

ภาคผนวก ง

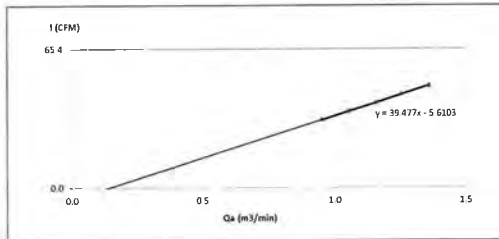
ใบรับรองเอกสารการสอบเทียบเครื่องมือตรวจวิเคราะห์



High Volume Air Sampler Calibration Worksheet

Project Site : Siam City Cement Public Company Limited
 Calibrate Location : สะพานปูน
 Calibrate Date : 6-Aug-24
 CalibrationSheet No. : C-060824-BKK-FS0374
 Calibrator ID : BKK-FS0624
 Calibrator Model : TE-5028A
 Calibrator S/N : 2584
 Barometric Pressure (mm Hg) : 753.3
 Temperature (°C) : 34
 High Volume ID : BKK-FS0374
 High Volume Model : TE-5009X
 High Volume S/N : 5195
 Calibrator Slope : 1.0268
 Calibrator Intercept : -0.01116

Test No.	Delta H ₂ O (inch)	Qa (m ³ /min)	I : Chart (CFM)	Linear Regression
1	2.3	0.954	32	Slope: 39.4774 Intercept: -5.6103 Correlation Coefficient: 0.9999
2	2.8	1.052	36	
3	3.4	1.158	40	
4	4.0	1.255	44	
5	4.7	1.359	48	



Calibrated by :
 (Mr. Teeravut Sukdee)
 Field Scientist (2)

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

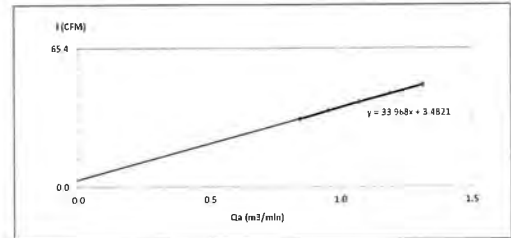
FORM NO. F 06-073 REVISION NO. - ISSUE DATE: 14/03/16



High Volume Air Sampler Calibration Worksheet

Project Site : Siam City Cement Public Company Limited
 Calibrate Location : สะพานปูน
 Calibrate Date : 6-Aug-24
 CalibrationSheet No. : C-060824-BKK-FS1378
 Calibrator ID : BKK-FS0624
 Calibrator Model : TE-5028A
 Calibrator S/N : 2584
 Barometric Pressure (mm Hg) : 753.3
 Temperature (°C) : 34
 High Volume ID : BKK-FS1378
 High Volume Model : TE-5009X
 High Volume S/N : 6263
 Calibrator Slope : 1.0268
 Calibrator Intercept : -0.01116

Test No.	Delta H ₂ O (inch)	Qa (m ³ /min)	I : Chart (CFM)	Linear Regression
1	1.8	0.845	32	Slope: 33.9677 Intercept: 3.4021 Correlation Coefficient: 0.9997
2	2.3	0.954	36	
3	2.9	1.070	40	
4	3.6	1.191	44	
5	4.4	1.315	48	



Calibrated by :
 (Mr. Teeravut Sukdee)
 Field Scientist (2)

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

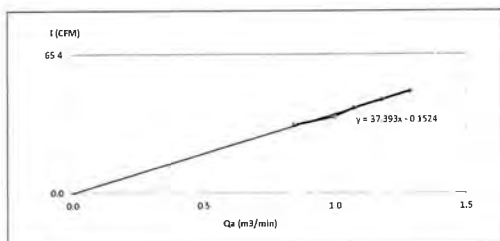
FORM NO. F 06-074 REVISION NO. - ISSUE DATE: 14/03/16



High Volume Air Sampler Calibration Worksheet

Project Site : Siam City Cement Public Company Limited
 Calibrate Location : สะพานปูน
 Calibrate Date : 6-Aug-24
 CalibrationSheet No. : C-060824-BKK-FS0385
 Calibrator ID : BKK-FS0624
 Calibrator Model : TE-5028A
 Calibrator S/N : 2584
 Barometric Pressure (mm Hg) : 753.3
 Temperature (°C) : 34
 High Volume ID : BKK-FS0385
 High Volume Model : TE-5009X
 High Volume S/N : 4789
 Calibrator Slope : 1.0268
 Calibrator Intercept : -0.01116

Test No.	Delta H ₂ O (inch)	Qa (m ³ /min)	I : Chart (CFM)	Linear Regression
1	1.8	0.845	32	Slope: 37.3925 Intercept: -0.1524 Correlation Coefficient: 0.9955
2	2.5	0.994	36	
3	2.9	1.070	40	
4	3.5	1.171	44	
5	4.2	1.205	48	



Calibrated by :
 (Mr. Teeravut Sukdee)
 Field Scientist (2)

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

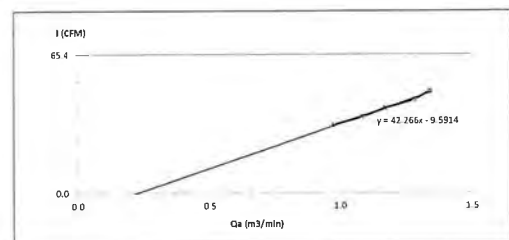
FORM NO. F 06-074 REVISION NO. - ISSUE DATE: 14/03/16



High Volume Air Sampler Calibration Worksheet

Project Site : Siam City Cement Public Company Limited
 Calibrate Location : สะพานปูน
 Calibrate Date : 6-Aug-24
 CalibrationSheet No. : C-060824-BKK-FS1061
 Calibrator ID : BKK-FS0624
 Calibrator Model : TE-5028A
 Calibrator S/N : 2584
 Barometric Pressure (mm Hg) : 753.3
 Temperature (°C) : 34
 High Volume ID : BKK-FS1061
 High Volume Model : TE-5009X
 High Volume S/N : 5504
 Calibrator Slope : 1.0268
 Calibrator Intercept : -0.01116

Test No.	Delta H ₂ O (inch)	Qa (m ³ /min)	I : Chart (CFM)	Linear Regression
1	2.4	0.974	32	Slope: 42.2659 Intercept: -9.5914 Correlation Coefficient: 0.9955
2	3.0	1.088	36	
3	3.5	1.171	40	
4	4.2	1.285	44	
5	4.6	1.345	48	



Calibrated by :
 (Mr. Teeravut Sukdee)
 Field Scientist (2)

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

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



High Volume Air Sampler Calibration Worksheet

Project Site : Siam City Cement Public Company Limited. Barometric Pressure (mm Hg) : 751

Calibrate Location : โถงเก็บฝุ่นปูนซีเมนต์ Temperature (°C) : 32

Calibrate Date : 21-Aug-24 High Volume ID : BKK FS0378

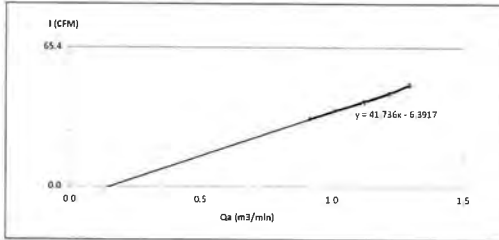
Calibration Sheet No : C-210824-BKK FS0378 High Volume Model : TE-5009X

Calibrator ID : BKK FS0625 High Volume S/N : 4155

Calibrator Model : TE-5028A Calibrator Slope : 1.04104

Calibrator S/N : 2585 Calibrator Intercept : -0.00779

Test No.	Delta H ₂ O (inch)	Qa (m ³ /min)	I : Chart (CFM)	Linear Regression
1	2.2	0.916	32	Slope: 41.7355 Intercept: -6.3917 Correlation Coefficient: 0.9483
2	2.7	1.014	36	
3	3.3	1.120	40	
4	3.9	1.217	44	
5	4.4	1.292	48	



Calibrated by Promee
(Mr. Prommee Sripanet)
Field Scientist (2)

Approved by N. Nong
(Mr. Nongpon Juntarupun)
Enviro Field Coordinator Scientist (3)

FORM NO. F 06-074 REVISION NO. 2 ISSUE DATE: 10/11/23



High Volume Air Sampler Calibration Worksheet

Project Site : Siam City Cement Public Company Limited. Barometric Pressure (mm Hg) : 753.5

Calibrate Location : โถงเก็บฝุ่นปูนซีเมนต์ Temperature (°C) : 33.6

Calibrate Date : 21-Aug-24 High Volume ID : BKK FS1378

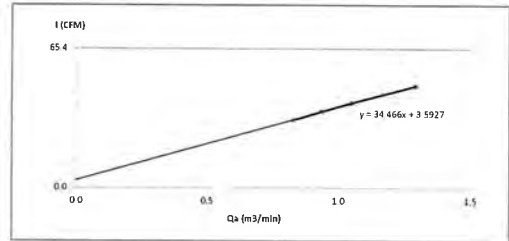
Calibration Sheet No : C-210824-BKK FS1378 High Volume Model : TE-5009X

Calibrator ID : BKK FS0625 High Volume S/N : 6263

Calibrator Model : TE-5028A Calibrator Slope : 1.04104

Calibrator S/N : 2585 Calibrator Intercept : -0.00779

Test No.	Delta H ₂ O (inch)	Qa (m ³ /min)	I : Chart (CFM)	Linear Regression
1	1.8	0.830	32	Slope: 34.4650 Intercept: 3.5927 Correlation Coefficient: 0.9997
2	2.3	0.937	36	
3	2.9	1.051	40	
4	3.6	1.170	44	
5	4.4	1.293	48	



Calibrated by Promee
(Mr. Prommee Sripanet)
Field Scientist (2)

Approved by N. Nong
(Mr. Nongpon Juntarupun)
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 : Siam City Cement Public Company Limited. Barometric Pressure (mm Hg) : 752

Calibrate Location : โถงเก็บฝุ่นปูนซีเมนต์ Temperature (°C) : 31

Calibrate Date : 21-Aug-24 High Volume ID : BKK FS0303

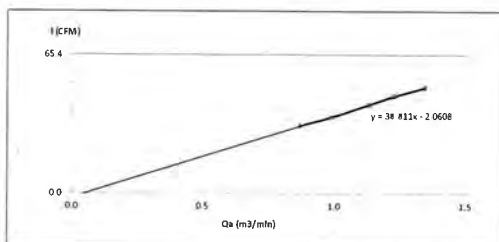
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Calibrator ID : BKK FS0625 High Volume S/N : 4707

Calibrator Model : TE-5028A Calibrator Slope : 1.04104

Calibrator S/N : 2585 Calibrator Intercept : -0.00779

Test No.	Delta H ₂ O (inch)	Qa (m ³ /min)	I : Chart (CFM)	Linear Regression
1	2.8	0.872	32	Slope: 38.0114 Intercept: -2.0608 Correlation Coefficient: 0.9990
2	2.6	0.993	36	
3	3.4	1.134	42	
4	4.0	1.229	46	
5	4.8	1.316	50	



Calibrated by Promee
(Mr. Prommee Sripanet)
Field Scientist (2)

Approved by N. Nong
(Mr. Nongpon Juntarupun)
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 : Siam City Cement Public Company Limited. Barometric Pressure (mm Hg) : 747.7

Calibrate Location : โถงเก็บฝุ่นปูนซีเมนต์ Temperature (°C) : 31.5

Calibrate Date : 21-Aug-24 High Volume ID : BKK FS0305

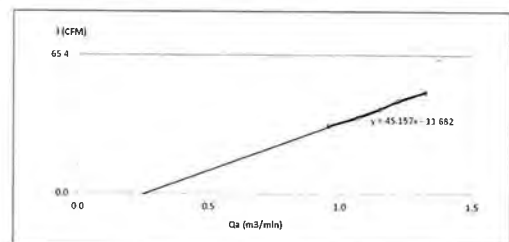
Calibration Sheet No : C-210824-BKK FS0305 High Volume Model : TE-5009X

Calibrator ID : BKK FS0625 High Volume S/N : 4709

Calibrator Model : TE-5028A Calibrator Slope : 1.04104

Calibrator S/N : 2585 Calibrator Intercept : -0.00779

Test No.	Delta H ₂ O (inch)	Qa (m ³ /min)	I : Chart (CFM)	Linear Regression
1	2.4	0.957	32	Slope: 45.1567 Intercept: -11.6819 Correlation Coefficient: 0.9962
2	3.0	1.070	36	
3	3.5	1.155	40	
4	3.9	1.218	44	
5	4.6	1.323	48	



Calibrated by Promee
(Mr. Prommee Sripanet)
Field Scientist (2)

Approved by N. Nong
(Mr. Nongpon Juntarupun)
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 : Siam City Cement Public Company Limited Barometric Pressure (mm Hg) : 750.5

Calibrate Location : โรงโม่ปูนซีเมนต์ Temperature (°C) : 29.1

Calibrate Date : 18-Oct-24 High Volume ID : BKK-FS0388

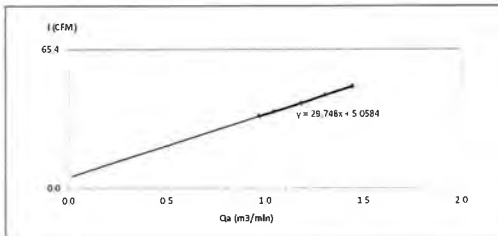
CalibrationSheet No : C-181024-BKK-FS0388 High Volume Model : TE-5009X

Calibrator ID : BKK-FS0624 High Volume S/N : 5378

Calibrator Model : TE-5028A Calibrator Slope : 1.03303

Calibrator S/N : 2584 Calibrator Intercept : -0.01606

Test No.	Delta H ₂ O (inch)	Qa (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.4	0.968	34	Slope: 29.7476 Intercept: 5.0584 Correlation Coefficient: 0.9996
2	2.8	1.044	36	
3	3.6	1.181	40	
4	4.4	1.304	44	
5	5.4	1.443	48	



Calibrated by: Promme
(Mr. Promme Sripatnet)
Field Scientist (2)

Approved by: N. Noppong
(Mr. Noppong Juntarupun)
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 : Siam City Cement Public Company Limited Barometric Pressure (mm Hg) : 750.2

Calibrate Location : โรงโม่ปูนซีเมนต์ Temperature (°C) : 33.8

Calibrate Date : 18-Oct-24 High Volume ID : BKK-FS0383

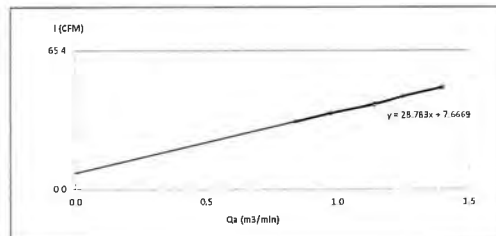
CalibrationSheet No : C-181024-BKK-FS0383 High Volume Model : TE-5009X

Calibrator ID : BKK-FS0624 High Volume S/N : 4787

Calibrator Model : TE-5028A Calibrator Slope : 1.03303

Calibrator S/N : 2584 Calibrator Intercept : -0.01606

Test No.	Delta H ₂ O (inch)	Qa (m ³ /min)	I: Chart (CFM)	Linear Regression
1	1.8	0.847	32	Slope: 28.7826 Intercept: 7.6669 Correlation Coefficient: 0.9900
2	2.4	0.975	36	
3	3.3	1.141	40	
4	4.0	1.251	44	
5	5.0	1.400	48	



Calibrated by: Promme
(Mr. Promme Sripatnet)
Field Scientist (2)

Approved by: N. Noppong
(Mr. Noppong Juntarupun)
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 : Siam City Cement Public Company Limited Barometric Pressure (mm Hg) : 744.2

Calibrate Location : โรงโม่ปูนซีเมนต์ Temperature (°C) : 33.5

Calibrate Date : 18-Oct-24 High Volume ID : BKK-FS1377

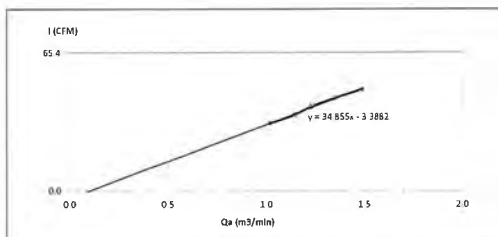
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Calibrator ID : BKK-FS0624 High Volume S/N : 6262

Calibrator Model : TE-5028A Calibrator Slope : 1.03303

Calibrator S/N : 2584 Calibrator Intercept : -0.01606

Test No.	Delta H ₂ O (inch)	Qa (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.6	1.018	32	Slope: 34.1551 Intercept: -3.3002 Correlation Coefficient: 0.9970
2	3.3	1.145	36	
3	3.8	1.227	40	
4	4.6	1.348	44	
5	5.6	1.186	48	



Calibrated by: Promme
(Mr. Promme Sripatnet)
Field Scientist (2)

Approved by: N. Noppong
(Mr. Noppong Juntarupun)
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 : Siam City Cement Public Company Limited Barometric Pressure (mm Hg) : 740.5

Calibrate Location : โรงโม่ปูนซีเมนต์ Temperature (°C) : 32.3

Calibrate Date : 18-Oct-24 High Volume ID : BKK-FS1062

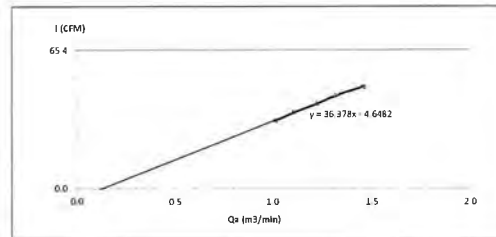
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Calibrator ID : BKK-FS0624 High Volume S/N : 5686

Calibrator Model : TE-5028A Calibrator Slope : 1.03303

Calibrator S/N : 2584 Calibrator Intercept : -0.01606

Test No.	Delta H ₂ O (inch)	Qa (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.6	1.018	32	Slope: 36.3775 Intercept: -4.6402 Correlation Coefficient: 0.9973
2	3.1	1.110	36	
3	3.8	1.228	40	
4	4.4	1.320	44	
5	5.4	1.160	48	



Calibrated by: Promme
(Mr. Promme Sripatnet)
Field Scientist (2)

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

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



PLAY SOLUTION TECHNOLOGY COMPANY LIMITED
179/75 Nawong Pracha Pattana Road, Sihan, Donmuang, Bangkok 10210
Tel : +66 2 011 0505, Fax : +66 2 010 7700
www.playstech.com



CERTIFICATE OF CALIBRATION

Certificate No. : PST-0126-24

W/O No : WO-0051-24

Customer

Company : ALS LABORATORY GROUP (THAILAND) CO., LTD.
Address : 104 Phuttharakon Rd., Phuttharakon Road, Khwaeng Phuttharakon,
City / Province : Khel Suan Luang, Bangkok
Zip/Postal : 10250

Device

Equipment : Electronic Balance Capacity : 120 / 220 g
Manufacturer : OHAUS Readability : 0.00001 / 0.0001 g
Model : EK225D/AD ID No : BKK-EN0403
Serial No : C305774648
Condition : Normal

Environment Conditions

Location of Calibration : Environment Lab
Ambient Temperature : 20.1 (°C) ± 3 °C
Relative Humidity : 70.3 (RH) ± 15 %RH
Barometric Pressure : 1011.1 (mbar) ± 10 hPa
Comment :

REVIEWED BY *Junda K*
APPROVED BY *Sinluk P.*
NEXT CAL DATE : 06/01/25

Date of Receipt : June 3, 2024
Date of Calibration : June 3, 2024
Issue Date : June 5, 2024

Calibrated by : Mr. Kittichai Ratanasakum
Calibrator

Approved by : *K*
Mr. Kittichai Ratanasakum
Approved Signature

The reported measurement result relates only to the measurand and applies only at the time of measurement.

This Certificate is issued in accordance with the conditions of accreditation granted by Thai Laboratory Accreditation scheme which has assessed the measurement capability of the laboratory and is traceable to recognize national standards and to the unit of measurement realized at the corresponding national standard laboratory. This certificate may not be reproduced other than in full, except with the prior written approval prior written approval of the calibration center, Play Solution Technology Co., Ltd.

F 019

REV 03 30/09/16



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CERTIFICATE OF CALIBRATION

Certificate No. : PST-0126-24

W/O No : WO-0051-24

Result of Calibration

1. Repeatability

Weighting Range	g	Nominal Value	g	Standard Deviation	g
Max Capacity	220	50	200	0.000012	0.000048

2. Linearity, Departure of Indication from nominal value

Weighting Range	Nominal Value	Standard Value	Indication	Error of Indication	Expanded Uncertainty	Factor k
1	0.01	0.00000	0.01000	-0.00000	0.000002	2.47
2	0.1	0.00000	0.10000	-0.00000	0.000002	2.47
3	0.5	0.00000	0.50000	-0.00000	0.000002	2.47
4	1	0.00000	1.00000	-0.00000	0.000002	2.47
5	5	0.00000	5.00000	-0.00000	0.000002	2.47
10	5	0.00000	9.99999	-0.00000	0.000002	2.47
20	5	0.00000	9.99999	-0.00000	0.000002	2.47
30	50.00000	49.99999	0.00000	0.00000	0.000002	2.47
100	100.00000	100.00000	0.00000	0.00000	0.000002	2.47
150	150.00000	150.00000	0.00000	0.00000	0.000002	2.47
200	200.00000	200.00000	0.00000	0.00000	0.000002	2.47

F 019

REV 03 30/09/16



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Tel : +66 2 011 0505, Fax : +66 2 010 7700
www.playstech.com



CERTIFICATE OF CALIBRATION

Certificate No. : PST-0126-24

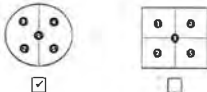
W/O No : WO-0051-24

Result of Calibration

Page No : 3 of 3

3. Eccentricity

Test load at least 1/3 of the maximum capacity, typically placed between 1/2 and 1/3 of the distance from the centre of the load receptor to the edge



Weighting Range 1

Position	Indication	g
1	100.00004	
2	100.00005	
3	100.00003	
4	100.00004	
5	100.00003	
Max Deviation	0.00002	

Standard method

The calibration was performed by using calibration laboratory's in-house calibration method : M 001 based on UKAS LA 14 Calibration of weighing machines : edition 6 | October 2013

Reference standards instrument

Instrument	Model	S/N	Certificate No.	Due Date
Standard Weighing Set	12	4000021052	27 128775	November 30, 2024

Measurement Uncertainty

The given measurement uncertainty is the standard of the measurement multiplied by an extension factor k which corresponds to a confidence level of about 95% for a normal distribution. The standard uncertainty was calculated according to UKAS M3003.

Traceability : The measurement is traceable to national standard, which realizes the physical unit of measurement (SI) through the reference calibration laboratory of Asia Medical and Agricultural Laboratory and Research Center Co., Ltd.

END OF REPORT

F 019

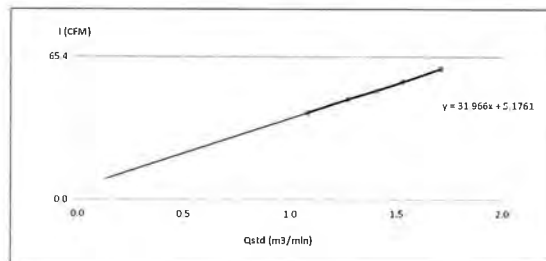
REV 03 30/09/16



High Volume Air Sampler Calibration Worksheet

Project Site : Siam City Cement Public Company Limited
Barometric Pressure (mm Hg) : 753.3
Calibrate Location : กรุงเทพมหานคร
Temperature (°C) : 34
Calibrate Date : 6-Aug-24
High Volume ID : BKK-FS1057
Calibration Sheet No : C-060824-BKK-FS1057
High Volume Model : TE-5009X
Calibrator ID : BKK-FS0624
High Volume S/N : 5500
Calibrator Model : TE-5028A
Calibrator Slope : 1.63932
Calibrator S/N : 2584
Calibrator Intercept : -0.01785

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I : Chart (CFM)	Linear Regression
1	3.2	1.0882	40	Slope : 31.9661
2	4.4	1.2729	46	Intercept : 5.1761
3	5.4	1.4083	50	Correlation Coefficient : 0.9998
4	6.4	1.5315	54	
5	8.0	1.7102	60	



Calibrated by : *hnp*

(Mr. Teeravut Sukdee)
Field Scientist(2)

Approved by : *2. Pongp*

(Mr. Noppong Juntarapan)
Enviro Field Coordinator Scientist (3)



High Volume Air Sampler Calibration Worksheet

Project Site: Siam City Cement Public Company Limited Barometric Pressure (mm Hg): 753.3

Calibrate Location: โรงงานปูนซีเมนต์ Temperature (°C): 34

Calibrate Date: 6-Aug-24 High Volume ID: BKK_FS1376

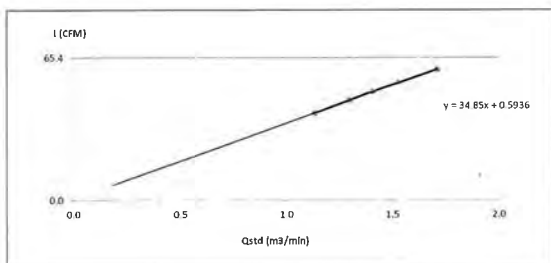
Calibration Sheet No.: C-060824-BKK_FS1376 High Volume Model: TE-5009X

Calibrator ID: BKK_FS0624 High Volume S/N: 6257

Calibrator Model: TE-5028A Calibrator Slope: 1.63932

Calibrator S/N: 2584 Calibrator Intercept: -0.01785

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	3.5	1.1372	40	Slope: 34.8500 Intercept: 0.5936 Correlation Coefficient: 0.9996
2	4.6	1.3012	46	
3	5.4	1.4083	50	
4	6.4	1.5315	54	
5	8.0	1.7102	60	



Calibrated by: Mr. Teeravut Sukdee
Field Scientist(2)

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

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



High Volume Air Sampler Calibration Worksheet

Project Site: Siam City Cement Public Company Limited Barometric Pressure (mm Hg): 753.3

Calibrate Location: โรงงานปูนซีเมนต์ Temperature (°C): 34

Calibrate Date: 6-Aug-24 High Volume ID: BKK_FS0373

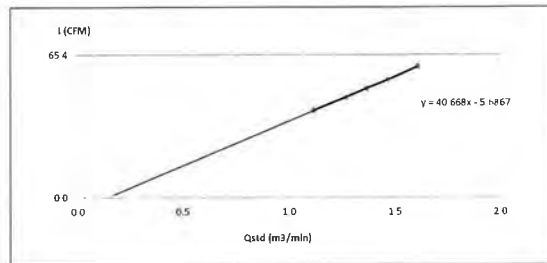
Calibration Sheet No.: C-060824-BKK_FS0373 High Volume Model: G1051

Calibrator ID: BKK_FS0624 High Volume S/N: 1330

Calibrator Model: TE-5028A Calibrator Slope: 1.63932

Calibrator S/N: 2584 Calibrator Intercept: -0.01785

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	3.4	1.1211	40	Slope: 40.6676 Intercept: -5.6867 Correlation Coefficient: 0.9999
2	4.4	1.2729	46	
3	5.1	1.3691	50	
4	5.9	1.4712	54	
5	7.1	1.6122	60	



Calibrated by: Mr. Teeravut Sukdee
Field Scientist(2)

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

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



High Volume Air Sampler Calibration Worksheet

Project Site: Siam City Cement Public Company Limited Barometric Pressure (mm Hg): 752.3

Calibrate Location: โรงงานปูนซีเมนต์ Temperature (°C): 34

Calibrate Date: 6-Aug-24 High Volume ID: BKK_FS0368

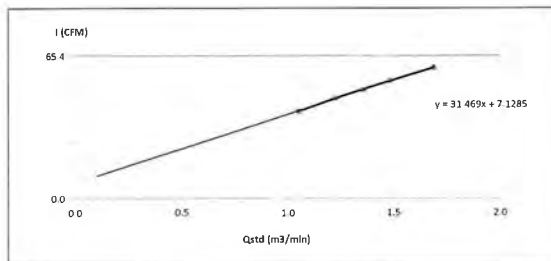
Calibration Sheet No.: C-060824-BKK_FS0368 High Volume Model: TE-5009X

Calibrator ID: BKK_FS0624 High Volume S/N: 4165

Calibrator Model: TE-5028A Calibrator Slope: 1.63932

Calibrator S/N: 2584 Calibrator Intercept: -0.01785

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	3.0	1.0542	40	Slope: 31.4686 Intercept: 7.1285 Correlation Coefficient: 0.9994
2	4.1	1.2294	46	
3	5.0	1.3558	50	
4	6.0	1.4835	54	
5	7.8	1.6889	60	



Calibrated by: Mr. Teeravut Sukdee
Field Scientist(2)

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

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



High Volume Air Sampler Calibration Worksheet

Project Site: Siam City Cement Public Company Limited Barometric Pressure (mm Hg): 751

Calibrate Location: โรงงานปูนซีเมนต์ Temperature (°C): 32

Calibrate Date: 21-Aug-24 High Volume ID: BKK_FS0365

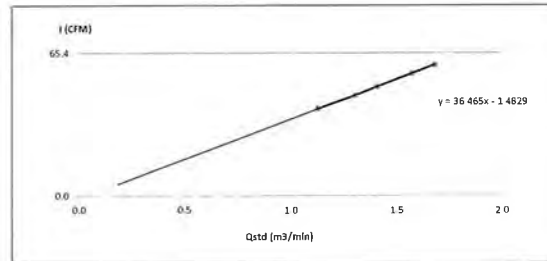
Calibration Sheet No.: C-210824-BKK_FS0365 High Volume Model: TE-5009X

Calibrator ID: BKK_FS0625 High Volume S/N: 4164

Calibrator Model: TE-5028A Calibrator Slope: 1.66209

Calibrator S/N: 2585 Calibrator Intercept: -0.01241

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	3.6	1.1341	40	Slope: 36.4650 Intercept: -1.4829 Correlation Coefficient: 0.9999
2	4.8	1.3076	46	
3	5.6	1.4114	50	
4	7.0	1.5765	56	
5	8.0	1.6845	60	



Calibrated by: Mr. Prommee Sripanit
Field Scientist(2)

Approved by: 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: Siam City Cement Public Company Limited. Barometric Pressure (mm Hg): 753.5

Calibrate Location: โรงงานปูนซีเมนต์ Temperature (°C): 33.6

Calibrate Date: 21-Aug-24 High Volume ID: BKK_FS0372

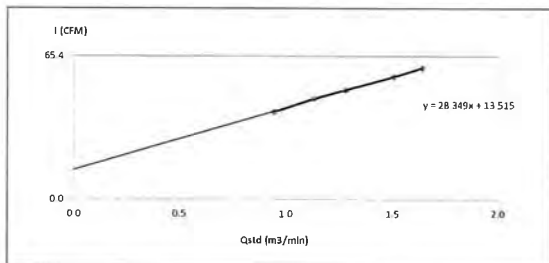
Calibration Sheet No.: C-210824-BKK_FS0372 High Volume Model: TE-5009X

Calibrator ID: BKK_FS0625 High Volume S/N: 5332

Calibrator Model: TE-5028A Calibrator Slope: 1.66209

Calibrator S/N: 2585 Calibrator Intercept: -0.01241

Test No.	Delta H ₂ O (Inch)	Q _{std} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.5	0.9462	40	Slope: 28.3491 Intercept: 13.5148 Correlation Coefficient: 0.9993
2	3.6	1.1330	46	
3	4.6	1.2791	50	
4	6.4	1.5065	56	
5	7.6	1.6406	60	



Calibrated by: Prommee
(Mr. Prommee Sriprattiet)
Field Scientist(2)

Approved by: Mr. Noppong Juntarupan
(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: Siam City Cement Public Company Limited. Barometric Pressure (mm Hg): 752

Calibrate Location: สถานีรถไฟกรุงเทพ Temperature (°C): 31

Calibrate Date: 21-Aug-24 High Volume ID: BKK_FS1056

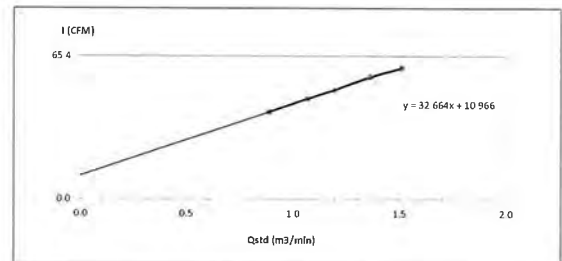
Calibration Sheet No.: C-210824-BKK_FS1056 High Volume Model: TE-5009X

Calibrator ID: BKK_FS0625 High Volume S/N: 5499

Calibrator Model: TE-5028A Calibrator Slope: 1.66209

Calibrator S/N: 2585 Calibrator Intercept: -0.01241

Test No.	Delta H ₂ O (Inch)	Q _{std} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.2	0.8913	40	Slope: 32.6644 Intercept: 10.9664 Correlation Coefficient: 0.9993
2	3.2	1.0724	46	
3	4.0	1.1975	50	
4	5.2	1.3636	56	
5	6.4	1.5114	60	



Calibrated by: Prommee
(Mr. Prommee Sriprattiet)
Field Scientist(2)

Approved by: Mr. Noppong Juntarupan
(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: Siam City Cement Public Company Limited. Barometric Pressure (mm Hg): 747.7

Calibrate Location: โรงงานปูนซีเมนต์ Temperature (°C): 31.5

Calibrate Date: 21-Aug-24 High Volume ID: BKK_FS0373

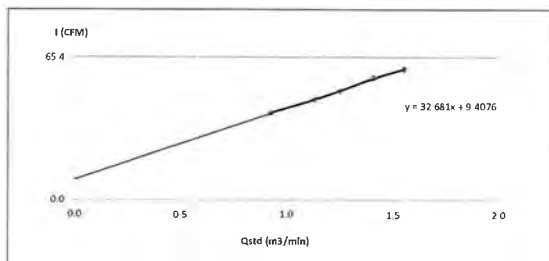
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Calibrator ID: BKK_FS0625 High Volume S/N: 1330

Calibrator Model: TE-5028A Calibrator Slope: 1.66209

Calibrator S/N: 2585 Calibrator Intercept: -0.01241

Test No.	Delta H ₂ O (Inch)	Q _{std} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.4	0.9270	40	Slope: 32.6811 Intercept: 9.4076 Correlation Coefficient: 0.9987
2	3.6	1.1325	46	
3	4.4	1.2508	50	
4	5.6	1.4094	56	
5	6.8	1.5519	60	



Calibrated by: Prommee
(Mr. Prommee Sriprattiet)
Field Scientist(2)

Approved by: Mr. Noppong Juntarupan
(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: Siam City Cement Public Company Limited. Barometric Pressure (mm Hg): 750.5

Calibrate Location: โรงงานปูนซีเมนต์ Temperature (°C): 29.1

Calibrate Date: 18-Oct-24 High Volume ID: BKK_FS1375

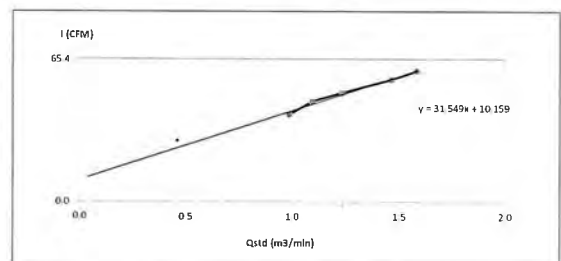
Calibration Sheet No.: C-181024-BKK_FS1375 High Volume Model: TE-5009X

Calibrator ID: BKK_FS0624 High Volume S/N: 6256

Calibrator Model: TE-5028A Calibrator Slope: 1.64931

Calibrator S/N: 2584 Calibrator Intercept: -0.02579

Test No.	Delta H ₂ O (Inch)	Q _{std} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.6	0.9907	40	Slope: 31.5490 Intercept: 10.1586 Correlation Coefficient: 0.9911
2	3.2	1.0963	46	
3	4.1	1.2375	50	
4	5.8	1.4669	56	
5	6.8	1.5862	60	



Calibrated by: Prommee
(Mr. Prommee Sriprattiet)
Field Scientist(2)

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

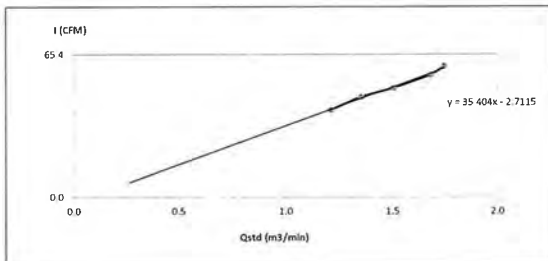
FORM NO: F 06-073 REVISION NO:2 ISSUE DATE: 20/11/23



High Volume Air Sampler Calibration Worksheet

Project Site: Siam City Cement Public Company Limited
Calibrate Location: สถานีฟาร์ม (สระบุรี)
Calibrate Date: 18-Oct-24
Calibration Sheet No.: C-181024-BKK_FS0367
Calibrator ID: BKK_FS0624
Calibrator Model: TE-5028A
Calibrator S/N: 2584
Barometric Pressure (mm Hg): 750.2
Temperature (°C): 33.8
High Volume ID: BKK_FS0367
High Volume Model: TE-5009X
High Volume S/N: 4162
Calibrator Slope: 1.64931
Calibrator Intercept: -0.02579

Test No.	Delta H ₂ O (Inch)	Q _{std} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	4.0	1.2132	40	Slope: 35.4036 Intercept: -2.7115 Correlation Coefficient: 0.9949
2	5.0	1.3533	46	
3	6.2	1.5041	50	
4	7.8	1.6839	56	
5	8.4	1.7465	60	



Calibrated by: *Prommee*
(Mr. Prommee Sripattet)
Field Scientist(2)

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

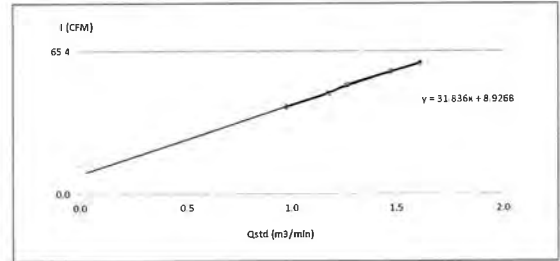
FORM NO: F 06-073 REVISION NO:2 ISSUE DATE: 20/11/23



High Volume Air Sampler Calibration Worksheet

Project Site: Siam City Cement Public Company Limited
Calibrate Location: บ้านนาเกลือ
Calibrate Date: 18-Oct-24
Calibration Sheet No.: C-181024-BKK_FS1057
Calibrator ID: BKK_FS0624
Calibrator Model: TE-5028A
Calibrator S/N: 2584
Barometric Pressure (mm Hg): 744.2
Temperature (°C): 33.5
High Volume ID: BKK_FS1057
High Volume Model: TE-5009X
High Volume S/N: 5500
Calibrator Slope: 1.64931
Calibrator Intercept: -0.02579

Test No.	Delta H ₂ O (Inch)	Q _{std} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.6	0.9797	40	Slope: 31.8359 Intercept: 8.9268 Correlation Coefficient: 0.9983
2	3.8	1.1790	46	
3	4.4	1.2667	50	
4	6.0	1.4749	56	
5	7.2	1.6132	60	



Calibrated by: *Prommee*
(Mr. Prommee Sripattet)
Field Scientist(2)

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

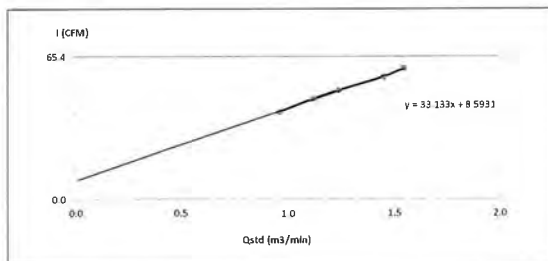
FORM NO: F 06-073 REVISION NO:2 ISSUE DATE: 20/11/23



High Volume Air Sampler Calibration Worksheet

Project Site: Siam City Cement Public Company Limited
Calibrate Location: สถานีฟาร์ม (สระบุรี)
Calibrate Date: 18-Oct-24
Calibration Sheet No.: C-181024-BKK_FS1376
Calibrator ID: BKK_FS0624
Calibrator Model: TE-5028A
Calibrator S/N: 2584
Barometric Pressure (mm Hg): 740.5
Temperature (°C): 32.3
High Volume ID: BKK_FS1376
High Volume Model: TE-5009X
High Volume S/N: 6257
Calibrator Slope: 1.64931
Calibrator Intercept: -0.02579

Test No.	Delta H ₂ O (Inch)	Q _{std} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.5	0.9607	40	Slope: 33.1332 Intercept: 8.5931 Correlation Coefficient: 0.9981
2	3.4	1.1161	46	
3	4.2	1.2376	50	
4	5.8	1.4498	56	
5	6.6	1.5448	60	



Calibrated by: *Prommee*
(Mr. Prommee Sripattet)
Field Scientist(2)

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

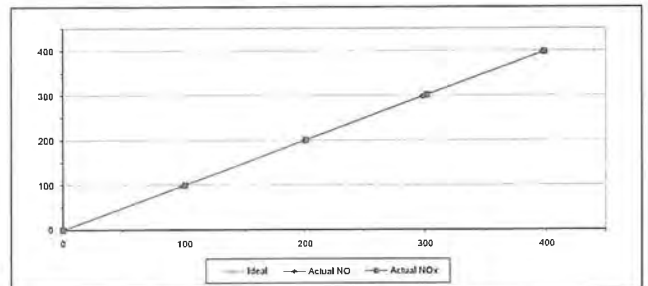
FORM NO: F 06-073 REVISION NO:2 ISSUE DATE: 20/11/23



MULTIPOINT CALIBRATION REPORT

Calibration Date: 3-Jul-24
Manufacturer: HORIBA
Serial No.: XBRAXHD0
Calibrator Manufacturer: Teledyne API
Serial No.: 947
Std. Gas Concentration (PPM): 65.88
Cylinder Pressure (psi): 1800
Certified Date: 9-Feb-22
Equipment Name: NOx Analyzer
Model: APNA-370
Equipment ID: BKK_FS0803
Model: 700
Cylinder No.: GN0027222
Certified By: Airgas Inc.
Expired Date: 9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	98.80	-1.20	-1.20	100.50	0.50	0.50
2	200.00	201.50	1.50	0.75	201.20	1.20	0.60
3	300.00	298.40	-1.60	-0.53	302.10	2.10	0.70
4	400.00	396.50	-3.50	-0.88	398.50	-1.50	-0.38
AVERAGE (%)				-0.35			0.31



Calibrated By: *Jirawat Sakam*

Approved By: *Mr. Sarayuth Jitranont*

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

(Mr. Sarayuth Jitranont)
Assistant General Manager

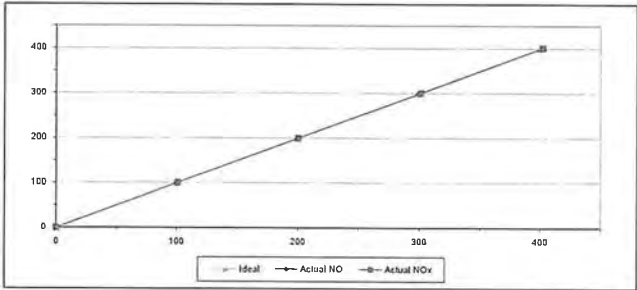
ALS Laboratory Group
FORM NO: F 06-056 REVISION NO: - ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	2-Jul-24	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	VJVBGEPP	Equipment ID	BKK_FS0779
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	100.10	0.10	0.10	101.00	1.00	1.00
2	200.00	199.50	-0.50	-0.25	200.30	0.30	0.15
3	300.00	299.50	-0.50	-0.17	301.20	1.20	0.40
4	400.00	400.20	0.20	0.05	402.30	2.30	0.58
AVERAGE (%)				-0.03			0.45



Calibrated By

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

Approved By

(Mr. Sarayuth Jittrantont)
Assistant General Manager

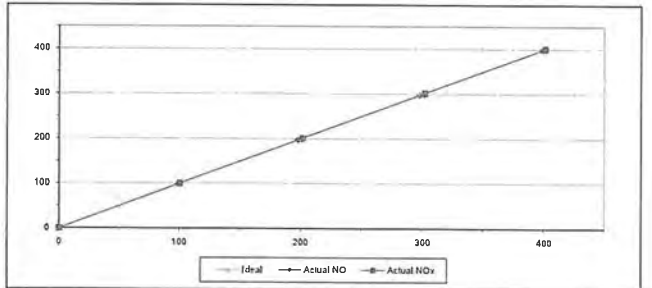
ALS Laboratory Group
FORM NO. F 05-055 REVISION NO. - ISSUE DATE 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	2-Jul-24	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	HCWSR881	Equipment ID	BKK_FS0800
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	99.10	-0.90	-0.90	100.50	0.50	0.50
2	200.00	197.60	-2.40	-1.20	201.40	1.40	0.70
3	300.00	298.00	-2.00	-0.67	302.40	2.40	0.80
4	400.00	398.70	-1.30	-0.33	401.30	1.30	0.33
AVERAGE (%)				-0.60			0.49



Calibrated By

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

Approved By

(Mr. Sarayuth Jittrantont)
Assistant General Manager

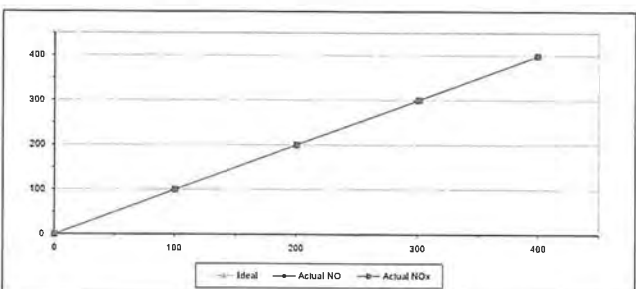
ALS Laboratory Group
FORM NO. F 05-055 REVISION NO. - ISSUE DATE 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	2-Jul-24	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	TLTATGDW	Equipment ID	BKK_FS0785
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	99.00	-1.00	-1.00	100.30	0.30	0.30
2	200.00	199.40	-0.60	-0.30	200.50	0.50	0.25
3	300.00	299.00	-1.00	-0.33	301.10	1.10	0.37
4	400.00	398.50	-1.40	-0.35	399.30	-0.70	-0.17
AVERAGE (%)				-0.36			0.17



Calibrated By

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

Approved By

(Mr. Sarayuth Jittrantont)
Assistant General Manager

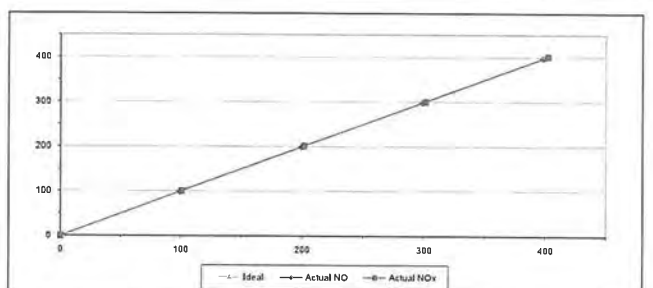
ALS Laboratory Group
FORM NO. F 05-055 REVISION NO. - ISSUE DATE 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	2-Jul-24	Equipment Name	NOx Analyzer
Manufacturer	Teledyne API	Model	N200
Serial No.	90	Equipment ID	BKK_FS1406
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	99.30	-0.70	-0.70	101.00	1.00	1.00
2	200.00	199.50	-0.50	-0.25	201.70	1.70	0.85
3	300.00	298.80	-1.20	-0.40	301.50	1.50	0.50
4	400.00	398.50	-1.50	-0.38	402.30	2.30	0.58
AVERAGE (%)				-0.33			0.60



Calibrated By

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

Approved By

(Mr. Sarayuth Jittrantont)
Assistant General Manager

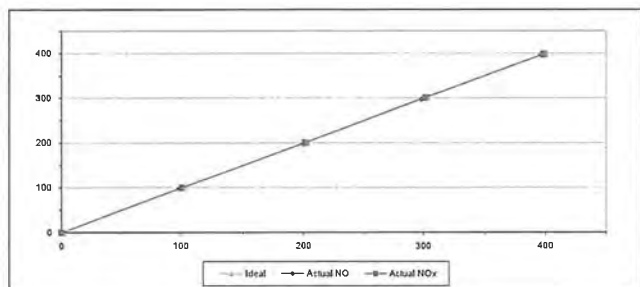
ALS Laboratory Group
FORM NO. F 05-055 REVISION NO. - ISSUE DATE 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	3-Jul-24	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	X9RAXH0D	Equipment ID	BKK_FS0803
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	98.80	-1.20	-1.20	100.50	0.50	0.50
2	200.00	201.50	1.50	0.75	201.20	1.20	0.60
3	300.00	298.40	-1.60	-0.53	302.10	2.10	0.70
4	400.00	398.50	-1.50	-0.38	398.50	-1.50	-0.38
AVERAGE (%)				-0.35			0.31



Calibrated By

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

Approved By

(Mr. Sarayuth Jitranont)
Assistant General Manager

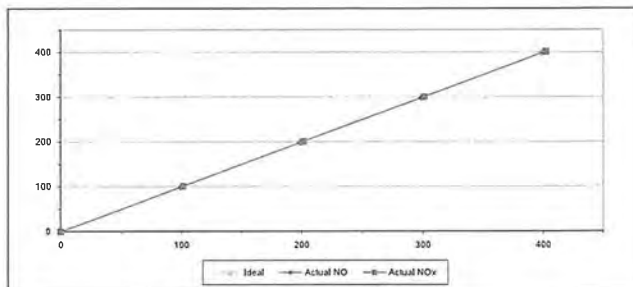
ALS Laboratory Group
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MULTIPOINT CALIBRATION REPORT

Calibration Date	3-Jul-24	Equipment Name	NOx Analyzer
Manufacturer	Teledyne API	Model	T200
Serial No.	6305	Equipment ID	BKK_FS1096
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	95.40	-0.60	-0.60	101.20	1.20	1.20
2	200.00	198.50	-1.50	-0.75	201.40	1.40	0.70
3	300.00	298.50	-1.50	-0.50	301.10	1.10	0.37
4	400.00	398.50	-1.50	-0.38	402.00	2.00	0.50
AVERAGE (%)				-0.42			0.57



Calibrated By

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

Approved By

(Mr. Sarayuth Jitranont)
Assistant General Manager

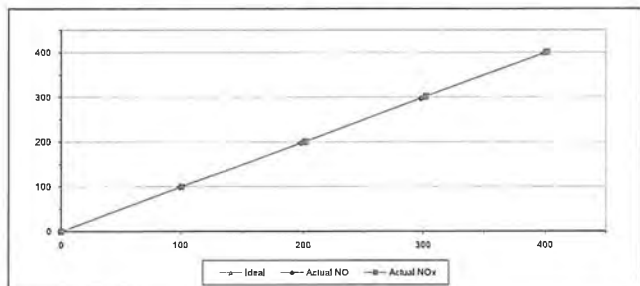
ALS Laboratory Group
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MULTIPOINT CALIBRATION REPORT

Calibration Date	2-Jul-24	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	HCWSR681	Equipment ID	BKK_FS0800
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	99.10	-0.90	-0.90	100.50	0.50	0.50
2	200.00	197.60	-2.40	-1.20	201.40	1.40	0.70
3	300.00	298.00	-2.00	-0.67	302.40	2.40	0.80
4	400.00	398.70	-1.30	-0.33	401.30	1.30	0.33
AVERAGE (%)				-0.60			0.49



Calibrated By

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

Approved By

(Mr. Sarayuth Jitranont)
Assistant General Manager

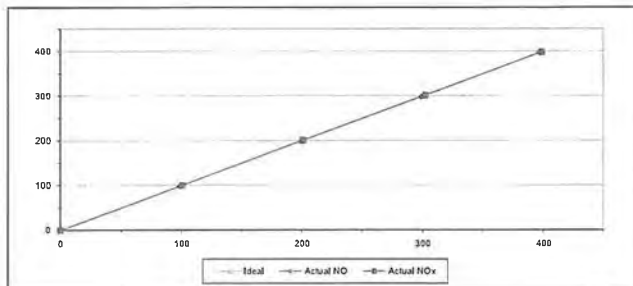
ALS Laboratory Group
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MULTIPOINT CALIBRATION REPORT

Calibration Date	3-Jul-24	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	X9RAXH0D	Equipment ID	BKK_FS0803
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	98.80	-1.20	-1.20	100.50	0.50	0.50
2	200.00	201.50	1.50	0.75	201.20	1.20	0.60
3	300.00	298.40	-1.60	-0.53	302.10	2.10	0.70
4	400.00	398.50	-1.50	-0.38	398.50	-1.50	-0.38
AVERAGE (%)				-0.35			0.31



Calibrated By

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

Approved By

(Mr. Sarayuth Jitranont)
Assistant General Manager

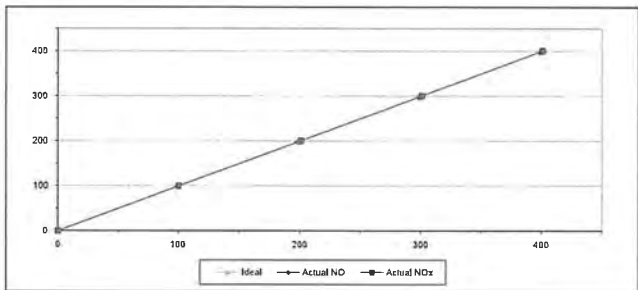
ALS Laboratory Group
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MULTIPOINT CALIBRATION REPORT

Calibration Date 3-Jul-24 Equipment Name NOx Analyzer
 Manufacturer HORIBA Model APNA-370
 Serial No. 30K18RHM Equipment ID BKK_FS1086
 Calibrator Manufacturer Teledyne API Model 700
 Serial No. 947
 Std. Gas Concentration (PPM) 55.88 Cylinder No. GN0027222
 Cylinder Pressure (psi) 1800 Certified By Airgas Inc.
 Certified Date 9-Feb-22 Expired Date 9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.05	0.05	0.05	0.10	0.10	0.10
1	100.00	99.50	-0.50	-0.50	100.20	0.20	0.20
2	200.00	198.30	-1.70	-0.85	201.10	1.10	0.55
3	300.00	298.10	-1.90	-0.63	301.10	1.10	0.37
4	400.00	398.60	-1.40	-0.35	401.20	1.20	0.30
AVERAGE (%)				-0.46			0.30



Calibrated By

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

Approved By

(Mr. Sarayuth Jitranont)
Assistant General Manager

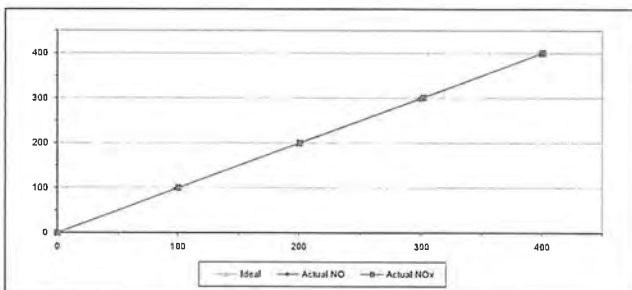
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MULTIPOINT CALIBRATION REPORT

Calibration Date 3-Jul-24 Equipment Name NOx Analyzer
 Manufacturer HORIBA Model APNA-370
 Serial No. PHD13MC7 Equipment ID BKK_FS1072
 Calibrator Manufacturer Teledyne API Model 700
 Serial No. 947
 Std. Gas Concentration (PPM) 55.88 Cylinder No. GN0027222
 Cylinder Pressure (psi) 1800 Certified By Airgas Inc.
 Certified Date 9-Feb-22 Expired Date 9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	98.80	-1.20	-1.20	100.50	0.50	0.50
2	200.00	201.40	1.40	0.70	200.50	0.50	0.25
3	300.00	298.30	-1.70	-0.57	302.00	2.00	0.67
4	400.00	398.50	-1.50	-0.38	401.40	1.40	0.35
AVERAGE (%)				-0.27			0.37



Calibrated By

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

Approved By

(Mr. Sarayuth Jitranont)
Assistant General Manager

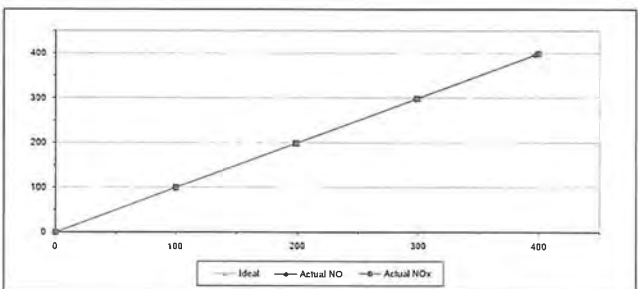
ALS Laboratory Group
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MULTIPOINT CALIBRATION REPORT

Calibration Date 2-Jul-24 Equipment Name NOx Analyzer
 Manufacturer HORIBA Model APNA-370
 Serial No. R0A0GWJC Equipment ID BKK_FS0794
 Calibrator Manufacturer Teledyne API Model 700
 Serial No. 947
 Std. Gas Concentration (PPM) 55.88 Cylinder No. GN0027222
 Cylinder Pressure (psi) 1800 Certified By Airgas Inc.
 Certified Date 9-Feb-22 Expired Date 9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	99.40	-0.60	-0.60	100.20	0.20	0.20
2	200.00	198.50	-1.50	-0.75	198.80	-1.20	-0.60
3	300.00	297.50	-2.50	-0.83	298.80	-1.20	-0.40
4	400.00	396.70	-3.30	-0.83	399.50	-0.50	-0.13
AVERAGE (%)				-0.58			-0.16



Calibrated By

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

Approved By

(Mr. Sarayuth Jitranont)
Assistant General Manager

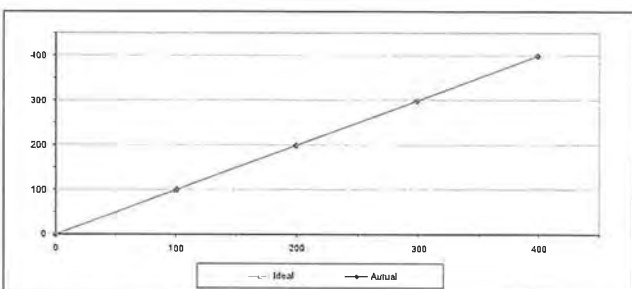
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MULTIPOINT CALIBRATION REPORT

Calibration Date 5-Jul-24 Equipment Name SO2 Analyzer
 Manufacturer HORIBA Model APSA-370
 Serial No. 2SSLA6G0 Equipment ID BKK_FS0802
 Calibrator Manufacturer Teledyne API Model 700
 Serial No. 947
 Std. Gas Concentration (PPM) 56.3 Cylinder No. GN0027222
 Cylinder Pressure (psi) 1800 Certified By Airgas Inc.
 Certified Date 9-Feb-22 Expired Date 9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	101.00	1.00	1.00
2	200.00	199.40	-0.60	-0.30
3	300.00	298.30	-1.70	-0.57
4	400.00	399.20	-0.80	-0.20
AVERAGE (%)				0.01



Calibrated By

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

Approved By

(Mr. Sarayuth Jitranont)
Assistant General Manager

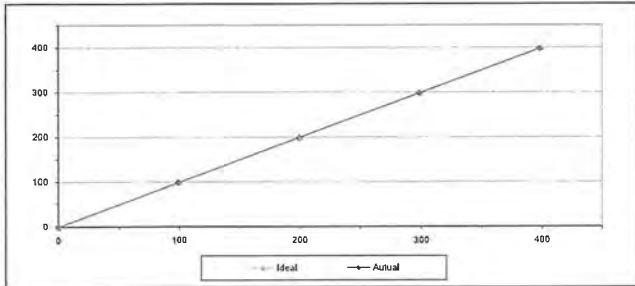
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MULTIPOINT CALIBRATION REPORT

Calibration Date 4-Jul-24 Equipment Name SO2 Analyzer
 Manufacturer HORIBA Model APSA-370
 Serial No. VXABVTRT Equipment ID BKK_FS0778
 Calibrator Manufacturer Teledyne API Model 700
 Serial No. 947
 Std. Gas Concentration (PPM) 56.3 Cylinder No. GN0027222
 Cylinder Pressure (psi) 1800 Certified By Algas Inc.
 Certified Date 9-Feb-22 Expiry Date 9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	99.00	-1.00	-1.00
2	200.00	198.80	-1.20	-0.60
3	300.00	298.50	-1.50	-0.50
4	400.00	398.00	-2.00	-0.50
AVERAGE (%)				-0.50



Calibrated By

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

Approved By

(Mr.Sarayuth Jitranont)
Assistant General Manager

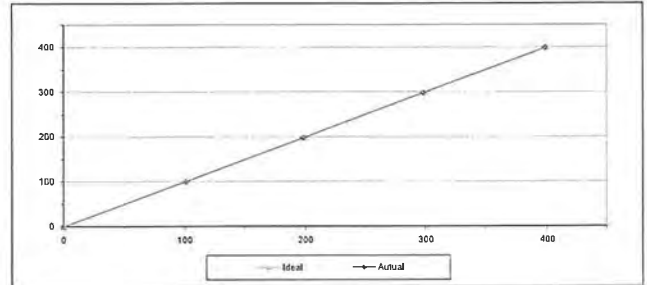
ALS Laboratory Group
FORM NO.: F 06-056 REVISION NO.: - ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date 4-Jul-24 Equipment Name SO2 Analyzer
 Manufacturer HORIBA Model APSA-370
 Serial No. YU8Y8F8 Equipment ID BKK_FS0798
 Calibrator Manufacturer Teledyne API Model 700
 Serial No. 947
 Std. Gas Concentration (PPM) 56.3 Cylinder No. GN0027222
 Cylinder Pressure (psi) 1800 Certified By Algas Inc.
 Certified Date 9-Feb-22 Expiry Date 9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	101.30	1.30	1.30
2	200.00	198.00	-2.00	-1.00
3	300.00	298.50	-1.50	-0.50
4	400.00	398.70	-1.30	-0.33
AVERAGE (%)				-0.09



Calibrated By

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

Approved By

(Mr.Sarayuth Jitranont)
Assistant General Manager

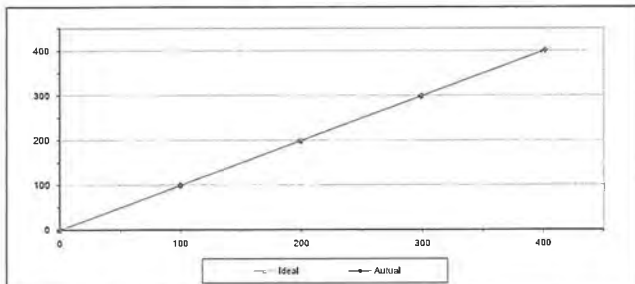
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MULTIPOINT CALIBRATION REPORT

Calibration Date 4-Jul-24 Equipment Name SO2 Analyzer
 Manufacturer HORIBA Model APSA-370
 Serial No. 3C72K8HB Equipment ID BKK_FS0784
 Calibrator Manufacturer Teledyne API Model 700
 Serial No. 947
 Std. Gas Concentration (PPM) 56.3 Cylinder No. GN0027222
 Cylinder Pressure (psi) 1800 Certified By Algas Inc.
 Certified Date 9-Feb-22 Expiry Date 9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	99.60	-0.40	-0.40
2	200.00	198.50	-1.50	-0.75
3	300.00	298.80	-1.20	-0.40
4	400.00	401.50	1.50	0.38
AVERAGE (%)				-0.22



Calibrated By

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

Approved By

(Mr.Sarayuth Jitranont)
Assistant General Manager

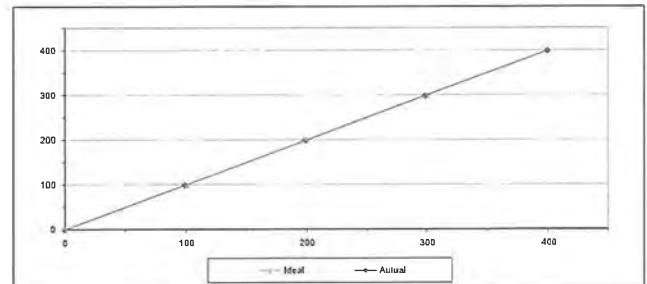
ALS Laboratory Group
FORM NO.: F 06-056 REVISION NO.: - ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date 5-Jul-24 Equipment Name SO2 Analyzer
 Manufacturer Teledyne API Model N100
 Serial No. 88 Equipment ID BKK_FS1408
 Calibrator Manufacturer Teledyne API Model 700
 Serial No. 947
 Std. Gas Concentration (PPM) 56.3 Cylinder No. GN0027222
 Cylinder Pressure (psi) 1800 Certified By Algas Inc.
 Certified Date 9-Feb-22 Expiry Date 9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	98.90	-1.10	-1.10
2	200.00	198.50	-1.50	-0.75
3	300.00	298.50	-1.50	-0.50
4	400.00	399.20	-0.80	-0.20
AVERAGE (%)				-0.49



Calibrated By

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

Approved By

(Mr.Sarayuth Jitranont)
Assistant General Manager

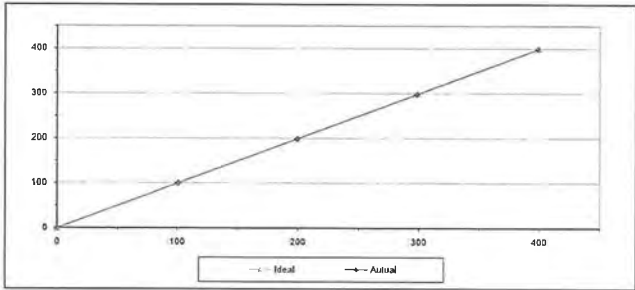
ALS Laboratory Group
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MULTIPOINT CALIBRATION REPORT

Calibration Date	5-Jul-24	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	2SSLA6G0	Equipment ID	BKK_FS0802
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	56.3	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	101.00	1.00	1.00
2	200.00	199.40	-0.60	-0.30
3	300.00	298.30	-1.70	-0.57
4	400.00	399.20	-0.80	-0.20
AVERAGE (%)				0.01



Calibrated By

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

Approved By

(Mr.Sarayuth Jitranont)
Assistant General Manager

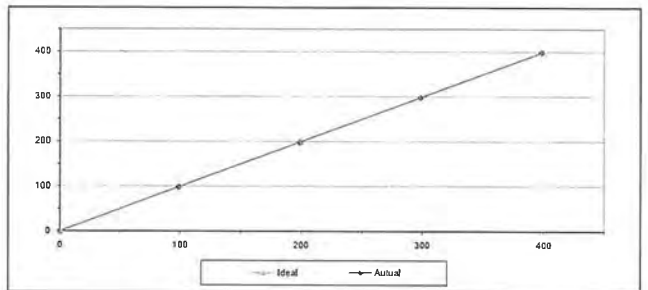
ALS Laboratory Group
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MULTIPOINT CALIBRATION REPORT

Calibration Date	5-Jul-24	Equipment Name	SO2 Analyzer
Manufacturer	Teledyne API	Model	T100
Serial No.	5345	Equipment ID	BKK_FS1087
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	56.3	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	98.60	-1.40	-1.40
2	200.00	198.80	-1.20	-0.60
3	300.00	298.40	-1.60	-0.53
4	400.00	398.70	-1.30	-0.33
AVERAGE (%)				-0.55



Calibrated By

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

Approved By

(Mr.Sarayuth Jitranont)
Assistant General Manager

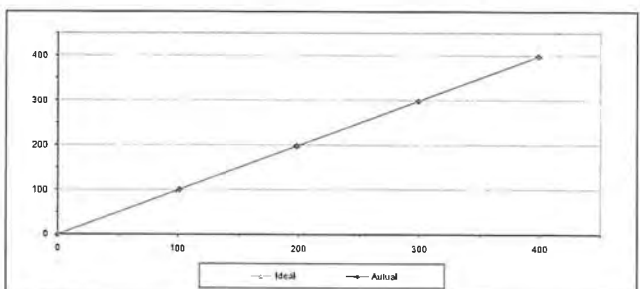
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MULTIPOINT CALIBRATION REPORT

Calibration Date	4-Jul-24	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	YU6BY9F9	Equipment ID	BKK_FS0789
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	56.3	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	101.30	1.30	1.30
2	200.00	198.00	-2.00	-1.00
3	300.00	298.50	-1.50	-0.50
4	400.00	398.70	-1.30	-0.33
AVERAGE (%)				-0.09



Calibrated By

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

Approved By

(Mr.Sarayuth Jitranont)
Assistant General Manager

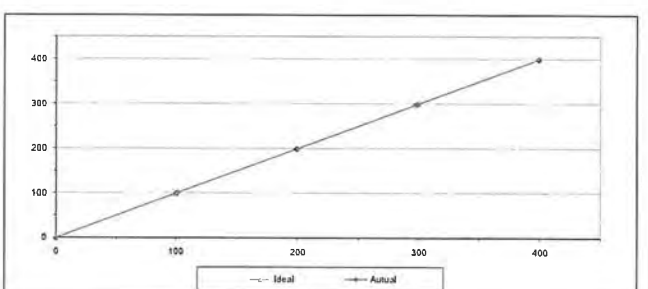
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MULTIPOINT CALIBRATION REPORT

Calibration Date	5-Jul-24	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	2SSLA6G0	Equipment ID	BKK_FS0802
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	56.3	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	101.00	1.00	1.00
2	200.00	199.40	-0.60	-0.30
3	300.00	298.30	-1.70	-0.57
4	400.00	399.20	-0.80	-0.20
AVERAGE (%)				0.01



Calibrated By

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

Approved By

(Mr.Sarayuth Jitranont)
Assistant General Manager

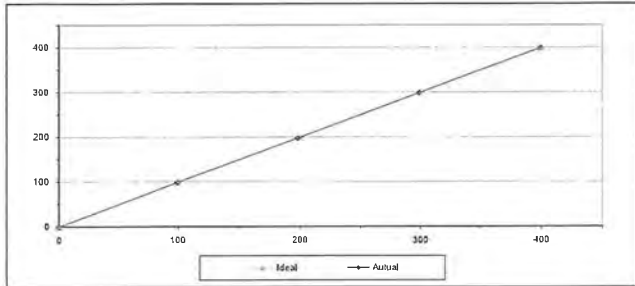
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MULTIPOINT CALIBRATION REPORT

Calibration Date	5-Jul-24	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	42B579RC	Equipment ID	BKK_FS1085
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	56.3	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	99.50	-0.50	-0.50
2	200.00	197.90	-2.10	-1.05
3	300.00	299.10	-0.90	-0.30
4	400.00	399.50	-0.50	-0.13
AVERAGE (%)				-0.37



Calibrated By

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

Approved By

(Mr.Sarayuth Jitranont)
Assistant General Manager

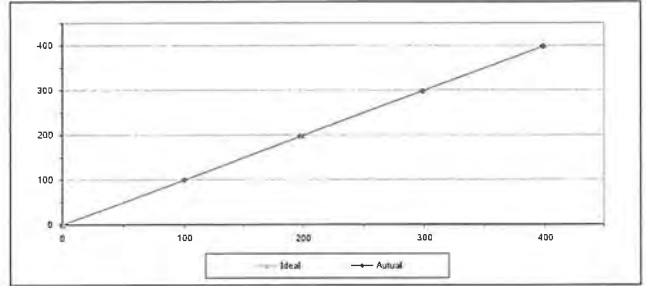
ALS Laboratory Group
FORM NO.: F 06-056 REVISION NO.: ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	5-Jul-24	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	ROH40S60	Equipment ID	BKK_FS1071
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	56.3	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	100.30	0.30	0.30
2	200.00	197.30	-2.70	-1.35
3	300.00	298.40	-1.60	-0.53
4	400.00	398.50	-1.50	-0.36
AVERAGE (%)				-0.37



Calibrated By

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

Approved By

(Mr.Sarayuth Jitranont)
Assistant General Manager

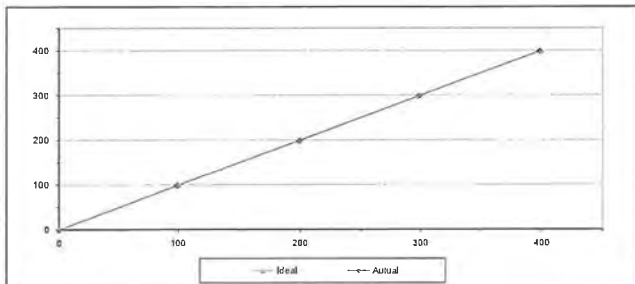
ALS Laboratory Group
FORM NO.: F 06-056 REVISION NO.: ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	4-Jul-24	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	2BGDABSF	Equipment ID	BKK_FS0793
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	56.3	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	99.10	-0.90	-0.90
2	200.00	198.80	-1.20	-0.60
3	300.00	298.50	-1.50	-0.50
4	400.00	398.50	-1.50	-0.36
AVERAGE (%)				-0.46



Calibrated By

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

Approved By

(Mr.Sarayuth Jitranont)
Assistant General Manager

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



Accredited calibration laboratory
ISO/IEC 17025:2017
NAC TSI 17025
CALIBRATION 0167
Air speed measurement laboratory
Calibration services department

Accredited calibration laboratory
ISO/IEC 17025:2017
NAC TSI 17025
CALIBRATION 0167
Air speed measurement laboratory
Calibration services department

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM
MANUFACTURER
MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS RECEIVED

CUSTOMER

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow

Temperature

Relative Humidity

Atmospheric Pressure

PLACE OF CALIBRATION

CALIBRATION CONDITIONS

Preconditioning

Measurement Condition

TABULATION OF RESULTS:

The table on next page give the measurement results

Calibrated by

Approved by

Remark:

Note: Must section area of the wind tunnel

Projected cross-section area of the tested object include mounting plate

Diameter of mounting plate

Approx. 100

Cup anemometer

Novallux

Sensor: WS 02FA

Data logger: LID WS-2501-D

Sensor: WS0 AS966

Data logger: AS966

BKK-FS137

New item

ALS Laboratory group (Thailand) Co., Ltd

104 Phantabank Rd. Phantabank Rd. Khwaeng Suan Luang

Khet Suan Luang, Bangkok 10250 Thailand

15 Jun 2023

19 Jun 2023

19 Jun 2023

23.0 ± 3.0 °C

55.0 ± 15.0 %RH

1010 ± 10 mPa

Effect type wind tunnel of Jirawut Sakam Co., Ltd

Wind tunnel cross-section area

Wind direction frontal area

Diameter of mounting plate

Size range type of test object

500 cm²

100 cm²

mm

0.11 [-]

24 hours in ambient condition

The average value was during measurement at (23.0) °C, (55.0) %RH and (1010.0) mPa

The table on next page give the measurement results

Calibrated by

Approved by

Remark:

Note: Must section area of the wind tunnel

Projected cross-section area of the tested object include mounting plate

Diameter of mounting plate

Approx. 100

REVIEW BY: Jirawut P.

APPROVED BY: Sarayuth J.

NEXT DUE DATE: 10/12/24

Certificate Number

CC 005 16

Calibration procedure:
The cup anemometer with calibration against standard air velocity (reference value) 8155-82 and pilot tube with precision differential pressure meter model DPM2500 in an open test section of effect type wind tunnel with 100 mm cross test section area. The WS 02FA sensor in BS 54200 12-1. Wind energy generation apparatus - Part 12-1. Power performance measurements of electricity producing wind turbines. March 2017 was used as calibration guideline.

Traceability:
This certificate provides a traceability of the measurement to recognized the national standards, and to measurement of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: NIMT-0052-21 and NIMT-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 uncertainty - Guide to the expression of uncertainty in measurement).

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

Certificate Number

CD-009-66

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

: Wind Direction Sensor

: Novolyne

: Sensor: WS-02FA

: Data logger: L10-WS-25DL-D

: Sensor: WSD-A5966

: Data logger: A5966

: BKK-FS1371

: New item

: ALS laboratory group (Thailand) Co., Ltd.

: 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Suan Luang,

: Khet Suan Luang, Bangkok 10250 Thailand.

: 16 Jun 2023

: 19 Jun 2023

: 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

: Diffel type wind tunnel of Jirante Assoc. atls Co., Ltd.

CALIBRATION CONDITION

: Wind tunnel cross section area¹

: 900

cm²

: Win direction frontal area²

: 129

cm²

: Diameter of mounting pipe³

: 129

mm

: Blockage ratio of test object⁴

: 0.143

%

Preconditioning

: 24 hours at ambient conditions

Measurement Condition

: The average values during measurement are (24 ± 3) °C, (44 ± 7) %RH and (1010 ± 1) hPa

TABULATION OF RESULTS:

The table on next page give the measured values

Calibrated by:

: Zin Sorawit Thachalao

: Miss Jitraporn Lensamphol



Approved Signatory:

Mr. Parinya Booncharoen
Calibration Department Manager

Remarks:

¹ Wind tunnel cross section area of the wind tunnel

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

³ Diameter of mounting pipe

⁴ Ratio %

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CERTIFICATE OF CALIBRATION

Cert. No.: CT-019-66
Page: 1 of 2

Equipment Name: Data Logger with Temperature sensor

Manufacturer: Novolyne

Model: L10-WS-25DL-D

Serial No.: A5966

ID No.: BKK_FS1371

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) %

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

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.

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

Calibrated by:

☐ Mr. Sorawit Thachalao

☒ Miss Jitraporn Lensamphol

☐ Miss Ruangrump Phoomrit



Approved Signatory:

Mr. Parinya Booncharoen
Calibration Department Manager

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Certificate Number

CD-009-66

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

The wind direction sensor was calibrated against standard rotary encoder by comparison method. During calibration, the measurement was carried out at 45° intervals in clockwise and 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 ₁₀₀ Degree (°)	D ₁₀₀ Degree (°)	Error Degree (°)	U (k=2) Degree (°)
0.000	0	0	0	1.0
45.000	43	-2	-2	1.0
90.000	87	-3	-3	1.0
135.000	132	-3	-3	1.0
180.000	182	2	2	1.0
225.000	228	3	3	1.0
270.000	273	3	3	1.0
315.000	318	3	3	1.0

Remarks:

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





63/14-15,67/35-36, Soi Pelchkasem 7,7/1, Pelchkasem Rd,
Walthapra, Bangkokyai, Bangkok 10600 Thailand
Tel: (66) 02-8680812#13 Fax: (66) 02 8680860 www.jiranatee.com

CERTIFICATE OF CALIBRATION

Calibration No : RH-02042023
Page 1 of 1 Pages

Measurement Item: Relative humidity with data logger
Manufacturer: Novolyx
Model/Type: 110 WS-25DL-D
Serial Number: AS906
ID No: RKK_F51371
Customer: AIS 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: 20P26 001 Due date: Sep 25 2024

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

Measurement Results:
The equipment was connected with indoor air quality probe and Displayed (UFI) on display Model HMP60, Serial num ber V1920207
Calibration was performed in the range of 20%RH to 80%RH
The results of calibration are reported in table below

Determined (%RH)	Standard (%RH)	UUC Reading (%RH)	Error (%RH)	Uncertainty (%RH)
20	20.06	19.5	-0.6	0.53
50	50.22	50.4	0.2	0.53
80	80.21	81.5	1.3	0.53

Performed by:
☐ Mr. Sorawit Thachalad
☒ Miss Jitraporn Lertsomphon
☐ Miss Ruangsamai Phoommit



Approved Signatory:
Mr. Parniya Booncharoen
Calibration Department Manager

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



JIRANATEE ASSOCIATES CO., LTD
63/14-15, 67/35-36,
Soi Pelchkasem 7,7/1, Pelchkasem Rd,
Walthapra, Bangkokyai, Bangkok 10600 Thailand
Tel: (66) 02-8680812#13 Fax: (66) 02 8680860
E-mail: jiracal@jiranatee.com
Web site: www.jiranatee.com

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

Pressure measurement laboratory
Calibration services department



NSC-TISI - TIS 17025
CALIBRATION 0367

CERTIFICATE OF CALIBRATION

Certificate No CP 003 66

Page 1 of 2 Pages

MEASUREMENT ITEM: Digital barometer
MANUFACTURER: Novolyx
MODEL/TYPE: Sensor 110-WS-25RP
Data logger 110 WS 25DL-D
SERIAL NUMBER: Senso BP-AS966
Data logger AS966
ID NUMBER: dHX F51371
CONDITION AS RECEIVED: New item
CUSTOMER: AIS 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 OVD-R 5.1

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
factor k=2, providing a level of confidence of
approximately 95%.

CONDITION OF THIS RESULT OF CALIBRATION:

- Reference Standard Instrument
- 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
At (20°C, 1 bar)
Mass: 1.15 kg/m³
Flow: 1.175 %
Time: (1000±10) mbar
- The certificate is valid only to the item calibrated on date and place of calibration



Calibrated by:
Mr. Sorawit Thachalad
Miss Jitraporn Lertsomphon

Approved signatory:
Mr. Parniya 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



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

Pressure measurement laboratory
Calibration services department



NSC-TISI - TIS 17025
CALIBRATION 0367



JIRANATEE ASSOCIATES CO., LTD
63/14-15, 67/35-36,
Soi Pelchkasem 7,7/1, Pelchkasem Rd,
Walthapra, Bangkokyai, Bangkok 10600 Thailand
Tel: (66) 02-8680812#13 Fax: (66) 02 8680860
E-mail: jiracal@jiranatee.com
Web site: www.jiranatee.com

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

Air speed measurement laboratory
Calibration services department

Handwritten signature and date: 30/11/24

Certificate Number

CC 005 66

CERTIFICATE OF CALIBRATION

Certificate No. CP 003 66

Page 2 of 2 Pages

MEASUREMENT RESULTS: ☒ Without adjustment ☐ With adjustment

CALIBRATION IN THE RANGE OF: 550 mbar to 1050 mbar

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

STD (mbar)	UUC* (mbar)	Error (mbar)	Uncertainty (k=2) (mbar)
550.03	950.6	0.6	0.77
970.14	970.4	0.3	0.51
990.04	990.1	0.1	0.35
1010.12	1010.1	-0.1	0.38
1030.09	1025.8	-0.3	0.50
1050.07	1049.6	-0.5	0.70

Note: UUC* Unit Under Calibration

To convert the result in report unit to Pa should be multiply by 100

End of certificate



Page 1 of 2 Pages

MEASUREMENT ITEM: Cup anemometer
MANUFACTURER: Novolyx
MODEL/TYPE: Sensor WS 03F
Data logger 110 WS-25DL-D
SERIAL NUMBER: Sensor WSD-AS966
Data logger AS966
ID NUMBER: RKK_F51370
CONDITION AS RECEIVED: New item
CUSTOMER: AIS laboratory group (Thailand) Co. Ltd
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand

RECEIVED DATE: 18 May 2023
MEASUREMENT DATE: 30 May 2023
ISSUE DATE: 31 May 2023

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follows:
Temperature: 23.0 ± 3.0 °C
Relative Humidity: 55.0 ± 15.0 %RH
Atmospheric Pressure: 1010.1 ± 10 hPa

PLACE OF CALIBRATION

Eiffel type wind tunnel of Jiranatee Associates Co., Ltd

CALIBRATION CONDITIONS

Wind tunnel cross section area: 900 cm²
Wind direction frontal area: 100 cm²
Diameter of mounting pipe: 10 mm
Blockage ratio of test object: 0.311 [-]

Preconditioning

Measurement Condition

24 hours at ambient conditions
The average values during measurement are (25.0) °C, (46.9) %RH and (1005.9) hPa

TABULATION OF RESULTS

The table on next page give the numerical values

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



Approved signatory:
Mr. Parniya Booncharoen
Calibration Department Manager

Remarks:
* Nominal cross-section area of the wind tunnel
* Measured cross-section area of the tested objects include mounting pipe
* Diameter of mounting pipe
* Ratio "a/b"

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

Certificate Number

CC-005-66

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

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

V_{ref} (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V_{meas} (m/s)	Error (m/s)	U (k=2) (m/s)
1.044	25.06	25.00	0.9	-0.1	0.31
2.049	24.90	25.00	1.9	-0.1	0.31
3.079	25.14	25.00	2.9	-0.1	0.31
4.175	25.00	25.00	3.9	-0.1	0.31
5.00	25.00	25.00	4.9	-0.1	0.31
5.99	24.80	25.00	5.9	-0.1	0.31
7.05	24.96	25.00	6.9	-0.1	0.31
8.18	24.70	25.00	8.0	-0.2	0.31
9.06	25.06	25.00	8.9	-0.1	0.31
10.08	24.70	25.00	10.0	-0.1	0.31
11.15	25.10	25.00	11.0	-0.2	0.31
12.12	24.72	25.00	12.0	-0.1	0.31
13.18	25.08	25.00	13.1	-0.1	0.31
14.22	24.80	25.00	14.1	-0.1	0.31
15.21	25.00	25.00	15.1	-0.1	0.31
16.26	24.90	25.00	16.1	-0.2	0.31

Remarks:

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

² Velocity of standard

³ Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET-UP



Calibration set up of the cup anemometer calibration in the wind tunnel of Jiraratte 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 the image quality.



Jiraratte Associates Co., Ltd.
62/14 15, 17/25 36
Ponkhaeng 7/73, Ad. Westpark Bangkok
Bangkok 10400 Thailand
Tel: +662-008-9192
Fax: +662-008-9193
E-mail: jaco.calibration@jiraratte.com
Web site: www.jiraratte.com

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

Air speed measurement laboratory
Calibration services department

Certificate Number

CD-005-66

CERTIFICATE OF CALIBRATION

Page 2 of 2 Pages

MEASUREMENT ITEM : Wind Direction Sensor
MANUFACTURER : Novalynx
MODEL/TYPE : Sensor WS-02F
SERIAL NUMBER : Data logger 110-WS-250L-D
ID NUMBER : Sensor WSD A5965
CONDITION AS-RECEIVED : Data logger A5965
CUSTOMER : New Item
ALS laboratory group (Thailand) Co., Ltd.
104 Phantananan 40, Phantananan Rd, Khwaeng Suan Luang,
Khet Suan Luang, Bangkok 10250 Thailand

RECEIVED DATE : 19 May 2023
MEASUREMENT DATE : 30 May 2023
ISSUE DATE : 31 May 2023

ENVIRONMENTAL CONDITIONS:

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

PLACE OF CALIBRATION

Diff type wind tunnel of Jiraratte Associates Co., Ltd

CALIBRATION CONDITION

Wind tunnel cross-section area¹ : 900 cm²
Win direction frontal area² : 129 cm²
Diameter of mounting pipe : 0.143 mm
Blockage ratio of test object³ : [-]

Preconditioning

24 hours at ambient conditions.

Measurement Condition

The average values during measurement are (24.5°C, (45.8) %RH and (1005.8) hPa

TABULATION OF RESULTS:

The table on next page give the measured values

Calibrated by:

Mr. Surawut Thachalai
Miss Jiraporn Jertsomphol



Approved signatory

Mr. Parinya Booncharoen
Calibration Department Manager

Remark:

¹ Inside cross-section area of the wind tunnel
² Projected cross-section area of the tested object include mounting pipe
³ Diameter of mounting pipe
⁴ Area ratio

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Certificate Number

CD-005-66

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

The wind direction sensor was calibrated against standard rotary encoder by comparison method. During calibration, the measurement was carried out at 45° intervals in clockwise and 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 in vertical axis. The results of calibration and associated measurement uncertainties are reported in the table below.

Air speed m/s	D°_{ref} Degree (°)	D°_{meas} Degree (°)	Error Degree (°)	U (k=2) Degree (°)
	0.000	0	0	1.0
	45.000	43	-2	1.0
	90.000	89	-1	1.0
	135.000	135	0	1.0
	180.000	182	2	1.0
	225.000	226	1	1.0
	270.000	273	3	1.0
	315.000	317	2	1.0

Remarks:

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

² Direction of standard

³ Direction of Unit Under Calibration



Jiraratte Associates Co., Ltd.

Jiraratte Associates Co., Ltd.
62/14 15, 17/25 36
Ponkhaeng 7/73, Ad. Westpark Bangkok
Bangkok 10400 Thailand
Tel: +662-008-9192
Fax: +662-008-9193
E-mail: jaco.calibration@jiraratte.com
Web site: www.jiraratte.com

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

Pressure measurement laboratory
Calibration services department



CERTIFICATE OF CALIBRATION

Certificate No. CP-002-66

Page 1 of 2 Pages

MEASUREMENT ITEM : Digital barometer
MANUFACTURER : Novalynx
MODEL/TYPE : 110 WS 253P
SERIAL NUMBER : HP A5965
ID NUMBER : Bk-F51370
CONDITION AS-RECEIVED : New Item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phantananan 40, Phantananan Rd,
Khwaeng Suan Luang, Khet Suan Luang,
Bangkok 10250 Thailand

RECEIVED DATE : 19 May 2023
MEASUREMENT DATE : 31 May 2023
ISSUE DATE : 31 May 2023

Calibration procedure:

The pressure calibration was done by in-house calibration method as WI-C-003 according to comparison method with digital pressure calibrator based on DKD R 6.1

Traceability:

The measurement results are traceable to the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) which complies with the requirements of ISO/IEC 17025:2017, ANSI/NCSL Z540-1 and Certificate number: MAP 0205-22

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

CONDITION OF THIS RESULT OF CALIBRATION:

1. Reference Standard Instrument

Instrument	Model	Serial No.	Certificate No.	Due Date
Absolute Pressure Transducer	CPG2500	4100126P	MP-0205-22	02 Dec 2023

2. Calibration effort for calibration sequence A

3. The UUC¹ was installed in vertical orientation above reference standard instrument and center of UUC² was used as the reference level

4. Calibration conditions

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

Calibrated by:

Mr. Surawut Thachalai
Miss Jiraporn Jertsomphol



Approved signatory

Mr. Parinya Booncharoen
Calibration Department Manager

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CERTIFICATE OF CALIBRATION

Certificate No.: CP-007-66

Page 2 of 2 Pages

MEASUREMENT RESULTS

☒ Without adjustment ☐ With adjustment

CALIBRATION IN THE RANGE OF : 950 - 1050 mbar

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

STD (mbar)	UUC* (mbar)	Error (mbar)	Uncertainty (k=2) (mbar)
950.09	951.0	0.9	1.1
970.05	970.7	0.7	0.85
990.02	990.5	0.5	0.71
1010.04	1010.3	0.3	0.46
1030.01	1030.0	0.1	0.33
1050.03	1049.8	-0.2	0.44

Note: UUC* Unit Under Calibration

To convert the result in report unit to Pa should be multiply by 100



CERTIFICATE OF CALIBRATION

Certificate No.: CI-005-66
Page 1 of 2

Equipment Name: Data Logger with Temperature
Sensor

Manufacturer: Novalynx
Model: 110-WS-2501-D
Serial No.: A5965
ID No.: BKA_RS1370

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

Received date: 19 May 2023
Calibration date: 31 May 2023
Issue date: 31 May 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: (25±3) °C
Relative Humidity: (55±15) %

Calibration Procedure

The temperature calibration was done by in-house calibration method as WI-CL-001 according to comparator 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: 11-0038-23, Certificate number: E1-0092 22

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

Calibrated by
Mr. Sorawit Thachalad
Ms. Jitraporn Lertsomphol



Approved Signatory: Mr. Parinya Booncharoen
Calibration Department Manager

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Certificate No.: CI-005-66
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: U3641226

Dimension : Diameter 12 mm Length 80 mm

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	20.001	20.0	0.0	0.099
60	25.004	24.9	-0.1	0.099
60	30.005	29.8	-0.2	0.099
60	35.002	34.8	-0.2	0.099
60	40.001	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-03052023
Page 1 of 1 Pages

Measurement Item : Relative humidity with data logger
Manufacturer : Novalynx
Model/Type : 110-WS-2501-D
Serial Number : A5965
ID No : BKA_RS1370
Customer : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanachai 40, Phatthanachai 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 error.

Traceability

This instrument was calibrated using standard equipment whose accuracy is traceable 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 : May 31, 2023
Issued Date : May 31, 2023

Measurement Results

This equipment was connected with indoor air quality probe and Displayed (RH) on display Model HMP60, Serial number: U3641226

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	19.3	-0.8	0.62
50	50.29	49.4	-0.9	0.63
80	80.27	79.8	-0.5	0.62

Performed by
Mr. Sorawit Thachalad
Ms. Jitraporn Lertsomphol



Approved Signatory: Mr. Parinya Booncharoen
Calibration Department Manager

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

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

Cup anemometer
: Navalyne
: Sensor WS-02F

SERIAL NUMBER

Data logger: 110-WS-250U-D
: Sensor WSD-A5564
Data logger: A5564

ID NUMBER

BKK_F51369

CONDITION AS-RECEIVED

: New Item

CUSTOMER

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

RECEIVED DATE

: 19 May 2023

MEASUREMENT DATE

: 30 May 2023

ISSUE DATE

: 31 May 2023

ENVIRONMENTAL CONDITIONS:

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

PLACE OF CALIBRATION

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

CALIBRATION CONDITIONS

Wind tunnel cross section area¹: 900 cm²
Win direction frontal area²: 103 cm²
Diameter of mounting pipe³: 1 mm
Blockage ratio of test object⁴: 0.111 [%]

Preconditioning

: 24 hours at ambient conditions.

Measurement Condition

: The average values during measurement are (25.0) °C, (47.7) %RH and (1007.4) hPa

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

(1) Mr. Sorawat Thairakul
(2) Miss Jiraporn Leetvornphol



Approved signatory

Mr. Parinya Booncharoen
Calibration Department Manager

Remarks:

¹ Nozzle cross section area of the wind tunnel.
² Projected cross section area of the tested object include mounting pipe.
³ Diameter of mounting pipe.
⁴ Ratio: $\frac{A_o}{A_t}$

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Page 2 of 2 Pages

MEASUREMENT RESULTS⁵

The cup anemometer, UN Under Calibration (UUC) was exercised at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s in 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 _{unc} (m/s)	Error (m/s)	U (k=2) (m/s)
0.548	24.96	25.00	0.9	-0.1	0.31
2.048	25.10	25.00	1.8	-0.2	0.31
3.044	24.92	25.00	2.9	-0.1	0.31
4.170	24.58	25.00	3.9	0.3	0.31
5.02	25.10	25.00	4.9	-0.2	0.31
6.00	24.50	25.00	5.9	-0.1	0.31
7.04	25.20	25.00	6.9	-0.2	0.31
8.17	24.46	25.00	8.0	-0.2	0.31
9.09	25.28	25.00	8.9	-0.2	0.31
10.09	24.40	25.00	10.0	-0.1	0.31
11.13	25.30	25.00	11.0	-0.2	0.31
12.11	24.64	25.00	11.9	-0.2	0.31
13.18	25.16	25.00	13.0	-0.2	0.31
14.24	24.72	25.00	14.0	-0.2	0.31
15.22	25.02	25.00	15.1	-0.1	0.31
16.28	24.86	25.00	16.0	0.3	0.31

Remark:

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

⁵ Velocity of standard

⁵ Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET-UP



Calibration set up of the cup anemometer calibration in the wind tunnel of Jirante Associates Co., Ltd. The cup anemometer shown may differ from the calibrated one. Remark: The proportion of the set-up is not representative of the actual set-up.



CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

Wind Direction Sensor
: Navalyne

MANUFACTURER

: Sensor WS-02F

MODEL/TYPE

Data logger: 110-WS-250U-D

SERIAL NUMBER

: Sensor WSD-A5564

ID NUMBER

: BKK_F51369

CONDITION AS-RECEIVED

: New Item

CUSTOMER

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

RECEIVED DATE

: 19 May 2023

MEASUREMENT DATE

: 10 May 2023

ISSUE DATE

: 31 May 2023

ENVIRONMENTAL CONDITIONS:

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

PLACE OF CALIBRATION

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

CALIBRATION CONDITION

Wind tunnel cross section area¹: 900 cm²
Win direction frontal area²: 129 cm²
Diameter of mounting pipe³: 1 mm
Blockage ratio of test object⁴: 0.143 [%]

Preconditioning

: 24 hours at ambient conditions.

Measurement Condition

: The average values during measurement are (24.0) °C, (46.3) %RH and (1005.6) hPa

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

(1) Mr. Sorawat Thairakul
(2) Miss Jiraporn Leetvornphol



Approved signatory

Mr. Parinya Booncharoen
Calibration Department Manager

Remarks:

¹ Nozzle cross section area of the wind tunnel.
² Projected cross section area of the tested object include mounting pipe.
³ Diameter of mounting pipe.
⁴ Ratio: $\frac{A_o}{A_t}$

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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 direction after initial 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 _{unc} Degree (°)	D _{unc} Degree (°)	Error Degree (°)	U (k=2) Degree (°)
	0.000	0	0	1.0
	45.000	42	-3	1.0
	90.001	88	-2	1.0
	135.000	133	-2	1.0
	180.000	180	0	1.0
	225.000	227	2	1.0
	270.000	272	2	1.0
	315.000	318	3	1.0

Remark:

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

⁵ Direction of standard

⁵ Direction of Unit Under Calibration





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



CERTIFICATE OF CALIBRATION

Certificate No.: CT-005-66
Page 1 of 2

Equipment Name: Data Logger with Temperature Sensor

Manufacturer: Novalynx
Model: 110-WS-25DL-D
Serial No.: A5964
ID No.: BAK-FS1369

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: 19 May 2023
Calibration date: 31 May 2023
Issue date: 31 May 2023

Reference Used During Calibration:
1 Standard Temperature Probe Model: STS-100 A500,
Serial No.: 667662-03, 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: (25±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 sensor 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 0036-23, Certificate number: ER 0092 22

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

Calibrated by:
☐ Mr. Suwail Thachalad
☒ Miss Jitraporn Lertsompol



Approved Signatory:
Mr. Parinya Boonchoroen
Calibration Department Manager

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Watthapra, Bangkokyai, Bangkok 10600 Thailand.
Tel: (66) 02-8680812#13 Fax: (66) 02-8680860 www.jiranatec.com

CERTIFICATE OF CALIBRATION

Calibration No.: RH-02052023
Page 1 of 1 Pages

Measurement Item: Relative humidity with data logger
Manufacturer: Novalynx
Model/Type: 110 WS 25DL-D
Serial Number: A5964
ID No: BAK-FS1369
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 1560 3 in the humidity generator chamber to determine the errors

Traceability:
This instrument was calibrated using standard equipment whose accuracy is traceability through National Institute of Standards and Technology to the international system of units (SI) via MCS Calibration, Inc. Certificate number: 20926 601, Due date: Sep 26, 2024.

Measurement Date: May 31, 2023
Issue Date: May 31, 2023

Measurement Results

This equipment was connected with indicator on quality probe and Displayed (UFR) on display, Model HMP60 Serial number: U3911251.

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

The results of calibration are reported in table below.

Detected (%RH)	Standard Reading (%RH)	UUC average (%RH)	Offset (%RH)	Uncertainty (%RH)
20	20.06	19.2	-0.8	0.52
50	50.28	49.3	-1.0	0.51
80	80.30	79.7	-0.6	0.51

Performed by:
☐ Mr. Suwail Thachalad
☒ Miss Jitraporn Lertsompol



Approved Signatory:
Mr. Parinya Boonchoroen
Calibration Department Manager

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Watthapra, Bangkokyai, Bangkok 10600 Thailand.
Tel: (66) 02-8680812#13 Fax: (66) 02-8680860 www.jiranatec.com



Certificate No.: CT-005-66
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: U3911251.

Dimension: Diameter 12 mm, Length 80 mm

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	20.001	19.9	-0.1	0.099
60	25.004	24.8	-0.2	0.099
60	30.005	29.8	-0.2	0.099
60	35.002	34.8	-0.2	0.099
60	40.001	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 ★



IRANATEC ASSOCIATES CO., LTD.
15,67/35-36, Soi Petchkasem 7/71, Petchkasem Rd,
Watthapra, Bangkokyai, Bangkok 10600 Thailand.
Tel: (66) 02-8680812#13 Fax: (66) 02-8680860
www.jiranatec.com

Accredited calibration laboratory
ISO/IEC 17025:2017
NSC-15H-15 17025
CALIBRATION 0367



Pressure measurement laboratory
Calibration services department

CERTIFICATE OF CALIBRATION

Certificate No.: CP-003-65

Page 1 of 2 Pages

MEASUREMENT ITEM: Digital barometer
MANUFACTURER: Novalynx
MODEL/TYPE: 110 WS 25H-P
SERIAL NUMBER: BK-A5964
ID NUMBER: BAK-FS1369
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: 19 May 2023
MEASUREMENT DATE: 31 May 2023
ISSUE DATE: 31 May 2023

CONDITION OF THIS RESULT OF CALIBRATION:

- Reference Standard Instrument:
Instrument: Model: Serial No.: Certificate No.: Due Date:
Absolute Pressure Transducer: CPG2500 4100120-P MP-0205-22 02 Dec 2023
- Calibration effort for calibration sequence A
- The UUC* was installed in vertical orientation above reference standard instrument and center of UUC* was used as the reference level
- Calibration conditions:
4. Condition: ☒ Normal ☐ Abnormal
Pressure transmitting medium: Air
p (20°C, 1 bar): 1.19 kg/m³
H₂₀: (55±15) %
t_{amb}: (23±3) °C
P_{acc}: (1010±10) mbar
- The certificate is valid only to the item calibrated on date and place of calibration

Calibrated by:
☒ Mr. Suwail Thachalad
☐ Miss Jitraporn Lertsompol



Approved signatory:
Mr. Parinya Boonchoroen
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.

Continuation of Certificate of Calibration Number: CRT-010-67

Measurement Results

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

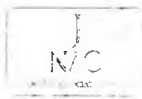
Result of Calibration: ☒ Within Acceptance ☐ Out of Acceptance

Table 1: The results of calibration of the cup anemometer at 20°C calibration temperature.
Calibration Range: 20.0 m/s to 30.0 m/s

Air Temperature (°C)	Standard Reading (m/s)	UUC Reading (m/s)	Error (m/s)	Uncertainty (m/s)
20.56	13.81	13.71	-0.10	0.04
20.69	14.51	14.41	-0.10	0.04
20.83	15.21	15.11	-0.10	0.04

UUC: Uncertainty Calibration

End of Certificate of Calibration



Jirarate Associates Co., Ltd.
67/14-15, 67/15-16
Jirarate Tower 2/20, Rajawongse, Bangkok
Bangkok 10330 (Thailand)
Tel: +66-2-682212
Mobile: +66-2-682213
E-mail: nac@jirarate.com
Website: www.jirarate.com

Accredited calibration laboratory
ISO/IEC 17025:2017
NSC TSI ITS 17025
CALIBRATION 0367

Air speed measurement laboratory
Calibration services department

Certificate Number

CC-011-66

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

: Cup anemometer

: Navalyra

: Sensor: WS-02FA

: Data logger: 110 WS-25DL-D

: Sensor: WSD-A5970

: Data logger: A5970

: BKK_F51373

: New Item

: ALS laboratory group (Thailand) Co., Ltd.

: 104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,

: Khet Suan Luang, Bangkok 10250 Thailand

Calibration procedure:

The cup anemometer was calibrated against Standard air velocity transducer model: 8455-32 and pitot tube with precision differential pressure meter model: DPM2500 in an open test section of Effel-type wind tunnel with 900 cm² cross test section area. The WSD-A5970 based on IEC 61400-12-2, Wind energy generation systems - Part 12-2: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:

This certificate provides a traceability of the measurement to 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: NM-0052-23 and NM-0066-23.

Uncertainty of Measurement:

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

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

: 16 Jun 2023

: 19 Jun 2023

: 19 Jun 2023

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follows:

Temperature

Relative Humidity

Atmospheric Pressure

: 23.0 ± 3.0 °C

: 55.0 ± 15.0 %RH

: 1010 ± 10 hPa

PLACE OF CALIBRATION

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

CALIBRATION CONDITIONS

Wind tunnel cross-section area¹

Wind direction frontal area²

Diameter of mounting pipe³

Blockage ratio of test object⁴

: 900 cm²

: 100 cm²

: 0.111 [-]

Preconditioning

Measurement Condition

: 24 hours at ambient conditions

: The average values during measurement are (24.0) °C, (43.4) %RH and (1007.9) hPa

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

: Mr. Sorawit Thuehwalid

: Miss Jiraporn Lertsomphol



Approved signature:

Mr. Pannya Boontharoen

Calibration Department Manager

Remarks:

¹ Available 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: [-]

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

Certificate Number

CC-011-66

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

The cup anemometer, Unit Under Calibration (UUC) was exercised at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was generated 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} ² (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V _{meas} ³ (m/s)	Error (m/s)	U (m/s)
1.024	23.98	24.00	0.8	-0.1	0.31
2.021	24.00	24.00	1.9	-0.1	0.31
3.019	23.82	24.00	2.9	-0.1	0.31
4.124	24.00	24.00	4.0	-0.1	0.31
5.02	23.62	24.00	4.9	-0.1	0.31
5.9	24.06	24.00	5.9	-0.1	0.31
7.05	23.58	24.00	7.0	-0.1	0.31
8.17	24.04	24.00	8.0	-0.2	0.31
9.09	23.56	24.00	9.0	-0.1	0.31
10.08	23.92	24.00	10.0	-0.1	0.31
11.14	23.56	24.00	11.0	0.1	0.31
12.14	23.72	24.00	12.1	0.1	0.31
13.19	23.50	24.00	13.2	0.0	0.31
14.25	23.68	24.00	14.3	0.0	0.31
15.34	23.50	24.00	15.1	0.1	0.31
16.29	23.52	24.00	16.2	-0.1	0.31

Remark:

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

¹ Velocity of standard

² Velocity of test object Calibration

PHOTO OF CALIBRATION SET-UP



Calibration set-up of the cup anemometer calibration in the wind tunnel of Jirarate Associates Co., Ltd. The cup anemometer shown may differ from the calibrated one. Remarks: The proportion of 1: scale up is not true to scale due to imaging geometry.



Jirarate Associates Co., Ltd.
67/14-15, 67/15-16
Jirarate Tower 2/20, Rajawongse, Bangkok
Bangkok 10330 (Thailand)
Tel: +66-2-682212
Mobile: +66-2-682213
E-mail: nac@jirarate.com
Website: www.jirarate.com

Accredited calibration laboratory
ISO/IEC 17025:2017
NSC TSI ITS 17025
CALIBRATION 0367

Air speed measurement laboratory
Calibration services department

Certificate Number

CC-011-66

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

: Wind Direction Sensor

: Navalyra

: Sensor: WS-02FA

: Data logger: 110 WS-25DL-D

: Sensor: WSD-A5970

: Data logger: A5970

: BKK_F51373

: New Item

: ALS laboratory group (Thailand) Co., Ltd.

: 104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,

: Khet Suan Luang, Bangkok 10250 Thailand

Calibration procedure:

The wind direction sensor was calibrated against Standard Rotary Encoder model: 84400175 DMD-83 S-10 in an open test section of Effel-type wind tunnel with 900 cm² cross test section area. The WSD-A5970 based on IEC 61400-12-2, Wind energy generation systems - Part 12-2: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:

This certificate provides a traceability of the measurement to 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: NM-0052-23 and NM-0066-23.

Uncertainty of Measurement

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

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

: 16 Jun 2023

: 19 Jun 2023

: 19 Jun 2023

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follows:

Temperature

Relative Humidity

Atmospheric Pressure

: 23.0 ± 3.0 °C

: 55.0 ± 15.0 %RH

: 1010 ± 10 hPa

PLACE OF CALIBRATION

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

CALIBRATION CONDITION

Wind tunnel cross-section area¹

Wind direction frontal area²

Diameter of mounting pipe³

Blockage ratio of test object⁴

: 900 cm²

: 129 cm²

: 0.143 [-]

Preconditioning

Measurement Condition

: 24 hours at ambient conditions

: The average values during measurement are (24.1) °C, (48.7) %RH and (1011.3) hPa

TABULATION OF RESULTS

The table on next page give the measured values.

Calibrated by:

: Mr. Sorawit Thuehwalid

: Miss Jiraporn Lertsomphol



Approved signature:

Mr. Pannya Boontharoen

Calibration Department Manager

Remarks:

¹ Available 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: [-]

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

Certificate Number

CD-011-66

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

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

Air speed m/s	D ₁ °	D ₂ °	Error Degree (°)	U (k=2) Degree (°)
	Degree (°)	Degree (°)	Degree (°)	Degree (°)
	0.000	0	0	1.0
	45.000	42	-3	1.0
	90.000	87	-3	1.0
5.06	135.000	133	-2	1.0
	180.000	181	1	1.0
	225.001	226	3	1.0
	270.000	273	3	1.0
	315.000	318	3	1.0

Remark:

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

² Direction of standard

Direction of Unit Under Calibration

End of Certificate



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



CERTIFICATE OF CALIBRATION

Certificate No.: CT-021-66
Page 1 of 2

Equipment Name: Data Logger with Temperature sensor

Manufacturer: Novatynx

Model: 110 WS 25DL D

Serial No.: A5970

ID No.: BKK_FS1373

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: CR 0092 22.

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

Calibrated by

☐ Mr. Sorawit Thachalad
☒ Miss Jittaporn Lertsomphol
☐ Miss Ruangrumpi Phoommit



Approved Signatory:

Mr. Parinya Booncharoen
Calibration Department Manager

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



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



Certificate No.: CT-021-66
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: V1920209

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	25.052	25.0	0.1	0.099
70	30.044	29.8	-0.2	0.099
70	35.040	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 *



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

CERTIFICATE OF CALIBRATION

Calibration No.: RH-04062023
Page 1 of 1 Pages

Measurement Item: Relative humidity with data logger

Manufacturer: Novatynx

Model/Type: 110 WS 25DL D

Serial Number: A5970

ID No.: BKK_FS1373

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 (60±10)%.

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 traceable through National Institute of Standards and Technology to the international system of units (SI) via MCS Calibration Inc. Certificate number: 20026 001. 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 (RH) on display. Model HMP60, Serial number V1920209.

Calibration was performed in the range of 20%RH to 60%RH.

The results of calibration are reported in table below:

Determined (%RH)	Standard (%RH)	UUC (%RH)	Error (%RH)	Uncertainty (%RH)
20	20.07	19.2	-0.9	0.52
50	50.23	49.2	-1.0	0.51
60	60.24	59.5	-0.8	0.52

Performed by

☐ Mr. Sorawit Thachalad
☒ Miss Jittaporn Lertsomphol
☐ Miss Ruangrumpi Phoommit



Approved Signatory:

Mr. Parinya Booncharoen
Calibration Department Manager

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



JIRANATTE ASSOCIATES CO., LTD.
Jirante Associate Co., Ltd.
67/14 15 67/15 16
Pichasum 7/21, 5/1 Wathana Bangk
Bangkok 10250 Thailand
Tel : +662 001812
Mobile : +662 999453
E-mail : jirante@jirante.co.th
Web site : www.jirante.com

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

Pressure measurement laboratory
Calibration services department



NSC-TISI-TIS 17025
CALIBRATION 0367

CERTIFICATE OF CALIBRATION

Certificate No. : CP-005-GG

Page 1 of 2 Pages

MEASUREMENT ITEM : Digital barometer
MANUFACTURER : NovaYma
MODEL/TYPE : Sensor: 110-WS-258P
Data logger: 110-WS-25D-LD
SERIAL NUMBER : Sensor: BP-A5970
Data logger: A5970
ID NUMBER : BKK_FS1373
CONDITION AS-RECEIVED : New Item
CUSTOMER : ALS laboratory group (Tha) and Co., Ltd
104 Phatthanakan 40, Phatthanakan Rd,
Khwang 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 linked on DDC-2 F-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 factor $k=2$, providing a level of confidence of approximately 95%

CONDITION OF THIS RESULT OF CALIBRATION:

1. Reference Standard Instrument

Instrument	Model	Serial No.	Certificate No.	Due Date
Absolute Pressure Transducer	CPG2500	4100126P	MP-0205-22	02 Dec 2023

- 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 in 1
- Calibration conditions
- Condition

<input checked="" type="checkbox"/> Normal	<input type="checkbox"/> Abnormal
Pressure transmitting medium	Air
p_1 (20°C, 1 bar)	$\pm 1.5 \text{ kg/m}^3$
H	$(55 \pm 15) \text{ m}$
T_{true}	$(23.4 \pm 1) ^\circ\text{C}$
P_{true}	$(1010 \pm 10) \text{ mbar}$
- The certificate is valid only to the item calibrated on date and place of calibration

Calibrated by:
Mr. Sorawit Thachala
Ms. 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 IN WRITING FROM THE LABORATORY



JIRANATTE ASSOCIATES CO., LTD.
Jirante Associate Co., Ltd.
67/14 15 67/15 16
Pichasum 7/21, 5/1 Wathana Bangk
Bangkok 10250 Thailand
Tel : +662 001812
Mobile : +662 999453
E-mail : jirante@jirante.co.th
Web site : www.jirante.com

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

Pressure measurement laboratory
Calibration services department



NSC-TISI-TIS 17025
CALIBRATION 0367

CERTIFICATE OF CALIBRATION

Certificate No. : CT-005-66

Page 2 of 2 Pages

MEASUREMENT RESULTS : ☒ Without adjustment ☐ With adjustment

CALIBRATION IN THE RANGE OF : 950 mbar to 1050 mbar

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

STD (mbar)	UUC* (mbar)	Error (mbar)	Uncertainty (k=2) (mbar)
950.05	950.9	0.6	1.0
970.11	970.7	0.6	0.79
990.07	990.4	0.3	0.50
1010.10	1010.2	0.1	0.38
1030.06	1029.6	-0.3	0.48
1050.09	1049.6	-0.5	0.65

Note: UUC* Unit Under Calibration
To convert the result in report unit to Pa should be multiply by 100.

End of certificate



Certificate Number

CC-010-66

Page 2 of 2 Pages

MEASUREMENT RESULTS⁵

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

V_{std} (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V_{true} (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
8.15	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	23.96	24.10	13.0	-0.2	0.31
14.23	24.04	24.10	14.0	-0.2	0.31
15.22	24.01	24.10	15.1	-0.1	0.31
16.27	23.92	24.10	16.1	-0.2	0.31

Remark:

Calibration results only apply for the tested circumstances and environmental conditions during which calibration was done.

Velocity of standard

Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET UP



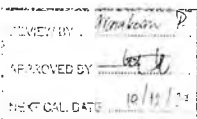
Calibration set up of the cup anemometer calibration in the wind tunnel of Jirante Associates Co., Ltd. The cup anemometer shown may differ from the calibrated one in Remark. The proportion of the set up is not true to scale due to imaging geometry.



JIRANATTE ASSOCIATES CO., LTD.
Jirante Associate Co., Ltd.
67/14 15 67/15 16
Pichasum 7/21, 5/1 Wathana Bangk
Bangkok 10250 Thailand
Tel : +662 001812
Mobile : +662 999453
E-mail : jirante@jirante.co.th
Web site : www.jirante.com

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

Air speed measurement laboratory
Calibration services department



Certificate Number

CC-010-66

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM : Cup anemometer
MANUFACTURER : NovaYma
MODEL/TYPE : Sensor: WS-02FA
Data logger: 110-WS-25D-LD
SERIAL NUMBER : Sensor: WSD-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, Khwang 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 : $23.0 \pm 0.5 ^\circ\text{C}$
Relative Humidity : $55.0 \pm 15.0 \%$
Atmospheric Pressure : $1010 \pm 10 \text{ hPa}$

PLACE OF CALIBRATION : Eiffel-type wind tunnel at Jirante Associates Co., Ltd

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

Preconditioning : 24 hours at ambient conditions
Measurement Condition : The average values during measurement are $(24.1 \pm 1) ^\circ\text{C}$, $(44.5 \pm 5) \%$ RH and $(1008.0 \pm 10) \text{ hPa}$

TABULATION OF RESULTS

The table on next page give the measures values

Calibrated by:
Mr. Sorawit Thachala
Ms. Jitraporn Lertsomphol



Approved signatory

Mr. Parinya Booncharoen
Calibration Department Manager

Remark:

- nominal cross-section area of the wind tunnel
- Pre-wind cross-section area of the tested object include mounting pipe
- Diameter of mounting pipe
- Ratio $\frac{A_o}{A_t}$

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

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM : Wind Direction Sensor
MANUFACTURER : Novolyn
MODEL/TYPE : Sensor WS-02FA
Data logger: STS-100 WS-25DL-D
SERIAL NUMBER : Sensor WSD-A5969
Data logger: BKK-FS1372
ID NUMBER : New item
CONDITION AS RECEIVED : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,
Khet Suan Luang, Bangkok 10250 Thailand

RECEIVED DATE : 16 Jun 2023
MEASUREMENT DATE : 19 Jun 2023
ISSUE DATE : 19 Jun 2023

ENVIRONMENTAL CONDITIONS:

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

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

CALIBRATION CONDITION
Wind tunnel cross-section area¹ : 900 cm²
Win direction frontal area² : 129 cm²
Diameter of nozzle of pipe³ : mm
Blockage ratio of test object⁴ : 0.343 [-]

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (24.3°C, 64.7%RH) and (1010.1) hPa

TABULATION OF RESULTS:

The table on next page give the measured values

Calibrated by:
Mr. Sorawit Thachala
Miss Jiraporn Lertsuaporn



Approved signatory

Mr. Panyak Booncharoen
Calibration Department Manager

Remarks:
¹ Nozzle cross-section area of the wind tunnel
² Mounted cross-section area of the tested object include mounting pipe
³ Diameter of mounting pipe
⁴ Ratio to ¹

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

Page 2 of 2 Pages

MEASUREMENT 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 _{1m} Degree (°)	D _{1m} Degree (°)	Error Degree (°)	U (k=2) Degree (°)
0.000	0	0	0	1.0
45.000	42	42	-3	1.0
90.000	87	87	-3	1.0
135.000	133	133	-2	1.0
180.000	180	180	1	1.0
225.000	228	228	8	1.0
270.000	273	273	3	1.0
315.000	318	318	8	1.0

Remarks:

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

Direct on standard

Direction of Unit Under Calibration

End of Certificate of Calibration



CERTIFICATE OF CALIBRATION

Certificate No.: CT 020 66
Page 1 of 2

Equipment Name : Data Logger with Temperature sensor
Manufacturer : Novolyn
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

Reference Used During Calibration
1 Standard Temperature Probe Model STS-100 A500
Serial No.: 667582-09, Due date: 28 Mar 2024
2 Digital Temperature Indicator Model: DTI 1000 A MK
II Serial No.: 671407-00591 Due date: 27 July 2023

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

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

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

Traceability
The measurement results are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT) Certificate number: TT 0036 23 Certificate number: ER 0092 22

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

Calibrated by:
☒ Mr. Sorawit Thachala
☒ Miss Jiraporn Lertsuaporn
☒ Miss Ruangrumpai Phoommit



Approved Signatory

Mr. Panyak Booncharoen
Calibration Department Manager

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 ★





63/14-15,67/35-36, Soi Pelchhasem 7,7/1, Pelchhasem Rd,
Wallhapra, Bangkokyui, Bangkok 10600 Thailand.
Tel: (66) 02-8680812#13 Fax: (66) 02 8680860 www.jiranate.com

CERTIFICATE OF CALIBRATION

Calibration No : RI103062023
Page 1 of 1 Pages

Measurement Item : Relative humidity with data logger
Manufacturer : Novatlynx
Model/Type : 110 WS 25D-D
Serial Number : A5069
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: 20926-001. Due date Sep 26, 2024

Measurement Date : 1 Jun 19, 2023
Issued Date : 1 Jun 22, 2023

Measurement Results

This equipment was connected with indoor air quality probe and Displayed (UUC) on display. Model: HMP60, Serial number: 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 (%RH)	UUC (%RH)	Error (%RH)	Uncertainty (%RH)
20	20.05	19.8	-0.7	0.52
50	50.28	49.8	-0.5	0.52
80	80.34	80.4	0.1	0.52

Performed by

- ☒ Mr. Sorawit Thachaiad
☒ Miss Jitraporn Lerlsonphol
☒ Miss Ruangrumpai Phoomini



Approved Signatory:

Mr. Parinya Booncharoen
Calibration Department Manager



JIRANATE ASSOCIATES CO., LTD.

Branches Associates Co., Ltd.
63/14-15, 67/35-36
Pelchhasem 7,7/1, Pelchhasem Rd, Bangkok
Bangkok 10600 (Thailand)
Tel: (66) 02-8680812
Fax: (66) 02-8680860
E-mail: info@jiranate.com
Web site: www.jiranate.com

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



Pressure measurement laboratory
Calibration services department

CERTIFICATE OF CALIBRATION

Certificate No : CP-004-66

Page 2 of 2 Pages

MEASUREMENT ITEM
MANUFACTURER
MODEL/TYPE

: Digital barometer
: Novatlynx
: Sensor : 110 WS-25BP
Data logger: 110-WS 25D-D
: Sensor : 3P-A5069
Data logger: A5069

SERIAL NUMBER

ID NUMBER
CONDITION AS-RECEIVED
CUSTOMER

: BKK-FS1372
: New item
: ALS laboratory group (Thailand) Co., Ltd
104 Phatthanakan 40, Phatthanakan Rd,
Khwaeng Suan Luang, Khet Suan Luang
Bangkok 10250 Thailand

RECEIVED DATE
MEASUREMENT DATE
ISSUE DATE

: 16 Jun 2023
: 19 Jun 2023
: 19 Jun 2023

Calibration procedure:

The pressure calibration was done by in-house calibration method as W/CL-003 according to comparison method with Digital pressure calibrator based on DKO-2-5

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 factor $k=2$, providing a level of confidence of approximately 95%

CONDITION OF THIS RESULT OF CALIBRATION

1. Reference Standard Instrument:

Instrument	Model	Serial No.	Certificate No.	Due Date
Absolute Pressure Transducer	CPG2500	4100124P	MP-0205-22	02 Dec 2023

2. 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

3. Calibration conditions

4. Condition
Pressure transmitting medium ☒ Normal ☐ Abnormal
Air
 p (20°C, 3 bar) : 3.19 kg/m³
 H_{rel} : (55±15) %
 T_{amb} : (23±3) °C
 p_{max} : (1030±10) mbar

5. The certificate is valid only for the item calibrated on date and place of calibration

Calibrated by:

- ☒ Mr. Sorawit Thachaiad
☒ Miss Jitraporn Lerlsonphol



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 IN WRITING FROM THE LABORATORY



JIRANATE ASSOCIATES CO., LTD.

Branches Associates Co., Ltd.
63/14-15, 67/35-36
Pelchhasem 7,7/1, Pelchhasem Rd, Bangkok
Bangkok 10600 (Thailand)
Tel: (66) 02-8680812
Fax: (66) 02-8680860
E-mail: info@jiranate.com
Web site: www.jiranate.com

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



Pressure measurement laboratory
Calibration services department



JIRANATE ASSOCIATES CO., LTD.

Branches Associates Co., Ltd.
63/14-15, 67/35-36
Pelchhasem 7,7/1, Pelchhasem Rd, Bangkok
Bangkok 10600 (Thailand)
Tel: (66) 02-8680812
Fax: (66) 02-8680860
E-mail: info@jiranate.com
Web site: www.jiranate.com

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

Air speed measurement laboratory
Calibration services department



Certificate Number

CWS-003-67

CERTIFICATE OF CALIBRATION

Certificate No : CP-004-66

Page 2 of 2 Pages

MEASUREMENT RESULTS : ☒ Without adjustment ☐ With adjustment

CALIBRATION IN THE RANGE OF : 950 mbar to 1050 mbar

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

STD (mbar)	UUC* (mbar)	Error (mbar)	Uncertainty (k=2) (mbar)
950.05	950.5	0.4	0.59
970.06	970.3	0.7	0.45
990.05	990.2	0.1	0.41
1010.07	1010.0	-0.1	0.38
1030.05	1029.6	-0.2	0.48
1050.05	1049.6	-0.4	0.64

Note: UUC* Unit Under Calibration

To convert the result in report unit to Pa should be multiply by 100

End of certificate



Page 1 of 2 Pages

MEASUREMENT ITEM
MANUFACTURER
MODEL/TYPE

: Cup anemometer
: Novatlynx
: Sensor : WS-02F
Data logger: 200-WS-25D-D
: Sensor: WSD A4940
Data logger: A4940
: 80K-FS0165

SERIAL NUMBER

ID NUMBER
CONDITION AS-RECEIVED
CUSTOMER

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

RECEIVED DATE
MEASUREMENT DATE
ISSUE DATE

: 25 Dec 2023
: 04 Jan 2024
: 05 Jan 2024

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follows:
Temperature : 23.0 ± 3.0 °C
Relative Humidity : 55.0 ± 15.0 %RH
Atmospheric Pressure : 1010.0 ± 30 hPa

PLACE OF CALIBRATION

: Entry type wind tunnel of Jiranate Associates Co., Ltd

CALIBRATION CONDITIONS

Wind tunnel cross section area¹ : 900 cm²
Wind direction vertical angle² : 100 cm²
Diameter of mounting pipe³ : mm
Blockage ratio of test object⁴ : 0.111 [-]

Preconditioning
Measurement Condition

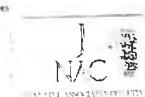
24 hours at ambient conditions
The average values during measurement are (23.9) °C, (50.5) %RH and (1011.5) hPa

TABULATION OF RESULTS:

The table on next page give the measured values

Calibrated by:

- ☒ Mr. Sorawit Thachaiad
☒ Miss Jitraporn Lerlsonphol



Approved signatory

Mr. Parinya Booncharoen
Calibration Department Manager

Remark:

- ¹ Nominal 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 P_{obj}/P_{ref}

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

Certificate Number

CWS-003 67

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

The Cup anemometer Unit Under Calibration (UUC) was exercised at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer which was installed 30 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 pressure 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 30 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

V_{ref} (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V_{meas} (m/s)	Error (m/s)	U (k=2) (m/s)
1.018	23.82	23.85	0.5	-0.1	0.31
2.043	23.80	23.85	1.9	-0.2	0.31
2.993	23.78	23.85	2.9	-0.1	0.31
4.164	23.80	23.85	3.9	0.2	0.31
5.06	23.44	23.85	5.0	0.0	0.31
6.00	23.98	23.85	6.0	0.0	0.31
7.02	23.30	23.85	7.0	0.0	0.31
7.97	23.48	23.85	8.0	0.1	0.31
8.97	23.20	23.85	9.1	0.1	0.31
10.02	23.50	23.85	10.1	0.1	0.31
11.04	23.30	23.85	11.2	0.2	0.31
12.07	23.60	23.85	12.2	0.2	0.31
13.04	23.40	23.85	13.2	0.2	0.31
14.03	23.64	23.85	14.2	0.2	0.31
15.03	23.50	23.85	15.3	0.3	0.31
16.03	23.50	23.85	16.3	0.3	0.31

Remark:

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

² Value of 1 m/s standard.

Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET UP



Calibration set up of the Cup anemometer calibration in the wind tunnel of Jirarat Associates Co., Ltd. The Cup anemometer shown may differ from the calibrated one. Remark: The proportion of the set up is not true to scale for environmental purposes.



Jirarat Associates Co., Ltd.
107/111 107/112-10
Petchkasem 7 St., N. Wattana Bangkok
Bangkok 10600 (Thailand)
Tel: +66-2-618-8112
Mobile: +66-9-0994542
E-mail: jirarat@jirarat.com
Web site: www.jirarat.com

Accredited calibration laboratory

ISO/IEC 17025:2017
NSC-TIS 16 17025
CALIBRATION 0367

Wind direction measurement laboratory
Calibration services department



NSC-TIS1-TIS 17025
CALIBRATION 0367

Certificate Number

CWS-003 67

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature: 23.0 ± 3.0 °C

Relative Humidity: 55.0 ± 35.0 %RH

Atmospheric Pressure: 1010 ± 10 hPa

PLACE OF CALIBRATION

CALIBRATION CONDITION

Wind tunnel cross section area¹ 900 cm²

Wind direction frontal area² 129 cm²

Diameter of mounting pipe³ 1 mm

Blockage ratio of test object⁴ 0.143 [-]

Preconditioning

Measurement Condition

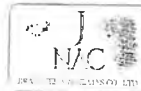
TABULATION OF RESULTS:

The table on next page give the measured values

Calibrated by:

☒ Mr. Sorawat Thakulad

☐ Miss Jiraporn Lertsupamol



Approved signatory

Mr. Rattana Booncharoen
Calibration Department Manager

Remark:

¹ Available cross-section area of the wind tunnel

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

³ Diameter of mounting pipe

⁴ Ratio $\frac{A_o}{A_t}$

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

Certificate Number

CWS-003-67

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° interval 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 (°)
5.04	45.000	41	-4	0.83
	90.919	87	-3	0.80
	135.000	133	-2	0.80
	180.000	182	2	0.80
	225.000	230	5	0.80
	270.000	275	5	0.80
	315.000	320	5	0.80
	350.000	359	-1	0.80

Remark:

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

² Direction of standard

Direction of Unit Under Calibration

End of Certificate of Calibration



Jirarat Associates Co., Ltd.
107/111 107/112-10
Petchkasem 7 St., N. Wattana Bangkok
Bangkok 10600 (Thailand)
Tel: +66-2-618-8112
Mobile: +66-9-0994542
E-mail: jirarat@jirarat.com
Web site: www.jirarat.com

Accredited calibration laboratory

ISO/IEC 17025:2017
NSC-TIS-15 17025
CALIBRATION 0367

Air speed measurement laboratory

Calibration services department



NSC-TIS1-TIS 17025
CALIBRATION 0367

Certificate Number

CWS-003-66

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature: 23.0 ± 3.0 °C

Relative Humidity: 55.0 ± 35.0 %RH

Atmospheric Pressure: 1010 ± 10 hPa

PLACE OF CALIBRATION

CALIBRATION CONDITIONS

Wind tunnel cross-section area¹ 900 cm²

Wind direction frontal area² 100 cm²

Diameter of mounting pipe³ 1 mm

Blockage ratio of test object⁴ 0.111 [-]

Preconditioning

Measurement Condition

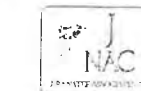
TABULATION OF RESULTS:

The table on next page give the measured values

Calibrated by:

☒ Mr. Sorawat Thakulad

☐ Miss Jiraporn Lertsupamol



Approved signatory

Mr. Rattana Booncharoen
Calibration Department Manager

Remark:

¹ Available cross-section area of the wind tunnel

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

³ Diameter of mounting pipe

⁴ Ratio $\frac{A_o}{A_t}$

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

Certificate Number
CWS-017-66

Page 2 of 2 Pages

MEASUREMENT RESULTS⁵

The Cup anemometer, Unit Under Calibration (UUC) was exercised at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 16 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 3 m/s to 16 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 power 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 3 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)	$U^*(k=2)$ (m/s)
0.978	24.10	24.05	0.8	-0.2	0.31
2.031	24.00	24.05	1.9	-0.2	0.31
3.020	23.90	24.05	2.8	-0.2	0.31
4.245	23.94	24.05	3.9	-0.2	0.31
5.06	23.60	24.05	5.0	-0.1	0.31
6.01	24.30	24.05	5.9	-0.1	0.31
7.04	23.62	24.05	7.0	0.0	0.31
7.57	24.24	24.05	8.0	0.0	0.31
8.57	23.70	24.05	9.0	0.0	0.31
10.03	24.08	24.05	10.1	0.1	0.31
11.03	23.70	24.05	11.1	0.1	0.31
12.34	23.94	24.05	12.0	0.0	0.31
13.01	23.70	24.05	13.1	0.1	0.31
14.00	23.62	24.05	14.3	0.1	0.31
15.02	23.70	24.05	15.1	0.1	0.31
16.02	23.74	24.05	16.1	0.1	0.31

Remarks:

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

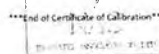
¹ Velocity of standard

Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET-UP



Calibration set-up of the Cup anemometer calibration in the wind tunnel of Jiranatee Associates Co., Ltd. The Cup anemometer shown may differ from the calibrated one. Remarks: The proportion of the set-up is not true for better understanding of the picture.



Jiranatee Associates Co., Ltd.
6/14-15, 67523-31
P.O. Box 100, 10110 Bangkok, Bangkok
Bangkok 10110, Thailand
Tel: 02-010-8822
Mobile: 09-010-8822
E-mail: nac@jiranatee.com
Website: www.jiranatee.com

Accredited calibration laboratory
ISO/IEC 17025:2017
NSC-TISI TIS 17025
CALIBRATION 0367
Wind direction measurement laboratory
Calibration services department



NSC-TISI-TIS 17025
CALIBRATION 0367

Certificate Number
CWD-017-66

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

Wind Direction Sensor

: Navalyne

: Sensor: WS-02F

: Data logger: 110-WS-2500-D

: Sensor: WS0-AS447

: Data logger: AS447

: SSK_F50039

: Used item

: ALS laboratory group (Thailand) Co., Ltd.

: 104 Phatthanasukan 40, Phatthanasukan Rd, Khwaeng Suan Luang,

: Khet Suan Luang, Bangkok 10250 Thailand

RECEIVED DATE

: 15 Dec 2023

MEASUREMENT DATE

: 19 Dec 2023

ISSUE DATE

: 20 Dec 2023

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follows:

Temperature : 23.0 ± 3.0 °C

Relative Humidity : 55.0 ± 15.0 %RH

Atmospheric Pressure : 1010 ± 10 hPa

PLACE OF CALIBRATION

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

CALIBRATION CONDITION

: Wind tunnel cross section area¹ : 500 cm²

: Win direction frontal area² : 129 cm²

: Diameter of mounting pipe³ : 1 mm

: Blockage ratio of first object⁴ : 0.143 (-)

Preconditioning

: 24 hours at ambient conditions

Measurement Condition

: The average values during measurement are (24.2) °C, (52.6) %RH and (1013.7) hPa

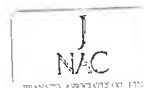
TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

: Mr. Sorawit Thachalad

: Miss Jiraporn Lertsomphol



Approved signature

Mr. Pannya Booncharoen
Calibration Department Manager

Remarks:

¹ Nominal cross-section area of the wind tunnel

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

³ Diameter of mounting pipe

⁴ Ratio: 1 to 1

THIS CERTIFICATE OF CALIBRATION MAY NOT BE REPRODUCED EXCEPT IN FULL UNLESS PERMISSION FOR REPRODUCTION HAS BEEN OBTAINED
JIRANATEE ASSOCIATES CO., LTD.

Certificate Number
CWD 017 66

Page 2 of 2 Pages

MEASUREMENT RESULTS⁵

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

Air speed m/s	D°_{CW} Degree (°)	D°_{CCW} Degree (°)	Error Degree (°)	$U^*(k=2)$ Degree (°)
5.04	45.000	41	-4	0.80
	90.000	87	-3	0.80
	135.000	132	-3	0.80
	180.000	182	2	0.80
	225.000	228	4	0.80
	270.000	275	5	0.80
	315.000	320	5	0.80
	360.000	359	-1	0.80

Remarks:

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

¹ Direction of standard

Direction of Unit Under Calibration

End of Certificate of Calibration



Jiranatee Associates Co., Ltd.
6/14-15, 67523-31
P.O. Box 100, 10110 Bangkok, Bangkok
Bangkok 10110, Thailand
Tel: 02-010-8822
Mobile: 09-010-8822
E-mail: nac@jiranatee.com
Website: www.jiranatee.com

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

Temperature measurement laboratory
Calibration services department



NSC-TISI-TIS 17025
CALIBRATION 0367

CERTIFICATE OF CALIBRATION

Certificate No : CDT-065-66

Page 1 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

Data Logger with Temperature sensor

: Navalyne

: 110-WS-2500-D

: AS447

: SSK_F50039

: Used item

: ALS laboratory group (Thailand) Co., Ltd.

: 104 Phatthanasukan 40, Phatthanasukan Rd,

: Khwaeng Suan Luang, Khet Suan Luang,

: Bangkok 10250 Thailand

RECEIVED DATE

: 15 Dec 2023

MEASUREMENT DATE

: 19 Dec 2023

ISSUE DATE

: 20 Dec 2023

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follows:

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.



Approved signature

Mr. Pannya Booncharoen
Calibration Department Manager

Calibrated by:

: Mr. Sorawit Thachalad

: Miss Jiraporn Lertsomphol

: Miss Ruangsri Phoommit

THIS CERTIFICATE MAY NOT BE REPRODUCED EXCEPT IN FULL UNLESS PERMISSION FOR REPRODUCTION HAS BEEN OBTAINED
JIRANATEE ASSOCIATES CO., LTD.

CERTIFICATE OF CALIBRATION

Certificate No. CPR-015-66

Page 2 of 2 Pages

MEASUREMENT RESULTS : ☒ Without adjustment ☐ With adjustment

CALIBRATION IN THE RANGE OF : 950 mbar to 1050 mbar

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

STD (mbar)	UUC* (mbar)	Error (mbar)	Uncertainty (k=2) (mbar)
950.00	951.1	1.1	0.37
970.00	970.8	0.8	0.37
990.00	990.2	0.2	0.37
1009.99	1009.9	0.1	0.37
1030.01	1029.6	-0.4	0.37
1050.00	1049.0	-1.0	0.37

Note: UUC* Unit Under Calibration

* To convert the result in report unit to Pa should be multiply by 100

End of certificate



CALIBRATION REPORT

Calibration Number: RD-06122023
Page 1 of 2 Pages

Measurement Item: Rain gauge with data logger
Manufacturer: Data logger: Novolyx
Rain gauge: Novolyx
Model/Type: Data logger: 110 WS 250L D
Rain gauge: 110 WS 250L D
Serial Number: Data logger: A5447
Rain gauge: RG-A5447
ID NO: 90K FS0039
Customer: ALS laboratory group (Thailand) Co., Ltd
104 Phathanakan Rd, Phathanakan Rd, Khwaeng Suan Luang
Bangkok 10250, Thailand

Environmental Condition

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

Measurement Method

The Rain gauge, Unit Under Calibration (UUC) was calibrated by Precision reference bottle with flow adjuster at low rate 0.6 mm per minute of 1 tipping every 20 seconds. The tipping number was determined by procedure below

- Obtain rain gauge inlet area
Rain gauge precise diameter in cm = F (meter) / R (radius)
Rain gauge area: $RH \times 3.14$ (RUC diameter 20.3 cm, UUC radius=10.15 cm)
Rain gauge area= 323.6 cm²
- Obtain Invertical correct rain gauge shower (number of lippings) using 323.6 cm² inlet area and 0.5 L of rain
a) 10.000 cm³ / 32.6 mm² inlet area = 30.90 (rain gauge area 1/30.90 of square meter)
b) 30.90 * 0.6 L volume=18.54 mm (mm of rain over 1 m² surface) 500 ml of rain volume on the rain gauge area = 18.54 mm of rain
c) Number of "lippings" = 5.45 / 0.25 mm = 22 lippings

Note: Rain gauge is fully cleaned and leveling prior the calibration performed

Measurement Date: Dec 19, 2023
Issued Date: Dec 20, 2023

Performed by:
☐ Mr. Sorawat Thachakul
☒ N.S. Jiraporn Lertsomphut



Approved Signatory:
Mr. Panyia Booncharoen
Calibration Department Manager

THIS CERTIFICATE IS VALID FOR 12 MONTHS FROM THE DATE OF CALIBRATION. IT IS VALID FOR MEASUREMENTS
WITHIN THE RANGE AND CONDITIONS OF CALIBRATION.

Continuation of Calibration of Calibration Number

Calibration Number: RD-06122023
Page 2 of 2 Pages

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

The results of calibration are reported in table below

Quantity of H ₂ O (ml)	Determined tipping	Tipping count	Acceptable Tipping count
500	62	60	60 ± 64
500	62	60	60 ± 64
500	62	60	60 ± 64
500	62	60	60 ± 64
500	62	60	60 ± 64

Remark: The procedure is made to verify the correct reading of the Unit under Calibration rain gauge when a precise vol
ume of water falls into its cone. We suggest that the number of tipping should be within ±2% different from the 62 tipping
(correct range: 60-64 tipping) it means that the rain gauge meets the manufacturer acceptable limit

End of calibration report



Certificate Number

CWS 005-67

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM: Cup anemometer
MANUFACTURER: Novolyx
MODEL/TYPE: Sensor: WS-02F
Data logger: 200 WS-250L
SERIAL NUMBER: Sensor: WSD A5261
Data logger: A5261
ID NUMBER: BAK_FS0048
CONDITION AS RECEIVED: Used item
CUSTOMER: ALS laboratory group (Thailand) Co., Ltd
104 Phathanakan Rd, Phathanakan Rd, Khwaeng Suan Luang,
Khet Suan Luang, Bangkok 10250 Thailand

Calibration procedure:
The Cup anemometer was calibrated against standard air velocity transducer model: 6455-32 and pilot tube with precision differential pressure meter model: DPM2500 in an clean section of Effel-type wind tunnel with 500 cm² cross test section area. The WS-02F000 being in IEC 61400-12-2, Power performance measurements of directly producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:
This certificate provides a traceability of the measurement to recognized national standards and to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) and Certificate number: NAM-0002-23 and NAM-0003-23

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

RECEIVED DATE: 25 Dec 2023
MEASUREMENT DATE: 04 Jan 2024
ISSUE DATE: 05 Jan 2024

ENVIRONMENTAL CONDITIONS:
Ambient condition in the laboratory are as follows:
Temperature: 23.0 ± 0.3 °C
Relative Humidity: 55.0 ± 5.0 % RH
Atmospheric Pressure: 1010 ± 10 hPa

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

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

Preconditioning: 24 hours at ambient conditions.
Measurement Condition: The average values during measurement are (23.71 °C, (46.6) %RH and (1016.3) hPa

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

Calibrated by:
Mr. Sorawat Thachakul
Mr. Jiraporn Lertsomphut



Approved signatory:
Mr. Panyia Booncharoen
Calibration Department Manager

Remark:
¹ Wind direction area of the wind tunnel
² Projected cross-section area of the tested object include mounting pipe
³ Diameter of mounting pipe
⁴ Ratio to ¹

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 – 40 °C

Function: Table 3: This equipment was connected with temperature sensor Model: HMP60 S/N: N0330783.
Dimension: Diameter 12 mm. Length 80 mm

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.054	19.8	-0.3	0.099
70	25.051	24.6	-0.5	0.099
70	30.043	29.5	-0.5	0.099
70	35.035	34.4	-0.6	0.099
70	40.030	39.3	-0.7	0.099

UUC*: Unit Under Calibration

End of Certificate of Calibration



CERTIFICATE OF CALIBRATION

Certificate No.: CRH-004-67

MEASUREMENT ITEM: Relative humidity with data logger
MANUFACTURER: Novallym
MODEL/TYPE: 200 WS 75L8
SERIAL NUMBER: AS261
ID NUMBER: BKK FS0888
CONDITION AS-RECEIVED: Used item
CUSTOMER: ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanasak 40, Phatthanasak Rd, Khwaeng Suan Luang,
Khet Suan Luang, Bangkok 10250 Thailand

RECEIVED DATE: 25 Dec 2023
MEASUREMENT DATE: 04 Jan 2024
ISSUE DATE: 05 Jan 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 firm calibrated on date and place of calibration

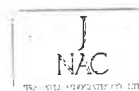
Calibration procedure:
The Relative humidity calibration was done by In House calibration method via WH-CL-010 according to comparison method with Standard Caliber Mirror hygrometer and standard Humidity generator chamber

Traceability:
This instrument was calibrated using standard equipment whose accuracy is traceable by through the NMI (National Metrology Institute of Thailand) to the international system of units (SI) via Certificate number TH 0079 23

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

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

Calibrated by:
☐ Mr. Sorawat Thuchaiud
☒ Mr. Jiraporn Lertvongphol
☐ Miss Pungumai Phoommit



Approved signatory

Mr. Panyee Boonchauee
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:

This equipment was connected with indoor air quality probe and Displayed (UUC) on display Model HMV-60 Serial number N0330783

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

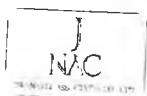
Calibration Range: 20%RH to 80%RH

Table 3: The results of calibration of relative humidity are reported in table below

Determined (%RH)	Standard Reading (%RH)	UUC Reading (%RH)	Error (%RH)	Uncertainty (%RH)
20.0	20.04	18.6	-1.5	0.40
50.0	51.31	48.7	-2.6	0.6
80.0	82.85	78.9	-4.0	1.6

UUC*: Unit Under Calibration

End of Certificate of Calibration



CERTIFICATE OF CALIBRATION

MEASUREMENT ITEM: Cup anemometer
MANUFACTURER: Novallym
MODEL/TYPE: Sensor: WS-02F
Data logger: 110-WS-2501-D
SERIAL NUMBER: Sensor: WS0 AS445
Data logger: AS445
ID NUMBER: RYG_FS0436
CONDITION AS-RECEIVED: Used item
CUSTOMER: ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanasak 40, Phatthanasak Rd, Khwaeng Suan Luang,
Khet Suan Luang, Bangkok 10250 Thailand

RECEIVED DATE: 15 Dec 2023
MEASUREMENT DATE: 19 Dec 2023
ISSUE DATE: 20 Dec 2023

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

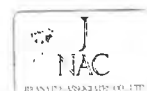
PLACE OF CALIBRATION: Effel type wind tunnel of Jiranate Associates Co., Ltd

CALIBRATION CONDITIONS:
Wind tunnel cross section area¹: 900 cm²
Wind direction frontal area²: 100 cm²
Diameter of mounting pipe³: 1 mm
Blockage ratio of test object⁴: 0.111 [-]

Preconditioning: 24 hours at ambient conditions
Measurement Condition: The average values during measurement are (23.9) °C, (45.2) %RH and (1029.5) hPa

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

Calibrated by:
☒ Mr. Sorawat Thuchaiud
☐ Miss Jiraporn Lertvongphol



Approved signatory

Mr. Panyee Boonchauee
Calibration Department Manager

Remarks:
¹ Note: cross-section area of the wind tunnel
² Projected cross-section area of the tested object include mounting pipe
³ Diameter of mounting pipe
⁴ Ratio $\frac{A_o}{A_t}$

Calibration procedure:
The Cup anemometer was calibrated against Standard air velocity transducer model: B45-22 and also fine with pressure differential transducer model: DPS42500 in an effel type calibration of Effel type wind tunnel with 900 cm² test section area. The WS-02F based on (IEC 61400-12-2, Wind energy generation systems - Part 12, 2 - Power performance measurements of electricity producing wind turbines, March 2007) was used as a reference guideline

Traceability:
The certificate provides a traceability of the measurement to recognized the national standard and to realization of the international system of units (SI) through the NMI (National Metrology Institute of Thailand) via Certificate Number: MN-0023 23 and MN-0025 23

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

THIS CERTIFICATE OF CALIBRATION 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-064-66

Page 2 of 2 Pages

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 – 40 °C

Function:

Table 3 This equipment was connected with temperature sensor Model: HMP60 S/N: R1131113.
Dimension: Diameter 12 mm. Length 80 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.062	20.0	-0.1	0.099
70	25.051	25.0	-0.1	0.14
70	30.041	30.0	-0.1	0.16
70	35.040	34.8	-0.2	0.099
70	40.026	39.8	-0.2	0.099

UUC*: Unit Under Calibration

Remark: The reported uncertainty of measurement is 0.14, 0.16, based on standard uncertainty multiplied by a coverage factor $k=2.21$ providing a level of confidence of approximately 95%.

End of Certificate of Calibration



Continuation of Certificate of Calibration Number: CRH-014-66

Page 2 of 2 Pages

Measurement Results:

This equipment was connected with Relative humidity Sensor on display Model: HMP60 Serial number: R1131113

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

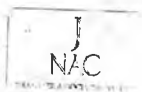
Calibration Range: 20%RH to 80%RH

The results of calibration of relative humidity are reported in table below

Determined (%RH)	Standard Reading (%RH)	UUC Reading (%RH)	Error (%RH)	Uncertainty (%RH)
20.0	20.19	18.4	-1.8	0.52
50.0	51.51	48.0	-3.5	0.70
80.0	82.80	75.9	-6.9	0.56

UUC*: Unit Under Calibration

End of Certificate of Calibration



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

Relative humidity measurement laboratory
Calibration services department

Jiranae Associates Co., Ltd.
43/24-25, 43/25, 35
Petchburi 7, 7/1, Rd Wathana, Bang, Srin-
Bangkok 10320 (Thailand)
Tel: (66) 02-08812
Fax: (66) 02-08813
E-mail: jiranae@jiranae.com
Web site: www.jiranae.com

CERTIFICATE OF CALIBRATION

Certificate No. : CRH-014-66

Page 1 of 2 Pages

MEASUREMENT ITEM : Relative humidity with data logger
MANUFACTURER : Novolin
MODEL/TYPE : 110 WS-25DL D
SERIAL NUMBER : AS445
ID NUMBER : RVG_F50436
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 : 15 Dec 2023
MEASUREMENT DATE : 19 Dec 2023
ISSUE DATE : 20 Dec 2023

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:
Temperature : 23.0 ± 1.0 °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 calibration was done by in
house calibration method by W-CL-012 according to
comparison method with standard Certified Metro
hygrometer and standard Humidity generator
chamber.

Traceability:
This instrument was calibrated using standard
equipment whose accuracy is traceability through
the NMET (National Metrology Institute of Thailand)
to the international system of units (SI) via
Certificate number TH-0025-23.

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

Calibrated by:

☐ Mr. Sorawat Thachalai
☒ Mr. Jiraporn Lertsomphol
☐ Miss P. Jiraporn Poommit



Approved signatory

Mr. Parinya Booncharoen
Calibration Department Manager

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IN WRITING FROM THE LABORATORY

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

Pressure measurement laboratory
Calibration services department

Jiranae Associates Co., Ltd.
43/24-25, 43/25, 35
Petchburi 7, 7/1, Rd Wathana, Bang, Srin-
Bangkok 10320 (Thailand)
Tel: (66) 02-08812
Fax: (66) 02-08813
E-mail: jiranae@jiranae.com
Web site: www.jiranae.com



CERTIFICATE OF CALIBRATION

Certificate No. : CPR-014-66

Page 1 of 2 Pages

MEASUREMENT ITEM : Digital barometer
MANUFACTURER : Novolin
Sensor: 110-WS-25BP
Data logger: 110-WS-25DL-D
Sensor: BP-AS445
Data logger: AS445
RVG_F50436
ID NUMBER : Used item
CONDITION AS RECEIVED : ALS laboratory group (Thailand) Co., Ltd.
CUSTOMER : 104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,
Khet Suan Luang, Bangkok 10250 Thailand

RECEIVED DATE : 15 Dec 2023
MEASUREMENT DATE : 19 Dec 2023
ISSUE DATE : 20 Dec 2023

Calibration procedure:
The pressure calibration was done by in-
house calibration method by W-CL-003
according to comparison method with digital
pressure calibrator based on DKO-P 6-7

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

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

CONDITION OF THIS RESULT OF CALIBRATION:

1. Reference Standard Instrument

Instrument	Model	Serial No.	Certificate No.	Due Date
Absolute Pressure Transducer	CPG2500	4100126P	MP 0705-22	02 Dec 2023

1. Calibration effort for calibration sequence C

2. The UUC* was installed in vertical orientation above reference standard instrument and center of UUC* was used as the reference level

3. Calibration conditions

4. Condition ☒ Normal ☐ Abnormal

Pressure transmitting medium:

p_1 (20°C, 1 bar) : 1.19 kg/m³
 p_{amb} (55±15) °C : (23±3) °C
 p_{ref} : (1013±10) mbar

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

Calibrated by:

☒ Mr. Sorawat Thachalai
☐ Miss Jiraporn 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
IN WRITING FROM THE LABORATORY

CERTIFICATE OF CALIBRATION

Certificate No. CFK 014-66

Page 2 of 2 Pages

MEASUREMENT RESULTS : ☒ Without adjustment ☐ With adjustment
CALIBRATION IN THE RANGE OF : 950 mbar to 1050 mbar

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

STD (mbar)	UUC* (mbar)	Error (mbar)	Uncertainty (k=2) (mbar)
950.00	950.8	0.8	0.37
970.00	970.5	0.5	0.37
990.01	990.2	0.2	0.37
1010.00	1009.9	-0.1	0.37
1030.01	1029.6	-0.4	0.57
1050.00	1049.0	-1.0	0.37

Note UUC* Unit Under Calibration

*To convert the result in report unit to Pa should be multiply by 100

End of certificate



CALIBRATION REPORT

Calibration Number: RG-05122023
Page 1 of 2 Pages

Measurement item : Rain gauge with data logger

Manufacturer : Data logger Noveltyx
Rain gauge Noveltyx

Model/Type : Data logger 110 WS 25DL-D
Rain gauge 110 WS-25RG

Serial Number : Data logger AS446
Rain gauge RG-A5445

ID NO : RYG-FS0430

Customer : ALS laboratory group (Thailand) co., ltd
104 Phatthanahan 40, Phatthanahan 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

The Rain gauge Unit Under Calibration (UUC) was calibrated by Precision reference bottle with flow adjuster at low rate 0.6 mm per minute or 1 tipping every 20 seconds. The tipping number was determined by procedures below

1. Obtain rain gauge inlet area:
Rain gauge precise diameter in cm = $\sqrt{\frac{A}{\pi}}$ (radius)
Rain gauge area = πR^2 (UUC diameter 20.3 cm, UUC radius=10.15 cm)
Rain gauge area = 323.6 cm²
2. Obtain theoretical correct rain gauge answer (number of tipplings) using 223.6 cm² inlet area and 0.6 L of rain
a) 10000 cm³ / 32.6 mm inlet area = 30.90 (rain gauge area = 1/30.90 of square meter)
b) 30.90 * 0.6 L volume = 18.54 mm (mm of rain over 1 m² surface) 500 ml of rain volume on the rain gauge area = 15.45 mm of rain
c) Number of tipping = 15.45 / 0.25 mm = 62 tipplings

Note: Rain gauge is fully cleaned and leveling prior the calibration performed

Measurement Date : Dec 19, 2023
Issued Date : Dec 20, 2023

Performed by :
☐ Mr. Soraw Thachulad
☒ Miss Jittaporn Limsupit



Approved Signatory

Mr. Panyas Booncharoen
Calibration Department Manager

THIS CERTIFICATE IS VALID FOR THE PERIOD OF 12 MONTHS FROM THE DATE OF CALIBRATION. THE CALIBRATION SHALL BE REPEATED AT THE END OF THE PERIOD.

Continuation of Calibration of Calibration Number

Calibration Number RG 05122023
Page 2 of 2 Pages

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment
The results of calibration are reported in table below

Quantity of H ₂ O (mm)	Determined Tipping	Tipping count	Acceptable Tipping count
500	62	60	60 - 64
500	62	60	60 - 64
500	62	60	60 - 64
500	62	60	60 - 64
500	62	60	60 - 64

Reason: The procedure is made to verify the correct reading of the Unit under Calibration rain gauge when a precise volume of water falls into its cone. We suggest that the number of tipping should be within ± 7% different from the 62 tipping (correct range 60-64 tipping) it means that the rain gauge meets the manufacturer acceptable limit

End of calibration report



Certificate Number

CWS 015 66

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER : Noveltyx
MODEL/TYPE : Sensor WS 02F
Data logger 110 WS 25DL-D
SERIAL NUMBER : Sensor WSD-A5444
Data logger AS444
ID NUMBER : RYG-FS0435
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS Laboratory group (Thailand) Co., Ltd
104 Phatthanahan 40, Phatthanahan Rd Khwaeng Suan Luang Khet Suan Luang, Bangkok 10250 Thailand

RECEIVED DATE : 15 Dec 2023
MEASUREMENT DATE : 15 Dec 2023
ISSUE DATE : 20 Dec 2023

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:
Temperature : 23.0 ± 0.5 °C
Relative Humidity : 55.0 ± 15.0 %RH
Atmospheric Pressure : 1010.0 hPa

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

CALIBRATION CONDITIONS

Wind tunnel cross section area¹ : 900 cm²
Wind direction frontal area² : 100 cm²
Diameter of mounting pipe³ : - mm
Rockage mass of test object⁴ : 0.111 kg

Preconditioning : 24 hours at ambient conditions
Measurement Condition : The average values during measurement are (23.9) °C, (53.0) %RH and (1010.9) hPa

TABULATION OF RESULTS:

The table on next page gives the measured values

Calibrated by :
☒ Mr. Soraw Thachulad
☐ Miss Jittaporn Limsupit



Approved signatory

Mr. Panyas Booncharoen
Calibration Department Manager

Remarks:

1. Inside cross-section area of the wind tunnel
2. Projected cross-section area of the tested object include mounting pipe
3. Diameter of mounting pipe
4. Rockage mass

Certificate Number

CWD-015-56

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

The Cup anemometer, Unit Under Calibration (UUC) was exercise at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer 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 strong and weak air velocity in the range of 3 m/s to 30 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

V_{ref} (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V_{UUC} (m/s)	Error (m/s)	U (k=2) (m/s)
1.015	23.82	23.90	0.8	-0.2	0.13
2.069	23.94	23.90	1.9	-0.2	0.31
3.009	23.76	23.90	2.9	-0.1	0.31
4.155	23.76	23.90	4.0	-0.2	0.31
5.06	23.70	23.90	5.0	-0.1	0.31
6.02	24.08	23.90	6.0	0.0	0.31
7.01	23.68	23.90	7.1	0.0	0.31
7.97	23.98	23.90	8.0	0.1	0.31
8.96	23.54	23.90	9.1	0.1	0.31
10.03	23.85	23.90	10.2	0.1	0.31
11.02	23.44	23.90	11.1	0.1	0.31
12.04	23.89	23.90	12.1	0.1	0.31
13.02	23.44	23.90	13.2	0.2	0.31
14.03	23.72	23.90	14.2	0.1	0.31
15.03	23.50	23.90	15.2	0.2	0.31
16.03	23.52	23.90	16.3	0.2	0.31

Remarks:

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

² Velocity of standard.

³ Velocity of Unit Under Calibration.

PHOTO OF CALIBRATION SET-UP



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

End of Certificate of Calibration

Certificate Number

CWD-015-56

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 when 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_{true} Degree (°)	D_{UUC} Degree (°)	Error Degree (°)	U (k=2) Degree (°)
4.58	45.000	42	-3	0.40
	90.000	87	-3	0.80
	135.000	132	-3	0.80
	180.000	180	0	0.80
	225.001	227	2	0.80
	270.001	274	4	0.80
	315.000	320	5	0.80
	360.000	359	-1	0.80

Remarks:

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

¹ Direction of standard.

Direction of Unit Under Calibration.

End of Certificate of Calibration



JIRANATE ASSOCIATES CO., LTD.

Jiranate Associates Co., Ltd.
67/14-15, 67/15-16
Bangkok 10250 Thailand
Tel: +662-015-56222
Fax: +662-015-56223
E-mail: info@jiranate.com
Web site: www.jiranate.com

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

Wind direction measurement laboratory
Calibration services department



NSC-TISI-TIS 17025
CALIBRATION 0367

Certificate Number

CWD-015-56

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as 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 Jiranate Associates Co., Ltd

CALIBRATION CONDITION

1. Wind tunnel cross-section area¹ : 900 cm²
2. Wind direction frontal area² : 129 cm²
3. Diameter of mounting pipe³ : - mm
4. Blockage ratio of test object⁴ : 0.143 []

Preconditioning

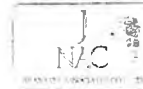
Measurement Condition

24 hours at ambient conditions
The average values during measurement are (23.8) °C, (54.9) %RH and (1013.1) hPa

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:
Mr. Sorawit Thachalad
Miss Jitraporn Lertsompho



Approved signatory

Mr. Paninya Booncharoen
Calibration Department Manager

Remarks:

¹ Inside cross-section area of the wind tunnel

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

³ Diameter of mounting pipe

⁴ Ratio (%)

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



Jiranate Associates Co., Ltd.
67/14-15, 67/15-16
Bangkok 10250 Thailand
Tel: +662-015-56222
Fax: +662-015-56223
E-mail: info@jiranate.com
Web site: www.jiranate.com

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

Temperature measurement laboratory
Calibration services department



NSC-TISI-TIS 17025
CALIBRATION 0367

CERTIFICATE OF CALIBRATION

Certificate No. : CDT-063-66

Page 1 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

ENVIRONMENTAL CONDITIONS:

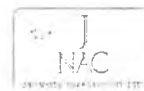
Ambient condition in the laboratory are as follow

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. Sorawit Thachalad
Miss Jitraporn Lertsompho
Miss Ruangrattana Phoomm

Approved signatory

Mr. Paninya Booncharoen
Calibration Department Manager

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Continuation of Certificate of Calibration Number CDT-063-66

Page 2 of 2 Pages

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 ~ 40 °C

Function:

Table 3: This equipment was connected with temperature sensor Model: HMP60 S/N: R1131112.
Dimension: Diameter 12 mm. Length 80 mm

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.054	19.6	-0.5	0.069
70	25.046	24.5	-0.5	0.072
70	30.039	29.4	-0.6	0.090
70	35.033	34.2	-0.8	0.14
70	40.025	39.2	-0.8	0.14

UUC*: Unit Under Calibration

Remark: The reported uncertainty of measurement is 0.14, based on standard uncertainty multiplied by a coverage factor k=2.21 providing a level of confidence of approximately 95%.

End of Certificate of Calibration



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

Relative humidity measurement laboratory
Calibration services department

CERTIFICATE OF CALIBRATION

Certificate No.: CRH-013-66

Page 1 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

Relative humidity with data logger

Novalyne

: 110 WS-25DL-D

: AS444

: RYG, FS0435

: Used item

: ALS laboratory group (Thailand) Co., Ltd

104 Phatthakan 40, Phatthakan Rd, Khwaeng Suan Luang,

Khet Suan Luang, Bangkok 10250 Thailand

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

: 15 Dec 2023

: 19 Dec 2023

: 20 Dec 2023

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 calibration was done by in house calibration method as WI-CL-010 according to comparison method with Standard Labeled Mirror hygrometer and standard Humidity generator chamber.

Traceability:

The instrument was calibrated using standard equipment whose accuracy is traceable through the NIMT (National Metrology Institute of Thailand) to the international system of units (SI) via Certificate number TH 0075 23

Uncertainty of Measurement:

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

Calibrated by:

☒ Mr. Sorawit Thacharod

☒ Ms. Jittasorn Lertsomphon

☐ Miss Jitgrasamee Phonmait



Approved signatory

Mr. Panya Booncharoen
Calibration Department Manager

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Continuation of Certificate of Calibration Number: CRH-013-66

Page 2 of 2 Pages

Measurement Results:

This equipment was connected with Relative humidity Sensor on display Model: HMP60, Serial number: R131112

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20.000 to 80.000

The results of calibration of relative humidity are reported in table below.

Determined (RH)	Standard Reading (RH)	UUC Reading (RH)	Error (RH)	Uncertainty (RH)
20.0	20.07	18.3	-1.8	0.04
50.0	51.42	48.0	-3.4	0.16
80.0	82.86	77.3	-5.5	0.16

UUC*: Unit Under Calibration

End of Certificate of Calibration



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

Pressure measurement laboratory
Calibration services department

CERTIFICATE OF CALIBRATION

Certificate No.: CPR-013-66

Page 1 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

Digital barometer

Novalyne

: Sensor: 110 WS-25DL-D

: Data logger: 110 WS-25DL-D

: Sensor: BP-AS444

: Data logger: AS444

: RYG, FS0435

: Used item

: ALS laboratory group (Thailand) Co., Ltd

104 Phatthakan 40, Phatthakan Rd,

Khwaeng Suan Luang, Khet Suan Luang,

Bangkok 10250 Thailand

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

: 15 Dec 2023

: 19 Dec 2023

: 20 Dec 2023

CONDITION OF THIS RESULT OF CALIBRATION:

1 Reference Standard Instrument

Instrument

Model

Serial No

Certificate No

Due Date

Absolute Pressure Transducer

: CPG2500

: 4100126P

: MP 0205 27

: 02 Dec 2023

1 Calibration effort for calibration sequence C

2 The UUC* was installed in vertical orientation above reference standard instrument and center of UUC* was used as the reference level

3 Calibration conditions:

4 Condition

: ☒ Normal ☐ Abnormal

: Air

: 1.19 kg/m³

: 155(15) °C

: 12(13) °C

: 101(10) mbar

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

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 DPK-P 6.3

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 27

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

Calibrated by:

☒ Mr. Sorawit Thacharod

☒ Ms. Jittasorn Lertsomphon



Approved signatory

Mr. Panya Booncharoen
Calibration Department Manager

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CERTIFICATE OF CALIBRATION

Certificate No. : CPR-013-66

Page 2 of 2 Pages

MEASUREMENT RESULTS : ☒ Without adjustment ☐ With adjustment

CALIBRATION IN THE RANGE OF : 950 mbar to 1050 mbar

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

STD (mbar)	UUC* (mbar)	Error (mbar)	Uncertainty (k=2) (mbar)
950.00	950.8	0.8	0.37
970.00	970.5	0.5	0.37
990.01	990.2	0.2	0.37
1010.00	1009.9	-0.1	0.37
1030.02	1029.4	-0.6	0.40
1050.00	1049.0	-1.0	0.37

Note: UUC* Unit under Calibration

To convert the result in report unit to Pa should be multiply by 100

End of certificate



CALIBRATION REPORT

Calibration Number : RG 04122023
Page 1 of 2 Pages

Measurement Item : Rain gauge with data logger
Manufacturer : Data logger Novelynx
Rain gauge Novelynx
Model/Type : Data logger: 110 WS 25DI D
Rain gauge: 110 WS 25RG
Serial Number : Data logger: A5444
Rain gauge: RG A5444
ID NO : RYS_FSD435
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 (26±3)°C, and relative humidity of (50±15)%

Measurement Method
The Rain gauge, Unit Under Calibration (UUC) was calibrated by Precision reference bottle with flow adjuster at low rate 0.6 mm per minute or 1 tipping every 20 seconds. The tipping number was determined by procedures below

- Obtain rain gauge inlet area
Rain gauge precise diameter in cm = Diameter / 2 = R (radius)
Rain gauge area = πR^2 3.14 (UUC diameter=20.3 cm, UUC radius=10.15 cm)
Rain gauge area = 323.6 cm²
- Obtain theoretical correct rain gauge answer (number of tipping) using 323.6 cm² inlet area and 0.6 mm of rain
a) 10,000 mm / 323.6 mm² inlet area = 30.90 (rain gauge area = 1/30.90 of square meter)
b) 30.90 * 0.6 mm = 18.54 mm (mm of rain over 1 m² surface) 500 ml of rain volume on the rain gauge area = 18.54 mm of rain
c) Number of tipping 18.54 / 0.6 mm = 30.9 tipping

Note: Rain gauge is fully checked and leveling prior the calibration performance

Measurement Date : Dec 19, 2023
Issue Date : Dec 20, 2023

Performed by
☐ Mr. Sorawat Thachit
☒ Miss Jitraporn Leisutaphu



Approved Signature
Mr. Pannya Boonchaisri
Calibration Department Manager

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Continuation of Calibration of Calibration Number

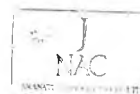
Calibration Number RG 04122023
Page 2 of 2 Pages

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment
The results of calibration are reported in table below

Quantity of H ₂ O (mm)	Determined Tipping	Tipping count	Acceptable Tipping count
500	62	64	60 - 64
500	62	63	60 - 64
500	62	63	60 - 64
500	62	64	60 - 64
500	62	63	60 - 64

Remark: The procedure is made to verify the correct reading of the Unit under Calibration rain gauge when a precise volume of water falls into its cone. We suggest that the number of tipping should be within ±2% different from the 62 tipping (correct range 60-64 tipping) it means that the rain gauge meets the manufacturer acceptable limit.

End of calibration report



Certificate Number

CWS 004 67

CERTIFICATE OF CALIBRATION

Page 2 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature : 23.0 ± 0.2 °C

Relative Humidity : 55.0 ± 1.0 %RH

Atmospheric Pressure : 1010.10 hPa

PLACE OF CALIBRATION

CALIBRATION CONDITIONS:

Wind tunnel cross section area¹

Wind direction frontal area²

Diameter of mounting pipe³

Blockage ratio of test object⁴

900 cm²

100 cm²

mm

0.111 -

Preconditioning

Measurement Condition

24 hours at ambient conditions

The average values during measurement are (23.8) °C, (52.2) %RH and (1010.8) hPa

TABULATION OF RESULTS:

The table on next page give the measured values

Calibrated by:

1. Mr. Sorawat Thachit

2. Miss Jitraporn Leisutaphu

3. Mr. Jitraporn Leisutaphu

4. Auto "to"

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Certificate Number

CWS-004-67

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

The Cup anemometer, Unit Under Calibration (UUC) was exercised at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer which was installed 30 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 18 m/s at calibration air velocity 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)
1.010	23.80	23.75	0.8	-0.2	0.31
2.097	23.64	23.75	1.9	-0.2	0.31
2.998	23.60	23.75	2.9	-0.1	0.33
4.150	23.64	23.75	4.0	-0.2	0.33
5.05	23.40	23.75	5.1	0.0	0.33
6.00	23.80	23.75	6.1	0.1	0.33
7.03	23.34	23.75	7.0	0.0	0.33
7.98	23.62	23.75	8.0	0.0	0.33
8.95	23.16	23.75	9.1	0.1	0.33
10.03	23.50	23.75	10.2	0.2	0.33
11.04	23.10	23.75	11.2	0.2	0.33
12.01	23.50	23.75	12.2	0.2	0.38
13.04	23.18	23.75	13.3	0.3	0.33
14.02	23.50	23.75	14.4	0.3	0.33
15.03	23.22	23.75	15.4	0.3	0.33
16.03	23.48	23.75	16.3	0.3	0.39

Remark:

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

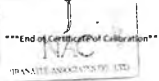
² Velocity of standard

Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET UP



Calibration setup of the Cup anemometer calibration in the wind tunnel of Jiranate Associates Co., Ltd. The Cup anemometer shown may differ from the calibrated one. Remark: The proportion of the set up is not for legal use and is for information only.



Accredited calibration laboratory
ISO/IEC 17025:2017
NSC-TIS 115 17025
CALIBRATION 0367

Wind direction measurement laboratory
Calibration services department



Certificate Number

CWD-004-67

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

ENVIRONMENTAL CONDITIONS

Ambient condition in the laboratory are as follow

Temperature

Relative Humidity

Atmospheric Pressure

PLACE OF CALIBRATION

CALIBRATION CONDITION

Wind tunnel cross-section area¹Wind direction from M area¹Diameter of mounting pipe¹Blockage ratio of test object¹

Preconditioning

Measurement Condition

TABULATION OF RESULTS:

The table on next page give the measured values

Calibrated by:

Mr. Sorawit Thachalad

Miss Intaraporn Lensomphol

Remark:

¹ Inside cross-section area of the wind tunnel² Reported cross-section area of the tested object include mounting pipe³ Diameter of mounting pipe⁴ Ratio %

Wind Direction Sensor

: Nuvalynx

: Sensor: WS-02F

: Data logger: 200-WS-25LB

: Sensor: WSD-AS244

: Data logger: AS244

: BKK_F50887

: Used item

: AIS laboratory group (Thailand) Co., Ltd.

: 104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang

: Khet Suan Luang Bangkok 10250 Thailand

: 25 Dec 2023

: 04 Jan 2024

: 05 Jan 2024

: 23.0 ± 1.0 °C

: 55.0 ± 15.0 %RH

: 1010.10 hPa

: Effect type wind tunnel of Jiranate Associates Co., Ltd

: 900 cm²: 120 cm²

: 120 mm

: 0.143 [-]

: 24 hours at ambient condition

: The average values during measurement are (23.6°C, (57.5) %RH and 1010.1 hPa

Calibration procedure

The wind direction sensor was calibrated against standard rotary encoder model A-400/TS-DV80 P15-10 in an open test section of Effect type wind tunnel in a 900 cm² open test section area. The W1 C101 board on IFC 63400 12.1 Wind energy generator system - Part 12.1 Power performance measurements of electricity producing wind turbines. March 2017 was used as a calibration standard.

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-0336-23

Uncertainty of Measurement:

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

Approved signatory

Mr. Panyia Booncharoen
Calibration Department Manager

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Certificate Number

CWD-004-67

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 _{ref} Degree (°)	D _{UUC} Degree (°)	Error Degree (°)	U (k=2) Degree (°)
5.02	45 000	42	-3	0.80
	90 000	87	-3	0.80
	135 000	132	-3	0.80
	180 000	179	-1	0.80
	225 000	226	1	0.80
	270 000	273	-3	0.80
	315 000	319	4	0.80
	360 000	359	-1	0.80

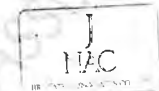
Remark:

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

² Direction of standard

Direction of Unit Under Calibration

End of Certificate of Calibration



Accredited calibration laboratory
ISO/IEC 17025:2017
NSC-TIS 115 17025
CALIBRATION 0367

Temperature measurement laboratory
Calibration services department



CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

Certificate No. : CDT-002-67

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature

Relative Humidity

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.

: Data Logger with Temperature sensor

: Nuvalynx

: 200-WS-25LB

: AS244

: BKK_F50887

: Used item

: AIS laboratory group (Thailand) Co., Ltd.

: 104 Phatthanakan 40, Phatthanakan Rd,

: Khwaeng Suan Luang, Khet Suan Luang,

: Bangkok 10250 Thailand

: 25 Dec 2023

: 04 Jan 2024

: 05 Jan 2024

: 23.0 ± 3.0 °C

: 55.0 ± 15.0 %RH

Calibration procedure:

The temperature calibration was done by in-house calibration method using W1-C1-001 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-0101 23

Reference Used During Calibration

: Standard Temperature Probe

Model: ST1-100 AS00, Serial No: 66/582-09

Due date: 28 Mar 2024

: Digital Temperature Indicator

Model: DTI 1000-A M², Serial No: 671407

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'

Approved signatory

Mr. Panyia Booncharoen
Calibration Department Manager

Calibrated by:

Mr. Sorawit Thachalad

Miss Intaraporn Lensomphol

Miss Ruangrumpai Phoommit



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Certificate Number

CC-006-66

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

The cup anemometer, Unit Under Calibration (UUC) was exercised at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer and above 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 40 mm and 100 mm respectively away from wind tunnel inside. UUC was exercised 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 uncertainty are reported in the table below.

V _{ref} (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V _{meas} (m/s)	Error (m/s)	U _r (k=2) (m/s)
1.027	24.56	24.55	0.9	-0.1	0.31
2.025	24.54	24.55	1.9	-0.1	0.31
3.003	24.38	24.55	3.0	0.0	0.31
4.200	24.32	24.55	4.1	-0.1	0.31
5.02	24.40	24.55	5.0	0.0	0.31
5.99	24.36	24.55	6.0	0.0	0.31
7.05	24.46	24.55	7.0	0.0	0.31
8.16	24.74	24.55	8.0	-0.1	0.31
9.10	24.46	24.55	9.0	-0.1	0.31
10.08	24.18	24.55	10.0	-0.1	0.31
11.16	24.40	24.55	11.1	0.0	0.31
12.13	24.12	24.55	12.0	0.1	0.31
13.20	24.40	24.55	13.0	-0.2	0.31
14.25	24.70	24.55	14.2	-0.1	0.32
15.25	24.30	24.55	15.2	0.0	0.31
16.31	24.20	24.55	16.1	-0.2	0.34

Remark:

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

² Velocity of standard.

Velocity of Unit Under Calibration.

PHOTO OF CALIBRATION SET-UP



Calibration set-up of the cup anemometer calibration in the wind tunnel of 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.



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ISO/IEC 17025:2017
ASC 15616 J2035
CALIBRATION 0367

Air speed measurement laboratory
Calibration services department

Certificate Number

CD-006-65

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

Wind direction sensor

MANUFACTURER

Nacal

MODEL/TYPE

Sensor WS-02F

SERIAL NUMBER

Data logger 200-WS-25LB

ID NUMBER

Sensor AA596

CONDITION AS RECEIVED

BNA F50157

CUSTOMER

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

RECEIVED DATE

31 May 2023

MEASUREMENT DATE

14 Jun 2023

ISSUE DATE

14 Jun 2023

ENVIRONMENTAL CONDITIONS

Ambient condition in the laboratory are as follows:

Temperature	23.0 ± 3.0	°C
Relative Humidity	±5.0 ± 15.0	%RH
Atmospheric Pressure	1010 ± 10	hPa

PLACE OF CALIBRATION

E MeI type wind tunnel of Jiranatee Associates Co., Ltd.

CALIBRATION CONDITION

Wind tunnel cross-section area ¹	990	cm ²
Wind direction frontal area ²	125	cm ²
Diameter of measuring pipe ³		mm
Blockage ratio of test object ⁴	0.143	(%)

Preconditioning

≥ 24 hours at ambient conditions

Measurement Condition

Average values during measurement are (23.7)°C, (46.7) %RH and (1009.2) hPa

TABULATION OF RESULTS

The table on next page give the measured values.

Calibrated by

Mr. Sarawit Thirathai
Miss Jiraporn Jirathornpini



Approved signature

Mr. Parinya Koonchaisri
Calibration Department Manager

Remark:

¹ Inside cross-section area of the wind tunnel.

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

³ Diameter of measuring pipe.

⁴ Block ratio.

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Certificate Number

CD-006-65

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

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

Air speed m/s	D _{max} Degree (°)	D _{min} Degree (°)	Error Degree (°)	U _r (k=2) Degree (°)
45.000	41	41	-4	1.0
90.000	87	87	-3	1.0
134.949	134	134	-1	1.0
180.000	181	181	1	1.0
225.000	228	228	3	1.0
270.000	274	274	4	1.0
315.000	319	319	4	1.0
360.000	359	359	-1	1.0

Remark:

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

² Direction of standard.

Direction of Unit Under Calibration.

End of Certificate of Calibration



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Agilent CrossLab Compliance Services

Certificate of System Qualification

GC-OQ + GCMS-OQ

System ID:	RYG_EN0136
Organization Name:	ALS Laboratory Group (Thailand) Co.Ltd.
Organization Location:	616/10, Moo 5, Tambon Mae Nam Khu, Phrak Daeng, Rayong, 21140, Thailand
Date:	January 5, 2024 10:53:24 AM
EQP Name:	Agilent Recommended, Agilent Recommended
EQP Revision:	GC.02.54, GCMS.02.54
Overall Qualification Status:	Pass

REVIEW BY	Chonticha Khunkaew
APPROVED BY	[Signature]
NEXT CAL DATE	11/07/2025

CDS Logon Verification - GC

Logon: chonticha.khunkaew

Overall CDS Logon Verification - GC Test Status

Pass

System Inspection and Basic Safety and Operation

Name: 7890
Setpoint Status: Pass

Overall System Inspection and Basic Safety and Operation Test Status

Pass

Inlet Pressure Accuracy

Name: 7890
Front SSL
Setpoint Status: Pass
Setpoint: 25.0 psi
Actual: 25 psi
Accuracy: 0.0 psi
Agilent Recommended: ±1.2

Date: January 5, 2024 10:53:24 AM
System ID: RYG_EN0136

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Overall Inlet Pressure Accuracy Test Status

Pass

GC Oven Temperature Accuracy

Name: 7890

Setpoint Status: Pass

Zone: Oven

Setpoint/Actual

Temperature: 230.0 229 °C

Accuracy: -1.0 °C

Agilent Recommended: ≥ -1.0 °C (-5.0 °C)
 ≤ 1.0 °C (5.0 °C)

Setpoint Status: Pass

Zone: Oven

Setpoint/Actual

Temperature: 100.0 100.8 °C

Accuracy: 0.8 °C

Agilent Recommended: ≥ -1.0 °C (-3.7 °C)
 ≤ 1.0 °C (3.7 °C)

Overall GC Oven Temperature Accuracy Test Status

Pass

GC Oven Temperature Stability

Name: 7890

Setpoint Status: Pass

Setpoint/Average

Temperature: 100.0 100.8167 °C

Stability: 0.1 °C

Agilent Recommended: ≤ 0.5 °C

Overall GC Oven Temperature Stability Test Status

Pass

Date: January 5, 2024 10:53:24 AM

System ID: RYG_EN0136

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Log Amp

Tested Combination1 Front SSL / External SQ

Name: 5977B

Setpoint Status: Pass

Overall Log Amp Test Status

Pass

RFPA

Tested Combination1 Front SSL / External SQ

Name: 5977B

Setpoint Status: Pass

Amu: 1050 m/z Drift After Five Minutes: 6 mV RFPA Voltage: 509 mV

Agilent Recommended: ≥ -100 mV and ≤ 100 mV ≤ 1100 mV

Overall RFPA Test Status

Pass

Tune EI

Tested Combination1 Front SSL / External SQ

Name: 5977B

Setpoint Status: Pass

Filament: 1

Setpoint Status: Pass

Filament: 2

Overall Tune EI Test Status

Pass

Scouting Run

Date: January 5, 2024 10:53:24 AM

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Tested Combination1 Front SSL / External SQ

Name: Manual Injection

Source: EI - Extractor

Setpoint Status: Completed

Injection Volume on Column: 1.0 uL

Overall Scouting Run Status

Completed

Signal to Noise EI

Tested Combination1 Front SSL / External SQ

Name: 5977B

Source: EI - Extractor Filament: 1

Setpoint Status: Pass

Signal to Noise: 5113

Agilent Recommended: ≥ 1200

Source: EI - Extractor Filament: 2

Setpoint Status: Pass

Signal to Noise: 4456

Agilent Recommended: ≥ 1200

Overall Signal to Noise EI Test Status

Pass

NOTE: This test's 2 comment(s) and 3 deviation(s) are available in the Attachments section.

Date: January 5, 2024 10:53:24 AM

System ID: RYG_EN0136

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Instrument Details

Purpose

This section describes the as found system configuration.

Details

System

System ID RYG_EN0136

Manufacturer Agilent Technologies

Name 7890

Flow Data Input Manual Data

Temperature Data Input Manual Data or Other Data Logging

Tested Combination1

Injection Technique Manual Injection

Inlet Front

Detector External

LTM Included? No

Sampler 1

Manufacturer Agilent Technologies

Type Manual Injection

Usage Sample Injection

Syringe Volume (uL) 10

Mainframe 1

Manufacturer Agilent Technologies

Name 7890

Model Number G3442B

Serial Number CN18463238

Firmware Revision B.02.04.3

Component ID/Assat No. 081117000236

Open Type Standard

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Inlet 1

Manufacturer	Agilent Technologies
Name	7690
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

Mass Spectrometer 1

Manufacturer	Agilent Technologies
Type	SO
Name	5977B
Model Number	G7077B
Serial Number	US1701M008
Firmware Revision	5977 5.00.34
High Vacuum System	Turbo Pump
Scavenging Run Standard	OFN Std

Component ID/Asset No. 081117000236

MS EI Source 1

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

Date: January 5, 2024 10:53:24 AM
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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:	Eaknarin Puangsopa
Logged On User Name:	eaknarin_puangsoa@agilent.com
Signature Creation Date:	January 5, 2024
Reason for Signature:	Executed protocol and published this original version of document

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Date: January 5, 2024 10:53:24 AM
System ID: RYG_EN0136

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User Name: eaknarin_puangsoa
Report Generated by Hostname: ASRYOWX074
Print Date: January 5, 2024 10:53:25 AM
System ID: RYG_EN0136

ALS_OQ_RYG_EN0136 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
January 4, 2024 10:37:21 AM	Audit	Session Created	Session	None
January 4, 2024 10:37:21 AM	Start	Configuration	Session	None
January 4, 2024 10:37:21 AM	Audit	Enrollment	Licensing	User is Field Engineer and does not require an unlock code
January 4, 2024 10:39:29 AM	Audit	Eqp loaded	Session	EQP details for primary technique (GC) - File path: [ProtocolPath]\Data\Config\enrol02.54\GC_02.54.eeq EQP File Name: [GC_02.54.eeq], EQP Name [AgilentRecommended] Protocol Revision: GC_02.54 EQP details for hybridated technique (GCMS) - File path: [ProtocolPath]\Data\Config\enrol02.54\GCMS_02.54.eeq EQP File Name: [GCMS_02.54.eeq], EQP Name: [AgilentRecommended]
January 4, 2024 10:38:40 AM	End	Configuration	Session	None
January 4, 2024 10:38:44 AM	Start	Qualification	Session	OQ
January 4, 2024 10:38:44 AM	Start	Execution	CDS Login Verification - GC - 7690 - Qualitative test	None
January 4, 2024 10:46:00 AM	End	Execution	CDS Login Verification - GC - 7690 - Qualitative test	Run Count: 1

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Date: January 5, 2024 10:53:24 AM
System ID: RYG_EN0136

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User Name: eaknarin_puangsoa
Report Generated by Hostname: ASRYOWX074
Print Date: January 5, 2024 10:53:25 AM
System ID: RYG_EN0136

ALS_OQ_RYG_EN0136 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
January 4, 2024 10:46:00 AM	Start	Execution	System Inspection and Basic Safety and Operation - 7690 - Qualitative Test - No sample associated	None
January 4, 2024 10:46:16 AM	End	Execution	System Inspection and Basic Safety and Operation - 7690 - Qualitative Test - No sample associated	Run Count: 1
January 4, 2024 10:46:22 AM	Start	Execution	Inlet Pressure Accuracy - Front SSL - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	None
January 4, 2024 10:48:52 AM	End	Execution	Inlet Pressure Accuracy - Front SSL - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	Run Count: 1
January 4, 2024 10:48:54 AM	Start	Execution	GC Oven Temperature Accuracy - 7690 - Temperature Oven - S: 220.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
January 4, 2024 10:51:25 AM	Audit	Data	GC Oven Temperature Accuracy - 7690 - Temperature Oven - S: 220.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Manual Data Entry
January 4, 2024 10:51:58 AM	End	Execution	GC Oven Temperature Accuracy - 7690 - Temperature Oven - S: 220.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Run Count: 1
January 4, 2024 10:51:43 AM	Start	Execution	GC Oven Temperature Accuracy - 7690 - Temperature Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
January 4, 2024 10:58:45 AM	Audit	Data	GC Oven Temperature Accuracy - 7690 - Temperature Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Manual Data Entry

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Date: January 5, 2024 10:53:24 AM
System ID: RYG_EN0136

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User Name: eaknann_puangsohn
Report Generated by Hostname: ASRYOWX074
System ID: RYG_EN0136
Print Date: January 5, 2024 10:53:25 AM

ALS_OQ_RYG_EN0136 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
January 4, 2024 10:58:48 AM	End	Execution	GC Oven Temperature Accuracy - 7890 - Temperature ~ 7890 - Temperature: Oven - S: 100.0°C - L: <= 0.5°C AND <= 1.0 % setpoint in K	Run Count: 1
January 4, 2024 10:58:59 AM	Start	Execution	GC Oven Temperature Stability - 7890 - Temperature: Oven - S: 100.0°C - L: <= 0.5°C	None
January 4, 2024 11:23:26 AM	Audit	Data	GC Oven Temperature Stability - 7890 - Temperature: Oven - S: 100.0°C - L: <= 0.5°C	Manual Data Entry
January 4, 2024 11:23:29 AM	End	Execution	GC Oven Temperature Stability - 7890 - Temperature: Oven - S: 100.0°C - L: <= 0.5°C	Run Count: 1
January 4, 2024 11:23:35 AM	Start	Execution	Log Amp - 5977B SQ - Source: None	EI - Extractor
January 4, 2024 11:43:23 AM	End	Execution	Log Amp - 5977B SQ - Source: Run Count: 1	EI - Extractor
January 4, 2024 11:43:26 AM	Start	Execution	RIPA - 5977B SQ - Source: EI None	- Extractor
January 4, 2024 11:53:20 AM	End	Execution	RIPA - 5977B SQ - Source: EI Run Count: 1	- Extractor
January 4, 2024 11:53:26 AM	Start	Execution	Tune EI - 5977B SQ - Source: None	EI - Extractor Filament 1 (Qualitative - No setpoints associated)
January 4, 2024 1:37:26 PM	End	Execution	Tune EI - 5977B SQ - Source: Run Count: 1	EI - Extractor Filament 1 (Qualitative - No setpoints associated)
January 4, 2024 1:37:28 PM	Start	Execution	Tune EI - 5977B SQ - Source: None	EI - Extractor Filament 2 (Qualitative - No setpoints associated)

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Date: January 5, 2024 10:53:24 AM
System ID: RYG_EN0136

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User Name: eaknann_puangsohn
Report Generated by Hostname: ASRYOWX074
System ID: RYG_EN0136
Print Date: January 5, 2024 10:53:26 AM

ALS_OQ_RYG_EN0136 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
January 4, 2024 1:48:59 PM	End	Execution	Tune EI - 5977B SQ - Source: Run Count: 1	EI - Extractor Filament 2 (Qualitative - No setpoints associated)
January 4, 2024 1:49:02 PM	Start	Execution	Scouting Run - Manual Injection, Front SSL, SQ - Source: EI - Extractor Part of GCMS System Preparation	None
January 4, 2024 2:20:35 PM	Audit	AcqClosed	Session	None
January 5, 2024 8:28:16 AM	Audit	AcqRestarted	Session	None
January 5, 2024 8:28:18 AM	Audit	SessionReloaded	Session	None
January 5, 2024 8:28:29 AM	Start	Qualification	Session	OQ
January 5, 2024 8:28:29 AM	Start	Execution	Scouting Run - Manual Injection, Front SSL, SQ - Source: EI - Extractor Part of GCMS System Preparation	None
January 5, 2024 9:21:29 AM	Audit	Data	Scouting Run - Manual Injection, Front SSL, SQ - Source: EI - Extractor Part of GCMS System Preparation	Data files Path: D:\OQ2024\count1.D
January 5, 2024 9:21:53 AM	End	Execution	Scouting Run - Manual Injection, Front SSL, SQ - Source: EI - Extractor Part of GCMS System Preparation	Run Count: 1
January 5, 2024 9:21:58 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L: >= 1200	None

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Date: January 5, 2024 10:53:24 AM
System ID: RYG_EN0136

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User Name: eaknann_puangsohn
Report Generated by Hostname: ASRYOWX074
System ID: RYG_EN0136
Print Date: January 5, 2024 10:53:25 AM

ALS_OQ_RYG_EN0136 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
January 5, 2024 9:32:39 AM	End	Qualification	Session	OQ
January 5, 2024 9:35:00 AM	Start	Reporting	Session	None
January 5, 2024 9:27:46 AM	End	Reporting	Session	None
January 5, 2024 9:27:46 AM	Start	Qualification	Session	OQ
January 5, 2024 9:27:46 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L: >= 1200	None
January 5, 2024 9:33:16 AM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L: >= 1200	Data files Path: D:\OQ2024\SN_F1.D
January 5, 2024 9:48:22 AM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 1 - L: >= 1200	Run Count: 1
January 5, 2024 9:45:32 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L: >= 1200	None
January 5, 2024 9:56:15 AM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L: >= 1200	Data files Path: D:\OQ2024\SN_F2.D
January 5, 2024 10:30:19 AM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L: >= 1200	Run Count: 1

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Date: January 5, 2024 10:53:24 AM
System ID: RYG_EN0136

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User Name: eaknann_puangsohn
Report Generated by Hostname: ASRYOWX074
System ID: RYG_EN0136
Print Date: January 5, 2024 10:53:25 AM

ALS_OQ_RYG_EN0136 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
January 5, 2024 10:33:03 AM	Audit	TestUnlocked	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L: >= 1200	Deviation fixed for Run Count: 1
January 5, 2024 10:33:53 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L: >= 1200	None
January 5, 2024 10:33:48 AM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L: >= 1200	Data files Path: D:\OQ2024\SN_F2.D
January 5, 2024 10:17:58 AM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L: >= 1200	Run Count: 2
January 5, 2024 10:22:04 AM	Audit	TestUnlocked	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L: >= 1200	Deviation fixed for Run Count: 2
January 5, 2024 10:22:04 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L: >= 1200	None
January 5, 2024 10:22:15 AM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L: >= 1200	Data files Path: D:\OQ2024\SN_F2.D
January 5, 2024 10:25:37 AM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ - Source: EI - Extractor using Filament 2 - L: >= 1200	Run Count: 3

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Date: January 5, 2024 10:53:24 AM
System ID: RYG_EN0136

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User Name: gahnamr_boonyanth
Report Generated by Hostname: ASRYGW074
System ID: RYG_EN0136
Print Date: January 5, 2024 10:53:24 AM

ALS_OG_RYG_EN0136 Transaction Log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
January 5, 2024 10:25:11 AM	Audit	Test/Inspection	Signal to Noise EI - Liquid Injection Front SSL SQ - Source: EI - Extractor using Flammant 2 - L: >= 1200	Deviation free for Run Count 3
January 5, 2024 10:26:11 AM	Start	Extraction	Signal to Noise EI - Liquid Injection Front SSL SQ - Source: EI - Extractor using Flammant 2 - L: >= 1200	None
January 5, 2024 10:42:05 AM	Audit	Data	Signal to Noise EI - Liquid Injection Front SSL SQ - Source: EI - Extractor using Flammant 2 - L: >= 1200	Data File Path: D:\OG2024\OGV_F002.D
January 5, 2024 10:43:24 AM	End	Execution	Signal to Noise EI - Liquid Injection Front SSL SQ - Source: EI - Extractor using Flammant 2 - L: >= 1200	Run Count: 4
January 5, 2024 10:46:41 AM	End	Qualification	Session	OO
January 5, 2024 10:48:41 AM	Start	Reporting	Session	None
January 5, 2024 10:50:27 AM	Audit	Reporting	Session	Report Generated: Certificate
January 5, 2024 10:51:07 AM	Audit	Reporting	Session	Report Generated: Report
January 5, 2024 10:51:28 AM	Audit	Reporting	Session	Report Generated: Certificate
January 5, 2024 10:51:59 AM	Audit	Reporting	Session	Report Generated: Report

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Date: January 5, 2024 10:53:24 AM
System ID: RYG_EN0136

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CONSOLE CONTROL UNIT CALIBRATION TEST REPORT

Barometric Pressure (mmHg): 760
Relative Humidity (%): 64.0
Temperature (°C): 33.0

Reference Dry Gas Meter Data

Reference Dry Gas Meter ID: BKK_FS1122

Serial No: A2003240

Correction Factor (Y): 0.9824

Next Calibration Date: 7 Nov 24

Console Control Meter Data

Calibration No: C-060724-BKK_FS1093

Dry Gas Meter ID: BKK_FS1093

Serial No: 1706090

Model No: XC-572-V

ΔH (mm H ₂ O)	Θ	Reference Dry Gas Meter Calibration				Console Control Dry Gas Meter				Dry Gas Meter Correction Factor (Y)	Office Calibration Factor
		Final	Initial	Total	Tr (°C)	Final	Initial	Total	To (°C)		
15	12.40	150.00	0.00	150.00	29.0	835770.4	835620.0	150.40	28.0	0.9751	ΔH ₀
25	9.62	150.00	0.00	150.00	30.0	835293.2	835140.0	150.20	29.0	0.9756	47.0393
50	6.80	150.00	0.00	150.00	31.0	835480.2	835330.0	150.20	31.0	0.9764	47.3421
100	4.81	150.00	0.00	150.00	31.0	835655.2	835515.0	150.20	31.0	0.9777	47.3057
150	3.95	150.00	0.00	150.00	31.0	835655.0	835505.0	150.00	31.0	0.9783	47.3416
											47.8803
											47.3842

Y: Ratio of reading of reference to dry gas meter; tolerance for individual values: ± 0.02 from average

ΔH₀: Office pressure differential that equals to 21.24 in. of air at 25 °C and 760 mm of mercury; tolerance for individual values: ± 5.08 from average

Procedure: 40 CFR 60 APP A METH SEC 5.3.8.7

Calibrated by: Boonyanth I.

(Mr. Boonyanth Iamted)

Approved by:

(Mr. Samart Roongnan)

Field Scientist (1)

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



Stopwatch Calibration Test Report

Calibration Date: 6 Jul 24
Barometric Pressure (mmHg): 760
Relative Humidity (%): 64.0

Next Cal Date: 6 Jan 25
Temperature (°C): 33.0

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_FS1093
Model: XC-572-V
Serial No: 1706090

Run No.	Time Actual (m:ss.ms)	Time Reading (m:ss)	Diff. (ms)	Diff. (min)
1	5:00:11	5:00	11	0.00018
2	5:00:10	5:00	10	0.00017
3	5:00:11	5:00	11	0.00018
4	5:00:10	5:00	10	0.00017
5	5:00:12	5:00	12	0.00020
6	5:00:12	5:00	12	0.00020
7	5:00:10	5:00	10	0.00017
8	5:00:10	5:00	10	0.00017
9	5:00:06	5:00	6	0.00013
10	5:00:09	5:00	9	0.00015
Average				0.00017
SD				0.00002

Calibrate by:

Mr. Boonyanth Iamted

Field Scientist (2)

Approved by:

Mr. Samart Roongnan

Specialist (1)



DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date :	6 Jul 24	Ambient Temperature (°C):	33		
Calibration sheet No : C-060724-BKK_FS1093		Relative Humidity (%) :	64		
Digital Temperature ID : BKK_FS1093		Reference Temperature ID	BKK_FS1144		
Serial No. : 1706090		Serial No : 201090006013			
Model : XC-572-V		Model : Digicon-CC-VT-MS			
		Next Calibrate :	16 Jan 25		
Location	Reference Temperature °C	Digital Temperature °C	Error °C	MPE	Pass / Fail
Stack	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass
	100	100	0	±3	Pass
	150	150	0	±3	Pass
	200	200	0	±3	Pass
Probe	250	249	-1	±3	Pass
	300	299	-1	±3	Pass
	500	498	-2	±3	Pass
	100	100	0	±3	Pass
Oven	120	120	0	±3	Pass
	140	141	1	±3	Pass
	100	100	0	±3	Pass
Filter	120	120	0	±3	Pass
	140	141	1	±3	Pass
	100	100	0	±3	Pass
	120	120	0	±3	Pass
Exit	140	141	1	±3	Pass
	0	0	0	±3	Pass
	10	10	0	±3	Pass
	20	20	0	±3	Pass
Meter	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass
AUX	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass

MPE: (Maximum permissible error of measurement) ค่าความคลาดเคลื่อนสูงสุดของการวัด

Calibrated by:

Mr. Boonyanth Iamted

Field Scientist (2)

Approved by:

Mr. Samart Roongnan

Specialist (1)

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



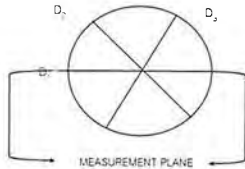
PROBE NOZZLE DIAMETER CALIBRATION DATA SHEET

Calibration Date :	6 Jul 24	Nozzle Set ID :	BKK_FS1093
Calibration Sheet No. :	C-060724-BKK_FS1106	Vernier Caliper ID :	RYG_FS0539

Nozzle ID #	Nozzle Diameter (cm.)			Hi - Lo ΔD	$(D_1 + D_2 + D_3) / 3$ D_{avg}
	D_1	D_2	D_3		
1	0.300	0.300	0.300	0.000	0.300
2	0.450	0.450	0.450	0.000	0.450
3	0.600	0.600	0.600	0.000	0.600
4	0.790	0.790	0.790	0.000	0.790
5	0.950	0.950	0.950	0.000	0.950
6	1.090	1.090	1.090	0.000	1.090
7	1.250	1.250	1.250	0.000	1.250
8	1.600	1.600	1.600	0.000	1.600

Where:

D_1, D_2, D_3 = Three different nozzle diameters at 60 degrees to each other, each measured the nearest 0.025 mm.
 ΔD = Maximum distance between any two diameters, must be ≤ 0.100 mm.
 D_{avg} = $(D_1 + D_2 + D_3) / 3$



Calibrated by: Boonyarth J. Approved by: S.T.
 (Mr Boonyarth Jantit) (Mr Samart Ro-ngan)
 Field Scientist (2) Field Specialist (1)

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



CONSOLE CONTROL UNIT CALIBRATION TEST REPORT

Barometric Pressure (mmHg) : 756.5
 Relative Humidity (%) : 48.0
 Temperature (°C) : 32.0

Reference Dry Gas Meter ID : BKK_FS0629
 Serial No : 1607009
 Correction Factor (Y) : 1.0000
 Next Calibration Date : 10 Jun 25

Calibration of Date : 30 Nov 24
 Next Cal Date : 30 May 25
 Console Control Meter Data
 Calibration No : C-301124-BKK_FS0448
 Dry Gas Meter ID : BKK_FS0448
 Serial No : 1901983
 Model No : XC-572-V

ΔH (mm Hg)	Θ (mm Hg)	Reference Dry Gas Meter Calibration				Console Control : Drygas Meter				Dry Gas Meter Correction Factor (Y)	Avg
		Final	Initial	Total	T ₁ (°C)	Final	Initial	Total	T ₁ (°C)		
15	12.41	149.95	0.00	149.95	31.0	427180.0	427032.0	156.00	31.0	0.9599	47.5143
25	9.86	150.06	0.00	150.06	31.0	427353.0	427196.0	157.00	31.0	0.9535	46.9317
50	6.89	150.00	0.00	150.00	31.0	427528.0	427372.0	156.00	31.0	0.9569	48.7939
80	5.21	150.00	0.00	150.00	31.0	427697.0	427541.0	156.00	31.0	0.9541	44.6399
120	4.25	150.01	0.00	150.01	31.0	427874.2	427718.0	156.20	31.0	0.9493	44.6511
										0.9547	46.4862

Y = Rate of reading of reference to dry gas meter : tolerance for individual values ± 0.02 from a range
 ΔH = Orifice pressure differential that equals to 21.4 mm of air @ 25 °C and 750 mm of mercury, mm H₂O : tolerance for individual values ± 5.08 from average.

Procedure: 40 CFR 60 APP A METH SEC 5.3 & 7

Calibrated by: Khamsan Approved by: S.T.
 (Mr Khamsan Khamsan) (Mr Samart Ro-ngan)
 Field Scientist (3) Field Specialist (1)

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



DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date :	30 Nov 24	Ambient Temperature (°C)	32
Calibration sheet No. :	C-301124-BKK_FS0446	Relative Humidity (%) :	48
Digital Temperature ID :	BKK_FS0485	Reference Temperature ID	BKK_FS1144
Serial No :	1901983	Serial No :	201090006013
Model :	XC-572-V	Model :	Digicon-CC-VT-MS
		Next Calibrate :	28 Nov 25

Location	Reference Temperature °C	Digital Temperature °C	Error °C	MPE	Pass / Fail
Stack	0	2	-2	±3	Pass
	25	23	-2	±3	Pass
	50	48	-2	±3	Pass
	100	98	-2	±3	Pass
	150	147	-3	±3	Pass
	200	197	-3	±3	Pass
	250	247	-3	±3	Pass
Probe	300	297	-3	±3	Pass
	500	497	-3	±3	Pass
	100	99	-1	±3	Pass
	120	119	-1	±3	Pass
	140	139	-1	±3	Pass
	160	159	-1	±3	Pass
	180	179	-1	±3	Pass
Oven	140	139	-1	±3	Pass
	120	119	-1	±3	Pass
	100	99	-1	±3	Pass
	80	79	-1	±3	Pass
	60	59	-1	±3	Pass
	40	39	-1	±3	Pass
	20	19	-1	±3	Pass
Filter	100	98	-2	±3	Pass
	120	118	-2	±3	Pass
	140	139	-1	±3	Pass
	160	159	-1	±3	Pass
	180	179	-1	±3	Pass
	200	197	-3	±3	Pass
	250	247	-3	±3	Pass
Exit	0	2	-2	±3	Pass
	10	12	-2	±3	Pass
	20	21	1	±3	Pass
	50	50	0	±3	Pass
	100	98	-2	±3	Pass
	150	147	-3	±3	Pass
	200	197	-3	±3	Pass
Meter	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass
	100	98	-2	±3	Pass
	150	147	-3	±3	Pass
	200	197	-3	±3	Pass
	250	247	-3	±3	Pass
AUX	0	2	-2	±3	Pass
	25	23	-2	±3	Pass
	50	48	-2	±3	Pass
	100	98	-2	±3	Pass
	150	147	-3	±3	Pass
	200	197	-3	±3	Pass
	250	247	-3	±3	Pass

MPE : (Maximum permissible error of measurement) ค่าความคลาดเคลื่อนของเครื่องมือ

Calibrated by: Khamsan Approved by: S.T.
 (Mr Khamsan Khamsan) (Mr Samart Ro-ngan)
 Field Scientist (3) Specialist (1)

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



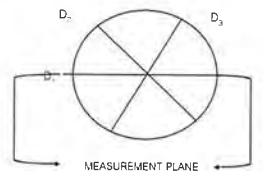
PROBE NOZZLE DIAMETER CALIBRATION DATA SHEET

Calibration Date :	30 Nov 24	Nozzle Set ID :	BKK_FS0454
Calibration Sheet No :	C-301124-BKK_FS0454	Vernier Caliper ID :	RYG_FS0539

Nozzle ID #	Nozzle Diameter (cm.)			Hi - Lo ΔD	$(D_1 + D_2 + D_3) / 3$ D_{avg}
	D_1	D_2	D_3		
1	0.315	0.315	0.315	0.000	0.315
2	0.475	0.475	0.475	0.000	0.475
3	0.530	0.530	0.530	0.000	0.530
4	0.635	0.635	0.635	0.000	0.635
5	0.790	0.790	0.790	0.000	0.790
6	0.950	0.950	0.950	0.000	0.950
7	1.110	1.110	1.110	0.000	1.110
8	1.270	1.270	1.270	0.000	1.270
9	1.600	1.600	1.600	0.000	1.600

Where:

D_1, D_2, D_3 = Three different nozzle diameters at 60 degrees to each other, each measured the nearest 0.025 mm.
 ΔD = Maximum distance between any two diameters, must be ≤ 0.100 mm.
 D_{avg} = $(D_1 + D_2 + D_3) / 3$



Calibrated by: S.Thong-on Approved by: S.T.
 (Mr Suwicha Thong-On) (Mr Samart Ro-ngan)
 Field Scientist (2) Field Specialist (1)

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



CONSOLE CONTROL UNIT CALIBRATION TEST REPORT

Calibration Date : 3 Dec 24
 Next Cal Date : 3 Jun 25

Barometric Pressure (mmHg) : 756
 Relative Humidity (%) : 46.0
 Temperature (°C) : 30.0

Reference Dry Gas Meter Data
 Calibration No : C-031224-BKK_F50485
 Dry Gas Meter ID : BKK_F50485
 Serial No : 1310055
 Model No : XC-572-V

Reference Dry Gas Meter ID : BKK_F50629
 Serial No : 1607009
 Correction Factor (Y) : 1.0000
 Next Calibration Date : 10 Jun 25

ΔH (mm H ₂ O)	Θ Mmiles	Reference Dry Gas Meter Calibration					Console Control Drygas Meter					Dry Gas Meter Correction Factor (Y)	Office Calibration Factor ΔH _{adj}
		V ₁ (Liters)		T ₁ (°C)		Tr (°C)	V ₂ (Liters)		T ₂ (°C)		Avg T _m (°C)		
		Final	Initial	Total	Final		Initial	Total	Fi	Ti			
15	12.67	150.11	0.00	150.11	35.0	261.0	110.0	151.00	34.0	34.0	34.0	0.9894	50.238
25	9.55	150.10	0.00	150.10	35.0	422.0	270.0	152.00	35.0	35.0	35.0	0.9851	47.558
50	6.87	151.70	0.00	151.70	35.0	583.0	430.0	153.00	36.0	36.0	36.0	0.9899	47.9302
80	5.32	153.04	0.00	153.04	35.0	744.0	590.0	154.00	36.0	36.0	36.0	0.9893	45.1856
120	4.27	150.50	0.00	150.50	35.0	907.0	755.0	152.00	37.0	37.0	37.0	0.9851	45.0046
												0.9878	47.7100
												Avg	Avg

Y : Ratio of reading of reference to dry gas meter : tolerance for individual values ± 0.02 from average

ΔH_{adj} : Office pressure differential that equals to 21.24 in. of air @ 25 Cand 760 mm of mercury, mm H₂O ; tolerance for individual values ± 5.08 from average

Procedure: 40 CFR 60 APP A, METH SEC 5.3 & 7

Calibrated by:

(Mr Khaneon Khamphet)

Field Scientist(3)

Approved by:

Mr Samart Roo-ngan

Field Specialist(1)

FORM NO F 06 027 REVISION NO 2 ISSUE DATE 1 Jun 21



DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date :	3 Dec 24	Ambient Temperature (°C)	30		
Calibration sheet No :	C-031224-BKK_F50485	Relative Humidity (%) :	46		
Digital Temperature ID	BKK_F50485	Reference Temperature ID	BKK_FS1144		
Serial No :	1310055	Serial No :	201090006013		
Model :	XC-572-V	Model :	Digicon-CC-VT-MS		
		Next Calibrate :	28 Nov 25		
Location	Reference Temperature °C	Digital Temperature °C	Error °C	MPE	Pass / Fail
Stack	0	2	2	±3	Pass
	25	26	1	±3	Pass
	50	50	0	±3	Pass
	100	100	0	±3	Pass
	150	149	-1	±3	Pass
	200	197	-3	±3	Pass
	250	248	-2	±3	Pass
Probe	300	297	-3	±3	Pass
	500	497	-3	±3	Pass
	100	100	0	±3	Pass
	120	120	0	±3	Pass
	140	141	1	±3	Pass
	100	101	1	±3	Pass
	120	120	0	±3	Pass
Oven	140	140	0	±3	Pass
	100	101	1	±3	Pass
	120	120	0	±3	Pass
Fiber	140	140	0	±3	Pass
	100	101	1	±3	Pass
	120	120	0	±3	Pass
Exit	140	140	0	±3	Pass
	0	2	2	±3	Pass
	10	12	2	±3	Pass
Meter	20	21	1	±3	Pass
	0	2	2	±3	Pass
	25	26	1	±3	Pass
AUX	50	50	0	±3	Pass
	0	2	2	±3	Pass
	25	26	1	±3	Pass
	50	50	0	±3	Pass

MPE : (Maximum permissible error of measurement) ค่าความผิดพลาดสูงสุดของเครื่องมือวัด

Calibrated by :

(Mr Khaneon Khamphet)

Field Scientist (3)

Approved by :

Mr Samart Roo-ngan

Specialist (1)

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

PROBE NOZZLE DIAMETER CALIBRATION DATA SHEET

Calibration Date :	3 Dec 24	Nozzle Set ID :	BKK_F50491
Calibration Sheet No : C-031224-BKK_F50491		Vernier Caliper ID :	RYG_F50539

Nozzle ID #	Nozzle Diameter (cm.)			H ₁ - L ₀	(D ₁ - D ₂ - D ₃) / 3
	D ₁	D ₂	D ₃	ΔD	D _{avg}
1	0.315	0.315	0.315	0.000	0.315
2	0.475	0.475	0.475	0.000	0.475
3	0.530	0.530	0.530	0.000	0.530
4	0.635	0.635	0.635	0.000	0.635
5	0.790	0.790	0.790	0.000	0.790
6	0.950	0.950	0.950	0.000	0.950
7	1.110	1.110	1.110	0.000	1.110
8	1.270	1.270	1.270	0.000	1.270
9	1.600	1.600	1.600	0.000	1.600

Where :

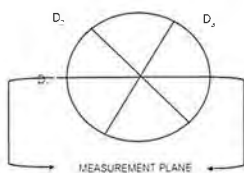
D₁, D₂, D₃ : There different nozzle diameters at 60 degrees to

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

Worawich T.

(Mr Worawich Tongpoom)

Field Scientist (2)

Approved by

Samart R.

(Mr Samart Roo-ngan)

Field Specialist (1)

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



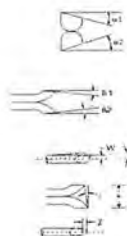
Type S Pitot Tube Calibration

Date Calibration
 Pitot ID
 Pitot SN

5-Jul-24
 BKK_F51119
 -

Due Date
 Inclinator ID
 Vernier ID

5-Jan-25
 BKK_F51131
 BKK_F51405



Parameter	Value	Allowable Range	Check
α1	2.4	-10° < α1 < +10°	OK
α2	3.1	-10° < α2 < +10°	OK
β1	2.9	-5° < β1 < +5°	OK
β2	4.2	-5° < β2 < +5°	OK
γ	1.2	-	-
θ	1.3	-	-
Z = A tan γ	0.018	Z ≤ 0.125"	OK
W = A tan θ	0.020	W ≤ 0.031"	OK
Dt	0.375	0.188" to 0.375"	OK
A/2Dt	1.173	1.05 ≤ PA/Dt ≤ 1.5	OK
A	0.88	2.1Dt ≤ A ≤ 3Dt	OK

Certify that pitot tube/probe 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

Prasert S.

(Mr Prasert Surakhan)

Enviro Field Services Scientist (3)

Approved by

Samart R.

(Mr Samart Roo-ngan)

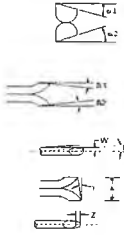
Enviro Field Services Specialist (1)

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



Type S Pitot Tube Calibration

Date Calibration 5-Jul-24 Due Date 5-Jan-25
 Pitot ID BKK_FS1105 Inclinator ID BKK_FS1131
 Pitot SN - Vernier ID BKK_FS1405



Parameter	Value	Allowable Range	Check
$\alpha 1$	1.2	$-10^\circ < \alpha 1 < +10^\circ$	OK
$\alpha 2$	3	$-10^\circ < \alpha 2 < +10^\circ$	OK
$\beta 1$	3.3	$-5^\circ < \beta 1 < +5^\circ$	OK
$\beta 2$	3.3	$-5^\circ < \beta 2 < +5^\circ$	OK
γ	4	-	-
θ	1.2	-	-
$Z = A \tan \gamma$	0.074	$Z \leq 0.125"$	OK
$W = A \tan \theta$	0.022	$W \leq 0.031"$	OK
Dt	0.375	0.188" to 0.375"	OK
A/2Dt	1.413	$1.05 \leq PA/Dt \leq 1.5$	OK
A	1.06	$2.1Dt \leq A \leq 3Dt$	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:
 (Mr. Prasert Surakhan)
 Enviro Field Services Scientist (3)

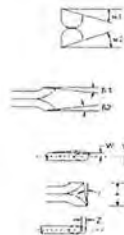
Approved By:
 (Mr. Samart Roo-ngan)
 Enviro Field Services Specialist (1)

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



Type S Pitot Tube Calibration

Date Calibration 3-Jun-24 Due Date 2-Dec-24
 Pitot ID BKK_FS0511 Inclinator ID BKK_FS1131
 Pitot SN - Vernier ID SGK_FS0113



Parameter	Value	Allowable Range	Check
$\alpha 1$	-1.8	$-10^\circ < \alpha 1 < +10^\circ$	OK
$\alpha 2$	-1.4	$-10^\circ < \alpha 2 < +10^\circ$	OK
$\beta 1$	-1.7	$-5^\circ < \beta 1 < +5^\circ$	OK
$\beta 2$	-2	$-5^\circ < \beta 2 < +5^\circ$	OK
γ	-1.3	-	-
θ	-0.4	-	-
$Z = A \tan \gamma$	-0.021	$Z \leq 0.125"$	OK
$W = A \tan \theta$	-0.006	$W \leq 0.031"$	OK
Dt	0.330	0.188" to 0.375"	OK
A/2Dt	1.394	$1.05 \leq PA/Dt \leq 1.5$	OK
A	0.92	$2.1Dt \leq A \leq 3Dt$	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:
 (Mr. Prasert Surakhan)
 Enviro Field Services Scientist (3)

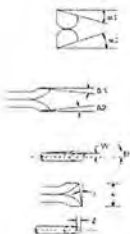
Approved By:
 (Mr. Samart Roo-ngan)
 Enviro Field Services Specialist (1)

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



Type S Pitot Tube Calibration

Date Calibration 5-Jul-24 Due Date 5-Jan-25
 Pitot ID BKK_FS1109 Inclinator ID BKK_FS1131
 Pitot SN - Vernier ID BKK_FS1405



Parameter	Value	Allowable Range	Check
$\alpha 1$	-3.1	$-10^\circ < \alpha 1 < +10^\circ$	OK
$\alpha 2$	2.6	$-10^\circ < \alpha 2 < +10^\circ$	OK
$\beta 1$	4	$-5^\circ < \beta 1 < +5^\circ$	OK
$\beta 2$	2.9	$-5^\circ < \beta 2 < +5^\circ$	OK
γ	2.9	-	-
θ	1.3	-	-
$Z = A \tan \gamma$	0.045	$Z \leq 0.125"$	OK
$W = A \tan \theta$	0.020	$W \leq 0.031"$	OK
Dt	0.375	0.188" to 0.375"	OK
A/2Dt	1.187	$1.05 \leq PA/Dt \leq 1.5$	OK
A	0.89	$2.1Dt \leq A \leq 3Dt$	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:
 (Mr. Prasert Surakhan)
 Enviro Field Services Scientist (3)

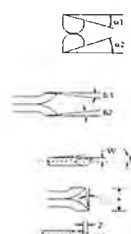
Approved By:
 (Mr. Samart Roo-ngan)
 Enviro Field Services Specialist (1)

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



Type S Pitot Tube Calibration

Date Calibration 5-Jul-24 Due Date 5-Jan-25
 Pitot ID BKK_FS0541 Inclinator ID BKK_FS1131
 Pitot SN - Vernier ID BKK_FS1405



Parameter	Value	Allowable Range	Check
$\alpha 1$	3.7	$-10^\circ < \alpha 1 < +10^\circ$	OK
$\alpha 2$	2.3	$-10^\circ < \alpha 2 < +10^\circ$	OK
$\beta 1$	-0.7	$-5^\circ < \beta 1 < +5^\circ$	OK
$\beta 2$	5.3	$-5^\circ < \beta 2 < +5^\circ$	OK
γ	4.6	-	-
θ	1.2	-	-
$Z = A \tan \gamma$	0.085	$Z \leq 0.125"$	OK
$W = A \tan \theta$	0.022	$W \leq 0.031"$	OK
Dt	0.375	0.188" to 0.375"	OK
A/2Dt	1.413	$1.05 \leq PA/Dt \leq 1.5$	OK
A	1.06	$2.1Dt \leq A \leq 3Dt$	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:
 (Mr. Prasert Surakhan)
 Enviro Field Services Scientist (3)

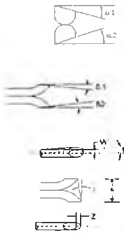
Approved By:
 (Mr. Samart Roo-ngan)
 Enviro Field Services Specialist (1)

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



Type S Pitot Tube Calibration

Date Calibration 5-Jul-24 Due Date 3-Jan-25
 Pitot ID BKK_FS0551 Inclinator ID BKK_FS1131
 Pitot SN - Vernier ID BKK_FS1405



Parameter	Value	Allowable Range	Check
α_1	2.4	$-10^\circ < \alpha_1 < +10^\circ$	OK
α_2	-3.1	$-10^\circ < \alpha_2 < +10^\circ$	OK
β_1	-0.4	$-5^\circ < \beta_1 < +5^\circ$	OK
β_2	9.3	$-5^\circ < \beta_2 < +5^\circ$	OK
γ	1.3	-	-
θ	1.4	-	-
$Z = A \tan \gamma$	0.020	$Z \leq 0.125"$	OK
$W = A \tan \theta$	0.021	$W \leq 0.031"$	OK
Dt	0.375	0.188" to 0.375"	OK
A/2Dt	1.160	$1.05 \leq PA/Dt \leq 1.5$	OK
A	0.87	$2.1Dt \leq A \leq 3Dt$	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:
 (Mr Prasert Surakhan)
 Enviro Field Services Scientist (3)

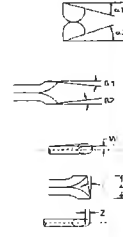
Approved By:
 (Mr Samart Roo-ngan)
 Enviro Field Services Specialist (1)

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



Type S Pitot Tube Calibration

Date Calibration 5-Jul-24 Due Date 5-Jan-25
 Pitot ID BKK_FS1112 Inclinator ID BKK_FS1131
 Pitot SN - Vernier ID BKK_FS1405



Parameter	Value	Allowable Range	Check
α_1	4.1	$-10^\circ < \alpha_1 < +10^\circ$	OK
α_2	4.5	$-10^\circ < \alpha_2 < +10^\circ$	OK
β_1	0.2	$-5^\circ < \beta_1 < +5^\circ$	OK
β_2	0.2	$-5^\circ < \beta_2 < +5^\circ$	OK
γ	1.6	-	-
θ	1.6	-	-
$Z = A \tan \gamma$	0.029	$Z \leq 0.125"$	OK
$W = A \tan \theta$	0.029	$W \leq 0.031"$	OK
Dt	0.375	0.188" to 0.375"	OK
A/2Dt	1.373	$1.05 \leq PA/Dt \leq 1.5$	OK
A	1.03	$2.1Dt \leq A \leq 3Dt$	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:
 (Mr Prasert Surakhan)
 Enviro Field Services Scientist (3)

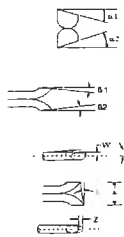
Approved By:
 (Mr Samart Roo-ngan)
 Enviro Field Services Specialist (1)

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



Type S Pitot Tube Calibration

Date Calibration 3-Jun-24 Due Date 3-Dec-24
 Pitot ID BKK_FS1113 Inclinator ID BKK_FS1131
 Pitot SN - Vernier ID SGK_FS0113



Parameter	Value	Allowable Range	Check
α_1	2.2	$-10^\circ < \alpha_1 < +10^\circ$	OK
α_2	-2.4	$-10^\circ < \alpha_2 < +10^\circ$	OK
β_1	-1.7	$-5^\circ < \beta_1 < +5^\circ$	OK
β_2	-0.1	$-5^\circ < \beta_2 < +5^\circ$	OK
γ	1.6	-	-
θ	-0.4	-	-
$Z = A \tan \gamma$	0.026	$Z \leq 0.125"$	OK
$W = A \tan \theta$	-0.006	$W \leq 0.031"$	OK
Dt	0.310	0.188" to 0.375"	OK
A/2Dt	1.484	$1.05 \leq PA/Dt \leq 1.5$	OK
A	0.92	$2.1Dt \leq A \leq 3Dt$	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:
 (Mr Prasert Surakhan)
 Enviro Field Services Scientist (3)

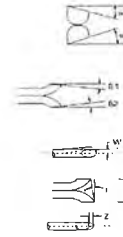
Approved By:
 (Mr Samart Roo-ngan)
 Enviro Field Services Specialist (1)

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



Type S Pitot Tube Calibration

Date Calibration 30-Nov-24 Due Date 1-Jun-25
 Pitot ID BKK_FS0512 Inclinator ID BKK_FS1131
 Pitot SN - Vernier ID SGK_FS0113



Parameter	Value	Allowable Range	Check
α_1	-0.2	$-10^\circ < \alpha_1 < +10^\circ$	OK
α_2	2.4	$-10^\circ < \alpha_2 < +10^\circ$	OK
β_1	-1.2	$-5^\circ < \beta_1 < +5^\circ$	OK
β_2	-1.6	$-5^\circ < \beta_2 < +5^\circ$	OK
γ	-1.1	-	-
θ	0.2	-	-
$Z = A \tan \gamma$	-0.018	$Z \leq 0.125"$	OK
$W = A \tan \theta$	0.003	$W \leq 0.031"$	OK
Dt	0.308	0.188" to 0.375"	OK
A/2Dt	1.494	$1.05 \leq PA/Dt \leq 1.5$	OK
A	0.92	$2.1Dt \leq A \leq 3Dt$	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:
 (Mr Prasert Surakhan)
 Enviro Field Services Scientist (3)

Approved By:
 (Mr Samart Roo-ngan)
 Enviro Field Services Specialist (1)

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



Certificate No: G 670051
Date of issue : 25-Jan-24

Instrument description : Flue Gas Analyzer
Instrument model : Testo 350 Nov
Control unit serial no. : 03580227/1121
Instrument serial no. : 6295030/1121
ID no. or control no. : BKK_F51157
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-240265
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 ± 5 °C
Humidity : 55 ± 15 %RH

Calibration place : 17/121 Soi Ngamwongwan 47 Yaek 46, Toongsonghong, Laka, Bangkok 10210

Calibration procedure no : This instrument was calibrated by comparison with Standard gas mixture according to calibration Work Instruction no WI-CL-26-C

The calibration certificate expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by coverage factor $k=2$, which for a normal distribution corresponds to a coverage probability of approximately 95%. This certificate is applied only to item under test Environmental condition.
This Calibration Certificate may not be reproduced other than in full except with the permission of the issuing laboratory.
Calibration certificates without signature and seal are 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 : 25-Jan-24

Kwanchoek
Mr. Kwanchoek Khamdoun
Calibration Technician

Wattana
Mrs. Nongluck Wongsettee
Technical Manager



Certificate No.: G 670051

Standard References (Table 1)

Standard	Certificate No.	Vendor	Due date
Oxygen (O ₂) 2.50 % Vol	2412/23	Unde	27-Aug-27
Oxygen (O ₂) 10.04 % Vol	CG-0153-21	Nimt	18-Nov-26
Oxygen (O ₂) 21.02 % Vol	CG-0041-27	Nimt	10-Feb-27
Carbon monoxide (CO) 80.14 ppm	CG-0040-22	Nimt	14-Feb-27
Carbon monoxide (CO) 302 ppm	1915/23	Unde	16-Jun-25
Carbon monoxide (CO) 1003 ppm	2584/23	Unde	10-Sep-25
Nitrogen Dioxide (NO ₂) 30.34 ppm	2703/22	Unde	22-Aug-24
Nitrogen Dioxide (NO ₂) 80.96 ppm	3240/21	Unde	26-Jun-24
Nitrogen Dioxide (NO ₂) 201.9 ppm	1975/23	Unde	17-Jul-25
Nitric Oxide (NO) 30.01 ppm	CG-0014-23	Nimt	19-Feb-25
Nitric Oxide (NO) 151.5 ppm	0161/23	Unde	22-Jan-25
Nitric Oxide (NO) 322.5 ppm	1974/23	Unde	17-Jul-25
Sulphur Dioxide (SO ₂) 50.36 ppm	2004/23	Unde	17-Jul-25
Sulphur Dioxide (SO ₂) 100.8 ppm	3507/22	Unde	09-Nov-24
Sulphur Dioxide (SO ₂) 600.8 ppm	2903/23	Unde	17-Jul-25

Measured room conditions

Temperature : 22.9 °C Humidity : 59.8 %RH Pressure : 1012.7 mbar

Calibration conditions

Gas Temperature : 23 °C Flow rate : 1,200 ml/min Gas pressure : 1016.8 mbar

Calibration Results (Without adjustment) (Table 2)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O ₂ (%Vol)	2.50	2.47	-0.03	0.15
O ₂ (%Vol)	10.04	9.91	-0.13	0.20
O ₂ (%Vol)	21.02	21.17	0.10	0.30
CO (ppm)	80.14	81	0.86	3.0
CO (ppm)	302	303	1	6.0
CO (ppm)	1003	1006	3	12
NO ₂ (ppm)	30.34	29.3	-1.04	8.0
NO ₂ (ppm)	80.96	79.8	-1.16	8.0
NO ₂ (ppm)	201.9	199.2	-2.7	12
NO (ppm)	30.01	30	-0.01	8.0
NO (ppm)	151.5	153	1.5	8.0
NO (ppm)	322.5	320	-2.5	12
SO ₂ (ppm)	50.36	49	-1.36	6.0
SO ₂ (ppm)	100.8	100	-0.8	6.0
SO ₂ (ppm)	600.8	596	-4.8	12

Remark : 1 cmol/mol = 1 %vol 1 μmol/mol = 1 ppm

End of Report



Certificate No: G 670682
Date of issue : 30-Sep-24

Instrument description : Flue Gas Analyzer
Instrument model : Testo 340
Instrument serial no. : 63119029
Control unit serial no. :
ID no. or control no. : BKK_F51158
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-243090
Receiving date : 24 Sep-24
Parameter of calibration : Gas Calibration (Oxygen 2.50, 10.04, 21.02 %vol, Carbon Monoxide 80.18, 302, 1007 ppm, Nitric Oxide 30.0, 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 ± 5 °C
Humidity : 55 ± 15 %RH

Calibration place : 17/121 Soi Ngamwongwan 47 Yaek 46, Toongsonghong, Laka, Bangkok 10210

Calibration procedure no : This instrument was calibrated by comparison with Standard gas mixture according to calibration Work Instruction no WI-CL-26-C

The calibration certificate expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by coverage factor $k=2$, which for a normal distribution corresponds to a coverage probability of approximately 95%. This certificate is applied only to item under test Environmental condition.
This Calibration Certificate may not be reproduced other than in full except with the permission of the issuing laboratory.
Calibration certificates without signature and seal are 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 : 27-Sep-24

Kwanchoek
Mr. Kwanchoek Khamdoun
Calibration Technician

Wattana
Mrs. Nongluck Wongsettee
Technical Manager



Certificate No.: G 670682

Standard References (Table 1)

Standard	Certificate No.	Vendor	Due date
Oxygen (O ₂) 2.50 % Vol	2412/23	Unde	27-Aug-27
Oxygen (O ₂) 10.04 % Vol	CG-0153-21	Nimt	18-Nov-26
Oxygen (O ₂) 21.02 % Vol	CG-0041-27	Nimt	10-Feb-27
Carbon monoxide (CO) 80.18 ppm	CG-0032-24	Nimt	11-Jan-29
Carbon monoxide (CO) 302 ppm	1915/23	Unde	16-Jun-25
Carbon monoxide (CO) 1007 ppm	1870/24	Unde	17-Jun-26
Nitric Oxide (NO) 30.0 ppm	CG-0065-24	Nimt	06-May-26
Nitric Oxide (NO) 151.5 ppm	0161/23	Unde	17-Jul-25
Nitric Oxide (NO) 322.5 ppm	1974/23	Unde	17-Jul-25
Sulphur Dioxide (SO ₂) 50.36 ppm	2004/23	Unde	17-Jul-25
Sulphur Dioxide (SO ₂) 100.8 ppm	3507/22	Unde	09-Nov-24
Sulphur Dioxide (SO ₂) 600.8 ppm	2003/23	Unde	17-Jul-25

Measured room conditions

Temperature : 22.9 °C Humidity : 65.6 %RH Pressure : 1011.2 mbar

Calibration conditions

Gas Temperature : 23 °C Flow rate : 600 ml/min Gas pressure : 1013.4 mbar

Calibration Results (Without adjustment) (Table 2)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O ₂ (%Vol)	2.50	2.46	-0.04	0.15
O ₂ (%Vol)	10.04	9.94	-0.10	0.20
O ₂ (%Vol)	21.02	21.11	0.09	0.30
CO (ppm)	80.18	80	-0.18	3.0
CO (ppm)	302	302	0	6.0
CO (ppm)	1007	1006	1	12
NO (ppm)	30.0	31	1.0	8.0
NO (ppm)	151.5	154	2.5	8.0
NO (ppm)	322.5	325	2.5	12
SO ₂ (ppm)	50.36	52	1.64	6.0
SO ₂ (ppm)	100.8	101	0.2	6.0
SO ₂ (ppm)	600.8	603	2.2	12

Remark : 1 cmol/mol = 1 %vol 1 μmol/mol = 1 ppm, O₂, NO, SO₂ New Sensor

End of Report



Certificate No: G 660765
Date of issue : 30-Nov-23

Instrument description : Flue Gas Analyzer
Instrument model : Testo 340
Control unit serial no. :
Instrument serial no. : 63119046
ID no. or control no. : BKK FS1160
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-234087
Receiving date : 24 Nov 23
Parameter of calibration : Gas Calibration(Oxygen 2.498,10.04,21.02 %Vol, Carbon Monoxide 80.14,302,1003 ppm, Nitric Oxide 30.0, 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 ±5 °C
Humidity : 55 ± 5 %RH
Calibration place : 17/121 Soi Ngamwongwan 47 Yaek 48, Toongsonghong, Laksi, Bangkok 10210
Calibration procedure no : This instrument was calibrated by comparison with Standard gas mixture according to calibration Work Instruction no. WI-CL-76-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 : 30 Nov-23

Kwanchoi
Mr. Kwanchoi Khairoung
Calibration Technician

D. Wuttie
Mrs. Nongluk Wongsettee
Technical Manager



Certificate No.: G 660765

Standard References (Table 1)

Standard	Certificate No.	Vendor	Due date
Oxygen (O2) 2.498 % Vol	4219/21	Linde	30-Sep-25
Oxygen (O2) 10.04 % Vol	CG 0153-21	Nimt	18-Nov-25
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	29-4/24	Linde	10-Sep-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 : 22.5 °C Humidity : 63.6 %RH Pressure : 1009.2 mbar

Calibration conditions

Gas Temperature : 23 °C Flow rate : 690 ml/min Gas pressure : 1017.3 mbar

Calibration Results (Without adjustment) (Table 2)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O2 (%Vol)	2.498	2.49	-0.008	0.15
O2 (%Vol)	10.04	9.94	-0.10	0.20
O2 (%Vol)	21.02	21.08	0.06	0.30
CO (ppm)	80.14	81	0.86	3.0
CO (ppm)	302	301	-1	6.0
CO (ppm)	1003	1000	-3	12
NO (ppm)	30.01	30	-0.01	8.0
NO (ppm)	151.5	151	-0.5	8.0
NO (ppm)	322.5	320	-2.5	12
SO2 (ppm)	50.36	52	1.64	6.0
SO2 (ppm)	100.8	103	2.2	6.0
SO2 (ppm)	600.8	594	-6.8	13

Remark : 1 cmol/mol = 1 %vol ; 1 mol/mol = 1 ppm

End of Report



Certificate No: G 670895
Date of issue : 18-Dec-24

Instrument description : Flue Gas Analyzer
Instrument model : Testo 340
Instrument serial no. : 63119036
Control unit serial no. :
ID no. or control no. : BKK FS1159
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 : 3 Pages
Receiving no. : L-244988
Receiving date : 16-Dec-24
Parameter of calibration : Gas Calibration(Oxygen 2.50,9.984,21.02 %vol, Carbon Monoxide 80.18,302,1007 ppm, Nitric Oxide 30.0, 151.5, 322.5 ppm, Sulphur Dioxide 50.36, 100.7, 600.8 ppm)

Condition of UUC : Used
Ambient condition : All of the Measurement were carried out the stabilized laboratory
Temperature : 23 ±5 °C
Humidity : 55 ± 5 %RH
Calibration place : 17/121 Soi Ngamwongwan 47 Yaek 48, Toongsonghong, Laksi, Bangkok 10210 THAILAND
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 : 16-Dec-24

Kwanchoi
Mr. Kwanchoi Khairoung
Calibration Technician

D. Wuttie
Mrs. Nongluk Wongsettee
Technical Manager



Certificate No.: G 670895

Standard References (Table 1)

Standard	Certificate No.	Vendor	Due date
Oxygen (O2) 2.50 % Vol	2412/23	Linde	27-Aug-27
Oxygen (O2) 9.984 % Vol	CG-0113-24	Nimt	01-Aug-29
Oxygen (O2) 21.02 % Vol	CG-0041-22	Nimt	10-Feb-27
Carbon monoxide (CO) 80.18 ppm	CG-0002-24	Nimt	11-Jan-29
Carbon monoxide (CO) 302 ppm	1915/23	Linde	16-Jun-25
Carbon monoxide (CO) 1007 ppm	1870/24	Linde	17-Jun-26
Nitric Oxide (NO) 30.0 ppm	CG-0065-24	Nimt	06-May-26
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) 100.7 ppm	2662/24	Linde	25-Aug-26
Sulphur Dioxide (SO2) 600.8 ppm	2003/23	Linde	17-Jul-25

Measured room conditions

Temperature : 22.5 °C Humidity : 61.2 %RH Pressure : 1010.6 mbar

Calibration conditions

Gas Temperature : 23 °C Flow rate : 600 ml/min Gas pressure : 1013.5 mbar

Calibration Results (Before adjustment) (Table 2)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O2 (%Vol)	2.50	2.44	-0.06	0.15
O2 (%Vol)	9.984	9.95	-0.034	0.20
O2 (%Vol)	21.02	21.14	0.12	0.30
CO (ppm)	80.18	81	0.82	3.0
CO (ppm)	302	303	1	6.0
CO (ppm)	1007	1009	2	12
NO (ppm)	30.0	29	-1.0	8.0
NO (ppm)	151.5	146	-5.5	8.0
NO (ppm)	322.5	303	-19.5	12
SO2 (ppm)	50.36	48	-2.36	6.0
SO2 (ppm)	100.7	97	-3.7	6.0
SO2 (ppm)	600.8	586	-14.8	13

Calibration Results (After adjustment) (Table 3)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O2 (%Vol)	3.50	2.44	-0.06	0.15
O2 (%Vol)	9.984	9.95	-0.034	0.20
O2 (%Vol)	21.02	21.14	0.12	0.30
CO (ppm)	80.18	81	0.82	3.0
CO (ppm)	302	303	1	6.0
CO (ppm)	1007	1009	2	12
NO (ppm)	30.0	31	1.0	8.0
NO (ppm)	151.5	153	1.5	8.0
NO (ppm)	322.5	324	1.5	12
SO2 (ppm)	50.35	51	0.64	6.0
SO2 (ppm)	100.7	100	-0.7	6.0
SO2 (ppm)	600.8	599	-1.8	13

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

End of Report

FM-CI-09-C Rev.8

Page 3 of 3

Issued Date 26/02/16

Entech Industrial Solution Co., Ltd.

17/121 Soi Narmwan 47, Yae 48, Toonsonthong, Lakki, Bangkok 10210 THAILAND Tel: 0-2779-8888 Calibration@entech.co.th
Fax: 0-215536035501 www.entech.co.th

Calibration certificate Kalibrier-Zertifikat

5753680

Object: Control Unit 1350 Measuring Box testo 350
Gegenstand: Hersteller: TESTO SE & Co. KGaA
Hersteller: TESTO SE & Co. KGaA
Type description: 0632 3511 0632 3510
Typ: 64554987 64749301
Serial no.: 64554987 64749301
Serien-Nr.:
Inventory no.:
Inventar-Nr.:
Test equipment no.:
Prüfmittel-Nr.:
Equipment no.: 15862735 15861583
Equipment-Nr.:
Location:
Standort:

Customer: ALS Laboratory Group (Thailand) Co., Ltd.
Auftraggeber: Eastern Seaboard Ind. Estate, 64/7 Moo 4
Highway 331 km 91.5, T. Phrakdaeng,
TH-21140 A. Phrakdaeng, Rayong Thailand

Customer ID no.: 1031994
Kunden-Nr.:
Order no.: 12459713 / 0520 0055
Auftrags-Nr.:
Date of calibration: 16.07.2024
Datum der Kalibrierung:
Date of the recommended re-calibration: 16.07.2025
Datum der empfohlenen Re-Kalibrierung:

Conformity statement: Pass
Sachgemäßes Messergebnis
The expanded uncertainty of measurement was calculated according to ISO 4102 M:2012 with a coverage probability of about 95% and contains the uncertainty of the reference, the uncertainty of the method and the uncertainty of the item specimen. The conformity statement is made according to the decision rule of the reference. The uncertainty of the method and the uncertainty of the item specimen are not included in the conformity statement. The conformity statement is made according to the decision rule of the reference. The uncertainty of the method and the uncertainty of the item specimen are not included in the conformity statement. The conformity statement is made according to the decision rule of the reference. The uncertainty of the method and the uncertainty of the item specimen are not included in the conformity statement.

Hereby we confirm that the performing calibration laboratory is working with a management system according to ISO 9001:2015 and DIN EN ISO/IEC 17025:2018. Accreditation certificates can be found under www.testo.de. The measuring installations used for calibration are regularly calibrated and traceable to the national standards of the German Federal Physical Institute (PTB) or other national standards. Should no national standards exist, the measuring procedure corresponds with the technical regulations and norms valid at the time of the measurement. The documents established for this procedure are available for viewing. All the necessary measured data can be found on this calibration certificate.

Hiermit bestätigen wir, dass das durchgeführte Kalibrierlabor mit einem Managementsystem nach ISO 9001:2015 sowie DIN EN ISO/IEC 17025:2018 arbeitet. Die Kalibrierungszertifikate sind unter www.testo.de zu finden. Die für die Kalibrierung verwendeten Messmittel sind regelmäßig kalibriert und auf die nationalen Normale der Physikalisch-Technischen Bundesanstalt (PTB) oder andere nationale Normale zurückzuführen. Sollten keine nationalen Normale existieren, entspricht das Messverfahren den geltenden technischen Vorschriften und Normen zum Zeitpunkt der Messung. Die für diesen Vorgang aufgestellten Dokumente sind einsehbar. Alle notwendigen Messergebnisse sind in diesem Kalibrierzertifikat aufgeführt.

REVIEW BY: [Signature]
APPROVED BY: [Signature]
NEXT CAL DATE: 16/07/25



Supervisor: [Signature]
Martin Förderer

Technician: [Signature]
Samuel Garcia Ziedi

Testo Industrial Services GmbH

Gewerbestraße 3
79199 Kirchzarten

Tel: +49 7851 9201-8000 www.testo.de
Fax: +49 7851 9201-8001 info@testo.de Page 1/2

Calibration certificate Kalibrier-Zertifikat

5753680

Measuring equipment Messausrüstungen

Reference	Traceability Rückführung	Next cal. Revid.	Certificate no. Zertifikat-Nr.	Eq.-No. Eq.-Nr.
a. Test gas medium 1 Prüfgas Medium 1	SC9-SC50006 2024-02	2025-02	5514410	12188976
b. Test gas medium 2 Prüfgas Medium 2	SC9-SC50006 2024-02	2025-02	5514410	12188976
c. Test gas medium 3 Prüfgas Medium 3	SC9-SC50006 2024-02	2025-02	5514410	12188976
d. Test gas medium 4 Prüfgas Medium 4	SC9-SC50006 2024-02	2025-02	5514410	12188976
e. Test gas medium 5 Prüfgas Medium 5	SC9-SC50006 2024-02	2025-02	5514410	12188976
f. Test gas medium 6 Prüfgas Medium 6	SC9-SC50006 2024-02	2025-02	5514410	12188976
g. Test gas medium 7 Prüfgas Medium 7	SC9-SC50006 2024-02	2025-02	5514410	12188976
h. Test gas medium 8 Prüfgas Medium 8	SC9-SC50006 2024-02	2025-02	5514410	12188976
i. Test gas medium 9 Prüfgas Medium 9	SC9-SC50006 2024-02	2025-02	5514410	12188976
j. Test gas medium 10 Prüfgas Medium 10	SC9-SC50006 2024-02	2025-02	5514410	12188976

Reference certificates are available at: www.primasone.com/Referenzzertifikate and/or www.primasone.com/about

Ambient conditions Umgebungsbedingungen

Temperature Temperatur (20...26) °C Humidity Feuchte (20...60) % RH % rH

Measuring procedure Messverfahren

The calibration was carried out by comparison measurement with calibrated test gases.
Die Kalibrierung erfolgte durch Vergleichsmessung mit kalibrierten Prüfgasen.

Measuring results Messergebnisse

Channel Kanal

Reference value Bezugswert	Indicated measured value angezeigter Messwert K ₀	Deviation Abweichung	Allowed deviation ²⁾ Zulassung	Measurement uncertainty (k=2) Messunsicherheit (k=2)	Confirmation Bestätigung
ppm Vol.-%	ppm Vol.-%	ppm Vol.-%	ppm Vol.-%	ppm Vol.-%	
CO					
100.6 ^a	102	0.6	± 1.1	3.3	pass
401.6 ^a	402	1.0	± 2.1	8.4	pass
700.6 ^a	700	0.0	± 3.6	14.4	pass
NO					
150.2 ^a	150	-0.2	± 9	4.0	pass
300 ^a	300	0	± 16	6.9	pass
NO2					
100.6 ^a	101.3	0.6	± 6.1	3.20	pass
SO2					
97.9 ^a	98	0.1	± 6	3.5	pass
O2					
0.00 ^a	0.08	0.08	± 0.21	0.027	pass
2.52 ^a	2.56	0.04	± 0.21	0.055	pass
5.01 ^a	5.15	0.14	± 0.21	0.102	pass

²⁾ in accordance with the manufacturer's instructions

Remarks Bemerkungen:

Channel Kanal

Sartorius (Thailand) Co., Ltd.
123 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10210
Tel: +66 2643 8361 6, e-mail: service.thailand@sartorius.com



SARTORIUS

Certificate of Calibration

REVIEW BY: [Signature]
APPROVED BY: [Signature]
NEXT CAL DATE: 30/11/24

Model Number: SECURA224-1S Certificate No.: 238C0469
Description: Analytical Balance Issued Date: Friday, December 01, 2023
Serial Number: 0038304155 Reference No.: 223958
ID No.: BKK_EN0309
Manufacturer: Sartorius Page No.: 1 of 2

Customer Name: ALS Laboratory Group (Thailand) Co., Ltd.
104 Phthalhanakan 40, Phthalhanakan Rd., Kwaeng Suan Luang, Khel Suan Luang, Bangkok 10250

Calibrated Place: Lab Room

Calibrated By: Mr Chonchai Inthana
Calibration Date: Thursday, November 30, 2023
Calibration Procedure No.: This calibration was conducted by
Using in-house calibration procedure number (WI-003)
Based on UKAS LAB 14: 2019

Metrological data: Capacity: 220 g Readability: 0.0001 g
Reasons for calibration: ☐ New Installation ☐ Service / Repair ☒ Re-calibration / Maintenance
Ambient Conditions: Temperature: 21.1 °C ± 5.0 °C
Humidity: 59.0 % RH ± 10.0 % RH
Pressure: ±
Equipment Condition: ☒ Good Operation ☐ Fair

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

Traceability:

Model Number	Description	Traceability	Certificate No.	Due Date
YCS011-522-00	Sartorius weight set 1mg - 5000g E2 YCS011-522-00	TCS	M2308197S	23-Aug-2025
MHB-382SD	Humidity/Balometer/Temp. Luton MHB-382SD	DKSH	C1923184S	23-Aug-2024

This certificate relates to 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.

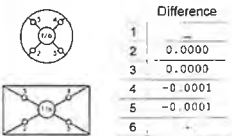
Mr Chonchai Inthana (Technical Manager)



Certificate of Calibration

Model Number: SECURA224-1S Certificate No.: 23BCI0468
Description: Analytical Balance Issued Date: Friday, December 01, 2023
Serial Number: 0038304165 Reference No.: 223958
ID No: BKK_EN0309
Manufacturer: Sartorius Page No.: 2 of 2

Calibration Results : Without Adjustment

Repeatability			Eccentricity (Off-center loading error)		
The repeatability is the ability of a weighing instrument to display nearly identical readouts under constant test conditions when the same load within a measurement range is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.			The off-center loading error is yielded by the difference between the readout of the load, i.e. 1/3 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 OIML R110).		
Nominal Value : (Low Load)	20.0000	199.9999	Nominal value :	100	g
20 g	20.0000	200.0000	Tolerance	0.0004	g
Tolerance	19.9999	200.0000			
0.0001 g	19.9999	199.9999			
	20.0000	200.0000			
Nominal Value : (High Load)	19.9999	200.0000			
200 g	19.9999	199.9999			
Tolerance	20.0000	199.9999			
0.0001 g	20.0000	200.0000			
	20.0000	200.0000			
Standard Deviation	0.00005	0.00005			

Linearity				
The linearity, also called knownity error, describes the deviation of the characteristic curve of a weighing instrument from the linear slope.				
Tolerance	0.0002	g		
Nominal Value	Conventional Mass Value	Displayed Value	Deviation	Uncertainty
(g)	(g)	(g)	(g)	(g)
0.01	0.0100	0.0100	0.0000	0.00014
0.05	0.0500	0.0500	0.0000	0.00014
0.1	0.1000	0.1000	0.0000	0.00014
0.5	0.5000	0.5000	0.0000	0.00014
1	1.0000	1.0000	0.0000	0.00014
2	2.0000	2.0000	0.0000	0.00014
5	5.0000	5.0000	0.0000	0.00014
10	10.0000	10.0000	0.0000	0.00014
20	20.0000	20.0000	0.0000	0.00014
200	200.0000	200.0000	0.0000	0.00029

End of Report

SOP FM 33 03 February 2022

Accredited by

NSC-TISI-TIS 17025
Calibration 0426



Calibration certificate

Calibration Certificate No. 24BCI0440

Object	Electronic non-automatic weighing instrument	This calibration certificate documents the traceability to national standards.
Manufacturer	Sartorius	Uncertainties of measurements are taken into account when only statements of compliance are made.
Type	SECURA224-1S	This certificate was prepared by Sartorius Compliance in accordance to the current ISO/IEC 17025:2017 standard and Sartorius Work Instruction (Method) SOP-WI 08.
Serial QM Ident. no	38304165 BKK_EN0309	This certificate relate and apply this equipment only.
Customer	ALS Laboratory Group (Thailand) Co., Ltd.	
	104 Phatthanakarn 40, Phatthanakarn Rd., Khwaeng Phatthanakarn, Khet Suan Luang, Bangkok 10250	
Order no	246926	
Number of pages	4	
Date of calibration	05 Nov 2024	

REVIEW BY *Jinda K*

APPROVED BY *Suk P*

NEXT CAL. DATE 05/11/25

This calibration certificate may not be reproduced other than in full except with the permission of NSC-TISI-TIS-17025 and the issuing laboratory. Calibration certificates without signature are not valid.
The user is obliged to have the object recalibrated at appropriate intervals.

Date	05 Nov 2024	Approval of the Calibration Certificate	Person in charge
		<i>Chonchai Inthana</i>	<i>Chonchai Inthana</i>
		Mr. Chonchai Inthana	Chonchai Inthana

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang
10310 Bangkok

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Calibration certificate No.: 24BCI0440

Calibration Certificate

Calibration object

Single range instrument

Model SECURA224-1S
Serial Number 38304165
QM Ident. no | Inventory no BKK_EN0309 | —

Maximum capacity (Max. load) 220.0000 g
Measured range 220.0000 g
Scale interval 0.0001 g

Place of calibration

Address According to page 1
Department | Cost center Laboratory Department | —
Building | Floor — | 1st Floor.
Room Laboratory Room.
Maximum temperature variation at place of calibration 5 K

Calibration procedure

EURAMET cg-18, V4.0 - Guidelines on the Calibration of Non-Automatic Weighing Instruments

Test equipment

Test equipment type	Test equipment ID	Valid until
Thermometer	MHB-382SD s/nB011342 Traceable to SI unit through DKSH	21 Aug 2025
Test weight set OIML R111 E2	Certificate No. M23081978_E2 (Traceable to SI unit through TCS)	23 Aug 2025

Calibration certificate No.: 24BCI0440

Calibration Certificate

Adjustment Status

The measuring device was internally adjusted before the calibration.

Environmental and measuring conditions

Date of calibration 05 Nov 2024
Temperature at place of calibration | Temp. diff. 19.6 °C | 0.4 K
Weights - Place
Measuring conditions The installation site is suitable. The device was levelled. Balance was loaded up to Max before test.
Comments Humidity 68.0 %RH.

Measurement results | Measurement uncertainties

Repeatability			Eccentricity		
Test load (nominal): 10 g 100 g			Test load (nominal):	100 g	
10 g	100 g		Center	100.0000 g	
1 10.0000 g	100.0000 g		Front left	100.0001 g	
2 10.0000 g	99.9999 g		Back left	100.0000 g	
3 10.0001 g	100.0000 g		Back right	100.0000 g	
4 10.0000 g	99.9999 g		Front right	100.0000 g	
5 10.0000 g	100.0000 g		Maximum deviation from centric loading indication		
6 9.9999 g	99.9999 g		Δ ecc max = 0.0001 g		
7 10.0000 g	100.0000 g				
8 9.9999 g	100.0000 g				
9 10.0000 g	99.9999 g				
10 10.0001 g	100.0000 g				
s = 0.00007 g	s = 0.00005 g				

Error of indication					
Testload	Indication	Error	Expansion factor	Uncertainty	Uncertainty relative
0.0100 g	0.0100 g	0.0000 g	2.00	0.00015 g	1.5 %
0.0500 g	0.0500 g	0.0000 g	2.00	0.00013 g	0.26 %
0.1000 g	0.1000 g	0.0000 g	2.00	0.00013 g	0.13 %
0.5000 g	0.5000 g	0.0000 g	2.00	0.00013 g	0.027 %
1.0000 g	1.0000 g	0.0000 g	2.00	0.00013 g	0.013 %
2.0000 g	2.0000 g	0.0000 g	2.00	0.00013 g	0.0067 %
5.0000 g	5.0000 g	0.0000 g	2.00	0.00014 g	0.0027 %
10.0000 g	10.0000 g	0.0000 g	2.00	0.00014 g	0.0014 %
20.0000 g	20.0000 g	0.0000 g	2.00	0.00014 g	0.00071 %
200.0000 g	199.9999 g	-0.0001 g	2.00	0.00028 g	0.00014 %
210.0000 g	210.0000 g	0.0000 g	2.00	0.00031 g	0.00015 %
Maximum error of indication		E max = 0.0001 g			

Used(E) is the quotient of U(E) and test load L. The uncertainty of measurement u(E) is valid only if error E is considered. You will find reference notes on the uncertainty of measurement in the unit Appendix to the calibration certificate | Interpretation of measurement results.
Reference note: The reported expanded uncertainty of measurement is stated at the standard uncertainty of measurement multiplied by the documented Expansion factor determined in accordance with the European Calibration Guideline EURAMET cg-18, V4.0. There is a 95 % probability that the value of the measurand will lie in the assigned value range.

End of calibration certificate

Uncertainty of measurement in use

Device adjusted before measurement

Yes

Temperature deviation considered

1 K (isoCAL active)

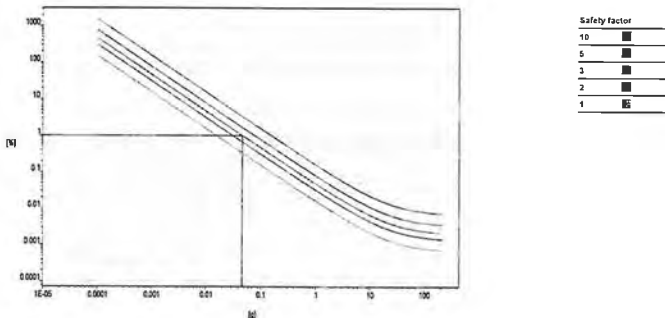
Temperature coefficient considered

 $2 \cdot 10^{-4}/K$ Uncertainty of the weighing result $U_{95}(W)$ $U_{95}(W) = 0.00016 \text{ g} + 6.42 \cdot 10^{-4} \cdot R$

Reference note: The current uncertainty of measurement is calculated by entering of the reading R into this formula. In relation to this, there is no need for a correction of the indication error. The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied with an expansion factor of 2, determined in accordance with the European Calibration Guideline EURAMET cg-18, V4.0. There is a 95 % probability that the value of the measurand will be in the assigned value range.

Indication in % from max load	Net indication R	Uncertainty $U_{95}(W)$	Uncertainty relative $U_{95}(W)/R$
1 %	2.0000 g	0.00017 g	0.0075 %
25 %	55.0000 g	0.00051 g	0.00093 %
50 %	110.0000 g	0.00087 g	0.00079 %
75 %	165.0000 g	0.0012 g	0.00074 %
100 %	220.0000 g	0.0016 g	0.00071 %

Graphic realization of the relative uncertainty of measurement | process accuracy



Displayed example

Process accuracy

1.00 %

Safety factor

3

Minimum sample weight

0.0470 g

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang
10310 Bangkok

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Version 6.5

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DRY GAS METER CALIBRATION TEST REPORT

Calibration of Date : 9 Jul 24

Next Calibration Date : 9 Jan 25

Barometric Pressure (mm Hg) :

757

Relative Humidity (%) :

54.0

Temperature (C) :

32.0

Dry Gas Meter Data

Calibration sheet No : C-050724-BKK_FS1094

Dry Gas Meter No : BKK_FS1094

Console Serial No : 5300

Model No : XC-60B-V

Reference Dry Gas Meter Data

Reference Dry Gas Meter ID : BKK_FS1122

Serial No : A2003240

Correction Factor (Yr) :

0.9824

Next Calibration Date : 7 Nov 24

Reference Dry Gas Meter Calibration				Dry Gas Meter						Dry Gas Meter Correction Factor
Vr (Liters)			Tr (°C)	Vm (Liters)			Tr (°C)	To (°C)	Avg Tr (°C)	Factor (%)
Final	Initial	Total		Final	Initial	Total				
30.00	0.00	30.00	32.0	29.87	0.00	29.87	31.0	31.0	31.0	0.9834
30.00	0.00	30.00	30.0	30.02	0.00	30.02	31.0	31.0	31.0	0.9850
60.00	0.00	60.00	32.0	59.92	0.00	59.92	32.0	32.0	32.0	1.0021
60.00	0.00	60.00	32.0	59.91	0.00	59.91	32.0	32.0	32.0	1.0006
90.00	0.00	90.00	33.0	89.97	0.00	89.97	33.0	33.0	33.0	1.0166
90.00	0.00	90.00	33.0	89.96	0.00	89.96	33.0	33.0	33.0	1.0203
										+ .3

 $Y = \text{Ratio of reading of reference dry gas meter to dry gas meter tolerance for individual} \pm 0.02 \text{ from average}$

Calibrate by

Mr. Apol Singh
Field Scientist (4)

Approved by

Mr. Saman Roonagan
Specialist (1)

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)



DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date :	9 Jul 24	Ambient Temperature (°C) :	32		
Calibration sheet No. :	C-050724-BKK_FS1094	Relative Humidity (%) :	54		
Digital Temperature ID :	BKK_FS1094	Reference Temperature ID :	BKK_FS1144		
Serial No. :	1706002	Serial No. :	201090006013		
Model :	XC-62-CV	Model :	Digicen-CC-VT-MS		
		Next Calibrate :	14 Aug 24		
Location	Reference Temperature °C	Digital Temperature °C	Error °C	MPE	Pass / Fail
Stack	0	1	1	±3	Pass
	25	26	1	±3	Pass
	50	51	1	±3	Pass
	100	101	1	±3	Pass
	150	151	1	±3	Pass
	200	201	1	±3	Pass
	250	251	1	±3	Pass
Probe	300	302	2	±3	Pass
	500	502	2	±3	Pass
	100	101	1	±3	Pass
	120	121	1	±3	Pass
Oven	140	141	1	±3	Pass
	100	-	-	±3	-
	120	-	-	±3	-
Filter	140	-	-	±3	-
	100	101	1	±3	Pass
	120	121	1	±3	Pass
Exit	140	141	1	±3	Pass
	0	1	1	±3	Pass
	10	11	1	±3	Pass
Meter	20	21	1	±3	Pass
	0	1	1	±3	Pass
	25	26	1	±3	Pass
AUX	50	51	1	±3	Pass
	0	1	1	±3	Pass
	25	26	1	±3	Pass
	50	51	1	±3	Pass

MPE : (Maximum permissible error of measurement) ค่าความคลาดเคลื่อนสูงสุดของผลการวัด

Calibrated by

Mr. Prasert Surakhon
Field Scientist (3)

Approved by

Mr. Saman Roonagan
Specialist (1)

FORM NO. F 06 027 REVISION NO. 2 ISSUE DATE 31 Feb 23



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)
Mechanical Engineering Standards Laboratory, 501/1 Bangpoo Industrial Estate, Muang Samutprakarn 10221, Thailand

Request No. 23-07/0215

MTC No. 23-66/0215-02

Number of Pages(S) 2

CALIBRATION CERTIFICATE

Nomenclature : "P" PRESSURE GAUGE

Manufactured by "P"

Dial size 60 mm

Serial No. VG05

ID BKK_FS0895

Range : -30 in Hg to 0 in Hg

Scale Interval : 0.05 in Hg

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

104 Phatthanakan 40, Phatthanakan Rd.,
Khwaeng Phatthanakan, Khui Suan Luang, Bangkok 10250, Thailand

Condition of calibrated item : Normal

Received date : 15 January 2024

Calibration date : 29 January 2024

Location of calibration : Mechanical Engineering Standards Laboratory, Room 119

Standard : Reference Pressure Monitor, Serial 1950, Certificate no. 23-66/0721-05

Due Date : 12 October 2024

The Standard used for the measurement is traceable to SI Unit through
Thailand Institute of Scientific and Technological Research (TISTR)

Calibrated by :
for (Mr. Uthair Chaiyapal)

APPROVED BY :
(Ms. Krana Luangthirun)

Director
Mechanical Engineering Standards Laboratory

Ref. 2013267011500197002

Issued Date : 16 February 2024

Head Office
250 Moo 4, Bangpoo Industrial Estate, Bangpoo District, Samutprakarn Province
10221, Thailand
Tel : 02-557-9900
Fax : 02-557-9901
E-mail : info@tistr.go.th

Office Laboratory
250 Moo 4, Bangpoo Industrial Estate, Bangpoo District, Samutprakarn Province
10221, Thailand
Tel : 02-557-9900
Fax : 02-557-9901
E-mail : info@tistr.go.th

Office
119 Moo 1, Bangpoo Industrial Estate, Bangpoo District, Samutprakarn Province
10221, Thailand
Tel : 02-557-9900
Fax : 02-557-9901
E-mail : info@tistr.go.th

TN-BMTC-002 Rev. 4



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)
Mechanical Engineering Standards Laboratory Soi 1, Bangpoo Industrial Estate, Muang Samutprakan 10280, Thailand

Request No. 23-67/0215

2 / 2

MTC.No. 23-67/0215-01

Calibration range : -28 in Hg to 0 in Hg

Calibration method : The Digital Pressure Gauge Under Calibration (UUC) was calibrated by comparison method followed DAKS-DKD-R 6-1: Calibration of Pressure Gauge, edition 03/2014

Calibration condition : Temperature (23.6 ± 2) °C, Relative Humidity (67 ± 10) %
Atmospheric pressure (1012 ± 10) hPa, Local gravity (9.783003 ± 0.000050) m/s²

Measurement Data :

Gauge position : Vertical

Medium : Air

Reference level : Gauge inlet

Unit : in Hg

UUC Reading	Gauge Pressure	Error	(±) Uncertainty
0.00	0.000	0.000	0.090
-10.00	-9.253	-0.747	0.090
-20.00	-18.981	-1.019	0.090
-26.00	-24.822	-1.178	0.090
-27.00	-25.801	-1.199	0.090
-28.00	-26.764	-1.236	0.090

Note : Conversion factor : 1 in Hg = 3.386384 kPa

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

The End of Calibration Certificate

P. P.

Head Office
35 Mu 3 Tambon Chaloeng Amnong, Bang Luang,
Changwat Pathumthani 12120, Thailand
Tel : 06-02577-9000
Fax : 06-02577-9009
E-mail : tistr@tistr.go.th

Office/Laboratory
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang, Chong Chuan, Samutprakan 10280, Thailand
Tel : 06-02323-1675 ext. 115, 116
Fax : 06-02323-9165
E-mail : mtc@tistr.go.th

Office
156 Mu 10 Tambon Chaloeng Amnong, Bang Luang,
Changwat Pathumthani 12120, Thailand
Tel : 06-02577-1121 ext. 5219, 5221, 5227
Fax : 06-02577-8592
E-mail : mtc@tistr.go.th

FM/BL/MTC.002 Rev.4



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)
Mechanical Engineering Standards Laboratory Soi 1, Bangpoo Industrial Estate, Muang Samutprakan 10280, Thailand

Request No. 23-67/0318

MTC.No. 23-67/00318-01

Number of Pages(S) 2

CALIBRATION CERTIFICATE

Nomenclature : "P" PRESSURE GAUGE

Dial Size 60 mm

Serial No. DVG03 ID BKK_FS0893

Range : -30 in Hg to 0 in Hg

Resolution : 0.5 in Hg

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

104 Phatthanakan 40, Phatthanakan Rd.,

Khwaeng Phatthanakan, Khel Suan Luang, Bangkok 10250, Thailand.

Condition of calibrated item : Normal

Received date : 20 February 2024

Calibration date : 4 April 2024

Standard : Reference Pressure Monitor, Serial 1950, Certificate no. 23-66/0721-05

Due Date 12 October 2024

The Standard used for the measurement is traceable to SI Unit through
Thailand Institute of Scientific and Technological Research (TISTR).

CALIBRATED BY : (Mr. Uthair Chaiyapatt)

APPROVED BY : (Ms. Kirana Luangphurin)

Director
Mechanical Engineering Standards Laboratory

Ref 2013267022000746001

Issued Date 9 April 2024

FM/BL/MTC.002 Rev.4



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)
Mechanical Engineering Standards Laboratory Soi 1, Bangpoo Industrial Estate, Muang Samutprakan 10280, Thailand

Request 23-67/0318

2 / 2

MTC.No. 23-67/00318-01

Calibration range : -28 in Hg to 0 in Hg

Calibration method : The Digital Pressure Gauge Under Calibration (UUC) was calibrated by comparison method followed DAKS-DKD-R 6-1: Calibration of Pressure Gauge, edition 03/2014

Calibration condition : Temperature (23.6 ± 2) °C, Relative Humidity (67 ± 10) %
Atmospheric pressure (1006 ± 10) hPa,
Local gravity (9.783003 ± 0.000050) m/s²

Measurement Data :

Gauge position : Vertical

Medium : Air

Reference level : Gauge inlet

Unit : in Hg

UUC Reading	Gauge Pressure	Error	(±) Uncertainty
0	0.00	0.00	0.12
-10	-8.45	-1.55	0.12
-20	-18.40	-1.60	0.12
-26	-24.41	-1.59	0.12
-27	-25.54	-1.46	0.13
-28	-26.57	-1.43	0.12

Note : 1 The reading taken after the gauge is lightly tapped

2 Conversion factor : 1 in Hg = 3.386384 kPa

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

The End of Calibration Certificate

Uthair

Head Office
35 Mu 3 Tambon Chaloeng Amnong, Bang Luang,
Changwat Pathumthani 12120, Thailand
Tel : 06-02577-9000
Fax : 06-02577-9009
E-mail : tistr@tistr.go.th

Office/Laboratory
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang, Chong Chuan, Samutprakan 10280, Thailand
Tel : 06-02323-1675 ext. 115, 116
Fax : 06-02323-9165
E-mail : mtc@tistr.go.th

Office
156 Mu 10 Tambon Chaloeng Amnong, Bang Luang,
Changwat Pathumthani 12120, Thailand
Tel : 06-02577-1121 ext. 5219, 5221, 5227
Fax : 06-02577-8592
E-mail : mtc@tistr.go.th

FM/BL/MTC.002 Rev.4



Bara Scientific Co., Ltd.
566 U Chu Liang Building Floor 7, Rama 4 Road
Siam Bangkok Bangkok Thailand 10500
Tel : 02-6324300 Fax : 02-6375496-7
www.barscientific.com



Certificate of Calibration

Number of Pages) 1 of 1

Certificate No. BSQC-UV-367/23
Equipment UV/Vis Spectrophotometer
Model UV-1800
Manufacturer Shimadzu
Serial No. A11454908533CD
ID No. BKK_EN0018
Date of receipt 15 September 2023
Date of calibration 16 September 2023
Date of issue 27 September 2023

Customer name ALS Laboratory Group (Thailand) Co., Ltd.

Address 104 Soi Phatthanakan 40 Phatthanakan Road Phatthanakan Suan Luang Bangkok 10250

Temperature (23.4 - 24.7) °C (On site)
Humidity (55.5 - 61.2) %RH (On site)

Equipment condition Good Operation

Calibration Location Organic Prep

Calibration Procedure In-house method WI-UV-702-01 based on ASTM E275-01

Traceability Wavelength Accuracy is traceable to certificate No. 95917 and 95918
Photometric Accuracy is traceable to certificate No. 95937 and 95924
Stray Light is traceable to certificate No. 85908
The above certificate are traceable to SI unit through Stama Scientific Ltd
(UKAS accredited calibration laboratory NO. 0659)

Calibrated by Mr. Wanchana Janloy

REVIEW BY: S. P.
APPROVED BY: S. P.
NEXT CAL DATE: 19/9/2024

Approved by

Mr. Kanchit Choothep
Technical Manager

The above results are valid only for the calibrated item. No other items in this report can be used.
Advertising the Report: Copying or the publication of these results are prohibited unless written permission is obtained from the provider of this report.



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Siam Bangkok Bangkok Thailand 10500
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www.barscientific.com



Certificate of Calibration

Certificate No. BSCC-UV-367/23

Number of Page(s) 2 of 3

Calibration Results:

1 Wavelength Accuracy

Certified Wavelength (nm)	UUC (nm)	Error (nm)	Uncertainty (±nm)
241.70	241.67	-0.03	0.18
334.02	334.03	0.01	0.18
418.53	418.59	0.06	0.18
572.99	573.14	0.15	0.18
879.41	879.21	-0.20	0.18

2 Photometric Accuracy (UV)

Wavelength (nm)	Certified Absorbance (A)	UUC (A)	Error (A)	Uncertainty (±A)
235	0.0000	0.0000	0.0000	0.0075
	0.7467	0.7460	-0.0007	0.0075
257	0.0000	0.0000	0.0000	0.0075
	0.8662	0.8646	-0.0016	0.0075
313	0.0000	0.0000	0.0000	0.0075
	0.2904	0.2908	0.0004	0.0075
350	0.0000	0.0001	0.0001	0.0075
	0.6429	0.6415	-0.0014	0.0075

*CNR = Customer not request

The above results are valid exclusively for the calibrated item(s) as mentioned in this report / certificate. Advertising the report / Certificate and publicity of the results are prohibited and also shall not be reproduced except in full, without written approval of the Bara Scientific Co., Ltd.

FM UV-706-02 Rev 01 (23/01/23)



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Siam Bangkok Bangkok Thailand 10500
Tel: 02-6324300 Fax: 02-6375498-7
www.barscientific.com



Certificate of Calibration

Certificate No. BSCC-UV-367/23

Number of Page(s) 3 of 3

Calibration Results:

3 Photometric Accuracy (Visible)

Wavelength (nm)	Certified Absorbance (A)	UUC (A)	Error (A)	Uncertainty (±A)
420.0	0.0000	0.0000	0.0000	0.0042
	0.5763	0.5793	0.0030	0.0042
	0.7615	0.7624	0.0009	0.0042
	1.0286	1.0288	0.0002	0.0042
440.0	0.0000	0.0000	0.0000	0.0042
	0.1621	0.1615	-0.0006	0.0042
	0.7451	0.7452	0.0001	0.0042
	0.9985	0.9984	-0.0001	0.0042
465.0	0.0000	0.0000	0.0000	0.0042
	0.5227	0.5229	0.0002	0.0042
	0.5841	0.5873	0.0032	0.0042
	0.9457	0.9486	0.0029	0.0042
546.1	0.0000	0.0000	0.0000	0.0042
	0.5207	0.5211	0.0004	0.0042
	0.6973	0.6960	-0.0013	0.0042
	0.9959	0.9944	-0.0015	0.0042
590.0	0.0000	0.0000	0.0000	0.0042
	0.5044	0.5038	-0.0006	0.0042
	0.7213	0.7215	0.0002	0.0042
	1.0942	1.0925	-0.0017	0.0042
635.0	0.0000	0.0000	0.0000	0.0042
	0.7610	0.7602	-0.0008	0.0042
	0.9427	0.9395	-0.0032	0.0042
	1.0841	1.0866	0.0025	0.0042

*CNR = Customer not request

4 Stray Light

Standard cut-off wavelength (nm)	Wavelength (nm)	Unit Under Calibration(UUC) Transmission (T)	Absorbance (A)
200 86±0.1nm	200.55	0.9770	2.0104

The stray light transmission reference is less than 1.0% and stray light absorbance reference is greater than 2.00A.

*Stray Light not NSC-ONSC Accredited.

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

End of Certificate

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FM UV-706-02 Rev 01 (23/01/23)



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www.barscientific.com



Certificate of Calibration

Certificate No. BSCC-UV-374/24

Number of Page(s) 1 of 3

Equipment UV/Vis Spectrophotometer
Model UV-1800
Manufacturer Shimadzu
Serial No. A11454908533 CD
ID No. BRK_END018
Date of receipt 13 September 2024
Date of calibration 13 September 2024
Date of issue 13 SEP 2024

Customer name ALS Laboratory Group (Thailand) Co., Ltd.

Address 104 Soi Phattananak 40, Phattananak Road, Phattananak, Suan Luang, Bangkok 10250

Temperature (25.3 - 26.7) °C (On site)
Humidity (50.4 - 55.9) %RH (On site)

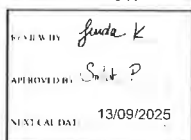
Equipment condition Good Operation

Calibration Location Organic Preparation Lab

Calibration Procedure In-house method WI-UV-702-01 based on ASTM E275-01

Traceability Wavelength Accuracy is traceable to certificate No. 106372 and 106371
Photometric Accuracy is traceable to certificate No. 106364 and 111398
Stray Light is traceable to certificate No. 106377
The above certificate are traceable to SI unit through Stama Scientific Ltd.
(UKAS accredited calibration laboratory No. 0659)

Calibrated by Mr Wanchana Janloy



Approved by

Mr. Sonthi Temboonsakdi
Service Manager

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FM UV-706-02 Rev 01 (23/01/23)



Bara Scientific Co., Ltd.
968 U Chu Luang Building Floor 7 Rama4 Road
Siam Bangkok Bangkok Thailand 10500
Tel: 02-6324300 Fax: 02-6375498-7
www.barscientific.com



Certificate of Calibration

Certificate No. BSCC-UV-374/24

Number of Page(s) 2 of 3

Calibration Results:

1. Wavelength Accuracy

Certified Wavelength (nm)	UUC (nm)	Error (nm)	Uncertainty (±nm)
241.70	241.55	-0.15	0.18
334.02	333.85	-0.17	0.18
418.53	418.57	0.04	0.18
572.99	572.97	-0.02	0.18
879.41	879.17	-0.24	0.18

2. Photometric Accuracy (UV)

Wavelength (nm)	Certified Absorbance (A)	UUC (A)	Error (A)	Uncertainty (±A)
235	0.0000	0.0000	0.0000	0.0075
	0.7171	0.7169	-0.0002	0.0075
257	0.0000	0.0000	0.0000	0.0075
	0.8354	0.8345	-0.0009	0.0075
313	0.0000	0.0000	0.0000	0.0075
	0.2786	0.2781	-0.0005	0.0075
350	0.0000	0.0000	0.0000	0.0075
	0.6199	0.6194	-0.0005	0.0075

*CNR = Customer not request

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FM UV-706-02 Rev 01 (23/01/23)



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Siam Bangkok Bangkok Thailand 10500
Tel : 02-6324300 Fax : 02-6374967
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Certificate of Calibration

Certificate No. BSCC-UV-37424 Number of Page(s) 3 of 3

Calibration Results:

3 Photometric Accuracy (Visible)

Wavelength (nm)	Certified Absorbance (A)	UUC (A)	Error (A)	Uncertainty (±A)
420.0	0.0000	0.0000	0.0000	0.0042
	0.5761	0.5765	0.0004	0.0042
	0.7119	0.7105	-0.0014	0.0042
	1.0189	1.0174	-0.0015	0.0042
	0.0000	0.0000	0.0000	0.0042
440.0	0.5610	0.5613	0.0003	0.0042
	0.7901	0.6994	-0.0907	0.0042
	1.0026	1.0011	-0.0015	0.0042
	0.0000	0.0000	0.0000	0.0042
	0.5235	0.5232	-0.0003	0.0042
465.0	0.5614	0.5598	-0.0016	0.0042
	0.9456	0.9444	-0.0012	0.0042
	0.0000	0.0000	0.0000	0.0042
	0.5249	0.5245	-0.0004	0.0042
	0.5975	0.5956	-0.0019	0.0042
546.1	1.0009	0.9994	-0.0015	0.0042
	0.0000	0.0000	0.0000	0.0042
	0.5590	0.5586	-0.0004	0.0042
	0.7725	0.7708	-0.0017	0.0042
	1.1125	1.1114	-0.0011	0.0042
635.0	0.0000	0.0000	0.0000	0.0042
	0.5666	0.5666	0.0000	0.0042
	0.7620	0.7604	-0.0016	0.0042
	1.0982	1.0971	-0.0011	0.0042
	0.0000	0.0000	0.0000	0.0042

*CNR = Customer not request

4. Stray Light*

Standard cut-off wavelength (nm)	Unit Under Calibration(UUC) Wavelength (nm)	Transmission (%)	Absorbance (A)
200.85±0.11nm	199.58	0.9520	2.0217

The Stray light transmission reference is less than 1.0%T and Stray light absorbance reference is greater than 2.00A

*Stray Light not NSC-ONSC Accredited.

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

End of Certificate

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FM-UV-705-02 Rev 01 (23/01/23)



Performance Verification Certificate for Mercury Analyzer

PRODUCT ID Quicktrace M-8000 , Teledyne Leeman Labs

Equipment ID BKK_EL0128 Mercury Analyzer
S/N: US22133002

BKK_EL0129 Autosampler
S/N: 052222A560

Customer Name AIS Laboratory Group (Thailand) Co., Ltd.

Address 104 Soi Pattana 40, Pattana Rd. Suan Luang, Suan Luang Bangkok 10250 Thailand

Date of Qualified December 6, 2023

Next Due date December 6, 2024

This certifies for products which was performed in acceptable criteria specifications

Autosampler & Sample Introduction	PASSED
Analyzer	PASSED
Gas Liquid Separator & Dryer	PASSED
CVAFS Detector	PASSED
Electronics/Mechanical	PASSED
Data station/IPC	PASSED
Analytical test	PASSED

Provided by

Scientist Instrument Co., Ltd.
113 Soi Ekachai 41, Ekachai Road
Khlong Bang Phran, Banghoo
Bangkok 10150 Thailand

Certified by
Thunraphol Sakdayos

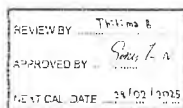
Service Engineer

DKN_EL0037



Agilent CrossLab Start Up Services

Agilent 5100 5110 ICP-OES
Preventive Maintenance



Agilent Preventive Maintenance provides factory recommended service for your analytical instruments to assure reliable operation and the accuracy of your results.

Delivered by highly trained and certified service engineers using genuine Agilent parts and supplies. Agilent Preventive Maintenance provides what you need to reduce unplanned downtime and keep your systems operating at their peak performance.

This checklist is used as a guide for completing the preventive maintenance task. A signed copy of this checklist is provided for your records.

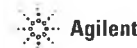
Agilent 5100 5110 Preventive Maintenance Checklist



Introduction

Customer Information

- Customers should provide all necessary operating supplies upon request of the engineer.
- A customer representative should be available to the engineer while performing the preventive maintenance procedures. Customers are responsible for regular maintenance and are encouraged to observe the service representative.
- Any parts not included in the Parts List section of this document are not part of the recommended Preventive Maintenance service nor are they included in the price of this service.
- If a system requires the use of extra or special procedures and/or parts for the maintenance service, then these must be ordered separately and charged as a repair, which may incur additional costs.
- For customers using HF applications, the instrument should be returned to its standard sample introduction system.



Important Customer Web Links

- To access **Agilent University**, visit <http://www.agilent.com/crosslab/university/> to learn about training options, which include online, classroom and onsite delivery. A training specialist can work directly with you to help determine your best options.
- To access the **Agilent Resource Center** web page, visit <https://www.agilent.com/en-us/agilentresources>. The following information topics are available:
 - Sample Prep and Containment
 - Chemical Standards
 - Analysis
 - Service and Support
 - Application Workflows
- The **Agilent Community** is an excellent place to get answers, collaborate with others about applications and Agilent products, and find in-depth documents and videos relevant to Agilent technologies. Visit <https://community.agilent.com/welcome>.
- Videos about specific preparation requirements for your instrument can be found by searching the **Agilent YouTube Channel** at <https://www.youtube.com/channel/UCagilent>.
- Need to place a service call?** Flexible Repair Options | Agilent

Service Engineer's Responsibilities

- Contact the customer and ensure that all necessary supplies are available before the preventive maintenance visit.
- Only select those pages that relate to the system or module being serviced.
- Complete empty fields with the relevant information.
- Complete the relevant checkboxes in the checklist using either a "X" or tick mark "✓".
- Check "Service not applicable" check boxes to indicate services/tasks not delivered as appropriate.
- Complete the Preventive Maintenance services in the most logical order relevant to the individual system service in the order of the tasks listed.
- Complete the **Service Review** section together with the customer.
- Complete the fields for page numbers at the foot of each selected page.
- Add relevant page numbers to selected pages and complete the total number of pages field in the Service Completion section.
- Ask the customer to sign the Service Verification section including the customer's and your signature.

Instrument Maintenance

System Information

- ☒ Check this box if an instrument configuration report is attached instead of completing the table.

Instrument System Name and ID	69010A / MW1010005
Instrument System Site and Location	RLS Laboratory Group (Thailand) Co., Ltd.

List System Component Product Numbers	List the Serial Numbers of each Component
1. Nebulizer	MW1010005
2. Spray Chamber	AL1010005
3. Torch	200100001
4.	
5.	
6.	
7.	
8.	
9.	

ICP-OES Configuration Table	Circle the type or write in the type if other
Nebulizer Type	Spray / Other: Conical Other
Spray Chamber	Cyclonic Single Pass / Cyclonic Double Pass / Other
Torch	Radial / Dual View / Other
Torch Type	One Piece / Semi-Dismountable / Fully Dismountable / Other
Injector Diameter	2.0mm / 2.5mm / 3.0mm / 3.5mm / Other
Injector Material	Quartz / Ceramic / Other

Preparation

- ☒ Discuss any specific issues with the customer before starting.
- ☒ Review the instrument logbook for recorded problems and comments.
- ☒ Save instrument control settings before starting the procedure.
- ☒ Perform a general inspection of the system for cleanliness.
- ☒ Check for proper installation of parts, assemblies, sensors, etc.
- ☒ Check system for required installation of components and implementation of Service Notes.
- ☒ Check for required firmware/software updates and verify with customers if they would like them installed.
- ☒ For HPLC application systems, if standard sample introduction system was not installed, ask the customer to install it.
- ☒ Ask the customer to remove any samples from the ICP-OES sample introduction area, auto sampler or around the ICP-OES.

Preventive Maintenance Procedures

Record Pre-PM instrument performance

- ☒ Run Instrument Performance test
- ☒ Record results in Instrument Performance Test Results Table - Pre-PM

Clean and inspect ICP-OES system

- ☒ Look for any obvious external damage or problems
- ☒ Inspect water cooling hoses, gas lines and power cord for excessive wear or damage
- ☒ Perform a general internal inspection of the system for excessive dust accumulation, clean if necessary
- ☒ Inspect sample introduction components and record any required maintenance in the Service Engineer Comments and notify the customer as the required actions required
- ☒ Record the instrument operating conditions in the ICP-OES Status Results Table
- ☒ Replace the polychromator purge filter
- ☒ Replace the radial pre-optics window
- ☒ Replace the axial pre-optics window for SVDV and VDV instruments
- ☒ Check exhaust flow for the correct positive extraction at the exhaust duct to insure they meet minimum specifications
- ☒ Replace air inlet dust filter
- ☒ Replace high capacity air inlet dust filter element if installed
- ☒ Remove and clean instrument water inlet filter

Agilent Water Recirculator

- ☐ Service not applicable
- ☒ Drain cooling fluid and remove any particles from the chiller reservoir
- ☒ Remove, clean and reinstall water inlet metal mesh filter if present
- ☒ Re fill with Agilent Cool Clear cooling fluid
- ☒ Clean the cooling system Air filter and the condenser

SPS 3 Auto Sampler

- ☒ Service not applicable
- ☐ Power cycle the autosampler and verify successful initialization
- ☐ Inspect X and Z axis belts for wear. Replace is necessary
- ☐ Clean X and Z axis slide shafts
- ☐ Using customer's racks and the Agilent software move the sample probe to the 4 outermost corners and rinse port, ensure that the probe is approximately centered in the vial

SPS 4 Auto sampler

- ☐ Service not applicable
- ☒ Clean the spill tray, rack location mat, end frames and chassis with a damp soft cloth and diluted mild detergent
- ☒ Clean the auto sampler cover panels, if cover kit is installed, with domestic window cleaner
- ☒ Check the X-axis and Z-axis drive belts for cracks, splits, damaged teeth, excessive fraying, color changes or degradation from fumes
- ☒ Check the X-axis, Theta-axis and Z-axis FFC cables for cracks, incorrect positioning, damaged edges or damaged connectors
- ☒ Pump Tubing Replacement: Replace peristaltic pump tubing. Replace all tubing that goes from the rinse station to the pump and from the pump to the waste/rinse bottles
- ☒ Test using customer's tray and move the sample probe to the sample vial 1, wash vial and rinse port and ensure that the probe is centered in the vial. If not use calibration wizard and calibrate the position

AVS 4, 6, 7 Advanced Valve System

- ☒ Service not applicable
- ☐ Replace valve rotor seal
- ☐ Check fittings for signs of leaks
- ☐ Check tubing including autosampler tubing for kinks or excessive wear
- ☐ Check high flow pump for signs of leaks

ICP-OES adjustment

- ☒ Check position of Zn peak, adjust if required
- ☒ Check Argon Ratio, adjust to specified value if required
- ☒ Perform Detector Calibration
- ☒ Perform Instrument Calibration

Record Post-PM instrument performance

- ☒ Run Instrument Performance test
- ☒ Record results in Instrument Performance Test Results Table - Post PM
- ☒ For systems using ICP Expert version 7.3 and above, run the following Instrument tests:
 - ☒ Subsystem Communications Test
 - ☒ Air Flow
 - ☒ Water Flow
 - ☒ Gas Flows
 - ☒ RF Generator
 - ☒ Camera Test
 - ☒ Optics Test
 - ☒ Nebulizer Test
- ☒ Record the result in the Instrument Test Results Table

Restore Instrument

- ☒ For HF applications, ask the customer to reinstall their sample introduction system
- ☒ Leave system in an idle state, on and purging
- ☒ Guidance: If the PM service is performed prior to a qualification service, then use the qualification procedure as a guide for final instrument set up and checkout

Service Review

- ☒ Attach available reports/printouts of all tests to the documentation
- ☒ Record the Preventive Maintenance service activity in the customer's records/logbook
- ☒ Record the PM event in the Smart Alerts logbook, if applicable
- ☒ Update/reset instrument maintenance counters as appropriate
- ☒ Affix the PM sticker to the system or instrument logbook based on the customer's request
- ☒ Complete the Service Engineer Comments section if there are additional comments
- ☒ Review this service, parts replaced, and test results obtained with the customer
- ☒ If the instrument firmware was updated, record the details of the change in the Service Engineer's Comments box. Systems in a compliant environment may need additional documentation
- ☒ Complete the Signature Page with both Service Engineer and Customer signatures

Test Results

Instrument Performance Test Results Table

Note: These measurements do not form part of any specification and are for reference only.

Pre PM Sensitivity Check		Post PM Sensitivity Check		
Radial	Axial *	Radial	Axial*	
Zn 213.857 nm SRBR	1571 ± 2	344 ± 3	1550 ± 5	2421 ± 8
Mn 257.610 nm SRBR	155 ± 1	19.55 ± 1	73 ± 4	17.95 ± 3
Al 296.132 nm SRB	3 ± 1	15.0	5 ± 1	10 ± 3
Pb 286.491 nm SRB	5 ± 1	6 ± 0.5	5 ± 1	10 ± 2

* Axial result is not applicable for G8016AA, G8012AA Radial View instruments.

Instrument Test Results Table

Note: The Instrument Test results are for systems using ICP Expert version 7.3 and above only.

Instrument Test	Result
System Communications Test	PASS
Air Flow	PASS
Water Flow	PASS
Gas Flows	PASS
RF Generator	PASS
Calomp Test	PASS
Optics Test	PASS
Nebulizer Test	PASS

ICP-OES Status Results Table

Note: These measurements do not form part of any specification and are for reference only.

Measurement	Standby Mode	Plasma On
Main Voltage	218.31 V	215.12 V
Main Current	0.01 A	0.11 A
Instrument Temperature	21.1 °C	23.1 °C
RF Air Flow (sensor speed)	19.0 Hz	23.0 Hz
Plasma Exhaust Temperature	No measurement	25.1 °C
Water Flow Oscillator	No measurement	1.10 L/min
Water Flow Detector	1.14 L/min	1.05 L/min
Water Inlet Temperature	22.1 °C	23.1 °C
Polychromator Temperature	25.1 °C	25.1 °C
CCD Temperature	-44.1 °C	-44.1 °C
Thermal Chamber	31.1 °C	24.1 °C
Argon Supply Pressure	61.1 kPa	55.1 kPa
Purge Gas Supply Pressure*1	5.1 kPa	5.1 kPa
Optic Gas Supply Pressure*1	1.1 kPa	1.1 kPa
Nebulizer Flow	No measurement	0.10 L/min
Nebulizer Back Pressure	No measurement	1.1 kPa
Plasma Gas Flow	No measurement	1.1 L/min
Auxiliary Gas Flow	No measurement	1.1 L/min
RF Power	No measurement	1.1 W
RF Supply Current	No measurement	1.1 A
RF Supply Voltage	No measurement	1.1 V

*1 If option installed.

Consumed PM Parts

Part Description	Part Number	Product or Model# where used	Quantity consumed
Axial Pre-Drain Window	G8010-68014	G8010A, G8011A, G8014A/G8015A	1
Radial Pre-Drain Window	G8010-68015	All	1
Agilent Cool Down Coolant Filter	5799-0037	Agilent Water Recirculator	1
Purge Gas Filter	G8010-68036	All	1
Air Inlet Filter	G6000-68002	All	1
High Capacity Air Filter	G8010-68089	Optional	1
Factor seal for 1/4 port valve for AVS4	G8494-68002	G8494A/G8495	1
Factor seal for 1/4 port valve for AVS4	G8494-68002	G8494A/G8495	1
Rinsing solution to rinse seal on 2.5mm ID x 1m	G8410-80723	SPS 4	1
Exhaust connector 2.5mm ID x 1.5mm ID	G8410-80724	SPS 4	1
PVC waste line connector 2.5mm ID x 1.5mm ID	G8410-80722	SPS 4	1
Additional Parts may be required from engineer's stock:			
400 drive belt	5610047500	SPS 3	1
200 drive belt	5610047400	SPS 2	1
Peristaltic pump tubing PVC Solvent Resistant	5710349500	SPS 4	1

Consumed Parts Reference
(Purchased by customer, not included as part of PM)☒ Section Not Applicable

Part Description	Part Number	Product or Model# where used	Quantity consumed
------------------	-------------	------------------------------	-------------------

Signature Page

Service Engineer Comments (optional)

If there are any specific points you wish to note as part of performing the installation or other items of interest for the customer, please write in this box.

Service Verification

Service Request Number: 6006601534
Service Engineer Name: Nyleen L. Luyten
Service Engineer Signature: Nyleen L. Luyten
Total number of pages in this document: 15

Date Service Completed: Feb 24, 2022
Customer Name: [blank]
Customer Signature: [blank]

SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY

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



Cert. No. : ACC23048
Pages : 1 of 3

Calibration Certificate

Equipment : SOUND CALIBRATOR
Manufacturer : RION
Model : NC-75
Serial No.: 35024431
ID No.: BKK_FS1221

Condition As Found : GOOD

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

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

Received Date : 28 NOVEMBER 2023
Calibration Date : 19 DECEMBER 2023
Date of Issue : 22 DECEMBER 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by :
(Thanakul Petchurai)

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

QF-TS12-04-04-020664

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Continuation of Calibration Certificate

Cert. No. : ACC23048
Job No. : VC67AC0035
Pages : 2 of 3

Calibration Procedure : CP-AC-03

Calibration Method :

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

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

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33511B	MY52302742	EF-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).

QI-1S12-04-04-020664

SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACC23048
Job No. : VC67AC0035
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	93.96	-0.04	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 (%)
0.35	0.10	3.0

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

End of Calibration Certificate

QF-TS12-04-04-020664

SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY

451-451/1 Sirinthorn Road, Bangbunru, Bangkok 10700 Thailand
Tel +66 2433 3331 Email: cal@brangsestiporn.com

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Cert. No. : ACL24019
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preampifier NI-24
Serial No.: 00858520 / 158771 / 58772
ID No.: BKK_FS0110

Condition As Found : GOOD

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

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

Received Date : 22 DECEMBER 2023
Calibration Date : 10-11 JANUARY 2024
Date of Issue : 12 JANUARY 2024

Calibrated by : Nathakorn Pisutpaisan

Approved by :
(Thanakul Petchurai)

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SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY

45F-45H/1 Srinthorn Road Bangbunru Bangplad Bangkok 10700 Thailand
Tel : +66 2433 8331 Email : calibratio@sithiporn.com

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Cert. No. : ACL24019
Job No. : VC67AC0045
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-42KAJ	34560495	AA-3002-23	14-FEB-24

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

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

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

T. Petin

SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY

45F-45H/1 Srinthorn Road Bangbunru Bangplad Bangkok 10700 Thailand
Tel : +66 2433 8331 Email : calibratio@sithiporn.com

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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

T. Petin

SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY

45F-45H/1 Srinthorn Road Bangbunru Bangplad Bangkok 10700 Thailand
Tel : +66 2433 8331 Email : calibratio@sithiporn.com

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Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
16.1

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

Frequency Weighting	Measured value (dB)
A-weight	10.8
C-weight	16.8
Flat	22.6

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.3	0.4	0.4	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-0.2	-0.2	-0.2	± 5.0

T. Petin

SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY

45F-45H/1 Srinthorn Road Bangbunru Bangplad Bangkok 10700 Thailand
Tel : +66 2433 8331 Email : calibratio@sithiporn.com

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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	-0.1	±2.0
125	0.0	0.0	0.0	±1.5
250	0.0	0.0	-0.1	±1.5
500	0.0	0.0	0.0	±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

T. Petin

SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY

451-451/11 Sunthorn Road Bangbunmu Bangkok 10700 Thailand
Tel +66 2433 6331 Email: calibration@sithiporn.com

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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	135.0	0.0	±1.1
134.0	134.0	0.0	±1.1
133.0	133.0	0.0	±1.1
132.0	131.9	-0.1	±1.1
131.0	130.9	-0.1	±1.1
129.0	129.0	0.0	±1.1
124.0	124.0	0.0	±1.1
119.0	119.0	0.0	±1.1
114.0	114.0	0.0	±1.1
109.0	109.0	0.0	±1.1
104.0	104.0	0.0	±1.1
99.0	99.0	0.0	±1.1
94.0	94.0	0.0	±1.1
89.0	89.0	0.0	±1.1
84.0	84.0	0.0	±1.1
79.0	79.0	0.0	±1.1
74.0	74.0	0.0	±1.1
69.0	69.0	0.0	±1.1
64.0	64.0	0.0	±1.1
59.0	59.0	0.0	±1.1
54.0	54.0	0.0	±1.1
49.0	49.0	0.0	±1.1
44.0	44.0	0.0	±1.1
39.0	39.0	0.0	±1.1
34.0	34.0	0.0	±1.1
30.0	30.0	0.0	±1.1
29.0	29.0	0.0	±1.1
28.0	28.0	0.0	±1.1
27.0	27.1	0.1	±1.1
26.0	26.1	0.1	±1.1
25.0	25.1	0.1	±1.1

T. Petch

SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY

451-451/11 Sunthorn Road Bangbunmu Bangkok 10700 Thailand
Tel +66 2433 6331 Email: calibration@sithiporn.com

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Cert. No. : ACL24019
Job No. : VC67AC0045
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, Lcpeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±3.0
One	136.4	135.5	-0.9	±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	135.2	-0.2	±2.0

T. Petch

SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY

451-451/11 Sunthorn Road Bangbunmu Bangkok 10700 Thailand
Tel +66 2433 6331 Email: calibration@sithiporn.com

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Cert. No. : ACL24019
Job No. : VC67AC0045
Pages : 8 of 8

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

T. Petch

INNOVATIVE INSTRUMENTS CALIBRATION LAB
INNOVATIVE INSTRUMENTS CO., LTD. 110/0011
110/00111, JIRASIN ROAD, SANGKHAWAT, BANGKOK, THAILAND
110/00111, JIRASIN ROAD, SANGKHAWAT, BANGKOK, THAILAND
110/00111, JIRASIN ROAD, SANGKHAWAT, BANGKOK, THAILAND



Certificate of Calibration

Customer : AISI Laboratory Group (Thailand) Co., Ltd.
Address : 104 Soi Phatthanasak 40 Phatthanasak Road, Suan Luang, Bangkok 10250
Certificate No. : 24-SLM-018
Request No. : R-2023-2671

Unit Under Calibration Details

Measurement item : Sound Level Meter
Manufacturer : RION
Model : NI-42
Serial Number : 01022261
ID : HKK-180040
Resolution : 0.1 dB
Microphone Class : 2
Microphone Model : UC-52
Microphone S/N : 180399
Pre-amplifier Model : NI-24
Pre-amplifier S/N : 83169
Instrument Status : Used

Calibration Environment and Details

Temperature : 23.0 ± 0.2 °C
Humidity : 50 ± 5% RH ± 20% RH
Barometric Pressure : 1013 hPa ± 10 hPa
Received Date : 20 December 2023
Calibrated Date : 29 January 2024
Calibration Procedure : In-house method CP-SLM-01 based on IEC 61672-3:2013 Electroacoustics - Sound level meters - Part 3, Permissible
Location of Calibration : Lab Acoustic

Reference Standard

Instrument	Brand	Model	SN	Due calibration	Traceability
Standard Microphone	GRAS	40AN	180273	21 August 2024	GRAS
Mid-frequency Calibrator	Quest	Quasi-cal	11 A090234	26 July 2024	ISI
Audio Generator	Stanek	Stan401	131	9 October 2024	WKF Electric

Note

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

Calibrated By : *T. Petch*
Mr. Nopphad Luangpan
Service Calibration Engineer

Approved By : *P. Petch*
Mr. Pichit Mulsayam
Calibration Engineer Supervisor
Issue Date : 29 January 2024

The results related to this certificate are valid. The certificate shall not be reproduced except in full with the approval of the Innovative Instruments Co., Ltd.

110/00111, JIRASIN ROAD, SANGKHAWAT, BANGKOK, THAILAND

Certificate No: 24-SI-M-018
Request No: Req-2023-2671

1. Indication at the calibration check frequency

UUC Setting	Nominal	Before Adjust	After Adjust	UNCERTAINTY	Acceptance
FAST / A / 30-130	Level	UUC	ERR	UUC	ERR
Calibrator Setting	(dB)	(dB)	(dB)	(dB)	(dB)
1000 Hz 114 dB	113.78	114.1	-0.32	113.8	0.02
				(\pm dB)	(\pm dB)
				0.20	0.30

Note: Absolute sensitivity was established by the use of Sound Calibrator Brand SVANTEK, Model SV 35A, SN: 58079

2. Self-generated noise, Microphone installed

UUC Setting	Measured	UNCERTAINTY
FAST / 30-130		
UUC Weighting	(dB)	(\pm dB)
A	16.2	0.10

3. Self-generated noise, Microphone replaced by the electrical input signal device

UUC Setting	Measured	UNCERTAINTY
FAST / 30-130		
UUC Weighting	(dB)	(\pm dB)
A	11.7	0.10
C	16.4	0.10
Z	19.9	0.10

4. Acoustic signal test of frequency weightings (Without Windscreen)

UUC Setting	Deviation from various Frequency	UNCERTAINTY	Acceptance
FAST / 30-130	Weighting Response curve		
STD Setting	A (dB) C (dB) Z (dB)	(\pm dB)	(\pm dB)
125 Hz	0.2 0.4 0.3	0.60	1.5
1000 Hz	0.0 0.0 0.0	0.60	1.0
4000 Hz	1.0 1.0 1.0	0.60	2.0
8000 Hz	-1.3 1.4 -1.4	0.70	5.0

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

ISO 9001:2015 / ISO 17025:2017

Certificate No: 24-SI-M-018
Request No: Req-2023-2671

5. Electrical signal test of frequency weightings, Weighting network response with relative to 1 kHz

UUC Setting	Deviation from various Frequency	UNCERTAINTY	Acceptance
FAST / 30-130	Weighting Response curve		
STD Setting	A (dB) C (dB) Z (dB)	(\pm dB)	(\pm dB)
63 Hz	-0.2 -0.1 0.0	0.20	2.0
125 Hz	-0.1 0.0 0.0	0.20	1.5
250 Hz	-0.1 0.0 0.0	0.20	1.5
500 Hz	0.0 0.0 0.0	0.20	1.5
1000 Hz	0.0 0.0 0.0	0.20	1.0
2000 Hz	0.0 0.0 0.0	0.20	2.0
4000 Hz	0.0 0.0 0.0	0.20	3.0
8000 Hz	0.0 0.0 0.0	0.20	5.0
16000 Hz	-1.4 -1.4 0.0	0.20	-5. (IN)

6. Frequency and time weightings at 1 kHz

UUC Setting	STD	Measured	UNCERTAINTY	Acceptance
FAST / 30-130	REF	UUC	ERR	
UUC Weighting	(dB)	(dB)	(dB)	(\pm dB)
A	114.00	114.0	0.0	0.20
C	114.00	114.0	0.0	0.20
Z	114.00	114.0	0.0	0.20

UUC Setting	STD	Measured	UNCERTAINTY	Acceptance
30-130 / A	REF	UUC	ERR	
UUC Time Response	(dB)	(dB)	(dB)	(\pm dB)
Fast	114.00	114.0	0.0	0.10
Slow	114.00	114.0	0.0	0.10
1 sec	114.00	114.0	0.0	0.10

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ISO 9001:2015 / ISO 17025:2017

Certificate No: 24-SI-M-018
Request No: Req-2023-2671

7. Long Term Stability

UUC Setting	Measured	UNCERTAINTY	Acceptance
FAST / A / 30-130	UUC		
STD Setting	(dB)	(\pm dB)	(\pm dB)
Initial	114.0		
Final	114.0		
Deviation	0.0	0.10	0.30

8. Level linearity on the reference level range

UUC Setting	Anticipated	Deviation	UNCERTAINTY	Acceptance
FAST / A / 30-130	REF	UUC	ERR	
STD dB	(dB)	(dB)	(dB)	(\pm dB)
118.00	118	118.0	0.0	1.1
114.00	114	114.0	0.0	1.1
129.00	129	129.0	0.0	1.1
124.00	124	124.0	0.0	1.1
119.00	119	119.0	0.0	1.1
114.00	114	114.0	0.0	1.1
109.00	109	109.0	0.0	1.1
104.00	104	104.0	0.0	1.1
99.00	99	99.0	0.0	1.1
94.00	94	94.0	0.0	1.1
89.00	89	89.0	0.0	1.1
84.00	84	84.0	0.0	1.1
79.00	79	79.0	0.0	1.1
74.00	74	74.0	0.0	1.1
69.00	69	69.0	0.0	1.1
64.00	64	64.0	0.0	1.1
59.00	59	59.0	0.0	1.1
54.00	54	54.0	0.0	1.1
49.00	49	49.0	0.0	1.1
44.00	44	44.0	0.0	1.1
39.00	39	39.0	0.0	1.1
34.00	34	34.0	0.0	1.1
29.00	29	29.0	0.0	0.9
24.00	24	24.0	0.0	1.1

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Certificate No: 24-SI-M-018
Request No: Req-2023-2671

9. Level linearity including the level range control

UUC Setting	STD	Measured	UNCERTAINTY	Acceptance
FAST / A	RFF	UUC	ERR	
UUC Range	(dB)	(dB)	(dB)	(\pm dB)
30-130	29.60	29.7	0.1	1.1
	114	114.0	0.0	0.20

10. Tone burst response

UUC Setting	STD	Anticipated	Measured	UNCERTAINTY	Acceptance
A / 30-130	Timeburst	Ref	UUC	ERR	
UUC Time Response	(ms)	(dB)	(dB)	(dB)	(\pm dB)
Fast	200	126.0	126.0	0.0	1.0
	2	108.0	108.9	-0.9	+1.0 -2.5
	0.25	100.0	99.9	-0.1	+1.0 -5.0
Slow	200	119.6	119.6	0.0	1.0
	2	100.0	100.0	0.0	+1.0 -5.0
SPL	200	120.0	120.0	0.0	1.0
	2	100.0	100.0	0.0	+1.0 -2.5
	0.25	91.0	90.8	0.2	+1.0 -5.0

11. Peak C Sound level

UUC Setting	Anticipated	Measured	UNCERTAINTY	Acceptance
FAST / C / 30-130	REF	UUC	ERR	
STD Setting	(dB)	(dB)	(dB)	(\pm dB)
Complete cycle	135.4	136.3	-0.10	2.0
Power half cycle	135.4	135.1	-0.30	2.0
Negative half cycle	135.4	135.1	-0.30	2.0

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

ISO 9001:2015 / ISO 17025:2017

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Continuation of Calibration Certificate

Cert. No. : ACL23343
Job No. : VC67AC0022
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

QF-TS12-04-04-020664

T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23343
Job No. : VC67AC0022
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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	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	29.0	0.0	± 1.1
28.0	28.0	0.0	± 1.1
27.0	27.0	0.0	± 1.1
26.0	26.1	0.1	± 1.1
25.0	25.1	0.1	± 1.1

QF-TS12-04-04-020664

T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23343
Job No. : VC67AC0022
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	108.0	0.0	1.5 ; -5.0
	2	8	117.0	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.1	0.1	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
SEL	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.1	0.1	±1.0

10. Peak C sound level

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

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

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Continuation of Calibration Certificate

Cert. No. : ACL23343
Job No. : VC67AC0022
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11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.5	89.5	0.0	±1.5

12. High level stability

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

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

End of Calibration Certificate

QF-TS12-04-04-020664

T. Petch

SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY

451-451/15 Nithorn Road Bangbunru Bangplud Bangkok 10700 Thailand
Tel: +66 2433 6331 Email: calibration@sithiporn.com

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Cert. No. : ACL24003
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NI-42 / Microphone UC-52 / Preamplifier NH-24
Serial No. : 00572562 / 170400 / 72901
ID No. : BKK FS0878

Condition As Found : GOOD

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

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

Received Date : 19 DECEMBER 2023
Calibration Date : 05-08 JANUARY 2024
Date of Issue : 09 JANUARY 2024

Calibrated by : Nithakorn Pisutpaisan

Approved by :

T. Petchurai
(Thanakul Petchurai)

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

SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY

451-451/15 Nithorn Road Bangbunru Bangplud Bangkok 10700 Thailand
Tel: +66 2433 6331 Email: calibration@sithiporn.com

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Cert. No. : ACL24003
Job No. : VC67AC0043
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	MA1-1070	62100114	EF-0011-23	08-FEB-24
Condenser Microphone	4180	2977900	AA-1001-23	14-FEB-24
Measuring Amplifier	NA-42KA1	34560495	AA-3002-23	14-FEB-24

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

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

3.1 National Institute of Metrology (Thailand).

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

SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY

451-451/15 Nithorn Road Bangbunru Bangplud Bangkok 10700 Thailand
Tel: +66 2433 6331 Email: calibration@sithiporn.com

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Cert. No. : ACL24003
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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

451-451/15 Nithorn Road Bangbunru Bangplud Bangkok 10700 Thailand
Tel: +66 2433 6331 Email: calibration@sithiporn.com

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Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
15.1

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

Frequency Weighting	Measured value (dB)
A - weight	13.4
C - weight	19.9
Flat	25.5

3. Acoustical signal tests of frequency weightings

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

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

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451-451/1 Sirinthorn Road Bangbunmu Bangkok 10700 Thailand
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4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

Frequency Weighting	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. Petin

SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY

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

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Cert. No. : ACL24003
Job No. : VC67AC0043
Pages : 6 of 8

7. Level linearity on the reference level range

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

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CALIBRATION LABORATORY

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

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Cert. No. : ACL24003
Job No. : VC67AC0043
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	93.9	-0.1	±1.1

9. Tone burst response

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

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, Lepeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±3.0
One	136.4	135.5	-0.9	±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

T. Petin

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CALIBRATION LABORATORY

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

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Cert. No. : ACL24003
Job No. : VC67AC0043
Pages : 8 of 8

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

T. Petin

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



Cert. No. : ACL23344
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42A / Microphone UC-52 / Preamplifier NH-24
Serial No.: 00623382 / 198628 / 26410
ID No.: BKK_FS1215

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PIATTHANAKAN ROAD
KIJWAENG 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 : 01 NOVEMBER 2023
Calibration Date : 07-08 NOVEMBER 2023
Date of Issue : 14 NOVEMBER 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchurai
(Thanakul Petchurai)

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

QF-TS12-04-04-020664

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACL23344
Job No. : VC67AC0022
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0009-23	07-FEB-24
Waveform Generator	33511B	MY52302742	EF-0010-23	07-FEB-24
Digital Multimeter	33461A	MY53220104	EEL BP 30/0266	13-FEB-24
Digital Multimeter	33461A	MY53220076	EEL BP 29/0266	13-FEB-24
Digital Multimeter	34461A	MY60024273	EEL BP 31/0266	14-FEB-24
Programmable Attenuator	MAT-1070	62100114	EF-0011-23	08-FEB-24
Condenser Microphone	4180	2977900	AA-1001-23	14-FEB-24
Measuring Amplifier	NA-42KA1	34560495	AA-3002-23	14-FEB-24

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

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

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

QF-TS12-04-04-020664

T. Petchurai

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACL23344
Job No. : VC67AC0022
Pages : 3 of 8

Summary of Measurement Result :

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

Note : Pass/Fail evaluation for each parameter, will be considered together from the acceptance limit and the Maximum-permitted uncertainty of measurement.

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T. Petchurai

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACL23344
Job No. : VC67AC0022
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.4

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

Frequency	Measured value (dB)
Weighting	10.8
A-weight	16.9
C-weight	22.7

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.3	0.3	0.3	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-0.2	-0.1	-0.1	± 5.0

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T. Petchurai

Continuation of Calibration Certificate

Cert. No. : ACL23344
Job No. : VC67AC0022
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
63	0.0	-0.1	0.0	±2.0
125	0.0	0.0	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.1	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.1	0.0	±2.0
4000	0.0	0.1	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	94.1	0.1	±0.3

QF-TS12-04-04-020664

T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23344
Job No. : VC67AC0022
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	119.1	0.1	±1.1
114.0	114.0	0.0	±1.1
109.0	109.0	0.0	±1.1
104.0	104.1	0.1	±1.1
99.0	99.0	0.0	±1.1
94.0	94.0	0.0	±1.1
89.0	89.0	0.0	±1.1
84.0	84.0	0.0	±1.1
79.0	79.0	0.0	±1.1
74.0	74.0	0.0	±1.1
69.0	69.0	0.0	±1.1
64.0	64.0	0.0	±1.1
59.0	59.0	0.0	±1.1
54.0	54.0	0.0	±1.1
49.0	49.0	0.0	±1.1
44.0	44.0	0.0	±1.1
39.0	39.0	0.0	±1.1
34.0	34.0	0.0	±1.1
30.0	29.9	-0.1	±1.1
29.0	28.9	-0.1	±1.1
28.0	27.9	-0.1	±1.1
27.0	26.9	-0.1	±1.1
26.0	25.9	-0.1	±1.1
25.0	24.8	-0.2	±1.1

QF-TS12-04-04-020664

T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23344
Job No. : VC67AC0022
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	108.0	0.0	1.5 ; -5.0
	2	8	117.0	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.1	0.1	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
SEL	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.1	0.1	±1.0

10. Peak C sound level

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

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.1	0.1	±2.0
Positive half cycle	135.4	135.2	-0.2	±2.0
Negative half cycle	135.4	135.2	-0.2	±2.0

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T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23344
Job No. : VC67AC0022
Pages : 8 of 8

11. Overload indication

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

12. High level stability

Frequency Weighting	SLM Display at initial (dB)	SLM Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	137.0	136.9	0.1	±0.3

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

End of Calibration Certificate

QF-TS12-04-04-020664

T. Petch

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



Cert. No. : ACL23311
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00597164 / 180407 / 88177
ID No.: BKK_FS0999

Condition As Found : GOOD

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

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

Received Date : 22 SEPTEMBER 2023
Calibration Date : 16-18 OCTOBER 2023
Date of Issue : 19 OCTOBER 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchur
(Thanakul Petchur)

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SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACL23311
Job No. : VC66AC0101
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM).
The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.

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

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0009-23	07-FEB-24
Waveform Generator	33511B	MY52302742	EF-0010-23	07-FEB-24
Digital Multimeter	33461A	MY53220104	EEL_BP 30/0266	13-FEB-24
Digital Multimeter	33461A	MY53220076	EEL_BP 29/0266	13-FEB-24
Digital Multimeter	34461A	MY60024273	EEL_BP 31/0266	14-FEB-24
Programmable Attenuator	MAT-1070	62100114	EF-0011-23	08-FEB-24
Condenser Microphone	4180	2977900	AA-1001-23	14-FEB-24
Measuring Amplifier	NA-42KA1	34560495	AA-3002-23	14-FEB-24

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

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

3.1 National Institute of Metrology (Thailand).

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

QF-TS12-04-04-020664

T. Petchur

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACL23311
Job No. : VC66AC0101
Pages : 3 of 8

Summary of Measurement Result :

Parameter	Pass	Fail	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
1. Absolute sensitivity	✓	-	0.2	N/A
2. Self-generated noise	✓	-	0.2	N/A
3. Acoustical signal tests of frequency weightings				
125 Hz	✓	-	0.3	0.6
1000 Hz	✓	-	0.3	0.6
8000 Hz	✓	-	0.3	0.7
4. Electrical signal tests of frequency weightings				
For 10 Hz to 4 kHz	✓	-	0.3	0.6
For > 4 kHz to 10 kHz	✓	-	0.3	0.7
For > 10 kHz to 20 kHz	-	-	-	1.0
5. Frequency and time weightings at 1 kHz	✓	-	0.2	0.3
6. Long-term stability	✓	-	0.1	0.1
7. Level linearity on the reference level range	✓	-	0.2	0.5
8. Level linearity including the level range control	✓	-	0.2	0.3
9. Tone burst response	✓	-	0.2	0.3
10. Peak C sound level	✓	-	0.2	0.35
11. Overload indication	✓	-	0.2	0.25
12. High level stability	✓	-	0.1	0.1

Note : Pass/Fail evaluation for each parameter, will be considered together from the acceptance limit and the Maximum-permitted uncertainty of measurement.

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Continuation of Calibration Certificate

Cert. No. : ACL23311
Job No. : VC66AC0101
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.8

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

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

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	0.0	0.0	0.0	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	1.1	1.1	1.1	±5.0

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Continuation of Calibration Certificate

Cert. No. : ACL23311
Job No. : VC66AC0101
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz

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

QF-TS12-04-04-020664

7. Peter

Continuation of Calibration Certificate

Cert. No. : ACL23311
Job No. : VC66AC0101
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	±1.1
136.0	136.0	0.0	±1.1
135.0	135.0	0.0	±1.1
134.0	134.0	0.0	±1.1
133.0	133.0	0.0	±1.1
132.0	132.0	0.0	±1.1
131.0	131.0	0.0	±1.1
129.0	129.0	0.0	±1.1
124.0	124.0	0.0	±1.1
119.0	119.0	0.0	±1.1
114.0	114.0	0.0	±1.1
109.0	109.0	0.0	±1.1
104.0	104.0	0.0	±1.1
99.0	99.0	0.0	±1.1
94.0	94.0	0.0	±1.1
89.0	89.0	0.0	±1.1
84.0	84.1	0.1	±1.1
79.0	79.0	0.0	±1.1
74.0	74.1	0.1	±1.1
69.0	69.0	0.0	±1.1
64.0	64.0	0.0	±1.1
59.0	59.1	0.1	±1.1
54.0	54.0	0.0	±1.1
49.0	49.0	0.0	±1.1
44.0	44.0	0.0	±1.1
39.0	39.0	0.0	±1.1
34.0	34.0	0.0	±1.1
30.0	30.0	0.0	±1.1
29.0	29.0	0.0	±1.1
28.0	28.0	0.0	±1.1
27.0	27.0	0.0	±1.1
26.0	25.9	-0.1	±1.1
25.0	25.0	0.0	±1.1

QF-TS12-04-04-020664

7. Peter

Continuation of Calibration Certificate

Cert. No. : ACL23311
Job No. : VC66AC0101
Pages : 7 of 8

8. Level linearity including the level range control

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

9. Tone burst response

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

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, 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	135.1	-0.3	±2.0
Negative half cycle	135.4	135.2	-0.2	±2.0

QF-TS12-04-04-020664

7. Peter

Continuation of Calibration Certificate

Cert. No. : ACL23311
Job No. : VC66AC0101
Pages : 8 of 8

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

QF-TS12-04-04-020664

7. Peter

SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY

451-451/5 Srinthorn Road, Bangbunmu, Bangkok, 10700 Thailand
Tel : +66 2433 8331 Email : calibration@sithiporn.com

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Cert. No. : ACL24017
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NI -42 / Microphone UC-52 / Preamplifier NH-24
Serial No.: 00572566 / 142140 / 22309
ID No.: BKK_FS0875

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 : 22 DECEMBER 2023
Calibration Date : 10-11 JANUARY 2024
Date of Issue : 12 JANUARY 2024

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchur
(Thanakul Petchurai)

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

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CALIBRATION LABORATORY

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Cert. No. : ACL24017
Job No. : VC67AC0045
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 test results of each items were made by observation of each Instruments display and also with SLM's display.

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0009-23	07-FEB-24
Waveform Generator	33511B	MY52302742	EF-0010-23	07-FEB-24
Digital Multimeter	33461A	MY53220104	EELBP 30/0266	13-FEB-24
Digital Multimeter	33461A	MY53220076	EELBP 29/0266	13-FEB-24
Digital Multimeter	34461A	MY60024273	EELBP 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).

T. Petchur

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

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Cert. No. : ACL24017
Job No. : VC67AC0045
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

T. Petchur

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451-451/5 Srinthorn Road, Bangbunmu, Bangkok, 10700 Thailand
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Cert. No. : ACL24017
Job No. : VC67AC0045
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)
16.3

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

Frequency (Hz)	Measured value (dB)
A-weight	13.8
C-weight	19.9
Flat	25.8

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.3	0.3	0.3	±1.5
1000	0.0	0.0	0.0	±1.0
8000	-0.2	-0.2	-0.2	±5.0

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451-451/1 Srinthorn Road Bangbunru, Bangolue, Bangkok 10700 Thailand
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Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighing network response with relative to 1 kHz.

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
63	0.0	0.0	0.0	±2.0
125	0.0	0.1	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.1	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.1	0.0	±2.0
4000	0.0	0.0	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
1 eq	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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Job No. : VC67AC0045
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	29.0	0.0	± 1.1
28.0	28.0	0.0	± 1.1
27.0	27.1	0.1	± 1.1
26.0	26.1	0.1	± 1.1
25.0	25.1	0.1	± 1.1

T. Petch

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CALIBRATION LABORATORY

451-451/1 Srinthorn Road Bangbunru, Bangolue, Bangkok 10700 Thailand
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Cert. No. : ACL24017
Job No. : VC67AC0045
Pages : 7 of 8

8. Level linearity including the level range control

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

9. Tone burst response

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

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, L _{peak} (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±3.0
One	136.4	135.7	-0.7	±3.0

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

T. Petch

SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY

451-451/1 Srinthorn Road Bangbunru, Bangolue, Bangkok 10700 Thailand
Tel : +66 2423 8331 Email : calibration@sithiporn.com

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Cert. No. : ACL24017
Job No. : VC67AC0045
Pages : 8 of 8

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

T. Petch



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 FAX 0-2719-9484



Cert.No.: 23CH1369
Page: 1 of 3

Certificate of Calibration

Equipment : pH Meter
Manufacturer : Hach
Model : HQ411d
Serial No. : 200100031163
ID No. : BKK_EN0342
Condition As-Received: Used Item
Received Date : 26 October 2023
Calibration Date : 27 October 2023
Reference : 2310-0865DSC-3
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd.
104 Phatthanakan 40, Phatthanakan Rd.,
Khwaeng Phatthanakan, Khet Suan Luang,
Bangkok 10250 Thailand
Ambient Temperature : (25 ± 2.5) °C
Relative Humidity : (50 ± 15) %
Calibration Procedure : In - house method :
- CP-CH5 by direct measurement with standard
voltage calibrator and direct measurement with
certified reference material (CRM)
- CP-CH8 by comparison with standard thermometer

Calibrated by : Warakorn Lemgagitrakul

Approved by :
Approved Signatory

(✓) Sathip Meangmai
() Warakorn Lemgagitrakul
() Ponpan Paipim

Issue Date : 31 October 2023

The Uncertainties are for a confidence probability of approximately 95%

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



Cert.No.: 23CH1369
Page: 2 of 3

Condition of this calibration result

1. Reference Standard Instrument : -

Instrument Serial No. ID No. Cert. No. Due Date
1) Ref. Standard Thermometer 4982054 110RC044 231908 28 Jul 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	913598	14 July 2025
pH 6.985	CPA chem	913599	14 July 2024
pH 9.997	CPA chem	931961	30 Sep 2024

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

Calibration Results

Function : pH Measurement

Performing three buffers standard curve by using buffer nominal pH (4.7,10)

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH measurement (±)	Coverage factor k
pH Electrode	4.008	4.002	166.5	0.0044	2.00
S/N :230473042902	6.985	6.987	-10.4	0.0084	2.00
	9.997	10.005	-189.3	0.0071	2.00

Remark : - Can not connect the BNC because the plug does not match with the socket

Sathip

a 1187344



Cert.No.: 23CH1369
Page: 3 of 3

Calibration Results

Function : Temperature Measurement

(*) Without adjustment

This equipment was connected with Temperature Probe;

- Model : PHC281
- Serial No. : 230473042902
Dimension of probe:
- Length : 103 mm
- Diameter : 12 mm
- Immersion Depth : 90 mm

Calibration Point (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of measurement (± °C)	Coverage factor k
25.0	25.002	25.1	0.098	0.13	2.00

Remark : - UUC* = Unit Under Calibration

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

-000-

Sathip

a 1187343



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
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TEL 0-2717-3000 FAX 0-2719-9484



Certificate of Calibration

Cert.No.: 24CH1295
Page: 1 of 3

Equipment : pH Meter
Manufacturer : Hach
Model : HQ411d
Serial No. : 200100031163
ID No. : BKK_EN0342
Condition As-Received: Used Item
Received Date : 16 October 2024
Calibration Date : 17 October 2024
Reference : 2410-0548DSC-5
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd.
104 Phatthanakan 40, Phatthanakan Rd.,
Khwaeng Phatthanakan, Khet Suan Luang,
Bangkok 10250 Thailand
Ambient Temperature : (25 ± 2.5) °C
Relative Humidity : (50 ± 15) %
Calibration Procedure : In - house method :
- CP-CH5 by direct measurement with
certified reference material (CRM)
- CP-CH8 by comparison with temperature standard

Calibrated by : Warakorn Lemgagitrakul

Approved by :
Approved Signatory

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

Issue Date : 21 October 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



Cert.No.: 24CH1295
Page.: 2 of 3

Condition of this calibration result

1. Reference Standard Instrument

Instrument	Serial No.	ID No.	Cert. No.	Due Date
1) Ref. Standard Thermometer	2188080	130RC044	2411022	16 Sep 2025

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

2. Certified Reference Materials

The measurement results are traceable to SI through Hoch Lenge GmbH Ltd.
Deutsche Akkreditierungsinstitut, Accredited No D-RM-15164-01-00
The measurement results are traceable to SI through CPA chem Ltd.,
ANSI-ASQ National Accreditation Board, Accredited No AR-1635

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	1034203	27 Sep 2026
pH 6.999	Hoch Lenge GmbH	C03145	28 Feb 2026
pH 10.010	CPA chem	1034205	27 Sep 2025

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

Calibration Results

Function : pH Measurement

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

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH Measurement (t)	Coverage factor k
pH Electrode	4.008	4.028	174.6	0.0044	2.00
S/N.: 230473042902	6.999	7.014	1.4	0.0084	2.05
	10.010	10.018	-172.8	0.0086	2.00

Remark - Can not connect the BNC because the plug does not match with the socket.



Cert.No.: 24CH1295
Page.: 3 of 3

Calibration Results

Function : Temperature Measurement

(*) Without adjustment

This equipment was connected with Temperature Probe;

- Model :	PHC281
- Serial No. :	230473042902
Dimension of probe	
- Length :	103 mm.
- Diameter :	12 mm.
- Immersion Depth :	90 mm.

Calibration Point (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of measurement (± °C)	Coverage factor k
25.0	25.002	25.0	-0.002	0.13	2.00

Remark : UUC* = Unit Under Calibration

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

-o0o-



Certificate of Calibration

Equipment: CONDUCTIVITY METER Certificate No.: C24230292
Model: ORION STAR A215 Issued Date: 25 December 2023
Serial No. (or ID.): X58031 Job No.: WO-00012682
Manufacturer: Thermo Scientific Page: 1 of 2
Electrode Serial No.: YV1-18416 Model: ORION 013005MD Brand: Thermo Scientific
Condition: In Condition

Customer: ALS Laboratory Group (Thailand) Co., Ltd.
104 Sol Pattanakarn 40, Pattanakarn Rd.,
Suan Luang, Bangkok 10250 Thailand

Environment Condition: Temperature 21.7 °C ± 0.1 °C
Humidity 53.7 %RH ± 0.1 %RH

Calibration Place: ALS Laboratory Group (Thailand) Co., Ltd. (Wet Chemistry Lab 2)
104 Sol Pattanakarn 40, Pattanakarn Rd.,
Suan Luang, Bangkok 10250 Thailand

Calibration By: Mr. Siwapan Srijan
Calibration Date: 25 December 2023

The Method used: In house method, CAL-WI-49, base on ASTM D 1125-14 and D 5391-14
Traceability: This certificate is traceable to the SI Units maintained by CRM of NIST (SRM) through CPA chem Co., Ltd. (ISO/IEC 17034) Certificate No. 890590, 890591, 890592

(Mr. Siwapan Srijan)
Person in charge

(Mr. Nitinun Sriharwan)
Authorized signatory

This certificate is issued the unit of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognized national standard laboratories.
The measurement uncertainty stated 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 the Expression of Uncertainty in Measurement (GUM).
True 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.

บริษัท ดิกซ์ เทคโนโลยี จำกัด
DKSH Technology Limited
2533 สุขุมวิท 40, กรุงเทพฯ, ประเทศไทย 10250
Phone: +66 2633 1000 Email: info.calibration@dksh.com Website: www.dksh.com/calibration-thailand

Delivering Growth - In Asia and Beyond.

CAL-FIA-C24-09: 12 Sep 2022



Certificate No.: C24230292 Page: 2 of 2

Calibration Results:

Before Adjustment

Standard Conductivity Solution	Unit Under Calibration Reading	Correction	Coverage Factor (k)	Uncertainty (±)
84.000 µS/cm	82.54 µS/cm	-8.840 µS/cm	2.00	0.68 µS/cm
1413.0 µS/cm	1423 µS/cm	+10.0 µS/cm	2.00	11 µS/cm
12.880 mS/cm	12.81 mS/cm	0.070 mS/cm	2.00	0.10 mS/cm

After Adjustment : at 84.0 µS/cm, 1413 µS/cm, 12.88 mS/cm

Standard Conductivity Solution	Unit Under Calibration Reading	Correction	Coverage Factor (k)	Uncertainty (±)
84.000 µS/cm	84.03 µS/cm	-0.030 µS/cm	2.00	0.68 µS/cm
1413.0 µS/cm	1414 µS/cm	-1.0 µS/cm	2.00	11 µS/cm
12.880 mS/cm	12.86 mS/cm	0.020 mS/cm	2.00	0.098 mS/cm

The End of Certificate

บริษัท ดิกซ์ เทคโนโลยี จำกัด
DKSH Technology Limited
2533 สุขุมวิท 40, กรุงเทพฯ, ประเทศไทย 10250
Phone: +66 2633 1000 Email: info.calibration@dksh.com Website: www.dksh.com/calibration-thailand

Delivering Growth - In Asia and Beyond.

CAL-FM-C24-06: 12 Sep 2022



ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: WO-00012682

ชนิดเครื่องมือ: CONDUCTIVITY METER

รุ่น: ORION STAR A215

หมายเลขเครื่อง: X58031

ตรวจสอบ (วัน)		รายการตรวจเช็ค	ตรวจสอบ (4)		หมายเหตุ
25 Dec 2023			25 Dec 2023		
ปกติ	ไม่ปกติ		ปกติ	ไม่ปกติ	
General					
<input checked="" type="checkbox"/>	<input type="checkbox"/>	1. ความแม่นยำเครื่อง	<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 เปิด – ปิด 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. แบตเตอรี่ไฟฟ้า (Battery Backup) ≥ 2.5 VDC	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	7. จำนวนเลือกความยาวคลื่น (Wavelength Control)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	8. ความยาวคลื่น (Wavelength Check)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	9. แหล่งกำเนิดแสง (UV $< 3,000$ hour)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	10. แหล่งกำเนิดแสง (Visible $< 5,000$ hour)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	11. ช่องใส่ภาชนะตัวอย่าง (Carousel Module)	<input type="checkbox"/>	<input type="checkbox"/>	
pH Meter and Conductivity Meter					
<input checked="" type="checkbox"/>	<input type="checkbox"/>	12. อิเล็กโทรด (Electrode and Connection Cable)	<input checked="" 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. ฝาปิดกันฝุ่น 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. ค่าความขุ่นที่ไม่มีค่า (No Sample)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	17. ระดับการส่องสว่างของแสง (≥ 2.5 ไมล์ 3.0)	<input type="checkbox"/>	<input type="checkbox"/>	
Automatic titrator					
<input type="checkbox"/>	<input type="checkbox"/>	18. สภาพ 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"/>	

ชื่อเจ้าหน้าที่:

Mr.Siwapin Srijan
Service Engineer

บริษัท ดีเคเอส อีเซีย จำกัด
DKSH Technology Limited
2533 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพฯ 10260
2533 Sukhumvit Road, Bangkok 10260 Thailand
Phone: +66 238 7300 Email: info.calibration@dksh.com Website: www.dksh.com/calibration-thailand
Delivering Growth - in Asia and Beyond.

CAL-FMR31-01 20 Jan 2022



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 FAX 0-2719-9484

Cert.No.: 23TW243
Page.: 1 of 2

Certificate of Testing

Equipment : DO Meter
Manufacturer : YSI
Model : 5000-230V
Serial No. : 09J101147
ID No. : BKK_EN0017
Received Date : 15 November 2023
Test Date : 16 November 2023
Reference : 2311-0505DSC-4
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd
104 Phatthanakan 40, Phatthanakan Rd.,
Khwaeng Phatthanakan, Khel Suan Luang,
Bangkok 10250 Thailand
Laboratory Condition : Temperature (25 ± 5) °C
Humidity (50 ± 20) %
Test Procedure : In - house method : CP-GH9
by Comparison Technique with Azide Modification Method
Tested by : Walalak Sirilhean
Approved by :
Approved Signatory
(✓) Sathip Meangmai
() Warakorn Lerngagratkul
() Ponpan Paipim
Issue Date : 17 November 2023

B 0328589



Cert.No.: 23TW243
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	1124013382	140RC006	23MM18	20 Feb 2024

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.: 16K100498

Titration Method (Azide Modification Method) (mg/L)	DO Meter Reading (mg/L)	Standard Deviation (mg/L)
8.18	8.18	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 1190297



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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TEL 0-2717-3000-29 FAX 0-2719-9484



Cert. No.: 23LM192
Page.: 1 of 2

Certificate of Calibration

Equipment : DO Meter with Sensor
Manufacturer : YSI
Model : 5000-230V
Serial No. : 09J101147
ID No. : BKK_EN0017
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd
104 Phatthanakan 40, Phatthanakan Rd.,
Khwaeng Phatthanakan, Khel Suan Luang,
Bangkok 10250 Thailand
Location : TPA Chemistry Calibration Laboratory
Received Order : 15 November 2023
Calibrated Date : 16 November 2023
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
AC Line Voltage : (220 ± 22) V
Calibrated by : Kunchit Promprat
Approved by :
Approved Signatory
() Pornthippa Tameyakul
() Ponpan Paipim
(✓) Suwit Imjai
Issue Date : 17 November 2023

The Uncertainties are for a confidence probability of approximately 95%

This certificate may not be reproduced other than in full, except as - in the print version
Approval of the head of Corporate Services 3 : Equipment Calibration and Testing Services

A 0060730



Equipment : DO Meter with Sensor
Condition As-Received : Used Item
Reference : Z311-0505DSC-10
Cert. No : Z3LM192
Page.: 2 of 2

Procedure Used :-

Calibration were conducted using in-house calibration procedure CP-QT01 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 3240076 231305 TPA 15 Mar 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: 16K100496

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty (± °C)	Coverage Factor k
20.0	60	19.997	19.93	-0.067	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 %

-00-

U1

a 1190296



QUALITY CALIBRATION CO.,LTD.

235 Petchkasem 63/2 Road, Laksong, Bangkok, Bangkok 10160
Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584

CERTIFICATE No : 24T2852

PAGE 2 OF 2

Calibration Report

EQUIPMENT : COOLED INCUBATOR
MANUFACTURER : MEMMERT
MODEL : ICP750
ID No : BKK_EN0304
RECEIVED DATE : 20-Mar-24
AMBIENT TEMPERATURE : 26 °C ± 1 °C
S/N : F819 0021
CALIBRATION DATE : 20-Mar-24
RELATIVE HUMIDITY : 54 %RH ± 10 %RH

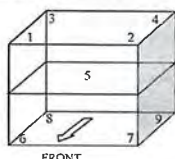
CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED ACCORDING TO TIAS G-20 BY COMPARISON WITH CALIBRATED THERMOCOUPLE TYPE K UNDER NO LOAD CONDITION. THE THERMOCOUPLES WERE PLACED ON NINE POINTS AND LOCATED ONE THERMOCOUPLE IN EACH OF THE EIGHT CORNERS OF THE CHAMBER AND WAS AWAY FROM THE EACH WALL OF 5 cm TO 10 cm. AND PLACED THE NINTH THERMOCOUPLE WITHIN 2.5 cm OF THE GEOMETRIC CENTER OF THE CHAMBER. THE UNIFORMITY WAS MEASURED BETWEEN REFERENCE PROBE AND OTHER PROBES AT THE SAME TIME.

2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT MODEL SERIAL No. CERTIFICATE No. DUE DATE
1) DATA LOGGER WITH TC TYPE K HYDRA 2635A 7286308 23T6641 14-Jul-24
3. THE CERTIFICATE IS VALID FOR THE ITEM CALIBRATED AS SHOWN ON THE DATE AND PLACE OF CALIBRATION ONLY
4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION
5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-
- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH QUALITY CALIBRATION CO.,LTD

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT



FRONT

GENERAL INFORMATION

Overall Ambient Temperature around the Chamber (°C) variation : 1

Overall Line Voltage (V) variation : 5

Instrument Condition : Normal

CHAMBER PERFORMANCE

Controller Temperature (°C)	Indicating Temperature (°C)	Temperature Stability (±°C)	Temperature Uniformity (°C)	Overall Variation (°C)
20.0	20.0	0.16	0.21	0.41

TEMPERATURE MEASUREMENT ACCURACY TEST

Controller Temp (°C)	Indicating Temp (°C)	#1	#2	#3	#4	#5	#6	#7	#8	#9	Uncertainty (±°C)
20.0	20.0	19.88	19.93	19.87	19.86	19.98	19.94	19.94	19.89	19.91	0.42

NOTE 1 : THE UNCERTAINTY OF MEASUREMENT EXCLUDED TEMPERATURE UNIFORMITY OF THE CHAMBER.

NOTE 2 : LOCATION 5 WAS REFERENCE LOCATION

NOTE 3 : THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA

THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A COVERAGE FACTOR *k*=2, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%

END OF CALIBRATION REPORT

F-0010 REV : 03



QUALITY CALIBRATION CO.,LTD.
235 Petchkasem 63/2 Road, Laksong, Bangkok, Bangkok 10160
Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584
www.qcalibration.com



CERTIFICATE No : 24T2852
REFERENCE No : 72619-8

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : COOLED INCUBATOR
MANUFACTURER : MEMMERT
MODEL : ICP750
SERIAL No : F819.0021
ID No : BKK_EN0304
CONDITION AS RECEIVED : USED ITEM
SUBMITTED BY : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTANAKAN 40, PHATTANAKAN RD.,
KHWAENG PHATTANAKAN, KHET SUAN LUANG, BANGKOK 10250, THAILAND

REVIEW BY : Jinda K.
APPROVED BY : Srikul P.
NEXT CAL DATE : 20/03/25

CALIBRATED BY : CHACHARN CH.
CALIBRATION DATE : 20-Mar-24

APPROVED BY : PONGSAK J.
ISSUED DATE : 21-Mar-24
RECEIVED DATE : 20-Mar-24

THIS CERTIFICATE MAY NOT BE REPRODUCED OTHER THAN IN FULL EXCEPT WITH THE PRIOR WRITTEN APPROVAL OF QUALITY CALIBRATION CO., LTD.

F-0010 REV : 03



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
53/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL 0-2717-3000-29 FAX 0-2719-9484



Certificate of Calibration

Cert.No.: 24CG952
Page.: 1 of 2

Equipment : Burette
Capacity : 50 mL
Serial No. : -
ID. No. : BKK_EN0171
Manufacturer : Wileg
Made in : Germany
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd.
104 Phatthanakan 40, Phatthanakan Rd.,
Khwaeng Phatthanakan, Khet Suan Luang,
Bangkok 10250 Thailand

REVIEW BY : Srikul P.
APPROVED BY : K. A.
NEXT CAL DATE : 27/08/25

Ambient Temperature : (20 ± 2.5) °C
Relative Humidity : (50 ± 10) %
Barometric Pressure : 760 mmHg
Calibration Procedure : ASTM E 542 - 01

Calibrated by : Naicha Chayyingcheiw

Approved by : Srikul P.
Approved Signatory

() Unnopphol Harachai
(✓) Srisuda Khamtha
() Sa-ngounkam Wongsas

Issue Date : 27 February 2024

The Uncertainties are for a confidence probability of approximately 95%

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Equipment : Burette
Received Date : 23 February 2024
Condition As-Received : New Item
Calibration Date : 27 February 2024
Reference : 2402-0757DSC-1

Cert.No.: 24CG952
Page.: 2 of 2

Condition of this result of calibration

1. Reference Standard Instruments :

Instruments	Model	Serial No.	ID No.	Certificate No.	Traceability	Due date
1) Balance	XP205DR	1126143764	140RC004	23MM538	TPA	15 Sep 2024
2) Thermo-Hygrograph	THDX-CE	00016540	140EC001	23H1275	TPA	09 June 2024
3) Thermometer	-	0834181	140EC005	23I948	TPA	10 Aug 2024

This certification is traceable to SI Unit

2. The certificate is valid only to the item calibrated on date and place of calibration.
3. True value is converted to true volume at the standard temperature of 20 °C

Calibration result :

Nominal capacity (mL)	Reading (mL)	Uncertainty (± mL)	k Factor
50	50.0032	0.010	2.00

Remark mL = cm³

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-



Metrological Center

SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A Kaengkhoei, Saraburi 18110

Telephone : +66 2 586 5792-4 Fax : +66 2 586 5109

Website : www.scieco.co.th

E-Mail : calibrate@scg.co.th

Certificate No.T240741

Page 1 of 5

Certificate of Calibration

Equipment : HOT BLOCK

Manufacturer : Environmental Express

Model : B3000- 240

Serial No. : 2017CODWI16

Customer Code : BKK_EN0222

ID No. : T6769A4


Customer : ALS Laboratory Group (Thailand) Co.,Ltd.

104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan,
Khet Suan Luang, Bangkok 10250



Customer Location : Wet Chemistry Lab2

Date of Receipt : 11 April 2024

Calibrated By : Sance Musikawan (Site Calibration Manager)

Approved By :  / Sujjar Naknakred (Site Calibration Manager)

Date of Issue : 23 APR 2024

REVIEW BY	
APPROVED BY	
NEXT CAL DATE	23/04/25

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

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Metrological Center.

TM-L13 10-30-05-57



Metrological Center

SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A Kaengkhoei, Saraburi 18110

Telephone : +66 2 586 5792-4 Fax : +66 2 586 5109

Website : www.scieco.co.th

E-Mail : calibrate@scg.co.th

Certificate No. T240741

Page 2 of 5

Calibration Report

Equipment : HOT BLOCK
Date of Calibration : 22 April 2024
Environment : Temperature : 22.9-24.4 °C
Line Voltage : 222.7-227.8 V
Relative Humidity : 55 - 65 %RH

Condition of this results of calibration :

1. This equipment was calibrated by insert 20 standard thermocouples type T into its chamber, the other one standard thermocouples type T use for ambient temperature measurement. The calibration was done in according to WI-T20 (based on ASTM E145-94 (Reapproved 2001) and AS2853-1986)
All data show below were final values and the initial data from customer request. The temperature scale used was based on ITS - 90.

2. Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	TYPE T	TN31-TN30	T240235	17 February 2025
TC	TYPE T	TN31-TN40	T240235	17 February 2025
DATA LOGGER	34970A	T195	T240235	17 February 2025

3. This certificate is traceable to :

National Institute of Metrology (Thailand) through Metrological Center (NSC-TISI-TIS 17025 CALIBRATION 0244)

4. Condition of calibrated item : good

Equipment Description :

Time Constant : 1 Hour 10 Minute At 150 °C
Fresh Air Damper : ☐ Open ☐ Min ☐ Medium ☐ Max
☐ Close
☒ Not Available

5. Adjustment :

(X) without adjustment () after adjustment

Approved By. 

TM-L13 10-30-05-57



Metrological Center

SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A Kaengkhoei, Saraburi 18110

Telephone : +66 2 586 5792-4 Fax : +66 2 586 5109

Website : www.scieco.co.th

E-Mail : calibrate@scg.co.th

Certificate No. T240741

Page 3 of 5

Calibration Report



Row	Hole
R7	H49 H50 H51 H52 H53 H54 H55 H56
R6	H41 H42 H43 H44 H45 H46 H47 H48
R5	H33 H34 H35 H36 H37 H38 H39 H40
R4	H25 H26 H27 H28 H29 H30 H31 H32
R3	H17 H18 H19 H20 H21 H22 H23 H24
R2	H9 H10 H11 H12 H13 H14 H15 H16
R1	H1 H2 H3 H4 H5 H6 H7 H8

II: STANDARD THERMOCOUPLE TYPE T

H1	=	TN21	H9	=	TN29	H17	=	TN37	H25	=	TN25	H33	=	TN33	H41	=	TN21	H49	=	TN29
H2	=	TN22	H10	=	TN30	H18	=	TN38	H26	=	TN26	H34	=	TN34	H42	=	TN32	H50	=	TN30
H3	=	TN23	H11	=	TN31	H19	=	TN39	H27	=	TN27	H35	=	TN35	H43	=	TN23	H51	=	TN31
H4	=	TN24	H12	=	TN32	H20	=	TN40	H28	=	TN28	H36	=	TN36	H44	=	TN24	H52	=	TN32
H5	=	TN25	H13	=	TN33	H21	=	TN21	H29	=	TN29	H37	=	TN37	H45	=	TN25	H53	=	TN33
H6	=	TN26	H14	=	TN34	H22	=	TN22	H30	=	TN30	H38	=	TN38	H46	=	TN26	H54	=	TN34
H7	=	TN27	H15	=	TN35	H23	=	TN23	H31	=	TN31	H39	=	TN39	H47	=	TN27	H55	=	TN35
H8	=	TN28	H16	=	TN36	H24	=	TN24	H32	=	TN32	H40	=	TN40	H48	=	TN28	H56	=	TN36

Approved By. 

TM-L13 10-30-05-57



Certificate No. T240741

Page 4 of 5

Calibration Report

Measurement Results

Calibration Point		Average Standard Reading at each position (°C)									
		TN21	TN22	TN23	TN24	TN25	TN26	TN27	TN28	TN29	TN30
150	Setting	Max	150.38	149.73	150.12	150.36	150.56	150.00	150.48	150.25	150.56
		Min	150.13	149.47	149.87	150.16	150.31	149.77	150.25	150.02	149.41
	Average	150.23	149.59	149.96	150.24	150.41	149.87	150.36	150.12	150.45	149.51
	Setting	Max	150.17	150.28	150.26	150.57	150.09	149.96	149.86	149.75	150.62
		Min	149.94	150.03	150.01	150.18	149.83	149.69	149.68	149.57	150.41
	Average	150.04	150.14	150.13	150.27	149.98	149.81	149.77	149.65	150.51	150.03
	Setting	Max	150.26	150.18	149.87	149.57	150.18	149.90	149.66	150.39	150.06
		Min	150.00	149.94	149.67	149.39	149.88	149.58	150.32	149.34	150.11
	Average	150.14	150.07	149.77	149.49	150.04	149.75	150.48	149.52	150.26	149.97
	Setting	Max	150.38	149.71	150.18	149.97	150.03	150.05	150.21	150.07	150.02
		Min	150.12	149.49	149.87	149.66	149.71	149.71	149.89	149.79	149.76
	Average	150.26	149.61	150.01	149.82	149.90	149.89	150.05	149.94	149.91	149.84
	Setting	Max	150.37	150.20	150.20	150.44	150.67	149.83	150.31	149.90	150.36
		Min	150.11	149.59	150.04	150.26	150.49	149.69	150.12	149.78	150.20
	Average	150.25	150.12	150.14	150.34	150.57	149.78	150.20	149.83	150.29	149.52
	Setting	Max	150.18	150.02	149.95	150.26	149.92	149.69			
		Min	150.06	149.88	149.79	150.12	149.80	149.58			
	Average	150.13	149.95	149.89	150.18	149.84	149.64				

Approved By:

[Signature]

FM-4.12 EN 30-05-87



Certificate No. T240741

Page 5 of 5

Calibration Report

Measurement Results

IIO1 BLOCK		Temperature Distribution	
Setting (°C)	Reading (°C)		Stability (°C)
	Min, Max	Average	
150.0	150.1, 150.1	150.0	0.20

The calibration result apply only the above calibrated item.

The result of test was found accurate as shown on date and place of test only.

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

Approved By:

[Signature]

FM-4.12 EN 30-05-87

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel : +66 2643 8331-4, e-mail : sarthai@thailand.sartorius.com



SARTORIUS
APPROVED BY: *[Signature]*
02/08/25

Certificate of Calibration

Model Number : MSE2245-100-DU
Description : Analytical Balance
Serial Number : 0027405555
ID No. : BKK_EN0003
Manufacturer : Sartorius
Customer Name : ALS Laboratory Group (Thailand) Co., Ltd.
104 Phatthanakan 40/Phatthanakan Rd., Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250.
Calibrated Place : Lab Room
Calibrated By : Mr Chonchai Intana
Calibration Date : Friday, August 02, 2024
Certificate No. : 24BC0270
Issued Date : Monday, August 05, 2024
Reference No. : 740942
Page No. : 1 of 2

Metrological data :
Capacity : 220 g Readability : 0.0001 g
Ambient Conditions
Temperature : 23.0 °C ± 5.0 °C
Humidity : 55.0 % RH ± 10.0 % RH
Pressure :
Reasons for calibration
☐ New Installation ☐ Service / Repair ☒ Recalibration / Maintenance
Equipment Condition : ☒ Good Operation ☐ Fair

Measurement Method UKAS Publication Ref:Lab 14

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

Traceability:

Model Number	Description	Traceability	Certificate No	Due Date
YC5011-S22-00	Sartorius weight set 100g - 5000g E2 YC5011-S22-00	ITS	M22081975	23-Aug-2026
Testo 174 H	Thermo-Hygrometer, Testo 174H	ENTECH	11/1 661303.H661140	12-Nov-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 Intana (Technical Manager)



SOP FM 33 03 February 2022

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel : +66 2643 8331-4, e-mail : sarthai@thailand.sartorius.com

SARTORIUS

Certificate of Calibration

Model Number : MSE2245-100-DU
Description : Analytical Balance
Serial Number : 0027405555
ID No. : BKK_EN0003
Manufacturer : Sartorius
Certificate No. : 24BC0270
Issued Date : Monday, August 05, 2024
Reference No. : 740942
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 result, nominal values under constant test conditions when the same test weight is measured repeatedly on the same day at the same location. The standard deviation is used to express repeatability.			The eccentricity loading error is defined by the difference between the result of the test, on 1/2 or 1/4 of maximum capacity, placed on the platform of the weighing pan and between each of four additional measurement points (positions defined according to ISO 1070).		
Nominal Value : (Low Load)	20.0000	200.0000	Nominal value :	100	g
20 g	20.0000	199.9999	Tolerance	0.0004	g
Tolerance:	20.0000	200.0000	Difference		
0.0001 g	20.0000	200.0000	1	0.0000	
	20.0000	200.0000	2	0.0000	
Nominal Value : (High Load)	200.0000	200.0000	3	0.0000	
200 g	200.0000	200.0000	4	0.0000	
Tolerance:	200.0000	200.0000	5	0.0001	
0.0001 g	200.0000	199.9999	6		
	200.0000	200.0000			
Standard Deviation	0.00004	0.00006			

Linearity				
The linearity, also called accuracy error, characterizes 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	0.00015
0.1	0.1000	0.1000	0.0000	0.00015
1	1.0000	1.0000	0.0000	0.00015
2	2.0000	2.0000	0.0000	0.00015
5	5.0000	5.0000	0.0000	0.00015
10	10.0000	10.0000	0.0000	0.00015
20	20.0000	20.0000	0.0000	0.00015
50	50.0000	50.0000	0.0001	0.00015
100	100.0000	100.0000	0.0001	0.00015
200	200.0000	200.0000	0.0000	0.00015

End of Report

SOP FM 33 03 February 2022



Metrology

SCI ECO Services Company Limited
33/2 Moo 3, T.Banpa, A.Kaengkhoh, Saraburi 18110, Thailand.
Saraburi Tel : +66 3627 3096 Fax : +66 3627 3100
Bangkok Tel : +668 9205 6851 , +669 8247 2360
Website : www.scieco.co.th E-Mail : calibrate@scg.com



Certificate No. T240904

Page 1 of 3

Certificate of Calibration

Equipment : Chamber (Oven)

Manufacturer : Memmert

Model : UF 450

Serial No. : B717.0531

Customer Code : BKK_EN0273

ID No. : T8042A4

Customer : ALS Laboratory Group (Thailand) Co.,Ltd.

104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan,

Khet Suan Luang, Bangkok 10250

Customer Location : Laboratory (Oven Room)

Date of Receipt : 08 May 2024

Calibrated By : Preecha Phisassutthikul (Temperature Calibration Manager)

Approved By : / Nuafun Sungehum (Metrology Manager)

Date of Issue : 23 MAY 2024

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

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Metrology.

FM-L14119/18-08-66



Metrology

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Certificate No. T240904

Page 2 of 3

Calibration Report

Equipment : Chamber (Oven)

Date of Calibration : 14 May 2024

Environment : Temperature : 26.5-28.1 °C

Line Voltage : 226.7-229.8 V

Relative Humidity : 51 - 57 %RH

Condition of this results of calibration :

- This equipment was calibrated by insert nine resistance thermometer detectors into its chamber , the other one resistance thermometer detector use for ambient temperature measurement . The calibration was done in according to WI-T20 (based on ASTM E145-94 (Reapproved 2001) and AS2853-1986) .
All data show below were final values and the initial data from customer request . The temperature scale used was based on ITS - 90 .
- Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
RTD	100 ohm	21-(CH1-10)	T231955	17 November 2024
DATA LOGGER	34970A	TI21	T231955	17 November 2024
- This certificate is traceable to :
National Institute of Metrology (Thailand) through Metrological Center (NSC-TIS-TIS 17025 CALIBRATION 0244)
- Condition of calibrated item : good
Equipment Description :
Time Constant : 1 Hour 30 Minute At 104 °C
Fresh Air Damper : ☐ Open ☐ Min ☐ Medium ☐ Max
☐ Close
☒ Not Available
- Adjustment :
(X) without adjustment () after adjustment

Approved By :

FM-L15118/18-08-66



Metrology

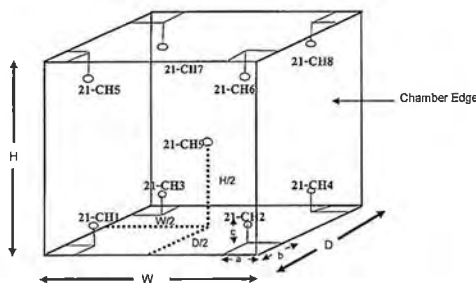
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Certificate No. T240904

Page 3 of 3

Calibration Report



Remark :

Internal Dimensions of Chamber : W (Width) = 104 cm , H (Height) = 72 cm and D (Depth) = 60 cm .
Size of Installed Standard sensor number 21-CH1 to number 21-CH8 : a = 5 cm , b = 5 cm and c = 5 cm .
Size of Installed Standard sensor number 21-CH9 : W/2 = 104 cm / 2 , H/2 = 72 cm / 2 and D/2 = 60 cm / 2

Measurement Results

Calibration Point	Average Standard Reading at each position (°C)							
	21-CH1	21-CH2	21-CH3	21-CH4	21-CH5	21-CH6	21-CH7	21-CH8
104	103.4	103.4	103.7	103.6	103.3	104.6	103.3	104.0
180	179.5	181.1	179.2	179.5	179.0	181.3	179.8	180.2

Chamber (Oven)			* Temperature Distribution				
Setting (°C)	Reading (°C)		Average (°C)	Stability (± °C)	Uniformity (°C)	Uncertainty (± °C)	Coverage Factor k
	Min , Max	Average					
104.0	103.9 , 104	104.0	103.85	0.14	1.27	0.44	2.00
180.0	179.9 , 180.1	180.0	179.94	0.39	2.29	0.76	2.00

* The quoted uncertainty exclude "uniformity"

The calibration result apply only the above calibrated item.

The result of test was found accurate as shown on date and place of test only

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k which for a t-distribution, providing a level of confidence of approximately 95 % .

End of Certificate

Approved By :

FM-L15118/18-08-66



Metrological Center

SCI ECO Services Company Limited
33/2 Moo 3 T Banpa, A Kaengkhoh, Saraburi 18110 Thailand
Saraburi Tel : +66 3627 3096 Fax : +66 3627 3100
Bangkok Tel : +668 9205 6851 +669 8247 2360
Website : www.scieco.co.th E-Mail : calibrate@scg.com



Certificate No. T231303

Page 1 of 3

Certificate of Calibration

Equipment : Liquid Bath (Water)

Manufacturer : MEMMERT

Model : WNB29

Serial No. : L611.0135

Customer Code : BKK_EN0148

ID No. : T6455A4

Customer : ALS Laboratory Group (Thailand) Co.,Ltd.

104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan,

Khet Suan Luang, Bangkok 10250

Customer Location : ORGANIC PREPARATION LAB

Date of Receipt : 27 June 2023

Calibrated By : Sujjar Naknakred (Site Calibration Manager)

Approved By : / Boonchai Suriyawong (Site Calibration Manager)

Date of Issue : 11 JUL 2023

The uncertainties are for a confidence probability of approximately 95%

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Metrological Center

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Metrological Center

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Certificate No. T231303

Page 2 of 3

Calibration Report

Equipment : Liquid Bath (Water)
Date of Calibration : 4 July 2023
Environment : Temperature : 22.2-22.5 °C
Line Voltage : 221.6-224.8 V
Relative Humidity : 55 - 65 %RH

Condition of this results of calibration :

1. This equipment was calibrated by insert five resistance thermometer detectors into its water bath, the other one thermocouple type T use for ambient temperature measurement. The calibration was done in according to WI-T36 (based on ASTM E715-80 (Reapproved 2001)).
All data show below were final values and the initial data from customer request. The temperature scale used was based on ITS-90.

2. Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
RTD	100 OIIM	M18 (CH1, CH6, CH7, CH9, CH10)	T230545	10 April 2024
DATA LOGGER	34970A	T149	T230545	10 April 2024

3. This certificate is traceable to :

National Institute of Metrology (Thailand) through Metrological Center (NSC-TIS-TIS 17025 CALIBRATION 0244)

4. Condition of calibrated item : good

Equipment Description :

Time Constant : 3 Hour 45 Minute At 60 °C

5. Adjustment :

(X) without adjustment () after adjustment

Approved By:

FM-L15 117 15-05-03



Metrological Center

SCI ECO Services Company Limited

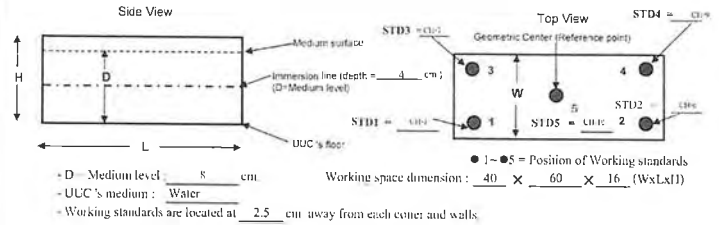
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Certificate No. T231303

Page 3 of 3

Calibration Report



Measurement Results:

Calibration Point	Average Standard Reading at each position (°C)				
	CH-1	CH-6	CH-7	CH-9	CH-10
60	60.03	60.06	60.24	60.11	60.18
85	84.79	84.83	85.42	85.05	85.20
95	95.71	95.83	94.62	94.15	94.42

Liquid Bath (Water)			Temperature Distribution				
Setting (°C)	Reading (°C)		Average (°C)	Stability (± °C)	Uniformity (± °C)	Uncertainty (± °C)	Coverage Factor k
	Min	Max					
60.0	60.9	61.1	61.0	0.12	0.19	0.29	2.04
85.0	85.8	86.2	86.0	0.19	0.47	0.44	2.17
95.0	94.6	95	94.9	0.32	0.55	0.55	2.13

* The quoted uncertainty exclude "uniformity"

The calibration result apply only the above calibrated item.

The result of test was found accurate as shown on date and place of test only.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k which for a t-distribution, providing a level of confidence of approximately 95 %.

Approved By:

FM-L15 117 15-05-03



Metrology

SCI ECO Services Company Limited

33/2 Moo 3, T. Banpa, A. Kaengkhoh, Saraburi 18110, Thailand
Saraburi Tel : +66 3627 3096 Fax : +66 3627 3100
Bangkok Tel : +668 9205 6851, +668 8247 2360
Website : www.scieco.co.th E-Mail : calibrate@scg.com

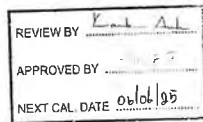


Certificate No. T232160

Page 1 of 4

Certificate of Calibration

Equipment : Chamber (Cooling Room)
Manufacturer : KOLDTECH
Model : KM 320
Serial No. : TBN-1012061/05
Customer Code : BKK_EN0167
ID No. : T2463A3
Customer : ALS Laboratory Group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan,
Khet Suan Luang, Bangkok 10250
Customer Location : Laboratory
Date of Receipt : 29 November 2023
Calibrated By : Atiphong Rongrat (Technician)
Approved By : / Boonchai Suriyawong (Site Calibration Manager)
Date of Issue : 09 JAN 2024



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

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Metrology.

FM-L14 119/18-08-66



Metrology

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Certificate No. T232160

Page 2 of 4

Calibration Report

Equipment : Chamber (Cooling Room)
Date of Calibration : 6 December 2023
Environment : Temperature : 23.4-24.9 °C
Line Voltage : 221.4-230.2 V
Relative Humidity : 55 - 65 %RH

Condition of this results of calibration :

1. This equipment was calibrated by insert 16 standard thermocouples type T into its chamber, the other one standard thermocouples type T use for ambient temperature measurement. The calibration was done in according to WI-T20 (based on ASTM E145-94 (Reapproved 2001) and AS2853-1986).

All data show below were final values and the initial data from customer request. The temperature scale used was based on ITS-90.

2. Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	TYPE T	TN161-TN170	T230773	10 April 2024
TC	TYPE T	TN171-TN180	T230773	10 April 2024
DATA LOGGER	34970A	T149	T230773	10 April 2024

3. This certificate is traceable to :

National Institute of Metrology (Thailand) through Metrological Center (NSC-TIS-TIS 17025 CALIBRATION 0244)

4. Condition of calibrated item : good

Equipment Description :

Time Constant : 1 Hour 30 Minute At 3 °C
Fresh Air Dampener : ☐ Open ☐ Min ☐ Medium ☐ Max
☐ Close
☒ Not Available

5. Adjustment :

(X) without adjustment () after adjustment

Approved By:

FM-L15 118/18-08-66

Service Information:

Problem Description: WU-QG-IM/HPLC-7700-5001143313		
Service Provided: Perform OQ Hardware control test CSD logon, Autosample, ISIS, Auto tune, BG and Stability. After done the instrument BKK_EL0026 calibrated pass all.		
Service Overview Code: Reason Code: Scheduled Service Diagnosis Code: Scheduled Service Resolution Code: Scheduled Service		
Reported Hours: 8.0	Travel Hours: 1.0	
Customer Field Service Representative Name: Panthep Kerasathain	Customer Field Service Representative Signature: 	Date: 12 Dec 2023
Customer Name: Supakwan Mek	Customer Signature: 	Date: 12 Dec 2023
Additional Comments:		

Page 3 of 3



Metrological Center

SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110

Telephone : +66 2 586 5792-4 Fax : +66 2 586 5109

Website : www.scieco.co.th E-Mail : calibrate@scg.co.th

Certificate No. T231676

Page 1 of 6

Certificate of Calibration

Equipment : HEATING BLOCK
Manufacturer : Environmental Express
Model : SC 196
Serial No. : 6974CECW3285
Customer Code : BKK_EL0054
ID No. : T5306A3
Customer : ALS Laboratory Group (Thailand) Co.,Ltd.
104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan,
Khet Suan Luang, Bangkok 10250
Customer Location : Acid Digestion Lab
Date of Receipt : 13 September 2023
Calibrated By : Saneek Musikawan (Site Calibration Manager)
Approved By : / Sujar Naknakred (Site Calibration Manager)
Date of Issue : 26 SEP 2023
The uncertainties are for a confidence probability of approximately 95%.

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Metrological Center.

FM-L12 109 30-05-57



Metrological Center

SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110

Telephone : +66 2 586 5792-4 Fax : +66 2 586 5109

Website : www.scieco.co.th E-Mail : calibrate@scg.co.th

Certificate No. T231676

Page 2 of 6

Calibration Report

Equipment : HEATING BLOCK
Date of Calibration : 22 September 2023
Environment : Temperature : 21.8-23.1 °C
Line Voltage : 221.6-226.3 V
Relative Humidity : 55 - 65 %RH

Condition of this results of calibration :

- This equipment was calibrated by insert 20 standard thermocouples type T into its chamber, the other one standard thermocouples type T use for ambient temperature measurement. The calibration was done in according to WI-T20
All data show below were final values and the initial data from customer request. The temperature scale used was based on ITS - 90.
- Reference Standard Instrument :

Instrument	Model	Instrument No	Certificate No	Due Date
TC	TYPE T	TN21-TN30	T230014	17 January 2024
1C	TYPE T	IN31-TN40	T230014	17 January 2024
DATA LOGGER	34970A	T151	T230014	17 January 2024
- This certificate is traceable to :
National Institute of Metrology (Thailand) through Metrological Center (NSC-TISI-TIS 17025 CALIBRATION 0244)
- Condition of calibrated item : good
Equipment Description :
Time Constant 2 Hour 20 Minute At 95 °C
Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max
☐ Close
☒ Not Available
- Adjustment :
() without adjustment (X) after adjustment

Approved By

FM-L13 108/30-05-57



Metrological Center

SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110

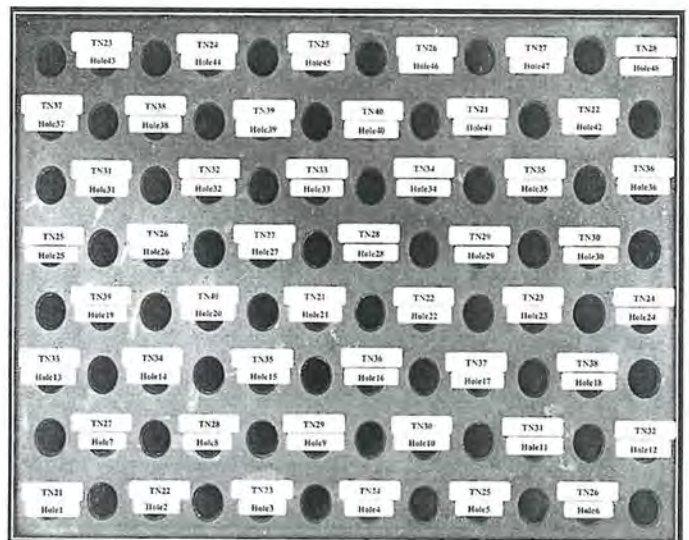
Telephone : +66 2 586 5792-4 Fax : +66 2 586 5109

Website : www.scieco.co.th E-Mail : calibrate@scg.co.th

Certificate No. T231676

Page 3 of 6

Calibration Report



FRONT CONTROL

Approved By

FM-L15 108 30-05-57



Certificate No T231676

Page 4 of 6

Calibration Report

Measurement Results

Calibration Point		Average Standard Reading at each position (°C)					
R1 Hole1-Hole6		TN21	TN22	TN23	TN24	TN25	TN26
CAL POINT	Max	95.01	94.41	95.20	95.41	94.51	95.17
	Min	94.57	93.95	94.75	94.92	94.00	94.72
	Average	94.79	94.18	94.98	95.17	94.26	94.95
R2 Hole7-Hole12		TN27	TN28	TN29	TN30	TN31	TN32
Max	95.36	95.43	95.19	95.16	95.35	94.97	
	Min	94.94	94.95	94.72	94.71	94.90	94.57
	Average	95.15	95.19	94.96	94.94	95.13	94.77
R3 Hole13-Hole18		TN33	TN34	TN35	TN36	TN37	TN38
Max	95.37	95.50	95.22	95.21	95.33	95.51	
	Min	94.99	95.09	94.78	94.42	94.88	94.96
	Average	95.18	95.30	95.00	95.02	95.11	95.13
R4 Hole19-Hole24		TN39	TN40	TN41	TN42	TN43	TN44
Max	95.59	94.42	94.52	94.24	94.63	94.67	
	Min	95.21	94.06	94.13	93.88	94.28	94.27
	Average	95.40	94.24	94.33	94.06	94.45	94.47
R5 Hole25-Hole30		TN45	TN46	TN47	TN48	TN49	TN50
Max	95.19	95.38	95.03	95.20	95.14	95.03	
	Min	94.83	95.03	92.56	94.95	94.79	94.70
	Average	95.01	95.20	92.75	95.12	94.96	94.87
R6 Hole31-Hole36		TN51	TN52	TN53	TN54	TN55	TN56
Max	95.62	94.90	94.77	94.31	94.24	93.77	
	Min	94.54	94.55	94.33	93.98	93.92	93.56
	Average	94.43	94.72	94.60	94.14	94.08	93.71
R7 Hole37-Hole42		TN57	TN58	TN59	TN60	TN61	TN62
Max	94.50	94.44	94.04	93.81	94.19	95.35	
	Min	93.95	94.05	93.67	93.48	94.39	94.90
	Average	94.13	94.24	93.86	93.65	94.64	95.12
R8 Hole43-Hole48		TN63	TN64	TN65	TN66	TN67	TN68
Max	95.99	95.63	95.28	95.29	95.45	94.87	
	Min	95.57	95.15	94.82	94.84	94.99	94.48
	Average	95.78	95.39	95.05	95.07	95.22	94.68

Approved By: _____

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Certificate No T231676

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Calibration Report

Measurement Results

Calibration Point		Average Standard Reading at each position (°C)					
R1 Hole1-Hole6		TN21	TN22	TN23	TN24	TN25	TN26
CAL POINT	Max	105.23	104.33	105.43	105.25	104.44	105.27
	Min	104.94	103.95	105.15	105.04	104.11	104.96
	Average	105.09	104.13	105.29	105.15	104.28	105.12
R2 Hole7-Hole12		TN27	TN28	TN29	TN30	TN31	TN32
Max	105.30	105.12	105.18	105.22	105.12	105.16	
	Min	105.11	104.92	104.96	105.00	104.92	104.97
	Average	105.20	105.02	105.07	105.11	105.02	105.06
R3 Hole13-Hole18		TN33	TN34	TN35	TN36	TN37	TN38
Max	105.37	105.63	105.02	104.80	104.69	105.19	
	Min	105.17	105.37	104.75	104.59	104.50	105.00
	Average	105.27	105.50	104.88	104.69	104.60	105.09
R4 Hole19-Hole24		TN39	TN40	TN41	TN42	TN43	TN44
Max	105.31	104.43	106.41	104.71	105.63	105.82	
	Min	105.08	104.22	106.15	104.41	105.37	105.56
	Average	105.19	104.33	106.28	104.56	105.50	105.69
R5 Hole25-Hole30		TN45	TN46	TN47	TN48	TN49	TN50
Max	104.95	106.26	105.34	105.78	105.59	105.87	
	Min	104.67	105.96	105.08	105.36	105.36	105.68
	Average	104.81	106.11	105.21	105.67	105.48	105.77
R6 Hole31-Hole36		TN51	TN52	TN53	TN54	TN55	TN56
Max	104.75	104.86	104.80	105.20	104.50	104.39	
	Min	104.54	104.63	104.59	105.00	104.32	104.18
	Average	104.65	104.75	104.69	105.10	104.41	104.28
R7 Hole37-Hole42		TN57	TN58	TN59	TN60	TN61	TN62
Max	104.30	104.90	104.85	104.65	104.44	104.85	
	Min	104.09	104.72	104.66	104.49	104.63	104.52
	Average	104.19	104.81	104.75	104.57	104.76	104.68
R8 Hole43-Hole48		TN63	TN64	TN65	TN66	TN67	TN68
Max	105.71	105.85	105.39	105.61	105.42	105.19	
	Min	105.45	105.61	105.14	105.27	105.18	104.94
	Average	105.58	105.73	105.27	105.44	105.30	105.07

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FM-L13 108 30-05-57



Certificate No. T231676

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Calibration Report

Measurement Results:

HEATING BLOCK		Temperature Distribution	
Setting (°C)	Reading (°C)		Stability (± °C)
	Min, Max	Average	
100.0	100.3, 100.5	100.4	0.26
107.0	107.0, 107.1	107.1	0.19

* The quoted uncertainty exclude " uniformity "

The calibration result apply only the above calibrated item

The result of test was found accurate as shown on date and place of test only

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k which for a t-distribution, providing

a level of confidence of approximately 95 %

Approved By: _____

FM-L13 108 30-05-57

ARCHIMICA

REVIEW BY: *Autichawan S*
APPROVED BY: *Tanwattana M*
NEXT CAL DATE: 12 Jan 2025

Certificate of Calibration

ICS-2100: Anion (ID#659)

This certificate is to verify that instrument below are calibrated

by Archimica Lab Co., Ltd.

ICS-2100 S/N: 15010977
AS-HV S/N: 5450A36659

For

ALS Laboratory Group (Thailand) Co., Ltd.

Operator Signature: *Nutdanai* Date: Jan 12, 2024
(Mr. Nutdanai Laekhwan)
Application Chemist

Agilent Technologies

Agilent Technologies (Thailand) Limited
U CHU LIANG BLDG 22/F UNIT A.D
9th FLOOR 4th FLOOR Bldg 22/F UNIT A.D
Bangkok 10500 Thailand

Tel: +662 637 6363
Fax: +662 632 4324
Email: ccc.smt@agilent.com
Website: www.agilent.com/thai

Service Confirmation Number: 6905876103
Service Confirmation Date: 23.08.2024

Customer Contact:

ALS Laboratory Group (Thailand) Co
Ltd Head Office

104 Phatthanakan 40 Phatthanakan Rd
Khaeng Phatthanakan: Khet Suan
TAX ID: 0105540004859

Chanattagarn Imchom@alsglobal.com
27603088

Invoice To:

ALS Laboratory Group (Thailand) Co
Ltd Head Office

104 Phatthanakan 40 Phatthanakan Rd
Khaeng Phatthanakan: Khet Suan

Delivery Site:

ALS Laboratory Group (Thailand) Co
Ltd Head Office

104 Phatthanakan 40 Phatthanakan Rd
Khaeng Phatthanakan: Khet Suan

Location:

Room

Building

Lab

Dept

SERVICE REPORT

Customer Purchase

Order Number:

Customer Number:

70371013

Service Request:

Service Request Data:

Service Order:

6906676091

Service Confirmation:

6905876103

REVIEW BY	Promphen C
APPROVED BY	Suwan O.
NEXT CAL DATE	31 Mar 2024

Direct Inquiries to:

Contact Name

Contact E mail

Contact Telephone

Contact Fax:

Customer Contact Center

ccc.smt@agilent.com

+662 637 6363

+662 632 4334

Agilent Technologies (Thailand) Limited Head Office

104 Phatthanakan 40 Phatthanakan Rd
Khaeng Phatthanakan: Khet Suan
Bangkok 10500 Thailand
Tax ID: 0105540004859

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Crabank N.A. Bangkok branch
239 Interchange 21 Building, Sukhumvit Road, Klongtoey New
Sub district, Wattana District, Bangkok 10110 Thailand
Acc. No: 017-4452 007
199-199 Thai Bank PCL
Siam Square Bldg 415/1 2 Floor 1 Rd, Pathumwan, EKK 10330
Thailand

010@NAL

Service Instrument:

Model Number	Model Description	Serial Number	System Handle	Parent Asset
SYS-ID-5100	ICP-OES 5100/5110 System			
G8010A	Agilent 5100 SVDV ICP-OES Spectrometer	MY16010005	ICP OES 5100	SYS-ID-5100
G8410A	SPS 4 Autosampler	AU15440764	ICP OES 5100	SYS-ID-5100

Service Items:



Item	Service/Part #	Description	Qty	Entitlement	Service Start	Service End
1000	EQO	Enterprise Operational Qualification	1.00	Agreement Entitlement 100 % covered	22.09.2024	23.09.2024
1010	6610030100	Bottle ICP-OES Waveca soln 500mL 5 ppm	1.00	Agreement Entitlement 100 % covered		
1020	6190-7001	Calibration blank solution Spet HND3	1.00	Agreement Entitlement 100 % covered		

Additional Information:

Service Confirmation Number: 6905876103

Service Confirmation Date: 23.08.2024

Service Information:

Problem Description: WU-DG-ID-5100-5001253655		
Service Provided: Complete OQHW 5100ICPOES Equipment ID: BKK_EL0037, all test passed		
Service Overview Code: Reason Code: Scheduled Service Diagnosis Code: Scheduled Service Resolution Code: Scheduled Service		
Reported Hours: 4.0	Travel Hours: 2.0	
Customer Field Service Representative Name: Suwan Onkhom	Customer Field Service Representative Signature: 	Date: 23 Sep 2024
Customer Name: CHANATTAGARN IMCHOM	Customer Signature: 	Date: 23 Sep 2024
Additional Comments:		