

ภาคผนวก ง

ใบรับรองการสอบเทียบเครื่องมือ



right solutions.
right partner.

รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

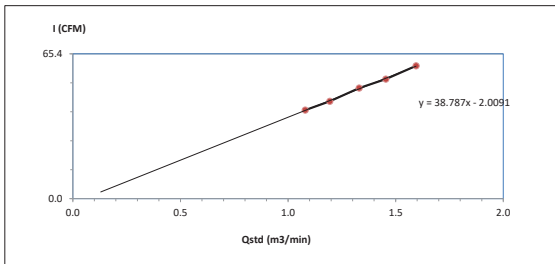
Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Ambient	Total Suspended Particulate	High Volume	RYG_FS0182	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RYG_FS0291	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RYG_FS0292	-	-	On site Calibration
Ambient	Total Suspended Particulate	Digital Balance	RYG_EN0001	22-Feb-24	22-Feb-25	12
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0192	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0294	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0295	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	Digital Balance	RYG_EN0001	22-Feb-24	22-Feb-25	12
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS1372	19-Jun-23	19-Dec-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS1212	21-May-24	21-Nov-25	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS1213	21-May-24	21-Nov-25	18
Stack	Butyl Acrylate	Pitot Tube	BKK_FS0532	31-Jul-24	31-Jan-25	6
Stack	Butyl Acrylate	Flue gas Analyzer	RYG_FS0563	26-Jan-24	25-Jan-25	12
Stack	Butyl Acrylate	DRYCAL FLOWMETER	BKK_FS1346	29-Jan-24	28-Jan-25	12
Stack	Butyl Acrylate	GC-MSD	BKK_EN0410	10-May-24	10-Nov-25	18
Stack	Methyl Methacrylate	Pitot Tube	BKK_FS0532	31-Jul-24	31-Jan-25	6
Stack	Methyl Methacrylate	Flue gas Analyzer	RYG_FS0563	26-Jan-24	25-Jan-25	12
Stack	Methyl Methacrylate	DRYCAL FLOWMETER	BKK_FS1346	29-Jan-24	28-Jan-25	12
Stack	Methyl Methacrylate	GC-MSD	BKK_EN0410	10-May-24	10-Nov-25	18
Stack	Total Suspended Particulate	Console Control Unit	BKK_FS0527	31-Jul-24	31-Jan-25	6
Stack	Total Suspended Particulate	Pitot Tube	BKK_FS0531	31-Jul-24	31-Jan-25	6
Stack	Total Suspended Particulate	Flue gas Analyzer	RYG_FS0563	26-Jan-24	25-Jan-25	12
Stack	Total Suspended Particulate	Digital Balance	RYG_EN0003	22-Feb-24	22-Feb-25	12
Stack	Total VOCs	Pitot Tube	BKK_FS0532	31-Jul-24	31-Jan-25	6
Stack	Total VOCs	Flue gas Analyzer	RYG_FS0563	26-Jan-24	25-Jan-25	12
Stack	Total VOCs	DRYCAL FLOWMETER	BKK_FS1346	29-Jan-24	28-Jan-25	12
Stack	Total VOCs	FID Analyzer	BKK_FS0758	1-Jul-24	1-Jan-25	6
Workplace	Total Dust	Field Rotameter	RYG_FS0659	1-Jul-24	2-Oct-24	3
Workplace	Total Dust	DRYCAL FLOWMETER	BKK_FS1346	29-Jan-24	28-Jan-25	12
Workplace	Total Dust	Digital Balance	RYG_EN0004	22-Feb-24	22-Feb-25	12
Workplace	Total VOC	TVOC Analyzer	BKK_FS0819	19-Jan-24	19-Jul-25	18
Noise	Leq 24 hrs	Sound Calibrator	RYG_FS0496	26-Jan-24	25-Jan-25	12
Noise	Leq 24 hrs	Sound Level Meter	RYG_FS0302	19-Sep-24	19-Sep-25	12
Noise	Leq 24 hrs	Sound Level Meter	RYG_FS0303	23-Aug-24	23-Aug-25	12
Noise	Leq 8 hrs	Sound Calibrator	RYG_FS0213	28-Feb-24	27-Feb-25	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0031	30-Aug-24	30-Aug-25	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0301	12-Jan-24	11-Jan-25	12
Rayong Lab	pH at 25 °C	pH meter	RYG_EN0183	19-Jan-24	19-Jul-25	18
Rayong Lab	BOD	DO meter with Sensor	RYG_EN0032	24-Jul-23	24-Jan-25	18
Rayong Lab	BOD	Incubator	RYG_EN0154	1-Nov-24	1-May-26	18
Rayong Lab	COD	Spectrophotometer	RYG_EN0037	18-Sep-23	18-Mar-25	18
Rayong Lab	Total Suspended Solids	Electronic Balance	RYG_EN0002	22-Feb-24	22-Feb-25	12
Rayong Lab	Total Suspended Solids	Hot Air Oven	RYG_EN0010	21-Mar-24	21-Sep-25	18
Rayong Lab	Total Dissolved Solids 180°C	Electronic Balance	RYG_EN0002	22-Feb-24	22-Feb-25	12
Rayong Lab	Total Dissolved Solids 180°C	Hot Air Oven	RYG_EN0010	21-Mar-24	21-Sep-25	18
Rayong Lab	Oil & Grease	Electronic Balance	RYG_EN0002	22-Feb-24	22-Feb-25	12
Rayong Lab	Oil & Grease	Hot Air Oven	RYG_EN0213	21-Mar-24	21-Mar-25	12
Rayong Lab	Oil & Grease	Water Bath	RYG_EN0061	21-Mar-24	21-Sep-25	18
Rayong Lab	Temperature	pH meter	RYG_FS0596	1-Jul-24	1-Jul-25	12



High Volume Air Sampler Calibration Worksheet

Project Site : THAI MMA Co., Ltd. Barometric Pressure (mm Hg) : 755.4
Calibrate Location : บ้านเนินพยอม Temperature (°C) : 30.8
Calibrate Date : 2-Nov-24 High Volume ID : RYG_FS0182
CalibrationSheet No.: C-021124-RYG_FS0182 High Volume Model : TE-5170D
Calibrator ID: RYG_FS0205 High Volume S/N : 5335
Calibrator Model : TE-5028A Calibrator Slope : 1.52567
Calibrator S/N : 1166 Calibrator Intercept : -0.03613

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.6	1.0797	40	Slope : 38.7870 Intercept : -2.0091 Correlation Coefficient : 0.9991
2	3.2	1.1939	44	
3	4.0	1.3305	50	
4	4.8	1.4541	54	
5	5.8	1.5948	60	



Calibrated by จตุรัสชัย
(Mr.Chatchai Sukpia)
Field Scientist(1)

Approved by : น.พ. นพ. จตุรัสชัย
(Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)

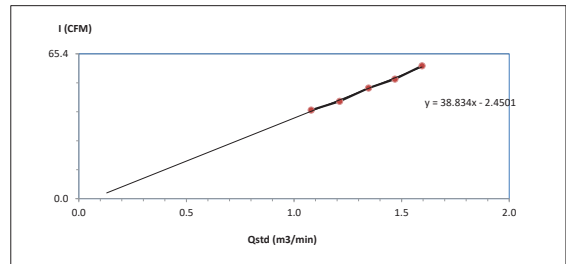
FORM NO.: F 06-073 REVISION NO.:2 ISSUE DATE: 20/11/23



High Volume Air Sampler Calibration Worksheet

Project Site : THAI MMA Co., Ltd. Barometric Pressure (mm Hg) : 755.4
Calibrate Location : บ้านนาหวาย Temperature (°C) : 30.8
Calibrate Date : 2-Nov-24 High Volume ID : RYG_FS0291
CalibrationSheet No.: C-021124-RYG_FS0291 High Volume Model : TE-5170D
Calibrator ID: RYG_FS0205 High Volume S/N : 5333
Calibrator Model : TE-5028A Calibrator Slope : 1.52567
Calibrator S/N : 1166 Calibrator Intercept : -0.03613

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.6	1.0797	40	Slope : 38.8340 Intercept : -2.4501 Correlation Coefficient : 0.9974
2	3.2	1.2118	44	
3	4.1	1.3466	50	
4	4.9	1.4687	54	
5	5.8	1.5948	60	



Calibrated by จตุรัสชัย
(Mr.Chatchai Sukpia)
Field Scientist(1)

Approved by : น.พ. นพ. จตุรัสชัย
(Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)

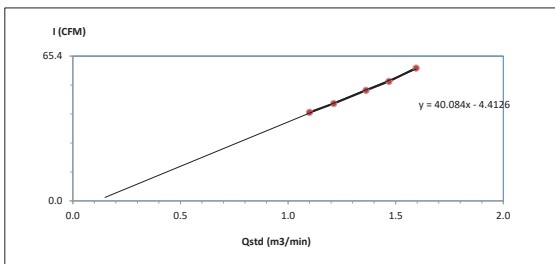
FORM NO.: F 06-073 REVISION NO.:2 ISSUE DATE: 20/11/23



High Volume Air Sampler Calibration Worksheet

Project Site : THAI MMA Co., Ltd. Barometric Pressure (mm Hg) : 755.4
Calibrate Location : บ้านนา Temperature (°C) : 30.8
Calibrate Date : 2-Nov-24 High Volume ID : RYG_FS0292
CalibrationSheet No.: C-021124-RYG_FS0292 High Volume Model : TE-5170D
Calibrator ID: RYG_FS0205 High Volume S/N : 5497
Calibrator Model : TE-5028A Calibrator Slope : 1.52567
Calibrator S/N : 1166 Calibrator Intercept : -0.03613

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.7	1.0996	40	Slope : 40.0843 Intercept : -4.4126 Correlation Coefficient : 0.9987
2	3.3	1.2118	44	
3	4.2	1.3625	50	
4	4.9	1.4687	54	
5	5.8	1.5948	60	



Calibrated by จตุรัสชัย
(Mr.Chatchai Sukpia)
Field Scientist(1)

Approved by : น.พ. นพ. จตุรัสชัย
(Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)

FORM NO.: F 06-073 REVISION NO.:2 ISSUE DATE: 20/11/23

Sartorius (Thailand) Co., Ltd.
122 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2843 8381-4, e-mail: service.thailand@sartorius.com



SARTORIUS
NSC-119-TS 17025
CALIBRATION 0428

Certificate of Calibration

Model Number : LA130S-F Certificate No.: 24BCI0088
Description : Analytical Balance Issued Date : Friday, February 23, 2024
Serial Number : 25409664 Reference No.: 229195
ID No.: RYG_EN0001
Manufacturer : Sartorius Page No.: 1 of 1

Customer Name : ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)
619/10 Moo 5 T.Maenam Khu, A.Pluek Daeng, Rayong 21140, Thailand

Calibrated Place : ALS Laboratory Group (Thailand) Co., Ltd. (Balance Room)
619/10 Moo 5 T.Maenam Khu, A.Pluek Daeng, Rayong 21140, Thailand.

Calibrated By : Mr.Chonchai Intirana
Calibration Date : Thursday, February 22, 2024
Calibration Procedure No.: This calibration was conducted by
Using in-house calibration procedure number (WI-003)
Based on UKAS LAB 14 : 2019

Metrological data : Capacity : 150 g Readability : 0.0001 g
Reasons for calibration : ☐ New Installation ☐ Service / Repaired ☒ Pre-calibration / Maintenance
Ambients Conditions : Temperature : 23.6 °C ± 5.0 °C
Humidity : 54.0 % RH ± 10.0 % RH
Pressure :
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 test of Sartorius Metrological Specifications.

Traceability:

Model Number	Description	Traceability	Certificate No.	Due Date
YCS011-522-00	Sartorius weight set 1mg - 3000g E2.YCS011-522-00	TCS	M2308197S	23-Aug-2025
MHB-382SD	Humidity/Barometer/Temp Lutron MHB-382SD	DKSH	C19231845	23-Aug-2024

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 Intirana

Mr.Chonchai Intirana(Technical Manager)

SOP FM 33 03 February 2022





Certificate of Calibration

Model Number : LA130S-F
Description : Analytical Balance
Serial Number : 25409854
ID No. : RYG_EN0001
Manufacturer : Sartorius

Certificate No. : 24BC10058
Issued Date : Friday, February 23, 2024
Reference No. : 229195
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 results under constant test conditions when the same load within a measurement range is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.		The off-center loading error is yielded by the difference between the result of the load, 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 R76).	
Nominal Value : (Low Load)	10.0000	99.9999	
10 g	10.0000	100.0000	
Tolerance	0.0001 g	0.0001 g	
Nominal Value : (High Load)	10.0000	100.0000	
100 g	10.0000	100.0000	
Tolerance	0.0001 g	0.0001 g	
Standard Deviation	0.00005	0.00008	

Difference	
1	-
2	-0.0001
3	0.0001
4	0.0002
5	0.0000
6	-

End of Report

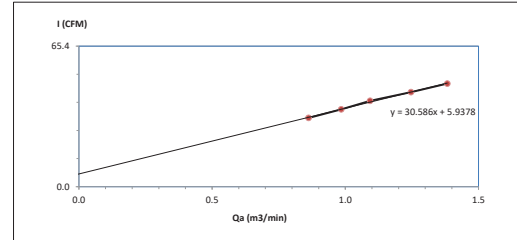
SCP FM 33 03 February 2022

High Volume Air Sampler Calibration Worksheet

Project Site : THAI MMA Co., Ltd.
Calibrate Location : บ้านนาบึง
Calibrate Date : 2-Nov-24
CalibrationSheet No. : C-021124-RYG_FS0192
Calibrator ID : RYG_FS0205
Calibrator Model : TE-S028A
Calibrator S/N : 1166

Barometric Pressure (mm Hg) : 755.4
Temperature (°C) : 30.8
High Volume ID : RYG_FS0192
High Volume Model : TE-S009X
High Volume S/N : 5331
Calibrator Slope : 0.95561
Calibrator Intercept : -0.02266

Test No.	Delta H ₂ O (inch)	Qa (m ³ /min)	I: Chart (CFM)	Linear Regression
1	1.6	0.862	32	Slope : 30.5864
2	2.1	0.984	36	Intercept : 5.9378
3	2.6	1.093	40	Correlation Coefficient : 0.9982
4	3.4	1.246	44	
5	4.2	1.383	48	



Calibrated by : (Mr. Chatchai Sukpia)
Field Scientist(1)

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

FORM NO.: F 06-074 REVISION NO.:2 ISSUE DATE: 20/11/23

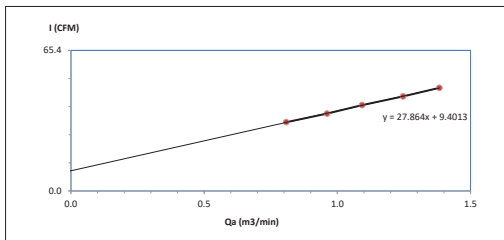


High Volume Air Sampler Calibration Worksheet

Project Site : THAI MMA Co., Ltd.
Calibrate Location : บ้านนาบึง
Calibrate Date : 2-Nov-24
CalibrationSheet No. : C-021124-RYG_FS0294
Calibrator ID : RYG_FS0205
Calibrator Model : TE-S028A
Calibrator S/N : 1166

Barometric Pressure (mm Hg) : 755.4
Temperature (°C) : 30.8
High Volume ID : RYG_FS0294
High Volume Model : TE-S009X
High Volume S/N : 5501
Calibrator Slope : 0.95561
Calibrator Intercept : -0.02266

Test No.	Delta H ₂ O (inch)	Qa (m ³ /min)	I: Chart (CFM)	Linear Regression
1	1.4	0.808	32	Slope : 27.8636
2	2.0	0.961	36	Intercept : 9.4013
3	2.6	1.093	40	Correlation Coefficient : 0.9997
4	3.4	1.246	44	
5	4.2	1.383	48	



Calibrated by : (Mr. Chatchai Sukpia)
Field Scientist(1)

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

FORM NO.: F 06-074 REVISION NO.:2 ISSUE DATE: 20/11/23

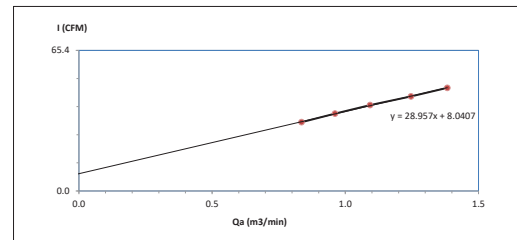


High Volume Air Sampler Calibration Worksheet

Project Site : THAI MMA Co., Ltd.
Calibrate Location : บ้านนาบึง
Calibrate Date : 2-Nov-24
CalibrationSheet No. : C-021124-RYG_FS0295
Calibrator ID : RYG_FS0205
Calibrator Model : TE-S028A
Calibrator S/N : 1166

Barometric Pressure (mm Hg) : 755.4
Temperature (°C) : 30.8
High Volume ID : RYG_FS0295
High Volume Model : TE-S009X
High Volume S/N : 5502
Calibrator Slope : 0.95561
Calibrator Intercept : -0.02266

Test No.	Delta H ₂ O (inch)	Qa (m ³ /min)	I: Chart (CFM)	Linear Regression
1	1.5	0.835	32	Slope : 28.9572
2	2.0	0.961	36	Intercept : 8.0407
3	2.6	1.093	40	Correlation Coefficient : 0.9994
4	3.4	1.246	44	
5	4.2	1.383	48	



Calibrated by : (Mr. Chatchai Sukpia)
Field Scientist(1)

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

FORM NO.: F 06-074 REVISION NO.:2 ISSUE DATE: 20/11/23

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM : Cup anemometer
MANUFACTURER : Novalyne
MODEL/TYPE : Sensor: WS-02FA
Data logger: 110-WS-250L-D
SERIAL NUMBER : Sensor: W50-AS969
Data logger: AS969
ID NUMBER : BIK_F51372
CONDITION AS-RECEIVED : New Item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,
Khet Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE : 16 Jun 2023
MEASUREMENT DATE : 19 Jun 2023
ISSUE DATE : 19 Jun 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 : Eiffel-type wind tunnel of Jiranatee Associates Co., Ltd.

CALIBRATION CONDITIONS : Wind tunnel cross-section area¹ : 900 cm²
Win direction frontal area¹ : 100 cm²
Diameter of mounting pipe¹ : - mm
Blockage ratio of test object¹ : 0.111 [-]

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (24.1) °C, (44.5) %RH and (1008.0) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:
☒ Mr. Sorawit Thachalad
☐ Miss Jittragoon Lertsomphol



Approved signatory: *Mr. Parinya Booncharoen*
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: 1/m

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

Calibration procedure:
The cup anemometer was calibrated against Standard air velocity transducer model: B455-02 and pitot tube with precision differential pressure meter model: DM2500 in on-chip test section of Eiffel-type wind tunnel with 900 cm² cross test section area. The W1-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 guideline.

Traceability:
This certificate provides a traceability of the measurement to recognized the national standards, and to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: MW-0052-21 and MW-0066-22

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'

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_{UUC} (m/s)	Error (m/s)	U (k=2) (m/s)
1.024	24.04	24.10	0.9	-0.1	0.31
2.027	24.10	24.10	1.9	-0.1	0.31
3.017	23.96	24.10	2.9	-0.1	0.31
4.117	24.04	24.10	4.0	-0.1	0.31
5.01	23.90	24.10	4.9	-0.1	0.31
5.99	24.00	24.10	6.0	0.0	0.31
7.05	23.90	24.10	7.0	-0.1	0.31
8.16	24.06	24.10	8.0	-0.1	0.31
9.09	23.94	24.10	9.0	-0.1	0.31
10.06	24.10	24.10	10.0	0.0	0.31
11.15	24.00	24.10	11.1	-0.1	0.31
12.12	24.10	24.10	12.0	-0.1	0.31
13.18	23.98	24.10	13.0	-0.2	0.31
14.23	24.04	24.10	14.0	-0.2	0.31
15.22	24.00	24.10	15.1	-0.1	0.31
16.27	23.92	24.10	16.1	-0.2	0.31

Remark:

⁵ 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 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 : Novalyne
MODEL/TYPE : Sensor: WS-02FA
Data logger: 110-WS-250L-D
SERIAL NUMBER : Sensor: W50-AS969
Data logger: AS969
ID NUMBER : BIK_F51372
CONDITION AS-RECEIVED : New Item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,
Khet Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE : 16 Jun 2023
MEASUREMENT DATE : 19 Jun 2023
ISSUE DATE : 19 Jun 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 : Eiffel-type wind tunnel of Jiranatee Associates Co., Ltd.

CALIBRATION CONDITION : Wind tunnel cross-section area¹ : 900 cm²
Win direction frontal area¹ : 129 cm²
Diameter of mounting pipe¹ : - mm
Blockage ratio of test object¹ : 0.143 [-]

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (24.3) °C, (44.7) %RH and (1010.1) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:
☒ Mr. Sorawit Thachalad
☐ Miss Jittragoon Lertsomphol



Approved signatory: *Mr. Parinya Booncharoen*
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: 1/m

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

Calibration procedure:
The wind direction sensor was calibrated against Standard Rotary Encoder, model: A4400/TS-DMA-P5-5-1.0 in on-chip test section of Eiffel-type wind tunnel with 900 cm² cross test section area. The W1-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 guideline.

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

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

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^+_{std} Degree (°)	D^-_{std} Degree (°)	Error Degree (°)	U (k=2) Degree (°)
	0.000	0	0	1.0
	45.000	42	-3	1.0
	90.000	87	-3	1.0
	135.000	133	-2	1.0
5.01	180.000	181	1	1.0
	225.000	226	1	1.0
	270.001	275	5	1.0
	315.000	318	3	1.0

Remark:

⁵ 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



CERTIFICATE OF CALIBRATION

Certificate No. : CT-020-66
Page 1 of 2

Equipment Name: Data Logger with Temperature sensor
Manufacturer: Novolynx
Model: 110-WS-25DL-D
Serial No.: A5969
ID No.: BKK_FS1372

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: 16 Jun 2023
Calibration date: 19 Jun 2023
Issue date: 22 Jun 2023

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

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

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

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

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

Calibrated by
☐ Mr. Sorawit Thachalad
☒ Miss Jitraporn Lertsomphol
☐ Miss Ruangrumpai Phoommit



Approved Signatory:
Mr. Parinya Booncharoen
Calibration Department Manager

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BEEN OBTAINED IN WRITING FROM THE LABORATORY.

Certificate No. : CT-020-66
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: V1920208.

Dimension : Diameter 12 mm. Length 80 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.057	20.0	-0.1	0.099
70	25.053	24.9	-0.2	0.099
70	30.045	29.9	-0.1	0.099
70	35.039	34.8	-0.2	0.099
70	40.034	39.7	-0.3	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

Calibration No. : RH-03062023
Page 1 of 1 Pages

Measurement Item : Relative humidity with data logger
Manufacturer : Novolynx
Model/Type : 110-WS-25DL-D
Serial Number : A5969
ID No. : BKK_FS1372
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±15)%.

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: 20920-
601, Due date: Sep 26, 2024.

Measurement Date : Jun 19, 2023
Issued Date : Jun 22, 2023

Measurement Result:

This equipment was connected with Indoor air quality probe and Displayed (UFI) on display. Model: HMP60, Serial num-
ber: V1920208.

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	20.06	19.4	-0.7	0.62
50	50.28	49.8	-0.5	0.62
80	80.34	80.4	0.1	0.62

Performed by
☐ Mr. Sorawit Thachalad
☒ Miss Jitraporn Lertsomphol
☐ Miss Ruangrumpai Phoommit



Approved Signatory:
Mr. Parinya Booncharoen
Calibration Department Manager

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CERTIFICATE OF CALIBRATION

Certificate No. : CP-004-66

Page 1 of 2 Pages

MEASUREMENT ITEM : Digital barometer
MANUFACTURER : Novolynx
MODEL/TYPE : Sensor: 110-WS-25BP
Data logger: 110-WS-25DL-D
SERIAL NUMBER : Sensor: BP-A5969
Data logger: A5969
ID NUMBER : BKK_FS1372
CONDITION AS-RECEIVED : New Item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd.,
Khwaeng Suan Luang, Khet Suan Luang,
Bangkok 10250 Thailand.
RECEIVED DATE : 16 Jun 2023
MEASUREMENT DATE : 19 Jun 2023
ISSUE DATE : 19 Jun 2023

Calibration procedure:
The pressure calibration was done by in-
house calibration method as WI-CL-003
according to comparison method with Digital
pressure calibrator based on DKD-B 6-1

Traceability:
The measurement results are traceable to
the international system of units (SI) through
the NIMT (National Metrology Institute of
Thailand) via Certificate number: MP-0205-22

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

CONDITION OF THIS RESULT OF CALIBRATION:

- Reference Standard Instrument:
- Calibration effort for calibration sequence C
- The UUC* was installed in vertical orientation above reference standard instrument and center of UUC* was used as the reference level.
- Calibration conditions:
- Condition: ☒ Normal ☐ Abnormal
Pressure transmitting medium: Air
p_h (20°C, 1 bar): 1.19 kg/m³
H_{amb}: (55±15) %
T_{amb}: (23±3) °C
P_{amb}: (1010±10) mbar
- The certificate is valid only to the item calibrated on date and place of calibration

Calibrated by:
☒ Mr. Sorawit Thachalad
☐ Miss Jitraporn Lertsomphol



Approved signatory:
Mr. Parinya Booncharoen
Calibration Department Manager

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

Certificate Number
CVD-033-67

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 3 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 ¹ _{std}	D ² _{std}	Error	U (k=2)
m/s	Degree (°)	Degree (°)	Degree (°)	Degree (°)
5.02	0.000	0	0	0.80
	45.000	44	-2	0.80
	90.000	80	-2	0.80
	135.000	116	-3	0.80
	180.000	152	-3	0.80
	225.000	188	-2	0.80
	270.000	224	1	0.80
	315.000	260	1	0.80
	360.000	296	0	0.80
	405.000	332	0	0.80

Remark:

¹ Calibration results only valid 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



JIRANATEE ASSOCIATES CO., LTD.

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Accredited calibration laboratory
ISO/IEC 17025:2017
NAC-TIS-TIS 17025
CALIBRATION 0367

Temperature measurement Laboratory
Calibration services department



NAC-TIS-TIS 17025
CALIBRATION 0367

CERTIFICATE OF CALIBRATION

Certificate No. : CDT-086-67

Page 1 of 2 Pages

MEASUREMENT ITEM

: Data Logger with Temperature sensor

MANUFACTURER

: Novalyn

MODEL/TYPE

: 130-W5-250L-D

SERIAL NUMBER

: AS907

ID NUMBER

: BKK_F31212

CONDITION AS-RECEIVED

: Used item

CUSTOMER

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

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 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-0087-24, Certificate number: IT-0102-23.

Reference Used During Calibration:

1. Standard Temperature Probe
Model: 915-100-A000, Serial No.: 06788-08,
Due date: 26 Mar 2023
2. Digital Temperature Indicator
Model: DTI-1000-A MX II, Serial No.: 673407-0053, Due date: 14 Sep 2024

Uncertainty of Measurement:

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

RECEIVED DATE

: 17 May 2024

MEASUREMENT DATE

: 21 May 2024

ISSUE DATE

: 21 May 2024

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature : 23.0 ± 3.0 °C

Relative Humidity : 55.0 ± 15.0 %RH

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

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

☒ Mr. Sorawat Thachalad
☐ Miss Jiraporn Lertbongkhit
☐ Miss Ruangsang Phosorn



Approved signature:

Mr. Parinya Booncharoen
Calibration Department Manager

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Continuation of Certificate of Calibration Number CDT-086-67

Page 2 of 2 Pages

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 °C to 40 °C

Function:

Table 3: This equipment was connected with temperature sensor Model: HMN60 S/N: U3641224.
Dimension: Diameter 12 mm, Length 80 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.038	19.8	-0.2	0.099
70	25.056	24.6	-0.5	0.099
70	30.042	29.7	-0.3	0.099
70	35.031	34.5	-0.5	0.099
70	40.021	39.5	-0.5	0.099

UUC: Unit Under Calibration

End of Certificate of Calibration



JIRANATEE ASSOCIATES CO., LTD.

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Accredited calibration laboratory
ISO/IEC 17025:2017
NAC-TIS-TIS 17025
CALIBRATION 0367

Relative humidity and Air Temperature measurement Laboratory
Calibration services department

CERTIFICATE OF CALIBRATION

Certificate No. : CRT-009-67

Page 1 of 2 Pages

MEASUREMENT ITEM

: relative humidity with data logger

MANUFACTURER

: Novalyn

MODEL/TYPE

: 130-W5-250L-D

SERIAL NUMBER

: AS907

ID NUMBER

: BKK_F31212

CONDITION AS-RECEIVED

: Used item

CUSTOMER

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

Calibration procedure:

The relative humidity and Air Temperature calibration was done by in-house calibration method as WCL-001 and WCL-010 according to comparison method with Standard chilled mirror hygrometer with temperature sensor and standard humidity generator chamber.

Traceability:

The measurement results are traceable to the International System of Units (SI) through National Institute of Metrology Thailand (NIMT). Certificate number: IT-0079-23 and through Jirantee Associates Co., Ltd. Certificate number: CRT-003-67.

Uncertainty of Measurement:

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

RECEIVED DATE

: 17 May 2024

MEASUREMENT DATE

: 21 May 2024

ISSUE DATE

: 21 May 2024

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature : 23.0 ± 3.0 °C

Relative Humidity : 55.0 ± 15.0 %RH

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

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

☒ Mr. Sorawat Thachalad
☐ Miss Jiraporn Lertbongkhit
☐ Miss Ruangsang Phosorn



Approved signature:

Mr. Parinya Booncharoen
Calibration Department Manager

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Continuation of Certificate of Calibration Number: CRT-009-07

Page 2 of 2 Pages

Measurement Results:

The results of calibration and associated measurement uncertainties are reported in the table below.

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Table 1: The results of calibration of relative humidity at 30 °C are reported in table below.

Calibration Range: 20(0.0) to 80(0.0)

Air Temperature (°C)	Standard Reading (NRH)	UUC Reading (NRH)	Error (NRH)	Uncertainty ± (NRH)
23.56	59.81	58.1	-1.8	0.50
29.45	51.02	48.1	-3.0	1.1
29.62	82.06	77.7	-4.4	1.7

UUC's Unit Under Calibration

End of Certificate of Calibration



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Accredited calibration laboratory
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ASQ-T09-TS 2.025
CALIBRATION 0367

Air speed measurement laboratory
Calibration services department



NAC-MRA
NAC
NAC-TSI - TIS 17025
CALIBRATION 0367

Certificate Number

CWS-014-67

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

Cup anemometer
Novallym
Sensor: WS-029
Data logger: 110-WS-250L-D

SERIAL NUMBER

Sensor: WS0-A5508

ID NUMBER

DATA: 151213

CONDITION AS-RECEIVED

Used item

CUSTOMER

ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanasukan 40, Phatthanasukan Rd, Khwaeng Siam Liang,
Khet Suan Luang, Bangkok 10250 Thailand

RECEIVED DATE

17 May 2024

MEASUREMENT DATE

21 May 2024

ISSUE DATE

21 May 2024

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 Jiranatee Associates Co., Ltd.

CALIBRATION CONDITIONS

Wind tunnel cross-section area¹ 900 cm²
Wind direction (frontal area)² 100 cm²
Diameter of mounting pipe³ mm
Blockage ratio of first object⁴ 0.111 [-]

Preconditioning

24 hours at ambient conditions.

Measurement Condition

The average values during measurement are (24.2) °C, (42.4) %RH and (1006.4) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

Dr. Mr. Saisawat Thirapong
Mr. Jiraporn Lertmanee



Approved signature:

Mr. Parnpa Booncharan
Calibration Department Manager

Remark:

- ¹ Adjust 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" to "b"

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Page 2 of 2 Pages

MEASUREMENT RESULTS¹

The Cup anemometer, UNI Under Calibration (UUC) was exercise at 30 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 which was installed 50 mm away from wind tunnel nozzle and installed 40 mm away from top of the test section and the standard air velocity 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 50 mm away from wind tunnel nozzle and installed 40 mm away from top of the test section. UUC was mounted on a round vertical tube of the lower plate at center of 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 _{std} (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	v _{uuc} (m/s)	Error (m/s)	U (m/s)
1.016	24.10	24.20	0.7	-0.3	0.31
2.017	24.36	24.20	1.7	-0.3	0.31
3.038	24.30	24.20	2.8	-0.2	0.31
4.042	24.26	24.20	3.7	-0.3	0.31
4.96	24.20	24.20	4.8	-0.2	0.31
5.99	24.28	24.20	5.9	-0.1	0.31
7.02	24.24	24.20	7.0	0.0	0.31
7.98	24.14	24.20	8.0	0.0	0.31
8.98	24.34	24.20	8.9	0.0	0.31
9.99	24.00	24.20	9.9	-0.1	0.31
11.07	24.48	24.20	11.1	0.0	0.31
12.00	23.92	24.20	12.1	0.1	0.31
13.06	24.48	24.20	13.2	0.1	0.31
14.00	24.06	24.20	14.0	0.0	0.38
15.03	24.34	24.20	15.1	0.1	0.38
16.08	24.16	24.20	16.1	0.0	0.39

Remark:

¹ Calibration results only valid for the tested preconditions 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 image after being calibrated one. Remark: The proportion of the set-up is not true to scale due to imaging geometry

End of Certificate of Calibration



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ASQ-T09-TS 2.025
CALIBRATION 0367

Accredited calibration laboratory
ISO/IEC 17025:2017
ASQ-T09-TS 2.025
CALIBRATION 0367

Wind direction measurement laboratory
Calibration services department



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NAC
NAC-TSI - TIS 17025
CALIBRATION 0367

Certificate Number

CWD-014-67

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

Wind Direction Sensor

MANUFACTURER

Novallym

MODEL/TYPE

Sensor: WS-029

SERIAL NUMBER

Data logger: 110-WS-250L-D

ID NUMBER

Sensor: WS0-A5508

CONDITION AS-RECEIVED

Used item

CUSTOMER

ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanasukan 40, Phatthanasukan Rd, Khwaeng Siam Liang,
Khet Suan Luang, Bangkok 10250 Thailand

RECEIVED DATE

17 May 2024

MEASUREMENT DATE

21 May 2024

ISSUE DATE

21 May 2024

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 Jiranatee Associates Co., Ltd.

CALIBRATION CONDITION

Wind tunnel cross-section area¹ 900 cm²
Wind direction (frontal area)² 129 cm²
Diameter of mounting pipe³ mm
Blockage ratio of first object⁴ 0.148 [-]

Preconditioning

24 hours at ambient conditions.

Measurement Condition

The average values during measurement are (23.7) °C, (40.8) %RH and (1005.7) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

Dr. Mr. Saisawat Thirapong
Mr. Jiraporn Lertmanee



Approved signature:

Mr. Parnpa Booncharan
Calibration Department Manager

Remark:

- ¹ Adjust 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" to "b"

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Certificate Number:
CWD-014-67

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 _{meas} Degree (°)	D _{ref} Degree (°)	Error Degree (°)	U (k=2) Degree (°)
	0.000	0	0	0.09
	45.000	43	-2	0.09
	90.000	90	0	0.09
	135.000	135	0	0.09
	180.000	181	1	0.09
	225.000	226	1	0.09
	270.000	271	1	0.09
	315.000	316	1	0.09

Remark:

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

² Direction of standard

³ Direction of Unit Under Calibration

End of Certificate of Calibration



JIRANATEE ASSOCIATES CO., LTD.
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Accredited calibration laboratory
ISO/IEC 17025:2017
ACC-150-TIS 17025
CALIBRATION 0367

Temperature measurement laboratory
Calibration services department



CERTIFICATE OF CALIBRATION

Certificate No. : CDT-087-67

Page 1 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER : Data Logger with Temperature sensor
MODEL/TYPE : Novatemp
SERIAL NUMBER : 110-WS-250L-D
ID NUMBER : AS908
CONDITION AS-RECEIVED : BKK_FS1213
CUSTOMER : Used item

MANUFACTURER : Novatemp

MODEL/TYPE : 110-WS-250L-D

SERIAL NUMBER : AS908

ID NUMBER : BKK_FS1213

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 : 17 May 2024

MEASUREMENT DATE : 21 May 2024

ISSUE DATE : 21 May 2024

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:
Temperature : 23.0 ± 3.0 °C
Relative Humidity : 55.0 ± 15.0 %RH

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

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibration procedure:

The temperature calibration was done by In-House calibration method as WtCL-001 according to comparison method with standard digital thermometer, industrial 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: IT-0047-24. Certificate number: IT-0101-23

Reference Used During Calibration:

1. Standard Temperature Probe
Model: STS-110-AS20, Serial No.: 957602-08,
Due date: 26 Mar 2023
2. Digital Temperature Indicator
Model: DTI-3000-A-MK II, Serial No.: 971407-00591 Due date: 14 Sep 2024

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"

Calibrated by:

☐ Mr. Satewit Thuchaisakul
☐ Mr. Jitraporn Lertsanaphol
☐ Mr. Ruangsamphai Phoonmit



Approved signature:

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



Continuation of Certificate of Calibration Number CDT-087-67

Page 2 of 2 Pages

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 °C to 40 °C

Function:

Table 3: This equipment was connected with temperature sensor Model: NMP60 S/N: U3641221.
Dimension: Diameter 12 mm. Length 80 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.036	19.6	-0.4	0.099
70	25.056	24.6	-0.5	0.099
70	30.042	29.7	-0.3	0.099
70	35.032	34.5	-0.5	0.099
70	40.021	39.4	-0.6	0.099

UUC: Unit Under Calibration

End of Certificate of Calibration



JIRANATEE ASSOCIATES CO., LTD.
Jirananee Associates Co., Ltd.
10/14-15, 17/10-18
Ponkhlaum 7, 2/1, Rd. Watthana, Bangkok,
Bangkok 10110 (Thailand)
Tel: +662 0082001
Mobile: +662 0082002
E-mail: jna-calibration@jiranatee.com
Web site: www.jiranatee.com

Accredited calibration laboratory
ISO/IEC 17025:2017
ACC-TIS TIS 17025
CALIBRATION 0367

Relative humidity and Air Temperature measurement laboratory
Calibration services department

CERTIFICATE OF CALIBRATION

Certificate No. : CRT-010-67

Page 1 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER : Novatemp
MODEL/TYPE : Data Logger: 110-WS-250L-D
SERIAL NUMBER : Sensor: HM160
ID NUMBER : Data Logger: AS908
CONDITION AS-RECEIVED : Sensor: U3641221
CUSTOMER : BKK_FS1213
Used item

Relative humidity with data logger

MANUFACTURER : Novatemp

MODEL/TYPE : Data Logger: 110-WS-250L-D

SERIAL NUMBER : Sensor: HM160

ID NUMBER : Data Logger: AS908

CONDITION AS-RECEIVED : Sensor: U3641221

CUSTOMER : BKK_FS1213

Used item

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

RECEIVED DATE : 17 May 2024

MEASUREMENT DATE : 21 May 2024

ISSUE DATE : 21 May 2024

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:
Temperature : 23.0 ± 3.0 °C
Relative Humidity : 55.0 ± 15.0 %RH

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

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibration procedure:

The Relative humidity and Air Temperature calibration was done by In-House calibration method as WtCL-001 and WtCL-002 according to comparison method with Standard, Child Mirror, Hygrometer with Temperature sensor and standard humidity generator chamber.

Traceability:

The measurement results are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT). Certificate number: TH0079-23 and through Jirananee Associates Co., Ltd. Certificate number: CDT-001-67.

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"

Calibrated by:

☐ Mr. Satewit Thuchaisakul
☐ Mr. Jitraporn Lertsanaphol
☐ Mr. Ruangsamphai Phoonmit



Approved signature:

Mr. Parinya Booncharoen
Calibration Department Manager

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

Measurement Results:

The results of calibration and associated measurement uncertainties are reported in the table below.

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Table 1: The results of calibration of relative humidity at 30 °C are reported in table below.

Calibration Range: 20%RH to 80%RH

Air Temperature [°C]	Standard Reading [5RH]	UUC Reading [5RH]	Error [5RH]	Uncertainty ±[5RH]
29.56	19.81	17.5	-2.3	0.48
29.64	51.01	47.0	-4.0	1.3
29.63	82.05	76.5	-5.5	1.7

UUC: Unit Under Calibration

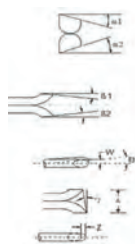
End of Certificate of Calibration



Type S Pitot Tube Calibration

Date Calibration 31-Jul-24
Pitot ID BKK_FS0532
Pitot SN -

Due Date 31-Jan-25
Inclinometer ID BKK_FS1131
Vernier ID RYG_FS0539



Parameter	Value	Allowable Range	Check
α_1	-2.4	$-10^\circ < \alpha_1 < +10^\circ$	OK
α_2	-1.2	$-10^\circ < \alpha_2 < +10^\circ$	OK
β_1	-2.0	$-5^\circ < \beta_1 < +5^\circ$	OK
β_2	1.3	$-5^\circ < \beta_2 < +5^\circ$	OK
γ	0.3	-	-
θ	0.2	-	-
$Z = A \tan \gamma$	0.005	$Z \leq 0.125''$	OK
$W = A \tan \theta$	0.003	$W \leq 0.031''$	OK
Dt	0.310	0.188" to 0.375"	OK
A/2Dt	1.468	$1.05 \leq PA/Dt \leq 1.5$	OK
A	0.91	$2.1Dt \leq A \leq 3Dt$	OK

Certify that pitot tube/porbe meets or exceeds all specifications, criteria and/or applicable design features and is hereby assigned a pitot tube certification fact of 0.84. See 40 CFR Pt. 60, App. A, EPA Method 2.

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

Approved By: Nattapol Jengwarewong
(Mr. Nattapol Jengwarewong)
RYG Field Services Specialist (1)

FORM NO.: F 06-124 REVISION NO.: 0 ISSUE DATE: 25/12/23

Calibration Certificate



Certificate No: G 670052
Date of issue: 26-Jan-24

Instrument description: Flue Gas Analyzer
Instrument model: Testo 350 New
Control unit serial no.: 03580098/1121
Instrument serial no.: 62985047/1121
ID no. or control no.: RYG_FS0563
Manufacturer: Testo SE & Co. KGaA
Probe description: -
Probe model: -
Probe serial no.: -
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: 2 Pages
Receiving no.: L-240266
Receiving date: 24-Jan-24
Parameter of calibration: Gas Calibration (Oxygen 2.50, 10.04, 21.02 %Vol, Carbon Monoxide 80.14, 302, 1003 ppm, Nitrogen Dioxide 30.34, 80.96, 201.9 ppm, Nitric Oxide 30.01, 151.5, 322.5 ppm, Sulphur Dioxide 50.36, 100.8, 600.8 ppm)
Condition of UUC: Used
Ambient condition: All of the Measurement were carried out the stabilized laboratory
Temperature: 23.45 °C
Humidity: 55 ± 15 %RH
Calibration place: 17/121 Soi Ngamwongwan 47 Yaek 48, Toongprongsong, Lakki, Bangkok 10210
Calibration procedure no.: This instrument was calibrated by comparison with Standard gas mixture according to calibration Work Instruction no. WI-CL-28-C



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

Date of calibration: 26-Jan-24

Kwanchai Khamsoung
Mr. Kwanchai Khamsoung
Calibration Technician

D. Wuttit
Mrs. Nongluck Wongsettee
Technical Manager

Calibration Certificate



Certificate No.: G 670052

Standard References (Table 1)

Standard	Certificate No.	Vendor	Due date
Oxygen (O2) 2.50 % Vol	2412/23	Linde	27-Aug-27
Oxygen (O2) 10.04 % Vol	CG-0153-21	Nimt	18-Nov-26
Oxygen (O2) 21.02 % Vol	CG-0041-22	Nimt	10-Feb-27
Carbon monoxide (CO) 80.14 ppm	CG-0040-22	Nimt	14-Feb-27
Carbon monoxide (CO) 302 ppm	1915/23	Linde	16-Jun-25
Carbon monoxide (CO) 1003 ppm	2584/23	Linde	10-Sep-25
Nitrogen Dioxide (NO2) 30.34 ppm	2703/22	Linde	22-Aug-24
Nitrogen Dioxide (NO2) 80.96 ppm	3240/21	Linde	26-Jun-24
Nitrogen Dioxide (NO2) 201.9 ppm	1975/23	Linde	17-Jul-25
Nitric Oxide (NO) 30.01 ppm	CG-0014-23	Nimt	19-Feb-25
Nitric Oxide (NO) 151.5 ppm	0161/23	Linde	22-Jan-25
Nitric Oxide (NO) 322.5 ppm	1974/23	Linde	17-Jul-25
Sulphur Dioxide (SO2) 50.36 ppm	2004/23	Linde	17-Jul-25
Sulphur Dioxide (SO2) 100.8 ppm	3507/22	Linde	09-Nov-24
Sulphur Dioxide (SO2) 600.8 ppm	2003/23	Linde	17-Jul-25

Measured room conditions

Temperature: 23.2 °C Humidity: 60.5 %RH Pressure: 1013.4 mbar

Calibration conditions

Gas Temperature: 23 °C Flow rate: 1,200 ml/min Gas pressure: 1017.1 mbar

Calibration Results (Without adjustment) (Table 2)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty
O2 (%Vol)	2.50	2.46	-0.04	0.15
O2 (%Vol)	10.04	9.93	-0.11	0.20
O2 (%Vol)	21.02	21.09	0.07	0.30
CO (ppm)	80.14	80	-0.14	3.0
CO (ppm)	302	302	0	6.0
CO (ppm)	1003	1005	2	12
NO2 (ppm)	30.34	30.1	-0.24	8.0
NO2 (ppm)	80.96	81.2	0.24	8.0
NO2 (ppm)	201.9	200.8	-1.1	12
NO (ppm)	30.01	31	0.99	8.0
NO (ppm)	151.5	152	0.5	8.0
NO (ppm)	322.5	321	-1.5	12
SO2 (ppm)	50.36	52	1.64	6.0
SO2 (ppm)	100.8	102	1.2	6.0
SO2 (ppm)	600.8	603	2.2	13

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

End of Report

Certificate of Calibration

Customer : ALS Laboratory Group Thailand Co., Ltd.
Name :
Address : 104 Soi Phathanakan 40, Phathanakan Road, Suan Luang, Bangkok
10250

Certificate No : 24-AFM-018 Rev.1
Request No : Req-2024-0043

Unit Under Calibration Details

Measurement Item : Air Flow Meter
Manufacturer : Bios
Model : Defender 510-L
Serial Number : 206895
ID : BKK_FS1346

Sensor Model : -
Sensor Serial Number : -

Location of Calibration : LAB 4 AIR VELOCITY METER

Calibration Environment and Details

Temperature : 23 °C ± 3 °C
Humidity : 55 %RH ± 20 %RH
Barometric Pressure : 1013 hPa ± 10 hPa
Received Date : 3 January 2024
Calibration Date : 29 January 2024

Calibration Procedure : In-house method CP-AFM-01 by Comparison technique with Standard Primary Flow Calibrator

Reference Standard	Model	Serial Number	Traceable	Due Calibration
Air Flow Meter	Gilibrator 3 Low flow	18501010006	Sensidyne	12 July 2024
Air Flow Meter	Gilibrator 3 Standard flow	19031011003	Sensidyne	12 July 2024
Temperature meter	GT 11	08000057	Qreborn	27 February 2024
Pressure meter	CPG2400	41000KDU/651882	TPA	9 November 2024


Traceability :


This Certificate is traceable to SI Unit through Sensidyne A2LA Accreditation No. 3943.01

Note :

The reported uncertainty is based on standard uncertainty multiplied by the Coverage Factor $k = 2$, providing a level of confidence approximately 95 %.

This Certificate was issued to replace to Calibration Certificate No. 24-AFM-018

Calibration By : 
Mr. Noppadon Luangart
Service Calibration Engineer

Approved By : 
Mr. Pacit Mathavorn
Calibration Engineer Supervisor
Issue Date : 1 February 2024

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.

FM-708-AFM-01 Rev.01 Issue date 25/01/24

Certificate No : 24-AFM-018 Rev.1

Request No : Req-2024-0043

Result of Calibration : Without Adjustment

Temperature (°C)	Pressure (kPa)	STD (ml/min)	UUC (ml/min)	Error (ml/min)	Uncertainty (ml/min)
25.00	101.66	20	20.148	0.1	1.3
25.00	101.67	100	99.409	-0.6	2.8
24.90	101.63	199	197.46	-1.5	5.6
25.00	101.61	300	298.15	-1.8	8.4
24.90	101.60	399	400.13	1	11
24.90	101.59	480	478.02	-2.0	6.8

Note

STD : Standard UUC : Unit Under Calibration

- UUC Reference Condition : At atmospheric pressure and room temperature condition

- Flow Rate was corrected for non-standard operating condition by using equation :

$$Q_{meas} = Q_{ref} \times \frac{P_{ref}}{P_{meas}} \times \frac{T_{meas}}{T_{ref}}$$

where Q = Flow Rate P = Absolute Pressure T = Absolute Temperature
Meas = Measurement Condition ref = Standard Condition

* Indicates non accredited

End of Certificate

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.

FM-708-AFM-01 Rev.01 Issue date 25/01/24

BKK_FS0614



Calibration Certificate

Certificate No. 610563
Product 200-S10M Defender 510 Medium Flow
Serial No. 151114
Cal. Date 21-May-2024

Sold To:

All calibrations are performed in accordance with ISO 17025 at Mesa Laboratories, Inc., 12100 W. 6th Ave, Lakewood, CO 80228, an ISO 17025:2017 accredited laboratory through NVLAP. This report shall not be reproduced except in full without the written approval of the laboratory. Results only relate to the items calibrated. This report must not be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S. Government.

As Received Calibration Data

Technician	Derek Dellape	Lab. Pressure Lab. Temperature	614.2 mmHg 24.3 °C
Instrument Reading	Lab Standard Reading	Deviation	Allowable Deviation
0 ccm	4504.81 ccm	-100.0%	1.00%
0 ccm	1000.98 ccm	-100.0%	1.00%
0 ccm	248.55 ccm	-100.0%	1.00%

Mesa Laboratories Standards Used

Description	Standard Serial Number	Calibration Date	Calibration Due Date
ML-800-24	117991	13-Nov-2023	13-Nov-2024



As Shipped Calibration Data

Certificate No	610563	Lab. Pressure	617 mmHg
Technician	Derek Dellape	Lab. Temperature	24.6 °C
Instrument Reading	Lab Standard Reading	Deviation	Allowable Deviation
4482.47 ccm	4493.49 ccm	-0.25%	1.00%
997.25 ccm	996.83 ccm	0.04%	1.00%
248.51 ccm	248.67 ccm	-0.06%	1.00%

Mesa Laboratories Standards Used

Description	Standard Serial Number	Calibration Date	Calibration Due Date
ML-800-24	211063	04-Oct-2023	04-Oct-2024

Calibration Notes

The expanded uncertainty of flow has a coverage factor of $k = 2$ for a confidence interval of approximately 95%.

Flow testing is in accordance with our test number MP-00672 with an expanded uncertainty of 0.27% using high-purity nitrogen or filtered laboratory air.

Traceability to the International System of Units (SI) is verified by accreditation to ISO/IEC 17025 by NVLAP under NVLAP Code 200661-0.

Technician Notes:

By:

Approved By:

Derek Dellape
Production Assembler II

Troy Thacker
Quality Engineer

Mesa Laboratories, Inc. certifies that the above instrument meets or exceeds published specifications, and that the calibration results in this certificate were obtained using equipment capable of producing results that are traceable through NIST to the International System of Units (SI). Calibration results are in compliance with ISO/IEC 17025:2017. Calibrations process has a Test Uncertainty Ratio (TUR) of 4:1 or greater. Any Pass/Fail determination is made without taking measurement uncertainty into account and is based on UUT performance against required tolerance only.

Certificate of Calibration

Customer
Name : ALS Laboratory Group Thailand Co., Ltd.
Address : 104 Soi Phatthamakan 40, Phatthamakan Road, Suan Luang, Bangkok 10250

Certificate No : 24-AFM-033
Request No : Req-2024-0241

Unit Under Calibration Details

Measurement Item : Primary Flow Calibrator
Manufacturer : Bios
Model : Defender 510-L
Serial Number : 130027
ID : RYG_FS0208
Sensor Model : -
Sensor Serial Number : -
Location of Calibration : LAB 4 AIR VELOCITY METER

Calibration Environment and Details

Temperature : 23 °C ± 3 °C
Humidity : 55 %RH ± 20 %RH
Barometric Pressure : 1013 hPa ± 10 hPa
Received Date : 31 January 2024
Calibration Date : 13 February 2024

Calibration Procedure : In-house method CP-AFM-01 by Comparison technique with Standard Primary Flow Calibrator

Reference Standard	Model	Serial Number	Traceable	Due Calibration
Air Flow Meter	Gilibrator 3 Low flow	18501010006	Sensidyne	12 July 2024
Air Flow Meter	Gilibrator 3 Standard flow	19031011003	Sensidyne	12 July 2024
Temperature meter	GT 11	08000057	Qreborn	27 February 2024
Pressure meter	CPG2400	41000KDU/651882	TPA	9 November 2024

Traceability :

This Certificate is traceable to SI Unit through Sensidyne A2LA Accreditation No. 3943.01

Note :

The reported uncertainty is based on standard uncertainty multiplied by the Coverage Factor $k=2$, providing a level of confidence approximately 95 %.

Calibration By : 
Mr. Noppadon Luangart
Service Calibration Engineer

Approved By : 
Mr. Pacit Mathavorn
Calibration Engineer Supervisor

Issue Date : 13 February 2024

Certificate No : 24-AFM-033
Request No : Req-2024-0241

Result of Calibration : Without Adjustment

Temperature (°C)	Pressure (kPa)	STD (cc/min)	UUC (cc/min)	Error (cc/min)	Uncertainty (cc/min)
24.50	101.26	20	19.965	0.0	1.3
24.20	101.25	101	100.50	-0.5	2.8
24.00	101.31	200	199.13	-0.9	5.6
23.90	101.42	301	303.56	2.6	8.4
24.10	101.41	401	404.57	4	11
24.10	101.49	480	483.81	3.8	7.0

Note STD : Standard UUC : Unit Under Calibration
- UUC Reference Condition : At atmospheric pressure and room temperature condition
- Flow Rate was corrected for non-standard operating condition by using equation :

$$Q_{\text{meas}} = Q_{\text{ref}} \times \frac{P_{\text{ref}}}{P_{\text{meas}}} \times \frac{T_{\text{meas}}}{T_{\text{ref}}}$$

where Q = Flow Rate P = Absolute Pressure T = Absolute Temperature
Meas = Measurement Condition ref = Standard Condition

* Indicates non accredited

End of Certificate

Certificate of Calibration

Customer
Name : ALS Laboratory Group Thailand Co., Ltd.
Address : 104 Soi Phatthamakan 40, Phatthamakan Road, Suan Luang, Bangkok 10250

Certificate No : 24-AFM-032
Request No : Req-2024-0240

Unit Under Calibration Details

Measurement Item : Primary Flow Calibrator
Manufacturer : Bios
Model : Defender 510-M
Serial Number : 129958
ID : RYG_FS0209
Sensor Model : -
Sensor Serial Number : -
Location of Calibration : LAB 4 AIR VELOCITY METER

Calibration Environment and Details

Temperature : 23 °C ± 3 °C
Humidity : 55 %RH ± 20 %RH
Barometric Pressure : 1013 hPa ± 10 hPa
Received Date : 31 January 2024
Calibration Date : 13 February 2024

Calibration Procedure : In-house method CP-AFM-01 by Comparison technique with Standard Primary Flow Calibrator

Reference Standard	Model	Serial Number	Traceable	Due Calibration
Air Flow Meter	Gilibrator 3 Low flow	18501010006	Sensidyne	12 July 2024
Air Flow Meter	Gilibrator 3 Standard flow	19031011003	Sensidyne	12 July 2024
Temperature meter	GT 11	08000057	Qreborn	27 February 2024
Pressure meter	CPG2400	41000KDU/651882	TPA	9 November 2024

Traceability :

This Certificate is traceable to SI Unit through Sensidyne A2LA Accreditation No. 3943.01

Note :

The reported uncertainty is based on standard uncertainty multiplied by the Coverage Factor $k=2$, providing a level of confidence approximately 95 %.

Calibration By : 
Mr. Noppadon Luangart
Service Calibration Engineer

Approved By : 
Mr. Pacit Mathavorn
Calibration Engineer Supervisor

Issue Date : 13 February 2024

Certificate No : 24-AFM-032
Request No : Req-2024-0240

Result of Calibration : Without Adjustment

Temperature (°C)	Pressure (kPa)	STD (cc/min)	UUC (cc/min)	Error (cc/min)	Uncertainty (cc/min)
23.80	101.89	95	100.13	5.1	2.8
23.90	101.71	501	513.93	12.9	7.2
24.18	101.62	1006	1019.3	13	14
24.00	101.81	1997	2023.0	26	29
24.10	101.87	2999	3035.5	37	45
24.60	102.00	3944	3991.8	48	59
24.60	102.08	4739	4790.5	52	72

Note STD : Standard UUC : Unit Under Calibration
- UUC Reference Condition : At atmospheric pressure and room temperature condition
- Flow Rate was corrected for non-standard operating condition by using equation :

$$Q_{\text{meas}} = Q_{\text{ref}} \times \frac{P_{\text{ref}}}{P_{\text{meas}}} \times \frac{T_{\text{meas}}}{T_{\text{ref}}}$$

where Q = Flow Rate P = Absolute Pressure T = Absolute Temperature
Meas = Measurement Condition ref = Standard Condition

* Indicates non accredited

End of Certificate

Certificate of Calibration

Customer

Name : ALS Laboratory Group Thailand Co., Ltd.
Address : 104 Soi Phatthanasak 40, Phatthanasak Road, Suan Luang,
Bangkok 10250

Certificate No : 24-AFM-174

Request No : Req-2024-1861

Unit Under Calibration Details

Measurement Item : Air Flow Meter
Manufacturer : MesaLabs
Model : 510-M
Serial Number : 208345
ID : BKK_FS1347

Accuracy : 1% of Reading

Sensor Model : -

Sensor Serial Number : -

Instrument Status : Used

Location of Calibration : LAB 4 AIR VELOCITY METER

Calibration Environment and Details

Temperature : 23 °C ± 3 °C
Humidity : 55 %RH ± 20 %RH
Barometric Pressure : 1013 hPa ± 10 hPa
Received Date : 22 August 2024
Calibration Date : 28 August 2024

Calibration Procedure : In-house method CP-AFM-01 by Comparison technique with Standard Primary Flow Calibrator

Reference Standard	Model	Serial Number	Traceable	Due Calibration
Air Flow Meter	Gilibrator 3 Low flow	18501010006	Sensidyne	6 August 2025
Air Flow Meter	Gilibrator 3 Standard flow	19031011003	Sensidyne	2 August 2025
Temperature meter	GT 11	08000057	Qreborn	1 March 2025
Pressure meter	CPG2400	41000KDU/651882	TPA	9 November 2024

Traceability :

This Certificate is traceable to SI Unit through Sensidyne A2LA Accreditation No. 3943.01

Note :

The reported uncertainty is based on standard uncertainty multiplied by the Coverage Factor $k = 2$, providing a level of confidence approximately 95 %.

Calibration By : Mr. Noppadon Luangari
Service Calibration Engineer

Approved By : Mr. Pacit Mathavorn
Calibration Engineer Supervisor
Issue Date : 28 August 2024

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.

FM-708-AFM-01 Rev.04 Issue date 17/6/24

Certificate No : 24-AFM-174

Request No : Req-2024-1861

Result of Calibration : Without Adjustment

Temperature (°C)	Pressure (kPa)	STD (cc/min)	UUC (cc/min)	Error (cc/min)	Uncertainty (cc/min)	MPE (cc/min)	Result
22.30	100.57	100	99.526	-0.5	2.8	1	N/A
22.40	100.61	499	500.48	1.5	7.8	5	N/A
22.50	100.56	1004	1004.8	1	15	10	N/A
22.60	100.54	2008	2003.3	-5	29	20	N/A
22.80	100.62	3034	3032.1	-2	45	30	N/A
23.20	100.71	4032	4022.4	-10	60	40	N/A
23.40	100.73	5060	5056.4	-4	79	51	N/A

Note

STD : Standard UUC : Unit Under Calibration

UUC Reference Condition : At atmospheric pressure and room temperature condition

Flow Rate was corrected for non-standard operating condition by using equation :

$$Q_{\text{meas}} = Q_{\text{ref}} \times \frac{P_{\text{ref}}}{P_{\text{meas}}} \times \frac{T_{\text{meas}}}{T_{\text{ref}}}$$

where Q = Flow Rate P = Absolute Pressure T = Absolute Temperature

Meas = Measurement Condition ref = Standard Condition

* Indicates non accredited

MPE = Maximum Permissible Error (Specified in Manufacturer's Specifications)

N/A = Not Available. Customer does not require a statement of conformity.

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.

FM-708-AFM-01 Rev.04 Issue date 17/6/24

Certificate No : 24-AFM-174

Request No : Req-2024-1861

Decision Rule for Statements of Conformity

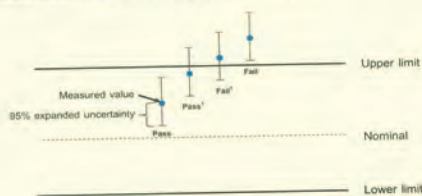
The standard decision rule employed for the statements of conformity to each calibration result will be applied using ILAC-G8:09-2019, Guidelines on the Reporting of Compliance with Specification as following Fig. and statements

Pass = The measurement result plus the expanded uncertainty with a 95% coverage probability were within the limit.

Pass¹ = The measurement result was within the limit. However, a portion of the expanded uncertainty of measurement at 95% exceeds the limit.

Fail¹ = The measurement result was out of the limit. However, a portion of the expanded uncertainty of measurement at 95% is within the limit.

Fail = The measurement result plus the expanded uncertainty with a 95% coverage probability were outside the limit.



End of Certificate

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.

FM-708-AFM-01 Rev.04 Issue date 17/6/24

Certificate of Calibration

Customer

Name : ALS Laboratory Group Thailand Co., Ltd.
Address : 104 Soi Phatthanasak 40, Phatthanasak Road, Suan Luang,
Bangkok 10250

Certificate No : 24-AFM-177

Request No : Req-2024-1862

Unit Under Calibration Details

Measurement Item : Air Flow Meter
Manufacturer : Bios
Model : Defender 510-L
Serial Number : 130026
ID : BKK_FS0619
Location of Calibration : LAB 4 AIR VELOCITY METER

Accuracy : 1% of Reading

Sensor Model : -

Sensor Serial Number : -

Instrument Status : Used

Calibration Environment and Details

Temperature : 23 °C ± 3 °C
Humidity : 55 %RH ± 20 %RH
Barometric Pressure : 1013 hPa ± 10 hPa
Received Date : 22 August 2024
Calibration Date : 9 September 2024

Calibration Procedure : In-house method CP-AFM-01 by Comparison technique with Standard Primary Flow Calibrator

Reference Standard	Model	Serial Number	Traceable	Due Calibration
Air Flow Meter	Gilibrator 3 Low flow	18501010006	Sensidyne	6 August 2025
Air Flow Meter	Gilibrator 3 Standard flow	19031011003	Sensidyne	2 August 2025
Temperature meter	GT 11	08000057	Qreborn	1 March 2025
Pressure meter	CPG2400	41000KDU/651882	TPA	9 November 2024

Traceability :

This Certificate is traceable to SI Unit through Sensidyne A2LA Accreditation No. 3943.01

Note :

The reported uncertainty is based on standard uncertainty multiplied by the Coverage Factor $k = 2$, providing a level of confidence approximately 95 %.

Calibration By : Mr. Noppadon Luangari
Service Calibration Engineer

Approved By : Mr. Pacit Mathavorn
Calibration Engineer Supervisor
Issue Date : 9 September 2024

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.

FM-708-AFM-01 Rev.04 Issue date 17/6/24

Certificate No : 24-AFM-177

Request No : Req-2024-1862

Result of Calibration : Without Adjustment

Temperature (°C)	Pressure (kPa)	STD (cc/min)	UUC (cc/min)	Error (cc/min)	Uncertainty (cc/min)	MPE (cc/min)	Result
24.70	100.92	20	20.192	0.2	1.3	0.2	N/A
24.70	100.90	100	99.923	-0.1	2.8	1.0	N/A
24.70	100.94	201	200.7	-0.3	5.6	2.0	N/A
24.70	100.97	298	300.1	2.1	8.4	3.0	N/A
24.70	100.99	403	399.1	-4	11	4.0	N/A
24.80	101.05	482	477.6	-4.4	6.9	4.8	N/A

Note STD : Standard UUC : Unit Under Calibration

- UUC Reference Condition : At atmospheric pressure and room temperature condition

- Flow Rate was corrected for non-standard operating condition by using equation :

$$Q_{meas} = Q_{ref} \times \frac{P_{ref}}{P_{meas}} \times \frac{T_{meas}}{T_{ref}}$$

where Q = Flow Rate P = Absolute Pressure T = Absolute Temperature
Meas = Measurement Condition ref = Standard Condition

* Indicates non accredited

MPE = Maximum Permissible Error (Specified in Manufacturer's Specifications)

N/A = Not Available, Customer does not require a statement of conformity.

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.

FM-708-AFM-01 Rev.04 Issue date 17/6/24

Certificate No : 24-AFM-177

Request No : Req-2024-1862

Decision Rule for Statements of Conformity

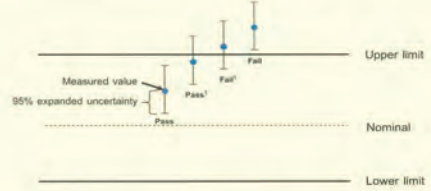
The standard decision rule employed for the statements of conformity to each calibration result will be applied using ILAC-G8:09-2019: Guidelines on the Reporting of Compliance with Specification as following Fig. and statements

Pass = The measurement result plus the expanded uncertainty with a 95% coverage probability were within the limit.

Pass¹ = The measurement result was within the limit. However, a portion of the expanded uncertainty of measurement at 95% exceeds the limit.

Fail¹ = The measurement result was out of the limit. However, a portion of the expanded uncertainty of measurement at 95% is within the limit.

Fail = The measurement result plus the expanded uncertainty with a 95% coverage probability were outside the limit.



End of Certificate

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.

FM-708-AFM-01 Rev.04 Issue date 17/6/24

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Agilent CrossLab Compliance Services

Certificate of System Qualification

GC-OQ + GCMS-OQ

System ID: GM-12
Organization Name: ALS Laboratory Group (Thailand) Co Ltd
Organization Location: 104 Phattanasak 40 Phatthanakan Rd Bangkok 10250
Date: May 10, 2024 2:18:55 PM
EQP Name: AgilentRecommended, AgilentRecommended
EQP Revision: GC-02.53, GCMS-02.54
Overall Qualification Status: Pass

REVIEW BY: *Suchada T.*
APPROVED BY: *Tomytom*
NEXT CAL. DATE: 10 Nov 25

CDS Logon Verification - GC

Logon: asbkk.env03

Overall CDS Logon Verification - GC Test Status

Pass

System Inspection and Basic Safety and Operation

Name: 8890
Setpoint Status: Pass

Overall System Inspection and Basic Safety and Operation Test Status

Pass

Inlet Pressure Accuracy

Name: 8890
Front SSL

Setpoint Status: Pass

Setpoint: 25.0 psi Actual: 25.0 psi

Accuracy: 0.0 psi
Agilent Recommended: <= 1.2

Date: May 10, 2024 2:18:55 PM
System ID: GM-12

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Agilent CrossLab Compliance Services

Overall Inlet Pressure Accuracy Test Status

Pass

GC Oven Temperature Accuracy

Name: 8890
Setpoint Status: Pass
Zone: Oven
Setpoint/Actual: 220.0 / 229.1 °C
Temperature: 220.0 / 229.1 °C
Accuracy: 0.9 °C
Agilent Recommended: >= -1.0 % setpoint in K (-5.0 °C) <= 1.0 % setpoint in K (5.0 °C)

Setpoint Status: Pass
Zone: Oven
Setpoint/Actual: 100.0 / 101.1 °C
Temperature: 100.0 / 101.1 °C
Accuracy: 1.1 °C
Agilent Recommended: >= -1.0 % setpoint in K (-3.7 °C) <= 1.0 % setpoint in K (3.7 °C)

Overall GC Oven Temperature Accuracy Test Status

Pass

GC Oven Temperature Stability

Name: 8890
Setpoint Status: Pass
Setpoint/Average: 100.0 / 100.9 °C
Temperature: 100.0 / 100.9 °C
Stability: 0.0 °C
Agilent Recommended: <= 0.5

Overall GC Oven Temperature Stability Test Status

Pass

Date: May 10, 2024 2:18:55 PM
System ID: GM-12

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Log Amp

Tested Combination1

Front

SSL

/ External

SQ

Name:

5977C

Setpoint Status:

Pass

Overall Log Amp Test Status

Pass

RPPA

Tested Combination1

Front

SSL

/ External

SQ

Name:

5977C

Setpoint Status:

Pass

Amu:

1050

m/z

Drift After Five Minutes:

4

mV

RPPA Voltage:

482

mV

Agilent Recommended:

>= -100

and

<= 100

<= 1100

Overall RPPA Test Status

Pass

Tune EI

Tested Combination1

Front

SSL

/ External

SQ

Name:

5977C

Setpoint Status:

Pass

Filament:

1

Setpoint Status:

Pass

Filament:

2

Overall Tune EI Test Status

Pass

Scouting Run

Date:

May 10, 2024 2:18:55 PM

System ID:

GM-12

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Agilent CrossLab Compliance Services

Tested Combination1

Front

SSL

/ External

SQ

Injection Tower

Name:

7693A

Source:

EI - Extractor

Setpoint Status:

Completed

Injection Volume on Column:

1.0

uL

Overall Scouting Run Status

Completed

Instrument Detection Limit

Tested Combination1

Front

SSL

/ External

SQ

Injection Tower

Name:

7693A

Source:

EI - Extractor

Setpoint Status:

Pass

Injection Volume on Column:

1.0

uL

Area

0.72

%

Agilent Recommended:

<= 5.00

Status:

Pass

Instrument Detection Limit:

2.41164

fg

Agilent Recommended:

<= 16.82500

Status:

Pass

Overall Instrument Detection Limit Test Status

Pass

Mass Ratio Precision

Date:

May 10, 2024 2:18:55 PM

System ID:

GM-12

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Agilent CrossLab Compliance Services

Tested Combination1

Front

SSL

/ External

SQ

Injection Tower

Name:

7693A

Source:

EI - Extractor

Setpoint Status:

Pass

Injection Volume on Column:

1.0

uL

Area Mass 1

0.71

%

Abundance's

<= 5.00

RSD:

0.19

%

Agilent Recommended:

<= 5.00

Mass Ratio

0.19

%

Agilent Recommended:

<= 5.00

Status:

Pass

Overall Mass Ratio Precision Test Status

Pass

Date:

May 10, 2024 2:18:55 PM

System ID:

GM-12

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Agilent CrossLab Compliance Services

Instrument Details

Purpose

This section describes the as found system configuration.

Details

System

System ID

GM-12

Manufacturer

Agilent Technologies

Name

5890

Flow Data Input

Manual Data

Temperature Data Input

Manual Data or Other Data Logging

Tested Combination1

Injection Technique

Injection Tower

Inlet

Front

Detector

External

LTM Included?

No

Sampler 1

Manufacturer

Agilent Technologies

Type

Injection Tower

Name

7693A

Model Number

G4513A

Serial Number

CN23123102

Firmware Revision

A.11.07

Usage

Simple Injection

Location

Front

Syringe Volume (uL)

10

Date: May 10, 2024 2:18:55 PM
System ID: GM-12

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Sampler 2

Manufacturer	Agilent Technologies
Type	Tray
Name	7693A
Model Number	G3514A
Serial Number	CN23147D49
Firmware Revision	A.12.03
Val Healer	Not installed

Mainframe 1

Manufacturer	Agilent Technologies
Name	8890
Model Number	G3540A
Serial Number	CN2303A031
Firmware Revision	2.8.1.6
Oven Type	Standard

Inlet 1

Manufacturer	Agilent Technologies
Name	8890
Type	SSL
Location	Front
Carrier Gas	Helium
Control Type	Electronic Pressure Control (EPC)
Purged Inlet	Yes

Detector 1

Manufacturer	Agilent Technologies
Name	Mass Spectrometer
Type	Mass Spectrometer
Location	External

Date: May 10, 2024 2:18:55 PM
System ID: GM-12

Mass Spectrometer 1

Manufacturer	Agilent Technologies
Type	SG
Name	5977C
Model Number	G7077C
Serial Number	JS2307MA35
Firmware Revision	6.00.36
High Vacuum System	Turbo Pump
Scouting Run Standard	CFN Std

MS EI Source 1

Manufacturer	Agilent Technologies
Source Type	EI - Extractor
Number of filaments	2

Date: May 10, 2024 2:18:55 PM
System ID: GM-12

Electronic Signature

Purpose

This signature page was created and published because the ACE sign-off action was executed, which is valid for the entire document, including attachments. The ACE sign-off is an electronic signature that requires two distinct identification components: unique username and personal password. The Agilent representative who has delivered this service understands the meaning and legal status of an electronic signature. As a trained official operator, the Agilent representative has a unique password and login to access ACE and electronically sign this document. (Other e-signatures can be applied to this document using a Document Content Management or other suitable method defined in your data access and control procedures.)

Details

Full Name of Signer:	Supasak Nimsongtham
Logged On User Name:	supasak.nimsongtham@agilent.com
Signature Creation Date:	May 10, 2024
Reason for Signature:	Executed protocol and published this original version of document

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Date: May 10, 2024 2:18:55 PM
System ID: GM-12

Data owner: supasak.nimsongtham Report Generated by Hardware: NCD111840C System ID: GM-12 Print Date: May 10, 2024 2:18:57 PM				
GM-12 Transaction Log:				
Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 9, 2024 2:25:19 PM	Auth	Session Created	Session	None
May 9, 2024 2:25:19 PM	Start	Configuration	Session	None
May 9, 2024 2:25:19 PM	Auth	Exit/Logout	Logging	User is First Engineer and does not require an initial code
May 9, 2024 2:31:20 PM	Auth	Exit/Logout	Session	EOP details for primary technique (GC) - File path: (Protocol)PacNetGCConfig\runGC2.S3\GC.D2.30.spl EOP File Name: (GC.D2.30.spl) EOP Name: (Agilent)PacNetGCConfig\runGC2.S3\GC.D2.30.spl EOP details for secondary technique (GC) - File path: (Protocol)PacNetGCConfig\runGC2.S3\GC.D2.30.spl EOP File Name: (GC.D2.30.spl) EOP Name: (Agilent)PacNetGCConfig\runGC2.S3\GC.D2.30.spl EOP details for tertiary technique (GC) - File path: (Protocol)PacNetGCConfig\runGC2.S3\GC.D2.30.spl EOP File Name: (GC.D2.30.spl) EOP Name: (Agilent)PacNetGCConfig\runGC2.S3\GC.D2.30.spl
May 9, 2024 2:31:23 PM	End	Configuration	Session	None
May 9, 2024 2:31:27 PM	Start	Qualification	Session	CO
May 9, 2024 2:31:27 PM	Start	Execution	CO2 Logon Verification - GC-1880 - Qualitative test	None
May 9, 2024 2:32:31 PM	End	Evaluation	CO2 Logon Verification - GC-1880 - Qualitative test	Run Count: 1
May 9, 2024 2:32:33 PM	Start	Evaluation	System Inspection and Basic Safety and Controls - GC-1880 - Qualitative test - No reports associated	None

Date: May 10, 2024 2:18:55 PM
System ID: GM-12

User Name: supasak.himwong@ham
Report Generated by Hostname: SCG11156KC
System ID: DM-12
Print Date: May 10, 2024 2:18:57 PM

DM-12 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 9, 2024 2:32:44 PM	End	Execution	System Inspection and Basic Safety and Operation - 8860 - Qualitative Test - No response anticipated	Run Count: 1
May 9, 2024 2:32:47 PM	Start	Execution	Heid Pressure Accuracy - Front SSU - Pressure Controlled inlet - S: 25.0 psi - L: <= 1.2 psi	None
May 9, 2024 2:32:54 PM	End	Execution	Heid Pressure Accuracy - Front SSU - Pressure Controlled inlet - S: 25.0 psi - L: <= 1.2 psi	Run Count: 1
May 9, 2024 2:32:58 PM	Auto	AcqClosed	Session	None
May 9, 2024 2:33:43 PM	Auto	AcqRestarted	Session	None
May 9, 2024 2:33:44 PM	Auto	SessionRelocated	Session	None
May 9, 2024 2:33:49 PM	Start	QualSession	Session	OQ
May 9, 2024 2:33:54 PM	Start	Execution	Instrument Detection Limit - Injection Tower, Front SSU, SQ - Source: E - Extractor - RSD L (Area): <= 5.00% - RSD L (Ret. Time): <= 1.00%	None
May 9, 2024 2:34:18 PM	Start	Execution	Mass Ratio Precision - Injection Tower, Front SSU, SQ - Source: E - Extractor - L (RSD): <= 5.00%	None
May 9, 2024 2:34:29 PM	Auto	AcqClosed	Session	None
May 10, 2024 10:19:02 AM	Auto	AcqRestarted	Session	None
May 10, 2024 10:19:05 AM	Auto	SessionRelocated	Session	None
May 10, 2024 10:19:08 AM	Start	QualSession	Session	OQ
May 10, 2024 10:19:09 AM	Start	Execution	Mass Ratio Precision - Injection Tower, Front SSU, SQ - Source: E - Extractor - L (RSD): <= 5.00%	None

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Date: May 10, 2024 2:18:55 PM
System ID: DM-12

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User Name: supasak.himwong@ham
Report Generated by Hostname: SCG11156KC
System ID: DM-12
Print Date: May 10, 2024 2:18:57 PM

DM-12 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 10, 2024 10:20:08 AM	Start	Execution	GC Oven Temperature Accuracy - 8860 - Temperature (Oven - S: 230.0°C - L: <= +1.0 AND <= 1.0 % repeat in K	None
May 10, 2024 10:24:46 AM	Auto	Drift	GC Oven Temperature Accuracy - 8860 - Temperature (Oven - S: 230.0°C - L: <= +1.0 AND <= 1.0 % repeat in K	Manual Data Entry
May 10, 2024 10:24:48 AM	End	Execution	GC Oven Temperature Accuracy - 8860 - Temperature (Oven - S: 230.0°C - L: <= +1.0 AND <= 1.0 % repeat in K	Run Count: 1
May 10, 2024 10:24:59 AM	Start	Execution	GC Oven Temperature Accuracy - 8860 - Temperature (Oven - S: 230.0°C - L: <= +1.0 AND <= 1.0 % repeat in K	None
May 10, 2024 10:25:33 AM	Auto	AcqClosed	Session	None
May 10, 2024 10:27:35 AM	Auto	AcqRestarted	Session	None
May 10, 2024 10:27:38 AM	Auto	SessionRelocated	Session	None
May 10, 2024 10:27:38 AM	Start	QualSession	Session	OQ
May 10, 2024 10:27:38 AM	Start	Execution	GC Oven Temperature Accuracy - 8860 - Temperature (Oven - S: 100.0°C - L: <= +1.0 AND <= 1.0 % repeat in K	None
May 10, 2024 10:28:02 AM	Auto	Data	GC Oven Temperature Accuracy - 8860 - Temperature (Oven - S: 100.0°C - L: <= +1.0 AND <= 1.0 % repeat in K	Manual Data Entry
May 10, 2024 10:28:05 AM	End	Execution	GC Oven Temperature Accuracy - 8860 - Temperature (Oven - S: 100.0°C - L: <= +1.0 AND <= 1.0 % repeat in K	Run Count: 1

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Date: May 10, 2024 2:18:55 PM
System ID: DM-12

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User Name: supasak.himwong@ham
Report Generated by Hostname: SCG11156KC
System ID: DM-12
Print Date: May 10, 2024 2:18:57 PM

DM-12 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 10, 2024 10:28:06 AM	Start	Execution	GC Oven Temperature Stability - 8860 - Temperature (Oven - S: 100.0°C - L: <= 0.5°C	None
May 10, 2024 10:31:26 AM	Auto	Data	GC Oven Temperature Stability - 8860 - Temperature (Oven - S: 100.0°C - L: <= 0.5°C	Manual Data Entry
May 10, 2024 10:31:28 AM	End	Execution	GC Oven Temperature Stability - 8860 - Temperature (Oven - S: 100.0°C - L: <= 0.5°C	Run Count: 1
May 10, 2024 10:51:00 AM	End	Execution	Log Amp - 5977C SQ - Source: E - Extractor	None
May 10, 2024 10:55:40 AM	Auto	AcqClosed	Session	None
May 10, 2024 10:57:33 AM	Auto	AcqRestarted	Session	None
May 10, 2024 10:57:33 AM	Auto	SessionRelocated	Session	None
May 10, 2024 10:57:38 AM	Start	QualSession	Session	OQ
May 10, 2024 10:57:52 AM	Start	Execution	Log Amp - 5977C SQ - Source: E - Extractor	None
May 10, 2024 11:00:05 AM	End	Execution	Log Amp - 5977C SQ - Source: E - Extractor	Run Count: 1
May 10, 2024 11:00:07 AM	Start	Execution	WFOA - 5977C SQ - Source: E - Extractor	None
May 10, 2024 11:01:19 AM	End	Execution	WFOA - 5977C SQ - Source: E - Extractor	Run Count: 1
May 10, 2024 11:01:25 AM	Start	Execution	Tune E1 - 5977C SQ - Source: E - Extractor Filament 1 - Qualitative - No response anticipated	None
May 10, 2024 11:01:50 AM	End	Execution	Tune E1 - 5977C SQ - Source: E - Extractor Filament 1 - Qualitative - No response anticipated	Run Count: 1

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Date: May 10, 2024 2:18:55 PM
System ID: DM-12

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User Name: supasak.himwong@ham
Report Generated by Hostname: SCG11156KC
System ID: DM-12
Print Date: May 10, 2024 2:18:57 PM

DM-12 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 10, 2024 11:01:52 AM	Start	Execution	Tune E1 - 5977C SQ - Source: E - Extractor Filament 2 - Qualitative - No response anticipated	None
May 10, 2024 11:02:45 AM	End	Execution	Tune E1 - 5977C SQ - Source: E - Extractor Filament 2 - Qualitative - No response anticipated	Run Count: 1
May 10, 2024 11:09:42 AM	Start	Execution	Spooling Run - Injection Tower, Front SSU, SQ - Source: E - Extractor - Part of QCMS System Preparation	None
May 10, 2024 11:09:10 AM	Start	Execution	Instrument Detection Limit - Injection Tower, Front SSU, SQ - Source: E - Extractor - RSD L (Area): <= 5.00% - RSD L (Ret. Time): <= 1.00%	None
May 10, 2024 11:17:54 AM	Start	Execution	Spooling Run - Injection Tower, Front SSU, SQ - Source: E - Extractor - Part of QCMS System Preparation	None
May 10, 2024 11:17:55 AM	Start	Execution	Instrument Detection Limit - Injection Tower, Front SSU, SQ - Source: E - Extractor - RSD L (Area): <= 5.00% - RSD L (Ret. Time): <= 1.00%	None
May 10, 2024 11:18:02 AM	Start	Execution	Mass Ratio Precision - Injection Tower, Front SSU, SQ - Source: E - Extractor - L (RSD): <= 5.00%	None
May 10, 2024 11:33:09 AM	Auto	AcqClosed	Session	None
May 10, 2024 11:40:08 PM	Auto	AcqRestarted	Session	None
May 10, 2024 11:40:08 PM	Auto	SessionRelocated	Session	None

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Date: May 10, 2024 2:18:55 PM
System ID: DM-12

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User Name: supasak.niamsangtham
Report Generated by Hostname: SCQ115MRG
System ID: GM-12
Print Date: May 10, 2024 2:16:57 PM

GM-12 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 10, 2024 1:14:12 PM	Start	QualCheck	Session	OQ
May 10, 2024 1:16:12 PM	Start	Execution	Mass Ratio Precision - Injection	None Tower, Front SSL, SQ - Source: E1 - Extractor - L (RSD): ≤ 5.00%
May 10, 2024 1:15:11 PM	Start	Execution	Sparging Run - Injection Tower	None Front SSL, SQ - Source: E1 - Extractor - Path of GCMS System Preparation
May 10, 2024 1:15:45 PM	Auto	Data	Sparging Run - Injection Tower	Data File Path: D:\GM-12 Front SSL, SQ - Source: E1 - GC2004MRP001.D Extractor - Path of GCMS System Preparation
May 10, 2024 1:15:55 PM	Auto	Reporting	Reintegration	Reintegration Count: 1 - [Integration Type: Injection; BaselineCorrectionMode: Advanced; InitialSlopeSensitivity: 10; InitialPeakWidth: 0.01; InitialAreaOffset: 0; InitialHeightOffset: 200; Integration: Off at 0; Integration: On at 5.]
May 10, 2024 1:16:57 PM	Auto	Recovery	Reintegration	Reintegration Count: 3 - [Integration Type: Injection; BaselineCorrectionMode: Advanced; InitialSlopeSensitivity: 10; InitialPeakWidth: 0.01; InitialAreaOffset: 0; InitialHeightOffset: 200; Integration: Off at 0; Integration: On at 5.]

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Date: May 10, 2024 2:16:55 PM
System ID: GM-12

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User Name: supasak.niamsangtham
Report Generated by Hostname: SCQ115MRG
System ID: GM-12
Print Date: May 10, 2024 2:16:57 PM

GM-12 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 10, 2024 1:18:43 PM	Auto	Reporting	Reintegration	Reintegration Count: 1 - [Integration Type: Injection; BaselineCorrectionMode: Advanced; InitialSlopeSensitivity: 10; InitialPeakWidth: 0.01; InitialAreaOffset: 0; InitialHeightOffset: 200; Integration: Off at 0; Integration: On at 5.]
May 10, 2024 1:19:35 PM	Auto	Reporting	Reintegration	Reintegration Count: 3 - [Integration Type: Injection; BaselineCorrectionMode: Advanced; InitialSlopeSensitivity: 10; InitialPeakWidth: 0.01; InitialAreaOffset: 0; InitialHeightOffset: 200; Integration: Off at 0; Integration: On at 5.]
May 10, 2024 1:17:03 PM	End	Execution	Increased Detection Limit - Injection Tower, Front SSL, SQ	Run Count: 1 Source: E1 - Extractor - RSD L (Area): ≤ 5.00% - RSD L (Rel. Time): ≤ 1.00%
May 10, 2024 1:17:05 PM	Start	Execution	Mass Ratio Precision - Injection	None Tower, Front SSL, SQ - Source: E1 - Extractor - L (RSD): ≤ 5.00%
May 10, 2024 1:21:25 PM	Start	Execution	Mass Ratio Precision - Injection	None Tower, Front SSL, SQ - Source: E1 - Extractor - L (RSD): ≤ 5.00%

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Date: May 10, 2024 2:16:55 PM
System ID: GM-12

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User Name: supasak.niamsangtham
Report Generated by Hostname: SCQ115MRG
System ID: GM-12
Print Date: May 10, 2024 2:16:57 PM

GM-12 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 10, 2024 1:21:35 PM	Start	Execution	Mass Ratio Precision - Injection	None Tower, Front SSL, SQ - Source: E1 - Extractor - L (RSD): ≤ 5.00%
May 10, 2024 2:02:49 PM	Auto	QMS	Mass Ratio Precision - Injection	Data File Path: D:\GM-12 Tower, Front SSL, SQ - Source: E1 - Extractor - L (RSD): ≤ 5.00%
May 10, 2024 2:02:49 PM	Auto	Data	Mass Ratio Precision - Injection	Data File Path: D:\GM-12 Tower, Front SSL, SQ - Source: E1 - Extractor - L (RSD): ≤ 5.00%
May 10, 2024 2:02:45 PM	Auto	Data	Mass Ratio Precision - Injection	Data File Path: D:\GM-12 Tower, Front SSL, SQ - Source: E1 - Extractor - L (RSD): ≤ 5.00%
May 10, 2024 2:02:45 PM	Auto	Data	Mass Ratio Precision - Injection	Data File Path: D:\GM-12 Tower, Front SSL, SQ - Source: E1 - Extractor - L (RSD): ≤ 5.00%
May 10, 2024 2:02:45 PM	Auto	Data	Mass Ratio Precision - Injection	Data File Path: D:\GM-12 Tower, Front SSL, SQ - Source: E1 - Extractor - L (RSD): ≤ 5.00%
May 10, 2024 2:02:45 PM	Auto	Data	Mass Ratio Precision - Injection	Data File Path: D:\GM-12 Tower, Front SSL, SQ - Source: E1 - Extractor - L (RSD): ≤ 5.00%
May 10, 2024 2:02:45 PM	Auto	Data	Mass Ratio Precision - Injection	Data File Path: D:\GM-12 Tower, Front SSL, SQ - Source: E1 - Extractor - L (RSD): ≤ 5.00%

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Date: May 10, 2024 2:16:55 PM
System ID: GM-12

Page 19 / 20

User Name: supasak.niamsangtham
Report Generated by Hostname: SCQ115MRG
System ID: GM-12
Print Date: May 10, 2024 2:16:57 PM

GM-12 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 10, 2024 2:03:15 PM	Auto	Reporting	Reintegration	Reintegration Count: 1 - [Integration Type: Injection; BaselineCorrectionMode: Advanced; InitialSlopeSensitivity: 10; InitialPeakWidth: 0.01; InitialAreaOffset: 0; InitialHeightOffset: 200; Integration: Off at 0; Integration: On at 5.]
May 10, 2024 2:03:31 PM	End	Execution	Mass Ratio Precision - Injection	Run Count: 1 Tower, Front SSL, SQ - Source: E1 - Extractor - L (RSD): ≤ 5.00%
May 10, 2024 2:03:49 PM	End	Qualification	Session	OQ
May 10, 2024 2:03:49 PM	Start	Reporting	Session	None
May 10, 2024 2:16:42 PM	Auto	Reporting	Session	Report Generated: Certificate
May 10, 2024 2:17:28 PM	Auto	Reporting	Session	Report Generated: Report

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Date: May 10, 2024 2:16:55 PM
System ID: GM-12

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Stopwatch Calibration Test Report

Calibration Date : 31 Jul 24 Next Cal. Date : 31 Jan 25
Barometric Pressure (mmHg) : 754 Temperature (°C) : 27.0
Relative Humidity (%) : 53.0

Reference Stopwatch Data

Stopwatch ID No. : RYG_FS0540
Model : F808
Serial No. : E18061
Calibration Date : 4 Jul 24
Certificate No. : E-2407022

Console Control Meter Data

Dry Gas Meter No. : BKK_FS0527
Model : XC-572-V
Serial No. : 1508053

Run No.	Time Actual (m:ss.ms)	Time Reading (m:ss)	Diff. (ms)	Diff. (min)
1	5:00:03	5:00	3	0.00005
2	5:00:09	5:00	8	0.00013
3	5:00:09	5:00	9	0.00015
4	5:00:11	5:00	11	0.00018
5	5:00:05	5:00	5	0.00008
6	5:00:06	5:00	6	0.00010
7	5:00:06	5:00	6	0.00010
8	5:00:08	5:00	8	0.00013
9	5:00:09	5:00	9	0.00015
10	5:00:07	5:00	7	0.00012
Average			0.00012	
SD			0.00004	

Calibrate by : Saksit Phaisanphiset

Mr. Saksit Phaisanphiset

RYG Field Service Scientist (4)

Approved by : Nattapon Jengwareewong

Mr. Nattapon Jengwareewong

RYG Field Service Specialist (1)



DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date : 31 Jul 24		Ambient Temperature (°C) 27			
Calibration sheet No. : C-310724-BKK_FS0527		Relative Humidity (%) : 53			
Digital Temperature ID : BKK_FS0527		Reference Temperature ID RYG_FS0681			
Serial No. : 201090014918		Serial No. :			
Model : XC-572-V		Model : Digicon-CC-VT-MS			
Next Calibrate :		13 Nov 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
	250	250	0	±3	Pass
	300	300	0	±3	Pass
	500	501	1	±3	Pass
	100	101	1	±3	Pass
Probe	120	121	1	±3	Pass
	140	141	1	±3	Pass
	100	101	-	±3	-
Oven	120	121	-	±3	-
	140	142	-	±3	-
	100	102	2	±3	Pass
Filter	120	121	1	±3	Pass
	140	141	1	±3	Pass
	0	1	1	±3	Pass
Exit	10	9	-1	±3	Pass
	20	20	0	±3	Pass
	0	-1	-1	±3	Pass
Meter	25	24	-1	±3	Pass
	50	48	-2	±3	Pass
	0	-1	-1	±3	Pass
AUX	25	25	0	±3	Pass
	50	50	0	±3	Pass

MPE : (Maximum permissible error of measurement) ค่าความผิดพลาดสูงสุดของรายการที่สอบวัด

Calibrated by : Saksit Phaisanphiset

Mr. Saksit Phaisanphiset

RYG Field Services Scientist (4)

Approved by : Nattapon Jengwareewong

(Mr. Nattapon Jengwareewong)

RYG Field Services Specialist (1)

FORM NO.: F 06-027 REVISION NO.: 2 ISSUE DATE: 16/2/23



PROBE NOZZLE DIAMETER

CALIBRATION DATA SHEET

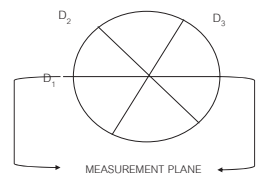
Calibration Date : 31 Jul 24				Nozzle Set ID. : BKK_FS0533	
Calibration Sheet No. : C-310724-BKK_FS0533				Vernier Caliper ID. : BKK_FS1123	
Nozzle ID #	Nozzle Diameter (cm.)			Hi - Lo	$(D_1 + D_2 + D_3) / 3$ D_{avg}
	D_1	D_2	D_3	ΔD	
1	0.316	0.318	0.316	0.002	0.317
2	0.480	0.475	0.474	0.006	0.476
3	0.635	0.635	0.635	0.000	0.635
4	0.791	0.792	0.791	0.001	0.791
5	0.950	0.952	0.951	0.002	0.951
6	1.088	1.080	1.089	0.009	1.086
7	1.270	1.270	1.270	0.000	1.270
8	1.600	1.600	1.598	0.002	1.599

Where :

D₁, D₂, D₃ = There 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 Phaisanphiset

(Mr. Saksit Phaisanphiset)

Field Scientist (4)

Approved by : Nattapon Jengwareewong

(Mr. Nattapon Jengwareewong)

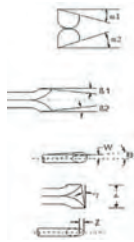
Field Specialist (1)

FORM NO.: F 06-026 REVISION NO.: 2 ISSUE DATE: 16/2/23



Type S Pitot Tube Calibration

Date Calibration 31-Jul-24 Due Date 31-Jan-25
Pitot ID BKK_FS0531 Inclinator ID BKK_FS1131
Pitot SN - Vernier ID RYG_FS0539



Parameter	Value	Allowable Range	Check
α_1	0.6	$-10^\circ < \alpha_1 < +10^\circ$	OK
α_2	1.4	$-10^\circ < \alpha_2 < +10^\circ$	OK
β_1	-2.3	$-5^\circ < \beta_1 < +5^\circ$	OK
β_2	-0.5	$-5^\circ < \beta_2 < +5^\circ$	OK
γ	-1.1	-	-
θ	1.3	-	-
$Z = A \tan \gamma$	-0.017	$Z \leq 0.125"$	OK
$W = A \tan \theta$	0.020	$W \leq 0.031"$	OK
Dt	0.311	0.188" to 0.375"	OK
A/2Dt	1.415	$1.05 \leq A/2Dt \leq 1.5$	OK
A	0.88	$2.1Dt \leq A \leq 3Dt$	OK

Certify that pitot tube/porbe meets or exceeds all specifications, criteria and/or applicable design features and is hereby assigned a pitot tube certification fact of 0.84 . See 40 CFR Pt. 60, App. A,EPA Method 2.

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

Approved by : Nattapong Jengwareewong
(Mr. Nattapong Jengwareewong)
RYG Field Services Specialist (1)

FORM NO.: F 06-124 REVISION NO.: 0 ISSUE DATE: 25/12/23

Sartorius (Thailand) Co., Ltd.
121 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2643 8381-6, e-mail: service.thailand@sartorius.com



MSC-101-TS 17023
CALIBRATION 0436

SARTORIUS

Certificate of Calibration

REVIEW BY: Thawit
APPROVED BY: Dr. Jitranont
NEXT CAL DATE: 01/02/2025

Model Number: MSU224S-100-DU Certificate No.: 24BCI0073
Description: Analytical Balance Issued Date: Friday, February 23, 2024
Serial Number: 0031709552 Reference No.: 229196
ID No.: RYG_EN0003
Manufacturer: Sartorius Page No.: 1 of 2

Customer Name: ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)
516/10 Moo 5 T.Maenam Khu, A.Pluak Daeng, Rayong 21140, Thailand.

Calibrated Place: ALS Laboratory Group (Thailand) Co., Ltd. (Balance Room)
516/10 Moo 5 T.Maenam Khu, A.Pluak Daeng, Rayong 21140, Thailand.

Calibrated By: Mr.Chonchai Inthana
Calibration Date: Thursday, February 22, 2024
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
Reasons for calibration: ☐ New Installation ☐ Service / Replend ☒ Re-calibration/ Maintenance
Ambients Conditions: Temperature: 23.7 °C ± 5.0 °C
Humidity: 62.0 % RH ± 10.0 % RH
Pressure: ±
Equipment Condition: ☒ Good Operate ☐ Fail

Measurement Method UKAS Publication Ref :Lab 14

The measurement uncertainty stated is this 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	TCS	M2308197S	23-Aug-2025
MHB-382SD	Humidity/Barenmeter Temp Lutron MHB-382SD	DKSH	C1923184S	23-Aug-2024

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.

SOP FM 33 03 February 2022

Mr.Chonchai Inthana(Technical Manager)



Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2643 8381-6 Fax: +66 2643-83817, e-mail: service.thailand@sartorius.com

SARTORIUS

Certificate of Calibration

Model Number: MSU224S-100-DU Certificate No.: 24BCI0073
Description: Analytical Balance Issued Date: Friday, February 23, 2024
Serial Number: 0031709552 Reference No.: 229196
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 results under constant test conditions within 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 repeatability quantitatively.	The off-center loading error is yielded by the difference between the resultant of the load, i.e. 1/3 or 1/6 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) 20 g Tolerance 0.0001 g	Nominal Value : 100 g Tolerance 0.0004 g
Nominal Value : (High Load) 200 g Tolerance 0.0001 g	
Standard Deviation 0.00005 0.00003	Difference 1 - 2 0.0000 3 -0.0001 4 0.0000 5 0.0001 6 -

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	0.00013
0.1	0.1000	0.1000	0.0000	0.00013
0.5	0.5000	0.5000	0.0000	0.00013
1	1.0000	1.0000	0.0000	0.00013
5	5.0000	5.0000	0.0000	0.00013
10	10.0000	10.0000	0.0000	0.00013
20	20.0000	20.0000	0.0000	0.00013
50	50.0000	50.0000	0.0000	0.00024
100	100.0000	99.9999	-0.0001	0.00018
200	200.0000	199.9999	-0.0001	0.00029

End of Report

SOP FM 33 03 February 2022

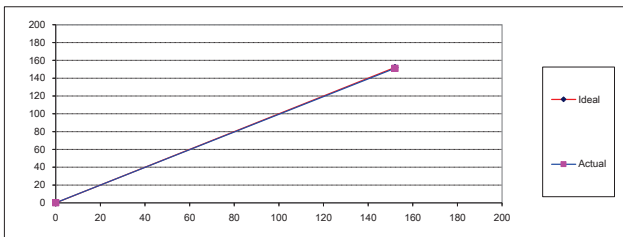


CALIBRATION REPORT

Calibration Date 1-Jul-24 Equipment ID BKK_FS0758
Equipment Name FID Analyzer Manufacturer Baseline Mocon
Model 9000H Serial No. 0315EF0047
Std.Gas Conc.(ppm) 152 Cylinder No. D878173
Certified Date 27-Jun-18 Expired Date 27-Jun-26

CALIBRATION RESULTS

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
SPAN	152.00	151.10	-0.90	-0.59
AVERAGE (%)				-0.25



Calibrated By

Approved By

Mr. Apleit Sing-ha
(Mr. Apleit Sing-ha)
Field Environmental Scientist (4)

Mr. Sarayuth Jitranont
(Mr. Sarayuth Jitranont)
Assistant General Manager

ALS Laboratory Group



ROTA METER CALIBRATION RESULT JULY 2024

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R ²)
BKK_FS0577	01 Jul 24	Y = 1.0001x - 0.0433	1.0000
BKK_FS0584	01 Jul 24	Y = 1.0056x - 2.7974	1.0000
BKK_FS0585	02 Jul 24	Y = 1.0315x + 3.0033	0.9998
BKK_FS0587	02 Jul 24	Y = 1.0294x + 0.71	1.0000
BKK_FS0588	01 Jul 24	Y = 0.9751x + 9.8452	0.9999
BKK_FS0591	01 Jul 24	Y = 1.0035x - 8.2303	1.0000
BKK_FS0592	02 Jul 24	Y = 1.002x + 14.273	1.0000
BKK_FS0594	02 Jul 24	Y = 1.0003x + 7.0095	1.0000
BKK_FS0595	01 Jul 24	Y = 1.0871x - 114.97	0.9985
BKK_FS1004	02 Jul 24	Y = 0.9826x + 13.51	0.9999
BKK_FS1005	02 Jul 24	Y = 1.0217x - 0.5833	0.9997
BKK_FS1006	02 Jul 24	Y = 1.149x - 1.0422	0.9981
BKK_FS1007	02 Jul 24	Y = 1.1116x + 3.3558	0.9994
BKK_FS1008	02 Jul 24	Y = 1.1273x + 0.4837	0.9999
BKK_FS1009	01 Jul 24	Y = 1.1044x - 0.8245	1.0000
BKK_FS1017	02 Jul 24	Y = 1.0488x + 2.2027	0.9998
BKK_FS1018	02 Jul 24	Y = 1.0173x - 0.1967	0.9999
BKK_FS1019	02 Jul 24	Y = 1.0022x + 5.619	1.0000
BKK_FS1026	01 Jul 24	Y = 1.072x - 2.4954	1.0000
BKK_FS1027	01 Jul 24	Y = 1.0104x - 4.4788	0.9999
BKK_FS1028	01 Jul 24	Y = 1.0009x - 3.7755	1.0000
BKK_FS1029	01 Jul 24	Y = 1.1118x - 4.4431	0.9965
BKK_FS1030	01 Jul 24	Y = 1.0159x - 6.395	1.0000
BKK_FS1031	01 Jul 24	Y = 0.9973x - 5.3371	0.9999
BKK_FS1039	02 Jul 24	Y = 0.9992x + 9.6833	0.9992
BKK_FS1040	01 Jul 24	Y = 1.0034x - 2.5343	1.0000
BKK_FS1041	02 Jul 24	Y = 1.0511x + 1.1272	0.9996
BKK_FS1042	02 Jul 24	Y = 1.0016x + 10.387	0.9995
BKK_FS1043	01 Jul 24	Y = 0.9965x + 9.3743	1.0000
BKK_FS1044	02 Jul 24	Y = 1.1237x - 0.4231	0.9981
BKK_FS1200	01 Jul 24	Y = 1.0337x - 0.1016	0.9994
BKK_FS1201	01 Jul 24	Y = 0.9871x + 5.0931	0.9986
BKK_FS1202	01 Jul 24	Y = 0.7978x + 301.39	0.9334
PHK_FS0027	02 Jul 24	Y = 1.0722x + 3.4395	0.9988
PHK_FS0028	02 Jul 24	Y = 1.0254x + 1.04	1.0000
PHK_FS0029	02 Jul 24	Y = 0.999x + 12.73	1.0000
RYG_FS0197	01 Jul 24	Y = 1.0045x + 10.291	1.0000
RYG_FS0198	01 Jul 24	Y = 1.0056x + 1.8883	1.0000
RYG_FS0199	02 Jul 24	Y = 1.0029x + 3.2381	0.9990

Page 1 of 2

ALS Laboratory Group



ROTA METER CALIBRATION RESULT JULY 2024

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R ²)
RYG_FS0654	02 Jul 24	Y = 1.0421x + 1.4935	1.0000
RYG_FS0655	02 Jul 24	Y = 0.975x + 15.2	0.9994
RYG_FS0656	01 Jul 24	Y = 1.0042x + 7.1067	0.9999
RYG_FS0657	02 Jul 24	Y = 1.0337x + 1.8918	0.9998
RYG_FS0658	02 Jul 24	Y = 0.9921x + 10.87	0.9996
RYG_FS0659	01 Jul 24	Y = 1.0022x + 8.4152	1.0000
SGK_FS0135	02 Jul 24	Y = 1.0193x + 3.6833	0.9999
SGK_FS0136	02 Jul 24	Y = 1.0217x + 1.63	1.0000
SGK_FS0138	02 Jul 24	Y = 1.055x + 4.5833	0.9999
SGK_FS0139	02 Jul 24	Y = 1.0154x + 3.74	0.9998
SGK_FS0140	02 Jul 24	Y = 1.0008x + 13.353	1.0000
SGK_FS0141	02 Jul 24	Y = 1.1185x + 1.4867	0.9998
SGK_FS0142	02 Jul 24	Y = 1.0211x + 1.39	1.0000
SGK_FS0143	02 Jul 24	Y = 1.0045x + 5.6981	1.0000

Review By :

(Mr. Wichan Choonharat)

Enviro Field Services Manager

Approved By :

(Mr. Sarayuth Jitranont)

Assistant General Manager

Page 2 of 2

ALS Laboratory Group

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2043 8301-6 Fax: +66 2043 8307, e-mail: service.thailand@sartorius.com



MAC
NSC 105-115 17025
CALIBRATION 0426

SARTORIUS

Certificate of Calibration

REVIEW BY: Thumthit
APPROVED BY: [Signature]
NEXT CAL DATE: 08/10/2025

Model Number: MSE125P-100-DU Certificate No.: 24BC10071
Description: Semi-micro Balance Issued Date: Friday, February 23, 2024
Serial Number: 0033108993 Reference No.: 229196
ID No.: RYG_EN0004
Manufacturer: Sartorius Page No.: 1 of 3

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 Date: Thursday, February 22, 2024

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

Metrological data:
Capacity: 60 /120 g Readability: 0.00001/0.0001 g
Ambient Conditions:
Temperature: 24.0 °C ± 5.0 °C
Humidity: 60.0 % RH ± 10.0 % RH
Pressure: ±

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

Measurement Method UKAS Publication Ref: Lab 14
The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM). The calibration certificate documents the traceability to National Standards, which realize 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	YCS	M2308197S	23-Aug-2025
MHB-362SD	Humidity/Baro-meter/Temp. Lutron MHB-362SD	DKSH	C19231845	23-Aug-2024

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)



Sartorius (Thailand) Co., Ltd.

129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2043 8301-6 Fax: +66 2043 8307, e-mail: service.thailand@sartorius.com

SARTORIUS

Certificate of Calibration

Model Number: MSE125P-100-DU Certificate No.: 24BC10071
Description: Semi-micro Balance Issued Date: Friday, February 23, 2024
Serial Number: 0033108993 Reference No.: 229196
ID No.: RYG_EN0004
Manufacturer: Sartorius Page No.: 2 of 3

Calibration Results : Without Adjustment

Repeatability	Eccentricity (Off-center loading error)
The repeatability is the ability of a weighing instrument to display nearly identical results 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, i.e. 1/3 or 1/4 of maximum capacity, placed in the middle of the weighing pan and between each of four additional measurement points (positions defined according to GUM, R76).
Nominal Value : (Low Load) 5 g Tolerance 0.000015 g	Nominal value : 50 g Tolerance 0.00015 g
Nominal Value : (High Load) 50 g Tolerance 0.000015 g	
Standard Deviation 0.000008 0.000005	

Linearity

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

Tolerance 0.00004 g				
Nominal Value (g)	Conventional Mass Value (g)	Displayed Value (g)	Deviation (g)	Uncertainty (g)
0.01	0.01000	0.01000	0.00000	0.000024
0.1	0.10000	0.10000	0.00000	0.000025
1	1.00000	1.00000	0.00000	0.000027
2	2.00002	2.00002	0.00000	0.000025
5	5.00002	5.00003	0.00001	0.000031
10	10.00002	10.00004	0.00002	0.000036
20	20.00002	20.00002	0.00000	0.000049
30	30.00004	30.00003	-0.00001	0.000089
40	40.00005	40.00003	-0.00002	0.000099
50	50.00002	50.00001	-0.00001	0.000089

SOP FM 33 03 February 2022



CALGAZ,
A DIVISION OF AIRGAS USA LLC
821 Chesapeake Drive,
Cambridge, MD 21613
USA Tel. 1-800-638-1197
www.calgaz.com

CERTIFICATE OF ANALYSIS

Date: 06/08/2022
Order Number: 1110821892
Lot Number: 302-402431506

Customer: EXECUTIVE TRADING LIMITED
Part Number: 600-0002-000
Use Before: JUN 6, 2027

Component	Concentration ($\pm 2\%$)
ISOBUTYLENE AIR	100PPM Balance

Cylinder Size: 1.2 Cu. Ft.
Contents: 34 Liter

Valve: CGA600
Pressure: 494 PSIG

Product composition verified by direct comparison to calibration standards traceable to N.I.S.T. weights and/or N.I.S.T. Gas Mixture reference materials.

Analyst:

Chris Donnelly
Chris Donnelly

Honeywell

Honeywell Analytics - Singapore Office
(1 Changi Business Park Central)
Singapore 486073
Cert Ref: 00098

CERTIFICATE of Attendance

It is hereby certified that

Mr Surinthorn Sainate
(Executive Trading Limited)

has successfully completed the

RAE Service Training Course

Conducted by

HONEYWELL

on 2nd August 2022

Desmond Tan
Conducted by: Desmond Tan
Service Engineer / Technical Trainer
Date of Issue: 2nd August 2022
Certificate valid for 2 years from date of issue

SITHIPORN ASSOCIATES CO., LTD. CALIBRATION LABORATORY

45/45/1 Sirinthorn Road, Bangbunrua, Bangkok, 10700 Thailand
Tel: +66 2433 8331 Email: calibration@sithiporn.com

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Cert. No.: ACC24008
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: (23.0 \pm 3) °C
Ambient Temperature: (101.3 \pm 3) kPa
Pressure: (50.0 \pm 20) %
Relative Humidity:

Received Date: 19 JANUARY 2024
Calibration Date: 26 JANUARY 2024
Date of Issue: 29 JANUARY 2024

Calibrated by: Nathakorn Pisutpaisan

Approved by:

Thanakul Petchum
(Thanakul Petchum)

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Cert. No.: ACC24008
Job No.: VC67AC0058
Pages: 2 of 3

Calibration Procedure: CP-AC-03

Calibration Method:

This equipment was calibrated by follow 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-0010-23	07-FEB-24
Digital Multimeter	33461A	MY53220104	EEL-BP 30/0266	13-FEB-24
Digital Multimeter	33461A	MY53220076	EEL-BP 30/0267	13-FEB-24
Digital Multimeter	33461A	MY60024273	EEL-BP 31/0266	14-FEB-24
Programmable Attenuator	MAT-1070	62100114	EF-0011-23	08-FEB-24
Condenser Microphone	4180	2977900	AA-1001-23	14-FEB-24
Measuring Amplifier	NA-42KAJ	34560495	AA-3002-23	14-FEB-24
Audio Analyzer	AVR-3360A	V744B6069	EF-0012-23	10-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).

Thanakul Petchum

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451-451/1 Sirinthorn Road, Bangbunrua, Bangplud, Bangkok, 10700 Thailand
Tel. +66 2433 8331 Email : calibration@sithiporn.com



Cert. No. : ACC24008
Job No. : VC67AC0058
Pages : 3 of 3

Result of calibration :

1. Sound pressure level

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

2. Frequency

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

3. Total distortion

Measured value (%)	Uncertainty (%)	Acceptance limit (%)
0.83	0.10	3.0

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

End of Calibration Certificate

T. Petchur

SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY

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Tel. +66 2433 8331 Email : calibration@sithiporn.com



Cert. No. : ACL24283
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No.: 00472127 / 169440 / 72461
ID No.: RYG_FS0302

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 \pm 3) °C
Pressure : (101.3 \pm 3) kPa
Relative Humidity : (50.0 \pm 20) %

Received Date : 04 SEPTEMBER 2024
Calibration Date : 19 SEPTEMBER 2024
Date of Issue : 20 SEPTEMBER 2024

REVIEW BY *Nathakorn P.*
APPROVED BY *T. Petchur*
NEXT CAL DATE 19/9/25

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchur
(Thanukul Petchurai)

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Cert. No. : ACL24283
Job No. : VC67AC0148
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

This equipment was calibrated by follow on IEC-61672-3 (2013) Standard for sound level meter (SLM).
The SLM had tests to Acoustical and Electrical signal tests of frequency weightings 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-0009-24	05-FEB-25
Waveform Generator	33511B	MY52302742	EF-0007-24	05-FEB-25
Digital Multimeter	33461A	MY53220104	EEL-BP 21/0267	13-FEB-25
Digital Multimeter	33461A	MY53220076	EEL-BP 20/0267	15-FEB-25
Digital Multimeter	34461A	MY60024273	EEL-BP 22/0267	15-FEB-25
Programmable Attenuator	MAT-1070	62100114	EF-0008-24	05-FEB-25
Condenser Microphone	4180	2977900	AA-1001-24	12-FEB-25
Measuring Amplifier	NA-42KAI	34560495	AA-3001-24	05-FEB-25

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).

T. Petchur

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Tel. +66 2433 8331 Email : calibration@sithiporn.com



Cert. No. : ACL24283
Job No. : VC67AC0148
Pages : 3 of 8

Summary of Measurement Result :

Parameter	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	0.3	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

T. Petchur

Cert. No. : ACL24283
Job No. : VC67AC0148
Page : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.94)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
17.5

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

Frequency Weighting	Weighting (dB)
A - weight	12.0
C - weight	18.2
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	0.1	0.2	0.2	± 1.5
1000	-0.2	-0.2	-0.2	± 1.0
8000	-1.2	-1.1	-1.1	±5.0

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Cert. No. : ACL24283
Job No. : VC67AC0148
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

Frequency Weighting	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	94.1	0.1	± 0.3

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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	24.9	-0.1	± 1.1

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Cert. No. : ACL24283
Job No. : VC67AC0148
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)
130	94.0	94.0	0.0	±1.1

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
130	30.0	30.0	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	127.5	-0.1	±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

T. Petch.

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Cert. No. : ACL24283
Job No. : VC67AC0148
Pages : 8 of 8

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	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	±2.0
Positive half cycle	135.4	135.1	-0.3	±2.0
Negative half cycle	135.4	135.1	-0.3	±2.0

11. Overload indication

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

T. Petchur

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Cert. No. : ACL24260
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No.: 00472130 / 169816 / 72464
ID No.: RYG_FS0303

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 : 09 AUGUST 2024
Calibration Date : 23 AUGUST 2024
Date of Issue : 26 AUGUST 2024

REVIEW BY	<i>Nathakorn P</i>
APPROVED BY	<i>T. Petchur</i>
NEXT CAL. DATE	25/8/25

Calibrated by : Nathakorn Pisutpaian

Approved by :

T. Petchur
(Thanakul Petchurai)

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Cert. No. : ACL24260
Job No. : VC67AC0140
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

This equipment was calibrated by follow 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-0009-24	05-FEB-25
Waveform Generator	33511B	MY52302742	EF-0007-24	05-FEB-25
Digital Multimeter	33461A	MY53220104	EEL_BP 21/0267	13-FEB-25
Digital Multimeter	33461A	MY53220076	EEL_BP 20/0267	15-FEB-25
Digital Multimeter	34461A	MY60024273	EEL_BP 22/0267	15-FEB-25
Programmable Attenuator	MAT-1070	62100114	EF-0008-24	05-FEB-25
Condenser Microphone	4180	2977900	AA-1001-24	12-FEB-25
Measuring Amplifier	NA-42KA1	34560495	AA-3001-24	05-FEB-25

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).

T. Petchur

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Cert. No. : ACL24260
Job No. : VC67AC0140
Pages : 3 of 8

Summary of Measurement Result :

Parameter	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	0.3	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

T. Petchur

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Cert. No. : ACL24260
Job No. : VC67AC0140
Page : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.94)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.5000003

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

Frequency Weighting	Weighting (dB)
A - weight	7.8
C - weight	14.8
Flat	20.5

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	1.3	1.4	1.4	± 1.5
1000	0.1	0.1	0.1	± 1.0
8000	-4.1	-4.0	-4.0	±5.0

T. Petch.

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Cert. No. : ACL24260
Job No. : VC67AC0140
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

T. Petch.

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CALIBRATION LABORATORY

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Cert. No. : ACL24260
Job No. : VC67AC0140
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	135.9	-0.1	± 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	28.1	0.1	± 1.1
27.0	27.1	0.1	± 1.1
26.0	26.1	0.1	± 1.1
25.0	25.0	0.0	± 1.1

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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)
130	94.0	94.0	0.0	±1.1

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
130	29.0	29.1	0.1	±1.1

9. Tone burst response

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

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Cert. No. : ACL24260
Job No. : VC67AC0140
Pages : 8 of 8

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	130.0	130.0	0.0	±3.0
One	133.4	133.4	0.0	±3.0

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	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

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

T. Petch



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0292

MTC No. EEL. BP. 83/0267

CALIBRATION CERTIFICATE

Submitted by : ALS Laboratory Group (Thailand) Co., Ltd.
Address : 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan, Khet Suan Luang, Bangkok, 10250.
Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre,
Sri 1C, Bangpoo Industrial Estate, Sukhumvit Rd., Muang, Samutprakan 10280,
Instrument Calibrated : **Ambient Environment**
Description : Sound Calibrator **Temperature** : (23 ± 3) °C
Manufacturer : Rion **Relative Humidity** : (50 ± 15) %
Model : NC-74 **Ambient Pressure** : (101.325 ± 1.500) kPa
Serial No. : 34178121 (ID:RYG_FS0213)
Standards used : 1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037.
2. Measuring Amplifier Bruel&Kjaer 2636 S/N 1537484.
3. Programmable Attenuator Tanagawa TPA-303A S/N OF 2214.
4. Digital Multimeter Agilent 34401A S/N MY44005560.
5. Pressure Transmitter Vaisala PTB202AD S/N T0650001.
6. Audio Analyzer Keithley 2015-P S/N4106495.
7. Condenser Microphone B&K 4180 S/N 2889871.

Calibration Procedure: CP-102-04 based on IEC 60942-2003; The sound pressure level generated by sound calibrator under test shall be measured by standard microphone using an insert voltage technique.

This instrument has been calibrated against standards maintained at Electrical and Electronic Standards Laboratory (EEL), which are traceable to the International System of Units through the National Institute of Metrology (Thailand).

The information on actual reading is attached herewith and the uncertainty limits quoted refer to the measured values only.

Date of Receipt : 19 Feb. 2024

Date of Calibration : 28 Feb. 2024

1/2

The results relate only to the items tested/calibrated or value assigned.
Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

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Tel. (66) 0 2325 1672-80 ext. 115, 116
(66) 08 3219 9440
E-mail : mtc@tistr.or.th Website : www.tistr.or.th

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0292

MTC No. EEL. BP. 83/0267

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

Nominal Output of Unit Under Test = 94 dB re 20µPa at 1000 Hz

Acoustic Output in dB re 20µPa, Corrected to Reference Conditions: 101.325 kPa, 23.0 °C and 50 %RH.

1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	94.01	0.01	± 0.10	±0.40 dB

2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	1003.1	3.1	± 1.5	±1.0%

3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	1.80	± 0.50	±3.0%

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was included at level of 0.16 dB from manual.

Calibrated by : *Mr. Weerachai Deechaiyao*
(Mr. Weerachai Deechaiyao)

Approved by : *Mr. Pravit Kiatyap*
(Mr. Pravit Kiatyap)
Director
Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration : 28 Feb. 2024

Date of Issue : 29 Feb. 2024

Ref : 2011267021900719001

End of Certificate

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FABL/MTC.002 Rev.4

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Cert. No. : ACL24266
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No. : 00734218 / 146937 / 34368
ID No. : RYG_FS0031

Condition As Found : GOOD

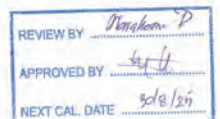
Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHWANG PHATTHANAKAN, KHET SUAN LUANG,
BANGKOK, 10250 THAILAND.

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

Received Date : 09 AUGUST 2024
Calibration Date : 30 AUGUST 2024
Date of Issue : 03 SEPTEMBER 2024

Calibrated by : Nathakorn 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.

SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY

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Cert. No. : ACL24266
Job No. : VC67AC0140
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

This equipment was calibrated by follow 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-0009-24	05-FEB-25
Waveform Generator	33511B	MY52302742	EF-0007-24	05-FEB-25
Digital Multimeter	33461A	MY53220104	EEL_BP 21/0267	13-FEB-25
Digital Multimeter	33461A	MY53220076	EEL_BP 20/0267	15-FEB-25
Digital Multimeter	34461A	MY60024273	EEL_BP 22/0267	15-FEB-25
Programmable Attenuator	MAT-1070	62100114	EF-0008-24	05-FEB-25
Condenser Microphone	4180	2977900	AA-1001-24	12-FEB-25
Measuring Amplifier	NA-42KAJ	34560495	AA-3001-24	05-FEB-25

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).

T. Petch

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Cert. No. : ACL24266
Job No. : VC67AC0140
Pages : 3 of 8

Summary of Measurement Result :

Parameter	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	0.3	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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Cert. No. : ACL24266
Job No. : VC67AC0140
Page : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.94)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
19.5

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

Frequency Weighting	Weighting (dB)
A - weight	11.6
C - weight	17.6
Flat	23.3

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Flat	C-weight	A-weight	Acceptance Limits
125	0.5	0.6	0.6	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-1.1	-1.1	-1.1	±5.0

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Cert. No. : ACL24266
Job No. : VC67AC0140
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	-0.1	-0.1	-0.1	±2.0
125	0.0	0.0	-0.1	±1.5
250	0.0	0.0	0.0	±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

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Cert. No. : ACL24266
Job No. : VC67AC0140
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	79.0	0.0	±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	29.1	0.1	±1.1
28.0	28.0	0.0	±1.1
27.0	27.0	0.0	±1.1
26.0	26.1	0.1	±1.1
25.0	25.1	0.1	±1.1

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Cert. No. : ACL24266
Job No. : VC67AC0140
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)
130	94.0	94.0	0.0	±1.1

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
130	30.0	29.8	-0.2	±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

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Cert. No. : ACL24266
Job No. : VC67AC0140
Pages : 8 of 8

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	136.4	0.0	±3.0

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	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

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

T. Petchur

Cert. No. : ACL24027
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No. : 00472126 / 158778 / 88180
ID No. : RYG_FS0301

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 : 19 DECEMBER 2023
Calibration Date : 12 JANUARY 2024
Date of Issue : 16 JANUARY 2024

Calibrated by : Nathakorn Pisutpaisan

Approved by : T. Petchur
(Thanakul Petchur)

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Cert. No. : ACL24027
Job No. : VC67AC0044
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

This equipment was calibrated by follow 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-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).

G. Retan

SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY

451-451/1 Sirinthorn Road, Bangbunnu, Bangplud, Bangkok, 10700 Thailand
Tel. +66 2433 8331 Email: calibration@sithiporn.com



Cert. No. : ACL24027
Job No. : VC67AC0044
Pages : 3 of 8

Summary of Measurement Result :

Parameter	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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CALIBRATION LABORATORY

451-451/1 Sirinthorn Road, Bangbunnu, Bangplud, Bangkok, 10700 Thailand
Tel. +66 2433 8331 Email: calibration@sithiporn.com



Cert. No. : ACL24027
Job No. : VC67AC0044
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)
18.8

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	18.4
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	0.7	0.8	0.9	± 1.5
1000	-0.2	-0.2	-0.2	± 1.0
8000	-2.5	-2.5	-2.5	± 5.0

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CALIBRATION LABORATORY

451-451/1 Sirinthorn Road, Bangbunnu, Bangplud, Bangkok, 10700 Thailand
Tel. +66 2433 8331 Email: calibration@sithiporn.com



Cert. No. : ACL24027
Job No. : VC67AC0044
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	-0.1	±2.0
125	0.0	0.0	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.0	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.1	0.1	±5.0

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

G. Retan

Cert. No. : ACL24027
Job No. : VC67AC0044
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	29.1	0.1	±1.1
28.0	28.1	0.1	±1.1
27.0	27.1	0.1	±1.1
26.0	26.1	0.1	±1.1
25.0	25.1	0.1	±1.1

G. Peter.

Cert. No. : ACL24027
Job No. : VC67AC0044
Pages : 7 of 8

8. Level linearity including the level range control

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

9. Tone burst response

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

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, L_{peak} (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	± 3.0
One	136.4	135.3	-1.1	± 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	±2.0
Positive half cycle	135.4	135.2	-0.2	±2.0
Negative half cycle	135.4	135.2	-0.2	±2.0

7. Set

Cert. No. : ACL24027
Job No. : VC67AC0044
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	89.6	-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



Cert.No.: 24CH96
Page.: 1 of 3

Certificate of Calibration

Equipment :	pH Meter
Manufacturer :	Mettler Toledo
Model :	SevenCompact S220
Serial No. :	C104059460
ID No. :	RYG_EN0163
Condition As-Received:	Used Item
Received Date :	18 January 2024
Calibration Date :	19 January 2024
Reference :	2401-0579DSC-2
Submitted by :	ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch) 616/10 Moo 5, T.Mae Nam Khu, A.Puakdaeng, Rayong 21140, Thailand

Ambient Temperature :	(25 ± 2.5) °C
Relative Humidity :	(50 ± 15) %
Calibration Procedure :	In - house method
	- CP-CH5 by direct measurement with standard voltage calibrator and direct measurement with certified reference material (CRM)
	- CP-CH8 by comparison with temperature standard

Calibrated by : Warakorn Lemgagrakul

Approved by : Sailly
Approved Signatory

(✓) Salthip Meangmai
() Warakorn Lemgatrakul
() Ponpan Paipim

Issue Date : 24 January 2024

The Uncertainties are for a confidence probability of approximately 95%.

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A 0062854



Cert.No.: 24CH96
Page: 2 of 3

Condition of this calibration result

1. Reference Standard Instrument

Instrument	Serial No.	ID No.	Cert. No.	Due Date
1) Document Process Calibrator	54030049	130RC116	23E2802	27 Aug 2024
2) Ref. Standard Thermometer	4982054	110RC044	23I908	26 July 2024

This certification is traceable to the International System of Unit maintained through:-
- Technology Promotion Association (Thailand-Japan)

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	940102	27 Nov 2025
pH 6.986	CPA chem	940104	02 Nov 2024
pH 9.997	CPA chem	940106	02 Nov 2024

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

Calibration Results

Function : mV Measurement

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

Unit Under Calibration	Nominal Value	Standard Voltage Input		Actual Reading		Uncertainty of Measurement (\pm mV)	Coverage factor k
	pH	mV	mV	mV	pH		
pH Meter S/N.: C104059460	4.000	177.48	177.4	4.000	0.058	2.00	
	7.000	0.00	0.0	7.000	0.058	2.00	
	10.000	-177.48	-177.5	10.000	0.058	2.00	

Santhip

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Cert.No.: 24CH96
Page: 3 of 3

Calibration Results

Function : pH Measurement

Performing three buffers standard curve by using buffer nominal pH (4.01,7.00,10.01)

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.: 3225367	4.008	4.013	176.0	0.0054	2.07
	6.986	6.983	2.2	0.0084	2.00
	9.997	9.995	-174.1	0.0065	2.00

Function : Temperature Measurement

(*) Without adjustment

This equipment was connected with Temperature Probe:

- Model : InLabSExpert Pro-ISM

- Serial No. : 3225367

- Dimension of probe

- Length : 120 mm

- Diameter : 12 mm

- Immersion Depth : 100 mm

Calibration Point ($^{\circ}$ C)	Standard Temperature ($^{\circ}$ C)	UUC* Reading ($^{\circ}$ C)	Error ($^{\circ}$ C)	Uncertainty of measurement (\pm $^{\circ}$ C)	Coverage factor k
25.0	25.001	25.2	0.199	0.13	2.00

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

-000-

Santhip

1198288



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES
2144 PATTANAKARN ROAD SOI 11, SUANLUANG, SUANLUANG, BANGKOK 10250
TEL: 0-2715-3000-24 FAX: 0-2719-9481



Certificate of Calibration

Certificate No.: 24E289
Page: 1 of 2

Equipment:	pH Meter	This certificate may not be reproduced other than in full, except with the prior written approval of the head of Corporate Services & Equipment Calibration and Testing Services.
Manufacturer:	Mettler Toledo	
Model:	SevenCompact S220	
Serial No.:	C104059460	
ID No.:	RYG_EN0183	
Condition As-Received:	Used Item	
Received Date:	18 January 2024	
Calibration Date:	23 January 2024	
Reference:	2401-0575DSC	Submitted by: ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)
Ambient Temperature:	(23 ± 2) $^{\circ}$ C	616/10 Moo 5, T.Mamun Khui, A.Phuakding, Rayong 21140, Thailand
Relative Humidity:	(50 ± 10) %	

Procedure used: Calibration were conducted using calibration procedure No. CP-E17 According to EURAMET cg-15.

Condition of this result of calibration

1. Reference standards instruments:

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Multi-Product Calibrator	5500A	6315011	1209300035	29 May 2024

2. This result of calibration was made on request 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 through:-

-NA Technologies Co., Ltd., ANAB Accredited No. Calibration AC-2638

Calibrated by: Wudhawanon Wongchabannin
Issue Date: 24 January 2024
Approved Signatory:
1. Pongwatt Boonyatoom
2. Nuntawat Khumchai
3. Pongwatt Boonyatoom

0333296



Cert. No.: 24E289
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	68
-150.0000	-150.0	0.0	65
-100.0000	-100.0	0.0	63
-50.0000	-50.0	0.0	61
0.0000	0.0	0.0	58
50.0000	50.0	0.0	61
100.0000	99.9	-0.1	63
150.0000	149.9	-0.1	65
200.0000	199.9	-0.1	68

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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Santhip

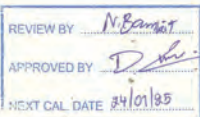
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Cert.No.: 23TW168
Page.: 1 of 2

Certificate of Testing

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



B 0320211



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	1126143764	140RC004	22MM50	20 Sep 2023

2. Standard Material :-

Material	Manufacturer	Lot.No.	Assay
Sodium Thiosulfate pentahydrate	Merck	AM1763316	100.2%

Result : Dissolved Oxygen Meter Adjustment With Air 100 %

Dissolved Oxygen Probe No.: 15E100464

Titration Method (Azide Modification Method)	DO Meter Reading	Standard Deviation
(mg/L)	(mg/L)	(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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a 1172155



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

Certificate of Calibration

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

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

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

Condition of this result of calibration

1. Reference standard instrument:-
Instrument Serial No. Cert. No. Traceable Due Date
1) Digital Thermometer 2188080 221285 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	Immersion Depth	Standard Temperature	UUC* Reading	Error	Uncertainty	Coverage Factor
(°C)	(mm)	(°C)	(°C)	(°C)	(± °C)	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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a 1159515



Cert. No.: 23TM962
Page : 1 of 3

Certificate of Calibration

Equipment : Low Temp. Incubator
Manufacturer : Memmert
Model : IPP750
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. Pluakdaeng, Rayong 21140 Thailand
Location : BOD Room
Received Order : 29 May 2023
Calibration Date : 29 May 2023
Ambient Temperature : $(26 \pm 10) ^\circ\text{C}$
Relative Humidity : $(50 \pm 30) \%$
Calibrated by : Man Pattanapongpaiboon
Approved by :
() Ponthippa Tameyakul
() Malee Butkruea
(✓) Suwit Imjai

Issue Date : 7 June 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 0054967



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

Cert. No.: 23TM962
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).
The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

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

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

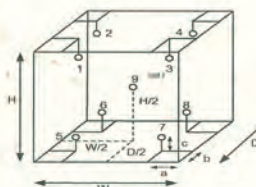
3. This certification is traceable to the International System of Unit.

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close

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



Probe installation Details :

	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

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

a 1165130



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

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

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

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

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

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

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

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

UUC* : Unit Under Calibration

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

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

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a 1165129



Certificate of Calibration

Cert. No.: 24TM1663
Page : 1 of 3

Equipment : Low Temp. Incubator
Manufacturer : Memmert
Model : IPP750
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. Pluakdaeng,
Rayong 21140, Thailand
Location : BOD Room

Received Order : 01 November 2024
Calibration Date : 01 November 2024
Ambient Temperature : $(26 \pm 10) ^\circ\text{C}$
Relative Humidity : $(50 \pm 30) \%$
AC Line Voltage : $(220 \pm 22) \text{ V}$

Calibrated by : Krinda Malee

Approved by :

() Ponpan Paipim
() Suwit Imjai
(✓) Kunchit Promprat

Issue Date : 07 November 2024

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the head of Corporate Services 3: Equipment Calibration and Testing Services.



Equipment : Low Temp. Incubator
Condition As-Received : Used Item
Reference : 2411-0002OC-1
Procedure Used :-

Cert. No.: 24TM1663
Page : 2 of 3

Calibration were conducted using calibration procedure CP-OT02 based on TLAS G-20 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

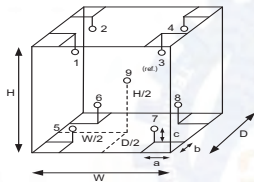
- Reference standard instrument:-
Instrument Serial No. Cert. No. Traceable Due Date
1) Data Acquisition MY44073381 24LM73 TPA 18 May 2025
- This certificate is valid only to the item calibrated on date and place of calibration.
- This certification is traceable to the International System of Unit.

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

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close



Environment during calibration		
	Beginning	Finished
Temp. (°C)	24	25
REL.Humid. (%)	55	53
AC Supply (Volt)	220	221

Position :	Ref. Std. ID No.:
1	1RTD-2/1
2	1RTD-2/2
3	22-01RTD-03
4	1RTD-2/4
5	1RTD-2/5
6	1RTD-2/6
7	23-01RTD-07
8	1RTD-2/8
9 (ref.)	23-01RTD-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 = 0.72 m ³



Equipment : Low Temp. Incubator
Condition As-Received : Used Item
Reference : 2411-0002OC-1
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

Cert. No.: 24TM1663
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	0.026	0.26	0.53	2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (± °C)
	1	2	3	4	5	6	7	8	9 (ref.)	
20.0	20.071	19.915	20.273	20.179	19.977	19.782	20.056	20.026	20.033	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.

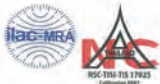
Overall Variation : The Difference of the maximum and minimum measured temperatures throughout observation.

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 %.

-000-



Certificate of Calibration

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

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

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

Calibration By: Mr.Nattapat Rungrueang
Calibration Date: 18 September 2023
The Method used: In house method, CAL-WI-24, base on ASTM E 275-08 and ASTM E 387-04
Traceability: This certificate is traceable to the CRM maintained by National Institute of Standards and Technology (NIST) through Stama Scientific Limited.

The standard for Wavelength Certificate No. 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. Nattapat Rungrueang)
Person in charge

(Mr. Nitinun 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).

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

DKSH Technology Limited
2533 Sukhumvit Road, Bangkok, Thailand 10260
Phone: +66 2636 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

Delivering Growth - in Asia and Beyond.

CAL-FM-C06-15: 12 Sep 2022



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
637.98	638.3	-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
	0.5073	0.509	-0.0017	0.0045
	1.0083	1.007	0.0013	0.0045
465 nm	0.0000	0.000	0.0000	0.0045
	0.2516	0.250	0.0016	0.0045
	0.4595	0.462	-0.0025	0.0045
	0.9334	0.933	0.0004	0.0045
546.1 nm	0.0000	0.000	0.0000	0.0045
	0.2461	0.245	0.0011	0.0045
	0.4652	0.468	-0.0008	0.0045
	0.9468	0.946	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

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Delivering Growth - in Asia and Beyond.

CAL-FM-C06-15: 12 Sep 2022

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
	0.2884	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 (%T)	Absorbance (A)	
260.62 +/- 0.11 nm	260.6	1.3	1.886	
391.44 +/- 0.11 nm	391.4	1.3	1.886	
Spectral Resolution *				
Nominal Concentration 0.02 % w/v	Peak	Trough	Ratio	SBW
Standard Wavelength (nm)	268.66	266.69	1.38	2.00
UUC: Wavelength (nm)	268.2	266.1		
Std Absorbance (A)	0.4566	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

บริษัท ดีเคเอส อีเซีย จำกัด
DKSH Technology Limited
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Delivering Growth - in Asia and Beyond.

CAL-FM-C08-15: 12 Sep 2022

ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: WO-00005382

ชนิดเครื่องมือ: SPECTROPHOTOMETER

รุ่น: DR6000

หมายเลขเครื่อง: 1627845

ตรวจสอบ (รับ)		รายการตรวจเช็ค	ตรวจสอบ (ส่ง)		หมายเหตุ
18 Sep 2023			18 Sep 2023		
ปกติ	ไม่ปกติ		ปกติ	ไม่ปกติ	
General					
<input checked="" type="checkbox"/>	<input type="checkbox"/>	1. ความสมบูรณ์เครื่อง	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	2. ความสะอาด (ช่องใส่ตัวอย่าง, ภายใน-นอกเครื่อง)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	3. สวิตช์ ปิด - เปิด เครื่อง (On-Off Switch)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	4. ปุ่มกด (Keypad)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	5. หน้าจอ (Display, Screen Contrast)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Spectrophotometer					
<input type="checkbox"/>	<input type="checkbox"/>	6. แรงดันไฟฟ้า (Battery Backup) >= 2.5 VDC	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	7. ควบคุมเลือกความยาวคลื่น (Wavelength Control)	<input type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	8. ความยาวคลื่น (Wavelength Check)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	9. แหล่งกำเนิดแสง (UV < 3,000 hour)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	9.2 Hours
<input checked="" type="checkbox"/>	<input type="checkbox"/>	10. แหล่งกำเนิดแสง (Visible < 5,000 hour)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	741.5 Hours
<input checked="" type="checkbox"/>	<input type="checkbox"/>	11. ช่องวัดหลายตัวอย่าง (Carousel Module)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
pH Meter and Conductivity Meter					
<input type="checkbox"/>	<input type="checkbox"/>	12. อิเล็กโทรด (Electrode and Connection Cable)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	13. ระดับสารละลายใน Electrode (Level KCl)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	14. ฝาปิดกันปลาย Electrode (Dust Protection Hood)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	15. ขาตั้งอิเล็กโทรด (Stand)	<input type="checkbox"/>	<input type="checkbox"/>	
Turbidimeter					
<input type="checkbox"/>	<input type="checkbox"/>	16. ค่าความขุ่นที่ต่ำสุด (No Sample)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	17. ระดับการส่องสว่างของแสง (>= 2.5 ไม่น้อย 3.0)	<input type="checkbox"/>	<input type="checkbox"/>	
Automatic titrator					
<input type="checkbox"/>	<input type="checkbox"/>	18. สภาว Piston Burettes	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	19. Function Rinsing and Dosing	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	20. ระบบท่อสายยางและอุปกรณ์ประกอบ	<input type="checkbox"/>	<input type="checkbox"/>	

เพิ่มตัวอย่างแนบมา: *656.1nm=656.1nm

*486.0nm=485.5nm

Mr.Nattapat Rungueang

Service Engineer

บริษัท ดีเคเอส อีเซีย จำกัด
DKSH Technology Limited
2533 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260
Phone: +66 2043 6361-6 Email: info.calibration@dksh.com Website: www.dksh.com/calibration

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CAL-FM-R31-03: 20 Jul 2022

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2642 6561-6, e-mail: service.thailand@sartorius.com



SARTORIUS

Certificate of Calibration

of Calibration

REVIEW BY: *[Signature]*
APPROVED BY: *[Signature]*
NEXT CAL DATE: 02/03/2025

Model Number: MSE224S-100-DU
Description: Analytical Balance
Serial Number: 0026207038
ID No.: RYG_EN0002
Manufacturer: Sartorius

Certificate No.: 248C0069
Issued Date: Friday, February 23, 2024
Reference No.: 229198
Page No.: 1 of 2

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

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

Calibrated By: Mr.Chonchai Inthana
Calibration Date: Thursday, February 22, 2024

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: 24.2 °C ± 5.0 °C
Humidity: 57.0 % 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 realize 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	TCS	M2308197S	23-Aug-2025
MHB-382SD	Humidity/Balometer/Temp. Control MHB-382SD	DKSH	C19231845	23-Aug-2024

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

Mr.Chonchai Inthana (Technical Manager)



SOP FM 33 03 February 2022

Sartorius (Thailand) Co., Ltd.

129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2642 6561-6 Fax: +66 2643-6367, e-mail: service.thailand@sartorius.com

SARTORIUS

Certificate of Calibration

Model Number: MSE224S-100-DU
Description: Analytical Balance
Serial Number: 0026207038
ID No.: RYG_EN0002
Manufacturer: Sartorius

Certificate No.: 248C0069
Issued Date: Friday, February 23, 2024
Reference No.: 229198
Page No.: 2 of 2

Calibration Results : Without Adjustment

Repeatability			Eccentricity (Off-center loading error)		
This repeatability is the ability of a weighing instrument to display nearly identical results under combined test conditions when the same load within a measurement range is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.			The off-center loading error is yielded by the difference between the result of the load, i.e. 1/2 or 1/4 of maximum capacity, placed in the middle of the weighing pan and between each of four additional measured points (positions defined according to OIML R113).		
Nominal Value : (Low Load)	20.0000	199.9999	Nominal value :	100	g
20 g	20.0000	200.0000	Tolerance	0.0004	g
Tolerance	0.0001 g	0.0001 g	Difference		
	20.0000	199.9999		1	-
	20.0001	200.0000		2	-0.0001
	19.9999	200.0000		3	-0.0001
	20.0000	199.9999		4	0.0000
	19.9999	200.0001		5	-0.0001
	19.9999	200.0000		6	-
Nominal Value : (High Load)	200 g	200.0000			
200 g	20.0000	200.0000			
Tolerance	0.0001 g	0.0001 g			
	20.0000	199.9999			
	19.9999	200.0001			
	19.9999	200.0000			
Standard Deviation	0.00007	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	0.00018
0.05	0.0500	0.0500	0.0000	0.00018
0.1	0.1000	0.1000	0.0000	0.00018
0.5	0.5000	0.5000	0.0000	0.00018
1	1.0000	1.0000	0.0000	0.00018
5	5.0000	5.0000	0.0000	0.00018
10	10.0000	10.0000	0.0000	0.00018
20	20.0000	20.0000	0.0000	0.00024
50	50.0000	49.9999	-0.0001	0.00019
100	100.0000	100.0000	0.0000	0.00023
200	200.0000	199.9999	-0.0001	0.00032

End of Report.

SOP FM 33 03 February 2022



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2403-0563OC-3
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) and Thermocouple Type T.

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) Data Acquisition MY57013711 23LM115 TPA 11 Jul 2024

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

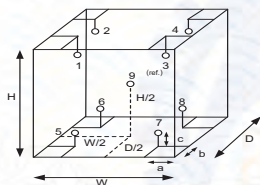
3. This certification is traceable to the International System of Unit.

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

Result of Calibration :- (*) Without Adjustment

Function 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)	27	27
REL.Humid. (%)	59	59
AC Supply (Volt)	224	223

Ref. Std. ID No.: @ Calibration Point		
Position :	(180) °C	(104) °C
1	18-18TC-01	18-18RTD-01
2	18-18TC-02	18-18RTD-02
3	18-18TC-03	18-18RTD-03
4	18-18TC-04	18-18RTD-04
5	18-18TC-05	18-18RTD-05
6	18-18TC-06	23-18RTD-06
7	18-18TC-07	18-18RTD-07
8	18-18TC-08	22-18RTD-08
9 (ref.)	18-18TC-09	18-18RTD-09



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2403-0563OC-3
Page : 3 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) and Thermocouple Type T.

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) Data Acquisition MY57013711 23LM115 TPA 11 Jul 2024

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 of UUC* : Temperature Source

Fresh air setting : Close

Calibration Point Setting Reading Temperature stability Temperature uniformity Overall Variation Coverage Factor

104.0 104.0 104.0 0.065 0.52 0.90 2

180.0 180.0 180.0 0.20 1.2 2.0 2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (± °C)
	1	2	3	4	5	6	7	8	9 (ref.)	
104.0	104.169	103.506	103.898	103.712	103.772	103.730	104.289	103.805	103.798	0.42
180.0	180.701	179.239	179.935	179.999	180.127	180.138	180.895	179.313	180.211	1.1

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 %.

-000-



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL.0-2717-3000-29 FAX.0-2719-9484



Certificate of Calibration

Cert. No.: 24TM635
Page : 1 of 3

Equipment : Water Bath

Manufacturer : Memmert

Model : WNB22

Serial No. : L513.0648

ID No. : RYG_EN0061

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

Location : Wet Chemistry Lab

Received Order : 21 March 2024

Calibration Date : 21 March 2024

Ambient Temperature : (26 ± 10) °C

Relative Humidity : (50 ± 30) %

Calibrated by : Man Pattanapongpaiboon

Approved by :
Approved Signatory

() Pornthipha Tameyakul

() Unnoppol Harachai

(✓) Suwit Imjai

Issue Date : 23 March 2024

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.



Equipment : Water Bath
Condition As-Received : Used Item
Reference : 2403-0563OC-4
Page : 2 of 3

Calibration were conducted using in-house calibration procedure CP-OT04 Based on ASTM E715 according to direct measurement method with Data Acquisition which connected with Industrial Platinum Resistance Thermometer (IPRT).

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) Data Acquisition MY57013711 23LM115 TPA 11 Jul 2024

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.

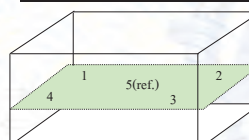
Remark : TPA : Technology Promotion Association (Thailand - Japan)

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Heat transfer medium used : Water

	Environmental		AC Voltage Supply
	(°C)	(%R.H.)	(Volt)
Beginning of Calibration	25	55	222
Finished of Calibration	25	57	223



Front

Position :	Ref. Std. ID No.:
1	4803988-001
2	4803988-002
3	4803988-003
4	4803988-004
5(ref.)	4803988-005



Equipment : Water Bath
Condition As-Received : Used Item
Reference : 2403-0563OC-4
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source

Cert. No.: 24TM635
Page : 3 of 3

Calibration point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Average* Standard Reading (°C)					Uncertainty (± °C)
			Position					
			1	2	3	4	5 (ref.)	
85.0	85.0	85.0	84.428	84.424	84.489	84.507	84.477	0.18

Calibration point (°C)	Uniformity (°C)	Stability (± °C)	Coverage Factor k
85.0	0.19	0.11	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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534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL.0-2717-3000-29 FAX.0-2719-9484



Certificate of Calibration

Cert.No.: 24CH774
Page.: 1 of 2

Equipment : pH Meter
Manufacturer : Mettler Toledo
Model : Seven2Go S2
Serial No. : C221115514
ID No. : RYG_FS0596
Condition As-Received: Used Item
Received Date : 28 June 2024
Calibration Date : 01 July 2024
Reference : 2406-0969DSC-6
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd. Rayong Branch
616/10 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 DC voltage standard and direct measurement with certified reference material (CRM)

Calibrated by : Warakorn Lernagatrakul

Approved by :
Approved Signatory

() Unnophol Harachai
() Ponpan Paipim
(✓) Salthip Meangmai

Issue Date : 03 July 2024

The Uncertainties are for a confidence probability of approximately 95%

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Cert.No.: 24CH774
Page.: 2 of 2

Condition of this calibration result

1. Reference Standard Instrument

Instrument	Serial No.	ID No.	Cert. No.	Due Date
1) Document Process Calibrator	54030049	130RC116	23E2802	27 Aug 2024

- This Certification is traceable to SI Through Technology Promotion Association (Thailand - Japan)

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	970851	25 Apr 2026
pH 6.986	CPA chem	970852	25 Apr 2025
pH 9.997	CPA chem	970853	25 Apr 2025

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 Document Process Calibrator at pH (4,7,10)

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement (±mV)	Coverage factor k
	pH	mV	mV	pH		
pH Meter S/N.: C221115514	4.00	177.48	178	4.00	0.58	2.00
	7.00	0.00	0	7.00	0.58	2.00
	10.00	-177.48	-178	10.00	0.58	2.00

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 (±)	Coverage factor k
pH Electrode S/N.: 3293232	4.008	4.01	180	0.0079	2.00
	6.986	6.99	5	0.011	2.00
	9.997	10.00	-172	0.0092	2.00

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

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Certificate of Calibration

Cert. No.: 24LM108
Page.: 1 of 2

Equipment : pH Meter with Sensor
Manufacturer : Mettler Toledo
Model : Seven2Go S2
Serial No. : C221115514
ID No. : RYG_FS0596
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd.
(Rayong Branch)
616/10 Moo 5 T. Maenam Khu, A. Pluakdaeng,
Rayong 21140 Thailand
Location : TPA On Site Calibration Laboratory

Received Order : 28 June 2024
Calibrated Date : 01 July 2024
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
AC Line Voltage : (220 ± 22) V

Calibrated by : Warakorn Lernagatrakul

Approved by :
Approved Signatory

() Ponpan Paipim
(✓) Suwit Imjai
() Kunchit Promprat

Issue Date : 03 July 2024

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.



Equipment : pH Meter with Sensor
Condition As-Received : Used Item
Reference : 2406-0969DSC-7
Procedure Used :-

Cert. No.: 24LM108
Page.: 2 of 2

Calibration were conducted using in-house calibration procedure CP-OT01 according to comparison with Industrial Platinum Resistance Thermometer (IPRT) into Temperature Bath.

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Serial No.	Cert. No.	Traceable	Due Date
1) Digital Thermometer	2188080	2311216	TPA	11 Oct 2024

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.: 3293232

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty (± °C)	Coverage Factor <i>k</i>
25.0	100	25.003	25.1	0.097	0.16	2.00
30.0	100	30.002	30.2	0.198	0.16	2.00
40.0	100	40.003	40.2	0.197	0.16	2.00
50.0	100	50.002	50.2	0.198	0.16	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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