

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_FS0023	13-Jan-23	13-Jan-24	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_FS0029	20-Jun-23	20-Jun-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_FS0017	3-Jan-23	3-Jan-24	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0016	1-Sep-23	1-Sep-24	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0439	19-Oct-23	19-Oct-24	12
Heat	Heat Stress	Heat Stress Monitor	RYG_FS0359	02-Feb-23	2-Feb-24	12
Heat	Heat Stress	Heat Stress Monitor	RYG_FS0521	24-Feb-23	24-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

Calibration of Date : 13-Jul-23
Next Cal. Date : 13-Jan-24
Barometric Pressure (mm-Hg) : 752
Relative Humidity (%) : 55.0
Temperature (C°) : 31.0

Console Control Meter Data

Calibration No. : C-130723-BKK_FS0556
Dry Gas Meter ID : BKK_FS0556
Serial No. : 1606041
Model No. : XC-572-V
Reference Dry Gas Meter ID : BKK_FS0629
Serial No. : 1607009
Correction Factor (Y) : 1.0000
Next Calibration Date : 9 Dec 23

ΔH (mm H ₂ O)	Meters	Reference Dry Gas Meter Calibration						Console Control Dry Gas Meter						Dry Gas Meter Correction Factor (Y)	Office Calibration Factor ΔH (g)
		Vr (Liters)			Tr (°C)	Vn (Liters)			Tn (°C)	To (°C)	Avg Tm (°C)				
		Final	Initial	Total		Final	Initial	Total							
15	11.35	150.00	0.00	150.00	31.0	233.8	147.8	146.00	30.0	30.0	30.0	1.0225	40.0924	30.9861	
25	8.78	150.00	0.00	150.00	31.0	447.5	300.0	147.50	30.0	30.0	32.0	1.0111	39.9861		
50	6.16	150.00	0.00	150.00	32.0	745.8	595.8	147.50	32.0	32.0	33.0	1.0120	39.9848		
80	5.01	150.00	0.00	150.00	32.0	909.2	752.2	147.00	33.0	33.0	33.0	1.0158	41.5259		
120	2.64	150.00	0.00	150.00	33.0	1083.0	956.0	146.50	34.0	34.0	34.0	1.0146	40.8372		
Avg														1.0152	40.3212

Y Ratio of reading of reference to dry gas meter : tolerance for individual values ± 0.02 from average.
ΔHg Office pressure differential that equates to 21.24 in. of air @ 25 C and 760 mm of mercury : tolerance for individual values ± 5.08 from average.
Procedure: 40 CFR 62 APP A, METH. SEC 5.3 & 7

Calibrated by : Saksit Phaisanphut
Approved by : Nattapon Jengwareewong

(Mr. Saksit Phaisanphut)
Field Scientist (4)
(Mr. Nattapon Jengwareewong)
Field Specialist (1)

FORM NO. F 05-024 REV. 04/04/2017 ISSUE DATE: 30 Jul 22



Pitot Tube Calibration Data

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

$$Cp(S) = Cp_{std} \sqrt{\frac{\Delta P(Std)}{\Delta P(S)}}$$

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

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

Calibrated by : Saksit Phaisanphut
(Mr. Saksit Phaisanphut)
Field Scientist (4)

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

FORM NO. F 05-024 REV. 04/04/2017 ISSUE DATE: 30 Jul 22

Pitot Tube Calibration Data

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

$$Cp(S) = Cp_{std} \sqrt{\frac{\Delta P(Std)}{\Delta P(S)}}$$

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

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

Calibrated by : Saksit Phaisanphut
(Mr. Saksit Phaisanphut)
Field Scientist (4)
Approved by : Nattapon Jengwareewong
(Mr. Nattapon Jengwareewong)
Specialist (1)

DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date : 13 Jul 23
Ambient Temperature (C°) : 26
Calibration sheet No. : C-130723-BKK_FS0557
Relative Humidity (%) : 60
Digital Temperature ID : BKK_FS0557
Reference Temperature ID : BKK_FS1144
Serial No. : 1606041
Serial No. : 201090000013
Model : XC-572-V
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	23	-2	±3	Pass
	50	48	-2	±3	Pass
	100	99	-1	±3	Pass
	150	149	-1	±3	Pass
	200	198	-2	±3	Pass
	250	248	-2	±3	Pass
Probe	300	298	-2	±3	Pass
	500	500	0	±3	Pass
	100	99	-1	±3	Pass
	120	119	-1	±3	Pass
	140	139	-1	±3	Pass
	100	100	0	±3	Pass
	120	119	-1	±3	Pass
Oven	140	139	-1	±3	Pass
	100	100	0	±3	Pass
	120	119	-1	±3	Pass
	140	139	-1	±3	Pass
	100	100	0	±3	Pass
	120	120	0	±3	Pass
	140	140	0	±3	Pass
Filter	0	0	0	±3	Pass
	10	9	-1	±3	Pass
	20	18	-2	±3	Pass
	Meier	0	0	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass
	AUX	0	0	±3	Pass
Exit	25	23	-2	±3	Pass
	50	48	-2	±3	Pass

MPE : (Maximum permissible error of measurement) ค่าที่วัดได้ค่าใดค่าหนึ่งจะต่ำกว่าหรือสูงกว่าค่าอ้างอิงไม่เกิน

Calibrated by : Saksit Phaisanphut
Mr. Saksit Phaisanphut
Field Scientist (4)
Approved by : Nattapon Jengwareewong
Mr. Nattapon Jengwareewong
Specialist (1)

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

FORM NO. F 05-028 REVISION NO. 3 ISSUE DATE: 30 Jul 22



PROBE NOZZLE DIAMETER
CALIBRATION DATA SHEET

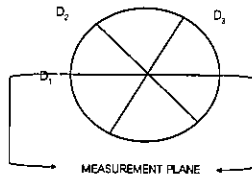
Calibration Date : 13 Jul 23			Nozzle Set ID. : BKK_FS0562		
Calibration Sheet No. : C-130723-BKK_FS0562			Vernier Caliper ID. : BKK_FS1123		
Nozzle ID #	Nozzle Diameter (cm.)			HI - Lo	(D ₁ + D ₂ + D ₃) / 3
	D ₁	D ₂	D ₃	ΔD	D _{avg}
1	0.300	0.302	0.302	0.002	0.301
2	0.480	0.475	0.480	0.005	0.478
3	0.625	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} = (D₁ + D₂ + D₃) / 3



Calibrated by Saksit Phaisanphut

(Mr. Saksit Phaisanphut)
Field Scientist (4)

Approved by Nattapol Jengwareewong

(Mr. Nattapol Jengwareewong)
Field Specialist (1)

FORM-CL-09-C Rev.8 (REVISED) 17-12-21



Certificate No.: G 560001
Date of issue : 03-Jan-23

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 30.08, 150.9, 320.6 ppm, Sulphur Dioxide 30.04, 100.8, 601.1 ppm)

REVIEW BY Nattapol J.
APPROVED BY Saksit P.
NEXT CAL DATE 05/12/23

Condition of UUC : Used
Ambient condition : All of the Measurement were carried out the stabilized laboratory
Temperature : 23 $\pm$ 5 °C
Humidity : 55 $\pm$ 15 %RH
Calibration place : 17/121 Soi Nigamwongwan 47 Yeak 48, Toongsonghong, Laksi, Bangkok 10210

Calibration procedure no. : WI-CL-20-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 are void. This calibration certificate documents are traceability to national standards, which require measurement according to the International System of Units (SI).

Date of calibration : 28-Dec-22

Mr. Sattawat Nueathong
Calibration Technician

Mrs. Nongluck Wongsettee
Technical Manager

FM-CL-09-C Rev.8

Page 1 of 3

Issued Date 26/02/16

Entech Industrial Solution Co.,Ltd.

17/121 Soi Nigamwongwan 47 Yeak 48, Toongsonghong, Laksi, Bangkok 10210 THAILAND Tel: 0-2779-8888 Calibration@entech.co.th
Tax ID: 0105536035591 www.entech.co.th



Certificate No.: G 560001

Standard References (Table 1)

Standard	Certificate No.	Vendor	Due date
Oxygen (O2) 2.498 % Vol	4219/21	Linde	30-Sep-25
Oxygen (O2) 10.04 % Vol	CG-0153-21	Nimk	18-Nov-26
Oxygen (O2) 21.02 % Vol	CG-0041-22	Nimk	10-Feb-27
Carbon monoxide (CO) 80.14 ppm	CG-0040-22	Nimk	14-Feb-27
Carbon monoxide (CO) 309.9 ppm	2803/21	Linde	22-Jun-23
Carbon monoxide (CO) 1003 ppm	2583/22	Linde	09-Aug-24
Nitric Oxide (NO) 30.08 ppm	CG-0089-22	Nimk	13-Jun-24
Nitric Oxide (NO) 150.9 ppm	2657/21	Linde	27-Jun-23
Nitric Oxide (NO) 320.6 ppm	2944/21	Linde	02-Jul-23
Sulphur Dioxide (SO2) 30.04 ppm	3205/21	Linde	25-Jul-23
Sulphur Dioxide (SO2) 100.8 ppm	3507/22	Linde	09-Nov-24
Sulphur Dioxide (SO2) 601.1 ppm	3204/21	Linde	26-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 (s)
O2 (%Vol)	2.498	2.47	-0.028	0.20
O2 (%Vol)	10.04	9.93	-0.11	0.40
O2 (%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)	30.08	28	-2.08	8.0
NO (ppm)	150.9	139	-11.9	8.0
NO (ppm)	320.6	299	-21.6	12
SO2 (ppm)	30.04	46	-16.04	6.0
SO2 (ppm)	100.8	98	-2.8	6.0
SO2 (ppm)	601.1	593	-8.1	13

Calibration Results After Adjustment (Table 3)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (s)
O2 (%Vol)	2.498	2.47	-0.028	0.20
O2 (%Vol)	10.04	9.93	-0.11	0.40
O2 (%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)	30.08	30	-0.08	8.0
NO (ppm)	150.9	154	3.1	8.0
NO (ppm)	320.6	322	1.4	12
SO2 (ppm)	30.04	49	-1.04	6.0
SO2 (ppm)	100.8	101	0.2	6.0
SO2 (ppm)	601.1	603	1.9	13

Remark : 1 cmol/mol = 1 %vol., 1 μ mol/mol = 1 ppm.

End of Report

FM-CL-09-C Rev.8

Page 2 of 3

Issued Date 24/02/16

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) : 808.9 CERTIFIED DATE : GC735972

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	99.303	-0.697	-0.697
3	199.200	197.378	-1.822	-0.915
4	400.300	396.331	-3.969	-0.992
5	808.900	810.799	1.899	0.235
AVERAGE (%)				0.577

REVIEW BY : *Thamkai*

APPROVED BY : *[Signature]*

NEXT CAL DATE : 1 Sep 2024

CALIBRATED BY : คุณพรชัย ภาณุวนิช DATE : 1 กุมภาพันธ์ 2566

ต้องการข้อมูลการดำเนินงานเพิ่มเติม : คุณพรชัย ภาณุวนิช โทรฯ/ฟ : 02-515-8987

เลขที่ 355 ถนนรามอินทรา แขวงจันทน์เกษม เขตจตุจักร กรุงเทพฯ 10600 โทรศัพท์ 0-2515-8999 โทรสาร 0-2515-8988 E-Mail info@calibration.co.th



CALIBRATION LABORATORY Co.,LTD.

2/10-11/14, 55 Soi Prasert Manukul 29 Yaek 4, Prasert Manukul Rd., Ladphrao, Bangkok 10230
Tel: 02-578-0353-4 Fax: 02-578-2672 www.cal-lab.co.th Email: sale@cal-lab.co.th



CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE : VACUUM GAUGE
MANUFACTURER : DWYER
MODEL / TYPE : DPGA-00
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, KHEB 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 Yoisoontorn
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. Q23016390

F3-011-04/01-12

page 1 of 3



CALIBRATION LABORATORY Co.,LTD.

2/10-11/14, 55 Soi Prasert Manukul 29 Yaek 4, Prasert Manukul Rd., Ladphrao, Bangkok 10230
Tel: 02-578-0353-4 Fax: 02-578-2672 www.cal-lab.co.th Email: sale@cal-lab.co.th



REPORT OF CALIBRATION

FOR

NOMENCLATURE : VACUUM GAUGE
MANUFACTURER : DWYER
MODEL / TYPE : DPGA-00
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-CPPP-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 700PV4 S/N. 19298401.

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. Q23016390

F3-011-04/01-12

page 2 of 3



CALIBRATION LABORATORY Co.,LTD.

2/10-11/14, 55 Soi Prasert Manukul 29 Yaek 4, Prasert Manukul Rd., Ladphrao, Bangkok 10230
Tel: 02-578-0353-4 Fax: 02-578-2672 www.cal-lab.co.th Email: sale@cal-lab.co.th



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	+0.023
-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 36 of 54

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

End of Certificate

Certificate No. Q23016390

F3-011-04/01-12

page 3 of 3





Certificate of Calibration



Certificate No.: C06220465 Page 2 of 3

Calibration Results: Without Adjustment

Wavelength Accuracy (nm), The spectral bandwidth of Bid at 5 nm and UUC at 5 nm				
Standard Wavelength	Unit Under Calibration	Correction	Uncertainty	
418.40	418	0.40	0.59	
537.00	536	1.00	0.59	
538.00	538	0.00	0.59	
747.51	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
	0.5606	0.562	-0.0015	0.0045
	0.7334	0.735	-0.0016	0.0045
440 nm	1.0534	1.054	-0.0006	0.0045
	0.0000	0.000	0.0000	0.0045
	0.5503	0.550	0.0003	0.0045
465 nm	0.7178	0.718	-0.0001	0.0046
	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
	0.8893	0.871	-0.0017	0.0045
	0.8804	0.884	-0.0036	0.0045
590 nm	0.0000	0.000	0.0000	0.0045
	0.5168	0.519	-0.0022	0.0045
	0.8903	0.891	-0.0007	0.0045
635 nm	0.8904	0.892	-0.0016	0.0045
	0.0000	0.000	0.0000	0.0045
	0.5525	0.553	-0.0005	0.0045
635 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
635 nm	0.5367	0.538	-0.0013	0.0045
	0.8647	0.865	-0.0003	0.0046
	0.9623	0.963	-0.0007	0.0045

Unit Under Calibration: 418 nm
 DKSH Technology Limited
 2533 Sukhumvit Road, Bangkok, Thailand 10260
 Phone: +66 2636 7000 Email: info@dksh.com Website: www.dksh.com/thailand

Delivering Growth - In Asia and Beyond.

CALFM-C06-13: 20 Jul 2022

Equipment: SPECTROPHOTOMETER
 Model: DR3900
 Serial No. (or ID.): 2021761 (RYG_EN0176)
 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.

REVIEW BY: N. Banjit
 APPROVED BY: [Signature]
 NERICAL DATE: 27/9/22

Environment Condition: Temperature 22.5 °C ±
 Humidity 87.5 %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 Fothong
 Calibration Date: 27 September 2022
 The Method Used: In house method, CAL-W1-24, base on ASTM E 275-06 and ASTM E 387-04
 Traceability: This certificate is traceable to the CRM maintained by National Institute of Standards and Technology (NIST) through Starna 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

[Signature]
 (Mr. Chutaphon Fothong)
 Person in charge

[Signature]
 (Mr. Theerakast Pongngem)
 Authorized signatory

This certificate is issued by the unit 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 in 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.

Unit Under Calibration: 418 nm
 DKSH Technology Limited
 2533 Sukhumvit Road, Bangkok, Thailand 10260
 Phone: +66 2636 7000 Email: info@dksh.com Website: www.dksh.com/thailand

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CALFM-C06-13: 20 Jul 2022



Certificate No.: C06220465 Page 3 of 3

Calibration Results: Without Adjustment

Stray Light *			
Standard: cut-off	UUC: Wavelength (nm)	UUC: Transmission (NT)	Absorbance (A)
391.94 ± 0.11 nm	392	4.1	1.367

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

The End of Certificate

Unit Under Calibration: 418 nm
 DKSH Technology Limited
 2533 Sukhumvit Road, Bangkok, Thailand 10260
 Phone: +66 2636 7000 Email: info@dksh.com Website: www.dksh.com/thailand

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CALFM-C06-13: 20 Jul 2022



ใบตรวจสอบสภาพเครื่องวัดรังสีแสง

เลขที่ใบงาน: KSPR2212225

ชนิดเครื่องมือ: SPECTROPHOTOMETER รุ่น: DR3900 หมายเลขเครื่อง: 2021761

ตรวจสอบ (รับ)		ตรวจสอบ (ส่ง)		หมายเหตุ
27 Sep 2022		27 Sep 2022		
ปกติ	ไม่ปกติ	ปกติ	ไม่ปกติ	
General				
☒	☐	☒	☐	
☒	☐	☒	☐	
☒	☐	☒	☐	
☒	☐	☒	☐	
☒	☐	☒	☐	
Spectrophotometer				
☐	☐	☐	☐	
☐	☐	☐	☐	
☒	☐	☒	☐	807.04 807.0 nm
☐	☐	☐	☐	
☒	☐	☒	☐	
☐	☐	☐	☐	
pH Meter and Conductivity Meter				
☐	☐	☐	☐	
☐	☐	☐	☐	
☐	☐	☐	☐	
☐	☐	☐	☐	
Turbidimeter				
☐	☐	☐	☐	
☐	☐	☐	☐	
Automatic titrator				
☐	☐	☐	☐	
☐	☐	☐	☐	
☐	☐	☐	☐	

เห็นด้วย/ไม่เห็นด้วย:

Mr. Chutaphon Fothong
 Service Engineer

Unit Under Calibration: 418 nm
 DKSH Technology Limited
 2533 Sukhumvit Road, Bangkok, Thailand 10260
 Phone: +66 2636 7000 Email: info@dksh.com Website: www.dksh.com/thailand

Delivering Growth - In Asia and Beyond.

CALFM-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 (%) 80.0
 Temperature (°C) 29.0

Dry Gas Meter Data
 Calibration sheet No. : C-DDMMYY-BKK_FS0563
 Dry Gas Meter ID BKK_FS0563
 Serial No. 1606011
 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
Vr (Liters)			Tr (°C)	Vm (Liters)			Ti (°C)	To (°C)	Avg. Tm (°C)	Correction	
Final	Initial	Total		Final	Initial	Total				Factor (Y)	
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	30.50	0.00	30.50	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	0.9800	
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	36.0	36.0	27.0	0.9581	
Avg.										0.9754	

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

Calibrate by:

Mr. Jitakorn Swessa
Field Scientist (2)

Approved by:

Mr. Natthapol Jengwateewong
Field Specialist (1)

FORM NO.: F-06-023 REVISION NO.: 1 ISSUE DATE 30 Jun 22

RYG_EN0003

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaywang, Huaywang, Bangkok 10310
Tel. +66 2643 8361-6, e-mail service.thailand@sartorius.com



MAC
NIST-17025
CALIBRATION 0425

SARTORIUS

REVIEW BY: Thaisakul
APPROVED BY: D
NEXT CAL DATE 01/03/24

Certificate of Calibration

Model Number: MSE224S-100-DU Certificate No.: 23BC01015
 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)
615/10 Moo 5 T.Maenam Khu, A.Pluak Daeng, Rayong 21140, Thailand.

Calibrated Place: ALS Laboratory Group (Thailand) Co., Ltd. (Balance Room)
615/10 Moo 5 T.Maenam Khu, A.Pluak Daeng, 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
Temperature: 23.0 °C $\pm$ 5.0 °C
Humidity: 56.0 % RH $\pm$ 10.0 % RH
Pressure: $\pm$ 0.1 hPa
Reasons for calibration
☐ New Installation ☐ Service / Repair ☒ Re-calibration / Maintenance
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 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	C02212555	14-Sep-2023
MHB-382SD	Humidity/Barometer/Temp. Lucas 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) 29			
Calibration sheet No. : C-130123-BKK_FS0563		Relative Humidity (%) : 60			
Digital Temperature ID : BKK_FS0563		Reference Temperature ID BKK_FS1144			
Serial No. : 1606011		Serial No. : 201090006013			
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	-
	140	-	-	±3	-
Fillet	100	100	0	±3	Pass
	120	120	0	±3	Pass
	140	140	0	±3	Pass
Exit	0	0	0	±3	Pass
	10	10	0	±3	Pass
	20	20	0	±3	Pass
Meter	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass
AUX	0	0	0	±3	Pass
	25	26	1	±3	Pass
	50	51	1	±3	Pass

MPE : (Maximum permissible error of measurement) ค่าความคลาดเคลื่อนสูงสุดที่อนุญาต

Calibrated by:

Mr. Jitakorn Swessa
Field Scientist (2)

Approved by:

Mr. Natthapol Jengwateewong
Specialist (1)

FORM NO.: F-06-027 REVISION NO.: 2 ISSUE DATE: 9 Feb 23

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaywang, Huaywang, Bangkok 10310
Tel. +66 2643 8361-6 Fax: +66 2643 8367, e-mail: service.thailand@sartorius.com

SARTORIUS

Certificate of Calibration

Model Number: MSE224S-100-DU Certificate No.: 23BC01015
 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 repeatability is the ability of a weighing instrument to display nearly identical readouts 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 $\pm 1/10$ or $1/16$ of maximum capacity placed in the middle of the weighing pan and between each of four additional measurement points (positions defined according to OIML R76).			
Nominal Value : (Low Load)	20 g	20.0000	200.0000	Nominal value :	100 g		
Tolerance	0.0001 g	20.0000	200.0000	Tolerance	0.0004 g		
		20.0000	200.0000				
		20.0000	200.0000				
Nominal Value : (High Load)	200 g	200.0000	200.0000				
Tolerance	0.0001 g	200.0000	200.0000				
		200.0000	200.0000				
		200.0000	200.0000				
Standard Deviation		0.00004	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)	(g)
0.01	0.0100	0.0100	0.0000	0.00013	
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	0.00024	
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

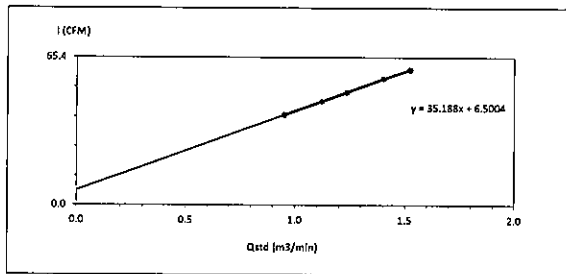


High Volume Air Sampler Calibration Worksheet

Project Site : Amata B.Grimm Power (Rayong) 2 Limited
 Calibrate Location : โรงผลิตปูนซีเมนต์
 Calibrate Date : 18-Sep-23
 Calibration Sheet No.: C-180923-RYG_FS0176
 Calibrator ID: RYG_FS0205
 Calibrator Model: TE-5028A
 Calibrator S/N: 1166

Barometric Pressure (mm Hg) : 758
 Temperature (°C) : 29
 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	2.8	1.1233	46	
3	3.4	1.2357	50	
4	4.4	1.4030	56	
5	5.2	1.5234	60	



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

Approved by: N. Nongpong Juntarupan
 (Mr. Nongpong Juntarupan)
 Enviro Field Coordinator Scientist (3)

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

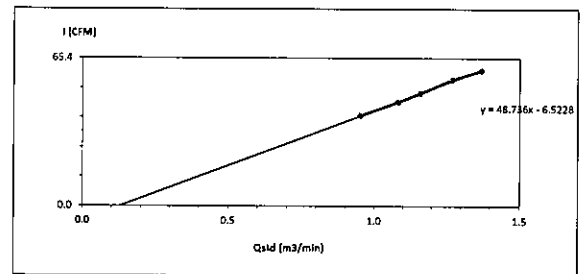


High Volume Air Sampler Calibration Worksheet

Project Site : Amata B.Grimm Power (Rayong) 2 Limited
 Calibrate Location : โรงผลิตปูนซีเมนต์
 Calibrate Date : 18-Sep-23
 Calibration Sheet No.: C-180923-RYG_FS0179
 Calibrator ID: RYG_FS0205
 Calibrator Model: TE-5028A
 Calibrator S/N: 1166

Barometric Pressure (mm Hg) : 758
 Temperature (°C) : 29
 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. Nontachai Uppathamp
 (Mr. Nontachai Uppathamp)
 Field Scientist(1)

Approved by: N. Nongpong Juntarupan
 (Mr. Nongpong Juntarupan)
 Enviro Field Coordinator Scientist (3)

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

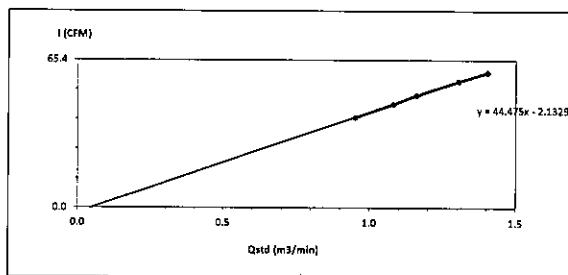


High Volume Air Sampler Calibration Worksheet

Project Site : Amata B.Grimm Power (Rayong) 2 Limited
 Calibrate Location : โรงผลิตปูนซีเมนต์
 Calibrate Date : 18-Sep-23
 Calibration Sheet 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. Nontachai Uppathamp
 (Mr. Nontachai Uppathamp)
 Field Scientist(1)

Approved by: N. Nongpong Juntarupan
 (Mr. Nongpong Juntarupan)
 Enviro Field Coordinator Scientist (3)

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

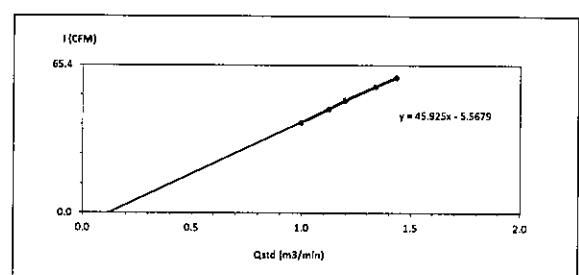


High Volume Air Sampler Calibration Worksheet

Project Site : Amata B.Grimm Power (Rayong) 2 Limited
 Calibrate Location : โรงผลิตปูนซีเมนต์
 Calibrate Date : 18-Sep-23
 Calibration Sheet 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. Nontachai Uppathamp
 (Mr. Nontachai Uppathamp)
 Field Scientist(1)

Approved by: N. Nongpong Juntarupan
 (Mr. Nongpong Juntarupan)
 Enviro Field Coordinator Scientist (3)

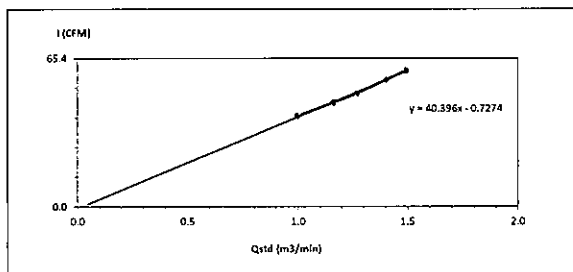
FORM NO: F 06-073 REVISION NO.: ISSUE DATE: 14/03/16



High Volume Air Sampler Calibration Worksheet

Project Site:	Amata B Grimm Power (Rayong) 2 Limited	Barometric Pressure (mm Hg):	758
Calibrate Location:	พื้นที่โรงงาน (โรงงานปูน)	Temperature (°C):	28
Calibrate Date:	18-Sep-23	High Volume ID:	RYG_F50395
Calibration Sheet No.:	C-180923-RYG_F50395	High Volume Model:	TE-5170D
Calibrator ID:	RYG_F50205	High Volume S/N:	5692
Calibrator Model:	TE-5028A	Calibrator Slope:	1.50765
Calibrator S/N:	1166	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: 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: Nupt
[Mr. Nontachai Uppathamp]
Field Scientist(1)

Approved by: N. Pong
[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 2643 8361-6, e-mail: service.thailand@sartorius.com



SARTORIUS
REVIEW BY: Phaitall
APPROVED BY: D. Pong
NEXT CAL DATE: 01/03/24

Certificate of Calibration

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

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 (WI-003)
Based on UKAS LAB 14 : 2019

Metrological data:	Ambients Conditions:
Capacity: <u>150</u> g Readability: <u>0.0001</u> g	Temperature: <u>24.2</u> °C ± <u>6.0</u> °C
Reasons for calibration	Humidity: <u>60.0</u> % RH ± <u>10.0</u> % RH
☐ New Installation ☐ Service / Repair ☒ Re-calibration/ Maintenance	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 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	C02212565	14-Sep-2023
MHB-382SD	Humidity/Barometer/Temp Lutron 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

Chonchai Inthana
Mr.chonchai inthana(Technical Manager)



SOP FM 33 03 February 2022

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2643 8361-6 Fax: +66 2643 8367, e-mail: service.thailand@sartorius.com

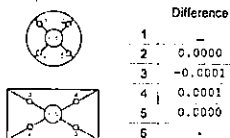
SARTORIUS

Certificate of Calibration

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

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 reading 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)	Nominal value : 50 g
10 g	Tolerance 0.0004 g
Tolerance	
0.0001 g	
Nominal Value : (High Load)	
100 g	
Tolerance	
0.0001 g	
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	0.000022
0.05	0.0500	0.0500	0.0000	0.000023
0.1	0.1000	0.1000	0.0000	0.000023
0.5	0.5000	0.5000	0.0000	0.000023
1	1.0000	1.0000	0.0000	0.000023
2	2.0000	2.0000	0.0000	0.000023
5	5.0000	5.0000	0.0000	0.000022
10	10.0000	10.0001	0.0001	0.000024
20	20.0000	20.0001	0.0001	0.000023
100	100.0000	100.0002	0.0002	0.000026

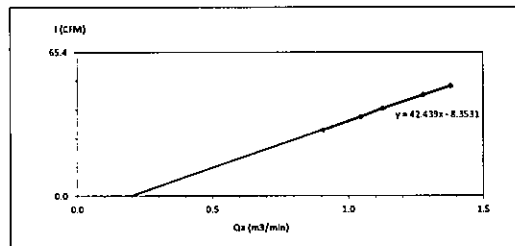
End of Report

End of Report

High Volume Air Sampler Calibration Worksheet

Project Site:	Amata B Grimm Power (Rayong) 2 Limited	Barometric Pressure (mm Hg):	758
Calibrate Location:	พื้นที่โรงงาน (โรงงานปูน)	Temperature (°C):	28
Calibrate Date:	18-Sep-23	High Volume ID:	RYG_F50397
Calibration Sheet No.:	C-180923-RYG_F50397	High Volume Model:	TE-5009X
Calibrator ID:	RYG_F50205	High Volume S/N:	5687
Calibrator Model:	TE-5028A	Calibrator Slope:	0.94434
Calibrator S/N:	1166	Calibrator Intercept:	-0.01292

Test No.	Delta H ₂ O (Inch)	Q _{std} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	1.8	0.998	30	Slope: 42.4389
2	2.4	1.047	36	Intercept: -0.3551
3	2.8	1.130	40	Correlation Coefficient: 0.9995
4	3.6	1.279	46	
5	4.2	1.380	50	



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

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

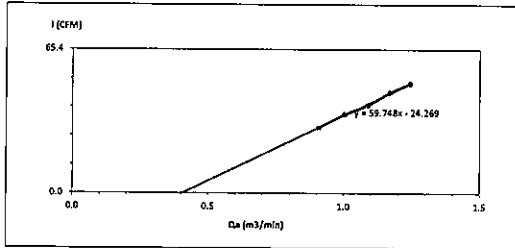
FORM NO.: F-06-074 REVISION NO.: - ISSUE DATE: 14/03/16



High Volume Air Sampler Calibration Worksheet

Project Site: Amata B.Grimm Power (Rayong) 2 Limited
 Calibrate Location: โรงไฟฟ้าถ่านหิน
 Calibrate Date: 18-Sep-23
 Calibration Sheet No.: C-180923-RYG_PS0192
 Calibrator ID: RYG_PS0205
 Calibrator Model: TE-5028A
 Calibrator S/N: 1166
 Barometric Pressure (mm Hg): 758
 Temperature (°C): 28
 High Volume ID: RYG_PS0192
 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)	Qa (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
 Field Scientist (1)

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

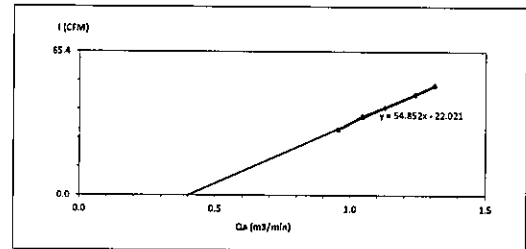
FORM NO.: F 06-074 REVISION NO.: ISSUE DATE: 14/03/16



High Volume Air Sampler Calibration Worksheet

Project Site: Amata B.Grimm Power (Rayong) 2 Limited
 Calibrate Location: โรงไฟฟ้าถ่านหิน
 Calibrate Date: 18-Sep-23
 Calibration Sheet No.: C-180923-RYG_PS0185
 Calibrator ID: RYG_PS0205
 Calibrator Model: TE-5028A
 Calibrator S/N: 1166
 Barometric Pressure (mm Hg): 758
 Temperature (°C): 28
 High Volume ID: RYG_PS0185
 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)	Qa (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
 Field Scientist (1)

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

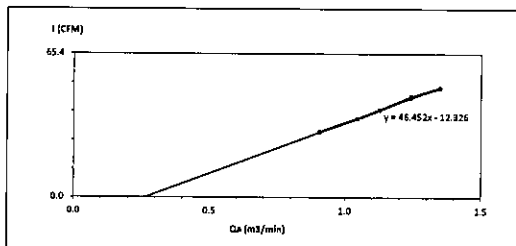
FORM NO.: F 06-074 REVISION NO.: ISSUE DATE: 14/03/16



High Volume Air Sampler Calibration Worksheet

Project Site: Amata B.Grimm Power (Rayong) 2 Limited
 Calibrate Location: โรงไฟฟ้าถ่านหิน
 Calibrate Date: 18-Sep-23
 Calibration Sheet No.: C-180923-RYG_PS0295
 Calibrator ID: RYG_PS0205
 Calibrator Model: TE-5028A
 Calibrator S/N: 1166
 Barometric Pressure (mm Hg): 758
 Temperature (°C): 28
 High Volume ID: RYG_PS0295
 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)	Qa (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
 Field Scientist (1)

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

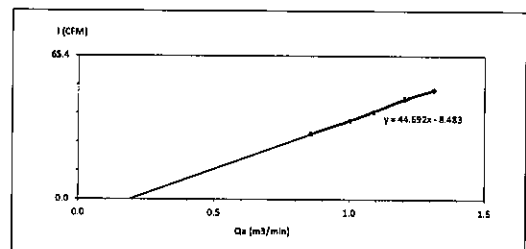
FORM NO.: F 06-074 REVISION NO.: ISSUE DATE: 14/03/16



High Volume Air Sampler Calibration Worksheet

Project Site: Amata B.Grimm Power (Rayong) 2 Limited
 Calibrate Location: โรงไฟฟ้าถ่านหิน
 Calibrate Date: 18-Sep-23
 Calibration Sheet No.: C-180923-RYG_PS0298
 Calibrator ID: RYG_PS0205
 Calibrator Model: TE-5028A
 Calibrator S/N: 1166
 Barometric Pressure (mm Hg): 758
 Temperature (°C): 28
 High Volume ID: RYG_PS0298
 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)	Qa (m ³ /min)	I: Chart (CFM)	Linear Regression
1	1.6	0.857	30	Slope: 44.6915 Intercept: -8.4030 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
 Field Scientist (1)

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

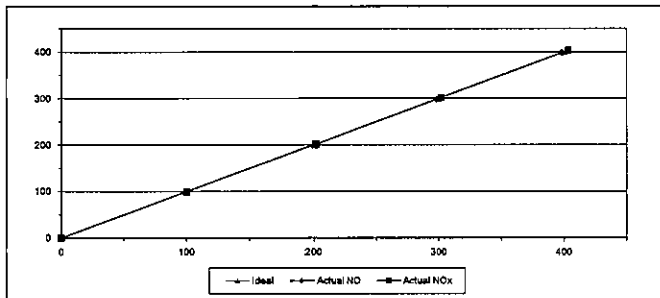
FORM NO.: F 06-074 REVISION NO.: ISSUE DATE: 14/03/16



MULTIPOINT CALIBRATION REPORT

Calibration Date 1-Jul-23 Equipment Name NOx Analyzer
 Manufacturer HORIBA Model APNA-370
 Serial No. T95HWM41 Equipment ID RYG_F80481
 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. Jirawat Sakam)
Field Environmental Scientist (3)

Approved By

(Mr. Sarayuth Jittrant)
Assistant General Manager

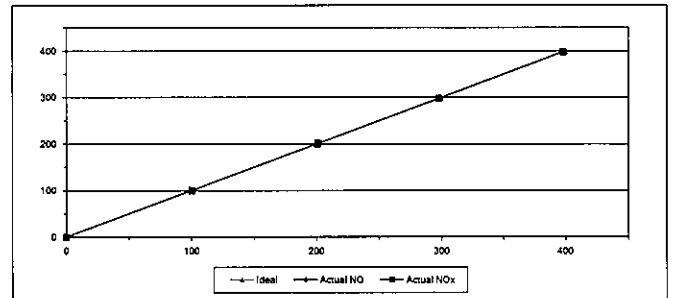
ALS Laboratory Group
FORM NO.: F-06-056 REVISION NO.: - ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date 1-Jul-23 Equipment Name NOx Analyzer
 Manufacturer Teledyne API Model 200E
 Serial No. 1578 Equipment ID BKK_F80735
 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	299.00	-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. Jirawat Sakam)
Field Environmental Scientist (3)

Approved By

(Mr. Sarayuth Jittrant)
Assistant General Manager

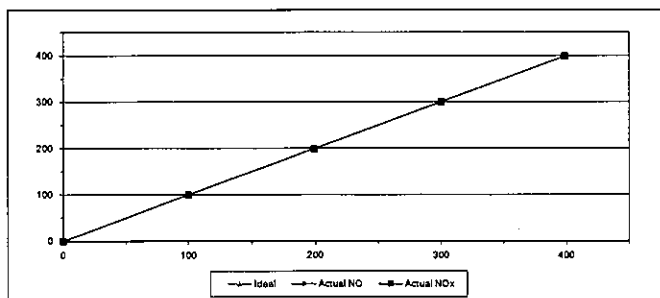
ALS Laboratory Group
FORM NO.: F-06-056 REVISION NO.: - ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date 1-Jul-23 Equipment Name NOx Analyzer
 Manufacturer HORIBA Model APNA-370
 Serial No. 7AV88544 Equipment ID RYG_F80272
 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. Jirawat Sakam)
Field Environmental Scientist (3)

Approved By

(Mr. Sarayuth Jittrant)
Assistant General Manager

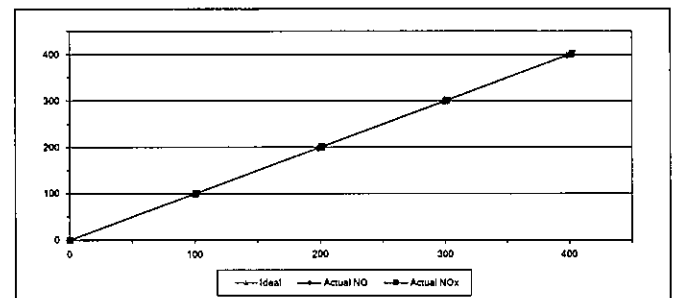
ALS Laboratory Group
FORM NO.: F-06-056 REVISION NO.: - ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date 1-Jul-23 Equipment Name NOx Analyzer
 Manufacturer Teledyne API Model T200
 Serial No. 7238 Equipment ID RYG_F80535
 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	199.30	-0.70	-0.35	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. Jirawat Sakam)
Field Environmental Scientist (3)

Approved By

(Mr. Sarayuth Jittrant)
Assistant General Manager

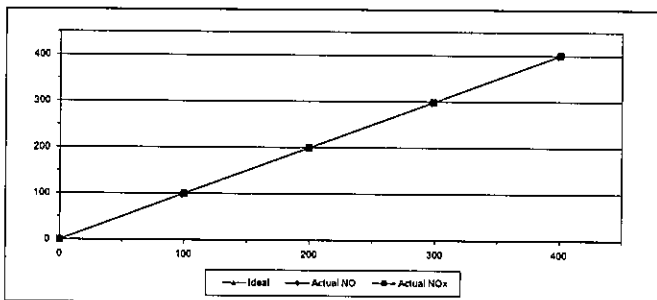
ALS Laboratory Group
FORM NO.: F-06-056 REVISION NO.: - ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	1-Jul-23	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APHA-370
Serial No.	T2TBYRLL	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	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual	Error	%Error	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	199.60	-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. Jirawut Sakam)
Field Environmental Scientist (3)

Approved By

(Mr. Sarayuth Jitranont)
Assistant General Manager

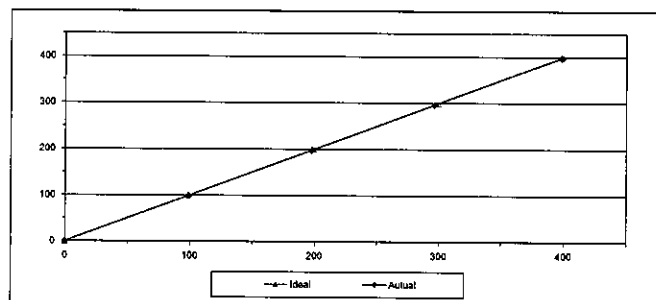
ALS Laboratory Group
FORM NO.: F 06-056 REVISION NO.: ISSUE DATE: 02/04/12



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)	58.3	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	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	98.70	-1.30	-1.30
2	200.00	197.60	-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. Jirawut Sakam)
Field Environmental Scientist (3)

Approved By

(Mr. Sarayuth Jitranont)
Assistant General Manager

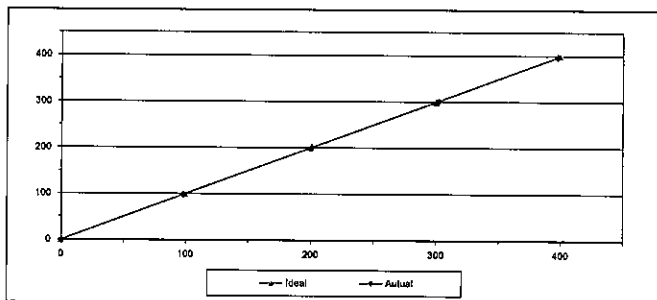
ALS Laboratory Group
FORM NO.: F 06-056 REVISION NO.: ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	2-Jul-23	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	H083D8FA	Equipment ID	RYG_FS0454
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	58.3	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	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. Jirawut Sakam)
Field Environmental Scientist (3)

Approved By

(Mr. Sarayuth Jitranont)
Assistant General Manager

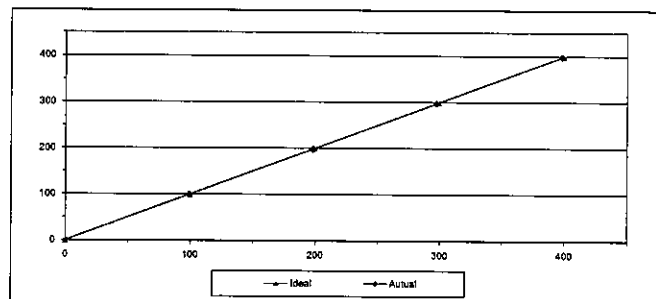
ALS Laboratory Group
FORM NO.: F 06-056 REVISION NO.: ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	2-Jul-23	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	1082NYKM	Equipment ID	RYG_FS0271
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	58.3	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	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. Jirawut Sakam)
Field Environmental Scientist (3)

Approved By

(Mr. Sarayuth Jitranont)
Assistant General Manager

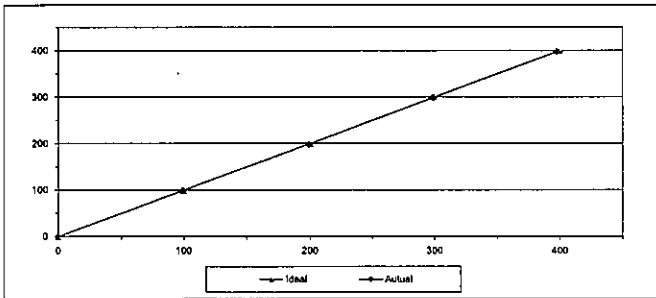
ALS Laboratory Group
FORM NO.: F 06-056 REVISION NO.: ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	2-Jul-23	Equipment Name	SO2 Analyzer
Manufacturer	Teledyne API	Model	T100
Serial No.	8061	Equipment ID	RYG_F80534
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	847		
Std. Gas Concentration (PPM)	56.3	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	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	98.80	-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 (%)				-0.60



Calibrated By

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

Approved By

(Mr.Sanyuth Jitranont)
Assistant General Manager

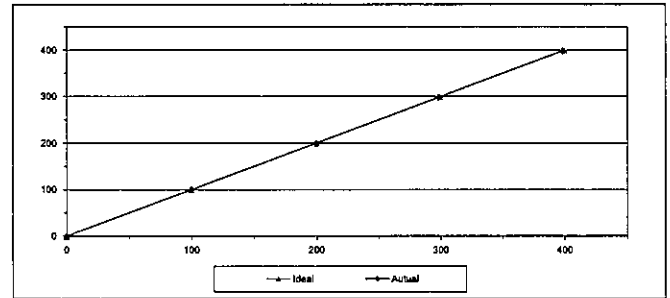
ALS Laboratory Group
FORM NO.: F-08-058 REVISION NO.: ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	2-Jul-23	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	R0HWYDVW	Equipment ID	RYG_F80456
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	847		
Std. Gas Concentration (PPM)	56.3	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	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

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

Approved By

(Mr.Sanyuth Jitranont)
Assistant General Manager

ALS Laboratory Group
FORM NO.: F-08-056 REVISION NO.: ISSUE DATE: 02/04/12



Jirante Associate Co., Ltd.
60714 15, 61701-16
P.O. Box 717, R3 Westgate, Bangkok
Bangkok 10600 (Thailand)
Tel: +662-048812
Mobile: +662-0775913
E-mail: jirante@jirante.com
Web site: www.jirante.com

Accredited calibration laboratory
ISO/IEC 17025:2017
MSC-758-TS 37005
CALIBRATION 03167

Air speed measurement laboratory
Calibration services department

Certificate Number
CL-018-66

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM	Cup anemometer
MANUFACTURER	Novalex
MODEL/TYPE	Sensor: WS-02F Data logger: 200-WS-2518
SERIAL NUMBER	Sensor: - Data logger: AS369
ID NUMBER	RYG_550411
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	27 Jan 2023
MEASUREMENT DATE	10 Feb 2023
ISSUE DATE	10 Feb 2023
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	Eiffel-type wind tunnel of Jirante Associate Co., Ltd.
CALIBRATION CONDITIONS	Wind tunnel cross-section area ¹ 900 cm ² Win direction frontal area ² 100 cm ² Diameter of mounting pipe ³ - mm Blockage ratio of test object ⁴ 0.131 [-]
Preconditioning	24 hours at ambient conditions.
Measurement Condition	The average values during measurement are (23.8) °C, (44.8) %RH and (1010.3) hPa.

Calibration procedure:
The cup anemometer was calibrated against Standard air velocity transducer model: 8455-A2 and pilot tube with precision differential pressure meter model: DP14500 in an open test section of Eiffel-type wind tunnel with 900 cm² cross test section area. The WS-CL-007 based on IEC 61400-12-2, Wind energy generation systems - Part 12-2: 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 realization of the international standards, and to realization of the international system of units (SI) through the NMJ (National Metrology Institute of Thailand) via Certificate number: NMJ-0052-21 and NMJ-0068-22.

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).

PLACE OF CALIBRATION: Eiffel-type wind tunnel of Jirante Associate Co., Ltd.

CALIBRATION CONDITIONS: Wind tunnel cross-section area¹ 900 cm²
Win direction frontal area² 100 cm²
Diameter of mounting pipe³ - mm
Blockage ratio of test object⁴ 0.131 [-]

Preconditioning: 24 hours at ambient conditions.
Measurement Condition: The average values during measurement are (23.8) °C, (44.8) %RH and (1010.3) hPa.

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

Calibrated by:
[X] Mr. Surawit Thachalad
[X] Miss Jiraporn Jantornphol



Approved signature
Mr. Parinya Moonsriharn
Calibration Department Manager

Remark:
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 10⁻⁴

Certificate Number

CL-018-66

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 30 m/s was calculated by a pilot 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 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)
0.583	23.60	23.55	0.8	-0.2	0.15
2.038	23.50	23.55	1.8	-0.7	0.16
3.044	23.50	23.55	2.8	-0.7	0.18
4.147	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	23.76	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	-0.1	0.19
10.07	23.50	23.55	10.0	-0.1	0.19
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	-0.7	0.28
16.29	23.20	23.55	16.0	-0.3	0.24

Remarks:

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

¹ Velocity of standard

² Velocity of unit Under Calibration

PHOTO OF CALIBRATION SET-UP



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



CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM : Wind Direction Sensor
MANUFACTURER : Novatec
MODEL/TYPE : Sensor: WS-02F
Data logger: 200-WS-25LB
SERIAL NUMBER : Sensor:
Data logger: AS369
ID NUMBER : RYG_750411
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan Rd., Phatthanakan Rd., Khwaeng Suan Luang,
Khet Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE : 27 Jan 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 : Effel-type wind tunnel of Jirantee Associates Co., Ltd.

CALIBRATION CONDITION : Wind tunnel cross-section area¹ 900 cm²
Win direction frontal area² 129 cm²
Diameter of mounting pipe³ 129 mm
Blockage ratio of test object⁴ 0.143 [-]

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : 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:
[X] Mr. Sorawit Thachalad
[X] Miss Jiraporn Lertsomphol



Approved signature:

Mr. Pailiya Boonchaoen
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 "a" / "b"

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-016-66

Page 2 of 2 Pages

MEASUREMENT RESULTS⁵

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
	135.000	135	0	0.68
	180.000	187	7	0.74
	225.000	230	5	0.68
	270.000	275	5	0.58
	315.000	320	5	0.58

Remarks:

⁵ Calibration results only count for the tested circumstances and environmental conditions during which calibration took place.
⁶ Direction of standard
⁷ Direction of Unit Under Calibration



End of Certificate of Calibration

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM : Cup anemometer
MANUFACTURER : Novatec
MODEL/TYPE : Sensor: WS-02F
Data logger: 110 WS-25DL-D
SERIAL NUMBER : Sensor: WSD-AS816
Data logger: AS816
ID NUMBER : RYG_750455
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan Rd., Phatthanakan Rd., Khwaeng Suan Luang,
Khet Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE : 13 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

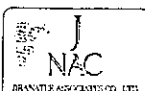
PLACE OF CALIBRATION : Effel-type wind tunnel of Jirantee Associates Co., Ltd.

CALIBRATION CONDITIONS : Wind tunnel cross-section area¹ 900 cm²
Win direction frontal area² 100 cm²
Diameter of mounting pipe³ 100 mm
Blockage ratio of test object⁴ 0.111 [-]

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (23.9) °C, (45.3) %RH and (1008.2) hPa.

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

Calibrated by:
[X] Mr. Sorawit Thachalad
[X] Miss Jiraporn Lertsomphol



Approved signature:

Mr. Pailiya Boonchaoen
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 "a" / "b"

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 RESULTS⁵

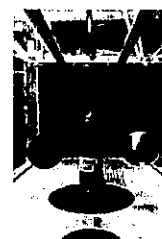
The cup anemometer, Unit Under Calibration (UUC) was exercise at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer and above 5 m/s to 30 m/s was calculated by a pitot tube with precision differential 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 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 _{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
4.148	23.92	23.90	3.9	-0.2	0.31
5.00	23.60	23.90	4.8	-0.2	0.31
5.59	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	-0.2	0.31
9.08	23.50	23.90	8.9	-0.2	0.31
10.06	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

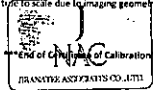
Remarks:

⁵ Calibration results only count for the tested circumstances and environmental conditions during which calibration took place.
⁶ Velocity of standard
⁷ 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 imaging geometry.



End of Certificate of Calibration

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM : Wind Direction Sensor
MANUFACTURER : Novamex
MODEL/TYPE : Sensor: WS-02F
Data logger: 110 WS-25DL-D
SERIAL NUMBER : Sensor: WSO-AS816
Data logger: AS816
ID NUMBER : RYG_F50545
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 follows:
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 Jirante Associates Co., Ltd.

CALIBRATION CONDITION : Wind tunnel cross section area¹ 900 cm²
Wind direction frontal area² 129 cm²
Diameter of mounting pipe³ - mm
Blockage ratio of test object⁴ 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. Sorawit Thachalad
☐ Miss Jitraporn Lertsompnot
☐ Miss Ruangrumpi Phoommit

Approved signatory:
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 to 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 OF CALIBRATION

Certificate No.: CDT-038-66
Page 1 of 2

Equipment Name: Data Logger with Temperature sensor
Manufacturer: Novamex
Model: 110 WS-25DL-D
Serial No.: AS816
ID No.: RYG_F50545

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

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: DTI 1000-A MK
II, Serial No.: 671407-00591 Due date: 22 July 2023

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

Received date: 11 Jul 2023
Calibration date: 21 Jul 2023
Issue date: 21 Jul 2023

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

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. Sorawit Thachalad
☒ Miss Jitraporn Lertsompnot
☐ Miss Ruangrumpi Phoommit

J NAC
JIRANATE ASSOCIATES CO., LTD.

Approved Signatory:
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 _{cal}	D _{unc}	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
	270.001	273	3	1.0
	315.000	317	2	1.0
	360.000	359	-1	1.0

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

J NAC
JIRANATE ASSOCIATES CO., LTD.

Certificate No.: CDT-038-66
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: T23205595.

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	0.099
70	25.055	24.6	-0.4	0.14
70	30.050	29.7	-0.4	0.099
70	35.043	34.5	-0.5	0.099
70	40.036	39.5	-0.5	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 ★

J NAC
JIRANATE ASSOCIATES CO., LTD.

CERTIFICATE OF CALIBRATION

Calibration No.: RH-02072023
Page 1 of 1 Pages

Measurement Item: Relative humidity with data logger
Manufacturer: Novolynx
Model/Type: 110-WS-26DL-D
Serial Number: A5816
ID No.: RYB_PS0545
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±5)%.

Measurement Method:
Unit Under Calibration (UUC) was calibrated by comparison method with standard chilled mirror hygrometer model: 1860-3 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: 209226-001. 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 (UIP) on display. Model: 16MP60, Serial number: T2320595.

Calibration was performed in the range of 20%RH to 80%RH

The results of calibration are reported in table below.

Determined (%RH)	Standard (%RH)	UUC (%RH)	Error (%RH)	Uncertainty ±(%RH)
20	20.05	17.5	-2.6	0.62
50	50.23	46.5	-3.7	0.61
80	80.26	75.5	-4.8	0.61

Performed by:
☒ Mr. Sorawit Thacholad
☒ Miss Jitraporn Lertsomphol
☒ Miss Ruengrumpal Pitsomrit



Approved Signatory: *Mr. Parinya Booncharoen*
Calibration Department Manager

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

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM: Cup anemometer
MANUFACTURER: Novolynx
MODEL/TYPE: Sensor: WS-027
Data logger: WS-250K
SERIAL NUMBER: Sensor: Data logger: A4562
ID NUMBER: BXA_150143
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: 28 Dec 2022
MEASUREMENT DATE: 05 Jan 2023
ISSUE DATE: 09 Jan 2023

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: Effel-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: mm
Blockage ratio of test object⁴: 0.111 [-]

Preconditioning: 24 hours at ambient conditions.
Measurement Condition: The average values during measurement are (24.0) °C, (50.4) %RH and (1014.5) hPa.

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

Calibrated by:
1) Mr. Sorawit Thacholad
2) Miss Jitraporn Lertsomphol



Approved Signatory: *Mr. Parinya Booncharoen*
Calibration Department Manager

Remarks:
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 to 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

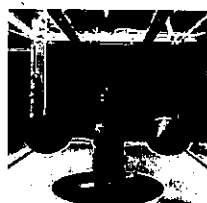
MEASUREMENT RESULTS¹

The 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 calibrated 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 rain 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.

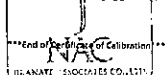
V _u ² (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V _u ² (m/s)	Error (m/s)	U (m/s)
0.989	24.10	24.00	0.7	-0.3	0.28
2.034	23.56	24.00	1.7	-0.3	0.36
3.051	24.06	24.00	2.9	-0.2	0.29
4.158	24.00	24.00	3.9	-0.2	0.19
4.99	24.00	24.00	4.8	-0.1	0.25
5.98	24.00	24.00	5.9	-0.1	0.18
7.05	23.90	24.00	6.9	-0.3	0.21
8.18	23.90	24.00	8.0	-0.2	0.21
9.60	23.72	24.00	9.1	0.0	0.30
10.09	23.80	24.00	9.9	-0.1	0.24
11.15	23.80	24.00	11.1	-0.1	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	23.95	24.00	14.4	0.1	0.22
15.26	23.88	24.00	15.1	-0.3	0.27
16.32	24.00	24.00	16.4	0.1	0.28

Remarks:
¹ Calibration results only co-nd for the tested 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 calibrated one. Remark: The proportion of the set-up is not true to scale due to imaging geometry.



CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM: Wind direction sensor
MANUFACTURER: Novolynx
MODEL/TYPE: Sensor: WS-01F
Data logger: WS-250L
SERIAL NUMBER: Sensor: Data logger: A4562
ID NUMBER: BXA_150143
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: 28 Dec 2022
MEASUREMENT DATE: 06 Jan 2023
ISSUE DATE: 09 Jan 2023

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: Effel-type wind tunnel of Jiranatee Associates Co., Ltd.

CALIBRATION CONDITION:
Wind tunnel cross-section area¹: 900 cm²
Win direction frontal area²: 129 cm²
Diameter of mounting pipe³: mm
Blockage ratio of test object⁴: 0.143 [-]

Preconditioning: 24 hours at ambient conditions.
Measurement Condition: The average values during measurement are (24.9) °C, (50.1) %RH and (1015.7) hPa.

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

Calibrated by:
1) Mr. Sorawit Thacholad
2) Miss Jitraporn Lertsomphol



Approved Signatory: *Mr. Parinya Booncharoen*
Calibration Department Manager

Remarks:
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 to 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-002-66

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 ₁ ° Degree (°)	D ₂ ° Degree (°)	Error Degree (°)	U (k=2) Degree (°)
4.58	0.000	0	0	0.58
	45.000	41	-4	0.74
	90.000	87	-3	0.74
	135.000	134	-1	0.74
	180.000	182	2	0.74
	225.000	228	3	0.68
	270.000	272	2	0.74
	315.000	318	3	0.74

Remarks:

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

² Velocity of standard

³ Velocity of Unit Under Calibration



End of Certificate of Calibration



Jiranae Associates Co. Ltd.
1314 P. P. 10/10, 10
Fahsarakon 3/10, 10/10, 10/10, 10/10
Bangkok 10100 (Thailand)
Tel: 02-000-0000
Mobile: 09-000-0000
E-mail: jiranae@jiranae.com
Web site: www.jiranae.com

Accredited calibration laboratory
ISO/IEC 17025:2017
MSC-185-115 J7025
CALIBRATION 0367

Air speed measurement laboratory
Calibration services department

REVISED BY: *Manon P.*
REVISED BY: *Manon P.*
DATE: 18/10/24

Certificate Number
CL 006 65

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

: Cup anemometer

MANUFACTURER

: Navalm

MODEL/TYPE

: Sensor: WS-017

SERIAL NUMBER

: Data logger: 110-WS-250L-D

ID NUMBER

: Sensor: WSD-016

CONDITION AS RECEIVED

: Data logger: AS510

CUSTOMER

: RVC, 150620
Newlorn
ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,
Khet Suan Luang, Bangkok 10250 Thailand

Calibration procedure:

The cup anemometer was calibrated against Standard air velocity transducer model: R155-12 and pitot tube with pressure differential pressure meter model: DP4000 in an open test section of Eiffel type wind tunnel with 300 cm² cross section area. The WI CL 007 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 guide.

Traceability:

This certificate provides a traceability of the measurement to recognized national standards, and to realization of the international system of units (SI) through the NMAT (National Metrology Institute of Thailand) via Certificate number: NMV 0050-21 and NMV 0004-22

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 uncertainty) Guide to the expression of uncertainty in measurement.

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

: Eiffel type wind tunnel of Jiranae Associates Co., Ltd

CALIBRATION CONDITIONS

: Wind tunnel cross section area¹: 900 cm²

: Wind direction frontal area²: 100 cm²

: Diameter of mounting pipe³: 1 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, (49.5) %RH and (1011.2) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values

Calibrated by:

: Mr. Surawit Thuchakul
: Miss Jitraporn Intsomphon



Approved signature:

Manon P.
Mr. Manon P.
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 %

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Certificate Number
CL-006-65

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

The cup anemometer, Unit Under Calibration (UUC) was preheated at 30 m/s for 5 minutes prior to calibration being performed. The standard air velocity 6.5 m/s to 5 m/s was calculated by a standard air velocity transducer and above 5 m/s to 40 m/s was calculated by a pitot tube with pressure differential pressure meter which was installed 40 mm and 100 mm respectively away from wind tunnel nozzle. UUC was placed at center of the test section. The calibration was carried out under both wind 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.

U _{ref} (m/s)	Temp. wind tunnel (°C)	Temp. UUC (°C)	U _{meas} (m/s)	Error (m/s)	U (k=2) (m/s)
0.971	23.98	23.70	0.8	-0.2	0.15
2.042	23.45	23.70	1.8	-0.2	0.15
3.069	23.50	23.70	2.8	-0.2	0.21
4.223	23.60	23.70	3.9	-0.4	0.20
5.502	23.80	23.70	4.8	0.2	0.20
5.599	23.84	23.70	5.8	0.2	0.15
7.064	23.66	23.70	6.8	-0.2	0.18
8.177	23.78	23.70	7.9	-0.2	0.18
9.10	23.60	23.70	8.8	-0.3	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
14.23	23.94	23.70	13.8	0.4	0.22
15.25	23.78	23.70	15.1	-0.2	0.25
16.30	23.84	23.70	15.9	-0.4	0.25

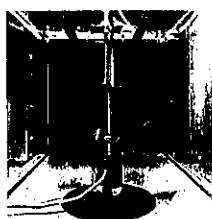
Remarks:

¹ Calibration results only apply for the tested 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 Jiranae 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 due to imaging geometry.



Jiranae Associates Co. Ltd.
1314 P. P. 10/10, 10
Fahsarakon 3/10, 10/10, 10/10, 10/10
Bangkok 10100 (Thailand)
Tel: 02-000-0000
Mobile: 09-000-0000
E-mail: jiranae@jiranae.com
Web site: www.jiranae.com

Accredited calibration laboratory
ISO/IEC 17025:2017
MSC-185-115 J7025
CALIBRATION 0367

Air speed measurement laboratory
Calibration services department

Certificate Number
CL 006 65

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

: Wind Direction Sensor

MANUFACTURER

: Navalm

MODEL/TYPE

: Sensor: WS-027

SERIAL NUMBER

: Data logger: 110-WS-JSDK-D

ID NUMBER

: Sensor: WSD-016

CONDITION AS RECEIVED

: Data logger: AS510

CUSTOMER

: RVC, 150620
Newlorn
ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,
Khet Suan Luang, Bangkok 10250 Thailand

Calibration procedure:

The wind direction sensor was calibrated against Standard Rotary Encoder model: AX4000TS-DIAM P1 1.0 in an open test section of Eiffel type wind tunnel with 900 cm² cross section area. The WI CL 008 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 guide.

Traceability:

This certificate provides a traceability of the measurement to recognized national standards, and to realization of the international system of units (SI) through the NMAT (National Metrology Institute of Thailand) via Certificate number: NM 0041-22

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 uncertainty) Guide to the expression of uncertainty in measurement.

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

: Eiffel type wind tunnel of Jiranae Associates Co., Ltd

CALIBRATION CONDITION

: Wind tunnel cross-section area¹: 900 cm²

: Wind direction frontal area²: 120 cm²

: Diameter of mounting pipe³: 1 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, (45.5) %RH and (1012.5) hPa

TABULATION OF RESULTS:

The table on next page give the measured values

Calibrated by:

: Mr. Surawit Thuchakul
: Miss Jitraporn Intsomphon



Approved signature:

Manon P.
Mr. Manon P.
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 %

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Certificate Number
CL-006-65

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 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 _{90°} Degree (°)	D _{0°} Degree (°)	Error Degree (°)	U (k=2) Degree (°)
5.01	0.000	0	0	0.58
	45.000	44	-2	0.75
	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 count for the tested circumstances and environmental conditions during which calibration took place.

¹ Direction of standard

² Direction of Unit Under Calibration



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

CERTIFICATE OF CALIBRATION

Calibration No.: JH-06112022
Page 1 of 1 Pages

Measurement Item: Relative Humidity with data logger
Manufactures: Novolyox
Model/Type: 110 WS-250L D
Serial Number: A59110
ID No.: IYD TS0609
Customer: A/C Laboratory group (Holland) Co., Ltd.
104 Phatthanasan 40, Phatthanasan Rd, Khwaeng Than Tunng, 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 thermo hygrometer in the humidity generation 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: 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 Display (IIR) on display. Model: IIM/60, Serial number: U3641223

Calibration was performed in the range of 20%RH to 80%RH

The results of calibration are reported in table below.

Determined (%RH)	Standard Reading (%RH)	UUC Reading (%RH)	Error (%RH)	Uncertainty (%RH)
20	19.98	17.6	-2.4	0.66
50	50.28	47.3	-3.0	0.51
80	80.30	77.6	-2.7	0.62

Performed by

☒ Mr. Sornwit Thachulad
☐ Miss Jitraporn Lertsamphol



Approved Signatory:

Mr. Panyon Boonchanon
Calibration Department Manager

THIS CALIBRATION REPORT 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 7/71, Petchkasem Rd,
Walthapra, Banghokya, Bangkok 10600 Thailand.
Tel: (66) 02-8680812#13 Fax: (66) 02-8680860 www.jiranatee.com



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



CERTIFICATE OF CALIBRATION

Certificate No. CL 16446
Page 2 of 2

Equipment Name: Data Logger with Temperature
Sensor

Manufacturer: Novolyox
Model: 110 WS-250L D
Serial No.: A59110
ID No.: IYD TS0609

Customer
Name: A/C Laboratory group (Holland) Co., Ltd
Address: 104 Phatthanasan 40, Phatthanasan
Rd, Khwaeng Than Tunng, Khet Suan Luang, Bangkok
10250 Thailand.

Received date: 09 Nov 2022
Calibration date: 18 Nov 2022
Issue date: 23 Nov 2022

Reference Used During Calibration
1. Standard Temperature Probe Model: S15-100 A409,
Serial No.: 6676R2 09, Due date: 25 Mar 2023
2. Digital Temperature Indicator Model: D11 1000 AMK
II, Serial No.: 671407 00591, Due date: 22 July 2023

Calibration Condition
Temperature: (23±3) °C
Relative Humidity: 60±10%

Calibration Procedure

The temperature calibration was done by in-house calibration method as W1C1.001 according to comparison method with standard digital temperature indicator and standard temperature probe. The temperature scale 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: 11 0034 22, Certificate number: TR 0032 22

Result of Calibration: Without Adjustment With Adjustment

Calibration Range: 20 to 80 °C

Function:

This equipment was connected with temperature sensor Model: IIM/60 S/N: U3641223.

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	0.30
60	25.02	24.8	-0.2	0.30
60	30.00	29.7	-0.3	0.30
60	35.00	34.6	-0.4	0.30
60	40.00	39.3	-0.7	0.30

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%.



Calibrated by
☒ Mr. Sornwit Thachulad
☐ Miss Jitraporn Lertsamphol



Approved Signatory:
Mr. Panyon Boonchanon
Calibration Department Manager

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

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

Calibrated by : Nathakorn Pisutpaisan

Approved by :

(Thanakul Petchum)

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

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACC23005
Job No. : VC66AC0024
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	MY53202742	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	22-Feb-23
Measuring Amplifier	NA-42KAJ	34560495	AA-3005-22	24-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).

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

451-451/1 Sirinthom 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. : ACC23047
Pages : 1 of 8

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACC23005
Job No. : VC66AC0024
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	93.95	-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

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NIT-24
Serial No. : 01222716 / 143832 / 22763
ID No. : RYG_FS0020

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

Calibrated by : Nathakorn Pisutpaisan

Approved by :

(Thanakul Petchum)

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QF-TS12-04-04-020664

QF-TS12-04-04-020664

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	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).

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

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QF-TS12-04-04-020664

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)	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

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)	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	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

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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

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P.T.N.

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	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

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
SEL	0.25	1	99.0	98.8	-0.2	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	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

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Tel:0-2435-8800 Fax:0-2433-1679 e-mail: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 : ALS LABORATORY GROUP (THAILAND) CO.,LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHUWAENG PHATTHANAKAN, KHUET 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 : Nashakorn Pirutpaian

Approved by :

T. Petchumai
(Thanakul Petchumai)

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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-42KA1	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

SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY

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



Cert. No. : ACL23082
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Pre-amplifier NH-24
Serial No. : 00734220 / 145722 / 34370
ID No. : RYG_FS0026

Condition As Found : GOOD

Customer : A.I.S LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHUWAENG 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 : Nuthakorn Pisulpaissan

Approved by :

T. Petchurai
(Thanakul Petchurai)

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associates CALIBRATION LABORATORY

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 item was 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	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-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

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 : 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 : 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)			
	Flat	C-weight	A-weight	Acceptance Limits
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

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

QF-TS12-04-04-020664

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
SEL	0.25	1	99.0	98.8	-0.2	1.5 ; -5.0
	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 LABORATORY451-451/1 Sirinthorn Rd, Bangbunru, Bangplud Bangkok 10700 THAILAND.
Tel:0-2435-8800 Fax:0-2433-1679 e-mail:cal-center@sithiporn.com http://www.sithiporn.comNSC-TS18-TS17233
CALIBRATION 0394Cert. No. : ACL23048
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No. : 01222724 / 143842 / 22771
ID No. : RYG_FS0023

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHUWANG 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 :

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.

QF-TS12-04-04-020664

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		
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

Continuation of Calibration Certificate

Cert. No. : ACL23048
Job No. : VC66AC0034
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. : ACL23048
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

Continuation of Calibration Certificate

Cert. No. : ACL23048
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)
15.4

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

Frequency Weighting	Measured value (dB)
A - weight	11.2
C - weight	17.6
Flat	23.4

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	-0.8	-0.8	-0.7	± 5.0

QP-TS12-04-04-020664

P.T.A.

Continuation of Calibration Certificate

Cert. No. : ACL23048
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	-0.1	-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	0.0	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

QP-TS12-04-04-020664

P.T.A.

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P.T.A.

Continuation of Calibration Certificate

Cert. No. : ACL23048
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	135.0	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	48.9	-0.1	± 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
29.0	29.9	-0.1	± 1.1
24.0	23.8	-0.2	± 1.1
19.0	18.9	-0.1	± 1.1
14.0	13.9	-0.1	± 1.1
9.0	8.9	-0.1	± 1.1
4.0	3.9	-0.1	± 1.1
-1.0	-1.1	-0.1	± 1.1

QP-TS12-04-04-020664

P.T.A.

Continuation of Calibration Certificate

Cert. No. : ACL23048
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	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
	0.25	1	99.0	98.9	-0.1	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	135.8	-0.6	±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

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SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY451-451/1 Sindhorn 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. : ACL22295
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NI-42/ Microphone UC-52 / Preampifier NI1-24
Serial No.: 00233183 / 144835 / 23230
ID No.: RYG_PS0024

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHUWAENG 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 : Nuthakorn Pisutpaisan

Approved by :

(Thunakul Petchurui)

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QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23048
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		
89.6	89.7	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

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associates CALIBRATION LABORATORY

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

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

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 : 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	SILM Display at initial (dB)	SILM 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

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

QF-TS12-04-04-020664

T. Petch

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 ; -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	128.1	0.1	±1.0

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, Lepen (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

QF-TS12-04-04-020664

SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY451-451/1 Srinthorn 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. : ACL23196
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No. : 00734223 / 169439 / 73460
ID No. : RYG_FSI029

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHAENG 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 : 15 JUNE 2023
Calibration Date : 20-22 JUNE 2023
Date of Issue : 23 JUNE 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchum
(Thanakul Petchum)

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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

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23196
Job No. : VC66AC0066
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 300266	13-FEB-24
Digital Multimeter	33461A	MY53220076	EEL-BP 290266	13-FEB-24
Digital Multimeter	34461A	MY60024273	EEL-UP 310266	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-12KAJ	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).

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QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23196
Job No. : VC66AC0066
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	✓	-	0.1	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.

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7. Petch.

Continuation of Calibration Certificate

Cert. No. : ACL23196
Job No. : VC66AC0066
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	0.0	0.0	0.0	±1.5
250	0.0	0.0	-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	0.1	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

Continuation of Calibration Certificate

Cert. No. : ACL23196
Job No. : VC66AC0066
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)
14.3

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	17.0
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)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.5	0.5	0.5	±1.5
1000	0.0	0.0	0.0	±1.0
8000	-2.1	-2.1	-2.1	±5.0

QF-TS12-04-04-020664

7. Petch.

Continuation of Calibration Certificate

Cert. No. : ACL23196
Job No. : VC66AC0066
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	132.9	-0.1	±1.1
132.0	131.9	-0.1	±1.1
131.0	130.9	-0.1	±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
34.0	34.0	0.0	±1.1
30.0	30.0	0.0	±1.1
29.0	29.0	0.0	±1.1
28.0	28.0	0.0	±1.1
27.0	27.0	0.0	±1.1
26.0	26.0	0.0	±1.1
25.0	24.9	-0.1	±1.1

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7. Petch.

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7. Petch.

Continuation of Calibration Certificate

Cert. No. : ACL23196
Job No. : VC66AC0066
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
	0.25	1	99.0	98.9	-0.1	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, Lepack (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±3.0
One	136.4	135.7	-0.7	±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	135.1	-0.3	±2.0
Negative half cycle	135.4	135.1	-0.3	±2.0

Continuation of Calibration Certificate

Cert. No. : ACL23196
Job No. : VC66AC0066
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	89.5	-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. Petch

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CALIBRATION LABORATORY

451-451/1 Sirinthorn 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. : ACL23008
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No. : 01122578 / 143486 / 22620
ID No. : RYG_FS0017

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 : 14 DECEMBER 2022
Calibration Date : 03-05 JANUARY 2023
Date of Issue : 06 JANUARY 2023

Calibrated by : Nubakorn Pisutpaisan

Approved by :

T. Petch
(Thanakul Petchurasi)

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QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23008
Job No. : VC66AC0021
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 Anchoic chamber and Reference Standard Instruments.

For tests results of each items were made by observation of each Instrument's 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-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

Continuation of Calibration Certificate

Cert. No. : ACL23008
Job No. : VC66AC0021
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

Continuation of Calibration Certificate

Cert. No. : ACL23008
Job No. : VC66AC0021
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)
17.1

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

Frequency Weighting	Measured value (dB)
A - weight	16.6
C - weight	22.6
Flat	28.1

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)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.1	0.2	0.2	±1.5
1000	0.0	0.0	0.0	±1.0
8000	0.6	0.7	0.7	±5.0

QF-TS12-04-04-020664

T. Ratan

Continuation of Calibration Certificate

Cert. No. : ACL23008
Job No. : VC66AC0021
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	0.0	-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	0.1	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. Ratan

Continuation of Calibration Certificate

Cert. No. : ACL23008
Job No. : VC66AC0021
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	132.9	-0.1	±1.1
132.0	131.9	-0.1	±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
34.0	34.0	0.0	±1.1
30.0	30.0	0.0	±1.1
29.0	28.9	-0.1	±1.1
28.0	28.0	0.0	±1.1
27.0	27.0	0.0	±1.1
26.0	26.0	0.0	±1.1
25.0	25.0	0.0	±1.1

QF-TS12-04-04-020664

T. Ratan

Continuation of Calibration Certificate

Cert. No. : ACL23008
Job No. : VC66AC0021
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
	0.25	1	99.0	98.9	-0.1	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	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

Continuation of Calibration Certificate

Cert. No. : ACL23008
Job No. : VC66AC0021
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	89.5	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

QF-TS12-04-04-020664

QF-TS12-04-04-020664

SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY

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

Cert. No. : ACL23263
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NII-24
Serial No.: 01122567 / 143473 / 22605
ID No.: RYQ FS0016

Condition As Found : GOOD

Customer : AIS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTANAKAN 40, PHATTANAKAN ROAD,
KHUANG PHATTANAKAN, 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 : 23 AUGUST 2023
Calibration Date : 01 SEPTEMBER 2023
Date of Issue : 04 SEPTEMBER 2023

Calibrated by : Nithakorn Pisutpaisan

Approved by :

T. Petch.
(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

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

Continuation of Calibration Certificate

Cert. No. : ACL23263
Job No. : VC66AC0094
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-42KA1	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 :

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

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23263
Job No. : VC66AC0094
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. P. P.

Continuation of Calibration Certificate

Cert. No. : ACL23263
Job No. : VC66AC0094
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	0.0	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	0.0	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. P. P.

Continuation of Calibration Certificate

Cert. No. : ACL23263
Job No. : VC66AC0094
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	12.0
C - weight	18.3
Flat	24.2

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	0.4	± 1.5
1000	-0.1	-0.1	-0.1	± 1.0
8000	-2.0	-1.9	-1.9	± 5.0

QF-TS12-04-04-020664

P. P. P.

Continuation of Calibration Certificate

Cert. No. : ACL23263
Job No. : VC66AC0094
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	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

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P. P. P.

Continuation of Calibration Certificate

Cert. No. : ACL23263
Job No. : VC66AC0094
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	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	±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

Continuation of Calibration Certificate

Cert. No. : ACL23263
Job No. : VC66AC0094
Pages : 8 of 8

11. Overload indication

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

QP-TS12-04-04-020664

SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY

451-451/1 Sindhorn 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. : ACL23322
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No. : 00597169 / 180411 / 88181
ID No. : RYG_FS0439

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHWAENG PHATTHANAKAN, KJIEI 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. 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.

QP-TS12-04-04-020664

QP-TS12-04-04-020664

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

Continuation of Calibration Certificate

Cert. No. : ACL23322
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	EELBP 300266	13-FEB-24
Digital Multimeter	33461A	MY53220076	EELBP 290266	13-FEB-24
Digital Multimeter	33461A	MY60024273	EELBP 310266	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-42KAI	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).

QP-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23322
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.

Continuation of Calibration Certificate

Cert. No. : ACL23322
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)
14.6

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	17.7
Flat	23.2

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	0.0	0.0	0.0	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	2.0	2.1	2.1	±5.0

QF-TS12-04-04-020664

7. Peth...

Continuation of Calibration Certificate

Cert. No. : ACL23322
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	0.0	±2.0
125	-0.1	0.0	0.0	±1.5
250	0.0	0.0	-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	0.1	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
Imp	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

7. Peth...

Continuation of Calibration Certificate

Cert. No. : ACL23322
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	89.1	0.1	± 1.1
84.0	84.1	0.1	± 1.1
79.0	79.1	0.1	± 1.1
74.0	74.1	0.1	± 1.1
69.0	69.1	0.1	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.1	0.1	± 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	30.0	0.0	± 1.1
29.0	29.0	0.0	± 1.1
28.0	28.0	0.0	± 1.1
27.0	27.0	0.0	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	25.0	0.0	± 1.1

QF-TS12-04-04-020664

7. Peth...

Continuation of Calibration Certificate

Cert. No. : ACL23322
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, Th (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, L _{peak} (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±3.0
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	133.1	0.1	±2.0
Positive half cycle	135.4	135.2	-0.2	±2.0
Negative half cycle	135.4	135.3	-0.1	±2.0

QI-TS12-04-04-020664

T. Petch

43/14-15,67/35-36, Soi Petchkasem 7/71, Petchkasem Rd,
Walthapa, Bangkokkyl, Bangkok 10600 Thailand.
Tel: (66) 02-8680812 Fax: (66) 02-8680860 www.jiranatee.com

CERTIFICATE OF CALIBRATION

Certificate No. : CL-015-56
Page 1 of 2Equipment Name: Heat Stress Monitor
Manufacturer: Delta OHM
Model: HD32.2
Serial No: 18018314
ID No: RYG_FS0359Customer
Name: ALS laboratory group (thailand) Co., Ltd.
Address: 104 Phatthanasak 40, Phatthanasak Rd.,
Khwaeng Suan Luang, Khet Suan Luang, Bangkok
10250 Thailand.Received 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.: 687692-09, Due date: 23 Mar 2023
2. Digital Temperature Indicator Model: DTI-1000-A MK
II, Serial No.: 671407-00591 Due date: 22 July 2023Calibration 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: IT-0034 22. Certificate number: ER-0092-
22

REVIEW BY	Flanglam P.
APPROVED BY	Signature
NEXT CAL DATE	8/12/24

Calibrated by
☒ Mr. Sorawit Thachalad
☐ Miss Jitraporn LertsomphonApproved Signature: Mr. Parinya Booncharoen
Calibration Department Manager

Continuation of Calibration Certificate

Cert. No. : ACL23322
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	0.0	±1.5
89.7	89.7		

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

QI-TS12-04-04-020664

T. Petch

43/14-15,67/35-36, Soi Petchkasem 7/71, Petchkasem Rd,
Walthapa, Bangkokkyl, Bangkok 10600 Thailand.
Tel: (66) 02-8680812 Fax: (66) 02-8680860 www.jiranatee.comCertificate No. : CL-015-56
Page 2 of 2Result 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: 18021465.
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
80	25.048	25.0	0.0	0.099
60	30.045	30.0	0.0	0.099
60	35.030	35.0	0.0	0.099
60	40.021	40.0	0.0	0.099

Table 2: This equipment was connected with temperature probe Model: TP3207.2 S/N: 18021262.
Dimension: Diameter 14 mm, Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.062	20.1	0.0	0.099
70	25.048	24.9	-0.1	0.099
70	30.040	29.9	-0.1	0.099
70	35.032	34.8	-0.2	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: 20008280.
Dimension: Diameter 8 mm, Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.060	20.0	-0.1	0.099
110	25.050	25.1	0.1	0.099
110	30.039	30.1	0.1	0.099
110	35.032	35.1	0.1	0.099
110	40.022	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 *



CERTIFICATE OF CALIBRATION

Certificate No.: CL-043-66
Page 1 of 2

Equipment Name: Heat Stress Monitor
Manufacturer: Delta OHM
Model: HD32.2
Serial No: 20032241
ID No: RYG_FSO521

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: 21 Feb 2023
Calibration date: 24 Feb 2023
Issue date: 26 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: 671407-00581 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: IT-0034-22, Certificate number: ER-0092-
22

Calibrated by
☐ Mr. Sorawit Thachalad
☒ Miss Jitraporn Lertsomphol



Approved Signatory: *Mr. Parinya Booncharoen*
Mr. Parinya Booncharoen
Calibration Department Manager

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

Certificate No.: CL-043-66
Page 2 of 2

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: 21001217,
Dimension: Diameter 14 mm, Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
50	20.045	20.1	0.1	0.099
60	25.055	25.1	0.0	0.099
60	30.056	30.1	0.0	0.099
60	35.048	35.1	0.1	0.099
60	40.043	40.1	0.1	0.099

Table 2: This equipment was connected with temperature probe Model: TP3207.2 S/N: 21001783,
Dimension: Diameter 14 mm, Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.045	20.2	0.2	0.099
70	25.055	25.1	0.0	0.099
70	30.055	30.0	-0.1	0.099
70	35.048	35.0	0.0	0.099
70	40.043	39.9	-0.1	0.099

Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 21001242,
Dimension: Diameter 8 mm, Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.045	20.0	0.0	0.099
110	25.055	25.0	-0.1	0.099
110	30.055	30.0	0.0	0.14
110	35.048	35.0	0.0	0.099
110	40.043	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 ★



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TEL 0-2317-8641-29 FAX 0-2319-9484



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_EN0183
Condition As-Received: Used item
Received Date: 24 February 2023
Calibration Date: 27 February 2023
Reference: 2302-0686DSC-2
Submitted by: ALS Laboratory Group (Thailand) Co., Ltd.
(Rayong Branch)
816/10 Moo 5, T.Maenam Khu, A.Pluakdaeng,
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-CH5 by comparison with standard thermometer

REVIEW BY: *N. B. B. B.*
APPROVED BY: *D. E.*
NEXT CAL. DATE: 27/2/24

Calibrated by: Walailak Sirithan

Approved by: *Sathip*
Approved Signatory

() Malee Bulkruea
(✓) Sathip Meangmai
() Warakorn Lerngajirakul

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

This certificate may not be reproduced other than in full, except with the prior written
Approval of the head of Corporate Services 3: Equipment Calibration and Testing Services.

A 0051538



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	22I1306	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	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	826588	09 July 2024
pH 5.997	CPA chem	826589	09 July 2024
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 (±mV)	Coverage factor k
			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

Sathip

a 1149525



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 6.987 10.010	4.008 6.988 10.013	179.1 4.7 -172.4	0.0046 0.0084 0.0069	2.00 2.00 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 %.

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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TEL. 0-2717-3000-24 FAX. 0-2719-9484



Certificate of Calibration

Certificate No.: 23E753
Page: 1 of 2

Equipment : pH Meter
Manufacturer : Mettler Toledo
Model : SevenCompact 6220
Serial No.: C104059480
ID No.: RYG_EN0183

This certificate may not be reproduced other than in full, except with the prior written approval of the head of Corporate Services 3: Equipment Calibration and Testing Services.

Condition As-Received: Used from
Received Date: 24 February 2023
Calibration Date: 28 February 2023

Reference: 2302-0680DSC
Ambient Temperature: (23 $\pm$ 2) °C
Relative Humidity: (50 $\pm$ 10) %

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

616/10 Moo 5, T.Moenam Khu, A.Pluakdaeng,
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.	Exp. Date
1) Multi-Product Calibrator	5500A	6440007	22E1670	18 May 2023

2. This result of calibration was made on requested at 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: Wutthachornpong Wongchulkrano
Issue Date: 02 March 2023

Approved Signatory :

[] Phatinee Prabpaijai
[x] Nuntawat Khanchai
[] Pornhippa Tomayakul

n 0309672



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

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

Function: DC voltage measurement

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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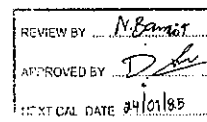


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Certificate of Testing

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

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.Moenam Khu, A.Pluakdaeng,
Rayong 21140, Thailand

Laboratory Condition : Temperature (25 $\pm$ 5) °C
Humidity (50 $\pm$ 20) %

Test Procedure : In - house method : CP-CH9
by Comparison Technique with Azide Modification Method

Tested by : Walalak Sirithean

Approved by :

Sailhip
Approved Signatory

() Malou Butkruee
(x) Sailhip Meangmal
() Warekom Lernagatrakul

Issue Date : 26 July 2023

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

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	112B143764	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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Signature

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TEL: 0-2717-3000-29 FAX: 0-2719-9484



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. Phukdaeng,
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 : *Signature*
() Pornthipha Tameyakul
() Malee Butkruea
(✓) Suwit Imjai
Issue Date : 31 July 2023

The Uncertainties are for a confidence probability of approximately 95%

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A 0053616



Equipment : DO Meter with Sensor
Condition As-Received : Used Item
Reference : 2307-0713DSC-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	2186080	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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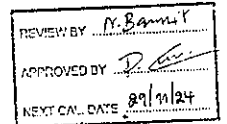
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TEL: 0-2717-3000-29 FAX: 0-2719-9484



Cert. No.: 23TM662
Page.: 1 of 3

Certificate of Calibration

Equipment : Low Temp. Incubator
Manufacturer : Memmert
Model : IPR750
Serial No. : V818.0084
ID No. : RYG_EN0154
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd.
(Rayong Branch)
616/10 Moo 5 T. Maenam Khu, A. Phukdaeng, Rayong 21140 Thailand
BDD Room
Location :
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 : *Signature*
() Pornthipha Tameyakul
() Malee Butkruea
(✓) Suwit Imjai
Issue Date : 7 June 2023



The Uncertainties are for a confidence probability of approximately 95%

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a 1159515

A 0054967



Equipment : Low Temp. Incubator
Condition As-Received : Used Item
Reference : 2305-0888OC-2
Procedure Used :-

Cert. No.: 23TM962
Page : 2 of 3

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	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.

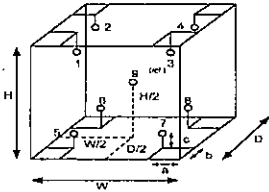
Result of Calibration :- (*) Without Adjustment

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

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



Probe Installation Details :

Dimension of Chamber :

a = 10 cm	D = 0.60 m
b = 10 cm	W = 1.0 m
c = 10 cm	H = 1.2 m
	Capacity = 0.75 m ³



Equipment : Low Temp. Incubator
Condition As-Received : Used Item
Reference : 2305-0888OC-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	20.118	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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Unit

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Unit

a 1165129



Certificate of Calibration

Certificate No.: C06230441 Page 2 of 3

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	
637.88	636.3	-0.32	0.13	
748.48	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	0.519	-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
	0.6073	0.509	-0.0917	0.0045
	1.0083	1.007	0.0013	0.0045
485 nm	0.0000	0.000	0.0000	0.0045
	0.2516	0.250	0.0016	0.0045
	0.4595	0.482	-0.0025	0.0045
	0.9334	0.933	0.0004	0.0045
546.1 nm	0.0000	0.000	0.0000	0.0045
	0.2481	0.245	0.0011	0.0045
	0.4652	0.486	-0.0009	0.0045
	0.8468	0.846	0.0008	0.0045
590 nm	0.0000	0.000	0.0000	0.0045
	0.2594	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

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)
616/10 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 Piece: 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. Nattepat 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 Sigma Scientific Limited.

The standard for Wavelength Certificate No. 111583 and 111584
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. Nattepat Rungueang)
Person in charge

(Mr. Nitirun Srihawan)
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).

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DKSH Technology Limited
2533 Sukhumvit Road, Bangkok, Phra Prachin, Bangkok 10260
Phone: +66 2536 7000 Email: info.calibration@dksh.com Website: www.dksh.com/thailand

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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	0.290	-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 (%)	Absorbance (A)	
280.62 +/- 0.11 nm	280.5	1.3	1.888	
391.44 +/- 0.11 nm	391.4	1.3	1.886	
Spectral Resolution *				
Nominal Concentration 0.02 % v/v	Peak	Trough	Ratio	SBW
Standard Wavelength (nm)	288.58	286.59	1.38	2.00
UUC: Wavelength (nm)	288.2	285.1		
Std Absorbance (A)	0.4566	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 2643 8361-6 Email: service.thailand@dksh.com Website: www.dksh.com/thailand

Delivering Growth - In Asia and Beyond.

CAL-FM-C06-15: 12 Sep 2022

ชนิดเครื่องมือ: SPECTROPHOTOMETER		รุ่น: DR5000	เลขที่งาน: WO-00005382	
ตรวจสอบ (วัน)		นามสกุลเครื่อง: 1627845		
18 Sep 2023		ตรวจสอบ (วัน)		หมายเหตุ
ปกติ	ไม่ปกติ	ปกติ	ไม่ปกติ	
General				
☒	☐	1. ความสมบูรณ์เครื่อง	☒	
☒	☐	2. ความสะอาด (ช่องใส่ตัวอย่าง, ภายใน-นอกเครื่อง)	☒	
☒	☐	3. สวิตช์ ปิด - เปิด เครื่อง (On-Off Switch)	☒	
☒	☐	4. ปุ่มกด (Keypad)	☒	
☒	☐	5. หน้าจอ (Display, Screen Contrast)	☒	
Spectrophotometer				
☐	☐	6. แบตเตอรี่ (Battery Backup) >= 2.5 VDC	☐	
☐	☐	7. ควบคุมเลือกความยาวคลื่น (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. ช่องใส่ตัวอย่าง (Carousel Module)	☒	
pH Meter and Conductivity Meter				
☐	☐	12. อิเล็กโทรด (Electrode and Connection Cable)	☐	
☐	☐	13. ระดับสารละลายใน Electrode (Level KCl)	☐	
☐	☐	14. ฝาปิดกันละออง Electrode (Dust Protection Hood)	☐	
☐	☐	15. ฐานยึดอิเล็กโทรด (Stand)	☐	
Turbidimeter				
☐	☐	16. ค่าความขุ่นที่ฟุ้ง (No Sample)	☐	
☐	☐	17. ระดับการส่องสว่างของแสง (>= 2.5 ไม่น้อย 3.0)	☐	
Automatic Titrator				
☐	☐	18. ภาชนะ Pison Burettes	☐	
☐	☐	19. Function Rinsing and Dosing	☐	
☐	☐	20. ระบบท่อสายยางและอุปกรณ์ประกอบ	☐	

เห็นด้วยหรือไม่: *656.1nm=656.1nm

*496.0nm=485.5nm

Mr.Nattapat Rungrueang

Service Engineer

DKSH Technology Limited
2533 Sukhumvit Road, Bangkok, Thailand 10260
Phone: +66 2643 8361-6 Email: service.thailand@dksh.com Website: www.dksh.com/thailand

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CAL-FM-R31-03: 20 Jul 2022

RYG_EN0002

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaywang, Huaywang, Bangkok 10310
Tel: +66 2643 8361-6 Email: service.thailand@sartorius.com



SARTORIUS

REVIEW BY: *[Signature]*
APPROVED BY: *[Signature]*
NEXT CAL DATE: 01/09/24

Certificate

of Calibration

Model Number: MSE224S-100-DU Certificate No.: 23BCI0112
Description: Analytical Balance Issued Date: Friday, March 03, 2023
Serial Number: 0026207038 Reference No.: 204833
ID No.: RYG_EN0002
Manufacturer: Sartorius Page No.: 1 of 2

Customer Name: ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)
615/10 Moo 5 T.Maenam Khu, A.Pluak Daeng, Rayong 21140, Thailand.

Calibrated Place: ALS Laboratory Group (Thailand) Co., Ltd. (Balance Room)
615/10 Moo 5 T.Maenam Khu, A.Pluak Daeng, 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
YCS011-522-00	Sartorius weight set 1mg - 5000g E2.YCS011-522-00	SPC-RT	C02212565	14-Sep-2023
MHB-382SD	Humidity/Barenometer/Temp Lutron MHB-382SD	DKSH	C19220444	5-Sep-2023

This certificate relate and apply this equipment only.
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Sartorius (Thailand) Co., Ltd.

Mr.Chonchai Inthana(Technical Manager)



YCS FM 33 03 February 2022

Sartorius (Thailand) Co., Ltd.

129 Rama 9 Road, Huaywang, Huaywang, Bangkok 10310
Tel: +66 2643 8361-6 Email: service.thailand@sartorius.com

SARTORIUS

Certificate of Calibration

Model Number: MSE224S-100-DU Certificate No.: 23BCI0112
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 repeatability is the ability of a weighing instrument to display nearly identical readouts 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 readout of the load, i.e. 1/2 or 1/4 of measuring capacity, placed in the middle of the weighing pan and between each of four additional measurement points (positions defined according to OIML R76)		
Nominal Value : (Low Load)	20.0000	199.9999	Nominal value :	100	g
20 g	20.0000	200.0000	Tolerance	0.0004	g
Tolerance	20.0000	199.9999	Difference		
0.0001 g	20.0000	200.0000			
	20.0000	199.9999	1	-	
Nominal Value : (High Load)	20.0000	199.9999	2	-0.0001	
200 g	19.9999	200.0000	3	-0.0001	
Tolerance	20.0000	200.0000	4	0.0001	
0.0001 g	20.0000	199.9999	5	0.0002	
	20.0000	200.0000	6		
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	0.00014	
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

YCS FM 33 03 February 2022



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-27 FAX. 0-2710-9154



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)
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 : $(26 \pm 10) ^\circ\text{C}$
Relative Humidity : $(50 \pm 30) \%$
Calibrated by : Man Pattanapongpalboon
Approved by :
() Pornthippa Tameyakul
() Malee Butkruea
() Suwit Imjai

REVIEW BY
APPROVED BY
NEXT CAL DATE 20/04/24

Issue Date : 2 November 2022

The Uncertainties are for a confidence probability of approximately 95%

This certificate may be reproduced other than in full, except with the prior written
Approval of 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 :-

Cert. No.: 22TM1517
Page: 2 of 3

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	34972A	MY49023932	22LM97	29 Jul 2023

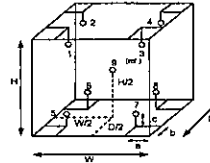
2. This certificate is valid only to the item calibrated on date and place of calibration.

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



Probe Installation Details : Dimension of Chamber :
a = 5.0 cm D = 0.40 m
b = 5.0 cm W = 0.56 m
c = 5.0 cm H = 0.48 m
Capacity = 0.11 m³

Environment during calibration		
	Beginning	Finished
Temp. (°C)	25	25
REL. Humid. (%)	54	59
AC Supply (Voll)	223	225

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	20-16RTD-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

a 1132466

RYG_EN0006



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

Cert. No.: 22TM1517
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
104.0	104.0	104.0	0.076	0.52	0.60	0.42	2
180.0	180.0	180.0	0.13	0.88	1.2	1.1	2

Measured Temperature (°C)									
Calibration Point (°C)	Position								
	1	2	3	4	5	6	7	8	9 (ref.)
104.0	103.768	103.734	103.723	103.800	104.215	104.131	104.132	103.740	103.747
180.0	179.723	179.359	179.439	179.489	180.361	180.114	180.131	180.243	179.605

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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a 1132465



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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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. : 6495.0899
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 : $(26 \pm 10) ^\circ\text{C}$
Relative Humidity : $(50 \pm 30) \%$
Calibrated by : Preecha Hiahb
Approved by :
() Pornthippa Tameyakul
() Malee Butkruea
() Suwit Imjai

REVIEW BY
APPROVED BY
NEXT CAL DATE 20/04/24

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 : 2210-0376OC-1

Cert. No.: 22TM1492
Page : 2 of 3

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	34970A	MY44035217	21LM30	23 Dec 2022

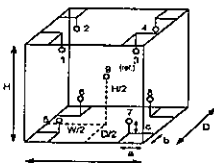
2. This certificate is valid only to the item calibrated on date and place of calibration.

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



Probe Installation Details :

Dimension of Chamber :

a = 5.0 cm	D = 0.33 m
b = 5.0 cm	W = 0.40 m
c = 5.0 cm	H = 0.40 m
	Capacity = 0.053 m ³

Environment during calibration		
	Beginning	Finished
Temp. (°C)	28	29
REL.Humid. (%)	43	47
AC Supply (Volt)	220	221

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



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2210-0376OC-1

Cert. No.: 22TM1492
Page : 3 of 3

Result of Calibration :-

(*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close

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	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.

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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a 1132473

RYG_EN0061

a 1132472



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES
53/1 PATANAKARN ROAD NO.14, SUKUMVANG, SUKUMVANG BANGKOK 10250
TEL. 0 2715 3000-27 FAX. 0 2710 9484



Cert. No.: 22TM1491
Page : 1 of 3

Certificate of Calibration

Equipment : Water Bath

Manufacturer : Momert

Model : WNB22

Serial No. : L513.0648

ID No. : RYG_EN0061

Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)
618/10 Moo 5, T. Maenam Khu,
A. Phrakdaeng,
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 Hahib

Approved by :
Approved Signatory

() Pornthippa Tameyakul
(/) Meilee Butkruea
() Suwit Imjai

Issue Date : 2 November 2022

The Uncertainties are for a confidence probability of approximately 95%

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Equipment : Water Bath
Condition As-Received : Used Item
Reference : 2210-0376OC-4

Cert. No.: 22TM1491
Page : 2 of 3

Procedure Used :-

Calibration were conducted using in-house calibration procedure CP-OT04 according to direct measurement method with Data Acquisition which connected with Industrial Platinum Resistance Thermometer (IPT).

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

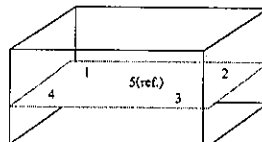
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

	Environmental (°C)		AC Voltage Supply (Volt)
	(°C)	(%R.H.)	
Beginning of Calibration	24	53	222
Finished of Calibration	24	50	221



Front

Position :	Ref. Std. S/N.:
1	N37P300726
2	N37P300727
3	N37P300728
4	N37P300729
5(ref.)	N37P300730

A 0046906

a 1132471



Equipment : Water Bath
 Condition As-Received : Used Item
 Reference : 2210-0376OC-4
 Result of Calibration : (*) Without Adjustment
 Function of UUC : Temperature Source

Cert. No.: 227M1491
 Page : 3 of 3

Calibration point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Average* Standard Reading (°C)				
			Position				
			1	2	3	4	5 (ref.)
85.0	85.0	85.0	84.527	84.563	84.628	84.516	84.582

Calibration point (°C)	Uniformity (°C)	Stability (± °C)	Uncertainty (± °C)	Coverage Factor k
85.0	0.12	0.081	0.18	2

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

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.

Stability : One-half of the greatest maximum difference of measured temperature at any one probe.

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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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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 TEL. 0-2717-3000-24 FAX. 0-2719-9484



Certificate of Calibration

Certificate No.: 237639
 Page : 1 of 2

Equipment : Digital Thermometer
 Manufacturer : Testo
 Model : 106
 Serial No.: 835177950921
 ID No.: RYG_FS0570

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Condition As-Received: Used Item

Received Date: 24 March 2023

Calibration Date: 12 April 2023

Reference: 2303-0687DSC

Ambient Temperature: (25 ± 3) °C

Relative Humidity: (50 ± 20) %

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

616/10 Moo 5, T.Maenam Khu, A.Pluakdaeng,
 Rayong 21140, Thailand

Procedure used: Calibration were conducted using in-house calibration procedure CP-T01 according to comparison with Industrial Platinum Resistance Thermometer (IPRT) into liquid bath temperature controller. The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standards instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Black Stack Thermometer	1560	80454	221615	23 May 2023
2) PRT Scanner Module	2562	A01303	221615	23 May 2023
3) Industrial PRT Probe	5027A	976442	221615	23 May 2023

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

3. This Certificate is traceable to the International System of Unit maintained through:-

-National Institute of Metrology Thailand (NIMT)

REVIEW BY	<i>P. Phaiyath</i>
APPROVED BY	<i>S. S.</i>
NEXT CAL DATE	12/04/24

Calibrated by : Sathinon Poomal
 Issue Date : 20 April 2023

Approved Signatory :

() Phaiyee Prabpai
 () Chatchawan Krungpuek
 (x) Wankop Larpkum

a 1132470

U 0313122



Cert. No.: 237639
 Page.: 2 of 2

Result of Calibration:

Without Adjustment

Function: Temperature measurement

Dimension of probe : Diameter 3 mm., Length 55 mm. Sheath material : Stainless Steel

Immersion Depth (mm.)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of Measurement (± °C)
50	25.0034	25.0	-0.0034	0.12
50	30.0018	30.0	-0.0018	0.12
50	40.0057	40.1	0.0943	0.12

UUC* : Unit Under Calibration

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

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