298.30	-1.70	-0.57
4	400.00	398.10	-1.90	-0.47
AVERAGE (%)				-0.30



Calibrated By

Approved By

(Mr.) Jirawat Sakam
Field Environmental Scientist (3)

(Mr.) Sarayuth Jittrantong
Assistant General Manager

ALS Laboratory Group

FORM NO. F-06-056 REVISION NO. - ISSUE DATE 02/04/12



Accredited calibration laboratory
ISO/IEC 17025:2017
NSC TCH-175 17025
CALIBRATION 0367

Accredited calibration laboratory
ISO/IEC 17025:2017
NSC TCH-175 17025
CALIBRATION 0367

Air speed measurement laboratory
Calibration services department

Certificate Number

CL-018-65

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM	Cup anemometer
MANUFACTURER	Navalynx
MODEL/TYPE	Sensor: WS-03F Data logger: 200 WS-2518
SERIAL NUMBER	Sensor: AS3C9 Data logger: RYG_FB0411
USED ITEM	Used item
CONDITION AS RECEIVED	ALS Laboratory Group (Thailand) Co., Ltd. 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.
RECEIVED DATE	27 Jun 2023
MEASUREMENT DATE	10 Feb 2023
ISSUE DATE	10 Feb 2023

ENVIRONMENTAL CONDITIONS:	
Ambient condition in the laboratory are as follow:	
Temperature	23.0 ± 3.0 °C
Relative Humidity	55.0 ± 15.0 %RH
Atmospheric Pressure	1010 ± 10 hPa

PLACE OF CALIBRATION: Effci type wind tunnel of Jaranate Associates Co., Ltd.

CALIBRATION CONDITIONS	Wind tunnel cross section area	100 cm ²
	Win direction frontal area	100 cm ²
	Diameter of mounting pipe	9.113 mm
	Blockage ratio of test object	1%

Preconditioning: 24 hours at Ambient conditions
Measurement Condition: The average values during measurement are 123.8 °C, (44.8) %RH and (1010.3) hPa

TABULATION OF RESULTS:
The table on next page give the measured values

Calibrated by:
Mr. Sarawat Thachulak
Mr. Jirawat Sakam (Thailand)



Approved signature

Mr. Parinya Boonsharen
Calibration Department Manager

Remarks:
1. Nozzle protrusion area of the wind tunnel
2. Projected cross section area of the tested object include mounting pipe
3. Diameter of mounting pipe
4. Ratio 1%

THIS CERTIFICATE OF CALIBRATION MAY NOT BE REPRODUCED EXCEPT IN FULL UNLESS PERMISSION FOR REPRODUCTION HAS BEEN OBTAINED IN WRITING FROM THE LABORATORY

Certificate Number

CL-018-65

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

V_{ref} (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V_{meas} (m/s)	Error (m/s)	$D (m=2)$ (m/d)
0.083	23.60	23.55	0.8	-0.2	0.15
2.038	23.50	23.55	1.8	-0.2	0.16
3.044	23.50	23.55	2.9	-0.2	0.18
4.149	23.58	23.55	3.9	-0.3	0.19
5.00	23.50	23.55	4.9	-0.1	0.18
5.98	23.62	23.55	5.9	-0.1	0.18
7.04	23.28	23.55	7.0	-0.1	0.18
8.16	23.56	23.55	8.0	-0.2	0.19
9.10	23.26	23.55	9.0	-0.3	0.19
10.07	23.50	23.55	10.0	-0.1	0.18
11.13	23.10	23.55	11.0	-0.2	0.20
12.13	23.50	23.55	12.1	-0.1	0.20
13.21	23.12	23.55	13.1	-0.1	0.22
14.25	23.36	23.55	14.0	-0.2	0.27
15.24	23.10	23.55	15.1	-0.2	0.28
16.20	23.20	23.55	16.0	-0.3	0.24

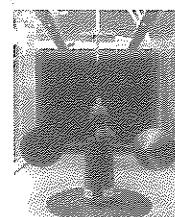
Remarks:

Calibration results only count for the tested circumstances and environmental conditions during which a variation task place

Velocity of standard

Velocity of fluid under Calibration

PHOTO OF CALIBRATION SET-UP



Calibration set up of the cup anemometer calibration in the wind tunnel of Jaranate Associates Co., Ltd. The cup anemometer shown may differ from the calibrated one. Remark: The position of the set up is not true to scale due to imaging geometry



Certificate Number

CL-016-66

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

Wind Direction Sensor

Novallmx

Sensor: WS-02F

Data logger: 100-WS-251B

Sensor: -

Data logger: AS369

RWG_FSD411

Used Item

ALS Laboratory group (Thailand) Co., Ltd.

104 Phatthanakan Rd, Phatthanakan Rd, Khwaeng Suan Luang,

Khet Suan Luang, Bangkok 10250 Thailand

Calibration procedure

The wind direction sensor was calibrated against Standard Rotary Encoder, model: AX40075-D104 P3-S-U9 in an close test section of Eiffel type wind tunnel with 900 cm² cross test section area. The WS-02F based on IEC 61400-12-1, Wind energy generation systems - Part 12-1 Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability

This certificate provides a traceability of the measurement to recognized the national standards, and to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: DA-0043-22

Uncertainty of Measurement

The reported uncertainty of measurement is based on the standard uncertainty multiplied by a coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty has been determined in accordance with the GUM "Evaluation of measurement data - Guide to the expression of uncertainty in measurement"

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature: 23.0 ± 3.0 °C

Relative Humidity: 55.0 ± 15.0 %RH

Atmospheric Pressure: 1010 ± 10 hPa

PLACE OF CALIBRATION

Eiffel-type wind tunnel of Jirantee Associates Co., Ltd.

CALIBRATION CONDITION

Wind tunnel cross section area¹ 900 cm²

Win direct on frontal area² 119 cm²

Diameter of mounting pipe³ mm

Blockage ratio of test object⁴ 0.143 [-]

Preconditioning

Measurement Condition

24 hours at ambient conditions.
The average values during measurement are (23.9) °C, (48.3) %RH and (1011.4) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

Mr. Sorawat Thachablad

Mr. Jiraporn Jirapornphol



Approved signatory

Mr. Parinya Booncharoen

Calibration Department Manager

Remarks:

¹ Nozzle cross section area of the wind tunnel

² Projected cross section area of the tested object include mounting pipe

³ Diameter of mounting pipe

⁴ Ratio $\frac{A_2}{A_1}$

THIS CERTIFICATE OF CALIBRATION MAY NOT BE REPRODUCED EXCEPT IN FULL UNLESS PERMISSION FOR REPRODUCTION HAS BEEN OBTAINED IN WRITING FROM THE LABORATORY

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

The wind direction sensor was calibrated against standard rotary encoder by comparison method. During calibration, the measurement was carried out at 45° intervals in clockwise and counterclockwise directions after offset adjustment has been made. The flow speed of wind tunnel (usually 5 m/s) is kept constant while the sensor is rotated around its vertical axis. The results of calibration and associated measurement uncertainties are reported in the table below.

Air speed m/s	D _{ref} Degree (°)	D _{meas} Degree (°)	Error Degree (°)	U (k=2) Degree (°)
	0.000	0	0	0.58
	45.000	41	-4	0.58
	90.000	87	-3	0.58
5.00	135.000	135	0	0.68
	180.000	182	2	0.74
	225.000	230	5	0.68
	270.000	275	5	0.58
	315.000	320	5	0.58

Remark:

¹ Calibration results only count for the tested circumstances and environmental conditions during which calibration took place.

² Direction of standard

³ Direction of Unit Under Calibration



End of Certificate of Calibration

Certificate Number

CWS-002-66

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

Cup anemometer

Novallmx

Sensor: WS-02F

Data logger: 110-WS-25DL-D

Sensor: WSD-AS816

Data logger: AS816

RWG_FSD411

Used Item

ALS Laboratory group (Thailand) Co., Ltd.

104 Phatthanakan Rd, Phatthanakan Rd, Khwaeng Suan Luang,

Khet Suan Luang, Bangkok 10250 Thailand

Calibration procedure

The cup anemometer was calibrated against Standard air velocity transducer model: B255-12 and pitot tube with precision differential pressure meter model: DP145-100 in an close test section of Eiffel-type wind tunnel with 900 cm² cross test section area. The WS-02F based on IEC 61400-12-1, Wind energy generation systems - Part 12-1 Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability

This certificate provides a traceability of the measurement to recognized the national standards, and to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: RMV-0052-21 and RMV-0060-23

Uncertainty of Measurement

The reported uncertainty of measurement is based on the standard uncertainty multiplied by a coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty has been determined in accordance with the GUM "Evaluation of measurement data - Guide to the expression of uncertainty in measurement"

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature: 23.0 ± 3.0 °C

Relative Humidity: 55.0 ± 15.0 %RH

Atmospheric Pressure: 1010 ± 10 hPa

PLACE OF CALIBRATION

Eiffel-type wind tunnel of Jirantee Associates Co., Ltd.

CALIBRATION CONDITIONS

Wind tunnel cross section area¹ 900 cm²

Win direct on frontal area² 100 cm²

Diameter of mounting pipe³ mm

Blockage ratio of test object⁴ 0.111 [-]

Preconditioning

Measurement Condition

24 hours at ambient conditions.
The average values during measurement are (23.9) °C, (45.7) %RH and (1008.2) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

Mr. Sorawat Thachablad

Mr. Jiraporn Jirapornphol



Approved signatory

Mr. Parinya Booncharoen

Calibration Department Manager

Remarks:

¹ Nozzle cross section area of the wind tunnel

² Projected cross section area of the tested object include mounting pipe

³ Diameter of mounting pipe

⁴ Ratio $\frac{A_2}{A_1}$

THIS CERTIFICATE OF CALIBRATION MAY NOT BE REPRODUCED EXCEPT IN FULL UNLESS PERMISSION FOR REPRODUCTION HAS BEEN OBTAINED IN WRITING FROM THE LABORATORY

Certificate Number

CWS-002-66

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

The cup anemometer, Unit Under Calibration (UUC) was exercise at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer and above 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 40 mm and 300 mm respectively away from wind tunnel nozzle. UUC was installed at center of the test section. The calibration was carried out under both rising and falling air velocity in the range of 1 m/s to 30 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

V _{ref} (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V _{meas} (m/s)	Error (m/s)	U (k=2) (m/s)
1.023	23.80	23.90	0.8	-0.2	0.31
2.078	24.00	23.90	1.8	-0.2	0.31
3.021	23.78	23.90	2.8	-0.2	0.31
4.248	23.92	23.90	3.9	-0.2	0.31
5.00	23.60	23.90	4.8	-0.2	0.31
5.99	23.68	23.90	5.8	-0.2	0.31
7.03	23.50	23.90	6.8	-0.2	0.31
8.16	23.60	23.90	7.9	-0.5	0.31
9.08	23.50	23.90	8.9	-0.2	0.31
10.05	23.78	23.90	9.8	-0.3	0.31
11.13	23.50	23.90	10.9	-0.2	0.31
12.11	23.78	23.90	12.0	-0.1	0.31
13.16	23.50	23.90	12.9	-0.3	0.31
14.21	23.66	23.90	14.0	-0.2	0.31
15.18	23.50	23.90	15.0	-0.2	0.31
16.26	23.58	23.90	16.0	-0.3	0.31

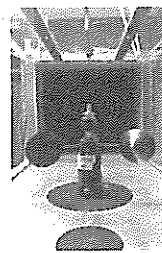
Remark:

Calibration results only count for the tested circumstances and environmental conditions during which calibration took place.

Velocity of standard

Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET UP



Calibration set up of the cup anemometer calibration in the wind tunnel of Jirantee Associates Co., Ltd. The cup anemometer shown may differ from the calibrated one. Remark: The proportion of the set-up is not to scale due to image geometry.



CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM MANUFACTURER MODEL/TYPE

Wind Direction Sensor
Novolynx
Sensor WS-02F

SERIAL NUMBER

Data logger: 110 WS 25DL D
Sensor: WSD-A5016

ID NUMBER

RNG_FS0545

CONDITION AS RECEIVED

Used item

CUSTOMER

ALS Laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,
Khet Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE

11 Jul 2023

MEASUREMENT DATE

21 Jul 2023

ISSUE DATE

21 Jul 2023

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature: 23.0 ± 3.0 °C
Relative Humidity: 55.0 ± 15.0 %RH
Atmospheric Pressure: 1010 ± 10 hPa

PLACE OF CALIBRATION

Efflux-type wind tunnel of Jiranatee Associates Co., Ltd.

CALIBRATION CONDITION

Wind tunnel cross section area: 900 cm²
Win direct on frontal area: 129 cm²
Diameter of mounting pipe: mm
Blockage ratio of test object: 0.143 [%]

Preconditioning

24 hours at ambient conditions

Measurement Condition

The average values during measurement are (23.8) °C, (46.9) %RH and (1012.4) hPa

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

Mr. Sorawat Thachalad
Miss Jittaporn Lertkarnphol

Approved signature

Mr. Parinya Booncharoen
Calibration Department Manager

Remarks:

* Exclude cross section area of the wind tunnel
* Projected cross section area of the tested object include mounting pipe
* Diameter of mounting pipe
* Note: %

Calibration procedure:
The wind direction sensor was calibrated against
Standard Rotary Encoder model: A400015-
DMDA P3-1.60 in an efflux section of Efflux-
type wind tunnel with 900 cm² cross test section
area. The WDC-008 Based on IEC 65420-12-1,
Wind energy generation systems, - Part 12-1
Power performance measurements of electricity
producing wind turbines, March 2017 was used as
a calibration guideline.

Traceability

This certificate provides a traceability of the
measurements to recognized the national
standards, and to recognition of the international
system of units (SI) through the NIMT (National
Metrology Institute of Thailand) via Certificate
Number: DA-6043-22

Uncertainty of Measurement:

The reported uncertainty of measurement is
based on the standard uncertainty multiplied by a
coverage factor k=2, which for a normal
distribution corresponds to a coverage probability
of approximately 95%. The standard uncertainty
has been determined in accordance with the GUM
'Evaluation of measurement
data: Guide to the expression of uncertainty in
measurement'

End of Certificate of Calibration



THIS CERTIFICATE OF CALIBRATION MAY NOT BE REPRODUCED EXCEPT IN FULL UNLESS PERMISSION FOR REPRODUCTION HAS BEEN OBTAINED
IN WRITING FROM THE LABORATORY



63/14-15, 67/35-36, Soi Petchkasem 7/11, Petchkasem Rd,
Watthapra, Bangkokiyai, Bangkok 10600 Thailand.
Tel: (66) 02-8680812#13 Fax: (66) 02-8680860 www.jiranatee.com



63/14-15, 67/35-36, Soi Petchkasem 7/11, Petchkasem Rd,
Watthapra, Bangkokiyai, Bangkok 10600 Thailand.
Tel: (66) 02-8680812#13 Fax: (66) 02-8680860 www.jiranatee.com



CERTIFICATE OF CALIBRATION

Certificate No: CDT-058-E6
Page 1 of 2

Equipment Name: Data Logger with Temperature sensor

Manufacturer: Novolynx
Model: 110-WS-25DL D
Serial No: A5816
ID No: RNG_FS0545

Customer

Name: ALS Laboratory group (Thailand) Co., Ltd
Address: 104 Phatthanakan 40, Phatthanakan Rd.,
Khwaeng Suan Luang, Khet Suan Luang, Bangkok
10250 Thailand

Received date: 11 Jul 2023

Calibration date: 21 Jul 2023
Issue date: 21 Jul 2023

Reference Used During Calibration

1 Standard Temperature Probe Model: STS 100 A500,
Serial No: 667682 09, Due date: 28 Mar 2024
2 Digital Temperature Indicator Model: DT1 1000 A-MK
II, Serial No: 671407-00591 Due date: 22 July 2023

Calibration Condition

Temperature: (23.73) °C
Relative Humidity: (55 ± 15) %

Calibration Procedure

The temperature calibration was done by In-House
calibration method as WI CL 601 according to
comparison method with standard digital temperature
indicator and standard temperature probe. The
temperature scale use was based on ITS-90.

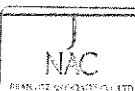
Traceability

The measurement results are traceable to the
international system of units (SI) through National
Institute of Metrology Thailand (NIMT) Certificate
number: TT-0038-23, Certificate number: ER-0092
22

Noted: The certificate is valid only to the item calibrated on date and place of calibration

Calibrated by:

Mr. Sorawat Thachalad
Miss Jittaporn Lertkarnphol
Miss Ruangsriwong Phoomont



Approved Signature

Mr. Parinya Booncharoen
Calibration Department Manager

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

The wind direction sensor was calibrated against standard rotary encoder by comparison method. During calibration, the measurement was carried out at 45° intervals in clockwise and counterclockwise directions after offset adjustment has been made. The flow speed of wind tunnel (usually 5 m/s) is kept constant while the sensor is rotated around its vertical axis. The results of calibration and associated measurement uncertainties are reported in the table below.

Air speed	D _{acc}	D _{acc}	Error	U (k=2)
m/s	Degree (°)	Degree (°)	Degree (°)	Degree (°)
	45.000	42	-3	1.0
	90.000	87	-3	1.0
	135.000	133	-2	1.0
	180.000	181	1	1.0
	225.000	229	4	1.0
	270.000	273	3	1.0
	315.000	317	2	1.0
	360.000	359	-1	1.0

Remark:

¹ Calibration results only count for the listed circumstances and environmental conditions during which calibration took place.

² Direction of standard

Direction of this order Calibration

End of Certificate of Calibration



Certificate No: CDT-058-E6
Page 2 of 2

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 - 40 °C

Function:

This equipment was connected with temperature sensor Model: HMP60 S/N: T2320595.

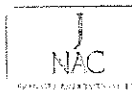
Dimension : Diameter 12 mm, Length 80 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.060	19.6	0.5	0.039
70	25.055	24.6	0.4	0.14
70	30.050	29.7	0.4	0.059
70	35.043	34.5	0.5	0.059
70	40.036	39.5	0.5	0.059

UUC¹ Unit Under Calibration

The reported expanded uncertainty is based on standard uncertainty multiplied by a coverage factor k=2
providing a level of confidence of approximately 95%.

★ End of Certificate ★





63/14-15,67/35-36, Soi Petchkasom 7/71, Petchkasom Rd,
Walthapa, Bangkok, Bangkok 10600 Thailand.
Tel: (66) 02-8680812/13 Fax: (66) 02-8680860 www.jiranatee.com

CERTIFICATE OF CALIBRATION

Calibration No.: PH 02072023
Page 1 of 1 Pages

Measurement Item: Relative humidity with data logger
Manufacturer: Novatex
Model/Type: T10-WS 25DL D
Serial Number: A5816
ID No.: RYO_FS0545
Customer: ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Suan Luang, Khet Suan Luang, Bangkok
10250 Thailand.

Environmental Condition
The measurement was carried out in an ambient temperature of (25±3)°C, and relative humidity of (50±10)%

Measurement Method:
Unit Under Calibration (UUC) was calibrated by comparison method with standard chilled mirror hygrometer model 1800 3 in the humidity generator chamber to determine the errors.

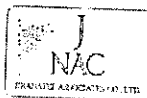
Traceability
This instrument was calibrated using standard equipment whose accuracy is traceability through National Institute of Standards and Technology to the international system of units (SI) via MCS Calibration, Inc. Certificate number: 20926 061. Due date: Sep 26, 2024

Measurement Date: Jul 21, 2023
Issued Date: Jul 21, 2023

Measurement Results
This equipment was connected with Indoor air quality probe and Displayed (LH) on display Model HMP60, Serial number: T2320095
Calibration was performed in the range of 20%RH to 80%RH
The results of calibration are reported in table below:

Determined (%RH)	Standard readings (%RH)	UUC (Reading) (%RH)	Error (%RH)	Uncertainty ±(%RH)
20	20.05	17.5	-2.6	0.52
50	50.23	46.5	-3.7	0.51
80	80.25	75.5	-4.8	0.51

Performed by
☐ Mr. Sorawit Thachelad
☒ Ms. Jitraporn Lertsomphol
☐ Ms. Ruengruep Phoommit



Approved Signatory:
Mr. Parinya Booncharoen
Calibration Department Manager

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Certificate Number

CL 002 66

Page 2 of 2 Pages

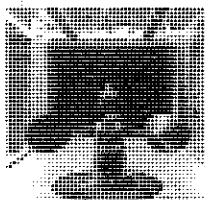
MEASUREMENT RESULTS¹

The cup anemometer, Unit Under Calibration (UUC) was exercise at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer and about 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 40 cm and 300 mm respectively away from wind tunnel outlet. UUC was installed at center of the test section. The calibration was carried out under both rising and falling air velocity in the range of 1 m/s to 16 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below:

V _{ref} (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V _{ref} (m/s)	Error (m/s)	U/(k=2) (m/s)
0.589	24.10	24.00	0.7	-0.3	0.18
2.034	23.96	24.00	1.7	-0.3	0.16
3.053	24.06	24.00	2.9	-0.2	0.19
4.135	24.00	24.00	3.9	-0.7	0.19
4.95	24.00	24.00	4.8	-0.1	0.26
5.68	24.00	24.00	5.9	0.1	0.18
7.05	23.90	24.00	6.9	-0.1	0.21
8.15	23.90	24.00	8.0	-0.2	0.21
9.00	23.72	24.00	9.1	0.0	0.20
10.01	23.85	24.00	9.9	-0.1	0.24
11.15	23.80	24.00	11.1	0.3	0.28
12.13	23.90	24.00	12.1	0.0	0.28
13.21	23.90	24.00	13.2	0.0	0.34
14.27	23.96	24.00	14.4	0.3	0.22
15.16	23.88	24.00	15.1	0.1	0.27
16.32	24.00	24.00	16.4	0.1	0.28

Remarks:
¹ Calibration results were carried out for the test case circumstances and environmental conditions during which calibration took place
² Velocity of standard
³ Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET UP



Calibration set up of the cup anemometer calibration in the wind tunnel of Jiranatee Associates Co., Ltd. The cup anemometer shown may differ from the calibration one. Remarks: The properties of the set up are not to be used for other than the calibration.

End of Certificate of Calibration
JIRANATEE ASSOCIATES CO., LTD.



JIRANATEE ASSOCIATES CO., LTD.

Jiranatee Associates Co., Ltd.
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Web site: www.jiranatee.com

Accredited calibration laboratory
ISO/IEC 17025:2017
ASC 765 TS 17025
CALIBRATION 0387

Air speed measurement laboratory
Calibration services department

REVIEW BY:
APPROVED BY:
NEXT CAL DATE: 5/14/24

Certificate Number

CL 002 66

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER
MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS RECEIVED

CUSTOMER

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follows:

Temperature: 23.0 ± 3.0 °C
Relative Humidity: 55.0 ± 15.0 %RH
Atmospheric Pressure: 1010 ± 10 hPa

PLACE OF CALIBRATION

E-tel type wind tunnel of Jiranatee Associates Co., Ltd.

CALIBRATION CONDITIONS

Wind tunnel cross section area¹: 900 cm²
Win direction frontal area²: 100 cm²
Diameter of mounting pipe³: 10 mm
Blockage ratio of test object⁴: 0.111 (%)

Preconditioning

Measurement Condition

24 hours at ambient conditions
The average values during measurement are (24.0) °C, (52.4) %RH and (1014.5) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values

Calibrated by:

☒ Mr. Sorawit Thachelad
☐ Ms. Jitraporn Lertsomphol

Remarks:

¹ Notable obstruction area of the wind tunnel
² Projected cross-section area of the tested object include mounting pipe
³ Diameter of mounting pipe
⁴ Ratio (%)



Approved Signatory:

Mr. Parinya Booncharoen
Calibration Department Manager

THIS CERTIFICATE OF CALIBRATION MAY NOT BE REPRODUCED EXCEPT IN FULL UNLESS PERMISSION FOR REPRODUCTION HAS BEEN OBTAINED IN WRITING FROM THE LABORATORY



JIRANATEE ASSOCIATES CO., LTD.

Jiranatee Associates Co., Ltd.
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Tel: +6628680812
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ISO/IEC 17025:2017
ASC 765 TS 17025
CALIBRATION 0387

Air speed measurement laboratory
Calibration services department

Certificate Number

CL 002 66

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER
MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS RECEIVED

CUSTOMER

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follows:

Temperature: 23.0 ± 3.0 °C
Relative Humidity: 55.0 ± 15.0 %RH
Atmospheric Pressure: 1010 ± 10 hPa

PLACE OF CALIBRATION

E-tel type wind tunnel of Jiranatee Associates Co., Ltd.

CALIBRATION CONDITION

Wind tunnel cross section area¹: 900 cm²
Win direction frontal area²: 229 cm²
Diameter of mounting pipe³: 10 mm
Blockage ratio of test object⁴: 0.143 (%)

Preconditioning

Measurement Condition

24 hours at ambient conditions
The average values during measurement are (23.9) °C, (52.3) %RH and (1015.3) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values

Calibrated by:

☒ Mr. Sorawit Thachelad
☐ Ms. Jitraporn Lertsomphol

Remarks:

¹ Notable obstruction area of the wind tunnel
² Projected cross-section area of the tested object include mounting pipe
³ Diameter of mounting pipe
⁴ Ratio (%)



Approved Signatory:

Mr. Parinya Booncharoen
Calibration Department Manager

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Certificate Number
CL-002-65

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

The wind direction sensor was calibrated against standard rotary encoder by comparison method. During calibration, the measurement was carried out at 45° intervals in clockwise and counter-clockwise directions after offset adjustment has been made. The flow speed of wind tunnel (staticly 5 m/s) is kept constant while the sensor is rotated around its vertical axis. The results of calibration and associated measurement uncertainties are reported in the table below.

Air speed m/s	D _{meas} Degree (°)	D _{ref} Degree (°)	Error Degree (°)	U (k=2) Degree (°)
	0.000	0	0	0.58
	45.000	45	-4	0.74
	90.000	87	3	0.74
	135.000	124	1	0.74
	180.001	182	2	0.74
	225.000	228	-3	0.68
	270.000	272	2	0.74
	315.000	316	3	0.74

Remark:

Calibration results only valid for the tested circumstances and environmental conditions during which calibration took place.

Version of standard

Version of this Under Calibration



End of Certificate of Calibration



Pranatee Associates Co. Ltd.
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E-mail: pranateer@pranateer.com
Web site: www.pranateer.com

Accredited calibration laboratory
ISO/IEC 17025:2017
MSC 105115 17025
CALIBRATION 0367

An speed measurement laboratory
Calibration services department

15/10/24

Certificate Number
CL-005-65

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM
MANUFACTURER
MODEL/TYPE

Cup anemometer
Novasys
Sensor: WS 02F

SERIAL NUMBER

Data logger: 110 WS 250L-D

ID NUMBER

Sensor: WS0-D16

CONDITION AS-RECEIVED

Data logger: MS510

CUSTOMER

NYG, JSC009

RECEIVED DATE

09 Nov 2022

MEASUREMENT DATE

18 Nov 2022

ISSUE DATE

23 Nov 2022

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature: 23.0 ± 3.0 °C

Relative Humidity: 55.0 ± 15.0 %RH

Atmospheric Pressure: 1010 ± 10 hPa

PLACE OF CALIBRATION

Effel type wind tunnel of Pranatee Associates Co., Ltd.

CALIBRATION CONDITIONS

Wind tunnel cross section area¹: 900 cm²

Wind direction frontal area²: 100 cm²

Diameter of mounting pipe³: 10 mm

Blockage ratio of test object⁴: 0.111 [-]

Preconditioning

24 hours at ambient conditions

Measurement Condition

The average values during measurement are (23.7) °C, (40.5) %RH and (1011.2) hPa

TABULATION OF RESULTS:

The table on next page give the measured values

Calibrated by:

1- Mr. Sornwit Thuchabul

2- Miss. Nitrasorn Leemongkol



Approved signature

Mr. Pranateer Boonchaisri
Calibration Services Manager

Remarks:

¹ Nozzle cross section area of the wind tunnel

² Projected cross section area of the tested object include mounting pipe

³ Diameter of mounting pipe

⁴ Ratio % to

Certificate Number
CL-005-65



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Accredited calibration laboratory
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MSC 105115 17025
CALIBRATION 0367

An speed measurement laboratory
Calibration services department

Certificate Number
CL-005-65

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM
MANUFACTURER
MODEL/TYPE

Wind Direction Sensor
Novasys
Sensor: WS 02F

SERIAL NUMBER

Data logger: 110 WS 250L-D

ID NUMBER

Sensor: WS0-D16

CONDITION AS-RECEIVED

Data logger: MS510

CUSTOMER

NYG, JSC009

RECEIVED DATE

09 Nov 2022

MEASUREMENT DATE

18 Nov 2022

ISSUE DATE

23 Nov 2022

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature: 23.0 ± 3.0 °C

Relative Humidity: 55.0 ± 15.0 %RH

Atmospheric Pressure: 1010 ± 10 hPa

PLACE OF CALIBRATION

Effel type wind tunnel of Pranatee Associates Co., Ltd.

CALIBRATION CONDITION

Wind tunnel cross section area¹: 900 cm²

Wind direction frontal area²: 120 cm²

Diameter of mounting pipe³: 10 mm

Blockage ratio of test object⁴: 0.143 [-]

Preconditioning

24 hours at ambient conditions

Measurement Condition

The average values during measurement are (24.3) °C, (45.3) %RH and (1012.5) hPa

TABULATION OF RESULTS:

The table on next page give the measured values

Calibrated by:

1- Mr. Sornwit Thuchabul

2- Miss. Nitrasorn Leemongkol



Approved signature

Mr. Pranateer Boonchaisri
Calibration Services Manager

Remarks:

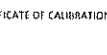
¹ Nozzle cross section area of the wind tunnel

² Projected cross section area of the tested object include mounting pipe

³ Diameter of mounting pipe

⁴ Ratio % to

Certificate Number
CL-005-65



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MSC 105115 17025
CALIBRATION 0367

An speed measurement laboratory
Calibration services department

Certificate Number
CL-005-65

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

The cup anemometer, test under calibration (BAC) was rotated at 30 m/s for 5 minutes prior to calibration being performed. The standard air velocity 5 m/s to 5 m/s was calculated by a standard anemometer and above 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 40 mm and 300 mm respectively away from wind tunnel nozzle. BAC was rotated at center of the test section. The calibration was carried out under both average and full air velocity in the range of 1 m/s to 16 m/s at 1 m/s intervals of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

V _{ref} (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V _{meas} (m/s)	Error (m/s)	U (k=2) (m/s)
0.973	23.98	23.70	0.8	0.2	0.15
2.042	23.46	23.70	1.8	0.2	0.16
3.069	23.00	23.70	2.8	0.2	0.21
4.221	23.60	23.70	3.9	0.4	0.20
5.02	23.80	23.70	4.8	0.2	0.20
5.09	23.84	23.70	5.8	0.2	0.20
7.06	23.66	23.70	6.8	0.2	0.18
8.17	23.78	23.70	7.9	0.2	0.18
9.10	23.60	23.70	8.8	0.2	0.22
10.05	23.74	23.70	9.9	-0.2	0.19
11.16	23.68	23.70	10.9	0.2	0.22
12.14	23.94	23.70	11.8	-0.3	0.22
13.19	23.70	23.70	13.0	0.2	0.22
14.27	23.96	23.70	13.8	0.4	0.22
15.25	23.78	23.70	15.1	0.2	0.26
16.30	23.84	23.70	15.9	0.4	0.25

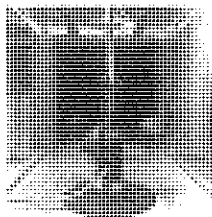
Remark:

Calibration results only valid for the tested circumstances and environmental conditions during which calibration took place.

Version of standard

Version of this Under Calibration

PHOTO OF CALIBRATION SET UP



Calibration set up of the cup anemometer calibration in the wind tunnel of Pranatee Associates Co., Ltd. The cup anemometer shows very stable after the calibrated cup. Remark: The proportion of the set up is not true to scale due to imaging geometry.



End of Certificate of Calibration

Certificate Number
CL-005-05

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

The wind direction sensor was calibrated against standard rotary encoder by comparison method. During calibration, the measurement was carried out at 65° intervals in clockwise and counter-clockwise directions after offset adjustment has been made. The flow speed of wind tunnel (usually 5 m/s) is kept constant while the sensor is rotated around its vertical axis. The results of calibration and associated measurement uncertainties are reported in the table below.

Air speed	D _{90°}	D _{270°}	Error	U (k=2)
m/s	Degree (°)	Degree (°)	Degree (°)	Degree (°)
5.01	0.000	0	0	0.58
	45.000	44	-2	0.76
	90.000	87	-3	0.58
	135.000	132	3	0.68
	180.000	177	3	0.68
	225.000	222	-3	0.58
	270.000	270	0	0.74
	315.000	318	3	0.58

Remarks:
Calibration results only cover for the tested circumstances and environmental conditions during which calibration took place.
Directional standard:
Direction of Unit Under Calibration:



63/14-15,67/35 36, Soi Petchkasem 7/71, Petchkasem Rd.
Walthapa, Bangkokyai, Bangkok 10600 Thailand.
Tel: (66) 02-8680812#13 Fax: (66) 02-8680860 www.jiranatae.com

CERTIFICATE OF CALIBRATION

Calibration No.: BH 06112022
Page 1 of 1 Pages

Measurement Item: Relative Humidity with data logger
Manufacturer: Novalyxa
Model/Type: 110 WS 250L D
Serial Number: A5910
ID No: BYG F80609
Customer: A/S Laboratory group (Thailand) Co., Ltd.
104 Phulthamburi 40, Phulthamburi Rd, Khwaeng Siang Luang, Yod Saen Luang, Bangkok
10250 Thailand

Environmental Condition:
The measurement was carried out in an ambient temperature of (25.4)°C, and relative humidity of (50)10%.

Measurement Method:
Unit Under Calibration (UUC) was calibrated by comparison method with standard thermo hygrometer in the humidity generator chamber to determine the errors.

Traceability:
This instrument was calibrated using standard equipment whose accuracy is traceability through National Institute of Standards and Technology in the international system of units (SI) by MCS Calibration, Inc. Certificate number 20314 101 Due date Mar 14, 2023.

Measurement Date: Nov 18, 2022
Issued Date: Nov 23, 2022

Measurement Results:
This equipment was connected with indoor air quality probe and Displayed (B9) on display Model IMB60, Serial number 130641223.

Calibration was performed in the range of 20%RH to 80%RH.
The results of calibration are reported in table below.

Defendant (RH)	Standard Reading (RH)	UUC Reading (RH)	Error (RH)	Uncertainty (RH)
20	19.98	17.8	-2.4	0.56
50	50.28	47.3	-3.0	0.51
80	80.30	77.6	-2.7	0.52

Performed by:
☒ Mr. Samwat Thachai
☐ Miss Jitraporn Tachasophon



Approved Signatory: Mr. Panyas Booncharoen
Calibration Department Manager

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63/14-15,67/35 36, Soi Petchkasem 7/71, Petchkasem Rd.
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CERTIFICATE OF CALIBRATION

Covered in No. CL 16116
Page 1 of 1

Equipment Name: Data Logger with Temperature Sensor
Manufacturer: Novolyxa
Model: 110 WS 250L D
Serial No: A5910
ID No: BYG F80609

Customer:
Name: A/S Laboratory group (Thailand) Co., Ltd.
Address: 104 Phulthamburi 40, Phulthamburi Rd, Khwaeng Siang Luang, Yod Saen Luang, Bangkok 10250 Thailand

Received date: 09 Nov 2022
Calibration date: 18 Nov 2022
Issue date: 24 Nov 2022

Reference Used During Calibration:
1 Standard Temperature Probe Model: SPS 160 A-M09
Serial No: G67682 09, Due date: 24 Mar 2023
2 Digital Temperature Indicator Model: DII 1000 A-M8
R, Serial No: G7140x 09/01 Due date: 22 July 2023

Calibration Condition:
Temperature: (23.3)°C
Relative Humidity: (50)10%

Calibration Procedure:
The temperature calibration was done by three calibration method as WELC01 according to comparison method with standard digital temperature indicator and standard temperature probe. The temperature scale error was based on ITS-90.

Traceability:
The measurement results are traceable to the international system of units (SI) through National Institute of Metrology (Thailand) (NIM). Certificate number: TH 0014 22. Certificate number: TH 0052 22.

Calibrated by:
Mr. Samwat Thachai
Miss Jitraporn Tachasophon



Approved Signatory: Mr. Panyas Booncharoen
Calibration Department Manager



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Tel: (66) 02-8680812#13 Fax: (66) 02-8680860 www.jiranatae.com



Covered in No. CL 16116
Page 2 of 2

Result of Calibration: Without Adjustment With Adjustment
Calibration Range: 20 to 80 %

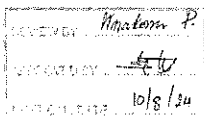
Function:
This equipment was connected with temperature sensor Model: HMI 605/R-130641223.

Dimension: Diameter 12 mm Length 80 mm

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	20.03	19.8	-0.2	0.50
40	20.02	20.8	0.7	0.50
20	20.00	20.7	0.7	0.50
10	20.00	21.6	1.6	0.50
01	20.00	21.7	1.7	0.50

UUC* Unit Under Calibration:
The reported expanded uncertainty is based on standard uncertainty multiplied by coverage factor k=2 providing a level of confidence of approximately 95%.





Certificate Number
CL-021-66

Certificate Number
CL-021-66

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

The cup anemometer, Unit Under Calibration (UUC) was exercised at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer and above 5 m/s to 10 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 40 mm and 300 mm respectively away from wind tunnel nozzle. UUC was installed at center of the test section. The calibration was carried out under both rising and falling air velocity in the range of 1 m/s to 16 m/s at calibration interval of 1 m/s. The results of calibration and measurement uncertainty are reported in the table below.

V _{ref} (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V _{uuc} (m/s)	Error (m/s)	U (k=2) (m/s)
0.985	24.10	24.10	0.8	-0.2	0.36
1.033	24.10	24.10	1.9	-0.1	0.16
3.040	23.94	24.10	3.0	-0.1	0.33
4.134	24.10	24.10	4.0	-0.1	0.20
4.99	23.92	24.10	4.9	-0.1	0.44
5.98	24.10	24.10	6.0	0.0	0.18
7.05	23.99	24.10	7.0	-0.1	0.36
8.19	24.06	24.10	8.2	0.0	0.26
9.09	23.84	24.10	9.1	0.0	0.24
10.09	23.92	24.10	10.1	0.0	0.28
11.15	23.80	24.10	11.1	0.0	0.45
12.14	23.80	24.10	12.2	0.0	0.31
13.19	23.60	24.10	13.2	0.0	0.47
14.26	23.74	24.10	14.2	0.0	0.42
15.25	23.78	24.10	15.1	0.1	0.66
16.28	23.70	24.10	16.3	0.0	0.56

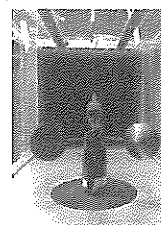
Remark:

¹ Calibration results only count for the tested circumstances and environmental conditions during which calibration took place.

² Velocity of standard.

Velocity of Unit Under Calibration.

PHOTO OF CALIBRATION SET-UP



Calibration set up of the cup anemometer calibration in the wind tunnel of Jirantee Associates Co., Ltd. The cup anemometer shown may differ from the calibrated one. Remark: The proportion of the set-up is not true to scale for the comparison quality.



Page 1 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

Cup anemometer

Novallux

Sensor WS-02F

Data logger 200 WS-2518

Sensor

Data logger AS376

RVG-RM14

Used item

ALS laboratory group (Thailand) Co., Ltd.

104 Phatthanakan Rd, Phatthanakan Rd, Khwaeng Suan Luang,

Khet Suan Luang, Bangkok 10150 Thailand.

Calibration procedure:

The cup anemometer was calibrated against standard air velocity transducer against 0.55532 and pitot tube with precision differential pressure meter model DP42500 in an open test section of Q101-type wind tunnel with 300 mm cross test section area. The W1-C1 607 based on IEC 61400-12 1, Wind energy generation systems - Part 12 1. Power performance measurement of electricity producing wind turbines. March 2017 was used as a calibration guideline.

Traceability:

This certificate provides a traceability of the measurement to recognized the national standards, and to realization of the international system of units (SI) through the NMRI (National Metrology Institute of Thailand) via Certificate Number: MN 0352 21 and MN 0366 22.

Uncertainty of Measurement:

The reported uncertainty of measurement is based on the standard uncertainty multiplied by a coverage factor k=2. Which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty has been determined in accordance with the GUM 'Evaluation of measurement data - Guide to the expression of uncertainty in measurement'.

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follows:

Temperature 23.0 ± 3.0 °C

Relative Humidity 55.0 ± 15.0 %RH

Atmospheric Pressure 1010 ± 10 hPa

PLACE OF CALIBRATION

Pitot-type wind tunnel of Jirantee Associates Co., Ltd.

CALIBRATION CONDITIONS

Wind tunnel cross-section area¹ 950 cm²

Win direct on frontal area² 100 cm²

Diameter of mounting pipe³ mm

Blockage ratio of test object⁴ 0.111 [-]

Pretconditioning

Measurement Condition

24 hours at ambient conditions.

The average values during measurement are (24.0) °C, (47.6) %RH and (1014.7) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values

Calibrated by:

Mr. Sorawit Thakulad

Miss Paragorn Jiraprasitkul



Approved signature:

Mr. Parinya Booncharoen
Calibration Department Manager

Remark:

¹ Inside cross-section area of the wind tunnel

² Projected cross-section area of the tested object include mounting pipe

³ Diameter of mounting pipe

⁴ Ratio 1/3

THIS CERTIFICATE OF CALIBRATION MAY NOT BE REPRODUCED EXCEPT IN FULL UNLESS PERMISSION FOR REPRODUCTION HAS BEEN OBTAINED IN WRITING FROM THE LABORATORY

Certificate Number
CL-019-66

Certificate Number
CL-019-66

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

The wind direction sensor was calibrated against standard rotary encoder by comparison method. During calibration, the measurement was carried out at 45° intervals in clockwise and counter-clockwise directions after offset adjustment has been made. The flow speed of wind tunnel (usually 5 m/s) is kept constant while the sensor is rotated around its vertical axis. The results of calibration and associated measurement uncertainties are reported in the table below.

Air speed m/s	D ₁₀₀ Degree (°)	D ₁₀₀ Degree (°)	Error Degree (°)	U (k=2) Degree (°)
	0.000	0	0	0.58
4.59	45.000	41	-4	0.58
	90.000	87	-3	0.58
	135.001	132	-3	0.68
	180.000	179	-1	0.74
	225.000	227	-2	0.91
	270.001	271	1	0.58
	315.000	318	3	0.74

Remark:

¹ Calibration results only count for the tested circumstances and environmental conditions during which calibration took place.

Direction of standard

Direction of Unit Under Calibration



End of Certificate of Calibration

Page 1 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

Wind Direction Sensor

Novallux

Sensor WS-02F

Data logger 200 WS-2518

Sensor

Data logger AS376

RVG-RM14

Used item

ALS laboratory group (Thailand) Co., Ltd.

104 Phatthanakan Rd, Phatthanakan Rd, Khwaeng Suan Luang,

Khet Suan Luang, Bangkok 10150 Thailand.

Calibration procedure:

The wind direction sensor was calibrated against standard Rotary Encoder model: AY400975-D004 F15 U010 on floor legislation of E0101-type wind tunnel with 950 cm² cross test section area. The W1-C1 608 based on IEC 61400-12 1, Wind energy generation systems - Part 12 1. Power performance measurement of electricity producing wind turbines. March 2017 was used as a calibration guideline.

Traceability:

This certificate provides a traceability of the measurement to recognized the national standards, and to realization of the international system of units (SI) through the NMRI (National Metrology Institute of Thailand) via Certificate Number: DA 0043 22.

Uncertainty of Measurement

The reported uncertainty of measurement is based on the standard uncertainty multiplied by a coverage factor k=2. Which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty has been determined in accordance with the GUM 'Evaluation of measurement data - Guide to the expression of uncertainty in measurement'.

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follows:

Temperature 23.0 ± 3.0 °C

Relative Humidity 55.0 ± 15.0 %RH

Atmospheric Pressure 1010 ± 10 hPa

PLACE OF CALIBRATION

Pitot-type wind tunnel of Jirantee Associates Co., Ltd.

CALIBRATION CONDITION

Wind tunnel cross-section area¹ 950 cm²

Win direct on frontal area² 129 cm²

Diameter of mounting pipe³ mm

Blockage ratio of test object⁴ 0.143 [-]

Pretconditioning

Measurement Condition

24 hours at ambient conditions.

The average values during measurement are (24.0) °C, (49.0) %RH and (1014.1) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values

Calibrated by:

Mr. Sorawit Thakulad

Miss Paragorn Jiraprasitkul



Approved signature:

Mr. Parinya Booncharoen
Calibration Department Manager

Remark:

¹ Inside cross-section area of the wind tunnel

² Projected cross-section area of the tested object include mounting pipe

³ Diameter of mounting pipe

⁴ Ratio 1/3

THIS CERTIFICATE OF CALIBRATION MAY NOT BE REPRODUCED EXCEPT IN FULL UNLESS PERMISSION FOR REPRODUCTION HAS BEEN OBTAINED IN WRITING FROM THE LABORATORY

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

451-451/1 Sirinthon Rd, Bangbunru, Bangplud Bangkok 10700 THAILAND
Tel:0-2435-8800 Fax:0-2433-1679 e-mail:cal-center@sithiporn.com http://www.sithiporn.com



Cert. No. : ACC23005
Pages : 1 of 3

Calibration Certificate

Equipment : SOUND CALIBRATOR
Manufacturer : RION
Model : NC-75
Serial No.: 35002736
ID No.: RYG_FS0496

Condition As Found : GOOD

Customer : A.I.S. LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHWAENG PHATTHANAKAN, KHET SUAN LUANG,
BANGKOK, 10250 THAILAND.

Location :
Ambient Temperature : (23.0 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %

Received Date : 06 JANUARY 2023
Calibration Date : 17 JANUARY 2023
Date of Issue : 19 JANUARY 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by :

(Thanakul Petchumai)

This certificate is issued in accordance with the requirements of ISO/IEC 17025 standard, may not be reproduced other than in full, except with the prior written approval of the head of Calibration Laboratory.

QI-TS12-04-04-020664

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACC23005
Job No. : YC66AC0024
Pages : 2 of 3

Calibration Procedure : CP-AC-03

Calibration Method :

This equipment was calibrated by based on IEC-60942-2003 Standard.

The sound pressure level, frequency and total distortion of the sound calibrator was measured using the reference microphone.

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL-BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL-BP. 03/0265	09-Feb-23
Digital Multimeter	33461A	MY60024273	EEL-BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	-180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-12KAI	34560495	AA-3005-22	22-Feb-23
Audio Analyzer	AVR-3360A	V744H6069	EF-0010-22	07-Feb-23

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.

3. This certificate is traceable to the international system of unit maintained at :

3.1 National Institute of Metrology (Thailand).

3.2 Thailand Institute of Scientific and Technological Research (TISTR).

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACC23005
Job No. : YC66AC0024
Pages : 3 of 3

Result of calibration :

1. Sound pressure level

Specified sound pressure level (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit (dB)
94	93.98	-0.02	0.14	0.40

2. Frequency

Specified Frequency (Hz)	Measured value (Hz)	Deviated value (%)	Uncertainty (%)	Tolerance limit (%)
1000	1000.0	0.0	0.1	1.0

3. Total distortion

Measured value (%)	Uncertainty (%)	Tolerance limit (%)
0.35	0.10	3.0

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor $k = 2$ or any value following calculation providing a level of confidence of approximately 95 %.

End of Calibration Certificate

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

451-451/1 Sirinthon Rd, Bangbunru, Bangplud Bangkok 10700 THAILAND
Tel:0-2435-8800 Fax:0-2433-1679 e-mail:cal-center@sithiporn.com http://www.sithiporn.com



Cert. No. : AC123047
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 01222716 / 143832 / 22763
ID No.: RYG FS0020

Condition As Found : GOOD

Customer : A.I.S. LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHWAENG PHATTHANAKAN, KHET SUAN LUANG,
BANGKOK, 10250 THAILAND.

Location :
Ambient Temperature : (23.0 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %

Received Date : 06 JANUARY 2023
Calibration Date : 13-18 JANUARY 2023
Date of Issue : 19 JANUARY 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by :

(Thanakul Petchumai)

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Continuation of Calibration Certificate

Cert. No. : ACL23047
Job No. : VC66AC0024
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM).
The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.
For tests results of each items were made by observation of each Instruments display and also with SLM's display.

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MYS2302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL-BP. 03/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL-BP. 03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL-BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KA1	34560495	AA-3005-22	22-Feb-23

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.
3. This certificate is traceable to the international system of unit maintained at :

- 3.1 National Institute of Metrology (Thailand).
3.2 Thailand Institute of Scientific and Technological Research (TISTR).

QF-TS12-04-04-020664

P.L.A.

Continuation of Calibration Certificate

Cert. No. : ACL23047
Job No. : VC66AC0024
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
15.1

2.2 The microphone of the sound level meter was replaced by electrical signal input device.

Frequency Weighting	Measured value (dB)
A - weight	11.6
C - weight	17.9
Flat	23.8

3. Acoustical signal tests of frequency weightings

Meter free-field acoustic response at a level of 94 dB

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.5	0.5	0.5	± 1.5
1000	0.1	0.1	0.1	± 1.0
8000	-1.3	-1.2	-1.2	± 5.0

QF-TS12-04-04-020664

P.L.A.

Continuation of Calibration Certificate

Cert. No. : ACL23047
Job No. : VC66AC0024
Pages : 3 of 8

Summary of Measurement Result :

Parameter	Pass	Fail	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
1. Absolute sensitivity	✓	-	0.2	N/A
2. Self-generated noise	✓	-	0.2	N/A
3. Acoustical signal tests of frequency weightings				
125 Hz	✓	-	0.3	0.6
1000 Hz	✓	-	0.3	0.6
8000 Hz	✓	-	0.3	0.7
4. Electrical signal tests of frequency weightings				
For 10 Hz to 4 kHz	✓	-	0.3	0.6
For > 4 kHz to 10 kHz	✓	-	0.3	0.7
For > 10 kHz to 20 kHz	-	-	-	1.0
5. Frequency and time weightings at 1 kHz	✓	-	0.2	0.2
6. Long - term stability	✓	-	0.1	0.1
7. Level linearity on the reference level range	✓	-	0.2	0.3
8. Level linearity including the level range control	✓	-	0.2	0.3
9. Tone burst response	✓	-	0.2	0.3
10. Peak C sound level	✓	-	0.2	0.35
11. Overload indication	✓	-	0.2	0.25
12. High level stability	✓	-	0.1	0.1

QF-TS12-04-04-020664

P.L.A.

Continuation of Calibration Certificate

Cert. No. : ACL23047
Job No. : VC66AC0024
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
63	0.0	0.0	0.0	±2.0
125	0.0	0.1	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.1	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.1	0.0	±2.0
4000	0.0	0.1	0.0	±3.0
8000	0.1	0.1	0.1	±5.0

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	94.0	0.0	-
C - weight	94.0	0.0	± 0.2
Flat	94.0	0.0	± 0.2

5.2 Time weighting at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	94.0	0.0	-
Slow	94.0	0.0	± 0.1
Leq	94.0	0.0	± 0.1

6. Long - term stability

Frequency Weighting	SI M Display at initial (dB)	SI M Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	94.0	94.1	0.1	± 0.3

QF-TS12-04-04-020664

P.L.A.

Continuation of Calibration Certificate

Cert. No. : ACL23047
Job No. : VC66AC0024
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.1	0.1	± 1.1
134.0	134.1	0.1	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.1	0.1	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.1	0.1	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	27.9	-0.1	± 1.1
27.0	26.9	-0.1	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.9	-0.1	± 1.1

QF-TS12-04-04-020664

T. Petchurai

Continuation of Calibration Certificate

Cert. No. : ACL23047
Job No. : VC66AC0024
Pages : 7 of 8

8. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Auto	94.0	94.0	0.0	± 1.1

9. Tone burst response

Time Weighting	Tone burst duration, Tb (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	116.9	-0.1	1.0 ; -2.5
	200	800	134.0	134.0	0.0	± 1.0
Slow	2	8	108.0	107.9	-0.1	1.5 ; -5.0
	200	800	127.6	127.6	0.0	± 1.0
	0.25	1	99.0	98.8	-0.2	1.5 ; -5.0
SEL	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.0	0.0	± 1.0

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, Lepeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	135.4	-1.0	± 3.0

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
Positive half cycle	135.4	135.1	-0.3	± 2.0
Negative half cycle	135.4	135.1	-0.3	± 2.0

QF-TS12-04-04-020664

T. Petchurai

Continuation of Calibration Certificate

Cert. No. : ACL23047
Job No. : VC66AC0024
Pages : 8 of 8

11. Overload Indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.5	89.6	0.1	± 1.5

12. High level stability

Frequency Weighting	S.L.M Display at initial (dB)	S.L.M Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A-weight	137.0	137.0	0.0	± 0.3

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor $k = 2$ or any value following calculation, providing a level of confidence of approximately 95 %

End of Calibration Certificate

QF-TS12-04-04-020664

T. Petchurai

451-451/1 Sitrinthorn Rd, Bangbunru, Bangplud Bangkok 10700 THAILAND
Tel:0-2435-8800 Fax:0-2433-1679 e-mail:cal-center@sithiporn.com http://www.sithiporn.comCert. No. : ACC23009
Pages : 1 of 3

Calibration Certificate

Equipment : SOUND CALIBRATOR
Manufacturer : RION
Model : NC-74
Serial No. : 34178121
ID No. : RYG_FS0213

Condition As Found : GOOD

Customer : AIS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHWAENG PHATTHANAKAN, KHET SUAN LUANG,
BANGKOK, 10250 THAILAND.

Location :
Ambient Temperature : (23.0 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %

Received Date : 24 JANUARY 2023
Calibration Date : 26 JANUARY 2023
Date of Issue : 27 JANUARY 2023

Calibrated by : Naibakorn Pisutpaisan

Approved by :

(Thanakul Petchurai)

This certificate is issued in accordance with the requirements of ISO/IEC 17025 standard, may not be reproduced other than in full, except with the prior written approval of the head of Calibration Laboratory.

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACC23009
Job No. : VC66AC0031
Pages : 2 of 3

Calibration Procedure : CP-AC-03

Calibration Method :

This equipment was calibrated by based on IEC-60942-2003 Standard.

The sound pressure level, frequency and total distortion of the sound calibrator was measured using the reference microphone.

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0265	09-Feb-23
Digital Multimeter	33461A	MY60024273	EEL.BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23
Audio Analyzer	AVR-3360A	V744B6069	EF-0010-22	07-Feb-23

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.

3. This certificate is traceable to the international system of unit maintained at :

3.1 National Institute of Metrology (Thailand).

3.2 Thailand Institute of Scientific and Technological Research (TISTR).

Continuation of Calibration Certificate

Cert. No. : ACC23009
Job No. : VC66AC0031
Pages : 3 of 3

Result of calibration :

1. Sound pressure level

Specified sound pressure level (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit (dB)
94	94.16	0.16	0.14	0.40

2. Frequency

Specified Frequency (Hz)	Measured value (Hz)	Deviated value (%)	Uncertainty (%)	Tolerance limit (%)
1000	1003.2	0.3	0.1	1.0

3. Total distortion

Measured value (%)	Uncertainty (%)	Tolerance limit (%)
1.97	0.10	3.0

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor $k = 2$ or any value following calculation, providing a level of confidence of approximately 95 %

End of Calibration Certificate —

QF-TS12-04-04-020664

QF-TS12-04-04-020664

SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY

451-451/1 Sirinithorn Rd., Bangbunru, Bangplud Bangkok 10700 THAILAND
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Cert. No. : ACL23082
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No. : 00734220 / 145272 / 34370
ID No. : RYG_FS0026

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHWAENG PHATTHANAKAN, KHET SUAN LUANG,
BANGKOK, 10250 THAILAND

Location : -
Ambient Temperature : (23.0 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %

Received Date : 24 JANUARY 2023
Calibration Date : 25-26 JANUARY 2023
Date of Issue : 27 JANUARY 2023

Calibrated by : Nattakorn Pisutpaisan

Approved by :

T. Petchurai
(Thanakul Petchurai)

This certificate is issued in accordance with the requirements of ISO/IEC 17025 standard, may not be reproduced other than in full, except with the prior written approval of the head of Calibration Laboratory.

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23082
Job No. : VC66AC0031
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM).

The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.

For tests results of each items were made by observation of each Instruments display and also with SLM's display.

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL.BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.

3. This certificate is traceable to the international system of unit maintained at :

3.1 National Institute of Metrology (Thailand).

3.2 Thailand Institute of Scientific and Technological Research (TISTR).

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23082
Job No. : VC66AC0031
Pages : 3 of 8

Summary of Measurement Result :

Parameter	Pass	Fail	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
1. Absolute sensitivity	✓	-	0.2	N/A
2. Self-generated noise	✓	-	0.2	N/A
3. Acoustical signal tests of frequency weightings				
125 Hz	✓	-	0.3	0.6
1000 Hz	✓	-	0.3	0.6
8000 Hz	✓	-	0.3	0.7
4. Electrical signal tests of frequency weightings				
For 10 Hz to 4 kHz	✓	-	0.3	0.6
For > 4 kHz to 10 kHz	✓	-	0.3	0.7
For > 10 kHz to 20 kHz	-	-	-	1.0
5. Frequency and time weightings at 1 kHz	✓	-	0.2	0.2
6. Long - term stability	✓	-	0.1	0.1
7. Level linearity on the reference level range	✓	-	0.2	0.3
8. Level linearity including the level range control	✓	-	0.2	0.3
9. Tone burst response	✓	-	0.2	0.3
10. Peak C sound level	✓	-	0.2	0.35
11. Overload indication	✓	-	0.2	0.25
12. High level stability	✓	-	0.1	0.1

QF-TS12-04-04-020664

T. Petch.

Continuation of Calibration Certificate

Cert. No. : ACL23082
Job No. : VC66AC0031
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
15.6

2.2 The microphone of the sound level meter was replaced by electrical signal input device.

Frequency Weighting	Measured value (dB)
A - weight	12.0
C - weight	18.3
Flat	24.1

3. Acoustical signal tests of frequency weightings

Meter free-field acoustic response at a level of 84 dB

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			Acceptance Limits
	Flat	C-weight	A-weight	
125	0.2	0.2	0.2	± 1.5
1000	-0.1	-0.1	-0.1	± 1.0
8000	-1.6	-1.5	-1.5	±5.0

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T. Petch.

Continuation of Calibration Certificate

Cert. No. : ACL23082
Job No. : VC66AC0031
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
63	-0.1	-0.1	-0.1	±2.0
125	-0.1	0.0	-0.1	±1.5
250	0.0	-0.1	-0.1	±1.5
500	0.0	0.0	-0.1	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.0	0.0	±5.0

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	94.0	0.0	-
C - weight	94.0	0.0	± 0.2
Flat	94.0	0.0	± 0.2

5.2 Time weighting at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	94.0	0.0	-
Slow	94.0	0.0	± 0.1
Leq	94.0	0.0	± 0.1

6. Long - term stability

Frequency Weighting	SLM Display at initial (dB)	SLM Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	94.0	94.1	0.1	± 0.3

QF-TS12-04-04-020664

T. Petch.

Continuation of Calibration Certificate

Cert. No. : ACL23082
Job No. : VC66AC0031
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.1	0.1	± 1.1
134.0	134.1	0.1	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.1	0.1	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.1	0.1	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	33.9	-0.1	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	27.9	-0.1	± 1.1
27.0	26.9	-0.1	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.8	-0.2	± 1.1

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T. Petch.

Continuation of Calibration Certificate

Cert. No. : ACL23082
Job No. : VC66AC0031
Pages : 7 of 8

8. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Auto	94.0	94.0	0.0	±1.1

9. Tone burst response

Time Weighting	Tone burst duration, Tb (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.9	-0.1	1.5 / -5.0
	2	8	117.0	116.9	-0.1	1.0 / -2.5
	200	800	134.0	134.0	0.0	±1.0
Slow	2	8	108.0	107.9	-0.1	1.5 / -5.0
	200	800	127.6	127.6	0.0	±1.0
	0.25	1	99.0	98.8	-0.2	1.5 / -5.0
SEL	2	8	108.0	107.9	-0.1	1.0 / -2.5
	200	800	128.0	128.0	0.0	±1.0

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, L _{peak} (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	136.3	-0.1	±3.0

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
Positive half cycle	135.4	135.1	-0.3	±2.0
Negative half cycle	135.4	135.1	-0.3	±2.0

QF-TS12-04-04-020664

T. Petchur

SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY

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Cert. No. : ACL23083
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/Microphone UC-52 / Preamplifier NH-24
Serial No. : 00734225 / 157777 / 22653
ID No. : RYG_FS0030

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHWAENG PHATTHANAKAN, KHET SUAN LUANG,
BANGKOK, 10250 THAILAND.

Location :
Ambient Temperature : (23.0 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %

Received Date : 24 JANUARY 2023
Calibration Date : 25-26 JANUARY 2023
Date of Issue : 27 JANUARY 2023

Calibrated by : Nakhorn Pisutpaisan

Approved by :

T. Petchur
(T. Petchur)

This certificate is issued in accordance with the requirements of ISO/IEC 17025 standard, may not be reproduced other than in full, except with the prior written approval of the head of Calibration Laboratory.

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23082
Job No. : VC66AC0031
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11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.6	89.5	-0.1	±1.5

12. High level stability

Frequency Weighting	SLM Display at initial (dB)	SLM Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A-weight	137.0	137.0	0.0	±0.3

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor $k = 2$ or any value following calculation, providing a level of confidence of approximately 95 %

End of Calibration Certificate

QF-TS12-04-04-020664

T. Petchur

SITHIPORN / SITHIPORN ASSOCIATES CO.,LTD.
associates
CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACL23083
Job No. : VC66AC0031
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM). The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments. For tests results of each items were made by observation of each Instruments display and also with SLM's display.

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Exp. Date
Waveform Generator	33210A	MY48017076	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL-BP_04/02/23	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL-BP_03/02/23	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL-BP_05/02/23	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1613-22	24-Feb-23
Measuring Amplifier	NA-42KA1	34560495	AA-3003-22	22-Feb-23

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.

3. This certificate is traceable to the international system of unit maintained at :

3.1 National Institute of Metrology (Thailand).

3.2 Thailand Institute of Scientific and Technological Research (TISTR).

QF-TS12-04-04-020664

T. Petchur

Continuation of Calibration Certificate

Cert. No. : ACL23083
Job No. : VC66AC0031
Pages : 3 of 8

Summary of Measurement Result:

Parameter	Pass	Fail	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
1. Absolute sensitivity	✓	-	0.2	N/A
2. Self-generated noise	✓	-	0.2	N/A
3. Acoustical signal tests of frequency weightings				
125 Hz	✓	-	0.3	0.6
1000 Hz	✓	-	0.3	0.6
8000 Hz	✓	-	0.3	0.7
4. Electrical signal tests of frequency weightings				
For 10 Hz to 4 kHz	✓	-	0.3	0.6
For > 4 kHz to 10 kHz	✓	-	0.3	0.7
For > 10 kHz to 20 kHz	-	-	-	1.0
5. Frequency and time weightings at 1 kHz	✓	-	0.2	0.2
6. Long - term stability	✓	-	0.1	0.1
7. Level linearity on the reference level range	✓	-	0.2	0.3
8. Level linearity including the level range control	✓	-	0.2	0.3
9. Tone burst response	✓	-	0.2	0.3
10. Peak C sound level	✓	-	0.2	0.35
11. Overload indication	✓	-	0.2	0.25
12. High level stability	✓	-	0.1	0.1

QF-TS12-04-04-020664

T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23083
Job No. : VC66AC0031
Pages : 4 of 8

Result of calibration:

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
19.3

2.2 The microphone of the sound level meter was replaced by electrical signal input device.

Frequency Weighting	Measured value (dB)
A - weight	13.1
C - weight	19.1
Flat	24.9

3. Acoustical signal tests of frequency weightings

Meter free-field acoustic response at a level of 84 dB

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.3	0.3	0.3	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-1.1	-1.1	-1.0	±5.0

QF-TS12-04-04-020664

T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23083
Job No. : VC66AC0031
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
63	0.0	-0.1	0.0	±2.0
125	0.0	0.0	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.1	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.1	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.1	0.1	±5.0

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	94.0	0.0	-
C - weight	94.0	0.0	± 0.2
Flat	94.0	0.0	± 0.2

5.2 Time weighting at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	94.0	0.0	-
Slow	94.0	0.0	± 0.1
Leq	94.0	0.0	± 0.1

6. Long - term stability

Frequency Weighting	SLM Display at initial (dB)	SLM Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	94.0	94.1	0.1	± 0.3

QF-TS12-04-04-020664

T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23083
Job No. : VC66AC0031
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	38.9	-0.1	± 1.1
34.0	34.0	0.0	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	27.9	-0.1	± 1.1
27.0	26.9	-0.1	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.9	-0.1	± 1.1

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T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23083
Job No. : VC66AC0031
Pages : 7 of 8

8. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Auto	94.0	94.0	0.0	±1.1

9. Tone burst response

Time Weighting	Tone burst duration, Tb (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.9	-0.1	1.5 / -5.0
	2	8	117.0	117.0	0.0	1.0 / -2.5
	200	800	134.0	134.1	0.1	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 / -5.0
	200	800	127.6	127.6	0.0	±1.0
SEL	0.25	1	99.0	98.9	-0.1	1.5 / -5.0
	2	8	108.0	108.0	0.0	1.0 / -2.5
	200	800	128.0	128.1	0.1	±1.0

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, L _{peak} (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	136.0	-0.4	±3.0

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	135.0	133.1	0.1	-
Positive half cycle	135.4	135.2	-0.2	±2.0
Negative half cycle	135.4	135.2	-0.2	±2.0

Continuation of Calibration Certificate

Cert. No. : ACL23083
Job No. : VC66AC0031
Pages : 8 of 8

11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle	0.0	±1.5
89.6	89.6		

12. High level stability

Frequency Weighting	SLM Display at initial (dB)	SLM Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A-weight	137.0	137.1	-0.1	±0.3

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor $k = 2$ or any value following calculation, providing a level of confidence of approximately 95 %

End of Calibration Certificate

QF-TS12-04-04-020664

T. Petchur

SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY451-451/1 Srinthom Rd., Bangbunru, Bangplud Bangkok 10700 THAILAND
Tel: 0-2435-8800 Fax: 0-2433-1679 e-mail: cal-center@sithiporn.com http://www.sithiporn.comCert. No. : ACL23077
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/Microphone UC-52 / Pre-amplifier NH-24
Serial No.: 00233184 / 144837 / 23232
ID No.: RYG, JS0025

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHIWAENG PHATTHANAKAN, KHET SUAN1 UANG,
BANGKOK, 10250 THAILAND.

Location : -
Ambient Temperature : (23.0 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %

Received Date : 24 JANUARY 2023
Calibration Date : 25-26 JANUARY 2023
Date of Issue : 27 JANUARY 2023

Calibrated by : Natchorn Pisutpaisan

Approved by :

T. Petchur
(Thanakul Petchurai)

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QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23077
Job No. : VC66AC0031
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM).
The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.
For tests results of each items were made by observation of each Instruments display and also with SLM's display.

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL-BP. 03/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL-BP. 03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL-BP. 03/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1613-22	24-Feb-23
Measuring Amplifier	NA-42KA1	34560495	AA-3005-22	22-Feb-23

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.

3. This certificate is traceable to the international system of unit maintained at :

3.1 National Institute of Metrology (Thailand).

3.2 Thailand Institute of Scientific and Technological Research (TISTR)

QF-TS12-04-04-020664

T. Petchur

Continuation of Calibration Certificate

Cert. No. : ACL23077
Job No. : VC66AC0031
Pages : 3 of 8

Summary of Measurement Result:

Parameter	Pass	Fail	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
1. Absolute sensitivity	✓	-	0.2	N/A
2. Self-generated noise	✓	-	0.2	N/A
3. Acoustical signal tests of frequency weightings				
125 Hz	✓	-	0.3	0.6
1000 Hz	✓	-	0.3	0.6
8000 Hz	✓	-	0.3	0.7
4. Electrical signal tests of frequency weightings				
For 10 Hz to 4 kHz	✓	-	0.3	0.6
For > 4 kHz to 10 kHz	✓	-	0.3	0.7
For > 10 kHz to 20 kHz	-	-	-	1.0
5. Frequency and time weightings at 1 kHz	✓	-	0.2	0.2
6. Long - term stability	✓	-	0.1	0.1
7. Level linearity on the reference level range	✓	-	0.2	0.3
8. Level linearity including the level range control	✓	-	0.2	0.3
9. Tone burst response	✓	-	0.2	0.3
10. Peak C sound level	✓	-	0.2	0.35
11. Overload indication	✓	-	0.2	0.25
12. High level stability	✓	-	0.1	0.1

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23077
Job No. : VC66AC0031
Pages : 4 of 8

Result of calibration:

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.2

2.2 The microphone of the sound level meter was replaced by electrical signal input device.

Frequency Weighting	Measured value (dB)
A - weight	10.8
C - weight	17.1
Flat	22.8

3. Acoustical signal tests of frequency weightings

Meter free-field acoustic response at a level of 84 dB

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			Acceptance Limits
	Flat	C-weight	A-weight	
125	0.2	0.2	0.2	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-1.0	-0.9	-0.8	±5.0

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23077
Job No. : VC66AC0031
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			Acceptance Limits
	Flat	C-weight	A-weight	
63	0.0	0.0	0.0	±2.0
125	0.0	0.1	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.1	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.1	0.1	±2.0
4000	0.0	0.1	0.1	±3.0
8000	0.1	0.1	0.1	±5.0

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	94.0	0.0	-
C - weight	94.0	0.0	± 0.2
Flat	94.0	0.0	± 0.2

5.2 Time weighting at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	94.0	0.0	-
Slow	94.0	0.0	± 0.1
Leq	94.0	0.0	± 0.1

6. Long - term stability

Frequency Weighting	SLM Display at initial (dB)	SLM Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	94.0	94.1	0.1	± 0.3

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23077
Job No. : VC66AC0031
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.1	0.1	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	29.0	0.0	± 1.1
28.0	27.9	-0.1	± 1.1
27.0	27.0	0.0	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.9	-0.1	± 1.1

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23077
Job No. : VC66AC0031
Pages : 7 of 8

8. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Auto	94.0	94.0	0.0	±1.1

9. Tone burst response

Time Weighting	Tone burst duration, T _b (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	108.0	0.0	1.5 / -5.0
	2	8	117.0	117.0	0.0	1.0 / -2.5
	200	800	134.0	134.1	0.1	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 / -5.0
	200	800	127.6	127.6	0.0	±1.0
SEL	0.25	1	99.0	98.9	-0.1	1.5 / -5.0
	2	8	108.0	108.0	0.0	1.0 / -2.5
	200	800	128.0	128.0	0.0	±1.0

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, L _{peak} (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	136.4	0.0	±3.0

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	132.9	-0.1	-
Positive half cycle	135.4	135.1	-0.3	±2.0
Negative half cycle	135.4	135.1	-0.3	±2.0

Continuation of Calibration Certificate

Cert. No. : ACL23077
Job No. : VC66AC0031
Pages : 8 of 8

11. Overload Indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle	0.2	±1.5
89.5	89.7		

12. High level stability

Frequency Weighting	SIM Display at initial (dB)	SIM Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A-weight	137.0	137.0	0.0	±0.3

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor $k = 2$ or any value following calculation, providing a level of confidence of approximately 95 %

End of Calibration Certificate

QF-TS12-04-04-020664

QF-TS12-04-04-020664

SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY

451-451/1 Sirinthorn Rd., Bangbunru, Bangpu Bangkok 10700 THAILAND
Tel: 0-2435-8800 Fax: 0-2433-1679 e-mail: cal-center@sithiporn.com http://www.sithiporn.com



Cert. No. : ACL22296
Pages : 1 of 9

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-21 / Microphone UC-52 / Preamplifier NH-21
Serial No. : 00376364 / 71486 / 23142
ID No. : RYG, FS0012

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATHANAKAN 40, PHATHANAKAN ROAD,
KHWAENG PHATHANAKAN, KHET SUAN LUANG,
BANGKOK, 10250 THAILAND.

Location : -
Ambient Temperature : (23.0 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %

Received Date : 07 DECEMBER 2022
Calibration Date : 16-20 DECEMBER 2022
Date of Issue : 21 DECEMBER 2022

Calibrated by : Natthakorn Pitsutparan

Approved by :

T. Petchur
(Thanakul Petchur)

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SITHIPORN / SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACL22296
Job No. : VC66AC0016
Pages : 2 of 9

Calibration Procedure : CP-AC-02

Calibration Method :

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM). The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.
For tests results of each items were made by observation of each Instruments display and also with SLM's display.

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL-BP_04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL-BP_03/0265	09-Feb-23
Digital Multimeter	8846A	MY60024273	EEL-BP_05/0265	09-Feb-23
Programmable Attenuator	MA1-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KA1	34560495	AA-2003-22	22-Feb-23

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.

3. This certificate is traceable to the international system of unit maintained at :

3.1 National Institute of Metrology (Thailand)

3.2 Thailand Institute of Scientific and Technological Research (TISTR)

QF-TS12-04-04-020664

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22296
Job No. : VC66AC0016
Pages : 3 of 9

Summary of Measurement Result :

Parameter	Pass	Fail	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
1. Absolute sensitivity	✓	-	0.2	N/A
2. Self-generated noise	✓	-	0.2	N/A
3. Acoustical signal tests of frequency weightings				
125 Hz	✓	-	0.3	0.6
1000 Hz	✓	-	0.3	0.6
8000 Hz	✓	-	0.3	0.7
4. Electrical signal tests of frequency weightings				
For 10 Hz to 4 kHz	✓	-	0.3	0.6
For > 4 kHz to 10 kHz	✓	-	0.3	0.7
For > 10 kHz to 20 kHz	-	-	-	1.0
5. Frequency and time weightings at 1 kHz	✓	-	0.2	0.2
6. Long - term stability	✓	-	0.1	0.1
7. Level linearity on the reference level range	✓	-	0.2	0.3
8. Level linearity including the level range control	✓	-	0.2	0.3
9. Tone burst response	✓	-	0.2	0.3
10. Peak C sound level	✓	-	0.2	0.35
11. Overload indication	✓	-	0.2	0.25
12. High level stability	✓	-	0.1	0.1

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22296
Job No. : VC66AC0016
Pages : 4 of 9

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
24.0

2.2 The microphone of the sound level meter was replaced by electrical signal input device.

Frequency Weighting	Measured value (dB)
A - weight	22.2
C - weight	21.9
Flat	21.6

3. Acoustical signal tests of frequency weightings

Meter free-field acoustic response at a level of 84 dB

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			Acceptance Limits
	Flat	C-weight	A-weight	
125	0.0	0.1	0.1	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	0.2	0.4	0.4	±5.0

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22296
Job No. : VC66AC0016
Pages : 5 of 9

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			Acceptance Limits
	Flat	C-weight	A-weight	
63	-0.2	0.0	0.0	±2.0
125	-0.1	0.0	0.0	±1.5
250	-0.1	0.0	0.0	±1.5
500	-0.1	0.0	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.1	0.1	±2.0
4000	0.0	0.1	0.1	±3.0
8000	0.0	0.2	0.2	±5.0

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	94.0	0.0	-
C - weight	94.0	0.0	± 0.2
Flat	94.1	0.1	± 0.2

5.2 Time weighting at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	94.0	0.0	-
Slow	94.0	0.0	± 0.1
Leq	94.0	0.0	± 0.1

6. Long - term stability

Frequency Weighting	SLM Display at initial (dB)	SLM Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	94.0	94.0	0.0	± 0.3

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22296
Job No. : VC66AC0016
Pages : 6 of 9

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1

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Continuation of Calibration Certificate

Cert. No. : ACL22296
Job No. : VC66AC0016
Pages : 7 of 9

8. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
130	94.0	94.0	0.0	±0.5
120	94.0	94.0	0.0	±0.5
110	94.0	94.0	0.0	±0.5
100	94.0	94.0	0.0	±0.5
90	94.0	94.0	0.0	±0.5

Level linearity on each level range

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
130	43.0	43.0	0.0	±0.5
120	33.0	33.0	0.0	±0.5

9. Tone burst response

Time Weighting	Tone burst duration, Tb (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	108.0	0.0	1.5, -5.0
	2	8	117.0	117.0	0.0	1.0, -2.5
	200	800	134.0	134.0	0.0	±1.0
Slow	2	8	108.0	108.0	0.0	1.5, -5.0
	200	800	127.6	127.6	0.0	±1.0
SEL	0.25	1	99.0	98.9	-0.1	1.5, -5.0
	2	8	108.0	108.0	0.0	1.0, -2.5
	200	800	128.0	128.0	0.0	±1.0

QF-TS12-04-04-020664

T. Petch...

Continuation of Calibration Certificate

Cert. No. : ACL22296
Job No. : VC66AC0016
Pages : 9 of 9

12. High level stability

Frequency Weighting	SLM Display at initial (dB)	SLM Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A-weight	137.0	137.0	0.0	±0.3

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor $k \approx 2$ or any value following calculation providing a level of confidence of approximately 95 %

End of Calibration Certificate

Continuation of Calibration Certificate

Cert. No. : ACL22296
Job No. : VC66AC0016
Pages : 8 of 9

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, L _{peak} (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	126.4	126.0	-0.4	±3.0

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
Positive half cycle	135.4	135.1	-0.3	±2.0
Negative half cycle	135.4	135.1	-0.3	±2.0

11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle	Value (dB)	Limits (dB)
89.4	89.2	-0.2	±1.5

QF-TS12-04-04-020664

T. Petch...

451-451/1 Sirinthorn Rd., Bangbunru, Bangkok 10700 THAILAND
Tel:0-2435-6800 Fax:0-2433-1679 e-mail:cal-center@sithiporn.com http://www.sithiporn.comCert. No. : ACL22295
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00233183 / 144835 / 23230
ID No.: RYG_FS0024

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAI AND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHWAENG PHATTHANAKAN, KHET SUAN LUANG,
BANGKOK, 10250 THAILAND.

Location :
Ambient Temperature : (23.0 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %

Received Date : 07 DECEMBER 2022
Calibration Date : 16-20 DECEMBER 2022
Date of Issue : 21 DECEMBER 2022

Calibrated by : Nadsakorn Pritupaisan

Approved by :

T. Petch...
(Thanasakul Petchurui)

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QF-TS12-04-04-020664

T. Petch...

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22295
Job No. : VC66AC0016
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM).

The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.

For tests results of each items were made by observation of each Instruments display and also with SLM's display.

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL.BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.

3. This certificate is traceable to the international system of unit maintained at :

3.1 National Institute of Metrology (Thailand).

3.2 Thailand Institute of Scientific and Technological Research (TISTR).

QF-TS12-04-04-020664

T. Petch.

Continuation of Calibration Certificate

Cert. No. : ACL22295
Job No. : VC66AC0016
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
19.3

2.2 The microphone of the sound level meter was replaced by electrical signal input device.

Frequency Weighting	Measured value (dB)
A - weight	14.8
C - weight	20.6
Flat	26.5

3. Acoustical signal tests of frequency weightings

Meter free-field acoustic response at a level of 84 dB

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	-0.1	-0.1	-0.1	± 1.5
1000	-0.1	-0.1	-0.1	± 1.0
8000	0.3	0.4	0.4	±5.0

QF-TS12-04-04-020664

T. Petch.

Continuation of Calibration Certificate

Cert. No. : ACL22295
Job No. : VC66AC0016
Pages : 3 of 8

Summary of Measurement Result :

Parameter	Pass	Fail	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
1. Absolute sensitivity	✓	-	0.2	N/A
2. Self-generated noise	✓	-	0.2	N/A
3. Acoustical signal tests of frequency weightings				
125 Hz	✓	-	0.3	0.6
1000 Hz	✓	-	0.3	0.6
8000 Hz	✓	-	0.3	0.7
4. Electrical signal tests of frequency weightings				
For 10 Hz to 4 kHz	✓	-	0.3	0.6
For > 4 kHz to 10 kHz	✓	-	0.3	0.7
For > 10 kHz to 20 kHz	-	-	-	1.0
5. Frequency and time weightings at 1 kHz	✓	-	0.2	0.2
6. Long - term stability	✓	-	0.1	0.1
7. Level linearity on the reference level range	✓	-	0.2	0.3
8. Level linearity including the level range control	✓	-	0.2	0.3
9. Tone burst response	✓	-	0.2	0.3
10. Peak C sound level	✓	-	0.2	0.35
11. Overload indication	✓	-	0.2	0.25
12. High level stability	✓	-	0.1	0.1

QF-TS12-04-04-020664

T. Petch.

Continuation of Calibration Certificate

Cert. No. : ACL22295
Job No. : VC66AC0016
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
63	0.0	0.0	0.0	±2.0
125	0.0	0.0	0.0	±1.5
250	0.0	0.0	-0.1	±1.5
500	0.0	0.0	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.1	0.1	±5.0

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	94.0	0.0	-
C - weight	94.0	0.0	± 0.2
Flat	94.0	0.0	± 0.2

5.2 Time weighting at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	94.0	0.0	-
Slow	94.0	0.0	± 0.1
Leq	94.0	0.0	± 0.1

6. Long - term stability

Frequency Weighting	SLM Display at initial (dB)	SLM Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	94.0	94.0	0.0	± 0.3

QF-TS12-04-04-020664

T. Petch.

Continuation of Calibration Certificate

Cert. No. : ACL22295
Job No. : VC66AC0016
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	±1.1
136.0	136.0	0.0	±1.1
135.0	135.0	0.0	±1.1
134.0	134.0	0.0	±1.1
133.0	133.0	0.0	±1.1
132.0	132.0	0.0	±1.1
131.0	131.0	0.0	±1.1
129.0	129.0	0.0	±1.1
124.0	124.0	0.0	±1.1
119.0	119.0	0.0	±1.1
114.0	114.0	0.0	±1.1
109.0	109.0	0.0	±1.1
104.0	104.0	0.0	±1.1
99.0	99.0	0.0	±1.1
94.0	94.0	0.0	±1.1
89.0	89.0	0.0	±1.1
84.0	84.0	0.0	±1.1
79.0	79.0	0.0	±1.1
74.0	74.0	0.0	±1.1
69.0	69.0	0.0	±1.1
64.0	64.0	0.0	±1.1
59.0	59.0	0.0	±1.1
54.0	53.9	-0.1	±1.1
49.0	49.0	0.0	±1.1
44.0	43.9	-0.1	±1.1
39.0	38.9	-0.1	±1.1
34.0	33.9	-0.1	±1.1
30.0	29.9	-0.1	±1.1
29.0	28.9	-0.1	±1.1
28.0	27.9	-0.1	±1.1
27.0	26.8	-0.2	±1.1
26.0	25.9	-0.1	±1.1
25.0	24.8	-0.2	±1.1

Continuation of Calibration Certificate

Cert. No. : ACL22295
Job No. : VC66AC0016
Pages : 7 of 8

8. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Auto	94.0	94.0	0.0	±1.1

9. Tone burst response

Time Weighting	Tone burst duration, Tb (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -3.0
	2	8	117.0	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.0	0.0	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
SEL	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.1	0.1	±1.0

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, L _{peak} (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	135.6	-0.8	±3.0

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
Positive half cycle	135.4	135.2	-0.2	±2.0
Negative half cycle	135.4	135.2	-0.2	±2.0

Q1-TS12-04-04-020664

T. Petchur

Q1-TS12-04-04-020664

T. Petchur

Continuation of Calibration Certificate

Cert. No. : ACL22295
Job No. : VC66AC0016
Pages : 8 of 8

11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.6	89.6	0.0	±1.5

12. High level stability

Frequency Weighting	SLM Display at initial (dB)	SLM Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A-weight	137.0	137.0	0.0	±0.3

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor $k = 2$ or any value following calculation, providing a level of confidence of approximately 95 %

End of Calibration Certificate

51-451/1 Sirinthorn Rd, Bangbunru, Bangplud Bangkok 10700 THAILAND
Tel: 0-2435-8900 Fax: 0-2433-1679 e-mail: cal-center@sithiporn.com http://www.sithiporn.comCert. No. : ACL23325
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 01073423 / 169513 / 73684
ID No.: RYG_FS0386

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHWAENG PHATTHANAKAN, KHET SUAN LUANG,
BANGKOK, 10250 THAILAND

Location :
Ambient Temperature : (23.0 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %

Received Date : 11 OCTOBER 2023
Calibration Date : 19-20 OCTOBER 2023
Date of Issue : 24 OCTOBER 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by : T. Petchur
(Thanakul Petchurai)

This certificate is issued in accordance with the requirements of ISO/IEC 17025 standard, may not be reproduced other than in full, except with the prior written approval of the head of Calibration Laboratory

Q1-TS12-04-04-020664

T. Petchur

Q1-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23325
Job No. : VC67AC0011
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM).

The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.

For tests results of each items were made by observation of each Instruments display and also with SLM's display.

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0009-23	07-FEB-24
Waveform Generator	33511B	MY52302742	EF-0010-23	07-FEB-24
Digital Multimeter	33461A	MY53220104	EEL.BP 30/0266	13-FEB-24
Digital Multimeter	33461A	MY53220076	EEL.BP 29/0266	13-FEB-24
Digital Multimeter	34461A	MY60024273	EEL.BP 31/0266	14-FEB-24
Programmable Attenuator	MAT-1070	62100114	EF-0011-23	08-FEB-24
Condenser Microphone	4180	2977900	AA-1001-23	14-FEB-24
Measuring Amplifier	NA-42KAJ	34560495	AA-3002-23	14-FEB-24

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.

3. This certificate is traceable to the international system of unit maintained at :

3.1 National Institute of Metrology (Thailand).

3.2 Thailand Institute of Scientific and Technological Research (TISTR).

QF-TS12-04-04-020664

P.T.A.

Continuation of Calibration Certificate

Cert. No. : ACL23325
Job No. : VC67AC0011
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.98)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
15.4

2.2 The microphone of the sound level meter was replaced by electrical signal input device.

Frequency Weighting	Measured value (dB)
A - weight	13.1
C - weight	18.8
Flat	24.6

3. Acoustical signal tests of frequency weightings

Meter free-field acoustic response at a level of 84 dB

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.2	0.2	0.2	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	1.6	1.7	1.6	±5.0

QF-TS12-04-04-020664

P.T.A.

Continuation of Calibration Certificate

Cert. No. : ACL23325
Job No. : VC67AC0011
Pages : 3 of 8

Summary of Measurement Result :

Parameter	Pass	Fail	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
1. Absolute sensitivity	✓	-	0.2	N/A
2. Self-generated noise	✓	-	0.2	N/A
3. Acoustical signal tests of frequency weightings				
125 Hz	✓	-	0.3	0.6
1000 Hz	✓	-	0.3	0.6
8000 Hz	✓	-	0.3	0.7
4. Electrical signal tests of frequency weightings				
For 10 Hz to 4 kHz	✓	-	0.3	0.6
For > 4 kHz to 10 kHz	✓	-	0.3	0.7
For > 10 kHz to 20 kHz	-	-	-	1.0
5. Frequency and time weightings at 1 kHz	✓	-	0.2	0.2
6. Long - term stability	✓	-	0.1	0.1
7. Level linearity on the reference level range	✓	-	0.2	0.3
8. Level linearity including the level range control	✓	-	0.2	0.3
9. Tone burst response	✓	-	0.2	0.3
10. Peak C sound level	✓	-	0.2	0.35
11. Overload indication	✓	-	0.2	0.25
12. High level stability	✓	-	0.1	0.1

Note : Pass/Fail evaluation for each parameter,

will be considered together from the acceptance limit and the Maximum-permitted uncertainty of measurement.

QF-TS12-04-04-020664

P.T.A.

Continuation of Calibration Certificate

Cert. No. : ACL23325
Job No. : VC67AC0011
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
63	0.0	0.0	-0.1	±2.0
125	0.0	0.0	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.0	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.1	0.1	±5.0

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

Frequency Weighting	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	94.0	94.0	0.0	± 0.2
C - weight	94.0	94.0	0.0	± 0.2
Flat	94.0	94.0	0.0	± 0.2

5.2 Time weighting at 1 kHz

Frequency Weighting	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	94.0	94.0	0.0	± 0.1
Slow	94.0	94.0	0.0	± 0.1
Leq	94.0	94.0	0.0	± 0.1

6. Long - term stability

Frequency Weighting	SLM Display at initial (dB)	SLM Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	94.0	94.0	0.0	± 0.3

QF-TS12-04-04-020664

P.T.A.

Continuation of Calibration Certificate

Cert. No. : ACL23325
Job No. : VC67AC0011
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	±1.1
136.0	136.0	0.0	±1.1
135.0	135.0	0.0	±1.1
134.0	134.0	0.0	±1.1
133.0	133.0	0.0	±1.1
132.0	132.0	0.0	±1.1
131.0	131.0	0.0	±1.1
129.0	129.0	0.0	±1.1
124.0	124.0	0.0	±1.1
119.0	119.0	0.0	±1.1
114.0	114.0	0.0	±1.1
109.0	109.0	0.0	±1.1
104.0	104.0	0.0	±1.1
99.0	99.0	0.0	±1.1
94.0	94.0	0.0	±1.1
89.0	89.0	0.0	±1.1
84.0	84.0	0.0	±1.1
79.0	79.0	0.0	±1.1
74.0	74.0	0.0	±1.1
69.0	69.0	0.0	±1.1
64.0	64.0	0.0	±1.1
59.0	59.0	0.0	±1.1
54.0	53.9	-0.1	±1.1
49.0	49.0	0.0	±1.1
44.0	43.9	-0.1	±1.1
39.0	38.9	-0.1	±1.1
34.0	33.9	-0.1	±1.1
30.0	29.9	-0.1	±1.1
29.0	28.9	-0.1	±1.1
28.0	27.9	-0.1	±1.1
27.0	26.9	-0.1	±1.1
26.0	25.9	-0.1	±1.1
25.0	24.8	-0.2	±1.1

QF-TS12-04-04-020664

T. P. Th.

Continuation of Calibration Certificate

Cert. No. : ACL23325
Job No. : VC67AC0011
Pages : 8 of 8

11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.6	89.6	0.0	±1.5

12. High level stability

Frequency Weighting	SI M Display at initial (dB)	SI M Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A-weight	137.0	137.0	0.0	±0.3

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor $k = 2$ or any value following calculation, providing a level of confidence of approximately 95 %

End of Calibration Certificate

Continuation of Calibration Certificate

Cert. No. : ACL23325
Job No. : VC67AC0011
Pages : 7 of 8

8. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Auto	94.0	94.0	0.0	±1.1

9. Tone burst response

Time Weighting	Tone burst duration, Tb (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.0	0.0	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
SEL	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.0	0.0	±1.0

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, Lepeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±3.0
One	136.4	136.1	-0.3	±3.0

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±2.0
Positive half cycle	135.4	135.2	-0.2	±2.0
Negative half cycle	135.4	135.2	-0.2	±2.0

QF-TS12-04-04-020664

T. P. Th.

Continuation of Calibration Certificate

Cert. No. : ACL23325
Job No. : VC67AC0011
Pages : 8 of 863/14-15,67/35-36, Soi Petchkasem 7/71, Petchkasem Rd,
Watthapra, Bangkok 10600 Thailand.
Tel: (66) 02-8680812 Fax: (66) 02-8680860 www.jkrantee.com

CERTIFICATE OF CALIBRATION

Certificate No.: CL-013-66
Page 1 of 2Equipment Name: Heat Stress Monitor
Manufacturer: Delta OHM
Model: HD32.2
Serial No: 18018312
ID No: RYG_FS0357Customer
Name: ALS Laboratory group (Thailand) Co., Ltd.
Address: 104 Phatthanasri 40, Phatthanasri Rd.,
Khwaeng Suan Luang, Khet Suan Luang, Bangkok
10250 ThailandReceived date: 23 Jan 2023
Calibration date: 02 Feb 2023
Issue date: 06 Feb 2023Reference Used During Calibration
1. Standard Temperature Probe Model: STS-100 A500,
Serial No.: 667682-09, Due date: 23 Mar 2023
2. Digital Temperature Indicator Model: DTH-1000 A MK
II, Serial No.: 671407-00591 Due date: 22 July 2023Calibration Condition
Temperature: (23±3)°C
Relative Humidity: (55±15)%Calibration Procedure
The temperature calibration was done by In-House
calibration method as WI-CL-001 according to
comparison method with standard digital temperature
indicator and standard temperature probe. The
temperature scale use was based on ITS 90.Traceability
The measurement results are traceable to the
international system of units (SI) through National
Institute of Metrology Thailand (NIMT) Certificate
number: TT 0034-22, Certificate number: ER 0092
22CHECKED BY: *Man/om P*
APPROVED BY: *Man/om P*
EFFECTIVE DATE: 3/3/24Calibrated by
☒ Mr. Sorawit Thachalad
☐ Miss Jitraporn LertsomphonApproved Signature: *Man/om P*
Mr. Parinya Booncharoen
Calibration Department Manager

QF-TS12-04-04-020664

T. P. Th.

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 ~ 40 °C

Function: Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 18021464.
Dimension: Diameter 14 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	20.061	20.0	-0.1	0.099
60	25.047	25.0	0.0	0.099
60	30.040	30.0	0.0	0.099
60	35.034	35.0	0.0	0.099
60	40.020	40.0	0.0	0.099

Table 2: This equipment was connected with temperature probe Model: TP3207.2 S/N: 18021263.
Dimension: Diameter 14 mm. Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.060	20.1	0.0	0.099
70	25.048	25.0	0.0	0.099
70	30.040	29.9	-0.1	0.099
70	35.034	34.9	-0.1	0.099
70	40.021	39.8	-0.2	0.099

Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 18020495.
Dimension: Diameter 8 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.060	20.1	0.0	0.14
110	25.047	25.0	0.0	0.099
110	30.040	30.0	0.0	0.099
110	35.034	35.0	0.0	0.099
110	40.020	40.0	0.0	0.099

UUC*: Unit Under Calibration

The reported expanded uncertainty is based on standard uncertainty multiplied by a coverage factor k=2 providing a level of confidence of approximately 95%.

★ End of Certificate ★



CERTIFICATE OF CALIBRATION

Certificate No.: CL-014-66
Page 1 of 2

Equipment Name: Heat Stress Monitor
Manufacturer: Delta OHM
Model: HD32.2
Serial No: 18018313
ID No: RYG_FS0358

Customer Name: ALS laboratory group (thailand) Co., Ltd.
Address: 104 Phatthanakan 40, Phatthanakan Rd.,
Khwaeng Suan Luang, Khet Suan Luang, Bangkok
10250 Thailand.

Received date: 23 Jan 2023
Calibration date: 02 Feb 2023
Issue date: 05 Feb 2023

Reference Used During Calibration
1. Standard Temperature Probe Model: STS-100 A500,
Serial No: 667682-09, Due date: 23 Mar 2023
2. Digital Temperature Indicator Model: DTI 1000 A MK
II, Serial No.: 671407 00591 Due date: 22 July 2023

Calibration Condition
Temperature: (23±3) °C
Relative Humidity: (55±15)%

Calibration Procedure
The temperature calibration was done by in-house calibration method as WI-CL-001 according to comparison method with standard digital temperature indicator and standard temperature probe The temperature scale use was based on ITS-90.

Traceability
The measurement results are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT) Certificate number: TT-0334-22. Certificate number: ER-0092-22

REVIEW BY	<i>Mr. P. P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	2/2/24

Calibrated by
☒ Mr. Sorawit Thechalad
☐ Miss Jitraporn Lertsomphol



Approved Signatory: *[Signature]*
Mr. Parinya Booncharoen
Calibration Department Manager

THIS CERTIFICATE REPORT MAY NOT BE REPRODUCED EXCEPT IN FULL UNLESS PERMISSION FOR REPRODUCTION HAS BEEN OBTAINED IN WRITING FROM THE LABORATORY.

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 ~ 40 °C

Function: Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 18021467
Dimension: Diameter 14 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	20.055	20.1	0.0	0.099
60	25.048	25.1	0.1	0.099
60	30.039	30.1	0.1	0.099
60	35.029	35.1	0.1	0.099
60	40.018	40.1	0.1	0.099

Table 2: This equipment was connected with temperature probe Model: TP3207.2 S/N: 18021270.
Dimension: Diameter 14 mm. Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.051	20.2	0.1	0.099
70	25.051	25.1	0.0	0.099
70	30.039	30.0	0.0	0.099
70	35.029	35.0	0.0	0.099
70	40.021	39.9	-0.1	0.099

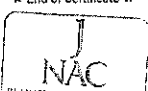
Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 18020497.
Dimension: Diameter 8 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.053	20.1	0.0	0.099
110	25.050	25.1	0.1	0.099
110	30.038	30.1	0.1	0.099
110	35.029	35.1	0.1	0.099
110	40.020	40.1	0.1	0.099

UUC*: Unit Under Calibration

The reported expanded uncertainty is based on standard uncertainty multiplied by a coverage factor k=2 providing a level of confidence of approximately 95%.

★ End of Certificate ★



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES
54/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL: 0 2712 860 79 FAX: 0 2719 9054



Cert. No.: 23CH275
Page: 1 of 3

Certificate of Calibration

Equipment: pH Meter
Manufacturer: Mettler Toledo
Model: SevenCompact S220

Serial No.: C104059460
ID No.: RYG_END183

Condition As-Received: Used Item

Received Date: 24 February 2023

Calibration Date: 27 February 2023

Reference: 2302-0860SC-2

Submitted by: ALS Laboratory Group (Thailand) Co., Ltd
(Rayong Branch)
610/10 Moo 5, T. Maenam Khu, A. Phukdaeng,
Rayong 21140, Thailand

Ambient Temperature: (25 ± 2.5) °C

Relative Humidity: (50 ± 15) %

Calibration Procedure: In-house method
- CP-CH5 by direct measurement with standard voltage calibrator and direct measurement with certified reference material (CRM)
- CP-CH8 by comparison with standard thermometer

Calibrated by: Walalak Sinithean

Approved by: *[Signature]*
Approved Signatory

() Malee Bulkruea
(✓) Saithip Meangmai
() Warakorn Lemgagtrakul

Issue Date: 28 February 2023
The Uncertainties are for a confidence probability of approximately 95%.

This certificate may not be reproduced without the full consent of the Laboratory.
Approval of the Head of Corporate Services & Equipment Calibration and Testing Services



Cert.No.: 23CH275
Page.: 2 of 3

Condition of this calibration result

1 Reference Standard Instrument

Instrument	Serial No.	ID No.	Cert. No.	Due Date
1) Document Process Calibrator	54030049	130RC116	22E2769	24 Aug 2023
2) Ref Standard Thermometer	4982054	110RC044	2211306	27 Oct 2023

This certification is traceable to the International System of Unit maintained at -
Traceable to National Institute of Metrology (Thailand), NIMT

2 Certified Reference Materials

The measurement results are traceable to SI through CPA chem Ltd.,
ANSI-ASQ National Accreditation Board, Accredited No. AR-1835

Buffer Solution

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	826588	09 July 2024
pH 6.987	CPA chem	826589	09 July 2023
pH 10.010	CPA chem	863835	28 Dec 2023

3. This certificate is valid only to the item calibrated on date and place of calibration.

Calibration Results

Function : mV Measurement

Performing standard curve by Fluke at pH (4,7,10)

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement ($\pm$ mV)	Coverage factor k
	pH	mV	mV	pH		
pH Meter S/N.: C104059460	4.000	177.48	177.4	4.000	0.058	2.00
	7.000	0.00	-0.1	7.000	0.058	2.00
	10.000	-177.48	-177.5	10.000	0.058	2.00



Cert.No.: 23CH275
Page.: 3 of 3

Calibration Results

Function : pH Measurement

Performing three buffers standard curve by using buffer nominal pH (4,7,10)

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH measurement ($\pm$)	Coverage factor k
pH Electrode S/N.: 1453404	4.008	4.008	179.1	0.0046	2.00
	6.987	6.988	4.7	0.0084	2.00
	10.010	10.013	-172.4	0.0069	2.00

Function : Temperature Measurement

(*) Without adjustment

This equipment was connected with Temperature Probe;

Model : InLabExpert Pro-ISM

Serial No. : 1453404

Dimension of probe;

Length : 120 mm.

Diameter : 12 mm.

Immersion Depth : 100 mm.

Calibration Point (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of measurement ($\pm$ °C)	Coverage factor k
25.0	25.001	24.8	-0.201	0.13	2.00

Remark : - UUC* = Unit Under Calibration

The reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor k, providing a level of confidence of approximately 95 %.

-000-

Saitip

a 1149925

Saitip

a 1149924



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
514/4 PATTANAKARN ROAD SOI 18, SUANLUANG, BANGKOK 10250
TEL: 0-2315-3080-24 FAX: 0-2315-9481



Certificate of Calibration

Certificate No.: 23E753
Page: 1 of 2

Equipment : pH Meter

Manufacturer: Mettler Toledo

Model : SevenCompact 5220

Serial No.: C104059460

ID No.: RYG_EN0183

Condition As-Received: Used Item

Received Date: 24 February 2023

Calibration Date: 28 February 2023

Reference: 2302-0960DSC

Submitted by: AIS Laboratory Group (Thailand) Co. Ltd. (Rayong Branch)

Ambient Temperature: $1 \pm 2 \pm 1$ °C

61E10 Moo 5, T Maenam Klu, A Puckaeng,

Relative Humidity: $1 \pm 10 \pm 1$ %

Rayong 21140, Thailand

Procedure used: Calibration were conducted using In-house calibration Procedure CP-E17 According to direct measurement method with Multi-Product Calibrator

Condition of this result of calibration

1 Reference standards instruments

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Multi-Product Calibrator	5500A	6440007	22E1670	18 May 2023

2 This result of calibration was made on request of the point specified by customer

3 The certificate is valid only to the item calibrated on date and place of calibration.

4 This Certification is traceable to the International System of Unit maintained at

National Institute of Metrology Thailand (NIMT)

Calibrated by: Watcharaporn Wongchulkrana

Approved Signatory:

Issue Date: 02 March 2023

[] Phatinee Prabpaipat

[x] Nuntawat Khanchai

[] Pornthippa Tameyskul

B 0309672



Cert. No.: 23E753
Page.: 2 of 2

Result of calibration :- (*) Without adjustment () After adjustment

Function: DC voltage measurer	Range: 2000 mV		
Standard Value (mV)	UUC* Reading (mV)	Error (mV)	Uncertainty ($\pm$ μ V)
-200.0000	-200.0	0.0	72
-150.0000	-150.0	0.0	69
-100.0000	-100.0	0.0	65
-50.0000	-50.0	0.0	62
0.0000	0.0	0.0	58
50.0000	50.0	0.0	62
100.0000	99.9	-0.1	65
150.0000	149.9	-0.1	69
200.0000	199.9	-0.1	72

The reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor k=2, providing a level of confidence of approximately 95 %

UUC* = Unit Under Calibration.

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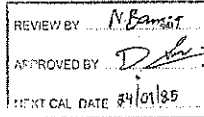
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Cert.No.: 23TW168
Page.: 1 of 2

Certificate of Testing

Equipment : DO Meter
Manufacturer : YSI
Model : 5000-115V
Serial No. : 15E102796
ID No. : RYG_EN0032
Received Date : 21 July 2023
Test Date : 24 July 2023
Reference : 2307-0713DSC-1
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd.
Rayong Branch
616/10 Moo 5, T. Maenam Khu, A. Pluakdaeng,
Rayong 21140, Thailand
Laboratory Condition : Temperature (25 ± 5) °C
Humidity (50 ± 20) %
Test Procedure : In - house method : CP-CH9
by Comparison Technique with Azide Modification Method
Tested by : Walalak Sirithean
Approved by :
Approved Signatory
() Malee Bulkruea
(x) Sathip Meangmai
() Warakorn Lemgagrakul
Issue Date : 26 July 2023



Condition of this result of calibration

1. Reference Standard Instruments :
This certification is traceable to the International System of Unit through the reference standards laboratory of Industrial Calibration Center, Technology Promotion Association (Thailand-Japan).
- | Instruments | Serial No. | ID No. | Certificate No. | Due Date |
|-------------|------------|----------|-----------------|-------------|
| 1) Burette | - | 130BU10 | 23CG1172 | 22 Mar 2025 |
| 2) Balance | 1126143764 | 140RC004 | 22MM50 | 20 Sep 2023 |
2. Standard Material :-
- | Material | Manufacturer | Lot.No. | Assay |
|---------------------------------|--------------|-----------|--------|
| Sodium Thiosulfate pentahydrate | Merck | AM1763316 | 100.2% |
- Result : Dissolved Oxygen Meter Adjustment With Air 100 %
Dissolved Oxygen Probe No.: 15E100464

Titration Method (Azide Modification Method) (mg/L)	DO Meter Reading (mg/L)	Standard Deviation (mg/L)
8.18	8.17	0.0055

This report was certified only for the instrument we tested it is allowable to use for study the system efficiency. The environmental impact control and present to organization it may concerned intend to use for advertising and referral purpose is prohibited. This report may not be reproduced other in full without written approval of the laboratory

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Cert. No.: 23LM125
Page.: 1 of 2

Certificate of Calibration

Equipment : DO Meter with Sensor
Manufacturer : YSI
Model : 5000-115V
Serial No. : 15E102796
ID No. : RYG_EN0032
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd.
Rayong Branch
616/10 Moo 5 T. Maenam Khu, A. Pluakdaeng,
Rayong 21140 Thailand
Location : TPA On Site Calibration Laboratory
Received Order : 25 July 2023
Calibrated Date : 27 July 2023
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
AC Line Voltage : (220 ± 22) V
Calibrated by : Preecha Hahib
Approved by :
Approved Signatory
() Pornthippa Tamayakul
() Malee Bulkruea
(x) Suwit Imjai
Issue Date : 31 July 2023



Equipment : DO Meter with Sensor
Condition As-Received : Used Item
Reference : 2307-0713OSC-2
Page.: 2 of 2

Procedure Used :-
Calibration were conducted using in-house calibration procedure CP-OT01 according to comparison with Industrial Platinum Resistance Thermometer (IPRT) into Temperature Bath.
The temperature scale used was based on ITS-90

Condition of this result of calibration

1. Reference standard instrument:-
- | Instrument | Serial No. | Cert. No. | Traceable | Due Date |
|------------------------|------------|-----------|-----------|-------------|
| 1) Digital Thermometer | 2188080 | 2211285 | TPA | 21 Oct 2023 |
2. This certificate is valid only to the item calibrated on date and place of calibration
3. This certification is traceable to the International System of Unit.

Remark : TPA : Technology Promotion Association (Thailand - Japan)

Result of Calibration :- (*) Without Adjustment

Function : Temperature measurement

This instrument was connected with temperature sensor, S/N.: 1228475367

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty (± °C)	Coverage Factor k
20.00	100	20.011	19.91	-0.101	0.15	2.00

UUC* : Unit Under Calibration

The reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor k, providing a level of confidence of approximately 95 %.

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The Uncertainties are for a confidence probability of approximately 95%

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A 0053616

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Cert. No.: 23TM062
Page: 1 of 3

Certificate of Calibration

Equipment : Low Temp. Incubator
Manufacturer : Memmert
Model : IPP750
Serial No. : V818 0004
ID No. : RYG_EN0154
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd.
(Rayong Branch)
616/10 Moo 5 T. Maenam Khu,
A. Pluakdaeng, Rayong 21140 Thailand
Location : BOD Room

Received Order : 29 May 2023
Calibration Date : 29 May 2023
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %

Calibrated by : Man Pattanapongpaiboon

Approved by :
Approved Signatory

() Ponthippa Tamayakul
() Malice Butkruea
(x) Sumit Injai

Issue Date : 7 June 2023

The Uncertainties are for a confidence probability of approximately 95%

This certificate may not be reproduced without the full approval of the issuing institution.
Approval of the Lead of Corporate Services 3: Equipment Calibration and Testing Services

A 0054967



Equipment : Low Temp. Incubator
Condition As-Received : Used Item
Reference : 2305-0898OC-2
Procedure Used :-

Calibration were conducted using calibration procedure CP-OT02 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector (RTD)
The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard Instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34972A	MY57013711	22LM93	02 Jul 2023

2. This certificate is valid only to the item calibrated on date and place of calibration.

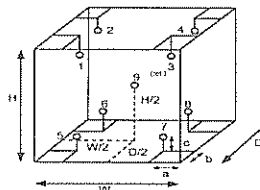
3. This certification is traceable to the International System of Unit.

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close

Environment during calibration		
	Beginning	Finished
Temp (°C)	23	23
REL.Humid. (%)	54	56
AC Supply (Volt)	223	222



Probe Installation Details :

a = 10 cm	D = 0.60 m
b = 10 cm	W = 1.0 m
c = 10 cm	H = 1.2 m
	Capacity = 0.75 m³

Position :	Ref. Std. ID No.:
1	18-18RTD-01
2	18-18RTD-02
3	18-18RTD-03
4	18-18RTD-04
5	18-18RTD-05
6	18-18RTD-10
7	18-18RTD-07
8	22-18RTD-08
9 (ref.)	18-18RTD-09

a 1165130



Equipment : Low Temp. Incubator
Condition As-Received : Used Item
Reference : 2305-0898OC-2
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

Cert. No.: 23TM962
Page: 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Coverage Factor k
20.0	20.0	20.0	0.019	0.72	1.0	2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (± °C)
	1	2	3	4	5	6	7	8	9 (ref.)	
20.0	19.547	19.780	19.487	19.529	19.408	20.139	20.112	20.406	20.116	0.30

Average* : The average of 30 values in each position.

Temperature stability : One-half of the greatest maximum difference of measured temperature at any one sensor

Temperature uniformity : The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location, which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions

Overall Variation : The Difference of the maximum and minimum measured temperatures throughout observation.

UUC* : Unit Under Calibration

Note : The reported uncertainty of measurement was included stability and excluded uniformity

The reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor k, providing a level of confidence of approximately 95 %

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Certificate of Calibration

Equipment : SPECTROPHOTOMETER
Model : DR6000
Serial No. (or ID.): 1627845 (RYG_EN0037)
Manufacturer : HACH
Condition : In Condition

Certificate No.: C06230441
Issued Date: 19 September 2023
Job No.: WO-00005382
Page: 1 of 3

Customer : ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)
610/10 Moo 5 T. Maenam Khu,
A. Pluakdaeng, Rayong 21140, Thailand.

Environment Condition: Temperature 23.9 °C ± 0.2
Humidity 65.3 %RH ± 1.4

Calibration Place: ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch) (Wet Chemistry)
616/10 Moo 5 T. Maenam Khu,
A. Pluakdaeng, Rayong 21140, Thailand.

Calibration By: Mr. Nattapat Rungueang

Calibration Date: 18 September 2023

The Method used: In house method, CAL-WI-24, base on ASTM E 275-08 and ASTM E 387-04

Traceability: This certificate is traceable to the CRM maintained by National Institute of Standards and Technology (NIST) through Stama Scientific Limited.

The standard for Wavelength Certificate No. 111593 and 111594

The standard for Photometric Certificate No. 9114984 and 111588

The standard for Stray light Certificate No. 111586 and 111585

The standard for Spectral resolution Certificate No. 111587

(Mr. Nattapat Rungueang)
Person in charge

(Mr. Nitin Srinawan)
Authorized signatory

This certificate is issued the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognized national standard laboratories.

The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).

These results may be affected by deviations from specified conditions. The results relate only to the items tested, calibrated or sampled. The report shall not be reproduced except in full without approval of DKSH Technology Limited.

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2333 Bangkok Expressway, Bangkok, Thailand 10260
Phone: +66 2826 7000 Email: info.calibration@dksh.com Website: www.dksh.com/en/thailand

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CAL-FM-C05-15 12 Sep 2022

a 1165129

Calibration Results:
Without Adjustment

Wavelength Accuracy (nm), The spectral bandwidth of Std at 2 nm and UUC at 2 nm				
Standard Wavelength	Unit Under Calibration	Correction	Uncertainty	
418.61	418.3	0.31	0.13	
536.66	536.6	0.06	0.13	
637.96	638.3	-0.32	0.13	
749.46	748.7	-0.22	0.13	
807.03	807.4	-0.37	0.13	
Photometric Accuracy (Absorbance)				
Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
420 nm	0.0000	0.000	0.0000	0.0045
	0.2930	0.289	0.0040	0.0045
	0.5168	0.510	-0.0022	0.0045
	1.0298	1.029	0.0008	0.0045
440 nm	0.0000	0.000	0.0000	0.0045
	0.2867	0.283	0.0037	0.0045
	0.5073	0.509	-0.0017	0.0045
	1.0083	1.007	0.0013	0.0045
465 nm	0.0000	0.000	0.0000	0.0045
	0.2516	0.250	0.0016	0.0045
	0.4595	0.462	-0.0025	0.0045
	0.9334	0.933	0.0004	0.0045
546.1 nm	0.0000	0.000	0.0000	0.0045
	0.2461	0.245	0.0011	0.0045
	0.4652	0.466	-0.0008	0.0045
	0.9468	0.946	0.0008	0.0045
590 nm	0.0000	0.000	0.0000	0.0045
	0.2504	0.259	0.0004	0.0045
	0.5040	0.505	-0.0010	0.0045
	1.0032	1.002	0.0012	0.0045
635 nm	0.0000	0.000	0.0000	0.0045
	0.2579	0.257	0.0009	0.0045
	0.4971	0.497	0.0001	0.0045
	0.9720	0.971	0.0010	0.0045

DKSH Technology Limited
2533 Sukhumvit Road, Bangkok, Thailand 10260
Phone: +66 2639 7000 Email: info@dksh.com Website: www.dksh.com

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CAL-FM-C06-15: 12 Sep 2021

Calibration Results:
Without Adjustment

Photometric Accuracy (Absorbance)				
Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
235 nm	0.0000	0.000	0.0000	0.0080
	0.7355	0.737	-0.0015	0.0080
257 nm	0.0000	0.000	0.0000	0.0080
	0.8574	0.857	0.0004	0.0080
313 nm	0.0000	0.000	0.0000	0.0080
	0.2864	0.289	-0.0036	0.0080
350 nm	0.0000	0.000	0.0000	0.0080
	0.6374	0.637	0.0004	0.0080
Stray light *				
Standard: cut-off	UUC: Wavelength (nm)	UUC: Transmission (%T)	Absorbance (A)	
260.62 +/- 0.11 nm	260.6	1.3	1.886	
391.44 +/- 0.11 nm	391.4	1.3	1.886	
Spectral Resolution *				
Nominal Concentration 0.02 % w/v	Peak	Trough	Ratio	SBW
Standard Wavelength (nm)	268.66	266.69	1.38	2.00
UUC: Wavelength (nm)	268.2	266.1		
Std Absorbance (A)	0.4556	0.2780		
Absorbance (A)	0.413	0.300		

* Calibration Marked * Not TISI Accredited * In this Certificate have been included for completeness.

The End of Certificate

DKSH Technology Limited
2533 Sukhumvit Road, Bangkok, Thailand 10260
Phone: +66 2639 7000 Email: info@dksh.com Website: www.dksh.com

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CAL-FM-C06-15: 12 Sep 2021

RYG_EN0002

ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: WO-00005382

ชนิดเครื่องมือ: SPECTROPHOTOMETER

รุ่น: DR6000

หมายเลขเครื่อง: 1627045

ตรวจสอบ (วัน)		รายการตรวจเช็ค	ตรวจสอบ (วัน)		หมายเหตุ
18 Sep 2023			18 Sep 2023		
ปกติ	ไม่ปกติ		ปกติ	ไม่ปกติ	
General					
☒	☐	1. ความสมบูรณ์เครื่อง	☒	☐	
☒	☐	2. ความสะอาด (ช่องให้ตัวอย่าง, ภายใน-นอกเครื่อง)	☒	☐	
☒	☐	3. สวิตซ์ ปิด – เปิด เครื่อง (On-Off Switch)	☒	☐	
☒	☐	4. ปุ่มกด (Keypad)	☒	☐	
☒	☐	5. หน้าจอ (Display, Screen Contrast)	☒	☐	
Spectrophotometer					
☒	☐	6. แบตเตอรี่ไฟฟ้า (Battery Backup) >= 2.5 VDC	☒	☐	
☒	☐	7. ความแม่นยำความยาวคลื่น (Wavelength Control)	☒	☐	
☒	☐	8. ความยาวคลื่น (Wavelength Check)	☒	☐	
☒	☐	9. แหล่งกำเนิดแสง (UV < 3,000 hour)	☒	☐	9.2 Hours
☒	☐	10. แหล่งกำเนิดแสง (Visible < 5,000 hour)	☒	☐	741.5 Hours
☒	☐	11. ช่องใส่หลอดตัวอย่าง (Carousel Module)	☒	☐	
pH Meter and Conductivity Meter					
☒	☐	12. อิเล็กโทรด (Electrode and Connection Cable)	☒	☐	
☒	☐	13. ระดับสารละลายใน Electrode (Level KCl)	☒	☐	
☒	☐	14. ฝาปิดกันภายใน Electrode (Dust Protection Hood)	☒	☐	
☒	☐	15. ขาตั้งอิเล็กโทรด (Stand)	☒	☐	
Turbidimeter					
☒	☐	16. ค่าความขุ่นที่สุญญากาศ (No Sample)	☒	☐	
☒	☐	17. ระดับการรบกวนแสงของหลอด (>= 2.5 ไมล์ใน 3.0)	☒	☐	
Automatic titrator					
☒	☐	18. สภาพ Piston Burettes	☒	☐	
☒	☐	19. Function Rinsing and Dosing	☒	☐	
☒	☐	20. ระบบท่อสายยางและอุปกรณ์ประกอบ	☒	☐	

เพิ่มเติมรุ่นและค่า: *658.1nm=658.1nm

*486.0nm=485.5nm

Mr.Nallapat Rungsuang

Service Engineer

DKSH Technology Limited
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CAL-FM-R31-03: 20 Jul 2022

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10210
Tel: +66 2843 6301-6, e-mail: service.thailand@sartorius.com



SARTORIUS

Certificate

of Calibration

Model Number MSE224S-100-DU

Description: Analytical Balance

Serial Number: 0026207036

ID No.: RYG_EN0002

Manufacturer: Sartorius

Certificate No.: 23BCI0112

Issued Date: Friday, March 03, 2023

Reference No.: 204833

Page No. 1 of 2

Customer Name: ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)
616/10 Moo 5 T Maenam Khu, A Pluak Daeng, Rayong 21140, Thailand

Calibrated Place: ALS Laboratory Group (Thailand) Co., Ltd. (Balance Room)
616/10 Moo 5 T Maenam Khu, A Pluakdaeng, Rayong 21140, Thailand

Calibrated By: Mr Chonchai Inthana

Calibration Date: Wednesday, March 01, 2023

Calibration Procedure No.: This calibration was conducted by
Using in-house calibration procedure number (WI-003)
Based on UKAS LAB 14: 2019

Metrological data:

Capacity: 220 g Readability: 0.0001 g

Ambients Conditions

Temperature: 23.6 °C ± 5.0 °C
Humidity: 60.0 % RH ± 10.0 % RH
Pressure: ±

Reasons for calibration

☒ New Installation ☐ Service / Repair ☐ Re-calibration / Maintenance

☒ Equipment Condition ☐ Good Operate ☐ Fail

Measurement Method UKAS Publication Ref: Lab 14

The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM). The calibration certificate documents the traceability to National Standards which realise the unit of measurement according to the International Standard System of Units (SI). Report of Tolerance came from list of Sartorius Metrological Specifications

Traceability:

Model Number	Description	Traceability	Certificate No.	Due Date
YC5011-522-00	Sartorius weight set Imp.: 5000g E2 YC5011-522-00	SPC-RT	C02212665	14-Sep-2023
MHB-3825D	Humidity/Balometer/Temp. Luton MHB-3825D	DKSH	C19220444	5-Sep-2023

This certificate relate and apply this equipment only

This certificate may not be reproduced other than in full except with the prior written approval of the Verification Operation Division
Sartorius (Thailand) Co., Ltd.

Mr. Chonchai Inthana (Technical Manager)

SOP FM 31: 03 February 2022



Certificate of Calibration

Model Number : MSE2245-100-DU Certificate No : 23BC0112
Description : Analytical Balance Issued Date : Friday, March 03, 2023
Serial Number : 0026207038 Reference No : 204833
ID No : RYG_EN0002
Manufacturer : Sartorius Page No : 2 of 2

Calibration Results : Without Adjustment

Repeatability			Eccentricity (Off-center loading error)		
The reproducibility is the ability of a weighing instrument to display nearly identical readings under constant test conditions when the same load within a measurement range is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.			The off-center loading error is yielded by the difference between the result of the load is 1/3 or 1/4 of maximum capacity placed in the middle of the weighing pan and between each of four additional measurement points (positions defined according to GIM, P16).		
Nominal Value : (Low Load)	20.0000	199.9999	Nominal value	100	g
20 g	20.0000	200.0000	Tolerance	0.0004	g
Tolerance	0.0001 g	20.0000	Difference		
	20.0000	199.9999	1		
	20.0000	200.0000	2	-0.0001	
	20.0000	199.9999	3	-0.0001	
	20.0000	200.0000	4	0.0001	
	20.0000	199.9999	5	0.0002	
	20.0000	200.0000	6		
Nominal Value : (High Load)	200 g	199.9999			
200 g	199.9999	200.0000			
Tolerance	0.0001 g	20.0000			
	20.0000	199.9999			
	20.0000	200.0000			
Standard Deviation	0.00003	0.00005			

Linearity

The linearity also called linearity error. Describes the deviation of the characteristic curve of a weighing instrument from the linear slope.

Tolerance 0.0002 g				
Nominal Value	Conventional Mass Value	Displayed Value	Deviation	Uncertainty
(g)	(g)	(g)	(g)	(g)
0.01	0.0100	0.0100	0.0000	0.00014
0.05	0.0500	0.0500	0.0000	0.00014
0.1	0.1000	0.1000	0.0000	0.00014
0.5	0.5000	0.5000	0.0000	0.00014
1	1.0000	1.0000	0.0000	0.00014
5	5.0000	5.0000	0.0000	0.00014
10	10.0000	10.0000	0.0000	0.00014
20	20.0000	20.0000	0.0000	0.00024
50	50.0000	50.0000	0.0000	0.00015
100	100.0000	99.9999	-0.0001	0.00019
200	200.0000	200.0000	0.0000	0.00032

End of Report

SOP FM 33 03 February 2022

RYG_EN0010



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534 PATTANAKARN ROAD SOI 16, SUANLUANG, SUANLUANG BANGKOK 10250
TEL: 0-2517 800-27 FAX: 0-2519 7484



Cert. No.: 22TM1517
Page : 1 of 3

Certificate of Calibration

Equipment : Hot Air Oven
Manufacturer : Memmert
Model : UFE 500
Serial No. : G511.1572
ID No. : RYG_EN0010
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)
618/10 Moo 5 T. Maenam Khu.
A. Pluakdaeng,
Rayong 21140 Thailand
Location : Oven Room
Received Order : 20 October 2022
Calibration Date : 20 October 2022
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
Calibrated by : Man Pattanapongpaiboon

Approved by : Manu
Approved Signatory

() Pornthippa Tameyakul
(x) Males Bulkrues
() Suwit Injai

Issue Date : 2 November 2022

The Uncertainties are for a confidence probability of approximately 95%

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Approved by the Head of Corporate Services & Equipment Calibration and Testing Services

A 0046908



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2210-0376OC-2
Procedure Used :-
Calibration were conducted using calibration procedure CP-OT02 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector (RTD) and Thermocouple Type T

The temperature scale used was based on ITS-90

Condition of this result of calibration

1 Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34572A	MY49023932	22LM97	29 Jul 2023

2 This certificate is valid only to the item calibrated on date and place of calibration.

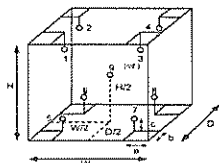
3 This certification is traceable to the International System of Unit

Result of Calibration :- () Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close

Environment during calibration		
	Beginning	Finished
Temp. (°C)	25	25
REL Humid. (%)	54	59
AC Supply (Volt)	223	225



Probe Installation Details : Dimension of Chamber :
a = 5.0 cm
b = 5.0 cm
c = 5.0 cm
D = 0.40 m
W = 0.56 m
H = 0.48 m
Capacity = 0.11 m³

Ref. Std. ID No.: @ Calibration Point		
Position	(180) °C	(104) °C
1	21-16TC-01	20-16RTD-01
2	21-16TC-02	20-16RTD-02
3	21-16TC-03	20-16RTD-03
4	21-16TC-04	20-16RTD-04
5	21-16TC-05	22-16RTD-05
6	21-16TC-06	20-16RTD-06
7	21-16TC-07	20-16RTD-07
8	21-16TC-08	22-16RTD-08
9 (ref.)	21-16TC-09	22-16RTD-09



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2210-0376OC-2
Result of Calibration :- () Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

Calibration Point : Measured Temperature (°C)

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Uncertainty (± °C)	Coverage Factor k
104.0	104.0	104.0	0.076	0.52	0.60	0.42	2
180.0	180.0	180.0	0.13	0.89	1.2	1.1	2

Measured Temperature (°C)								
Calibration Point (°C)	1	2	3	4	5	6	7	8
104.0	103.768	103.734	103.723	103.800	104.215	104.131	104.132	103.740
180.0	179.723	179.359	179.439	179.489	180.361	180.114	180.131	180.243

Average* : The average of 30 values in each position.

Temperature stability : One-half of the greatest maximum difference of measured temperature at any one sensor

Temperature uniformity : The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location, which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.

Overall Variation : The Difference of the maximum and minimum measured temperatures throughout observation UUC* : Unit Under Calibration

Note The reported uncertainty of measurement was included stability and excluded uniformity

The reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor k providing a level of confidence of approximately 95 %

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Manu.

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a 1132465



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Cert. No.: 22TM1492
Page: 1 of 3

Certificate of Calibration

Equipment: Hot Air Oven

Manufacturer: Memmert

Model: UM 400

Serial No.: b495 0899

ID No.: RYG_EN0006

Submitted by: ALS Laboratory Group (Thailand) Co. Ltd. (Rayong Branch)
616/10 Moo 5, T. Maenam Khu,
A. Pluakdaeng,
Rayong 21140, Thailand

Location: Oven Room

Received Order: 20 October 2022

Calibration Date: 20 October 2022

Ambient Temperature: (26 ± 10) °C

Relative Humidity: (50 ± 30) %

Calibrated by: Preecha Hiahb

Approved by:
Approved Signatory

() Pornthippa Tameyakul
(✓) Malee Butkruea
() Suwit Imjai

Issue Date: 2 November 2022

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the head of Corporate Services & Equipment Calibration and Testing Services

A 0046905



Equipment: Hot Air Oven
Condition As-Received: Used Item
Reference: 2210-03760C-1

Cert. No.: 22TM1492
Page: 2 of 3

Procedure Used:-

Calibration was conducted using calibration procedure CP-OT02 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector (RTD). The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34970A	MY44035217	21LM30	23 Dec 2022

2. This certificate is valid only to the item calibrated on date and place of calibration.

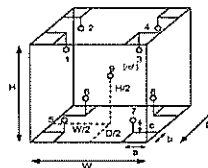
3. This certification is traceable to the International System of Unit.

Result of Calibration: () Without Adjustment

Function of UUC*: Temperature Source

Fresh air setting: Close

Environment during calibration		
	Beginning	Finished
Temp. (°C)	20	29
REL Humid. (%)	43	47
AC Supply (Volt)	220	221



Probe Installation Details: Dimension of Chamber:

a = 50 cm	D = 0.33 m
b = 50 cm	W = 0.40 m
c = 50 cm	H = 0.40 m
	Capacity = 0.053 m³

Position	Ref. Std. ID No.
1	18-10RTD-01
2	18-10RTD-02
3	18-10RTD-03
4	18-10RTD-04
5	18-10RTD-05
6	18-10RTD-06
7	18-10RTD-07
8	18-10RTD-08
9 (ref.)	18-10RTD-09

a 1132473

RYG_EN0061



Equipment: Hot Air Oven
Condition As-Received: Used Item
Reference: 2210-03760C-1
Result of Calibration: () Without Adjustment
Function of UUC*: Temperature Source
Fresh air setting: Close

Cert. No.: 22TM1492
Page: 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Uncertainty (± °C)	Coverage Factor k
70.0	70.0	70.0	0.079	0.47	0.77	0.42	2

Calibration Point (°C)	Measured Temperature (°C)								
	Position								
70.0	1	2	3	4	5	6	7	8	9 (ref.)
	70.262	69.995	70.079	70.177	70.864	70.039	70.688	70.149	70.328

Average*: The average of 30 values in each position.

Temperature stability: One-half of the greatest maximum difference of measured temperature at any one sensor and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.

Overall Variation: The Difference of the maximum and minimum measured temperatures throughout observation.

UUC*: Unit Under Calibration

Note: The reported uncertainty of measurement was included stability and excluded uniformity.

The reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor k, providing a level of confidence of approximately 95 %.

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Cert. No.: 22TM1491
Page: 1 of 3

Certificate of Calibration

Equipment: Water Bath

Manufacturer: Memmert

Model: WNB22

Serial No.: L513.0648

ID No.: RYG_EN0061

Submitted by: ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)
616/10 Moo 5, T. Maenam Khu,
A. Pluakdaeng,
Rayong 21140, Thailand

Location: Wet Chemistry Lab

Received Order: 20 October 2022

Calibration Date: 20 October 2022

Ambient Temperature: (26 ± 10) °C

Relative Humidity: (50 ± 30) %

Calibrated by: Preecha Hiahb

Approved by:
Approved Signatory

() Pornthippa Tameyakul
(✓) Malee Butkruea
() Suwit Imjai

Issue Date: 2 November 2022

The Uncertainties are for a confidence probability of approximately 95%

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Q 1158016