

ภาคผนวก ง

ใบรับรองการสอบเทียบเครื่องมือ



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รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Ambient	Particulate Matter (PM-10)	High Volume	BKK_FS0380	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	BKK_FS1061	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	BKK_FS0385	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	BKK_FS1060	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	BKK_FS0383	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	BKK_FS1061	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	BKK_FS0374	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	BKK_FS0380	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	BKK_FS0380	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	BKK_FS0374	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	BKK_FS1377	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	BKK_FS0385	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	Digital Balance	BKK_EN0403	3-Jun-24	3-Jun-25	12
Ambient	Total Suspended Particulate	High Volume	BKK_FS0365	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	BKK_FS1376	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	BKK_FS0373	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	BKK_FS0364	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	BKK_FS0370	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	BKK_FS0373	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	BKK_FS0369	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	BKK_FS0365	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	BKK_FS0365	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	BKK_FS1057	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	BKK_FS0367	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	BKK_FS0373	-	-	On site Calibration
Ambient	Total Suspended Particulate	Digital Balance	BKK_EN0403	3-Jun-24	3-Jun-25	12
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	BKK_FS0785	3-Jan-24	3-Jul-24	6
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	BKK_FS0794	3-Jan-24	3-Jul-24	6
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	BKK_FS0800	3-Jan-24	3-Jul-24	6
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	BKK_FS1098	3-Jan-24	3-Jul-24	6
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	BKK_FS1098	3-Jan-24	3-Jul-24	6
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	BKK_FS0800	3-Jan-24	3-Jul-24	6
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	BKK_FS0803	3-Jan-24	3-Jul-24	6
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	BKK_FS0779	3-Jan-24	3-Jul-24	6
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	BKK_FS0785	3-Jan-24	3-Jul-24	6
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	BKK_FS0803	3-Jan-24	3-Jul-24	6
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	BKK_FS0794	3-Jan-24	3-Jul-24	6
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	BKK_FS0800	3-Jan-24	3-Jul-24	6
Ambient	Sulfur Dioxide	SO ₂ Analyzer	BKK_FS0784	3-Jan-24	3-Jul-24	6
Ambient	Sulfur Dioxide	SO ₂ Analyzer	BKK_FS0793	3-Jan-24	3-Jul-24	6
Ambient	Sulfur Dioxide	SO ₂ Analyzer	BKK_FS0799	3-Jan-24	3-Jul-24	6
Ambient	Sulfur Dioxide	SO ₂ Analyzer	BKK_FS1097	3-Jan-24	3-Jul-24	6
Ambient	Sulfur Dioxide	SO ₂ Analyzer	BKK_FS1097	3-Jan-24	3-Jul-24	6
Ambient	Sulfur Dioxide	SO ₂ Analyzer	BKK_FS0799	3-Jan-24	3-Jul-24	6
Ambient	Sulfur Dioxide	SO ₂ Analyzer	BKK_FS0802	3-Jan-24	3-Jul-24	6
Ambient	Sulfur Dioxide	SO ₂ Analyzer	BKK_FS0784	3-Jan-24	3-Jul-24	6
Ambient	Sulfur Dioxide	SO ₂ Analyzer	BKK_FS0784	3-Jan-24	3-Jul-24	6
Ambient	Sulfur Dioxide	SO ₂ Analyzer	BKK_FS0802	3-Jan-24	3-Jul-24	6
Ambient	Sulfur Dioxide	SO ₂ Analyzer	BKK_FS0793	3-Jan-24	3-Jul-24	6
Ambient	Sulfur Dioxide	SO ₂ Analyzer	BKK_FS0799	3-Jan-24	3-Jul-24	6



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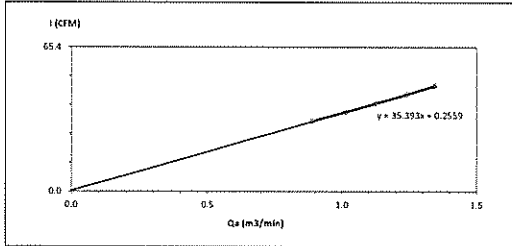
Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS1369	30-May-23	30-Nov-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS1371	19-Jun-23	19-Dec-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS1370	30-May-23	30-Nov-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS1213	17-Nov-22	17-May-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS0910	10-Dec-22	9-Jun-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	SGK_FS0039	19-Dec-23	18-Dec-24	12
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS0165	4-Jan-24	4-Jul-25	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS0918	21-Feb-23	21-Aug-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS0888	4-Jan-24	4-Jul-25	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS0918	21-Feb-23	21-Aug-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS0163	28-Sep-23	28-Mar-25	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS0165	4-Jan-24	4-Jul-25	18
Noise	Leq 24 hrs	Sound Calibrator	BKK_FS0632	26-Jan-24	25-Jan-25	12
Noise	Leq 24 hrs	Sound Level Meter	BKK_FS0968	22-Feb-24	21-Feb-25	12
Noise	Leq 24 hrs	Sound Level Meter	BKK_FS0930	22-Feb-24	21-Feb-25	12
Noise	Leq 24 hrs	Sound Level Meter	BKK_FS0993	19-Oct-23	19-Oct-24	12
Noise	Leq 24 hrs	Sound Calibrator	BKK_FS0632	26-Jan-24	25-Jan-25	12
Noise	Leq 24 hrs	Sound Level Meter	BKK_FS0099	17-Jul-23	17-Jul-24	12
Noise	Noise Annoyance	Sound Calibrator	BKK_FS0632	26-Jan-24	25-Jan-25	12
Noise	Noise Annoyance	Sound Level Meter	BKK_FS0968	22-Feb-24	21-Feb-25	12
Noise	Noise Annoyance	Sound Level Meter	BKK_FS0930	22-Feb-24	21-Feb-25	12
Noise	Noise Annoyance	Sound Level Meter	BKK_FS0993	19-Oct-23	19-Oct-24	12
Noise	Noise Annoyance	Sound Calibrator	BKK_FS0632	26-Jan-24	25-Jan-25	12
Noise	Noise Annoyance	Sound Level Meter	BKK_FS0099	17-Jul-23	17-Jul-24	12
Noise	Noise Annoyance	Sound Calibrator	BKK_FS0632	26-Jan-24	25-Jan-25	12
Noise	Noise Annoyance	Sound Level Meter	BKK_FS0970	22-Feb-24	21-Feb-25	12
Noise	Noise Annoyance	Sound Level Meter	BKK_FS0971	22-Feb-24	21-Feb-25	12
Noise	Noise Annoyance	Sound Calibrator	BKK_FS0632	26-Jan-24	25-Jan-25	12
Noise	Noise Annoyance	Sound Level Meter	BKK_FS0030	29-Jan-24	28-Jan-25	12
Water Lab	pH at 25 °C	pH meter	BKK_EN0342	27-Oct-23	27-Oct-24	12
Water Lab	Conductivity	Conductivity meter	BKK_EN0373	25-Dec-23	25-Dec-24	12
Water Lab	BOD	DO Meter	BKK_EN0017	16-Nov-23	16-May-25	18
Water Lab	BOD	Incubator	BKK_EN0304	20-Mar-24	20-Mar-25	12
Water Lab	BOD	Burette	BKK_EN0171	27-Feb-24	27-Aug-25	18
Water Lab	COD	Hot Block	BKK_EN0370	6-Dec-23	6-Dec-24	12
Water Lab	COD	Spectrophotometer	BKK_EN0018	15-Sep-23	15-Sep-24	12
Water Lab	Total Suspended Solids	Electronic Top-Loading Balance	BKK_EN0003	9-Aug-23	9-Aug-24	12
Water Lab	Total Suspended Solids	Oven	BKK_EN0425	6-Nov-23	6-Nov-24	12
Water Lab	Oil & Grease	Electronic Top-Loading Balance	BKK_EN0003	9-Aug-23	9-Aug-24	12
Water Lab	Oil & Grease	Water Bath	BKK_EN0148	4-Jul-23	4-Jan-25	18



High Volume Air Sampler Calibration Worksheet

Project Site : Slam City Cement Public Company Limited
 Calibrate Location : โรงงานปูนซีเมนต์ (สุพรรณบุรี)
 Calibrate Date : 13-Mar-24
 Calibration Sheet No. : C-130324-BKK-FS0380
 Calibrator ID : BKK-FS0624
 Calibrator Model : TE-5028A
 Calibrator S/N : 2584
 Barometric Pressure (mm Hg) : 753.5
 Temperature (°C) : 35.5
 High Volume ID : BKK-FS0380
 High Volume Model : TE-5009X
 High Volume S/N : 4163
 Calibrator Slope : 1.03303
 Calibrator Intercept : -0.01606

Test No.	Delta H ₂ O (Inch)	Qa (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.0	0.892	32	Slope : 35.3927 Intercept : 0.2559 Correlation Coefficient : 0.9997
2	2.6	1.015	36	
3	3.2	1.124	40	
4	3.9	1.239	44	
5	4.6	1.345	48	



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

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

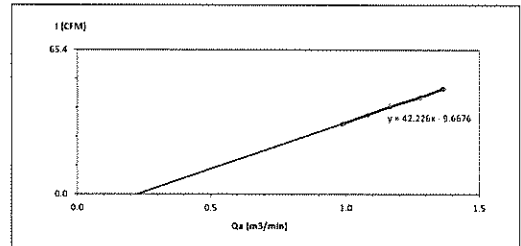
FORM NO. F-06-074 REVISION NO. 2 ISSUE DATE: 20/11/23



High Volume Air Sampler Calibration Worksheet

Project Site : Slam City Cement Public Company Limited
 Calibrate Location : โรงงานปูนซีเมนต์
 Calibrate Date : 13-Mar-24
 Calibration Sheet No. : C-130324-BKK-FS1061
 Calibrator ID : BKK-FS0624
 Calibrator Model : TE-5028A
 Calibrator S/N : 2584
 Barometric Pressure (mm Hg) : 756.6
 Temperature (°C) : 32.9
 High Volume ID : BKK-FS1061
 High Volume Model : TE-5009X
 High Volume S/N : 5504
 Calibrator Slope : 1.03303
 Calibrator Intercept : -0.01606

Test No.	Delta H ₂ O (Inch)	Qa (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.5	0.989	32	Slope : 42.2260 Intercept : 9.6676 Correlation Coefficient : 0.9993
2	3.0	1.082	36	
3	3.5	1.160	40	
4	4.2	1.278	44	
5	4.8	1.365	48	



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

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

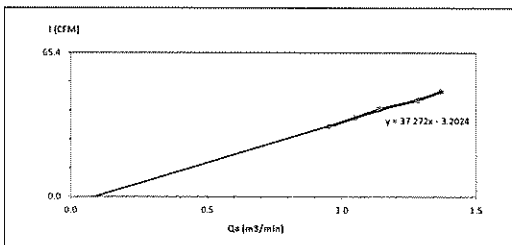
FORM NO. F-06-074 REVISION NO. 2 ISSUE DATE: 20/11/23



High Volume Air Sampler Calibration Worksheet

Project Site : Slam City Cement Public Company Limited
 Calibrate Location : โรงงานปูนซีเมนต์ (สุพรรณบุรี)
 Calibrate Date : 13-Mar-24
 Calibration Sheet No. : C-130324-BKK-FS0385
 Calibrator ID : BKK-FS0624
 Calibrator Model : TE-5028A
 Calibrator S/N : 2584
 Barometric Pressure (mm Hg) : 756.5
 Temperature (°C) : 35.4
 High Volume ID : BKK-FS0385
 High Volume Model : TE-5009X
 High Volume S/N : 4789
 Calibrator Slope : 1.03303
 Calibrator Intercept : -0.01606

Test No.	Delta H ₂ O (Inch)	Qa (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.3	0.953	32	Slope : 37.2725 Intercept : 3.2024 Correlation Coefficient : 0.9966
2	2.8	1.050	36	
3	3.3	1.139	40	
4	4.2	1.283	44	
5	4.8	1.370	48	



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

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

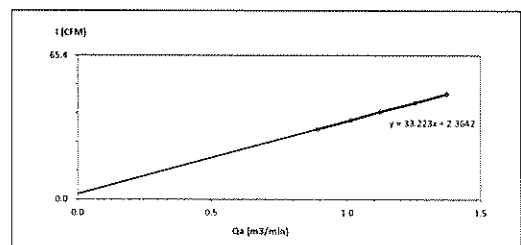
FORM NO. F-06-074 REVISION NO. 2 ISSUE DATE: 20/11/23



High Volume Air Sampler Calibration Worksheet

Project Site : Slam City Cement Public Company Limited
 Calibrate Location : โรงงานปูนซีเมนต์
 Calibrate Date : 13-Mar-24
 Calibration Sheet No. : C-130324-BKK-FS1060
 Calibrator ID : BKK-FS0624
 Calibrator Model : TE-5028A
 Calibrator S/N : 2584
 Barometric Pressure (mm Hg) : 749.4
 Temperature (°C) : 34.4
 High Volume ID : BKK-FS1060
 High Volume Model : TE-5009X
 High Volume S/N : 5503
 Calibrator Slope : 1.03303
 Calibrator Intercept : -0.01606

Test No.	Delta H ₂ O (Inch)	Qa (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.0	0.893	32	Slope : 33.2228 Intercept : 2.3642 Correlation Coefficient : 0.9997
2	2.6	1.016	36	
3	3.2	1.125	40	
4	4.0	1.256	44	
5	4.8	1.374	48	



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

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

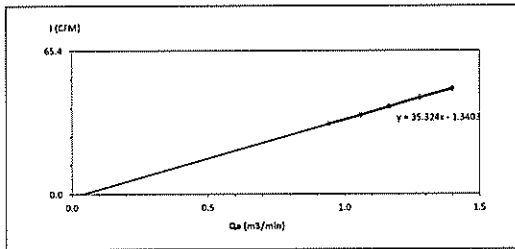
FORM NO. F-06-074 REVISION NO. 2 ISSUE DATE: 20/11/23



High Volume Air Sampler Calibration Worksheet

Project Site: Siam City Cement Public Company Limited
Calibrate Location: บ้านหินปูน
Calibrate Date: 2-May-24
Calibration Sheet No.: C-020524-BKK-FS0303
Calibrator ID: BKK-FS0624
Calibrator Model: TE-5028A
Calibrator S/N: 2584
Barometric Pressure (mm Hg): 743.5
Temperature (°C): 36.6
High Volume ID: BKK-FS0303
High Volume Model: TE-5009X
High Volume S/N: 4707
Calibrator Slope: 1.03303
Calibrator Intercept: -0.01606

Test No.	Delta H ₂ O (Inch)	Q _a (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.2	0.943	32	Slope: 35.3244 Intercept: -1.3403 Correlation Coefficient: 0.9999
2	2.0	1.061	36	
3	3.4	1.168	40	
4	4.1	1.281	44	
5	4.9	1.399	48	



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

Approved by: [Signature]
(Mr. Noppong Juntarapan)
Enviro Field Coordinator Scientist (3)

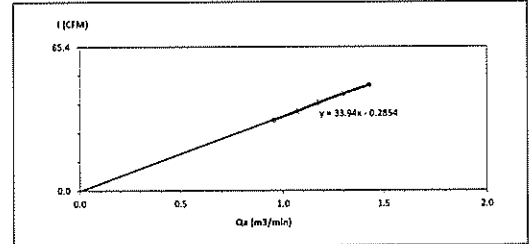
FORM NO. F-06-074 REVISION NO.2 ISSUE DATE: 20/11/23



High Volume Air Sampler Calibration Worksheet

Project Site: Siam City Cement Public Company Limited
Calibrate Location: บ้านหินปูน
Calibrate Date: 2-May-24
Calibration Sheet No.: C-020524-BKK-FS1061
Calibrator ID: BKK-FS0624
Calibrator Model: TE-5028A
Calibrator S/N: 2584
Barometric Pressure (mm Hg): 721.1
Temperature (°C): 35
High Volume ID: BKK-FS1061
High Volume Model: TE-5009X
High Volume S/N: 5504
Calibrator Slope: 1.03303
Calibrator Intercept: -0.01606

Test No.	Delta H ₂ O (Inch)	Q _a (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.3	0.956	32	Slope: 33.9404 Intercept: -0.2854 Correlation Coefficient: 0.9992
2	2.9	1.072	36	
3	3.5	1.176	40	
4	4.3	1.301	44	
5	5.2	1.430	48	



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

Approved by: [Signature]
(Mr. Noppong Juntarapan)
Enviro Field Coordinator Scientist (3)

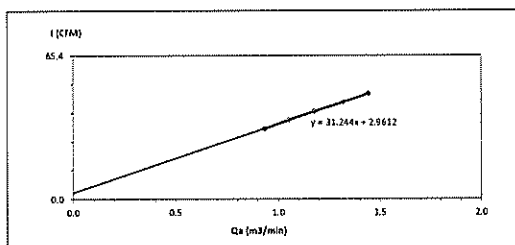
FORM NO. F-06-074 REVISION NO.2 ISSUE DATE: 20/11/23



High Volume Air Sampler Calibration Worksheet

Project Site: Siam City Cement Public Company Limited
Calibrate Location: บ้านหินปูน
Calibrate Date: 2-May-24
Calibration Sheet No.: C-020524-BKK-FS0374
Calibrator ID: BKK-FS0624
Calibrator Model: TE-5028A
Calibrator S/N: 2584
Barometric Pressure (mm Hg): 750
Temperature (°C): 34.9
High Volume ID: BKK-FS0374
High Volume Model: TE-5009X
High Volume S/N: 5195
Calibrator Slope: 1.03303
Calibrator Intercept: -0.01606

Test No.	Delta H ₂ O (Inch)	Q _a (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.2	0.936	32	Slope: 31.2435 Intercept: 2.9612 Correlation Coefficient: 0.9995
2	2.8	1.054	36	
3	3.5	1.176	40	
4	4.4	1.317	44	
5	5.3	1.444	48	



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

Approved by: [Signature]
(Mr. Noppong Juntarapan)
Enviro Field Coordinator Scientist (3)

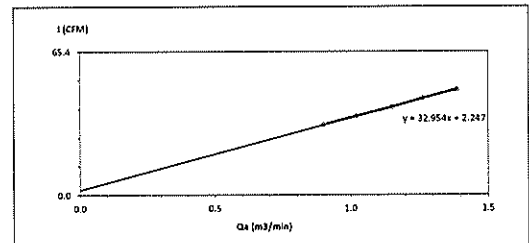
FORM NO. F-06-074 REVISION NO.2 ISSUE DATE: 20/11/23



High Volume Air Sampler Calibration Worksheet

Project Site: Siam City Cement Public Company Limited
Calibrate Location: บ้านหินปูน
Calibrate Date: 2-May-24
Calibration Sheet No.: C-020524-BKK-FS0300
Calibrator ID: BKK-FS0624
Calibrator Model: TE-5028A
Calibrator S/N: 2584
Barometric Pressure (mm Hg): 750
Temperature (°C): 39.8
High Volume ID: BKK-FS0300
High Volume Model: TE-5009X
High Volume S/N: 4163
Calibrator Slope: 1.03303
Calibrator Intercept: -0.01606

Test No.	Delta H ₂ O (Inch)	Q _a (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.0	0.900	32	Slope: 32.9544 Intercept: 2.2470 Correlation Coefficient: 0.9998
2	2.6	1.024	36	
3	3.3	1.152	40	
4	4.8	1.266	44	
5	4.8	1.386	48	



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

Approved by: [Signature]
(Mr. Noppong Juntarapan)
Enviro Field Coordinator Scientist (3)

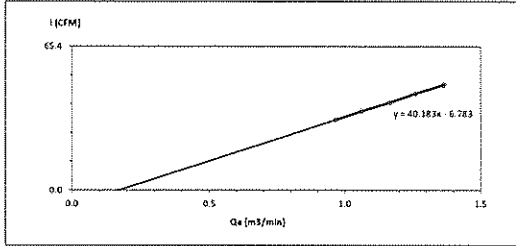
FORM NO. F-06-074 REVISION NO.2 ISSUE DATE: 20/11/23



High Volume Air Sampler Calibration Worksheet

Project Site: Siam City Cement Public Company Limited
 Calibrate Location: โรงงานปูนซีเมนต์
 Calibrate Date: 4 Jun 24
 Calibration Sheet No.: C-040624-BKK-FS0380
 Calibrator ID: RYG-FS0415
 Calibrator Model: TE-502HA
 Calibrator S/N: 3494
 Barometric Pressure (mm Hg): 755.6
 Temperature (°C): 35.6
 High Volume ID: BKK-FS0380
 High Volume Model: TE-5009X
 High Volume S/N: 4163
 Calibrator Slope: 1.03079
 Calibrator Intercept: -0.00629

Test No.	Delta H ₂ O (inch)	Q _a (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.4	0.967	32	Slope: 40.1025 Intercept: -0.7030 Correlation Coefficient: 0.9999
2	2.9	1.062	36	
3	3.5	1.166	40	
4	4.1	1.262	44	
5	4.8	1.365	48	



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

Approved by: [Signature]
 (Mr. Noppong Jantarapan)
 Enviro Field Coordinator Scientist (3)

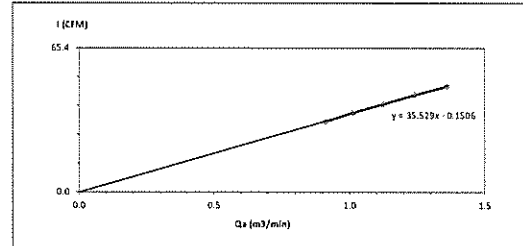
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High Volume Air Sampler Calibration Worksheet

Project Site: Siam City Cement Public Company Limited
 Calibrate Location: โรงงานปูนซีเมนต์
 Calibrate Date: 4 Jun 24
 Calibration Sheet No.: C-040624-BKK-FS0374
 Calibrator ID: RYG-FS0415
 Calibrator Model: TE-502HA
 Calibrator S/N: 3494
 Barometric Pressure (mm Hg): 747.4
 Temperature (°C): 37
 High Volume ID: BKK-FS0374
 High Volume Model: TE-5009X
 High Volume S/N: 5195
 Calibrator Slope: 1.03079
 Calibrator Intercept: -0.00629

Test No.	Delta H ₂ O (inch)	Q _a (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.1	0.912	32	Slope: 35.5294 Intercept: -0.1506 Correlation Coefficient: 0.9995
2	2.6	1.014	36	
3	3.2	1.124	40	
4	3.9	1.240	44	
5	4.7	1.361	48	



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

Approved by: [Signature]
 (Mr. Noppong Jantarapan)
 Enviro Field Coordinator Scientist (3)

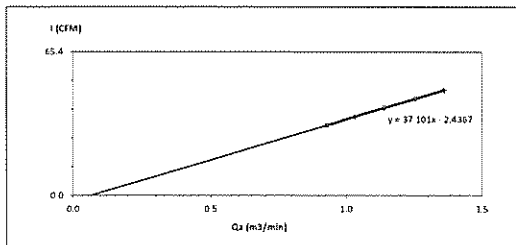
FORM NO. F-06-074 REVISION NO. ISSUE DATE: 14/03/16



High Volume Air Sampler Calibration Worksheet

Project Site: Siam City Cement Public Company Limited
 Calibrate Location: โรงงานปูนซีเมนต์
 Calibrate Date: 4 Jun 24
 Calibration Sheet No.: C-040624-BKK-FS1377
 Calibrator ID: RYG-FS0415
 Calibrator Model: TE-502HA
 Calibrator S/N: 3494
 Barometric Pressure (mm Hg): 747.7
 Temperature (°C): 36.6
 High Volume ID: BKK-FS1377
 High Volume Model: TE-5009X
 High Volume S/N: 6262
 Calibrator Slope: 1.03079
 Calibrator Intercept: -0.00629

Test No.	Delta H ₂ O (inch)	Q _a (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.2	0.932	32	Slope: 37.1011 Intercept: -2.4367 Correlation Coefficient: 0.9998
2	2.7	1.032	36	
3	3.3	1.140	40	
4	4.0	1.255	44	
5	4.7	1.360	48	



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

Approved by: [Signature]
 (Mr. Noppong Jantarapan)
 Enviro Field Coordinator Scientist (3)

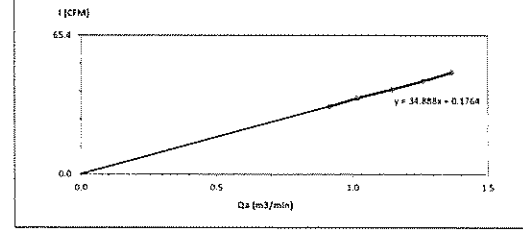
FORM NO. F-06-074 REVISION NO. ISSUE DATE: 14/03/16



High Volume Air Sampler Calibration Worksheet

Project Site: Siam City Cement Public Company Limited
 Calibrate Location: โรงงานปูนซีเมนต์
 Calibrate Date: 4 Jun 24
 Calibration Sheet No.: C-040624-BKK-FS0385
 Calibrator ID: RYG-FS0415
 Calibrator Model: TE-502HA
 Calibrator S/N: 3494
 Barometric Pressure (mm Hg): 740.6
 Temperature (°C): 36.8
 High Volume ID: BKK-FS0385
 High Volume Model: TE-5009X
 High Volume S/N: 4709
 Calibrator Slope: 1.03079
 Calibrator Intercept: -0.00629

Test No.	Delta H ₂ O (inch)	Q _a (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.1	0.916	32	Slope: 34.8875 Intercept: -0.1764 Correlation Coefficient: 0.9994
2	2.6	1.018	36	
3	3.3	1.146	40	
4	4.0	1.261	44	
5	4.7	1.367	48	



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

Approved by: [Signature]
 (Mr. Noppong Jantarapan)
 Enviro Field Coordinator Scientist (3)

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

CERTIFICATE OF CALIBRATION

W/O No. : WO-0051-24

page no. 2 of 3

Result of Calibration

W/O No.: WO-0051-24

Page no. 3 of 3

Test load at least 1/3 of the maximum of receptor to the edge.

✓

Weighting Range 1

Test Load = 100 g

Position	Indication g
1	100.00004
2	100.00005
3	100.00002
4	100.00004
5	100.00003

Max Deviation = 0.00002

2. Linearity. Departure of indication from nominal value

Weighting Range 1					
Nominal Value	Standard Value	Indication	Error of Indication	Expanded Uncertainty	Factor k
R_p	0.01000	0.01000	-0.000021	0.000047	2.85
0.1	0.10001	0.10001	0.000004	0.000082	2.87
0.5	0.50000	0.50001	0.000012	0.000088	2.87
1	1.00001	1.00002	0.000013	0.000066	2.87
5	5.00002	5.00003	0.000003	0.000008	2.52
10	9.99999	9.99999	0.000001	0.000008	2.28
50	50.00000	49.99999	-0.000027	0.000016	2.00
100	100.00000	100.00000	0.000004	0.000009	2.00
150	150.00000	150.00001	0.000007	0.000045	2.00
200	200.00000	200.00001	0.000003	0.000000	2.00

Standard method

The calibration was performed by using calibration laboratory's in house calibration method. CP M 503 based on "UKAS LAB 14 Calibration of weighing machine" edition 6 | October 2019

Reference standards/instrument

<u>Instrument</u>	<u>IML Class</u>	<u>S/N</u>	<u>Certificate No.</u>	<u>Due Date</u>
Standard Weight Set	C2	4300021852	22 12R725	November 30, 2024
Standard Weight Set				
Standard Weight Set				
Standard Weights Set				

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:

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

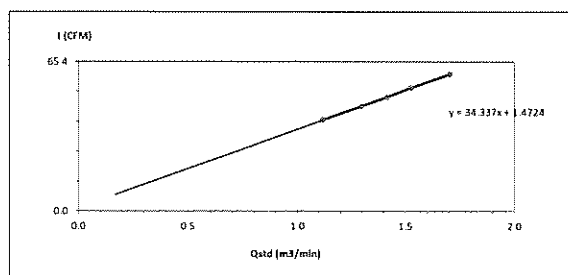
FD-302 (Rev. 12-13-60)

F-639 810320166

High Volume Air Sampler Calibration Worksheet

Project Site :	Siam City Cement Public Company Limited	Barometric Pressure (mm Hg) :	753.5
Calibrate Location :	โรงงานปูนซีเมนต์นครหลวงสมุทรสาคร	Temperature (°C) :	35.5
Calibrate Date :	13-Mar-24	High Volume ID :	RKK-FS0365
Calibration Sheet No.:	C-130324-RKK-FS0365	High Volume Model :	TE-5009X
Calibrator ID:	BKK-FS0624	High Volume S/N :	4164
Calibrator Model :	TE-5028A	Calibrator Slope :	1.64931
Calibrator S/N :	2584	Calibrator Intercept :	-0.02579

Test No.	Delta H ₂ O (inch)	Q _{ad} (m ² /min)	I : Chart (CFM)	Linear Regression	
1	3.4	1.1199	40	Slope :	34.3366
2	4.6	1.2984	46	Intercept	1.4724
3	5.5	1.4173	50	Correlation Coefficient :	0.9999
4	6.4	1.5269	54		
5	8.0	1.7040	60		



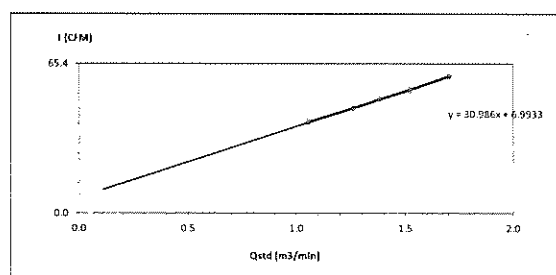
Calibrated by
(Mr Teeravut Sukdee)
Field Scientist(2)

Approved by _____
(Mr Noppong Juntarupan)
Enviro Field Coordinator Scientist (31)

High Volume Air Sampler Calibration Worksheet

Project Site :	Siam City Cement Public Company Limited	Barometric Pressure (mm Hg) :	756.6
Calibrate Location :	โรงงานปูนซีเมนต์	Temperature ("C) :	32.9
Calibrate Date :	13-Mar-24	High Volume ID :	BKF-F51376
Calibration Sheet No.:	C-130324-BKK-F51376	High Volume Model :	TE-5009X
Calibrator ID:	BKK-F50624	High Volume S/N :	6257
Calibrator Model :	TE-5028A	Calibrator Slope :	1.64931
Calibrator S/N :	2584	Calibrator Intercept :	-0.02579

Test No.	Delta h_2O (inch)	Q_{ss} (m^3/min)	I : Chart (CFM)	Linear Regression	
1	3.9	1.0660	40	Slope :	30.9856
2	4.3	1.2639	46	Intercept	6.9933
3	5.2	1.3874	50	Correlation Coefficient :	0.9997
4	6.3	1.5245	54		
5	7.9	1.7040	60		



Calibrated by hnp ja
(Mr Teerasut Sukdee)
Field Scientist 2)

Approved by _____
(Mr Noppong Juntarupan)
Emvco Field Coordinator Scientist (31)



High Volume Air Sampler Calibration Worksheet

Project Site: Slam City Cement Public Company Limited Barometric Pressure (mm Hg): 756.5

Calibrate Location: โรงงานปูน (บริเวณบ่อหิน) Temperature (°C): 35.4

Calibrate Date: 13-Mar-24 High Volume ID: BKK_FS0373

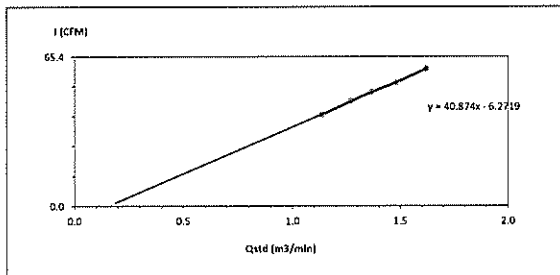
Calibration Sheet No.: C-130324-BKK_FS0373 High Volume Model: G1051

Calibrator ID: BKK_FS0624 High Volume S/N: 1330

Calibrator Model: TE-5028A Calibrator Slope: 1.64931

Calibrator S/N: 2584 Calibrator Intercept: -0.02579

Test No.	Delta H ₂ O (inch)	Q _{ad} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	3.5	1.1382	40	Slope: 40.8738 Intercept: -6.2719 Correlation Coefficient: 0.9993
2	4.4	1.2731	46	
3	5.1	1.3686	50	
4	6.0	1.4823	54	
5	7.2	1.6213	60	



Calibrated by: Mr. Teeravat Sukdee
(Mr. Teeravat Sukdee)
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: Slam City Cement Public Company Limited Barometric Pressure (mm Hg): 749.4

Calibrate Location: โรงงานปูน Temperature (°C): 34.4

Calibrate Date: 13-Mar-24 High Volume ID: BKK_FS0364

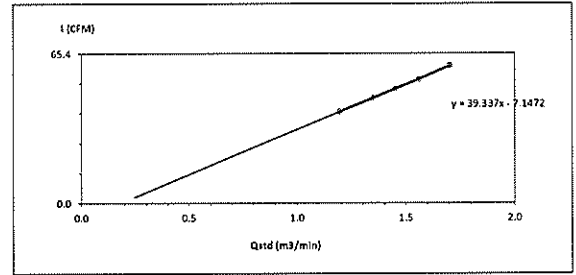
Calibration Sheet No.: C-130324-BKK_FS0364 High Volume Model: TE-5009X

Calibrator ID: BKK_FS0624 High Volume S/N: 4154

Calibrator Model: TE-5028A Calibrator Slope: 1.64931

Calibrator S/N: 2584 Calibrator Intercept: -0.02579

Test No.	Delta H ₂ O (inch)	Q _{ad} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	3.9	1.1965	40	Slope: 39.3368 Intercept: -7.1472 Correlation Coefficient: 0.9998
2	5.0	1.3513	46	
3	5.8	1.4534	50	
4	6.7	1.5602	54	
5	8.0	1.7025	60	



Calibrated by: Mr. Teeravat Sukdee
(Mr. Teeravat Sukdee)
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: Slam City Cement Public Company Limited Barometric Pressure (mm Hg): 743.5

Calibrate Location: โรงงานปูน Temperature (°C): 36.6

Calibrate Date: 2-May-24 High Volume ID: BKK_FS0370

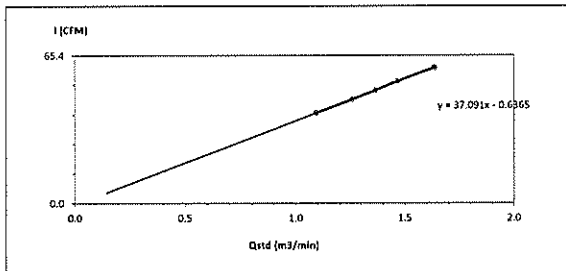
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Calibrator ID: BKK_FS0624 High Volume S/N: 4798

Calibrator Model: TE-5028A Calibrator Slope: 1.64931

Calibrator S/N: 2584 Calibrator Intercept: -0.02579

Test No.	Delta H ₂ O (inch)	Q _{ad} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	3.3	1.0946	40	Slope: 37.0912 Intercept: -0.6365 Correlation Coefficient: 0.9998
2	4.4	1.2599	46	
3	5.2	1.3674	50	
4	6.0	1.4669	54	
5	7.5	1.6371	60	



Calibrated by: Mr. Teeravat Sukdee
(Mr. Teeravat Sukdee)
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: Slam City Cement Public Company Limited Barometric Pressure (mm Hg): 751.1

Calibrate Location: โรงงานปูน Temperature (°C): 35

Calibrate Date: 2-May-24 High Volume ID: BKK_FS0373

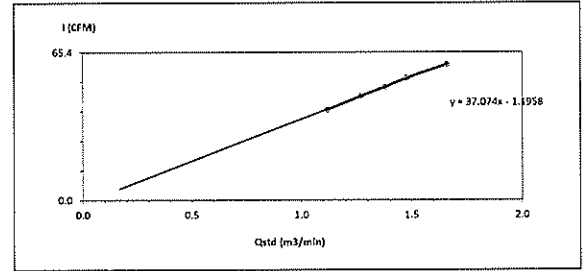
Calibration Sheet No.: C-020524-BKK_FS0373 High Volume Model: G1051

Calibrator ID: BKK_FS0624 High Volume S/N: 1330

Calibrator Model: TE-5028A Calibrator Slope: 1.64931

Calibrator S/N: 2584 Calibrator Intercept: -0.02579

Test No.	Delta H ₂ O (inch)	Q _{ad} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	3.4	1.1190	40	Slope: 37.0740 Intercept: -1.1958 Correlation Coefficient: 0.9991
2	4.4	1.2694	46	
3	5.2	1.3778	50	
4	6.0	1.4781	54	
5	7.6	1.6603	60	



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

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

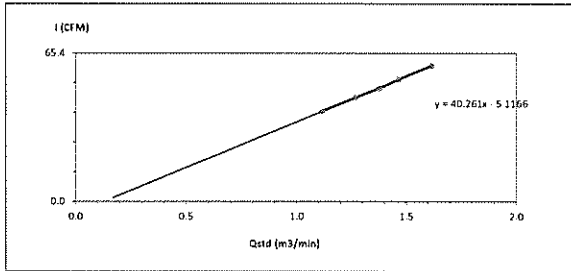
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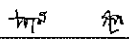



High Volume Air Sampler Calibration Worksheet

Project Site :	Siam City Cement Public Company Limited	Barometric Pressure (mm Hg) :	750
Calibrate Location :	สถานีรถไฟกรุงเทพ	Temperature (°C) :	34.9
Calibrate Date :	2-May-24	High Volume ID :	BKK_FS0369
Calibration Sheet No.:	C-020524-BKK_FS0369	High Volume Model :	TE-S009X
Calibrator ID:	BKK_FS0624	High Volume S/N :	4166
Calibrator Model :	TE-S028A	Calibrator Slope :	1.64931
Calibrator S/N :	2584	Calibrator Intercept :	-0.02579

Test No.	Delta H ₂ O (inch)	Q _{HW} (m ³ /min)	I : Chart (CFM)	Linear Regression
1	3.4	1.1184	40	Slope : 40.2608 Intercept : -5.1166 Correlation Coefficient : 0.9997
2	4.4	1.2607	46	
3	5.2	1.3770	50	
4	5.9	1.4651	54	
5	7.2	1.6158	60	



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

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

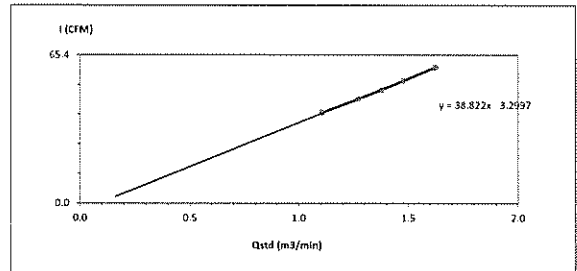
FORM NO. F-06-073 REVISION NO.2 ISSUE DATE: 20/11/23

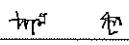



High Volume Air Sampler Calibration Worksheet

Project Site :	Siam City Cement Public Company Limited	Barometric Pressure (mm Hg) :	750
Calibrate Location :	สถานีรถไฟ	Temperature (°C) :	39.8
Calibrate Date :	2-May-24	High Volume ID :	BKK_FS0365
Calibration Sheet No.:	C-020524-BKK_FS0365	High Volume Model :	TE-S009X
Calibrator ID:	BKK_FS0624	High Volume S/N :	4164
Calibrator Model :	TE-S028A	Calibrator Slope :	1.64931
Calibrator S/N :	2584	Calibrator Intercept :	-0.02579

Test No.	Delta H ₂ O (inch)	Q _{HW} (m ³ /min)	I : Chart (CFM)	Linear Regression
1	3.4	1.1090	40	Slope : 38.8218 Intercept : -3.2997 Correlation Coefficient : 0.9996
2	4.5	1.2729	46	
3	5.3	1.3792	50	
4	6.1	1.4778	54	
5	7.4	1.6250	60	



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

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

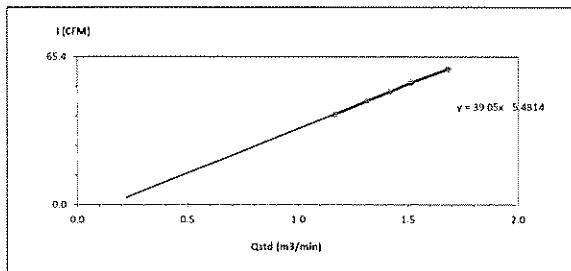
FORM NO. F-06-073 REVISION NO.2 ISSUE DATE: 20/11/23

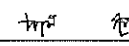



High Volume Air Sampler Calibration Worksheet

Project Site :	Siam City Cement Public Company Limited	Barometric Pressure (mm Hg) :	755.6
Calibrate Location :	โรงงานปูนซีเมนต์นครหลวง	Temperature (°C) :	35.6
Calibrate Date :	4-Jun-24	High Volume ID :	BKK_FS0365
Calibration Sheet No.:	C-040624-BKK_FS0365	High Volume Model :	TE-S009X
Calibrator ID:	RYG_FS0415	High Volume S/N :	4164
Calibrator Model :	TE-S028A	Calibrator Slope :	1.64572
Calibrator S/N :	3494	Calibrator Intercept :	-0.01006

Test No.	Delta H ₂ O (inch)	Q _{HW} (m ³ /min)	I : Chart (CFM)	Linear Regression
1	3.8	1.1707	40	Slope : 39.0504 Intercept : -5.4814 Correlation Coefficient : 0.9995
2	4.8	1.3145	46	
3	5.6	1.4190	50	
4	6.4	1.5163	54	
5	7.9	1.6835	60	



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

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

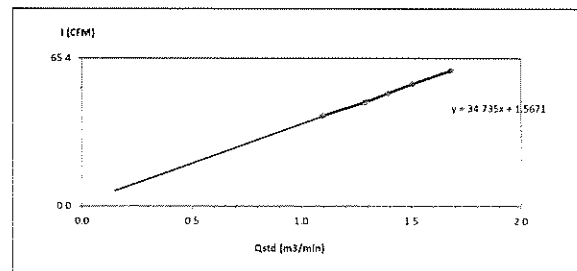
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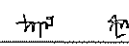



High Volume Air Sampler Calibration Worksheet

Project Site :	Siam City Cement Public Company Limited	Barometric Pressure (mm Hg) :	747.4
Calibrate Location :	สถานีรถไฟกรุงเทพ (ธนบุรี)	Temperature (°C) :	37
Calibrate Date :	6-Apr-24	High Volume ID :	BKK_FS1057
Calibration Sheet No.:	C-060424-BKK_FS1057	High Volume Model :	TE-S009X
Calibrator ID:	RYG_FS0415	High Volume S/N :	5500
Calibrator Model :	TE-S028A	Calibrator Slope :	1.64572
Calibrator S/N :	3494	Calibrator Intercept :	-0.01006

Test No.	Delta H ₂ O (inch)	Q _{HW} (m ³ /min)	I : Chart (CFM)	Linear Regression
1	3.4	1.0994	40	Slope : 34.7355 Intercept : 1.5671 Correlation Coefficient : 0.9994
2	4.7	1.2909	46	
3	5.5	1.3956	50	
4	6.4	1.5047	54	
5	8.0	1.6811	60	



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

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

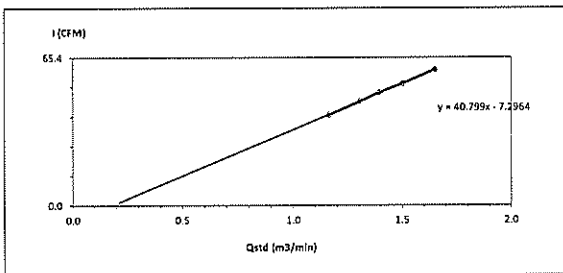
FORM NO. F-06-073 REVISION NO. ISSUE DATE: 14/03/16



High Volume Air Sampler Calibration Worksheet

Project Site: Siam City Cement Public Company Limited Barometric Pressure (mm Hg): 747.7
Calibrate Location: บ้านนาเกลือ Temperature (°C): 36.6
Calibrate Date: 4-Jun-24 High Volume ID: BKK_FS0367
Calibration Sheet No.: C-040624-BKK_FS0367 High Volume Model: TE-5009X
Calibrator ID: RYG_FS0415 High Volume S/N: 4162
Calibrator Model: TE-5028A Calibrator Slope: 1.64572
Calibrator S/N: 3494 Calibrator Intercept: -0.01006

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	3.8	1.1627	40	Slope: 40.7999 Intercept: -7.2964 Correlation Coefficient: 0.9997
2	4.8	1.3055	46	
3	5.5	1.3968	50	
4	6.4	1.5059	54	
5	7.7	1.6508	60	



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

Approved by: [Signature]
(Mr. Noppong Jitranont)
Enviro Field Coordinator Scientist (3)

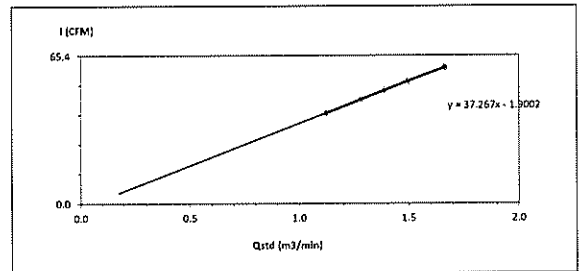
FORM NO. F-06-073 REVISION NO.: - ISSUE DATE: 14/03/16



High Volume Air Sampler Calibration Worksheet

Project Site: Siam City Cement Public Company Limited Barometric Pressure (mm Hg): 746.6
Calibrate Location: บ้านนาเกลือ Temperature (°C): 36.8
Calibrate Date: 4-Jun-24 High Volume ID: BKK_FS0373
Calibration Sheet No.: C-040624-BKK_FS0373 High Volume Model: G1051
Calibrator ID: RYG_FS0415 High Volume S/N: 1330
Calibrator Model: TE-5028A Calibrator Slope: 1.64572
Calibrator S/N: 3494 Calibrator Intercept: -0.01006

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	3.6	1.1263	40	Slope: 37.2667 Intercept: -1.9002 Correlation Coefficient: 0.9999
2	4.7	1.2854	46	
3	5.5	1.3897	50	
4	6.4	1.4983	54	
5	7.9	1.6636	60	



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

Approved by: [Signature]
(Mr. Noppong Jitranont)
Enviro Field Coordinator Scientist (3)

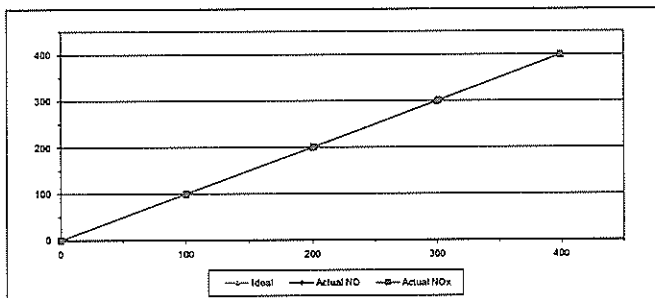
FORM NO. F-06-073 REVISION NO.: - ISSUE DATE: 14/03/16



MULTIPOINT CALIBRATION REPORT

Calibration Date: 3-Jan-24 Equipment Name: NOx Analyzer
Manufacturer: HORIBA Model: APNA-370
Serial No.: TLTATGOW Equipment ID: BKK_FS0785
Calibrator Manufacturer: Teledyne API Model: 700
Serial No.: 847
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	200.70	0.70	0.35
3	300.00	299.00	-1.00	-0.33	301.10	1.10	0.37
4	400.00	398.60	-1.40	-0.35	399.30	-0.70	-0.17
AVERAGE (%)				-0.38			0.19



Calibrated By

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

Approved By

(Mr. Sarayuth Jitranont)
Assistant General Manager

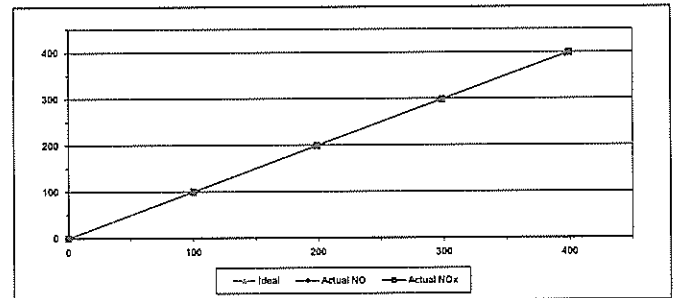
ALS Laboratory Group
FORM NO. F-06-056 REVISION NO.: - ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date: 3-Jan-24 Equipment Name: NOx Analyzer
Manufacturer: HORIBA Model: APNA-370
Serial No.: ROADGWJC Equipment ID: BKK_FS0784
Calibrator Manufacturer: Teledyne API Model: 700
Serial No.: 847
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	198.60	-1.40	-0.70	198.80	-1.20	-0.60
3	300.00	297.50	-2.50	-0.83	298.70	-1.30	-0.43
4	400.00	396.70	-3.30	-0.83	399.50	-0.50	-0.13
AVERAGE (%)				-0.58			-0.17



Calibrated By

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

Approved By

(Mr. Sarayuth Jitranont)
Assistant General Manager

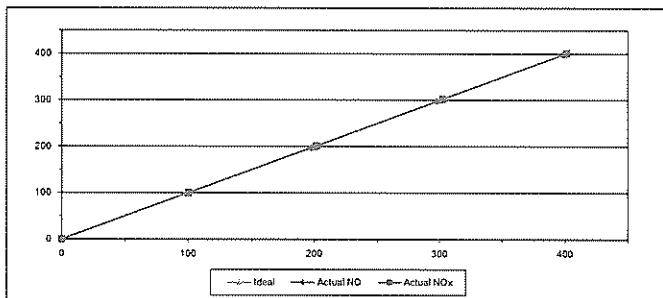
ALS Laboratory Group
FORM NO. F-06-056 REVISION NO.: - ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	3-Jan-24	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	HCWSR681	Equipment ID	BKK_FS0600
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	0-Feb-22	Expired Date	0-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	302.50	2.50	0.83
4	400.00	398.70	-1.30	-0.33	401.30	1.30	0.33
AVERAGE (%)				-0.60			0.49



Calibrated By

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

Approved By

(Mr. Sereyuth Jitranont)
Assistant General Manager

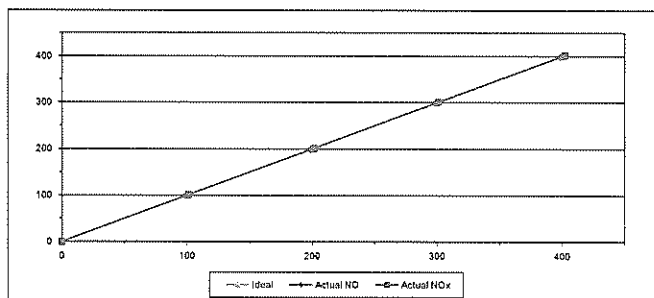
ALS Laboratory Group
FORM NO F 06-056 REVISION NO - ISSUE DATE 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	3-Jan-24	Equipment Name	NOx Analyzer
Manufacturer	Teledyne API	Model	T200
Serial No.	6305	Equipment ID	BKK_FS1008
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	0-Feb-22	Expired Date	0-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	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	402.20	2.20	0.55
AVERAGE (%)				-0.42			0.58



Calibrated By

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

Approved By

(Mr. Sereyuth Jitranont)
Assistant General Manager

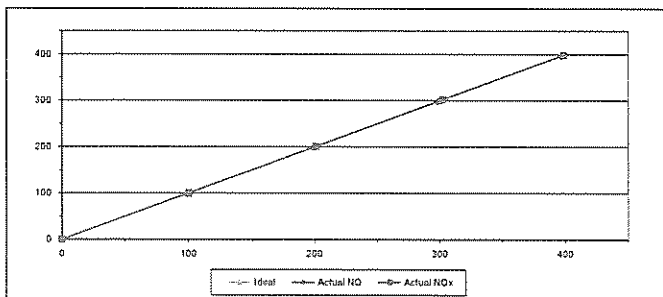
ALS Laboratory Group
FORM NO F 06-056 REVISION NO - ISSUE DATE 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	3-Jan-24	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	XBRAXH00	Equipment ID	BKK_FS0603
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	0-Feb-22	Expired Date	0-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	302.20	2.20	0.73
4	400.00	398.50	-1.50	-0.38	398.50	-1.50	-0.38
AVERAGE (%)				-0.35			0.31



Calibrated By

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

Approved By

(Mr. Sereyuth Jitranont)
Assistant General Manager

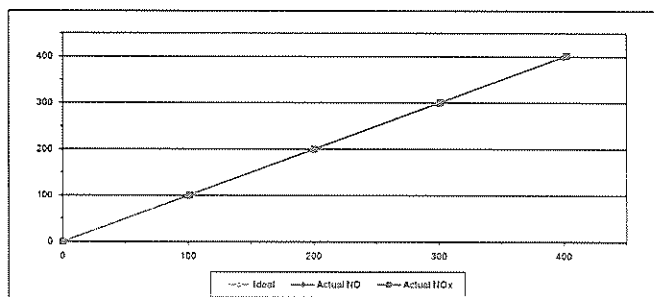
ALS Laboratory Group
FORM NO F 06-056 REVISION NO - ISSUE DATE 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	3-Jan-24	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	VJVDGEEP	Equipment ID	BKK_FS0778
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	0-Feb-22	Expired Date	0-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	299.60	-0.40	-0.13	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. Jirawat Sakam)
Field Environmental Scientist (3)

Approved By

(Mr. Sereyuth Jitranont)
Assistant General Manager

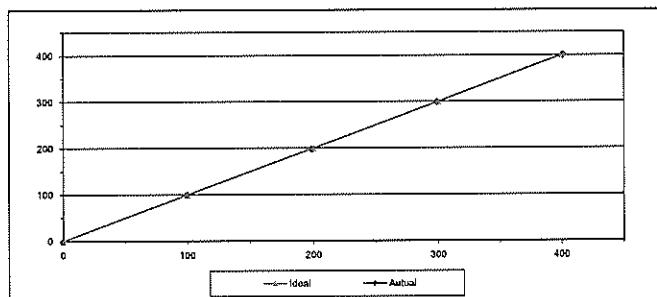
ALS Laboratory Group
FORM NO F 06-056 REVISION NO - ISSUE DATE 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	3-Jan-24	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	3C72K8HB	Equipment ID	BKK_FB0784
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	99.60	-0.40	-0.40
2	200.00	198.50	-1.50	-0.75
3	300.00	298.90	-1.10	-0.37
4	400.00	401.50	1.50	0.38
AVERAGE (%)				-0.21



Calibrated By

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

Approved By

(Signature)
(Mr. Sareyuth Jittrantorn)
Assistant General Manager

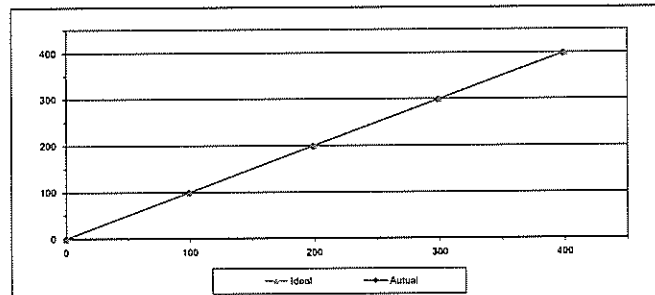
ALS Laboratory Group
FORM NO. F 06-056 REVISION NO. - ISSUE DATE 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	3-Jan-24	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	2BGDABBF	Equipment ID	BKK_FB0793
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	198.70	-1.30	-0.65
3	300.00	298.50	-1.50	-0.50
4	400.00	398.50	-1.50	-0.38
AVERAGE (%)				-0.47



Calibrated By

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

Approved By

(Signature)
(Mr. Sareyuth Jittrantorn)
Assistant General Manager

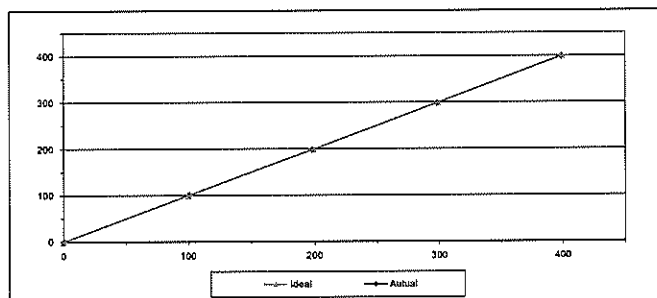
ALS Laboratory Group
FORM NO. F 06-056 REVISION NO. - ISSUE DATE 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	3-Jan-24	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	YUBBY8F9	Equipment ID	BKK_FB0789
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	198.10	-1.90	-0.95
3	300.00	298.50	-1.50	-0.50
4	400.00	398.70	-1.30	-0.33
AVERAGE (%)				-0.08



Calibrated By

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

Approved By

(Signature)
(Mr. Sareyuth Jittrantorn)
Assistant General Manager

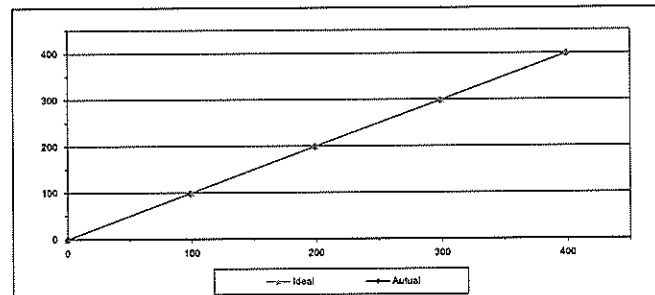
ALS Laboratory Group
FORM NO. F 06-056 REVISION NO. - ISSUE DATE 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	3-Jan-24	Equipment Name	SO2 Analyzer
Manufacturer	Teledyne API	Model	T100
Serial No.	5345	Equipment ID	BKK_FB1097
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	56.3	Cylinder No.	DN0027222
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	398.80	-1.20	-0.30
AVERAGE (%)				-0.55



Calibrated By

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

Approved By

(Signature)
(Mr. Sareyuth Jittrantorn)
Assistant General Manager

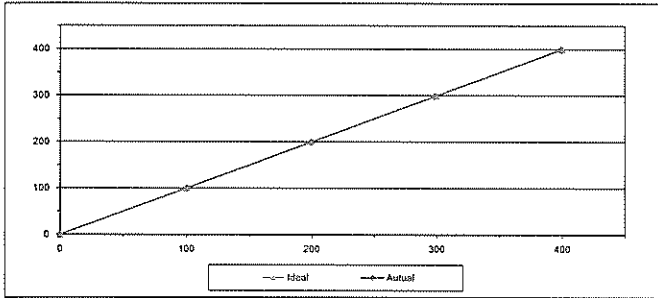
ALS Laboratory Group
FORM NO. F 06-056 REVISION NO. - ISSUE DATE 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	3-Jan-24	Equipment Name	CO2 Analyzer
Manufacturer	HORIBA	Model	APBA-370
Serial No.	28SLA600	Equipment ID	BKK_F80802
Calibrator Manufacturer	Teladyne API	Model	700
Serial No.	047		
Std. Gas Concentration (PPM)	50.3	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	199.50	-0.50	-0.25
3	300.00	298.30	-1.70	-0.57
4	400.00	399.20	-0.80	-0.20
AVERAGE (%)				0.02



Calibrated By

(Mr. Jitnont Sakum)
Field Environmental Scientist (3)

Approved By

(Mr. Sanjiv Jitnont)
Assistant General Manager

ALS Laboratory Group
FORM NO. F-00-056 REVISION NO. - ISSUE DATE: 02/04/12

ALS Laboratory Group

Certificate Number

CC-004-66

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 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 3 m/s to 16 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

V_{std} (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V_{UUC} (m/s)	Error (m/s)	U (k=2) (m/s)
1.049	24.00	25.00	0.9	-0.1	0.31
1.048	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	24.60	25.00	8.0	-0.2	0.31
9.09	25.28	25.00	8.9	0.2	0.31
10.09	24.00	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	24.88	25.00	16.0	-0.3	0.31

Remark:

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 Jirante 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. The image is for reference only.



Jirante Associates Co., Ltd.
63/14-15, 63/15-16,
Fechakum 7/18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000.

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

Relative Humidity

Atmospheric Pressure

PLATE OF CALIBRATION

CALIBRATION CONDITIONS

Preconditioning

Measurement Condition

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

Signature of Mr. Sanjiv Jitnont

Signature of Mr. Sanjiv Jitnont

Signature of Mr. Sanjiv Jitnont

Signature of Mr. Sanjiv Jitnont

Signature of Mr. Sanjiv Jitnont

Signature of Mr. Sanjiv Jitnont

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Signature of Mr. Sanjiv Jitnont

Signature of Mr. Sanjiv Jitnont

Signature of Mr. Sanjiv Jitnont

Signature of Mr. Sanjiv Jitn

Certificate Number
CD-004-66

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 ₂₀₀ Degree (°)	Error Degree (°)	U (k=2) Degree (°)
	0.000	0	0	1.0
	45.000	43	-3	1.0
	90.001	88	-2	1.0
	135.000	133	-2	1.0
5.00	180.000	180	0	1.0
	225.000	227	2	1.0
	270.000	272	2	1.0
	315.000	318	3	1.0

Remarks:

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



63/14-15,67/35-36, Soi Petchkasem 7,7/1, Petchkasem Rd,
Watthapra, Bangkokyai, Bangkok 10600 Thailand.
Tel: (66) 02-8680812#13 Fax: (66) 02-8680860 www.jiranatee.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.: BKH_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.: 667G82-D9, Due date: 28 Mar 2024
2. Digital Temperature Indicator Model: DTI 1000A 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: IT-0038-23, Certificate number: ER-0092-
22

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

Calibrated by
Mr. Sorawit Thachalad
Miss Jittaporn Lertsomphol



Approved Signatory: Mr. Panya Booncharoen
Calibration Department Manager

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



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



63/14-15,67/35-36, Soi Petchkasem 7,7/1, Petchkasem Rd,
Watthapra, Bangkokyai, Bangkok 10600 Thailand.
Tel: (66) 02-8680812#13 Fax: (66) 02-8680860 www.jiranatee.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.: BKH_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 (60±15)%.

Measurement Method

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

Traceability

This instrument was calibrated using standard equipment whose accuracy is traceability through National Institute of Standards and Technology to the international system of units (SI) via MCS Calibration, Inc. Certificate number 20926-601. 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 (UI) on display. Model: HMP60, Serial num
ber: U3911251

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	20.05	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. Sorawit Thachalad
Miss Jittaporn Lertsomphol



Approved Signatory: Mr. Panya 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

Certificate No. CP-001-66

Page 1 of 2 Pages

MEASUREMENT ITEM Digital barometer
MANUFACTURER Novatyna
MODEL/TYPE 110-WS-25BP
SERIAL NUMBER BP-A5964
ID NUMBER BKK-FS1363
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

Calibration procedure:
The pressure calibration was done by in-house calibration method as per CL-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 NMIT (National Metrology Institute of Thailand) which complies with the requirements of ISO/IEC 17025:2017, ANS/NCSL Z540-1 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	CP02500	41003261	MP-0205-22	02 Dec 2023

2. The UUC* was used as the reference level

3. Calibration conditions

4. Condition
☒ Normal ☐ Abnormal
 Pressure transmitting medium: Air
 p_0 (20°C, 1 bar): 1.19 kg/m³
 p_{exp} : (56±15)%
 t_{amb} : (23±3) °C
 p_{ref} : (1010±10) mbar
 5. The certificate is valid only to the item calibrated on date and place of calibration

Calibrated by:
☒ Mr. Saisai Thachalad
☒ 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. CP-001-66

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	950.9	0.8	1.0
970.12	970.7	0.6	0.79
990.02	990.4	0.3	0.56
1010.04	1010.1	0.0	0.39
1030.05	1029.9	-0.1	0.40
1050.05	1049.7	-0.4	0.57

Note: UUC* Unit Under Calibration

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



APPROVED BY: [Signature]
 APPROVED DATE: 19/12/24
 Certificate Number: CC-009-66

Certificate Number: CC-009-66

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM Cup anemometer
MANUFACTURER Novatyna
MODEL/TYPE Sensor WS-02FA
Data logger: 110-WS-25DL-D
Sensor WSD-A5566
SERIAL NUMBER Data logger: A5566
BKK-FS1371
ID NUMBER New item
CONDITION AS-RECEIVED New item
CUSTOMER ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,
Khet Suan Luang, Bangkok 10250 Thailand
RECEIVED DATE 16 Jun 2023
MEASUREMENT DATE 19 Jun 2023
ISSUE DATE 19 Jun 2023

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

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

CALIBRATION CONDITIONS
 Wind tunnel cross-section area^a 900 cm²
 Wind direction frontal area^b 100 cm²
 Diameter of mounting pipe^c 129 mm
 Blockage ratio of test object^d 0.143 [-]

Preconditioning 24 hours at ambient conditions.
Measurement Condition The average values during measurement are (23.0) °C, (45.2) %RH and (1010.2) hPa

TABULATION OF RESULTS:

The table on next page give the measured values

Calibrated by:
☒ Mr. Saisai Thachalad
☒ Miss Jiraporn Lertsomphol



Approved signatory:
 Mr. Parinya Booncharoen
 Calibration Department Manager

Remarks:
^a Nullify mounting area of the wind tunnel
^b Projected cross-section area of the tested object include mounting pipe
^c Diameter of mounting pipe
^d 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 Novatyna
MODEL/TYPE Sensor WS-02FA
Data logger: 110-WS-25DL-D
Sensor WSD-A5566
SERIAL NUMBER Data logger: A5566
BKK-FS1371
ID NUMBER New item
CONDITION AS-RECEIVED New item
CUSTOMER ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,
Khet Suan Luang, Bangkok 10250 Thailand
RECEIVED DATE 16 Jun 2023
MEASUREMENT DATE 19 Jun 2023
ISSUE DATE 19 Jun 2023

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

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

CALIBRATION CONDITION
 Wind tunnel cross-section area^a 900 cm²
 Wind direction frontal area^b 129 cm²
 Diameter of mounting pipe^c 129 mm
 Blockage ratio of test object^d 0.143 [-]

Preconditioning 24 hours at ambient conditions.
Measurement Condition The average values during measurement are (24.3) °C, (44.7) %RH and (1010.2) hPa

TABULATION OF RESULTS:

The table on next page give the measured values

Calibrated by:
☒ Mr. Saisai Thachalad
☒ Miss Jiraporn Lertsomphol



Approved signatory:
 Mr. Parinya Booncharoen
 Calibration Department Manager

Remarks:
^a Nullify mounting area of the wind tunnel
^b Projected cross-section area of the tested object include mounting pipe
^c Diameter of mounting pipe
^d 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
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 ₉₀ Degree (°)	D ₀₉₀ Degree (°)	Error Degree (°)	U (k=2) Degree (°)
	0.000	0	0	1.0
	45.000	43	-2	1.0
	90.000	87	-3	1.0
	135.000	132	-3	1.0
5.01	180.000	182	2	1.0
	225.000	228	3	1.0
	270.001	273	3	1.0
	315.000	318	3	1.0

Remark:

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

² Direction of standard

³ Direction of Unit Under Calibration

End of Certificate of Calibration



CERTIFICATE OF CALIBRATION

Certificate No. CT-019-66
Page 1 of 2

Equipment Name: Data Logger with Temperature sensor
Manufacturer: Novolynx
Model: 110 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)%

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-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. Sorawit Thachalad
☒ Miss Jitraporn Lertsomphol
☐ Miss Ruangrumpai Phoommit



Approved Signatory:
Mr. Parinya Booncharoen
Calibration Department Manager

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



Certificate No.: CT 019-66
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: V1920207.

Dimension: Diameter 12 mm. Length 80 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.058	20.0	0.1	0.099
70	25.051	24.9	0.2	0.099
70	30.044	29.9	0.1	0.099
70	35.040	34.9	0.1	0.099
70	40.034	39.8	0.2	0.099

UUC* - Unit Under Calibration

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

★ End of Certificate ★



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CERTIFICATE OF CALIBRATION

Calibration No.: BH-02062023
Page 1 of 1 Pages

Measurement Item: Relative humidity with data logger
Manufacturer: Novolynx
Model/Type: 110 WS 25DL D
Serial Number: A5966
ID No.: BKK_FS1371
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: 20926-601. Due date: Sep 26, 2024.

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

Measurement Results:

This equipment was connected with Indoor air quality probe and Displayed (URH) on display. Model: HMP60, Serial number: 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 Lertsomphol
☐ Miss Ruangrumpai Phoommit



Approved Signatory:
Mr. Parinya Booncharoen
Calibration Department Manager

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CERTIFICATE OF CALIBRATION

Certificate No. CP-003-66

Page 1 of 2 Pages

MEASUREMENT ITEM Digital barometer
MANUFACTURER Newlyn
MODEL/TYPE Sensor: 110 WS-25BP
Data logger: 110 WS-25DL-D
SERIAL NUMBER Sensor: BP-AS906
Data logger: AS906
ID NUMBER BKK_FS1371
CONDITION AS-RECEIVED New item
CUSTOMER ALS laboratory group (Thailand) Co., Ltd
104 Phatthanaburi 40, Phatthanaburi Rd.
Khwaeng Suam Luang, Khwaeng Suam 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 WJ CL-003 according to comparison method with Digital pressure calibrator based on DFD-R 6-1

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

This 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

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: Air
 p_1 (20°C, 1 bar): 1.10 kg/m³
 p_{1+2} (15-15) Pa
 p_{1+3} (23-31) °C
 p_{1+4} (1010-1100) mbar

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

Calibrated by:
☒ Mr. Sorawit Thacholad
☐ Miss. Jiraporn Lertsomphol



Approved signature

Mr. Parinya Booncharoen
Calibration Department Manager

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CERTIFICATE OF CALIBRATION

Certificate No. CP-003-66

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)
950.03	950.6	0.6	0.77
970.14	970.4	0.3	0.51
990.04	990.1	0.1	0.39
1010.12	1010.1	-0.1	0.38
1030.09	1029.8	-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



Handwritten signature and date: 30/11/24

Certificate Number
CC-005-66

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 0.4 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 200 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_{std} (m/s)	Error (m/s)	U (k=2) (m/s)
1.046	25.66	25.00	0.9	-0.1	0.31
2.049	24.90	25.00	1.9	-0.1	0.31
3.029	25.14	25.00	2.9	-0.1	0.31
4.175	25.00	25.00	3.9	0.0	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	24.55	25.00	6.9	-0.2	0.31
8.18	24.70	25.00	8.0	-0.2	0.31
9.05	25.05	25.00	8.9	-0.1	0.31
10.00	24.70	25.00	10.0	-0.3	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	24.83	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

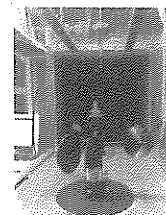
Remarks:

⁵ Calibration results only exist for the tested circumstances and environmental conditions during which calibration took place

Velocity of standard

Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET-UP



Calibration set up at the cup anemometer calibration in the wind tunnel of Jirante Associates Co., Ltd. The cup anemometer shown may differ from the standard one. But the projection of the set up must be in accordance to imaging geometry



Page 1 of 2 Pages

MEASUREMENT ITEM Cup anemometer
MANUFACTURER Newlyn
MODEL/TYPE Sensor: WS-02F
Data logger: 110 WS-25DL-D
SERIAL NUMBER Sensor: WSD-AS905
Data logger: AS905
ID NUMBER BKK_FS1370
CONDITION AS-RECEIVED New item
CUSTOMER ALS laboratory group (Thailand) Co., Ltd
104 Phatthanaburi 40, Phatthanaburi Rd., Khwaeng Suam Luang,
Khwaeng Suam 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 follow

Parameter	Value	Unit
Temperature	22.0 ± 3.0	°C
Relative Humidity	55.0 ± 15.0	%RH
Atmospheric Pressure	1010 ± 10	hPa

PLACE OF CALIBRATION 6-Ellet type wind tunnel of Jirante Associates Co., Ltd.

CALIBRATION CONDITIONS
Wind tunnel cross-section area^a 500 cm²
Win direction frontal area^b 100 cm²
Diameter of mounting pipe^c mm
Biological ratio of test object^d 0.111 [1]

Preconditioning 24 hours at ambient conditions
Measurement Condition 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 measured values

Calibrated by:
Jirante Sorawit Thacholad
Jirante Jiraporn Lertsomphol



Approved signature

Mr. Parinya Booncharoen
Calibration Department Manager

^a Radius cross-section area of the wind tunnel
^b Projected cross-section area of the tested object include mounting pipe
^c Diameter of mounting pipe
^d Ratio $\frac{A_o}{A_f}$

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CERTIFICATE OF CALIBRATION

Page 2 of 2 Pages

MEASUREMENT ITEM : Wind Direction Sensor
MANUFACTURER : Hovalynx
MODEL/TYPE : Sensor WS D3F
Data logger: 110-WS-25DR-D
SERIAL NUMBER : Sensor: WSD-AS-963
Data logger: AS365
ID NUMBER : BKK_FS1370
CONDITION AS-RECEIVED : New Item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan Rd, Phatthanakan 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 follow
Temperature : 23.0 ± 3.0 °C
Relative Humidity : 55.0 ± 15.0 %RH
Atmospheric Pressure : 1010 ± 10 hPa

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

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

Preconditioning : 24 hours at ambient conditions
Measurement Condition : The average values during measurement are (24.5) °C, (45.8) %RH and (1005.8) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:
☒ Mr. Surawit Thachalad
☐ Miss Jiraporn Lertsomphol



Approved signatory

Mr. Panyia Booncharoen
Mr. Panyia 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 $\frac{A_o}{A_t}$

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CERTIFICATE OF CALIBRATION

Certificate No. CP-002-66

Page 1 of 2 Pages

MEASUREMENT ITEM : Digital barometer
MANUFACTURER : Hivalynx
MODEL/TYPE : 110-WS-25BP
SERIAL NUMBER : BP-AS965
ID NUMBER : BKK_FS1370
CONDITION AS-RECEIVED : New Item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan Rd, 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:

1. Reference Standard Instrument

Instrument	Model	Serial No.	Certificate No.	Due Date
Absolute Pressure Transducer	CFG2500	4100126P	MP-0205-22	02 Dec 2023

1. Calibration effort for calibration sequence A

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
Pressure transmitting medium : Air
 p_1 (20°C, 1 bar) : 1.19 kg/m³
 $H_{p=0}$: (55±15) %
 t_{amb} : (23±3) °C
 p_{amb} : (1010±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 11-hour calibration method as (V1-CL-003) according to comparison method with Digital pressure calibrator based on OIMD R 6-3

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. ANSL/HCSL 2549-V via Certificate number MSP-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%.

Calibrated by:
☒ Mr. Surawit Thachalad
☐ Miss Jiraporn Lertsomphol



Approved signatory

Mr. Panyia Booncharoen
Mr. Panyia Booncharoen
Calibration Department Manager

CERTIFICATE OF CALIBRATION

Certificate No. CP-002-66

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)
950.03	950.0	0.9	1.1
970.05	970.7	0.7	0.85
990.02	990.5	0.5	0.71
1010.04	1010.3	0.2	0.46
1030.01	1030.0	0.0	0.38
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





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



CERTIFICATE OF CALIBRATION

Certificate No. CT-005-65
Page 1 of 2

Equipment Name: Data Logger with Temperature
Sensor
Manufacturer: Novolyx
Model: 110-WS-25DL D
Serial No.: A5965
ID No.: BKK_FS1370

Customer
Name: ALS laboratory group (Thailand) Co., Ltd.
Address: 104 Phatthanasak 40, Phatthanasak 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.: 607082 09, Due date: 28 Mar 2024
2. Digital Temperature Indicator Model: DT1 1000 A MK
II, Serial No.: 671407 00591 Due date: 22 July 2023

Calibration Condition
Temperature: (23±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 0638 23, Certificate number FR 0392-
22

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

Calibrated by
☐ Mr. Sorawit Thachalod
☒ Miss Jittaporn Lertsomphol



Approved Signatory:
Mr. Parinya Booncharoen
Calibration Department Manager

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

CERTIFICATE OF CALIBRATION

Calibration No. 194-03062023
Page 1 of 1 Pages

Measurement Item: Relative humidity with data logger
Manufacturer: Novolyx
Model/Type: 110-WS-25DL D
Serial Number: A5965
ID No.: BKK_FS1370
Customer: ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanasak 40, Phatthanasak Rd., Khwaeng Suan Luang, Khet Suan Luang, Bangkok
10250 Thailand.

Environmental Condition

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

Measurement Method

Uncertainty 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 MCD Calibration, Inc. Certificate number: 20926
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 (UFI) on display Model: HMP60, Serial num-
ber: 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 (%RH)	UUC (%RH)	Error (%RH)	Uncertainty (%RH)
20	20.06	19.3	-0.8	0.62
50	50.29	49.4	-0.9	0.53
80	80.27	79.8	-0.5	0.62

Performed by
☐ Mr. Sorawit Thachalod
☒ Miss Jittaporn Lertsomphol



Approved Signatory:
Mr. Parinya Booncharoen
Calibration Department Manager

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Accredited calibration laboratory
ISO/IEC 17025:2017
MSC 101-115 17025
CALIBRATION 0362

An ISO/IEC 17025:2017
Calibration services department

For more information, please contact:
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Email: jiranatee@jiranatee.com
Website: www.jiranatee.com

Page 1 of 1 Pages

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS RECEIVED

CUSTOMER

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follows:

Temperature: 23.0 ± 3.0 °C
Relative Humidity: 55.0 ± 15.0 %RH
Atmospheric Pressure: 1010.0 hPa

PLACE OF CALIBRATION

Eiffel type wind tunnel of Jiranatee Associates Co., Ltd.

CALIBRATION CONDITION

Wind tunnel cross section area^a

Win direction frontal area^a

Diameter of mounting pipe^a

Blockage ratio of test object^a

200 mm²

120 mm²

0.143 [1]

Preconditioning

Measurement Condition

24 hours at ambient conditions.

The average values during measurement are (24.0) °C, (49.7) %RH and (1009.5) hPa

800 mm²

120 mm²

0.143 [1]

24 hours at ambient conditions.

The average values during measurement are (24.0) °C, (49.7) %RH and (1009.5) hPa

800 mm²

120 mm²

0.143 [1]

24 hours at ambient conditions.

The average values during measurement are (24.0) °C, (49.7) %RH and (1009.5) hPa

800 mm²

120 mm²

0.143 [1]

24 hours at ambient conditions.

The average values during measurement are (24.0) °C, (49.7) %RH and (1009.5) hPa

800 mm²

120 mm²

0.143 [1]

24 hours at ambient conditions.

The average values during measurement are (24.0) °C, (49.7) %RH and (1009.5) hPa

800 mm²

120 mm²

0.143 [1]

24 hours at ambient conditions.

The average values during measurement are (24.0) °C, (49.7) %RH and (1009.5) hPa

800 mm²

120 mm²

0.143 [1]

24 hours at ambient conditions.

The average values during measurement are (24.0) °C, (49.7) %RH and (1009.5) hPa

800 mm²

120 mm²

0.143 [1]

24 hours at ambient conditions.

The average values during measurement are (24.0) °C, (49.7) %RH and (1009.5) hPa

800 mm²

120 mm²

0.143 [1]

24 hours at ambient conditions.

The average values during measurement are (24.0) °C, (49.7) %RH and (1009.5) hPa

800 mm²

120 mm²

0.143 [1]

24 hours at ambient conditions.

The average values during measurement are (24.0) °C, (49.7) %RH and (1009.5) hPa

800 mm²

120 mm²

0.143 [1]

24 hours at ambient conditions.

The average values during measurement are (24.0) °C, (49.7) %RH and (1009.5) hPa

800 mm²

120 mm²

0.143 [1]

24 hours at ambient conditions.

The average values during measurement are (24.0) °C, (49.7) %RH and (1009.5) hPa

800 mm²

120 mm²

0.143 [1]

24 hours at ambient conditions.

The average values during measurement are (24.0) °C, (49.7) %RH and (1009.5) hPa

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120 mm²

0.143 [1]

24 hours at ambient conditions.

The average values during measurement are (24.0) °C, (49.7) %RH and (1009.5) hPa

800 mm²

120 mm²

0.143 [1]

24 hours at ambient conditions.

The average values during measurement are (24.0) °C, (49.7) %RH and (1009.5) hPa

800 mm²

120 mm²

0.143 [1]

24 hours at ambient conditions.

The average values during measurement are (24.0) °C, (49.7) %RH and (1009.5) hPa

800 mm²

120 mm²

0.143 [1]

24 hours at ambient conditions.

The average values during measurement are (24.0) °C, (49.7) %RH and (1009.5) hPa

800 mm²

120 mm²

0.143 [1]

24 hours at ambient conditions.

The average values during measurement are (24.0) °C, (49.7) %RH and (1009.5) hPa

800 mm²

120 mm²

0.143 [1]

24 hours at ambient conditions.

The average values during measurement are (24.0) °C, (49.7) %RH and (1009.5) hPa

800 mm²

120 mm²

0.143 [1]

24 hours at ambient conditions.

The average values during measurement are (24.0) °C, (49.7) %RH and (1009.5) hPa

800 mm²

120 mm²

0.143 [1]

24 hours at ambient conditions.

The average values during measurement are (24.0) °C, (49.7) %RH and (1009.5) hPa

800 mm²

120 mm²

0.143 [1]

24 hours at ambient conditions.

The average values during measurement are (24.0) °C, (49.7) %RH and (1009.5) hPa

800 mm²

120 mm²

0.143 [1]

24 hours at ambient conditions.

The average values during measurement are (24.0) °C, (49.7) %RH and (1009.5) hPa

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120 mm²

0.143 [1]

24 hours at ambient conditions.

The average values during measurement are (24.0) °C, (49.7) %RH and (1009.5) hPa

800 mm²

120 mm²

0.143 [1]

24 hours at ambient conditions.

The average values during measurement are (24.0) °C, (49.7) %RH and (1009.5) hPa

800 mm²

120 mm²

0.143 [1]

24 hours at ambient conditions.

The average values during measurement are (24.0) °C, (49.7) %RH and (1009.5) hPa

800 mm²

120 mm²

0.143 [1]

24 hours at ambient conditions.

The average values during measurement are (24.0) °C, (49.7) %RH and (1009.5) hPa

800 mm²

120 mm²

0.143 [1]

24 hours at ambient conditions.

The average values during measurement are (24.0) °C, (49.7) %RH and (1009.5) hPa

800 mm²

120 mm²

0.143 [1]

24 hours at ambient conditions.

The average values during measurement are (24.0) °C, (49.7) %RH and (1009.5) hPa

800 mm²

120 mm²

0.143 [1]

24 hours at ambient conditions.

The average values during measurement are (24.0) °C, (49.7) %RH and (1009.5) hPa

800 mm²

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0.143 [1]

24 hours at ambient conditions.

The average values during measurement are (24.0) °C, (49.7) %RH and (1009.5) hPa

800 mm²

120 mm²

0.143 [1]

24 hours at ambient conditions.

The average values during measurement are (24.0) °C, (49.7) %RH and (1009.5) hPa

800 mm²

120 mm²

0.143 [1]

24 hours at ambient conditions.

The average values during measurement are (24.0) °C, (49.7) %RH and (1009.5) hPa

800 mm²

120 mm²

0.143 [1]

24 hours at ambient conditions.

The average values during measurement are (24.0) °C, (49.7) %RH and (1009.5) hPa



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Certificate No. CL 156/65
Page 2 of 2



63/14 15,67/35-36, Soi Petchkasem 7/1, Petchkasem Rd,
Wattthapra, Bangkokyai, Bangkok 10600 Thailand.
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CERTIFICATE OF CALIBRATION

Certification No. BH-01112022
Page 1 of 1 Pages

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment
Calibration Range: 20 - 40 °C

Function:

This equipment was connected with temperature sensor Model: HMP60 S/N: U3641221

Dimension: Diameter 12 mm Length 80 mm

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	20.00	19.7	-0.3	0.30
60	24.96	24.8	-0.2	0.30
60	29.91	29.8	-0.2	0.30
60	34.86	34.6	-0.4	0.30
60	39.81	39.5	-0.3	0.30

UUC: Unit Under Calibration

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

★ End of Certificate ★



Measurement Item: Relative humidity with data logger
Manufacturer: Novatek
Model/Type: 110 WS 250H II
Serial Number: AS-908
ID No: (NAC) C61213
Customer: ALS Laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd. Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand

Environmental Condition:

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

Measurement Method

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

Traceability

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

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

Measurement Results:

This equipment was connected with indoor air quality probe and Displayed RH on display Model HMP60. Serial number: U3641221

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

The results of calibration are reported in table below:

Determined (RH)	Standard (RH)	UUC Reading (RH)	Error (RH)	Uncertainty (RH)
20	19.93	17.6	-2.3	0.61
50	50.45	47.7	-2.8	0.57
80	80.30	77.0	-3.3	0.55

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



Approved Signatory

Mr. Pailaya 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



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Certificate No. CL-201-65
Page 2 of 2

CERTIFICATE OF CALIBRATION

Certificate No. CL-201-65
Page 1 of 2

Equipment Name: Data Logger with Temperature Sensor
Manufacturer: Novatek
Model: 200 WS-251B
Serial No.: AS263
ID No.: BKK_F50010

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: 02 Dec 2022
Calibration date: 10 Dec 2022
Issue date: 12 Dec 2022

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

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

Calibration Procedure

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

Traceability

The measurement results are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT). Certificate number TT-0034-22, Certificate number ER-0032-22

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment
Calibration Range: 20 - 40 °C

Function:

This equipment was connected with temperature sensor Model: HMP60 S/N: N0330786.

Dimension: Diameter 12 mm Length 80 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	20.063	19.7	-0.4	0.099
60	25.057	24.7	-0.4	0.099
60	30.049	29.7	-0.3	0.099
60	35.043	34.7	-0.3	0.099
60	40.033	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 ★



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

Approved Signatory:
Mr. Pailaya Booncharoen
Calibration Department Manager

CERTIFICATE OF CALIBRATION

Calibration No. : RH-20120222
Page 1 of 1 Pages

Measurement Item : Relative humidity with data logger
Manufacturer : Novaslym
Model/Type : 200-WS-25LB
Serial Number : A5263
ID No. : BKK_F50910
Customer : ALS Laboratory group (Thailand) Co., Ltd.
104 Phatthanasen 40, Phatthanasen 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 thermo hygrometer in the humidity generator chamber to determine the errors.

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

Measurement Date : Dec 10, 2022
Issued Date : Dec 12, 2022

Measurement Results:
This equipment was connected with indoor air quality probe and Displayed (UFI) on display. Model: HMF60, Serial number: N0330786.
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	19.98	18.2	-1.8	0.52
50	50.28	47.8	-2.4	0.54
80	80.38	77.4	-3.0	0.52

Performed by:
☒ Mr. Sorawit Thachalad
☐ Miss Jitraporn Lertsamphol



Approved Signatory:
Mr. Parinya Booncharoen
Calibration Department Manager

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Certificate Number

CL-014-05

Page 2 of 2 Pages

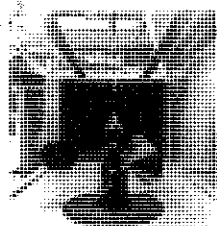
MEASUREMENT RESULTS¹

The cup anemometer, Unit Under Calibration (UUC) was exercise at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer and above 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 40 mm and 300 mm respectively away from wind tunnel nozzle. UUC was installed at center of the test section. The calibration was carried out under both rising and falling air velocity in the range of 1 m/s to 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 _{ref} (m/s)	Error (m/s)	U (k=2) (m/s)
0.977	24.18	24.25	0.8	-0.2	0.15
1.043	24.30	24.25	1.8	-0.2	0.16
3.068	24.10	24.25	2.9	-0.2	0.21
4.197	24.58	24.25	3.9	-0.3	0.19
5.02	24.06	24.25	4.8	-0.2	0.22
6.01	24.54	24.25	5.9	-0.1	0.18
7.06	23.54	24.25	6.8	-0.2	0.19
8.17	24.40	24.25	8.0	-0.2	0.18
9.11	23.50	24.25	9.0	-0.1	0.22
10.10	24.24	24.25	10.0	-0.1	0.24
11.17	23.88	24.25	11.0	-0.1	0.24
12.16	24.16	24.25	12.0	-0.2	0.23
13.19	24.00	24.25	13.0	-0.2	0.25
14.25	24.10	24.25	14.0	-0.2	0.26
15.26	24.06	24.25	15.0	-0.1	0.24
16.31	24.08	24.25	16.0	-0.3	0.35

Remark:
Calibration results only count for the tested circumstances and environmental conditions during which calibration took place
¹Velocity 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 photograph geometry.

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

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ISO/IEC 17025:2017
NAC-TU-ITS 17025
CALIBRATION 0367

Air speed measurement laboratory
Calibration services department

Certificate Number

CL-014-05

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM : Cup anemometer
MANUFACTURER : Novaslym
MODEL/TYPE : Senior: WS-022
Data logger: 200-WS-25LB
SERIAL NUMBER : Data logger: A5263
ID NUMBER : BKK_F50910
CONDITION AS RECEIVED : Used item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanasen 40, Phatthanasen Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand

RECEIVED DATE : 02 Dec 2022
MEASUREMENT DATE : 09 Dec 2022
ISSUE DATE : 12 Dec 2022

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

PLACE OF CALIBRATION : Eiffel-type wind tunnel of Jiranatee Associates Co., Ltd.

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

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (24.3) °C, (46.3) %RH and (1011.4) hPa.

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

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



Approved signatory:
Mr. Parinya Booncharoen
Calibration Department Manager

Remark:
¹Windy cross-section area of the wind tunnel
²Projected cross-section area of the tested object include mounting pipe
³Diameter of mounting pipe
⁴Ratio "a" to "b"

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

Jiranatee Associates Co., Ltd.
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Mobile: +66863995453
E-mail: jnac@jiranatee.com
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CALIBRATION 0367

Air speed measurement laboratory
Calibration services department

Certificate Number

CL-014-05

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM : Wind Direction Sensor
MANUFACTURER : Novaslym
MODEL/TYPE : Senior: WS-032
Data logger: 200-WS-25LB
SERIAL NUMBER : Data logger: A5263
ID NUMBER : BKK_F50910
CONDITION AS RECEIVED : Used item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanasen 40, Phatthanasen Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand

RECEIVED DATE : 02 Dec 2022
MEASUREMENT DATE : 12 Dec 2022
ISSUE DATE : 12 Dec 2022

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

PLACE OF CALIBRATION : Eiffel-type wind tunnel of Jiranatee Associates Co., Ltd.

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

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (24.3) °C, (48.2) %RH and (1007.5) hPa.

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

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



Approved signatory:
Mr. Parinya Booncharoen
Calibration Department Manager

Remark:
¹Windy cross-section area of the wind tunnel
²Projected cross-section area of the tested object include mounting pipe
³Diameter of mounting pipe
⁴Ratio "a" to "b"

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

Certificate Number
CL-014-65

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

The wind direction sensor was calibrated against standard rotary encoder by comparison method. During calibration, the measurement was carried out at 45° intervals in clockwise and counter-clockwise directions after offset adjustment has been made. The flow speed of wind tunnel (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 _{me} Degree (°)	D _{acc} Degree (°)	Error Degree (°)	U (k=2) Degree (°)
0.001	0	0	0	0.58
45.000	41	41	-4	0.58
90.000	87	87	-3	0.58
135.000	135	135	0	0.74
180.000	182	182	2	0.68
225.000	227	227	3	0.68
270.000	274	274	4	0.68
315.000	319	319	4	0.74

Remark:

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

² Direction of standard

³ Direction of Unit Under Calibration

End of Certificate of Calibration



JIRANATEE ASSOCIATES CO., LTD.

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CALIBRATION 0367

Air speed measurement laboratory
Calibration services department



NSC - TIS - TIS 17025
CALIBRATION 0367

Certificate Number

CWS-017-66

CERTIFICATE OF CALIBRATION

Page 2 of 2 Pages

MEASUREMENT ITEM
MANUFACTURER
MODEL/TYPE

Cup anemometer
Hovalynx
Sensor WS-01F

SERIAL NUMBER

Data logger: 110-WS-250LD

ID NUMBER

Sensor: WSD-AS447

CONDITION AS RECEIVED

SDK_F50039

CUSTOMER

Used item

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 Jiranatee Associates Co., Ltd.

CALIBRATION CONDITIONS

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

Preconditioning

24 hours at ambient conditions

Measurement Condition

The average values during measurement are (24.3) °C, (43.9) %RH and (1014.5) hPa.

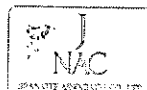
TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

Mr. Sorawat Thadadad

Mr. Jiranatee Jirapongpol



Approved signatory

Mr. Panyaporn Booncharoen
Calibration Department Manager

Remark:

¹ Usable cross-section area of the wind tunnel

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

³ Diameter of mounting pipe

⁴ Ratio = A/A₀

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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 tip 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 tip of the test section. UUC was mounted on a wind vertical tube of the lower plate at center of test section. The calibration was carried out under both rising and falling air velocity in the range of 1 m/s to 16 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

V _{std} (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	P _{std} (m/s)	Error (m/s)	U (k=2) (m/s)
0.578	24.10	24.05	0.8	-0.2	0.31
1.091	24.00	24.05	1.9	-0.2	0.31
3.023	23.90	24.05	2.8	-0.2	0.31
4.145	23.94	24.05	3.9	-0.2	0.31
5.06	23.60	24.05	5.0	-0.3	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
7.97	24.24	24.05	8.0	0.0	0.31
8.97	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
12.03	23.34	24.05	12.0	0.0	0.31
13.01	23.70	24.05	13.1	0.1	0.31
14.00	23.82	24.05	14.1	0.1	0.31
15.02	23.70	24.05	15.1	0.1	0.31
16.00	23.74	24.05	16.1	0.1	0.33

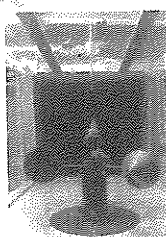
Remark:

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

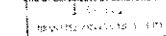
¹ Velocity of standard

Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET UP



End of Certificate of Calibration



JIRANATEE ASSOCIATES CO., LTD.

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CALIBRATION 0367

Wind direction measurement laboratory
Calibration services department



NSC - TIS - TIS 17025
CALIBRATION 0367

Certificate Number

CWD-017-66

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM
MANUFACTURER
MODEL/TYPE

Wind Direction Sensor
Hovalynx
Sensor WS-01F

SERIAL NUMBER

Data logger: 110-WS-250LD

ID NUMBER

Sensor: WSD-AS447

CONDITION AS RECEIVED

SDK_F50039

CUSTOMER

Used item

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 Jiranatee Associates Co., Ltd.

CALIBRATION CONDITION

Wind tunnel cross-section area¹ 900 cm²
Win direction frontal area² 129 cm²
Diameter of mounting pipe³ 10 mm
Blockage ratio of test object⁴ 0.143 (-)

Preconditioning

24 hours at ambient conditions

Measurement Condition

The average values during measurement are (24.7) °C, (52.6) %RH and (1014.3) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

Mr. Sorawat Thadadad

Mr. Jiranatee Jirapongpol



Approved signatory

Mr. Panyaporn Booncharoen
Calibration Department Manager

Remark:

¹ Usable cross-section area of the wind tunnel

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

³ Diameter of mounting pipe

⁴ Ratio = A/A₀

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Certificate Number
CWD-017-66

Page 2 of 2 Pages

MEASUREMENT RESULTS³

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 (°)
	45.000	41	-4	0.80
	50.000	87	-3	0.80
	135.000	132	-3	0.80
	180.000	182	2	0.80
	225.001	229	4	0.80
	270.001	275	5	0.80
	315.000	320	5	0.80
	360.000	350	-1	0.80

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.

End of Certificate of Calibration



Jirantee Associates Co., Ltd.
63/24 15, 17/23 15,
Petchaburi 7/72, 14 Wattana, Bangkok
Bangkok 10600, Thailand
Tel: +662 0550012
Mobile: +662 0550453
E-mail: jiracal@jirantee.com
Website: www.jirantee.com

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

Temperature measurement laboratory
Calibration services department



CERTIFICATE OF CALIBRATION

Certificate No. : CDT-065-66

Page 1 of 2 Pages

MEASUREMENT ITEM : Data Logger with Temperature sensor
MANUFACTURER : Hovalynx
MODEL/TYPE : 110-WS-250L-D
SERIAL NUMBER : AS447
ID NUMBER : SGK_F50039
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.

Calibration procedure:
The temperature calibration was done by in-house calibration method as VIM-C1-003 according to comparison method with standard digital temperature indicator and standard temperature probe. The temperature scale was based on ITS-90.

Traceability:
The measurement results are traceable to the international system of units (SI) through National Institute of Metrology (NIMT) Certificate number: TT-0038-23. Certificate number: ER-0101-23.

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

Reference Used During Calibration:
1. Standard Temperature Probe
Model: STS-100 A500, Serial No.: C67EAD 09,
Due date: 28 Mar 2024

2. Digital Temperature Indicator
Model: DTI-1000 A ME II, Serial No.: 671407,
Due date: 14 Sep 2024

ENVIRONMENTAL CONDITIONS:

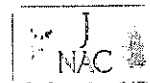
Ambient condition in the laboratory are as follow:

Temperature : 23.0 ± 3.0 °C
Relative Humidity : 55.0 ± 15.0 %RH

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

TABULATION OF RESULTS:

The table on next page give the measured values.



Calibrated by:
☒ Mr. Sorawit Thaisakul
☒ Miss Nijaraporn Lerttanaphol
☒ Miss Ruangsuda Phoommit

Approved signatory :
Mr. Panyia Booncharoen
Calibration Department Manager

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Continuation of Certificate of Calibration Number CDT-055-66

Page 2 of 2 Pages

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 ~ 40 °C

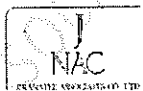
Function:

Table 3: This equipment was connected with temperature sensor Model: NMP60 S/H: R1131114.
Dimension: Diameter 12 mm, Length 80 mm

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.042	19.5	-0.5	0.099
70	25.047	24.5	-0.5	0.099
70	30.041	29.4	-0.6	0.099
70	35.034	34.3	-0.7	0.099
70	40.030	39.3	-0.7	0.099

UUC*: Unit Under Calibration

End of Certificate of Calibration



Jirantee Associates Co., Ltd.
63/24 15, 17/23 15,
Petchaburi 7/72, 14 Wattana, Bangkok
Bangkok 10600, Thailand
Tel: +662 0550012
Mobile: +662 0550453
E-mail: jiracal@jirantee.com
Web site: www.jirantee.com

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

Relative humidity measurement laboratory
Calibration services department

CERTIFICATE OF CALIBRATION

Certificate No. : CRH-015-66

Page 1 of 2 Pages

MEASUREMENT ITEM : Relative humidity with data logger
MANUFACTURER : Hovalynx
MODEL/TYPE : 110-WS-250L-D
SERIAL NUMBER : AS447
ID NUMBER : SGK_F50039
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.

Calibration procedure:
The Relative humidity calibration was done by in-house calibration method as VIM-C1-003 according to comparison method with standard Classed Mirror hygrometer and standard Humidity generator chamber.

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

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

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).

ENVIRONMENTAL CONDITIONS:

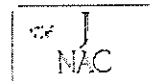
Ambient condition in the laboratory are as follow:

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 Thaisakul
☒ Miss Nijaraporn Lerttanaphol
☒ Miss Ruangsuda Phoommit

Approved signatory :
Mr. Panyia Booncharoen
Calibration Department Manager

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

Measurement Results

This equipment was connected with Relative humidity Sensor on display. Model: HMAPCO, Serial number: R1131134

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	20.06	17.2	2.9	0.76
50.0	51.40	46.4	5.0	0.77
80.0	82.75	74.7	8.0	0.75

UUC: Unit Under Calibration

End of Certificate



CERTIFICATE OF CALIBRATION

Certificate No. CPR-015-66

Page 1 of 2 Pages

MEASUREMENT ITEM

Digital barometer

MANUFACTURER

Novallinx

MODEL/TYPE

Sensor: 110 WS 25BP

SERIAL NUMBER

Data logger: 110-WS-25DL D

ID NUMBER

Sensor: DP-AS447

CONDITION AS-RECEIVED

Data logger: AS447

CUSTOMER

SKK_F50039
Used item
ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan Rd, Phatthanakan Rd,
Khwaeng Suan Luang, Khet Suan Luang,
Bangkok 10250 Thailand.

Calibration procedure:

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

Traceability:

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

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

RECEIVED DATE

15 Dec 2023

MEASUREMENT DATE

18 Dec 2023

ISSUE DATE

20 Dec 2023

CONDITION OF THIS RESULT OF CALIBRATION:

1. Reference Standard Instrument

Instrument

Model

Serial No.

Certificate No.

Due Date

Absolute Pressure Transducer

CPG-2500

4100126P

MP-0205-22

02 Dec 2023

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

Air

p (20°C, 1 bar)

1.19 kg/m³

H_{long}

(55±15) %

T_{amb}

(23±3) °C

P_{app}

(1010±10) mbar

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

Calibrated by:

Mr. Sorawat Thuchaid

Mr. Jiraporn Lertsomphol



Approved signature:

Mr. Pinyo Boonthachon

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. 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: RG-Do-120203

Page 1 of 2 Pages

Measurement Item	Rain gauge with data logger
Manufacturer	Data logger: Novallinx Rain gauge: Novallinx
Model/Type	Data logger: 110 WS-25DL D Rain gauge: 110 WS-25RG
Serial Number	Data logger: AS447 Rain gauge: HG-AS447
ID NO	SKK_F50039
Customer	ALS laboratory group (Thailand) Co., Ltd. 104 Phatthanakan Rd, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250, Thailand.

Environmental Condition:

The measurement was carried out in an ambient temperature of (26-35)°C, and relative humidity of (50-100)%

Measurement Method:

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

1. Obtain rain gauge inlet area

Rain gauge precise diameter in cm = $\text{Diameter} \times \pi \times \text{R (radius)}$

Rain gauge area = $\text{R}^2 \times 3.14$ (UUC diameter: 2.93 cm, UUC radius: 10.16 cm)

Rain gauge area = 323.6 cm²

2. Obtain theoretical correct rain gauge answer (number of lippings) using 323.6 cm² inlet area and 0.6 l of rain

a) $10,000 \text{ cm}^3 \div 323.6 \text{ cm}^2 \text{ inlet area} = 3090 \text{ lippings gauge area} = 1/3090 \text{ of gauge meter}$

b) $10 \text{ mL} \div 0.6 \text{ l volume} = 45 \text{ mm (mm of rain over 1 m}^2 \text{ surface)} = 500 \text{ ml of rain volume on the rain gauge area} = 1/45 \text{ mm of rain}$

c) Number of lippings = $45 \div 0.25 \text{ mm} = 62 \text{ lippings}$

Note: Rain gauge was kept in good and leveling prior the calibration performed

Measurement Date:

Dec. 19, 2023

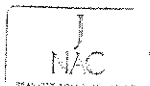
Issued Date:

Dec. 20, 2023

Calibrated by:

Mr. Sorawat Thuchaid

Mr. Jiraporn Lertsomphol



Approved Signature:

Mr. Pinyo Boonthachon

Calibration Department Manager



63/14-15,67/35-36, Soi Petchhaseem 7,7/1, Petchhaseem Rd.
Wathapra, Banghokyea, Bangkok 10600 Thailand.
Tel: (66) 02-8680812 Fax: (66) 02-8680860 www.jiranatec.com

Continuation of Calibration of Calibration Number

Calibration Number RQ-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 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



Jiranatec Associates Co., Ltd.
62/14-15, 67/35-36
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Accredited calibration laboratory
ISO/IEC 17025:2017
NSC-TIS-TIS 17025
CALIBRATION 0367

Alt speed measurement laboratory
Calibration services department



NSC-TIS-TIS 17025
CALIBRATION 0367

Certificate Number

CWS-003-67

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM
MANUFACTURER
MODEL/TYPE

Cup anemometer
Novolyte
Sensor: WS-027
Data logger: 200-WS-250L

SERIAL NUMBER

Sensor: WS0-A4940
Data logger: A4940
BNC_150165

ID NUMBER

Used Item

CONDITION AS-RECEIVED

Customer

CUSTOMER

ALS Laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan 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 follows:

Temperature

23.0 ± 3.0 °C

Relative Humidity

55.0 ± 15.0 %RH

Atmospheric Pressure

1010 ± 10 hPa

PLACE OF CALIBRATION

Effect-type wind tunnel of Jiranatec Associates Co., Ltd.

CALIBRATION CONDITIONS

Wind tunnel cross-section area¹ 500 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, (50.5) %RH and (1013.3) hPa

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

Mr. Soravit Thachabulad
Mr. Nattaporn Lertmanomkul

Approved by:

Mr. Panyee Booncharoen
Calibration Department Manager

Remarks:

¹ Hoely 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 Ratio² to¹

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



Jiranatec Associates Co., Ltd.
62/14-15, 67/35-36
Petchhaseem 7,7/1, 8/1 Wathapra, Bangkok,
Bangkok 10600 (Thailand)
Tel: +66(0)28680812
Mobile: +66(0)28680860
E-mail: jnac@jiranatec.com
Web site: www.jiranatec.com

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

Wind direction measurement laboratory
Calibration services department



NSC-TIS-TIS 17025
CALIBRATION 0367

Certificate Number

CWD-003-67

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM
MANUFACTURER
MODEL/TYPE

Wind direction Sensor
Novolyte
Sensor: WS-027
Data logger: 200-WS-250L

SERIAL NUMBER

Sensor: WS0-A4940
Data logger: A4940
BNC_150165

ID NUMBER

Used Item

CONDITION AS-RECEIVED

Customer

CUSTOMER

ALS Laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan 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 follows:

Temperature

23.0 ± 3.0 °C

Relative Humidity

55.0 ± 15.0 %RH

Atmospheric Pressure

1010 ± 10 hPa

PLACE OF CALIBRATION

Effect-type wind tunnel of Jiranatec Associates Co., Ltd.

CALIBRATION CONDITION

Wind tunnel cross-section area¹ 500 cm²

Wind direction frontal area² 120 cm²

Diameter of mounting pipe³ 1 mm

Blockage ratio of test object⁴ 0.143 [-]

Preconditioning

24 hours at ambient conditions

Measurement Condition

The average values during measurement are (23.6) °C, (54.1) %RH and (1010.9) hPa

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

Mr. Soravit Thachabulad
Mr. Nattaporn Lertmanomkul

Approved by:

Mr. Panyee Booncharoen
Calibration Department Manager

Remarks:

¹ Hoely 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 Ratio² to¹

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

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

The Cup anemometer, Unit Under Calibration (UUC) was exercise at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer which was installed 50 mm away from wind tunnel nozzle and occluded 40 mm away from top of the test section and the standard air velocity 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 50 mm away from wind tunnel nozzle and installed 40 mm away from top of the test section, UUC was mounted on a round vertical tube of the lower plate at center of test section. The calibration was carried out under both rising and falling air velocity in the range of 1 m/s to 16 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below

V _{std} (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V _{std} (m/s)	Error (m/s)	U (k=2) (m/s)
1.018	23.82	23.85	0.9	-0.1	0.31
2.083	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	23.88	23.85	8.0	0.0	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
12.02	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	23.60	23.85	16.3	0.3	0.31

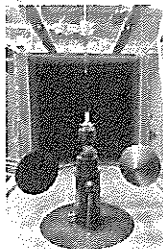
Remarks:

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

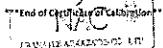
² Velocity of standard

³ Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET-UP



Calibration set up of the Cup anemometer calibration in the wind tunnel of Jiranatec 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 image proportionality



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

Certificate Number
CVD-003-67

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 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 ₁₀₀ Degree (°)	D ₁₀₀ Degree (°)	Error Degree (°)	U (m/s) Degree (°)
45.000	41	4	0.00	
89.999	87	3	0.00	
135.000	133	2	0.00	
180.000	182	2	0.00	
225.000	230	5	0.00	
270.000	275	5	0.00	
315.000	320	5	0.00	
360.000	359	1	0.00	

Remark:

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

Division of standard

Division of Unit Under Calibration

End of Certificate of Calibration



Jirarattee Associates Co., Ltd.
6/204 15-01/21 Th.
Petchaburi 7311, Rd. Wachapha, Bangkok
Bangkok 10200 (Thailand)
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Mobile: +66205379943
Email: jac.calibration@jirarattee.com
Web site: www.jirarattee.com

Accredited calibration laboratory
ISO/IEC 17025:2017
MSC T10 T15 T2025
CALIBRATION 0167

Air speed measurement laboratory
Calibration services department

Amkorn P.

21 Feb 2023

Certificate Number

CL-023-66

CERTIFICATE OF CALIBRATION

Page 2 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS RECEIVED

CUSTOMER

Cup anemometer

Novallina

Sensor WS-02F

Data logger 200 WS-2510

Sensor -

Data logger AS378

DIRK_F02018

Used item

ALS laboratory group (Thailand) Co., Ltd.

104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,
Khet Suan Luang, Bangkok 10150 Thailand.

Calibration procedure:

The cup anemometer was calibrated against standard air velocity transducer model: B515-12 one pitot tube with precision differential pressure meter model: DPM2500 in an open test section of Eiffel-type wind tunnel with 900 cm² cross test section area. The WS-CL-007 based on IEC 61400-12 1. Wind energy generation system - Part 12-1 Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:

This certificate provides a traceability of the measurement to recognize the national standard, and to realization of the international system of units (SI) through the NMI (National Metrology Institute of Thailand) via Certificate Number: RM-0052 21 and RM-0060 22.

Uncertainty of Measurement:

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

RECEIVED DATE

15 Feb 2023

MEASUREMENT DATE

21 Feb 2023

ISSUE DATE

21 Feb 2023

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature: 23.0 ± 3.0 °C

Relative Humidity: 55.0 ± 15.0 %RH

Atmospheric Pressure: 1010 ± 10 hPa

PLACE OF CALIBRATION

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

CALIBRATION CONDITIONS

Wind tunnel cross-section area¹

900 cm²

Win direction frontal area²

300 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 123.41 °C, (42.01) %RH and 1010.61 hPa.

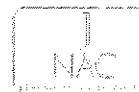
TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

Mr. Sorawat Thachakul

Miss Jiraporn Jongsomphol



Approved signature

Mr. Pinyak Booncharoen
Calibration Department Manager

Remark:

¹ Radially cross-section area of the wind tunnel

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

³ Diameter of mounting pipe

⁴ Ratio $\frac{A_2}{A_1}$

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

Certificate Number
CL-023-65

Page 2 of 2 Pages

MEASUREMENT RESULTS⁵

The cup anemometer, Unit Under Calibration (UUC) was exercise at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer and above 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 40 mm and 360 mm respectively away from wind tunnel nozzle. UUC was installed in center of the test section. The calibration was carried out under both rising and falling air velocity in the range of 1 m/s to 16 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

V _{ref} (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V _{ref} (m/s)	Error (m/s)	U (m/s) (m/s)
0.954	24.00	23.95	0.7	-0.3	0.35
2.035	23.96	23.95	1.7	-0.3	0.36
3.045	23.92	23.95	2.8	-0.3	0.37
4.119	24.00	23.95	3.9	-0.2	0.38
4.98	23.72	23.95	4.8	-0.2	0.20
5.97	23.82	23.95	5.7	0.2	0.38
7.05	23.60	23.95	6.8	-0.2	0.18
8.16	24.00	23.95	7.8	-0.3	0.20
9.28	23.52	23.95	8.8	-0.2	0.19
10.00	23.58	23.95	9.8	-0.2	0.19
11.14	23.64	23.95	10.9	-0.2	0.21
12.13	23.60	23.95	11.9	-0.2	0.23
13.19	23.80	23.95	12.9	-0.3	0.21
14.24	23.70	23.95	13.9	-0.3	0.22
15.17	23.74	23.95	14.9	-0.3	0.22
16.30	23.70	23.95	16.0	-0.3	0.28

Remark:

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 Jirarattee Associates Co., Ltd. The cup anemometer placed into after from the calibrated one. Remark: The proportion of the set-up is not true to scale due to image geometry.

End of Certificate of Calibration



Jirarattee Associates Co., Ltd.
6/204 15-01/21 Th.
Petchaburi 7311, Rd. Wachapha, Bangkok
Bangkok 10200 (Thailand)
Tel: +6620502012
Mobile: +66205379943
Email: jac.calibration@jirarattee.com
Web site: www.jirarattee.com

Accredited calibration laboratory
ISO/IEC 17025:2017
MSC T10 T15 T2025
CALIBRATION 0167

Air speed measurement laboratory
Calibration services department

Certificate Number

CL-023-66

CERTIFICATE OF CALIBRATION

Page 2 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS RECEIVED

CUSTOMER

Wind Direction Sensor

Novallina

Sensor WS-02F

Data logger 200 WS-2510

Sensor -

Data logger AS378

DIRK_F02018

Used item

ALS laboratory group (Thailand) Co., Ltd.

104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,
Khet Suan Luang, Bangkok 10150 Thailand.

Calibration procedure:

The wind direction sensor was calibrated against standard Rotary Encoder model: AX40015-DIM4 P3 5.00 in an open test section of Eiffel-type wind tunnel with 900 cm² open test section area. The WS-CL-008 based on IEC 61400-12 1. Wind energy generation system - Part 12-1 Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:

This certificate provides a traceability of the measurement to recognize the national standard, and to realization of the international system of units (SI) through the NMI (National Metrology Institute of Thailand) via Certificate Number: BA-0043 22.

Uncertainty of Measurement:

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

RECEIVED DATE

15 Feb 2023

MEASUREMENT DATE

21 Feb 2023

ISSUE DATE

21 Feb 2023

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature: 23.0 ± 3.0 °C

Relative Humidity: 55.0 ± 15.0 %RH

Atmospheric Pressure: 1010 ± 10 hPa

PLACE OF CALIBRATION

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

CALIBRATION CONDITION

Wind tunnel cross-section area¹

900 cm²

Win direction frontal area²

120 cm²

Diameter of mounting pipe³

mm

Blockage ratio of test object⁴

0.143 [-]

Preconditioning

24 hours at ambient conditions

Measurement Condition

The average values during measurement are 123.61 °C, (52.21) %RH and 1010.2 hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

Mr. Sorawat Thachakul

Miss Jiraporn Jongsomphol

Approved signature

Mr. Pinyak Booncharoen
Calibration Department Manager

Remark:

¹ Radially cross-section area of the wind tunnel

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

³ Diameter of mounting pipe

⁴ Ratio $\frac{A_2}{A_1}$

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

Certificate Number
CL-021-66

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 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	0.58
45.000	42	42	-3	0.69
90.000	87	87	-3	0.68
135.000	131	131	-4	0.68
180.000	179	179	-1	0.74
225.000	227	227	2	0.58
270.000	273	273	3	0.68
315.000	318	318	3	0.68

Remarks:

¹ Calibration results only covers 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



Jirananate Associates Co. Ltd.
42/14-15/17/20
Pochaisam 17/1, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000

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

Air speed measurement laboratory
Calibration services department



NSC-TIS-TIS 17025
CALIBRATION 0367

Certificate Number
CWS-005-67

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

Cup anemometer

MANUFACTURER

Novelux

MODEL/TYPE

Sensor: WS-02F

SERIAL NUMBER

Data logger: 200-WS-251B

ID NUMBER

Sensor: WSD-AS261

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

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

PLACE OF CALIBRATION

Edifice-type wind tunnel of Jirananate 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 [1]

Preconditioning

24 hours at ambient conditions

Measurement Condition

The average values during measurement are (23.7) °C, (46.6) %RH and (1014.3) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

Mr. Sorawit Thachubad
Mr. Nattaporn Lertsomphol

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 $\frac{A}{A_0}$

Calibration procedure:

The Cup anemometer was calibrated against Standard air velocity transducer model #45512 and plot tube with precision differential pressure meter model #DPM2500 in an edifice test section of Edifice-type wind tunnel with 900 cm² cross test section area. The Wt CL-007 based on IEC 61400-12-1, Wind energy generation systems - Part 12-1, Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:

This certificate provides a traceability of the measurement to recognized the national standards, and to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: NMV 0001/23 and NMV-0055-23

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



Jirananate Associates Co. Ltd.
42/14-15/17/20
Pochaisam 17/1, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860,

Certificate Number
CWD-005-67

Page 2 of 2 Pages

MEASUREMENT RESULTS⁴

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	D ₁₀₀	D ₁₀₀	Error	U (k=2)
m/s	Degree (°)	Degree (°)	Degree (°)	Degree (°)
	45.000	41	-4	0.80
	90.000	87	-3	0.80
	135.001	132	-3	0.80
5.03	180.000	180	0	0.80
	225.000	228	3	0.80
	270.000	274	4	0.80
	315.000	319	4	0.80
	360.000	359	1	0.80

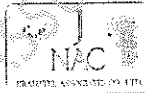
Remark:

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

⁴ Direction of standard

Direction of Unit Under Calibration

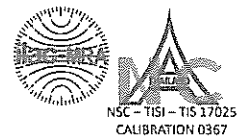
End of Certificate of Calibration



Iranatee Associates Co., Ltd.
63/14 15 47/25 16
Khet Suwan 17, Rd. Wapahara Bangkok
Bangkok 10250 (Thailand)
Tel: +6620020211
Mobile: +6620020212
E-mail: nac-calibration@iranatee.com
Web Site: www.iranatee.com

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

Temperature measurement laboratory
Calibration services department



NSC - TIS1 - TIS 17025
CALIBRATION 0367

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

Certificate No. : CDT-003-67

MEASUREMENT ITEM

Data Logger with Temperature sensor

MANUFACTURER

Novolyne

MODEL/TYPE

200-WS-251B

SERIAL NUMBER

AS261

ID NUMBER

BKK_F30888

CONDITION AS-RECEIVED

Used item

CUSTOMER

ALS laboratory group (Thailand) Co., Ltd.
104 Phathanakan 40, Phathanakan 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

Calibration procedure:

The temperature calibration was done by In-House calibration method as WS-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-0958 23, Certificate number: EN 0101 23

Reference Used During Calibration:

1. Standard Temperature Probe
Model: STS 100 AISD, Serial No. 607682 08,
Due date: 28 Mar 2024
2. Digital Temperature Indicator
Model: DTI 1000 A MK II, Serial No. 671407
06591 Due date: 14 Sep 2024

Uncertainty of Measurement:

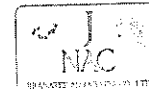
The reported uncertainty of measurement is based on the standard uncertainty multiplied by a coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty has been determined in accordance with the GUM (Evaluation of measurement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

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 Thachetad
☒ Miss Jitraporn Lertsomphol
☒ Miss Ruangsri Poommet



Approved signatory

Mr. Pinyaa Booncharoen
Calibration Department Manager

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



Continuation of Certificate of Calibration Number CDT-003-67

Page 2 of 2 Pages

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 ~ 40 °C

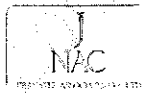
Function:

Table 3: This equipment was connected with temperature sensor Model: HMP60 5/N: N0310723.
Dimension: Diameter 12 mm, Length 80 mm.

Immersion Depth	Standard Reading	UUC Reading	Error	Uncertainty
(mm)	(°C)	(°C)	(°C)	(°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



Iranatee Associates Co., Ltd.
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Mobile: +6620020212
E-mail: nac-calibration@iranatee.com
Web Site: www.iranatee.com

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

Relative humidity measurement laboratory
Calibration services department

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

Certificate No. : CRH-004-67

MEASUREMENT ITEM

Relative humidity with data logger

MANUFACTURER

Novolyne

MODEL/TYPE

200-WS-251B

SERIAL NUMBER

AS261

ID NUMBER

BKK_F30888

CONDITION AS-RECEIVED

Used item

CUSTOMER

ALS laboratory group (Thailand) Co., Ltd.
104 Phathanakan 40, Phathanakan 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

Calibration procedure:

The Relative humidity calibration was done by In-House calibration method as RH-CL-010 according to comparison method with standard chilled mirror hygrometer and standard humidity generator chamber.

Traceability:

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

Uncertainty of Measurement:

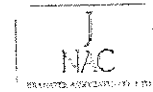
The reported uncertainty of measurement is based on the standard uncertainty multiplied by a coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty has been determined in accordance with the GUM (Evaluation of measurement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

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 Thachetad
☒ Miss Jitraporn Lertsomphol
☒ Miss Ruangsri Poommet



Approved signatory

Mr. Pinyaa Booncharoen
Calibration Department Manager

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

Measurement Results:

This equipment was connected with indoor air quality probe and displayed (UR) on display. Model: UR1P60, Serial number: NQ30703

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20%RH to 80%RH

Table 1: 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	49.7	-2.6	1.0
80.0	87.65	78.9	-4.0	1.6

UUC: Unit Under Calibration

End of Certificate of Calibration



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Web site: www.jirante.com

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ISO/IEC 17025:2017
JSC-TIS-TIS 17025
CALIBRATION 0367

Air speed measurement laboratory
Calibration services department



J NAC
JIRANATEE ASSOCIATES CO., LTD.
NSC - TIS - TIS 17025
CALIBRATION 0367

Certificate Number

CW5-010-66

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM
MANUFACTURER
MODEL/TYPE

Cup anemometer
Novalytis

SERIAL NUMBER

Sensor: WS-027

ID NUMBER

Data logger: 200-WS-25Lb

CONDITION AS-RECEIVED

Sensor: WSD-A4917

CUSTOMER

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

RECEIVED DATE

20 Sep 2023

MEASUREMENT DATE

28 Sep 2023

ISSUE DATE

28 Sep 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 Jirante 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 (24.0) °C, (43.7) %RH and (1010) hPa

TABULATION OF RESULTS:

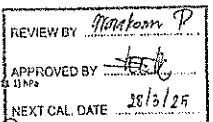
The table on next page give the measured values

Calibrated by:

Mr. Sorawat Thachulud
M.Sc. Jirantepon Lertthomphol



Approved signatory



Mr. Panyia Booncharoen
Calibration Department Manager

Remark:

- ¹ Include cross-section area of the wind tunnel
- ² Projected cross-section area of the tested object include mounting pipe
- ³ Diameter of mounting pipe
- ⁴ Ratio 10⁻¹

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

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

The Cup anemometer, Unit Under Calibration (UUC) was exercise at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer which was installed 50 mm away from wind tunnel nozzle and installed 40 mm away from top of the test section and the standard air velocity 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 50 mm away from wind tunnel nozzle and installed 40 mm away from top of the test section. UUC was mounted on a round vertical tube of the lower plate at center of test section. The calibration was carried out under both rising and falling air velocity in the range of 1 m/s to 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 _{me} (m/s)	Error (m/s)	U (k=2) (m/s)
1.015	23.78	23.95	0.9	-0.1	0.31
2.104	24.10	23.95	1.9	-0.7	0.31
3.016	23.90	23.95	2.9	-0.1	0.31
4.215	23.88	23.95	4.0	-0.2	0.31
4.99	23.54	23.95	5.1	0.3	0.31
6.00	23.94	23.95	6.1	0.3	0.31
7.03	23.50	23.95	7.1	0.1	0.31
7.98	24.02	23.95	8.1	0.1	0.31
8.98	23.50	23.95	9.2	0.3	0.31
9.97	23.89	23.95	10.2	0.2	0.31
11.04	23.50	23.95	11.3	0.3	0.31
12.03	23.60	23.95	12.2	0.2	0.31
13.03	23.50	23.95	13.2	0.2	0.31
13.97	23.54	23.95	14.3	0.3	0.31
15.03	23.60	23.95	15.3	0.3	0.42
15.97	23.50	23.95	16.4	0.4	0.32

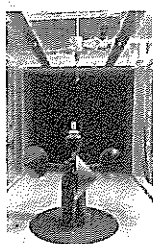
Remark:

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

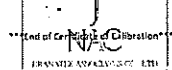
² Velocity of standard

Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET UP



Calibration set up of the Cup anemometer calibration in the wind tunnel of Jirante Associates Co., Ltd. The Cup anemometer shown may differ from the calibrated one. Remark: The proportion of the set up is not a scale for the following geometry.



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JSC-TIS-TIS 17025
CALIBRATION 0367

Wind direction measurement laboratory
Calibration services department



J NAC
JIRANATEE ASSOCIATES CO., LTD.
NSC - TIS - TIS 17025
CALIBRATION 0367

Certificate Number

CW5-010-66

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM
MANUFACTURER
MODEL/TYPE

Wind Direction Sensor
Novalytis

SERIAL NUMBER

Sensor: WS-027

ID NUMBER

Data logger: 200-WS-25Lb

CONDITION AS-RECEIVED

Sensor: WSD-A4917

CUSTOMER

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

RECEIVED DATE

20 Sep 2023

MEASUREMENT DATE

28 Sep 2023

ISSUE DATE

28 Sep 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 Jirante Associates Co., Ltd.

CALIBRATION CONDITION

Wind tunnel cross-section area¹ : 900 cm²
Wind direction frontal area² : 120 cm²
Diameter of mounting pipe³ : mm
Blockage ratio of test object⁴ : 0.143 (%)

Preconditioning

24 hours at ambient conditions.

Measurement Condition

The average values during measurement are (23.7) °C, (45.0) %RH and (1010) hPa

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

Mr. Sorawat Thachulud
M.Sc. Jirantepon Lertthomphol



Approved signatory

Mr. Panyia Booncharoen
Calibration Department Manager

Remark:

- ¹ Include cross-section area of the wind tunnel
- ² Projected cross-section area of the tested object include mounting pipe
- ³ Diameter of mounting pipe
- ⁴ Ratio 10⁻¹

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

Certificate Number
CWO-010-66

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 _{max} Degree (°)	D _{min} Degree (°)	Error Degree (°)	U (k=2) Degree (°)
4.59	45.000	42	3	0.25
	90.000	87	-3	0.25
	135.000	132	-3	0.25
	180.000	180	0	0.25
	225.000	228	4	0.25
	270.000	275	5	0.25
	315.000	320	5	0.25
	360.000	359	-1	0.25

Remarks:

¹ Calibration results only valid 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



SITHIPORN ASSOCIATES CO., LTD. CALIBRATION LABORATORY

45F-45/F Srinthorn Road, Banglumru, Bangkok 10700 Thailand
Tel: +66 2433 8331 Email: calibration@sithiporn.com

SITHIPORN
ASSOCIATES



Cert. No.: ACC24010
Pages : 1 of 3

Calibration Certificate

Equipment : SOUND CALIBRATOR
Manufacturer : RION
Model : NC-74
Serial No.: 34178119
ID No.: BKK_FS0632

Condition As Found : GOOD

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

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

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

Calibrated by : Nuthakorn Pisuwan

Approved by :

Thanakul 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

45F-45/F Srinthorn Road, Banglumru, Bangkok 10700 Thailand
Tel: +66 2433 8331 Email: calibration@sithiporn.com



Cert. No. : ACC24010
Job No. : VC67AC0059
Pages : 2 of 3

Calibration Procedure : CP-AC-03

Calibration Method :

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

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

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33511B	MY52302742	EF-0010-23	07-FEB-24
Digital Multimeter	33461A	MY53220104	EEL-BP 30/0266	13-FEB-24
Digital Multimeter	33461A	MY53220076	EEL-BP 30/0267	13-FEB-24
Digital Multimeter	33461A	MY60024273	EEL-BP 31/0266	14-FEB-24
Programmable Attenuator	MAT-1070	62100114	EF-0011-23	08-FEB-24
Condenser Microphone	4180	2977900	AA-1001-23	14-FEB-24
Measuring Amplifier	NA-42KA1	34560495	AA-3002-23	14-FEB-24
Audio Analyzer	AVR-3360A	V744D6069	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).

SITHIPORN ASSOCIATES CO., LTD. CALIBRATION LABORATORY

45F-45/F Srinthorn Road, Banglumru, Bangkok 10700 Thailand
Tel: +66 2433 8331 Email: calibration@sithiporn.com



Cert. No. : ACC24010
Job No. : VC67AC0059
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	93.94	-0.06	0.14	0.40

2. Frequency

Specified Frequency (Hz)	Measured value (Hz)	Deviated value (%)	Uncertainty (%)	Acceptance limit (%)
1000	1001.1	0.1	0.1	1.0

3. Total distortion

Measured value (%)	Uncertainty (%)	Acceptance limit (%)
1.48	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

Thanakul Petchurai

Thanakul Petchurai



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0231

MTC No. EEL. BP. 167/0167

CALIBRATION CERTIFICATE

Submitted by : A.I.S Laboratory Group (Thailand) Co., Ltd.
Address : 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan, Khet Suan Luang, Bangkok, 10250
Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre,
Sri 1C, Bangpoo Industrial Estate, Sukhumvit Rd., A.Muang, Samutprakan 10280.

Instrument Calibrated :
Description : Sound Level Meter
Manufacturer : Rion
Model : NL-42
Serial No. : 00296511 (ID : BKK_FS0968)
Microphone : UC-52 No.179112
Preamplifier : NII-24 No.87520
Standards used :

Ambient Environment
Temperature : $(23 \pm 3) ^\circ\text{C}$
Relative Humidity : $(50 \pm 15) \%$
Ambient Pressure : $(101.325 \pm 1.5) \text{ kPa}$

1. Band Pass Filter Wavelec 752A S/N 90010494.
2. Condenser Microphone Brüel&Kjær 4180 S/N 2889871
3. Decade Attenuator Ando AI-205 S/N 00464602.
4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
6. Digital Multimeter I luke 8520A S/N 4985007.
7. Pistonphone Rion NC-72 S/N 00402446.
8. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Date of Receipt : 24 Jan. 2024

Date of Calibration : 22 Feb. 2024

1/9

The results are only valid for the items tested and are not valid for other items.
Adjusting the Report Certificate and publish the results except in full as a prohibited unless written permission is obtained from the owner of TISTR.

FM.B.MTC.002 Rev.4

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Fax: (661) 0 2323 9165
E-mail: mtc@tistr.go.th

Office
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Thailand
Tel: (661) 0 2579 1121 Ext. 5219-5225-5217
Fax: (661) 0 2579 8592
E-mail: kumpap@tistr.go.th

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0231

MTC No. EEL. BP. 167/0167

9. Power Amplifier Brüel&Kjær 2706 S/N 1517650.
10. Speaker Tannoy Limited, Great Britain British Patent No. 215300.
11. Digital Multimeter Agilent 34401A S/N MY44005560.
12. Programmable Attenuator Tamagawa TPA-303A S/N 2212.

Calibration Procedure :

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2013). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

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

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

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

Date of Calibration : 22 Feb. 2024

2/9

The results are only valid for the items tested and are not valid for other items.
Adjusting the Report Certificate and publish the results except in full as a prohibited unless written permission is obtained from the owner of TISTR.

FM.B.MTC.002 Rev.4

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0231

MTC No. EEL. BP. 167/0167

1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)		Deviation value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	Before adjust	After adjust				
113.92	114.1	113.9	0.0	1.0	0.30	N/A

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 113.9 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
23.3	0.10	N/A

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

Frequency Weighting	Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-Weight	13.9	0.10	N/A
C-Weight	18.1	0.10	N/A
Flat	24.2	0.10	N/A

Date of Calibration : 22 Feb. 2024

3/9

The results are only valid for the items tested and are not valid for other items.
Adjusting the Report Certificate and publish the results except in full as a prohibited unless written permission is obtained from the owner of TISTR.

FM.B.MTC.002 Rev.4

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0231

MTC No. EEL. BP. 167/0167

3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response curve (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
125	0.1	0.2	0.2	1.5	0.45	0.6
1 000	0.2	0.2	0.2	1.0	0.45	0.6
8 000	-2.5	-2.6	-2.6	5.0	0.45	0.7

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response curve (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
63	0.0	0.0	0.0	2.0	0.20	0.6
125	0.0	0.0	0.0	1.5	0.20	0.6
250	0.0	0.0	0.0	1.5	0.20	0.6
500	0.0	0.0	0.0	1.5	0.20	0.6
1 000	0.0	0.0	0.0	1.0	0.20	0.6
2 000	-0.1	-0.1	-0.2	2.0	0.20	0.6
4 000	-0.3	-0.3	-0.3	3.0	0.20	0.6
8 000	0.0	0.0	-0.1	5.0	0.20	0.7

Date of Calibration : 22 Feb. 2024

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FM.B.MTC.002 Rev.4

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0231

MTC No. EEL-BP. 167/0167

5. Long-term stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	94.0	0.0	0.3	0.10	0.1
End	94.0				

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-weight	94.0	0.0	0.2	0.20	0.2
C-weight	94.0	0.0	0.2	0.20	0.2
Flat	94.0	0.0	0.2	0.20	0.2

6.2 Time weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	94.0	0.0	0.1	0.20	0.2
Slow	94.0	0.0	0.1	0.20	0.2
Leq	94.0	0.0	0.1	0.20	0.2

Date of Calibration 22 Feb 2024

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Request No. 21-67/0231

MTC No. EEL-BP. 167/0167

7. Level linearity on the reference level range (cont.)

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
59	58.9	-0.1	1.1	0.30	0.3
54	53.9	-0.1	1.1	0.30	0.3
49	48.9	-0.1	1.1	0.30	0.3
44	43.9	-0.1	1.1	0.30	0.3
39	38.9	-0.1	1.1	0.30	0.3
34	33.9	-0.1	1.1	0.30	0.3
29	28.9	-0.1	1.1	0.30	0.3
24	23.9	-0.1	1.1	0.30	0.3
19	18.9	-0.1	1.1	0.30	0.3
14	13.9	-0.1	1.1	0.30	0.3
9	8.9	-0.1	1.1	0.30	0.3
4	3.9	-0.1	1.1	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
30-130	94.0	94.0	0.0	1.1	0.30	0.3

Date of Calibration 22 Feb 2024

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Request No. 21-67/0231

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7. Level linearity on the reference level range

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
137	137.0	0.0	1.1	0.30	0.3
136	136.1	-0.1	1.1	0.30	0.3
135	135.0	0.0	1.1	0.30	0.3
134	134.1	-0.1	1.1	0.30	0.3
129	129.1	-0.1	1.1	0.30	0.3
124	124.0	0.0	1.1	0.30	0.3
119	119.1	-0.1	1.1	0.30	0.3
114	114.0	0.0	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.1	-0.1	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.0	0.0	1.1	0.30	0.3
84	84.0	0.0	1.1	0.30	0.3
79	79.0	0.0	1.1	0.30	0.3
74	74.0	0.0	1.1	0.30	0.3
69	69.0	0.0	1.1	0.30	0.3
64	63.9	-0.1	1.1	0.30	0.3

Date of Calibration 22 Feb 2024

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Request No. 21-67/0231

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8. Level linearity including the level range control

At reference level at 5 dB greater than the under-range on a level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
30-130	35	35.0	0.0	1.1	0.30	0.3

9. Tone burst response

Time Weighting	Toneburst Duration, T (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	126.0	0.0	±1.0	0.20	0.3
	2	109.0	0.0	+1.0, -2.5	0.20	0.3
	0.25	100.0	0.0	+1.5, -5.0	0.20	0.3
Slow	200	119.5	-0.1	±1.0	0.20	0.3
	2	99.9	-0.1	+1.0, -5.0	0.20	0.3
	0.25	90.9	-0.1	+1.5, -5.0	0.20	0.3

Date of Calibration 22 Feb 2024

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Request No. 21-67/0231

MTC No. EEL. BP. 167/0167

10. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Complete cycle	125.4	125.3	-0.1	3.0	0.20	0.35
Positive half cycle	124.4	124.2	-0.2	2.0	0.20	0.35
Negative half cycle	124.4	124.2	-0.2	2.0	0.20	0.35

11. Overload Indication

Measured value (dB)		Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Positive one-half cycle	Negative one-half cycle				
136.9	136.9	0.0	1.5	0.20	0.25

12. High-level stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	129.0	0.0	0.3	0.10	0.1
End	129.0				

Calibrated by:

Wittawat Supanich
(Mr. Wittawat Supanich)

Approved by:



Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration : 22 Feb. 2024

Date of Issue : 23 Feb. 2024

Ref: 2011267012400346005

End of Certificate

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0231

MTC No. EEL. BP. 166/0167

- Power Amplifier Brüel&Kjær 2706 S/N 1517650.
- Speaker Tammy Limited, Great Britain British Patent No. 215300
- Digital Multimeter Agilent 34401A S/N MY44005560.
- Programmable Attenuator Tamagawa TPA-303A S/N 2212.

Calibration Procedure:

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3: Periodic tests (2013). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

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

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

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

Date of Calibration : 22 Feb. 2024

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0231

MTC No. EEL. BP. 166/0167

CALIBRATION CERTIFICATE

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

Address : 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan, Khet Suan Luang, Bangkok, 10250

Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.

Soi 10, Bangpoo Industrial Estate, Sukhumvit Rd., A.Muang, Samutprakan 10280.

Instrument Calibrated :

Description : Sound Level Meter

Manufacturer : Rion

Model : NL-42

Serial No. : 00873053 (ID : BKK_FS0930)

Microphone : UC-52 No.171587

Preamplifier : NH-24 No.73329

Standards used :

- Band Pass Filter Wavetek 752A S/N 90010494.
- Condenser Microphone Brüel&Kjær 4180 S/N 2889871
- Decade Attenuator Ando AL 205 S/N 00464602.
- Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
- Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
- Digital Multimeter Fluke 8520A S/N 4985007.
- Pistonphone Rion NC-72 S/N 00402446
- Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Ambient Environment

Temperature : (23 ± 3) °C

Relative Humidity : (50 ± 15) %

Ambient Pressure : (101.325 ± 1.5) kPa

Date of Receipt : 24 Jan 2024

Date of Calibration : 22 Feb. 2024

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0231

MTC No. EEL. BP. 166/0167

1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
113.92	114.2	113.9	0.0	1.0	0.30

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 113.9 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
26.4	0.10	N/A

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

Frequency Weighting	Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A Weight	12.9	0.10	N/A
C Weight	18.9	0.10	N/A
Flat	23.8	0.10	N/A

Date of Calibration : 22 Feb. 2024

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Request No. 21-67/0231

MTC No. EEL BP. 166/0167

3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response curve (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
125	-0.1	0.0	0.0	1.5	0.45	0.6
1 000	0.2	0.2	0.2	1.0	0.45	0.6
8 000	-0.7	-0.7	-0.8	5.0	0.45	0.7

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response curve (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
63	0.0	0.0	0.0	2.0	0.20	0.6
125	0.1	0.1	0.0	1.5	0.20	0.6
250	0.1	0.0	0.0	1.5	0.20	0.6
500	0.1	0.0	0.0	1.5	0.20	0.6
1 000	0.0	0.0	0.0	1.0	0.20	0.6
2 000	-0.2	-0.2	-0.2	2.0	0.20	0.6
4 000	-0.3	-0.3	-0.3	3.0	0.20	0.6
8 000	0.1	0.0	-0.1	5.0	0.20	0.7

Date of Calibration 22 Feb. 2024

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7. Level linearity on the reference level range

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
137	137.1	0.1	1.1	0.30	0.3
136	136.1	0.1	1.1	0.30	0.3
135	135.1	0.1	1.1	0.30	0.3
134	134.1	0.1	1.1	0.30	0.3
129	129.1	0.1	1.1	0.30	0.3
124	124.0	0.0	1.1	0.30	0.3
119	119.0	+0.0	1.1	0.30	0.3
114	114.0	0.0	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.0	0.0	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.0	0.0	1.1	0.30	0.3
84	84.0	0.0	1.1	0.30	0.3
79	79.1	0.1	1.1	0.30	0.3
74	74.1	0.1	1.1	0.30	0.3
69	69.0	0.0	1.1	0.30	0.3
64	64.0	0.0	1.1	0.30	0.3

Date of Calibration 22 Feb. 2024

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0231

MTC No. EEL BP. 166/0167

5. Long-term stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	94.0	0.0	0.3	0.10	0.1
End	94.0				

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-weight	94.0	0.0	0.2	0.20	0.2
C-weight	94.0	0.0	0.2	0.20	0.2
Flat	94.0	0.0	0.2	0.20	0.2

6.2 Time weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	94.0	0.0	0.1	0.20	0.2
Slow	94.0	0.0	0.1	0.20	0.2
Leq	94.0	0.0	0.1	0.20	0.2

Date of Calibration 22 Feb. 2024

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This report is valid only for the items tested and calibrated under the conditions specified.

Advising the Report of Calibration and Calibration Certificate is not valid if the calibration is not performed in accordance with the requirements of the standard.

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FM-BL-MTC 002 Rev.4



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0231

MTC No. EEL BP. 166/0167

7. Level linearity on the reference level range (cont.)

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
59	59.0	0.0	1.1	0.30	0.3
54	53.9	-0.1	1.1	0.30	0.3
49	49.0	0.0	1.1	0.30	0.3
44	44.0	0.0	1.1	0.30	0.3
39	39.0	0.0	1.1	0.30	0.3
34	34.0	0.0	1.1	0.30	0.3
29	29.0	0.0	1.1	0.30	0.3
28	28.0	0.0	1.1	0.30	0.3
27	27.0	0.0	1.1	0.30	0.3
26	26.0	0.0	1.1	0.30	0.3
25	25.0	0.0	1.1	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
30-130	94.0	94.0	0.0	1.1	0.30	0.3

Date of Calibration 22 Feb. 2024

7/9

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Advising the Report of Calibration and Calibration Certificate is not valid if the calibration is not performed in accordance with the requirements of the standard.

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FM-BL-MTC 002 Rev.4

8. Level linearity including the level range control

At reference level at 5 dB greater than the under-range on a level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
30-130	35	35.0	0.0	1.1	0.30	0.3

9. Tone burst response

Time Weighting	Toneburst Duration, Tbrms	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	126.1	0.1	+1.0	0.20	0.3
	2	109.0	0.0	+1.0; +2.5	0.20	0.3
	0.25	100.0	0.0	+1.5; +5.0	0.20	0.3
Slow	200	119.6	0.0	±1.0	0.20	0.3
	2	100.0	0.0	+1.0; +5.0	0.20	0.3
	0.25	120.1	0.1	±1.0	0.20	0.3
SFI	200	100.0	0.0	+1.0; +2.5	0.20	0.3
	2	91.0	0.0	+1.5; +5.0	0.20	0.3
	0.25	91.0	0.0	+1.5; +5.0	0.20	0.3

Date of Calibration : 22 Feb. 2024

S-9

The results relate only to the items tested, calibrated or used as standard.

A further restriction on the use of the results is that they are not to be used for any purpose other than that for which they were issued.

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FMBL/MTC 002 Rev 4

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Cert. No. : ACL23318
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No. : 00597155 / 180398 / 88108
ID No. : BKK_FS0993

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTANAKAN 40, PHATTANAKAN ROAD,
KHAENG 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 : 11 OCTOBER 2023
Calibration Date : 19-20 OCTOBER 2023
Date of Issue : 24 OCTOBER 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchara
(Thanakul Petchara)

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.

10. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Complete cycle	125.4	125.3	-0.1	3.0	0.20	0.35
Positive half cycle	124.4	124.1	-0.3	2.0	0.20	0.35
Negative half cycle	124.4	124.1	-0.3	2.0	0.20	0.35

11. Overload indication

Measured value (dB)		Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Positive one-half cycle	Negative one-half cycle				
136.8	136.8	0.0	1.5	0.20	0.25

12. High-level stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	129.0	0.0	0.3	0.10	0.1
End	129.0				

Calibrated by :

Nathakorn Pisutpaisan
(Mr. Wittawat Supanich)

Approved by :

Mr. Thanakul Petchara
Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 22 Feb. 2024

Date of Issue : 23 Feb. 2024

Ref: 2011267012400346004

End of Certificate

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The results relate only to the items tested, calibrated or used as standard.

A further restriction on the use of the results is that they are not to be used for any purpose other than that for which they were issued.

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FMBL/MTC 002 Rev 4

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACL23318
Job No. : YC67AC0011
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	EP-0009-23	07-FEB-24
Waveform Generator	33511B	MY52302742	EP-0010-23	07-FEB-24
Digital Multimeter	33461A	MY53220104	EELBP 3040266	13-FEB-24
Digital Multimeter	33461A	MY53220076	EELBP 2940266	13-FEB-24
Digital Multimeter	34461A	MY60024273	EELBP 3140266	14-FEB-24
Programmable Attenuator	MAT-1070	62100114	EP-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).

T. Petchara

Continuation of Calibration Certificate

Cert. No. : ACL23318
Job No. : VC67AC0011
Pages : 3 of 8

Summary of Measurement Result :

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

Note : Pass/Fail evaluation for each parameter, will be considered together from the acceptance limit and the Maximum-permitted uncertainty of measurement.

Continuation of Calibration Certificate

Cert. No. : ACL23318
Job No. : VC67AC0011
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
15.4

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

Frequency Weighting	Measured value (dB)
A-weight	11.6
C-weight	17.4
Flat	23.0

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	1.2	1.2	1.3	±5.0

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T. P. S. M.

Continuation of Calibration Certificate

Cert. No. : ACL23318
Job No. : VC67AC0011
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
63	-0.1	-0.1	0.0	±2.0
125	-0.1	0.0	0.1	±1.5
250	-0.1	0.0	0.0	±1.5
500	0.0	0.0	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.1	±2.0
4000	0.0	0.0	0.1	±3.0
8000	0.0	0.0	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-TS12-04-04-020604

T. P. S. M.

Continuation of Calibration Certificate

Cert. No. : ACL23318
Job No. : VC67AC0011
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.1	0.1	±1.1
136.0	136.1	0.1	±1.1
135.0	135.1	0.1	±1.1
134.0	134.1	0.1	±1.1
133.0	133.0	0.0	±1.1
132.0	132.0	0.0	±1.1
131.0	131.0	0.0	±1.1
129.0	129.0	0.0	±1.1
124.0	124.0	0.0	±1.1
119.0	119.1	0.1	±1.1
114.0	114.1	0.1	±1.1
109.0	109.1	0.1	±1.1
104.0	104.1	0.1	±1.1
99.0	99.1	0.1	±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	28.0	0.0	±1.1
27.0	27.0	0.0	±1.1
26.0	25.9	-0.1	±1.1
25.0	24.9	-0.1	±1.1

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T. P. S. M.

Continuation of Calibration Certificate

Cert. No. : ACL23318
Job No. : VC67AC0011
Pages : 7 of 8

8. Level linearity including the level range control

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

9. Tone burst response

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

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, Lepeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±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	135.1	-0.3	±2.0

QF-TS12-04-04-020664

T. Petchur

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Cert. No. : ACL23236
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No. : 00658242 / 157782 / 48097
ID No. : BKK_FS0099

Condition As Found : GOOD

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

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

Received Date : 06 JULY 2023
Calibration Date : 17-18 JULY 2023
Date of Issue : 19 JULY 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchur
(Thannakul Petchur)

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

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23318
Job No. : VC67AC0011
Pages : 8 of 8

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

QF-TS12-04-04-020664

T. Petchur

SITHIPORN / SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACL23236
Job No. : VC66AC0072
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Exp. Date
Waveform Generator	33210A	MY48017076	EF-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-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. Petchur

Continuation of Calibration Certificate

Cert. No. : ACL23236
Job No. : VC66AC0072
Pages : 3 of 8

Summary of Measurement Result :

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

Note : Pass/Fail evaluation for each parameter, will be considered together from the acceptance limit and the Maximum-permitted uncertainty of measurement.

Continuation of Calibration Certificate

Cert. No. : ACL23236
Job No. : VC66AC0072
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)
17.6

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

Frequency Weighting	Measured value (dB)
A-weight	16.1
C-weight	21.8
Flat	27.7

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	0.2	0.2	0.2	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-1.4	-1.3	-1.3	±5.0

QF-TS12-04-04-020664

QF-TS12-04-04-020664

Continuation of Calibration Certificate

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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	-0.1	±2.0
125	0.0	0.0	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.1	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.1	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.1	0.1	±5.0

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

QF-TS12-04-04-020664

Continuation of Calibration Certificate

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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	38.9	-0.1	± 1.1
34.0	33.9	-0.1	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	27.9	-0.1	± 1.1
27.0	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

Continuation of Calibration Certificate

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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, 1b (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
SIL	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.0	0.0	±1.0

10. Peak C sound level

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

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

QT-1512-04-04-020664



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No.21-67/0231

MTC No. EEL BP 169/0167

CALIBRATION CERTIFICATE

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

Address : 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan, Khet Suan Luang, Bangkok 10250.

Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.

Sri IC, Bangpoo Industrial Estate, Sukhumvit Rd., A.Muang, Samutprakan 10280.

Instrument Calibrated :

Description : Sound Level Meter

Manufacturer : Rion

Model : NL-42

Serial No. : 00296513 (ID BKK_FS0970)

Microphone : Type UC-52 No.179115

Preamplifier : Type NH-24 No.87522

Standards used :

1. Band Pass Filter Wavetek 752A S/N 90010494.
2. Condenser Microphone Brüel&Kjær 4180 S/N 2889871.
3. Decade Attenuator Ando AI-205 S/N 00464602
4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037
6. Digital Multimeter Fluke 8520A S/N 4985007.
7. Pistonphone Rion NC-72 S/N 00402446.
8. Measuring Amplifier Brüel&Kjær 2036 S/N 1537484.

Date of Receipt : 24 Jan 2024

Date of Calibration : 22-28 Feb 2024

Ambient Environment

Temperature : (23 ± 3) °C

Relative Humidity : (50 ± 15) %

Ambient Pressure : (101.325 ± 1.5) kPa

Handwritten signature and date: 21/2/25

Continuation of Calibration Certificate

Cert. No. : ACL23236
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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	SIM Display at initial (dB)	SIM Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A-weight	137.0	137.0	0.0	±0.3

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

End of Calibration Certificate

QT-TS12-04-04-020664



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No.21-67/0231

MTC No. EEL BP 169/0167

9. Power Amplifier Brüel&Kjær 2706 S/N 1517650.

10. Speaker Tannoy Limited, Great Britain British Patent No 215300.

11. Digital Multimeter Agilent 34401A S/N MY44005560.

12. Programmable Attenuator Tamagawa TPA-303A S/N 2212.

Calibration Procedure

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2013). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

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

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

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

Date of Calibration : 22-28 Feb 2024

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67-0231

MTC No. EEL BP 169/0167

1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)		Deviation value (dB)	Acceptance limit Class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	Before adjust	After adjust				
113.96	114.2	113.9	-0.1	1.0	0.30	N/A

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 124.1 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
19.4	0.10	N/A

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

Frequency (Hz)	Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-Weight	10.8	0.10	N/A
C-Weight	16.1	0.10	N/A
Flat	21.4	0.10	N/A

Date of Calibration 22-28 Feb. 2024

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The results refer only to the items tested and do not include any other items.

All measurements were performed in accordance with the requirements of the Thai Standard TISI 17025:2017.

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Request No. 21-67-0231

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5. Long-term stability

Time	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	94.0	0.0	0.3	0.10	0.1
End	94.0				

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

Frequency (Hz)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-weight	94.0	0.0	0.2	0.20	0.2
C-weight	94.0	0.0	0.2	0.20	0.2
Flat	94.1	0.1	0.2	0.20	0.2

6.2 Time weightings at 1 kHz

Frequency (Hz)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	94.0	0.0	0.1	0.20	0.2
Slow	94.0	0.0	0.1	0.20	0.2
1 eq	94.0	0.0	0.1	0.20	0.2

Date of Calibration 22-28 Feb. 2024

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67-0231

MTC No. EEL BP 169/0167

3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
125	0.2	0.3	0.3	1.5	0.45	0.6
1 000	-0.2	-0.2	-0.2	1.0	0.45	0.6
8 000	-0.5	-0.5	-0.5	5.0	0.45	0.7

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
63	0.0	0.1	0.1	2.0	0.20	0.6
125	0.0	0.1	0.1	1.5	0.20	0.6
250	0.0	0.1	0.1	1.5	0.20	0.6
500	0.0	0.0	0.0	1.5	0.20	0.6
1 000	0.0	0.0	0.0	1.0	0.20	0.6
2 000	0.0	0.1	0.1	2.0	0.20	0.6
4 000	0.0	0.1	0.1	3.0	0.20	0.6
8 000	0.1	0.1	0.1	5.0	0.20	0.7

Date of Calibration 22-28 Feb. 2024

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67-0231

MTC No. EEL BP 169/0167

7. Level linearity on the reference level range

Anticipated value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
137	137.0	0.0	1.1	0.30	0.3
136	136.0	0.0	1.1	0.30	0.3
135	135.0	0.0	1.1	0.30	0.3
133	133.0	0.0	1.1	0.30	0.3
132	132.0	0.0	1.1	0.30	0.3
131	131.0	0.0	1.1	0.30	0.3
130	130.0	0.0	1.1	0.30	0.3
129	129.0	0.0	1.1	0.30	0.3
124	124.0	0.0	1.1	0.30	0.3
119	119.0	0.0	1.1	0.30	0.3
114	114.0	0.0	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.0	0.0	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.0	0.0	1.1	0.30	0.3
84	84.0	0.0	1.1	0.30	0.3
79	79.0	0.0	1.1	0.30	0.3
74	74.0	0.0	1.1	0.30	0.3
69	69.0	-0.1	1.1	0.30	0.3
64	64.0	-0.1	1.1	0.30	0.3
59	59.0	-0.1	1.1	0.30	0.3

Date of Calibration 22-28 Feb. 2024

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The results refer only to the items tested and do not include any other items.

All measurements were performed in accordance with the requirements of the Thai Standard TISI 17025:2017.

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Request No. 21-67-0231

MTC No. EEL BP. 169-0167

7. Level linearity on the reference level range (cont.)

Anticipated value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
54	53.9	-0.1	1.1	0.30	0.3
49	48.9	-0.1	1.1	0.30	0.3
44	43.9	-0.1	1.1	0.30	0.3
39	38.9	-0.1	1.1	0.30	0.3
34	33.9	-0.1	1.1	0.30	0.3
29	28.8	-0.2	1.1	0.30	0.3
28	27.9	-0.1	1.1	0.30	0.3
27	26.9	-0.1	1.1	0.30	0.3
26	25.9	-0.1	1.1	0.30	0.3
25	24.9	-0.1	1.1	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
30-130	94.0	94.0	0.0	1.1	0.30	0.3

Date of Calibration : 22-28 Feb. 2024

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The results relate only to the items tested and calibrated and are assigned. Adhering to the Report Certificate and scope of the results except in full, any further use without permission is prohibited from the government of TISTR.

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Request No. 21-67-0231

MTC No. EEL BP. 169-0167

10. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Complete cycle	125.4	125.5	0.1	3.0	0.20	0.35
Positive half cycle	124.4	124.1	-0.3	2.0	0.20	0.35
Negative half cycle	124.4	124.1	-0.3	2.0	0.20	0.35

11. Overload indication

Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Positive one-half cycle	135.4	0.0	1.5	0.55
Negative one-half cycle	135.4	0.0	1.5	0.55

12. High-level stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	129.0	0.0	0.3	0.10	0.1
End	129.0	0.0	0.3	0.10	0.1

Calibrated by:
(Mr. Pannasit Phasingseri)

Approved by:
Director
Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration : 22-28 Feb. 2024

Date of Issue : 29 Feb. 2024

Ref: 201126/012400346007

End of Certificate

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67-0231

MTC No. EEL BP. 169-0167

8. Level linearity including the level range control

At reference level at 5 dB greater than the under-range on a level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
30-130	25	25.0	0.0	1.1	0.30	0.3

9. Tone burst response

Time Weighting	Toneburst Duration, T _b (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	126.0	0.0	±1.0	0.20	0.3
	2	108.9	-0.1	+1.0; -2.5	0.20	0.3
	0.25	100.0	0.0	-1.5; -5.0	0.20	0.3
Slow	200	119.5	-0.1	±1.0	0.20	0.3
	2	100.0	0.0	+1.0; -5.0	0.20	0.3

Date of Calibration : 22-28 Feb. 2024

8/9

The results relate only to the items tested and calibrated and are assigned. Adhering to the Report Certificate and scope of the results except in full, any further use without permission is prohibited from the government of TISTR.

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67-0231

MTC No. EEL BP. 170-0167

CALIBRATION CERTIFICATE

Submitted by : A/S Laboratory Group (Thailand) Co., Ltd.

Address : 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan, Khet Suan Luang, Bangkok 10250

Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre

Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., A.Muang, Samutprakan 10280.

Instrument Calibrated :

Description : Sound Level Meter

Manufacturer : Rion

Model : NL-42

Serial No : 00296514 (ID: BKK_FS0971)

Microphone : Type UC-52 No.179116

Preamplifier : Type NH-24 No.87523

Standards used :

1. Band Pass Filter Wavecok 752A S/N 90010494.
2. Condenser Microphone Brüel&Kjær 4180 S/N 2889871.
3. Decade Attenuator Ando AL-205 S/N 00464602.
4. Function Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037
6. Digital Multimeter Fluke 8520A S/N 4985007
7. Pistophone Rion NC-72 S/N 00402446.
8. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484

Date of Receipt : 24 Jan. 2024

Date of Calibration : 22-28 Feb. 2024

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The results relate only to the items tested and calibrated and are assigned. Adhering to the Report Certificate and scope of the results except in full, any further use without permission is prohibited from the government of TISTR.

FMBL/MTC 002 Rev.4

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Request No. 21-67/0231

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9. Power Amplifier Druel&Kjer 2706 S/N 1517650.
10. Speaker Tannoy Limited, Great Britain British Patent No. 215300.
11. Digital Multimeter Agilent 34401A S/N MY44005560.
12. Programmable Attenuator Tamagawa TPA-303A S/N 2212.

Calibration Procedure

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2013). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

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

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

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

Date of Calibration 22-28 Feb. 2024

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The results stated on this certificate are valid only if the instrument is used in accordance with the instructions for use.

Adopting the Report certificate and data on this instrument, the user must ensure that the instrument is used in accordance with the instructions for use.

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0231

MTC No. EEL BP 170-0167

3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
125	0.5	0.6	0.7	1.5	0.45	0.6
1 000	-0.6	-0.6	-0.7	1.0	0.45	0.6
8 000	-1.4	-1.4	-1.3	5.0	0.45	0.7

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
63	-0.1	0.0	0.0	2.0	0.20	0.6
125	-0.1	0.0	0.0	1.5	0.20	0.6
250	-0.1	0.0	0.0	1.5	0.20	0.6
500	0.0	0.0	0.0	1.5	0.20	0.6
1 000	0.0	0.0	0.0	1.0	0.20	0.6
2 000	0.0	0.1	0.0	2.0	0.20	0.6
4 000	0.0	0.0	0.0	3.0	0.20	0.6
8 000	0.1	0.1	0.0	5.0	0.20	0.7

Date of Calibration 22-28 Feb. 2024

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0231

MTC No. EEL BP 170-0167

1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)		Deviation value (dB)	Acceptance limit Class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	Before adjust	After adjust				
113.96	114.4	113.9	-0.1	1.0	0.30	N/A

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 123.7 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
19.7	0.10	N/A

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

Frequency Weighting	Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-Weight	11.2	0.10	N/A
C-Weight	16.6	0.10	N/A
Flat	22.0	0.10	N/A

Date of Calibration 22-28 Feb. 2024

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0231

MTC No. EEL BP 170-0167

5. Long-term stability

Time	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	94.0	0.0	0.3	0.10	0.1
End	94.0				

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-weight	94.0	0.0	0.2	0.20	0.2
C-weight	94.0	0.0	0.2	0.20	0.2
Flat	94.1	0.1	0.2	0.20	0.2

6.2 Time weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	94.0	0.0	0.1	0.20	0.2
Slow	94.0	0.0	0.1	0.20	0.2
Leq	94.0	0.0	0.1	0.20	0.2

Date of Calibration 22-28 Feb. 2024

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0231

MTC No. EEL. BP. 170/0167

7. Level linearity on the reference level range

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
137	137.1	0.1	1.1	0.30	0.3
136	136.1	0.1	1.1	0.30	0.3
135	135.1	0.1	1.1	0.30	0.3
133	133.1	0.1	1.1	0.30	0.3
132	132.1	0.1	1.1	0.30	0.3
131	131.1	0.1	1.1	0.30	0.3
130	130.1	0.1	1.1	0.30	0.3
129	129.0	0.0	1.1	0.30	0.3
124	124.0	0.0	1.1	0.30	0.3
119	119.1	0.1	1.1	0.30	0.3
114	114.1	0.1	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.1	0.1	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.0	0.0	1.1	0.30	0.3
84	84.1	0.1	1.1	0.30	0.3
79	79.1	0.1	1.1	0.30	0.3
74	74.0	0.0	1.1	0.30	0.3
69	69.0	0.0	1.1	0.30	0.3
64	64.0	0.0	1.1	0.30	0.3
59	59.0	0.0	1.1	0.30	0.3

Date of Calibration : 22-28 Feb. 2024

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Request No. 21-67/0231

MTC No. EEL. BP. 170/0167

7. Level linearity on the reference level range (cont.)

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
54	54.0	0.0	1.1	0.30	0.3
49	49.0	0.0	1.1	0.30	0.3
44	44.0	0.0	1.1	0.30	0.3
39	39.0	0.0	1.1	0.30	0.3
34	34.0	0.0	1.1	0.30	0.3
29	28.9	-0.1	1.1	0.30	0.3
28	28.0	0.0	1.1	0.30	0.3
27	27.0	0.0	1.1	0.30	0.3
26	26.0	0.0	1.1	0.30	0.3
25	25.0	0.0	1.1	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
30-130	94.0	94.0	0.0	1.1	0.30	0.3

Date of Calibration : 22-28 Feb. 2024

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0231

MTC No. EEL. BP. 170/0167

8. Level linearity including the level range control

At reference level at 5 dB greater than the under-range on a level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
30-130	25	25.0	0.0	1.1	0.30	0.3

9. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	126.0	0.0	±1.0	0.20	0.3
	2	108.9	-0.1	+1.0; -2.5	0.20	0.3
	0.25	100.0	0.0	+1.5; -5.0	0.20	0.3
Slow	200	119.5	-0.1	±1.0	0.20	0.3
	2	100.0	0.0	+1.0; -5.0	0.20	0.3

Date of Calibration : 22-28 Feb. 2024

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Request No. 21-67/0231

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10. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Complete cycle	125.4	125.5	0.1	3.0	0.20	0.35
Positive half cycle	124.4	124.1	-0.3	2.0	0.20	0.35
Negative half cycle	124.4	124.1	-0.3	2.0	0.20	0.35

11. Overload indication

Measured value (dB)		Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Positive one-half cycle	Negative one-half cycle				
135.4	135.4	0.0	1.5	0.55	0.25

12. High-level stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	129.0	0.0	0.3	0.10	0.1
End	129.0				

Calibrated by
(Mr. Pannasit Phasingsri)

Approved by
Director

Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration : 22-28 Feb. 2024

Date of Issue : 29 Feb. 2024

Ref: 2011267012400346008

End of Certificate

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Certificate of Calibration

Customer

Name: AIS Laboratory Group Thailand Co., Ltd. Certificate No.: 24-SLM-018
Address: 104 Soi Phatthanasak 40 Phatthanasak Road, Sam Luang, Bangkok 10250 Request No.: Req-2023-2671

Unit Under Calibration Details

Measurement Item: Sound Level Meter Microphone Class: 2
Manufacturer: RION Microphone Model: UC-52
Model: M1-42 Microphone S/N: 180399
Serial Number: 01022261 Pre-amplifier Model: NH-24
ID: BKK_J50930 Pre-amplifier S/N: 88169
Resolution: 0.1 dB Instrument Status: Used

Calibration Environment and Details

Temperature: 23 °C ± 2 °C
Humidity: 50% RH ± 10% 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 61672-1:2013 Electroacoustics - Sound level meters - Part 1: Periodic tests
Location of Calibration: Lab Acoustic

Reference Standard

Instrument	Brand	Model	S/N	Due calibration	Traceability
Standard Microphone	GRAS	40AN	188273	21 August 2024	GRAS
Multifrequency Calibrator	Quest	Questcal	ETAP00234	26 July 2024	ISI
Audio Generator	Scanck	Svan-901	131	9 October 2024	WK 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: PhC
Mr. Neppadon Luangon
Service Calibration Engineer

Approved By: PhC
Mr. Pasi Mathavon
Calibration Engineer Supervisor
Issue Date: 29 January 2024

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

IMP-708 SLM-018 Rev-02 Issue date: 01-12

Certificate No: 24-SLM-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 Weighting Response curve			UNCERTAINTY	Acceptance
FAST - 30-130	A (dB)	C (dB)	Z (dB)	(± dB)	Limit (± dB)
STD Setting					
63 Hz	-0.2	0.1	0.0	0.20	± 0.5
125 Hz	-0.1	0.0	0.0		± 0.5
250 Hz	-0.1	0.0	0.0		± 0.5
500 Hz	0.0	0.0	0.0		± 0.5
1000 Hz	0.0	0.0	0.0		± 0.5
2000 Hz	0.0	0.0	0.0		± 0.5
4000 Hz	0.0	0.0	0.0		± 0.5
8000 Hz	0.0	0.0	0.0		± 0.5
16000 Hz	-1.4	-1.4	0.0		± 0.5

6. Frequency and time weightings at 1 kHz

UUC Setting	STD	Measured		UNCERTAINTY	Acceptance
FAST - 30-130	REF	UUC	ERR	(± dB)	Limit (± dB)
UUC Weighting	(dB)	(dB)	(dB)		
A	114.00	114.0	0.0	0.20	± 0.5
C	114.00	114.0	0.0	0.20	± 0.5
Z	114.00	114.0	0.0	0.20	± 0.5

UUC Setting	STD	Measured		UNCERTAINTY	Acceptance
30-130 A	REF	UUC	ERR	(± dB)	Limit (± dB)
UUC Time Response	(dB)	(dB)	(dB)		
Fast	114.00	114.0	0.0	0.10	± 0.5
Slow	114.00	114.0	0.0	0.10	± 0.5
1 eq	114.00	114.0	0.0	0.10	± 0.5

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IMP-708 SLM-018 Rev-02 Issue date: 01-12

Certificate No: 24-SLM-018
Request No: Req-2023-2671

1. Indication of the calibration check frequency

UUC Setting	Nominal	Before Adjust		After Adjust		UNCERTAINTY	Acceptance
FAST - A - 30-130	Level	UUC	ERR	UUC	ERR	(± dB)	Limit (± dB)
Calibrator Setting	(dB)	(dB)	(dB)	(dB)	(dB)		
1000 Hz 114 dB	113.78	114.3	-0.52	113.8	0.02	0.20	± 0.5

Note: Absolute sensitivity was established by the use of Sound Calibrator Brand SVANTEK, Model SV 35A, SN: 55079

2. Self-generated noise, Microphone installed

UUC Setting	Measured	UNCERTAINTY
FAST - 30-130		(± dB)
UUC Weighting	(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		(± dB)
UUC Weighting	(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 Weighting Response curve			UNCERTAINTY	Acceptance
FAST - 30-130	A (dB)	C (dB)	Z (dB)	(± dB)	Limit (± dB)
STD Setting					
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	± 1.0
8000 Hz	-1.3	1.4	-1.4	0.70	± 2.0

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IMP-708 SLM-018 Rev-02 Issue date: 01-12

Certificate No: 24-SLM-018
Request No: Req-2023-2671

7. Long Term Stability

UUC Setting	Measured	UNCERTAINTY	Acceptance
FAST - A - 30-130		(± dB)	Limit (± dB)
STD Setting	(dB)		
Initial	114.0		
Final	114.0		
Deviation	0.0	0.10	± 0.5

8. Level linearity on the reference level range

UUC Setting	Anticipated	Deviation		UNCERTAINTY	Acceptance
FAST - A - 30-130	REF	UUC	ERR	(± dB)	Limit (± dB)
STD dB	(dB)	(dB)	(dB)		
138.00	138	138.0	0.0	0.10	± 1.0
134.00	134	134.0	0.0	0.10	± 1.0
129.00	129	129.0	0.0	0.10	± 1.0
124.00	124	124.0	0.0	0.10	± 1.0
119.00	119	119.0	0.0	0.10	± 1.0
114.00	114	114.0	0.0	0.10	± 1.0
109.00	109	109.0	0.0	0.10	± 1.0
104.00	104	104.0	0.0	0.10	± 1.0
99.00	99	99.0	0.0	0.10	± 1.0
94.00	94	94.0	0.0	0.10	± 1.0
89.00	89	89.0	0.0	0.10	± 1.0
84.00	84	84.0	0.0	0.10	± 1.0
79.00	79	79.0	0.0	0.10	± 1.0
74.00	74	74.0	0.0	0.10	± 1.0
69.00	69	69.0	0.0	0.10	± 1.0
64.00	64	64.0	0.0	0.10	± 1.0
59.00	59	59.0	0.0	0.10	± 1.0
54.00	54	54.0	0.0	0.10	± 1.0
49.00	49	49.0	0.0	0.10	± 1.0
44.00	44	44.0	0.0	0.10	± 1.0
39.00	39	39.0	0.0	0.10	± 1.0
34.00	34	34.0	0.0	0.10	± 1.0
29.00	29	29.0	0.0	0.10	± 1.0
24.00	24	24.0	0.0	0.10	± 1.0

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

IMP-708 SLM-018 Rev-02 Issue date: 01-12

Certificate No : 24-SLM-018
Request No : Req-2023-2671

9. Level linearity including the level range control

UUC Setting	STD	Measured	UNCERTAINTY	Acceptance
FAST : A	REF	UUC	ERR	Limit
UUC Range	(dB)	(dB)	(dB)	(± dB)
30-130	29.60	29.7	0.1	1.1
	114	114.0	0.0	1.1

10. Tone burst response

UUC Setting	STD	Anticipated	Measured	UNCERTAINTY	Acceptance
A : 30-130	Timeburst	Ref	UUC	ERR	Limit
UUC Time Response	(ms)	(dB)	(dB)	(dB)	(± dB)
Fast	200	126.0	126.0	0.0	1.0
	2	109.0	108.9	-0.1	+1.0, -2.5
	0.25	100.0	99.9	-0.1	+1.5, -5.0
Slow	200	119.6	119.6	0.0	1.0
	2	100.0	100.0	0.0	+1.0, -5.0
	0.25	91.0	90.8	-0.2	+1.0, -2.5

11. Peak C Sound level

UUC Setting	Anticipated	Measured	UNCERTAINTY	Acceptance
FAST : C / 55-141	REF	UUC	ERR	Limit
STD Setting	(dB)	(dB)	(dB)	(± dB)
Complete cycle	136.4	136.3	-0.10	3.0
Positive 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 Innovative Instrument Co., Ltd.

TM-708-SLM-01 Rev-02 Issue Date: 7-19-23

Certificate No : 24-SLM-018
Request No : Req-2023-2671

12. Overload indication

UUC Setting	Measured	UNCERTAINTY	Acceptance
FAST : A : 30-130	UUC	(± dB)	Limit
STD Setting	(dB)	(± dB)	(± dB)
Positive one-half cycle	139.4		
Negative one-half cycle	139.5		
Deviated	-0.1	0.20	1.5

13. High Level Stability

UUC Setting	Measured	UNCERTAINTY	Acceptance
FAST : A : 30-130	UUC	(± dB)	Limit
STD Setting	(dB)	(± dB)	(± dB)
Initial	129.0		
Final	129.0		
Deviated	0.0	0.10	0.30

Note :

Function	Maximum-permitted Uncertainty of measurement
1. Indication at the calibration check frequency	Not applicable
2. Self-generated noise, Microphone installed	Not applicable
3. Self-generated noise, Microphone replaced by the electrical input signal device	Not applicable
4. Acoustic signal test of frequency weightings at 10 Hz to 4 kHz	0.60 dB
4. Acoustic signal test of frequency weightings at 4 kHz to 10 kHz	0.70 dB
5. Electrical signal test of frequency weightings, Weighting network response with relative to 1 kHz	0.20 dB
6. Frequency and time weightings at 1 kHz	0.20 dB
7. Long Term Stability	0.20 dB
8. Level linearity on the reference level range	0.10 dB
9. Level linearity including the level range control	0.30 dB
10. Tone burst response	0.30 dB
11. Peak C Sound level	0.30 dB
12. Overload indication	0.25 dB
13. High Level Stability	0.25 dB
Acceptance limit and Maximum permitted Uncertainty was IEC 61072-1:2013	0.10 dB

End of Certificate

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

TM-708-SLM-01 Rev-02 Issue Date: 7-19-23



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES
431 PATTANAKARN ROAD SOI 18, MUANG LUANG SUKUMVIT 11, BANGKOK 10110
TEL : 0-2717-8000 FAX : 0-2719-9452



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 Lemgagrakul

Approved by : *Sathip*
Approved Signatory

(✓) Sathip Meangmai
() Warakorn Lemgagrakul
() Ponpan Paipim

Issue Date : 31 October 2023

The Uncertainties are for a confidence probability of approximately 95%

This certificate may not be reproduced or altered in any way without the prior written approval of the Technology Promotion Association (Thailand-Japan)



Cert.No.: 23CH1369
Page: 2 of 3

Condition of this calibration result

- Reference Standard Instrument :
Instrument : Serial No. ID No. Cert. No. Due Date
1) Ref. Standard Thermometer 4982054 110RC044 231908 26 Jul 2024
This certification is traceable to the International System of Unit maintained through :
- Technology Promotion Association (Thailand-Japan)
- Certified Reference Materials : The measurement results are traceable to SI through CPA chem Ltd.,
ANSI-ASQ National Accreditation Board, Accredited No. AP-1635

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
	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



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 %.

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Saithy

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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 Soi 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 Soi 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 6391-14
Traceability: This certificate is traceable to the SI Units maintained by CRM of NIST(SRM) through CFA Chem Co., Ltd. (ISOMEC 17034) Certificate No. 890590, 890591, 890592

(Mr.Siwapan Srijan)

Person in charge

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

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

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

DKSH Technology Limited
2533 Sukhumvit Road, Bangkok, Thailand 10260
Phone: +66 2929 7000 Email: info@dksh.com Website: www.dksh.com/scientific-thailand

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CAL-FM-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 $\mu\text{S/cm}$	92.54 $\mu\text{S/cm}$	-8.540 $\mu\text{S/cm}$	2.00	0.68 $\mu\text{S/cm}$
1413.0 $\mu\text{S/cm}$	1423 $\mu\text{S/cm}$	-10.0 $\mu\text{S/cm}$	2.00	11 $\mu\text{S/cm}$
12.880 mS/cm	12.81 mS/cm	0.070 mS/cm	2.00	0.10 mS/cm

After Adjustment : at 84.0 $\mu\text{S/cm}$, 1413 $\mu\text{S/cm}$, 12.88 mS/cm

Standard Conductivity Solution	Unit Under Calibration Reading	Correction	Coverage Factor (k)	Uncertainty (±)
84.000 $\mu\text{S/cm}$	84.03 $\mu\text{S/cm}$	-0.030 $\mu\text{S/cm}$	2.00	0.68 $\mu\text{S/cm}$
1413.0 $\mu\text{S/cm}$	1414 $\mu\text{S/cm}$	-1.0 $\mu\text{S/cm}$	2.00	11 $\mu\text{S/cm}$
12.880 mS/cm	12.86 mS/cm	0.020 mS/cm	2.00	0.098 mS/cm

The End of Certificate



ใบตรวจสอบสภาพเครื่องวัดค่าความนำไฟฟ้า

เลขที่ใบงาน: WO-00012682

ชนิดเครื่องวัด: CONDUCTIVITY METER		รุ่น: ORION STAR A215	หมายเลขเครื่อง: X58031
การสอบ (วัน)	รายการตรวจสอบ	ตรวจสอบ (ผ่าน)	หมายเหตุ
25 Dec 2023		25 Dec 2023	
ปกติ	ผิดปกติ	ปกติ	ผิดปกติ
General			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	1. ความสมบูรณ์เครื่อง	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	2. ความสะอาด (ใช้น้ำกลั่นล้าง, ภายใน-นอกเครื่อง)	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	3. สวิตช์ เปิด - ปิด เครื่อง (On-Off Switch)	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	4. คีย์บอร์ด (Keypad)	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	5. หน้าจอ (Display, Screen Contrast)	<input checked="" type="checkbox"/>
Spectrophotometer			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	6. แบตเตอรี่ (Battery Backup) ≥ 2.5 VDC	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	7. ความแม่นยำความยาวคลื่น (Wavelength Control)	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	8. ความยาวคลื่น (Wavelength Check)	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	9. แหล่งกำเนิดแสง (UV $< 3,000$ hour)	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	10. แหล่งกำเนิดแสง (Visible $< 5,000$ hour)	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	11. ช่องใส่ตัวอย่าง (Carousel Module)	<input checked="" 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 checked="" type="checkbox"/>	<input type="checkbox"/>	13. ระดับความเข้มข้นอิเล็กโทรด (Level KCl)	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	14. ฝาปิดกันฝุ่นอิเล็กโทรด (Dust Protection Hood)	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	15. ขาตั้งอิเล็กโทรด (Stand)	<input checked="" type="checkbox"/>
Turbidimeter			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	16. ค่าความขุ่น (No Sample)	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	17. ระดับการกรองสารแขวนลอย (≥ 2.5 ไมครอน 3.0)	<input checked="" type="checkbox"/>
Automatic titrator			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	18. สลัก Piston Burettes	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	19. Function Rinsing and Dosing	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	20. ระบบทำความสะอาดอุปกรณ์ประกอบ	<input checked="" type="checkbox"/>

ผู้ตรวจ:

Mr.Siwapan Srijan
Service Engineer

DKSH Technology Limited
2533 Sukhumvit Road, Bangkok, Thailand 10260
Phone: +66 2929 7000 Email: info@dksh.com Website: www.dksh.com/scientific-thailand

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CAL-FM-C24-09: 12 Sep 2022

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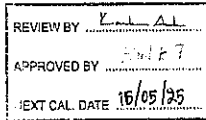
CAL-FM-R31-03: 20 Jul 2022



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, Khet Suan Luang,
Bangkok 10250 Thailand
Laboratory Condition : Temperature (25 ± 5) °C
Humidity (50 ± 20) %
Test Procedure : In - house method : CP-CH9
by Comparison Technique with Azide Modification Method
Tested by : Walalak Sirithean
Approved by :
() Saithep Meangmai
() Warakorn Lemgagrakul
() Ponpan Palpim
Issue Date : 17 November 2023



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)	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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Saithep



Cert. No.: 23LM182
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, Khet 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 Prompret
Approved by :
() Pomthippa Tameyskul
() Ponpan Palpim
() Suwit Imjai
Issue Date : 17 November 2023



Equipment : DO Meter with Sensor
Condition As-Received : Used Item
Reference : 2311-0505DSC-10
Procedure Used :-

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

Condition of this result of calibration

1. Reference standard instrument:-
- | Instrument | Serial No. | Cert. No. | Traceable | Due Date |
|------------------------|------------|-----------|-----------|-------------|
| 1) Digital Thermometer | 3240076 | 23I305 | 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.: 16K100498

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 %.

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The Uncertainties are for a confidence probability of approximately 95%

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

A 0060730

a 1190298

Saithep

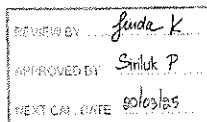


CERTIFICATE No : 24T2852
REFERENCE No : 72619-8

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 PHATTHANAKAN 40, PHATTHANAKAN
RD., KHWAENG PHATTHANAKAN, KHET SUAN
LUANG, DANGKOK 10250, THAILAND



CALIBRATED BY : CHAICHARN 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-G010 REV 03



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 : 34 %RH ± 10 %RH

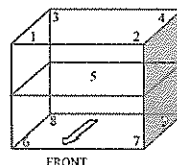
CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED ACCORDING TO TLAS 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	7286368	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



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	Ref 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-G010 REV 03



Certificate of Calibration

Cert.No.: 24C952
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

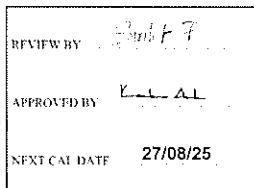
Ambient Temperature : (20 ± 2.5) °C
Relative Humidity : (50 ± 10) %
Barometric Pressure : 760 mmHg
Calibration Procedure : ASTM E 542 - 01

Calibrated by : Natcha Chayyingcheiw

Approved by :

() Unnophol Harachai
(✓) Srisuda Kharntha
() Sa-nguankam Wongsa

Issue Date : 27 February 2024



Equipment : Burette
Received Date : 23 February 2024
Condition As-Received : New Item
Calibration Date : 27 February 2024
Reference : 2402-075DSC-1

Cert.No.: 24C952
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	231948	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 %

-e9a-

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



Certificate No. T232157

Page 1 of 4

Certificate of Calibration

Equipment : Hot Block
Manufacturer : Environmental Express
Model : B3000-240
Serial No. : 2021CODW148
Customer Code : BKK_EN0370
ID No. : T2940A5
Customer : ALS Laboratory Group (Thailand) Co.,Ltd.
104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan,
Khet Suan Luang, Bangkok 10259
Customer Location : Wet Chemistry Lab2
Date of Receipt : 29 November 2023
Calibrated By : Sujjar Naknakred (Site Calibration Manager)
Approved By : Ponchai Suriyawong / Ponchai Suriyawong (Site Calibration Manager)
Date of Issue : 18 DEC 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



Certificate No. T232157

Page 2 of 4

Calibration Report

Equipment : Hot Block
Date of Calibration : 6 December 2023
Environment : Temperature : 20.1°C-23.0°C
Line Voltage : 222.1-227.3 V
Relative Humidity : 55 - 65 %RH

Condition of this results of calibration :

1. This equipment was calibrated by insert 29 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 .

2. Reference Standard Instrument

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	TYPE T	TN221-TN230	T230546	10 April 2024
TC	TYPE T	TN231-TN240	T230546	10 April 2024
TC	TYPE T	TN261-TN270	T230548	10 April 2024
DATA LOGGER	34970A	T149	T230546	10 April 2024

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 : 2 Hour 6 Minute At 150 °C
Fresh Air Damper : ☐ Open ☐ Min ☐ Medium ☐ Max
☐ Close
☒ Not Available

5. Adjustment :

() without adjustment (X) after adjustment

Approved By : Ponchai Suriyawong

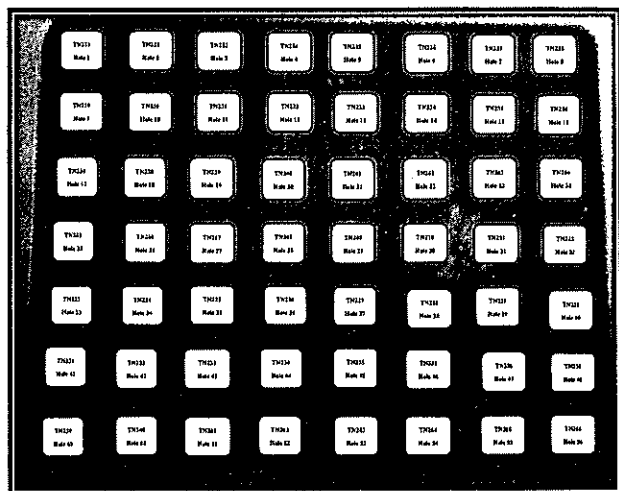
FM-L13 108/30-05-57



Certificate No. T232157

Page 3 of 4

Calibration Report



FRONT CONTROL

Approved By : Ponchai Suriyawong

FM-L13 108/30-05-57



Certificate No. T232157

Pag 4 of 4

Calibration Report

Measurement Results

CAL POINT		Average Standard Reading at each position (°C)																												
		TN211 (Pos 1)	TN212 (Pos 2)	TN213 (Pos 3)	TN214 (Pos 4)	TN215 (Pos 5)	TN216 (Pos 6)	TN217 (Pos 7)	TN218 (Pos 8)	TN219 (Pos 9)	TN220 (Pos 10)	TN221 (Pos 11)	TN222 (Pos 12)	TN223 (Pos 13)	TN224 (Pos 14)	TN225 (Pos 15)	TN226 (Pos 16)	TN227 (Pos 17)	TN228 (Pos 18)	TN229 (Pos 19)	TN230 (Pos 20)	TN231 (Pos 21)	TN232 (Pos 22)	TN233 (Pos 23)	TN234 (Pos 24)	TN235 (Pos 25)	TN236 (Pos 26)	TN237 (Pos 27)	TN238 (Pos 28)	TN239 (Pos 29)
150	Max	150.32	150.09	149.98	150.99	150.95	150.44	149.85	150.22	150.51	150.88																			
	Min	150.10	149.85	149.69	150.71	150.66	150.21	149.67	150.06	150.35	150.66																			
	Average	150.09	150.49	150.49	150.84	150.84	150.26	150.26	150.32	150.32	150.77																			
	Max	150.69	150.16	149.28	149.44	149.73	150.04	150.31	150.60	150.98	150.67																			
	Min	150.43	149.81	149.01	149.23	149.35	149.30	150.60	150.45	150.75	150.45																			
	Average	150.56	150.64	149.34	149.33	149.64	149.97	150.18	150.83	150.87	150.56																			
	Max	150.26	150.26	149.87	149.58	150.07	149.93	150.95	150.48	150.21	150.54																			
	Min	150.02	150.02	149.81	149.79	149.82	149.80	150.56	150.23	149.92	150.33																			
	Average	150.14	150.14	149.74	149.89	149.94	149.87	150.73	150.36	150.86	150.43																			
	Max	150.85	150.53	150.41	151.45	150.87	150.84	150.97	150.73	150.51	150.12																			
	Min	150.41	150.24	151.18	150.41	150.41	150.68	150.73	150.23	150.24	149.91																			
	Average	150.53	150.41	150.89	150.93	150.64	150.76	150.83	150.48	150.38	150.51																			
	Max	150.27	150.83	150.53	149.72	149.41	149.83	151.24	150.84	151.11	150.75																			
	Min	149.92	150.64	150.34	149.50	149.14	149.48	150.54	150.37	150.74	150.51																			
	Average	150.12	150.74	150.43	149.61	149.28	149.65	150.95	150.61	150.92	150.63																			
	Max	150.16	150.41	150.78	150.65	150.23	149.58																							
	Min	149.95	150.24	150.59	150.46	150.06	149.40																							
	Average	150.06	150.33	150.68	150.54	150.17	149.49																							

Setting (°C)		Reading (°C)		Temperature Distribution	
		Min, Max	Average	Stability (°C)	Uncertainty (°C)
150.0		149.9, 150.1	150.0	0.31	1.02

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 : Ponchai Suriyawong

FM-L13 108/30-05-57



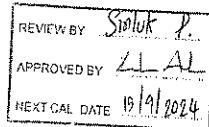
Bara Scientific Co., Ltd.
958 U Chu Leng Building Floor 7 Rama4 Road
Siam Bangkok, Bangkok Thailand 10250
Tel: 02-6324300 Fax: 02-6375406-7
www.barscientific.com



Certificate of Calibration

Certificate No. BSCC-UV-357/23
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 15 September 2023
Date of issue 22 September 2023

Number of Page(s) 1 of 3



Customer name ALS Laboratory Group (Thailand) Co., Ltd

Address 104 Soi Phattanakarn 40, Phattanakarn Road, Phattanakarn, 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. 95908
The above certificate are traceable to SI unit through Stamp Scientific Ltd
(UKAS accredited calibration laboratory NO. 0659)

Calibrated by Mr Wanchana Janitay

Approved by

Mr. Kanchit Choothep
Technical Manager

The above results are valid exclusively for the calibrated items as mentioned in this report. No other
Advertising the report. Certificate and calibration of the results are prohibited and shall not be reproduced
except in full without written approval of the Bara Scientific Co., Ltd.



Bara Scientific Co., Ltd.
958 U Chu Leng Building Floor 7 Rama4 Road
Siam Bangkok, Bangkok Thailand 10250
Tel: 02-6324300 Fax: 02-6375406-7
www.barscientific.com



Certificate of Calibration

Certificate No. BSCC-UV-357/23

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
572.69	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	0.8648	-0.0016	0.0075
313	0.0000	0.0000	0.0000	0.0075
	0.2904	0.2909	0.0004	0.0075
350	0.0000	0.0001	0.0001	0.0075
	0.6428	0.6415	-0.0014	0.0075

*CNR = Customer not request

The above results are valid exclusively for the calibrated items as mentioned in this report. No other
Advertising the report. Certificate and calibration of the results are prohibited and shall not be reproduced
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FM UV 702-02 Rev 01 (2301/23)



Bara Scientific Co., Ltd.
958 U Chu Leng Building Floor 7 Rama4 Road
Siam Bangkok, Bangkok Thailand 10250
Tel: 02-6324300 Fax: 02-6375406-7
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
	0.5783	0.5793	0.0010	0.0042
	0.7628	0.7624	-0.0004	0.0042
	1.6205	1.6216	0.0010	0.0042
440.0	0.0000	0.0000	0.0000	0.0042
	0.5021	0.5025	0.0004	0.0042
	0.7455	0.7452	-0.0003	0.0042
	0.9983	0.9989	0.0006	0.0042
460.0	0.0000	0.0000	0.0000	0.0042
	0.5227	0.5229	0.0002	0.0042
	0.6880	0.6873	-0.0007	0.0042
	0.8487	0.8486	-0.0001	0.0042
540.1	0.0000	0.0000	0.0000	0.0042
	0.5207	0.5211	0.0004	0.0042
	0.6973	0.6969	-0.0004	0.0042
	0.9953	0.9944	-0.0009	0.0042
590.0	0.0000	0.0000	0.0000	0.0042
	0.5544	0.5538	-0.0006	0.0042
	0.7293	0.7236	-0.0057	0.0042
	1.6942	1.6925	-0.0017	0.0042
635.0	0.0000	0.0000	0.0000	0.0042
	0.5016	0.5012	-0.0004	0.0042
	0.6927	0.6899	-0.0028	0.0042
	1.6881	1.6866	-0.0015	0.0042

*CNR = Customer not request

4. Stray Light*

Standard cut-off wavelength (nm)	Wavelength (nm)	Transmission (%)	Absorbance (A)
200.96±0.11nm	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

The above results are valid exclusively for the calibrated items as mentioned in this report. No other
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except in full without written approval of the Bara Scientific Co., Ltd.

Sartorius (Thailand) Co., Ltd.
120 Rama 9 Road, Huaywang, Huaywang Bangkok 10310
Tel: +66 2543 8301-8 e-mail: service.thailand@sartorius.com



Certificate of Calibration

Model Number MSE2245-100-DU
Description Analytical Balance
Serial Number 27405555
ID No BKK_EN0003
Manufacturer Sartorius

Certificate No. 23SC10510
Issued Date Friday, August 11, 2023
Reference No. 216011

Page No. 1 of 2

Customer Name ALS Laboratory Group (Thailand) Co., Ltd

104 Phattanakarn 40, Phattanakarn Rd., Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250

Calibrated Place Lab Room

Calibrated By Mr Chonchai Inthana

Calibration Date Wednesday, August 09, 2023

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

Metrological data

Capacity 220 g Readability 0.0001 g

Ambients Conditions

Temperature 22.8 °C ± 5.0 °C

Humidity 59.0 % RH ± 10.0 % RH

Pressure ±

Reasons for calibration

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

Equipment Condition ☒ Good Operation ☐ Fail

Measurement Method UKAS Publication Ref: Lab 14

The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM). 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
YCS011-522-06	Sartorius weight set 1mg - 5000g E2 YCS011-522-06	SPC-RT	C02212565	14-Sep-2023
MHB-3925D	Humidity/Barometer/Temp. Luton MHB-3925D	DKSH	C19220444	5-Sep-2023

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

Mr chonchai inthana (Technical Manager)

SOP FM 33 03 February 2022





Model Number :	MSE224S-100-DU
Description :	Analytical Balance
Serial Number :	27405555
ID No. :	BKK_EN0003
Manufacturer :	Sartorius

Certificate No. : 23BCI0310
Issued Date : Friday, August 11, 2023
Reference No. : 216011

Page No. : 2 of 2

Calibration Results : Without Adjustment

Repeatability			Eccentricity (Off-center loading error)																							
The reproducibility is the ability of a weighing instrument to display nearly identical readings under constant test conditions when the same load with a measurement error 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 resultant of the load, i.e. 1/8 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 R75).																							
Nominal Value : (Low Load)	20.0000	200.0000	Nominal value :	100	g																					
20 g	20.0000	200.0000	Tolerance	0.0004	g																					
Tolerance	20.0000	200.0000																								
0.0001 g	20.0000	200.0001																								
Nominal Value : (High Load)																										
200 g	20.0000	200.0000	<table> <tr> <th colspan="2"></th><th>Difference</th></tr> <tr> <td>1</td><td>-</td><td>-</td></tr> <tr> <td>2</td><td>0.0001</td><td>-</td></tr> <tr> <td>3</td><td>0.0000</td><td>-</td></tr> <tr> <td>4</td><td>0.0000</td><td>-</td></tr> <tr> <td>5</td><td>0.0001</td><td>-</td></tr> <tr> <td>6</td><td>-</td><td>-</td></tr> </table>					Difference	1	-	-	2	0.0001	-	3	0.0000	-	4	0.0000	-	5	0.0001	-	6	-	-
		Difference																								
1	-	-																								
2	0.0001	-																								
3	0.0000	-																								
4	0.0000	-																								
5	0.0001	-																								
6	-	-																								
Tolerance	20.0000	200.0001																								
0.0001 g	20.0000	200.0001																								
Standard Deviation																										
0.00003																										

Linearity				
The linearity, also called linearity error, describes the deviation of the characteristic curve of a weighing instrument from the linear slope.				
Tolerance		0.0002	g	
Nominal Value (g)	Conventional Mass Value (g)	Displayed Value (g)	Deviation (g)	Uncertainty (g)
0.01	0.0100	0.0100	0.0000	0.00014
0.1	0.1000	0.1000	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
50	50.0000	50.0001	0.0001	0.00015
100	100.0000	100.0000	0.0000	0.00019
200	200.0000	200.0001	0.0001	0.00030

End of Report.

SOP FM 33 03 February 2022.



Metrology
SCI ECO Services Company Limited
33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110, Thailand



Certificate No. T232009

Page 2 of 3

Calibration Report

Equipment : Chamber (Oven)
Date of Calibration : 6 November 2023
Environment : Temperature : 27.6-28.1 °C
Line Voltage : 222.7-227.4 V
Relative Humidity : 55 - 65 %RH

Condition of this results of calibration :

- 1 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 Yi-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 .

- | Instrument | Model | Instrument No. | Certificate No. | Due Date |
|-------------|---------|----------------|-----------------|---------------|
| RTD | 100 ohm | 31-(CH1-10) | T230504 | 24 March 2024 |
| DATA LOGGER | 34970A | T114 | T230504 | 24 March 2024 |

- 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 2 Hour 50 Minute At 104 °C
Fresh Air Damper ☒ Open ☒ Min ☐ Medium ☐ Max
☐ Close
☐ Not Available

5. Adjustment :
(X) without adjustment () after adjustment

Approved By.



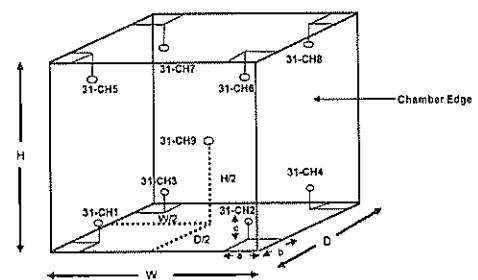
Metrology
SCI ECO Services Company Limited



Certificate No. T232009

Page 3 of 3

Calibration Report



Remark : Internal Dimensions of Chamber : W (Width) = 56 cm, H (Height) = 41 cm, and D (Depth) = 48 cm.
Size of Installed Standard sensor number 31-CH116 number 31-CH : a = 5 cm, b = 5 cm, and c = 5 cm.
Size of Installed Standard sensor number 31-CH9 : W/2 = 56 cm./2 H/2 = 41 cm./2 and D/2 = 48 cm./2

Measurement Results	Average Standard Reading at each position (°C)								
Calibration Point	31-CH1	31-CH2	31-CH3	31-CH4	31-CH5	31-CH6	31-CH7	31-CH8	31-CH9
104	103.82	104.10	103.74	104.28	103.95	104.31	103.87	104.00	103.81
160	160.04	160.21	179.44	160.31	178.02	180.13	180.17	180.35	179.69

Chamber (Oven)			Temperature Distribution				
Setting (°C)	Reading (°C)		Average (°C)	Stability (±°C)	Uniformity (°C)	Uncertainty (±°C)	Coverage Factor <i>k</i>
	Min, Max	Average					
104.0	-	104.0	103.99	0.14	0.60	0.42	2.00
110.0	-	110.0	109.93	0.35	0.78	0.53	2.00

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: 



Metrological Center

SCI ECO Services Company Limited

33/2 Moo 3, T. Banpa, A. Kaengkhroi, Saraburi 18110 Thailand
Saraburi Tel : +66 3627 3096 Fax : +66 3627 3100
Bangkok Tel : +668 9205 6851 , +668 8247 2360
Website : www.sci-eco.co.th E-Mail : calibrate@scg.com



Metrological Center

SCI ECO Services Company Limited

33/2 Moo 3, T. Banpa, A. Kaengkhroi, Saraburi 18110, Thailand



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, Phatthanakao 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 : Bun Loo / 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.

PMI-14118 31-06-63

PMI-14117 15-05-63



Metrological Center

SCI ECO Services Company Limited

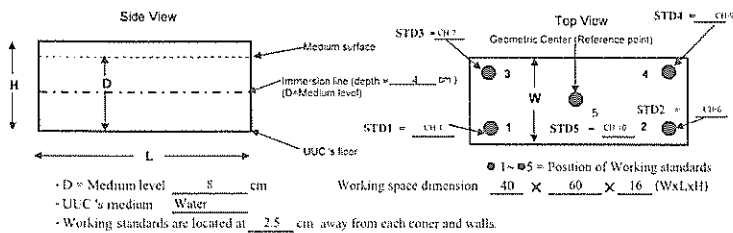
33/2 Moo 3, T. Banpa, A. Kaengkhroi, Saraburi 18110 Thailand



Certificate No. T231303

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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	93.71	93.83	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					
61.0	60.9	61.1	61.0	0.13	0.19	0.29	2.64
86.0	85.8	86.2	86.0	0.19	0.47	0.44	2.17
95.0	94.6	95	94.9	0.32	0.65	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: Bun Loo

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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: Bun Loo