

# ภาคผนวก ง

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เอกสารการสอบเทียบเครื่องมือตรวจวิเคราะห์



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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_FS0374	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	BKK_FS1378	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	BKK_FS1061	-	-	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_FS1057	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	BKK_FS1376	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	BKK_FS0368	-	-	On site Calibration
Ambient	Total Suspended Particulate	Digital Balance	BKK_EN0403	3-Jun-24	3-Jun-25	12
Ambient	Iron as FeO <sub>2</sub>	High Volume	BKK_FS1057	-	-	On site Calibration
Ambient	Iron as FeO <sub>2</sub>	High Volume	BKK_FS1376	-	-	On site Calibration
Ambient	Iron as FeO <sub>2</sub>	High Volume	BKK_FS0368	-	-	On site Calibration
Ambient	Iron as FeO <sub>2</sub>	ICP-OES	BKK_EL0037	29-Feb-24	28-Feb-25	12
Ambient	Nitrogen Dioxide	NO <sub>2</sub> Analyzer	BKK_FS0803	3-Jul-24	3-Jan-25	6
Ambient	Nitrogen Dioxide	NO <sub>2</sub> Analyzer	BKK_FS0782	2-Jul-24	2-Jan-25	6
Ambient	Nitrogen Dioxide	NO <sub>2</sub> Analyzer	BKK_FS0785	2-Jul-24	2-Jan-25	6
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_FS0887	4-Jan-24	4-Jul-25	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS0917	23-May-23	23-Nov-24	18
Stack	Oxides of Nitrogen	Console Control Unit	BKK_FS0547	6-Jul-24	6-Jan-25	6
Stack	Oxides of Nitrogen	Pitot Tube	BKK_FS0501	3-Jun-24	3-Dec-24	6
Stack	Oxides of Nitrogen	Pitot Tube	BKK_FS0489	3-Jun-24	3-Dec-24	6
Stack	Oxides of Nitrogen	Flue gas Analyzer	BKK_FS1156	10-Jan-24	9-Jan-25	12
Stack	Oxides of Nitrogen	Vacuum Gauge	BKK_FS0896	31-Jan-24	31-Jul-25	18
Stack	Oxides of Nitrogen	Spectrophotometer	BKK_EN0018	15-Sep-23	15-Sep-24	12
Stack	Total Suspended Particulate	Console Control Unit	BKK_FS0547	6-Jul-24	6-Jan-25	6
Stack	Total Suspended Particulate	Pitot Tube	BKK_FS0501	3-Jun-24	3-Dec-24	6
Stack	Total Suspended Particulate	Pitot Tube	BKK_FS0489	3-Jun-24	3-Dec-24	6
Stack	Total Suspended Particulate	Pitot Tube	BKK_FS0541	5-Jul-24	5-Jan-25	6
Stack	Total Suspended Particulate	Flue gas Analyzer	BKK_FS1156	10-Jan-24	9-Jan-25	12
Stack	Total Suspended Particulate	Digital Balance	BKK_EN0309	30-Nov-23	30-Nov-24	12
Stack	Triethanolamine (TEA)	Console Control Unit	BKK_FS0547	6-Jul-24	6-Jan-25	6
Stack	Triethanolamine (TEA)	Pitot Tube	BKK_FS0489	3-Jun-24	3-Dec-24	6
Stack	Triethanolamine (TEA)	Flue gas Analyzer	BKK_FS1156	10-Jan-24	9-Jan-25	12
Stack	Triethanolamine (TEA)	Dry Gas	BKK_FS0543	3-Jun-24	3-Dec-24	6
Workplace	Total Dust	DRYCAL FLOWMETER	BKK_FS1347	18-Aug-23	18-Aug-24	12
Workplace	Total Dust	DRYCAL FLOWMETER	BKK_FS1346	29-Jan-24	28-Jan-25	12
Workplace	Total Dust	Digital Balance	BKK_EN0403	3-Jun-24	3-Jun-25	12
Workplace	Respirable Dust	DRYCAL FLOWMETER	BKK_FS1347	18-Aug-23	18-Aug-24	12
Workplace	Respirable Dust	DRYCAL FLOWMETER	BKK_FS1346	29-Jan-24	28-Jan-25	12
Workplace	Respirable Dust	Digital Balance	BKK_EN0403	3-Jun-24	3-Jun-25	12
Workplace	Chromium	DRYCAL FLOWMETER	BKK_FS1347	18-Aug-23	18-Aug-24	12
Workplace	Chromium	DRYCAL FLOWMETER	BKK_FS1346	29-Jan-24	28-Jan-25	12
Workplace	Chromium	ICP-OES	BKK_EL0037	29-Feb-24	28-Feb-25	12
Workplace	Silica (SiO <sub>2</sub> )	DRYCAL FLOWMETER	BKK_FS1347	18-Aug-23	18-Aug-24	12
Workplace	Silica (SiO <sub>2</sub> )	DRYCAL FLOWMETER	BKK_FS1346	29-Jan-24	28-Jan-25	12
Workplace	Silica (SiO <sub>2</sub> )	Spectrophotometer	BKK_EN0018	15-Sep-23	15-Sep-24	12
Workplace	Silica (SiO <sub>2</sub> )	Spectrophotometer	BKK_EN0018	13-Sep-24	13-Sep-25	12
Workplace	Manganese	DRYCAL FLOWMETER	BKK_FS1347	18-Aug-23	18-Aug-24	12
Workplace	Manganese	DRYCAL FLOWMETER	BKK_FS1346	29-Jan-24	28-Jan-25	12
Workplace	Manganese	ICP-OES	BKK_EL0037	29-Feb-24	28-Feb-25	12
Workplace	Triethanolamine (TEA)	DRYCAL FLOWMETER	BKK_FS1347	18-Aug-23	18-Aug-24	12
Workplace	Triethanolamine (TEA)	DRYCAL FLOWMETER	BKK_FS1346	29-Jan-24	28-Jan-25	12
Noise	Leq 24 hrs	Sound Calibrator	BKK_FS0632	26-Jan-24	25-Jan-25	12
Noise	Leq 24 hrs	Sound Level Meter	BKK_FS0030	29-Jan-24	28-Jan-25	12
Noise	Leq 24 hrs	Sound Level Meter	BKK_FS0103	5-Jan-24	4-Jan-25	12
Noise	Leq 24 hrs	Sound Level Meter	BKK_FS0101	29-May-24	29-May-25	12



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รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

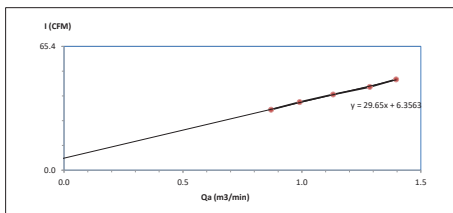
Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Noise	Leq 24 hrs	Sound Level Meter	BKK_FS0100	30-Aug-24	30-Aug-25	12
Noise	Leq 24 hrs	Sound Level Meter	BKK_FS0104	29-Jan-24	28-Jan-25	12
Noise	Leq 24 hrs	Sound Level Meter	BKK_FS0099	30-Aug-24	30-Aug-25	12
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
Noise	Noise Annoyance	Sound Level Meter	BKK_FS0103	5-Jan-24	4-Jan-25	12
Noise	Noise Annoyance	Sound Level Meter	BKK_FS0031	27-Jun-24	27-Jun-25	12
Noise	Noise Annoyance	Sound Level Meter	BKK_FS0101	29-May-24	29-May-25	12
Noise	Noise Annoyance	Sound Level Meter	BKK_FS0100	30-Aug-24	30-Aug-25	12
Noise	Noise Annoyance	Sound Level Meter	BKK_FS0104	29-Jan-24	28-Jan-25	12
Noise	Noise Annoyance	Sound Level Meter	BKK_FS0099	30-Aug-24	30-Aug-25	12
Noise	Noise Annoyance	Sound Level Meter	BKK_FS0107	29-Nov-23	28-Nov-24	12
Noise	Noise Annoyance	Sound Level Meter	BKK_FS0028	9-Apr-24	8-Apr-25	12
Noise	Leq 8 hrs	Sound Calibrator	BKK_FS0632	26-Jan-24	25-Jan-25	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS1217	7-Nov-23	7-Nov-24	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS1218	7-Nov-23	7-Nov-24	12
Noise	Leq 8 hrs	Sound Calibrator	BKK_FS0630	27-Jun-24	27-Jun-25	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS0996	23-Aug-24	23-Aug-25	12
Noise	Leq 8 hrs	Sound Calibrator	BKK_FS1221	19-Dec-23	18-Dec-24	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS1216	7-Nov-23	7-Nov-24	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS1217	7-Nov-23	7-Nov-24	12
Noise	Leq 8 hrs	Sound Level Meter	BKK_FS1218	7-Nov-23	7-Nov-24	12
Heat	Heat Stress	Heat Stress Monitor	BKK_FS0677	21-Jun-24	21-Jun-25	12
Heat	Heat Stress	Heat Stress Monitor	BKK_FS0678	14-Feb-24	13-Feb-25	12
Heat	Heat Stress	Heat Stress Monitor	BKK_FS0679	27-Oct-23	27-Oct-24	12
Noise	Noise Dose, TWA	Dose Badge Reader	BKK_FS0622	7-May-24	7-May-25	12
Noise	Noise Dose, TWA	Dose Badge Reader	BKK_FS0931	29-Jan-24	28-Jan-25	12
Illuminance	Illuminance	Lux Meter	BKK_FS1395	21-Nov-24	21-Nov-25	12
Water Lab	pH at 25 °C	pH meter	BKK_EN0342	17-Oct-24	17-Oct-25	12
Water Lab	Total Suspended Solids	Electronic Top-Loading Balance	BKK_EN0003	2-Aug-24	2-Aug-25	12
Water Lab	Total Suspended Solids	Oven	BKK_EN0273	14-May-24	14-Nov-25	18
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_EN0222	22-Apr-24	22-Apr-25	12
Water Lab	COD	Spectrophotometer	BKK_EN0018	13-Sep-24	13-Sep-25	12
Water Lab	Dissolved Oxygen	Burette	BKK_EN0171	27-Feb-24	27-Aug-25	18
Water Lab	Dissolved Oxygen	Chamber (Cooling Room)	BKK_EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Oil & Grease	Electronic Top-Loading Balance	BKK_EN0003	2-Aug-24	2-Aug-25	12
Water Lab	Oil & Grease	Water Bath	BKK_EN0148	4-Jul-23	4-Jan-25	18
Water Lab	Total Kjeldahl Nitrogen	Digestion Unit	BKK_EN0366	21-Apr-24	21-Apr-25	12
Water Lab	Total Kjeldahl Nitrogen	Discrete analyzer	BKK_EN0037	16-Aug-24	16-Aug-25	12
Water Lab	Total Dissolved Solids 180°C	Electronic Top-Loading Balance	BKK_EN0003	2-Aug-24	2-Aug-25	12
Water Lab	Total Dissolved Solids 180°C	Oven	BKK_EN0273	14-May-24	14-Nov-25	18
Water Lab	Chromium	ICP-MS	BKK_EL0026	12-Dec-23	13-Jun-25	18
Water Lab	Chromium	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Chromium	Chamber (Cooling Room)	BKK_EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Iron	ICP-MS	BKK_EL0026	12-Dec-23	13-Jun-25	18
Water Lab	Iron	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Iron	Chamber (Cooling Room)	BKK_EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Manganese	ICP-MS	BKK_EL0026	12-Dec-23	13-Jun-25	18
Water Lab	Manganese	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Manganese	Chamber (Cooling Room)	BKK_EN0167	6-Dec-23	6-Jun-25	18



### High Volume Air Sampler Calibration Worksheet

Project Site : Magotteaux Co., Ltd. Barometric Pressure (mm Hg) : 753.1  
Calibrate Location : บ้านใหญ่พรหม (A1) Temperature (°C) : 31.7  
Calibrate Date : 23-Jul-24 High Volume ID : BKK FS0374  
CalibrationSheet No.: C-230724-BKK FS0374 High Volume Model : TE-5009X  
Calibrator ID: BKK FS0625 High Volume S/N: 5195  
Calibrator Model : TE-5028A Calibrator Slope : 1.04803  
Calibrator S/N : 2585 Calibrator Intercept : -0.01206

Test No.	Delta H <sub>2</sub> O (inch)	Qa (m <sup>3</sup> /min)	I: Chart (CFM)	Linear Regression
1	2.0	0.970	32	Slope: 29.6499 Intercept: 6.3563 Correlation Coefficient : 0.9988
2	2.6	0.991	36	
3	3.4	1.131	40	
4	4.4	1.285	44	
5	5.2	1.396	48	



Calibrated by :   
(Mr. Thananat Anake)  
Field Scientist(2)

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

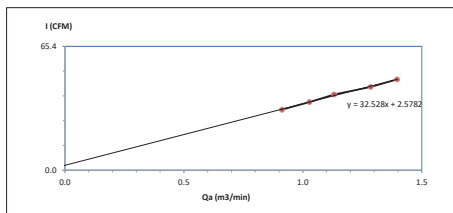
FORM NO.: F 06-074 REVISION NO.:2 ISSUE DATE: 20/11/23



### High Volume Air Sampler Calibration Worksheet

Project Site : Magotteaux Co., Ltd. Barometric Pressure (mm Hg) : 753.1  
Calibrate Location : บ้านใหญ่พรหม (A2) Temperature (°C) : 31.7  
Calibrate Date : 23-Jul-24 High Volume ID : BKK FS1378  
CalibrationSheet No.: C-230724-BKK FS1378 High Volume Model : TE-5009X  
Calibrator ID: BKK FS0625 High Volume S/N: 6263  
Calibrator Model : TE-5028A Calibrator Slope : 1.04803  
Calibrator S/N : 2585 Calibrator Intercept : -0.01206

Test No.	Delta H <sub>2</sub> O (inch)	Qa (m <sup>3</sup> /min)	I: Chart (CFM)	Linear Regression
1	2.2	0.912	32	Slope: 32.5276 Intercept: 2.5782 Correlation Coefficient : 0.9981
2	2.8	1.028	36	
3	3.4	1.131	40	
4	4.4	1.285	44	
5	5.2	1.396	48	



Calibrated by :   
(Mr. Thananat Anake)  
Field Scientist(2)

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

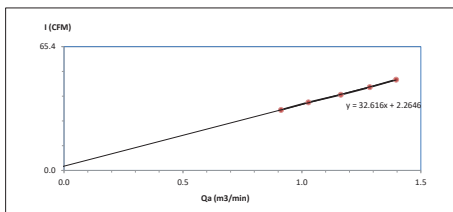
FORM NO.: F 06-074 REVISION NO.:2 ISSUE DATE: 20/11/23



### High Volume Air Sampler Calibration Worksheet

Project Site : Magotteaux Co., Ltd. Barometric Pressure (mm Hg) : 753.1  
Calibrate Location : บ้านใหญ่พรหม (A3) Temperature (°C) : 31.7  
Calibrate Date : 23-Jul-24 High Volume ID : BKK FS1061  
CalibrationSheet No.: C-230724-BKK FS1061 High Volume Model : TE-5009X  
Calibrator ID: BKK FS0625 High Volume S/N: 5504  
Calibrator Model : TE-5028A Calibrator Slope : 1.04803  
Calibrator S/N : 2585 Calibrator Intercept : -0.01206

Test No.	Delta H <sub>2</sub> O (inch)	Qa (m <sup>3</sup> /min)	I: Chart (CFM)	Linear Regression
1	2.2	0.912	32	Slope: 32.6162 Intercept: 2.2646 Correlation Coefficient : 0.9995
2	2.8	1.028	36	
3	3.6	1.164	40	
4	4.4	1.285	44	
5	5.2	1.396	48	



Calibrated by :   
(Mr. Thananat Anake)  
Field Scientist(2)

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

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



PLAY SOLUTION TECHNOLOGY COMPANY LIMITED  
179/75 Nawong Pracha Pattana Road, Sikan, Donmuang, Bangkok 10210  
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## CERTIFICATE OF CALIBRATION

Certificate No. : PST-0126-24

W/O No. : WO-0051-24

#### Customer

Page no. 1 of 3

Company : ALS LABORATORY GROUP (THAILAND) CO., LTD.  
Address : 104 Phatthanakan 40, Phatthanakan Road, Khwaeng Phatthanakan,  
City / Province : Khet Suan Luang, Bangkok  
Zip/Postal : 10750

#### Device

Equipment : Electronic Balance Capacity : 120 / 220 g  
Manufacturer : OHAUS Readability : 0.00001 / 0.0001 g  
Model : CX235D/AD ID No. : BKK\_EN0403  
Serial No. : C309774648  
Condition : Normal

#### Environment Conditions

Location of Calibration : Environment Lab  
Ambient Temperature : 30.1 (°C) ± 0.5 °C  
Relative Humidity : 70.3 (RH) ± 15 %RH  
Barometric Pressure : 1011.1 (mba) ± 10 hPa  
Comment :

REVIEW BY :   
APPROVED BY :   
NEXT CAL DATE : 03/06/25

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

Calibrated by : Mr. Kittichai Rattanatham  
Calibrator

Approved by :   
(Mr. Kittichai Rattanatham)  
Approved Signature

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

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

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## CERTIFICATE OF CALIBRATION

Certificate No. : PST-0126-24

W/O No. : WO-0051-24

Result of Calibration : Without Adjustment

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### 1. Repeatability

Weighting Range 1	g	Nominal Value	g	Standard Deviation	g
Max.capacity	220	50	0.000012		
		200	0.000048		

### 2. Linearity, Departure of Indication from nominal value

Weighting Range 1					
Nominal Value	Standard Value	Indication	Error of Indication	Expanded Uncertainty	Factor k
g	g	g	g	g	
0.01	0.01000	0.01000	-0.000001	0.000062	2.87
0.1	0.10001	0.10001	0.000004	0.000062	2.87
0.5	0.50002	0.50001	0.000012	0.00008	2.87
1	1.00001	1.00002	0.000013	0.00008	2.87
5	5.00002	5.00003	0.000009	0.00008	2.52
10	9.99999	9.99999	-0.000001	0.00008	2.38
50	50.00001	49.99998	-0.000027	0.00015	2.00
100	100.00002	100.00002	0.000004	0.00030	2.00
150	150.00002	150.0001	0.000077	0.00045	2.00
200	200.00003	200.0001	0.000068	0.00060	2.00

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## CERTIFICATE OF CALIBRATION

Certificate No. : PST-0126-24

W/O No. : WO-0051-24

Result of Calibration

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### 3. Eccentricity

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



### Weighting Range 1

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

### Standard method

The calibration was performed by using calibration laboratory's in-house calibration method : CP-MA-001 based on "UKAS LAB 14 : Calibration of weighing machine" edition 6 | October 2019.

### Reference standards instrument

Instrument	QIM Class	S/N	Certificate No.	Exp. Date
Standard Weight Set	E2	4000021952	22-128725	November 30, 2024
Standard Weight Set	-	-	-	-
Standard Weight Set	-	-	-	-
Standard Weight 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 : The measurement is traceable to national standard, which realize the physical unit of measurement [g]  
Through the reference calibration laboratory of Asia Medical and Agricultural Laboratory and Research Center Co., Ltd

END OF REPORT

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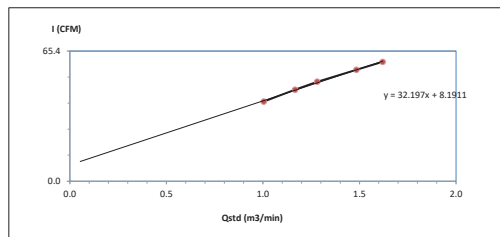
REV.03 30/08/66



## High Volume Air Sampler Calibration Worksheet

Project Site :	Magotteaux Co., Ltd.	Barometric Pressure (mm Hg) :	753.1
Calibrate Location :	วัดป่าพญา (A1)	Temperature (°C) :	31.7
Calibrate Date :	23-Jul-24	High Volume ID :	BKK_FS1057
CalibrationSheet No.:	C-230724-BKK_FS1057	High Volume Model :	TE-5009X
Calibrator ID:	BKK_FS0625	High Volume S/N :	5500
Calibrator Model :	TE-5028A	Calibrator Slope :	1.67329
Calibrator S/N :	2585	Calibrator Intercept :	-0.01925

Test No.	Delta H <sub>2</sub> O (inch)	Q <sub>std</sub> (m <sup>3</sup> /min)	I: Chart (CFM)	Linear Regression
1	2.8	1.0037	40	Slope : 32.1974
2	3.8	1.1661	46	Intercept : 8.1911
3	4.6	1.2811	50	Correlation Coefficient : 0.9985
4	6.2	1.4842	56	
5	7.4	1.6197	60	



Calibrated by   
(Mr. Thanant Anake)  
Field Scientist(2)

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

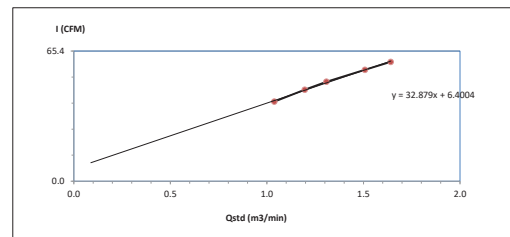
FORM NO.: F 06-073 REVISION NO.:2 ISSUE DATE: 20/11/23



## High Volume Air Sampler Calibration Worksheet

Project Site :	Magotteaux Co., Ltd.	Barometric Pressure (mm Hg) :	753.1
Calibrate Location :	วัดป่าพญา (A2)	Temperature (°C) :	31.7
Calibrate Date :	23-Jul-24	High Volume ID :	BKK_FS1376
CalibrationSheet No.:	C-230724-BKK_FS1376	High Volume Model :	TE-5009X
Calibrator ID:	BKK_FS0625	High Volume S/N :	6257
Calibrator Model :	TE-5028A	Calibrator Slope :	1.67329
Calibrator S/N :	2585	Calibrator Intercept :	-0.01925

Test No.	Delta H <sub>2</sub> O (inch)	Q <sub>std</sub> (m <sup>3</sup> /min)	I: Chart (CFM)	Linear Regression
1	3.0	1.0383	40	Slope : 32.8791
2	4.0	1.1959	46	Intercept : 6.4004
3	4.8	1.3082	50	Correlation Coefficient : 0.9983
4	6.4	1.5076	56	
5	7.6	1.6412	60	



Calibrated by   
(Mr. Thanant Anake)  
Field Scientist(2)

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

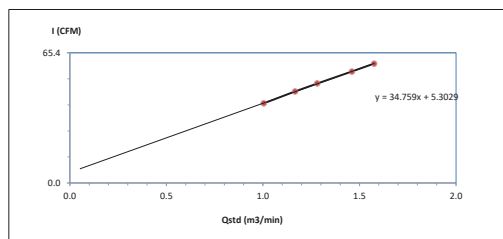
FORM NO.: F 06-073 REVISION NO.:2 ISSUE DATE: 20/11/23



### High Volume Air Sampler Calibration Worksheet

Project Site : Magotteaux Co., Ltd. Barometric Pressure (mm Hg) : 753.1  
Calibrate Location : กรุงเทพมหานคร (A3) Temperature (°C) : 31.7  
Calibrate Date : 23-Jul-24 High Volume ID : BKK\_FS0368  
Calibration Sheet No. : C-230724-BKK\_FS0368 High Volume Model : TE-5009X  
Calibrator ID : BKK\_FS0625 High Volume S/N : 4165  
Calibrator Model : TE-5028A Calibrator Slope : 1.67329  
Calibrator S/N : 2585 Calibrator Intercept : -0.01925

Test No.	Delta H <sub>2</sub> O (inch)	Q <sub>std</sub> (m <sup>3</sup> /min)	I : Chart (CFM)	Linear Regression
1	2.8	1.0037	40	Slope : 34.7594
2	3.8	1.1661	46	Intercept : 5.3029
3	4.6	1.2811	50	Correlation Coefficient : 0.9998
4	6.0	1.4603	56	
5	7.0	1.5758	60	



Calibrated by :   
(Mr. Thanant Anake)  
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

BKK\_EL0037



### Agilent CrossLab Start Up Services

### Agilent 5100 5110 ICP-OES Preventive Maintenance

REVIEW BY	Thirina B.
APPROVED BY	Sau L. N.
NEXT CAL DATE	31/01/2025

Agilent Preventive Maintenance provides factory recommended service for your analytical instruments to assure reliable operation and the accuracy of your results.

Delivered by highly trained and certified service engineers using genuine Agilent parts and supplies, Agilent Preventive Maintenance provides what you need to reduce unplanned downtime and keep your systems operating at their peak performance.

This checklist is used as a guide for completing the preventive maintenance tasks. A signed copy of this checklist is provided for your records.

Revision: A.02, Issued: 21 January 2022  
Document Number: G9014-90072  
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Page 1 of 11



Agilent 5100, 5110 Preventive Maintenance Checklist



### Introduction

#### Customer Information

- Customers should provide all necessary operating supplies upon request of the engineer.
- A customer representative should be available to the engineer while performing the preventive maintenance procedures. Customers are responsible for regular maintenance and are encouraged to observe the service representative.
- Any parts not included in the Parts Lists section of this document are not part of the recommended Preventive Maintenance service nor are they included in the price of this service.
- If a system requires the use of extra or special procedures and/or parts for the maintenance service, then these must be ordered separately and charged as a repair, which may incur additional costs.
- For customers using HIF applications, the instrument should be returned to its standard sample introduction system.

Revision: A.02, Issued: 21 January 2022  
Document Number: G9014-90072  
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Agilent 5100, 5110 Preventive Maintenance Checklist



### Important Customer Web Links

- To access **Agilent University**, visit <http://www.agilent.com/resources/university/> to learn about training options, which include online, classroom and onsite delivery. A training specialist can work directly with you to help determine your best options.
- To access the **Agilent Resource Center** web page, visit <https://www.agilent.com/en-us/agilentresources>. The following information topics are available:
  - Sample Prep and Containment
  - Chemical Standards
  - Analysis
  - Service and Support
  - Application Workflows
- The **Agilent Community** is an excellent place to get answers, collaborate with others about applications and Agilent products, and find in-depth documents and videos relevant to Agilent technologies. Visit <https://community.agilent.com/welcome>.
- Videos about specific preparation requirements for your instrument can be found by searching the **Agilent YouTube** channel at <https://www.youtube.com/user/agilent>.
- Need to place a service call?** Flexible Repair Options | Agilent

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Document Number: G9014-90072  
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### Service Engineer's Responsibilities

- Contact the customer and ensure that all necessary supplies are available before the preventive maintenance visit.
- Only select those pages that relate to the system or module being serviced.
- Complete empty fields with the relevant information.
- Complete the relevant checkboxes in the checklist using either a "X" or tick mark "✓".
- Check "Service not applicable" check boxes to indicate services/tasks not delivered, as appropriate.
- Complete the Preventive Maintenance services in the most logical order relevant to the individual system service in the order of the tasks listed.
- Complete the **Service Review** section together with the customer.
- Complete the fields for page numbers at the foot of each selected page.
- Add relevant page numbers to selected pages and complete the total number of pages field in the Service Completion section.
- **Ask the customer to sign the Service Verification section including the customer's and your signature.**

### Instrument Maintenance

#### System Information

- ☒ Check this box if an instrument configuration report is attached instead of completing the table.

Instrument System Name and ID	24010A / M71010005
Instrument System Site and Location	PLS Laboratory Group (Thailand) Co., Ltd.

List System Component Product Numbers	List the Serial Numbers of each Component
1. 02-1010A	M71010005
2. 02-1010A	AU1544-0764
3. 02-1010-10001	1005-00149
4.	
5.	
6.	
7.	
8.	
9.	

ICP-OES Configuration Table	Circle the type or write in the type if other
Nebulizer Type	Spray / On-line / Other
Spray Chamber	Cyclonic Single Pass / Cyclonic Double Pass / Other
Torch	Radial / Dual View / Other
Torch Type	One Piece / Semi-Demountable / Fully Demountable / Other
Injector Diameter	2.4mm / 1.8mm / 1.4mm / 0.8mm / Other
Injector Material	Quartz / Ceramic / Other

### Preparation

- ☒ Discuss any specific issues with the customer before starting.
- ☒ Review the instrument logbook for recorded problems and comments.
- ☒ Save instrument control settings before starting the procedure.
- ☒ Perform a general inspection of the system for cleanliness.
- ☒ Check for proper installation of parts, assemblies, sensors etc.
- ☒ Check system for required installation of components and implementation of Service Notes.
- ☒ Check for required firmware/software updates and verify with customers if they would like them installed.
- ☒ For HF application systems, if standard sample introduction system was not installed, ask the customer to install it.
- ☒ Ask the customer to remove any samples from the ICP-OES sample introduction area, auto sampler or around the ICP-OES.

### Preventive Maintenance Procedures

#### Record Pre-PM Instrument performance

- ☒ Run Instrument Performance test.
- ☒ Record results in Instrument Performance Test Results Table – Pre-PM.

#### Clean and inspect ICP-OES system

- ☒ Look for any obvious external damage or problems.
- ☒ Inspect water cooling hoses, gas lines and power cord for excessive wear or damage.
- ☒ Perform a general internal inspection of the system for excessive dust accumulation, clean if necessary.
- ☒ Inspect sample introduction components and record any required maintenance in the Service Engineer Comments and notify the customer as the required actions required.
- ☒ Record the instrument operating conditions in the ICP-OES Status Results Table.
- ☒ Replace the polychromator purge filter.
- ☒ Replace the radial pre-optics window.
- ☒ Replace the axial pre-optics window for SVDV and VDV instruments.
- ☒ Check exhaust flow for the correct positive extraction at the exhaust duct to insure they meet minimum specifications.
- ☒ Replace air inlet dust filter.
- ☒ Replace high capacity air inlet dust filter element if installed.
- ☒ Remove and clean instrument water inlet filter.

#### Agilent Water Recirculator

- ☐ Service not applicable
- ☒ Drain cooling fluid and remove any particles from the chiller reservoir.
- ☒ Remove, clean and reinstall water inlet metal mesh filter if present.
- ☒ Re fill with Agilent Cool Clear cooling fluid.
- ☒ Clean the cooling system Air filter and the condenser.



## SPS 3 Auto Sampler

☒ Service not applicable

- ☐ Power cycle the autosampler and verify successful initialization.
- ☐ Inspect X and Z axis belts for wear. Replace if necessary.
- ☐ Clean X and Z axis slide shafts.
- ☐ Using customer's racks and the Agilent software move the sample probe to the 4 outermost corners and rinse port, ensure that the probe is approximately centered in the vial.

## SPS 4 Auto sampler

☐ Service not applicable

- ☒ Clean the spill tray, rack location mat, end frames and chassis with a damp soft cloth and diluted mild detergent.
- ☒ Clean the auto sampler cover panels, if cover kit is installed, with domestic window cleaner.
- ☒ Check the X-axis and Z-axis drive belts for cracks, splits, damaged teeth, excessive fraying, color changes or degradation from fumes.
- ☒ Check the X-axis, Theta-axis and Z-axis FFC cables for cracks, incorrect positioning, damaged edges or damaged connectors.
- ☒ Pump Tubing Replacement: Replace peristaltic pump tubing. Replace all tubing that goes from the rinse station to the pump and from the pump to the waste/rinse bottles.
- ☒ Test using customer's tray and move the sample probe to the sample vial 1, wash vial and rinse port and ensure that the probe is centered in the vial. If not use calibration wizard and calibrate the position.

## AVS 4, 6, 7 Advanced Valve System

☒ Service not applicable

- ☐ Replace valve rotor seal
- ☐ Check fittings for signs of leaks
- ☐ Check tubing including autosampler tubing for kinks or excessive wear
- ☐ Check high flow pump for signs of leaks

## ICP-OES adjustment

- ☒ Check position of Zn peak, adjust if required.
- ☒ Check Argon Ratio, adjust to specified value if required.
- ☒ Perform Detector Calibration.
- ☒ Perform Instrument Calibration.

## Record Post-PM instrument performance

- ☒ Run Instrument Performance test.
- ☒ Record results in Instrument Performance Test Results Table - Post PM.
- ☒ For systems using ICP Expert version 7.3 and above, run the following Instrument tests
  - ☒ Subsystem Communications Test
  - ☒ Air Flow
  - ☒ Water Flow
  - ☒ Gas Flows
  - ☒ RF Generator
  - ☒ Camera Test
  - ☒ Optics Test
  - ☒ Nebulizer Test
- ☒ Record the result in the Instrument Test Results Table

## Restore Instrument

- ☒ For HF applications, ask the customer to reinstall their sample introduction system.
- ☒ Leave system in an idle state: on and purging.
- ☒ Guidance: If the PM service is performed prior to a qualification service, then use the qualification procedure as a guide for final instrument set up and checkout.

## Service Review

- ☒ Attach available reports/printouts of all tests to this documentation.
- ☒ Record the Preventive Maintenance service activity in the customer's records/logbook.
- ☒ Record the PM event in the Smart Alerts logbook, if applicable.
- ☒ Update/reset instrument maintenance counters as appropriate.
- ☒ Affix the PM sticker to the system or instrument logbook based on the customer's request.
- ☒ Complete the Service Engineer Comments section if there are additional comments.
- ☒ Review this service, parts replaced, and test results obtained with the customer.
- ☒ If the instrument firmware was updated, record the details of the change in the Service Engineer's Comments box. Systems in a compliant environment may need additional documentation.
- ☒ Complete the Signature Page with both Service Engineer and Customer signatures.

## Test Results

## Instrument Performance Test Results Table

Note: These measurements do not form part of any specification and are for reference only.

	Pre PM Sensitivity Check		Post PM Sensitivity Check	
	Radial	Axial *	Radial	Axial*
Zn 213.857 nm SRBR	1511.1	2444.3	1520.0	2421.8
Mn 257.610 nm SRBR	1355.1	11557.4	754.8	12199.3
Al 396.152 nm SBR	2.1	16.0	5.8	10.5
K 766.491 nm SBR	8.3	64.0	9.4	92.8

\* Axial result is not applicable for G8016AA, G8012AA Radial View instruments.

## Instrument Test Results Table

Note: The Instrument Test results are for systems using ICP Expert version 7.3 and above only.

Instrument Test	Result
Subsystem Communications Test	PASS
Air Flow	PASS
Water Flow	PASS
Gas Flows	PASS
RF Generator	PASS
Camera Test	PASS
Optics Test	PASS
Nebulizer test	PASS

## ICP-OES Status Results Table

Note: These measurements do not form part of any specification and are for reference only.

Measurement	Standby Mode	Plasma On
Mains Voltage	219.3 ± 1 VAC	215.1 ± 5 VAC
Mains Current	0.09 L A	0.113 A
Instrument Temperature	11.5 °C	23.2 °C
RF Air Flow (sensor speed)	9.1 L Hz	23.0 Hz
Plasma Exhaust Temperature	No measurement	50.1 °C
Water Flow Oscillator	No measurement	1.20 L/min
Water Flow Detector	1.14 L/min	1.09 L/min
Water Inlet Temperature	22.5 °C	22.6 °C
Polychromator Temperature	35.0 °C	35.0 °C
CCD Temperature	+40.1 °C	+40.0 °C
Thermal Stabilizer	31.5 °C	34.4 °C
Argon Supply Pressure	514.9 kPa	557.10 kPa
Purge Gas Supply Pressure*1	610.6 kPa	514.30 kPa
Option Gas Supply Pressure*1	— kPa	— kPa
Nebulizer Flow	No measurement	0.70 L/min
Nebulizer Back Pressure	No measurement	216.0 kPa
Plasma Gas Flow	No measurement	11.89 L/min
Auxiliary Gas Flow	No measurement	1.00 L/min
RF Power	No measurement	1599.6 W
RF Supply Current	No measurement	1.64 A
RF Supply Voltage	No measurement	164.8 V

\*1 If option installed

## Consumed PM Parts

Part Description	Part Number	Product or Model# where used	Quantity consumed
Axial Pre-Optic Window	G8010-68014	G8010A, G8011A, G8014A/G8015A	1
Radial Pre-Optic Window	G8010-68015	All	1
Agilent Cool Clear Coolant Fluid	5799-9037	Agilent Water Recirculator	1
Purge Gas Filter	G8010-60136	All	1
Air Inlet Filter	G8000-68002	All	1
High Capacity Air Filter	G8010-60189	Optional	1
Rotor seal for 6-7 port valve for AVS6/7	G8494-60002	G8494A/G8495	1
Rotor seal for 4 port valve for AVS4	G8493-60002	G8493A	1
Rinse solution to rinse station 2.5mm ID x 1m	G8410-80123	SPS 4	1
Barb connector 2.5mm ID x 5mm ID	G8410-80124	SPS 4	1
PVC waste tubing 8mm OD x 5mm ID, 2m	G8410-80122	SPS 4	1
Additional Parts may be required from engineer's stock:			
X axis drive belt	5410047800	SPS 3	1
Z axis drive belt	5410047400	SPS 3	1
Peristaltic pump tubing, PVC Solvaflex, 3/16" ID	3710049000	SPS 4	1

Consumed Parts Reference  
(Purchased by customer, not included as part of PM)

Section Not Applicable

Part Description	Part Number	Product or Model# where used	Quantity consumed
------------------	-------------	------------------------------	-------------------

## Signature Page

## Service Engineer Comments (optional)

If there are any specific points you wish to note as part of performing the installation or other items of interest for the customer, please write in this box.

## Service Verification

Service Request Number:

6006602534

Service Engineer Name:

Nakorn Jitranont

Service Engineer Signature:

Nakorn J.

Total number of pages in this document:

14

Date Service Completed:

Feb 21, 2022

Customer Name:

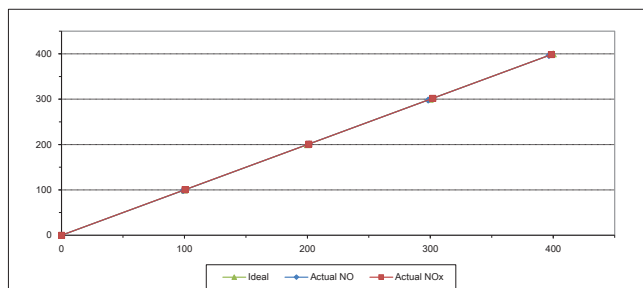
Customer Signature:



## MULTIPOINT CALIBRATION REPORT

Calibration Date	3-Jul-24	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	X9RAXHOD	Equipment ID	BKK_FS0803
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

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



Calibrated By


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

Approved By

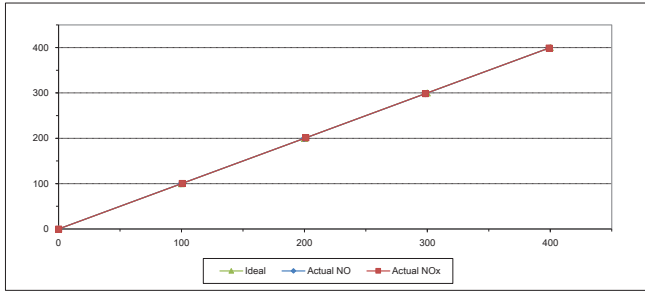

(Mr. Sarayuth Jitranont)  
Assistant General Manager



## MULTIPOINT CALIBRATION REPORT

Calibration Date	2-Jul-24	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	WPYJMWMD	Equipment ID	BKK_FS0782
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	99.60	-0.40	-0.40	100.60	0.60	0.60
2	200.00	199.70	-0.30	-0.15	201.20	1.20	0.60
3	300.00	298.40	-1.60	-0.53	298.50	-1.50	-0.50
4	400.00	398.70	-1.30	-0.33	399.10	-0.90	-0.22
AVERAGE (%)				-0.28			0.11



Calibrated By

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

Approved By

(Mr.Sarayuth Jitranont)  
Assistant General Manager

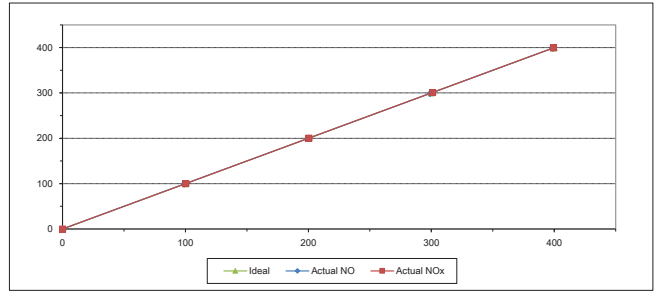
ALS Laboratory Group  
FORM NO.: F 06-056 REVISION NO.: - ISSUE DATE: 02/04/12



## MULTIPOINT CALIBRATION REPORT

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

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	99.00	-1.00	-1.00	100.30	0.30	0.30
2	200.00	199.40	-0.60	-0.30	200.50	0.50	0.25
3	300.00	299.00	-1.00	-0.33	301.10	1.10	0.37
4	400.00	398.60	-1.40	-0.35	399.30	-0.70	-0.17
AVERAGE (%)				-0.38			0.17



Calibrated By

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

Approved By

(Mr.Sarayuth Jitranont)  
Assistant General Manager

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



Jirananatee Associates Co., Ltd.  
62/14-15, 62/15-16  
Petchkasem 7/71, Rd. Watthana, Bangkok,  
Bangkok 10500 (Thailand)  
Tel: +66(0)858111  
Mobile: +66(0)8399453  
E-mail: jnac-calibration@jiranatee.com  
Web site: www.jiranatee.com

Accredited calibration laboratory  
ISO/IEC 17025:2017  
NSC-TIS-718 17025  
CALIBRATION 0367

Air speed measurement laboratory  
Calibration services department



NSC - TIS - 718 17025  
CALIBRATION 0367

Certificate Number

CWS-005-67

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM	: Cup anemometer
MANUFACTURER	: Novalynx
MODEL/TYPE	: Sensor: WS-02F Data logger: 200-WS-25LB
SERIAL NUMBER	: Sensor: WSD-AS261 Data logger: AS261
ID NUMBER	: BKK_FS0888
CONDITION AS-RECEIVED	: Used item
CUSTOMER	: ALS laboratory group (Thailand) Co., Ltd. 104 Phatthanakan Rd, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE	: 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
Atmospheric Pressure	: 1010 ± 10 hPa

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

CALIBRATION CONDITIONS : Wind tunnel cross-section area<sup>1</sup> 900 cm<sup>2</sup>

Wind direction frontal area<sup>2</sup> 100 cm<sup>2</sup>

Diameter of mounting pipe<sup>3</sup> - mm

Blockage ratio of test object<sup>4</sup> 0.111 [-]

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. Soravut Thachalad  
☐ Miss Jitraporn Lertthongmal



Approved signatory:

Mr. Parinya Booncharoen  
Calibration Department Manager

Remarks:  
<sup>1</sup> Including cross-section area of the wind tunnel  
<sup>2</sup> Projected cross-section area of the tested object include mounting pipe  
<sup>3</sup> Diameter of mounting pipe  
<sup>4</sup> Ratio "1" to "1"

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

Certificate Number

CWS-005-67

Page 2 of 2 Pages

## MEASUREMENT RESULTS<sup>5</sup>

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 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 <sub>std</sub> (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V <sub>std</sub> (m/s)	Error (m/s)	U (k=2) (m/s)
1.016	23.70	23.65	0.9	-0.1	0.31
2.058	23.50	23.65	1.9	-0.2	0.31
2.998	23.78	23.65	2.9	-0.1	0.31
4.168	23.74	23.65	4.0	-0.2	0.31
5.03	23.60	23.65	5.1	0.3	0.31
5.98	23.84	23.65	6.1	0.1	0.31
7.00	23.38	23.65	7.1	0.1	0.31
7.95	23.62	23.65	8.1	0.2	0.31
8.96	23.36	23.65	9.2	0.3	0.31
10.03	23.76	23.65	10.2	0.2	0.31
11.03	23.40	23.65	11.3	0.3	0.31
12.04	23.60	23.65	12.3	0.2	0.31
13.02	23.40	23.65	13.4	0.4	0.31
14.03	23.54	23.65	14.3	0.3	0.31
15.01	23.40	23.65	15.4	0.4	0.31
16.02	23.44	23.65	16.4	0.3	0.31

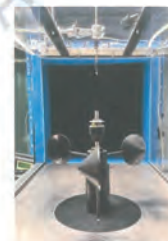
Remarks:

<sup>5</sup> Calibration results only count for the tested circumstances and environmental conditions during which calibration took place

<sup>1</sup> Velocity of standard

<sup>2</sup> Velocity of Unit Under Calibration

## PHOTO OF CALIBRATION SET-UP



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





## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Wind Direction Sensor  
**MANUFACTURER** : Novallix  
**MODEL/TYPE** : Sensor: WS-02F  
Data logger: 200-WS-25LB  
**SERIAL NUMBER** : Sensor: WS0-AS261  
Data logger: AS261  
**ID NUMBER** : BKK\_F50888  
**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 follow:

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

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

**CALIBRATION CONDITION** : Wind tunnel cross-section area<sup>1</sup> 900 cm<sup>2</sup>  
Wind direction frontal area<sup>2</sup> 129 cm<sup>2</sup>  
Diameter of mounting pipe<sup>3</sup> - mm  
Blockage ratio of test object<sup>4</sup> 0.143 [-]

**Preconditioning** : 24 hours at ambient conditions.

**Measurement Condition** : The average values during measurement are (23.5)°C, (53.5) %RH and (1010.5) hPa.

### TABULATION OF RESULTS:

The table on next page give the measured values.

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



Approved signatory:

*[Signature]*  
Mr. Parinya Booncharoen  
Calibration Department Manager

**Remark:**  
<sup>1</sup> Inside cross-section area of the wind tunnel  
<sup>2</sup> Projected cross-section area of the tested object include mounting pipe  
<sup>3</sup> Diameter of mounting pipe  
<sup>4</sup> 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 OF CALIBRATION

Certificate No. : CDT-003-67

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Data Logger with Temperature sensor  
**MANUFACTURER** : Novallix  
**MODEL/TYPE** : 200-WS-25LB  
**SERIAL NUMBER** : AS261  
**ID NUMBER** : BKK\_F50888  
**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 follow:

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

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

### TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:  
☐ Mr. Sorawit Thachalad  
☐ Miss Jittaporn Lertsomphol  
☒ Ms. Ruangrumpal Phoommit



Approved signatory:

*[Signature]*  
Mr. Parinya Booncharoen  
Calibration Department Manager

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Certificate Number

CWD-005-67

Page 2 of 2 Pages

### MEASUREMENT RESULTS<sup>5</sup>

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

Air speed	D <sub>90°</sub>	D <sub>270°</sub>	Error	U (k=2)
m/s	Degree (°)	Degree (°)	Degree (°)	Degree (°)
5.03	45.000	41	-4	0.80
	90.000	87	-3	0.80
	135.001	132	-3	0.80
	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:

<sup>5</sup> Calibration results only count for the tested circumstances and environmental conditions during which calibration took place

<sup>6</sup> Direction of standard

<sup>7</sup> Direction of Unit Under Calibration

\*\*\*End of Certificate of Calibration\*\*\*



## CERTIFICATE OF CALIBRATION

Certificate No. : CRH-004-67

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Relative humidity with data logger  
**MANUFACTURER** : Novolynx  
**MODEL/TYPE** : 200-WS-25LB  
**SERIAL NUMBER** : AS261  
**ID NUMBER** : BKK\_F50888  
**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 follow:  
Temperature : 23.0 ± 3.0 °C  
Relative Humidity : 55.0 ± 15.0 %RH

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

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

**Calibration procedure:**  
The Relative humidity calibration was done by In-House calibration method as per ISO 9001 according to comparison method with Standard Calibrated Minor hygrometer and standard Humidity generator chamber.

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

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

Calibrated by:  
☐ Mr. Sorawat Thachalad  
☐ Miss Jitraporn Lertsomphol  
☐ Miss Pungprapai Phommit



Approved signature:

*Mr. Parinya Booncharoen*

Mr. Parinya Booncharoen  
Calibration Department Manager

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Continuation of Certificate of Calibration Number: CRH-004-67

Page 2 of 2 Pages

### Measurement Results:

This equipment was connected with Indoor air quality probe and Displayed (UR) on display. Model: HAMP60, Serial number: N0330783.

**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 (NRH)	Standard Reading (NRH)	UUC Reading (NRH)	Error (NRH)	Uncertainty (NRH)
20.0	20.04	18.6	-1.5	0.40
50.0	51.31	48.7	-2.6	1.0
80.0	82.85	78.9	-4.0	1.6

UUC\*: Unit Under Calibration

\*\*\*End of Certificate of Calibration\*\*\*



Page 2 of 2 Pages

### MEASUREMENT RESULTS<sup>1</sup>

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 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)
1.010	23.80	23.75	0.8	-0.2	0.31
2.097	23.64	23.75	1.9	-0.2	0.31
2.998	23.60	23.75	2.9	-0.1	0.31
4.160	23.64	23.75	4.0	-0.2	0.31
5.06	23.40	23.75	5.1	0.0	0.31
6.00	23.80	23.75	6.1	0.1	0.31
7.01	23.34	23.75	7.0	0.0	0.31
7.98	23.62	23.75	8.0	0.0	0.31
8.96	23.16	23.75	8.1	0.1	0.31
10.03	23.50	23.75	10.2	0.2	0.31
11.04	23.10	23.75	11.2	0.2	0.31
12.01	23.50	23.75	12.2	0.2	0.38
13.04	23.18	23.75	13.3	0.3	0.31
14.02	23.50	23.75	14.4	0.3	0.31
15.03	23.22	23.75	15.4	0.3	0.31
16.03	23.48	23.75	16.3	0.3	0.39

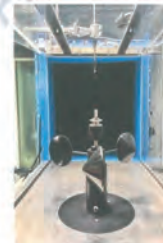
### Remark:

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

<sup>2</sup> Velocity of standard

<sup>3</sup> Velocity of Unit Under Calibration

### PHOTO OF CALIBRATION SET-UP



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



\*\*\*End of Certificate of Calibration\*\*\*

Certificate Number

CWS-004-67

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Cup anemometer  
**MANUFACTURER** : Novolynx  
**MODEL/TYPE** : Sensor: WS-02F  
Data logger: 200-WS-25LB  
**SERIAL NUMBER** : Sensor: WSD-AS244  
Data logger: AS244  
**ID NUMBER** : BKK\_F50887  
**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 follow:  
Temperature : 23.0 ± 3.0 °C  
Relative Humidity : 55.0 ± 15.0 %RH  
Atmospheric Pressure : 1010 ± 10 hPa

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

**CALIBRATION CONDITIONS** : Wind tunnel cross-section area<sup>1</sup> : 900 cm<sup>2</sup>  
Wind direction (frontal area)<sup>2</sup> : 100 cm<sup>2</sup>  
Diameter of mounting pipe<sup>3</sup> : -  
Blockage ratio of test object<sup>4</sup> : 0.111 [-]

**Preconditioning** : 24 hours at ambient conditions.  
**Measurement Condition** : The average values during measurement are (23.8) °C, (52.2) %RH and (1010.8) hPa.

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

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



Approved signature:

*Mr. Parinya Booncharoen*

Mr. Parinya Booncharoen  
Calibration Department Manager

**Remarks:**  
<sup>1</sup> Nulling cross-section area of the wind tunnel  
<sup>2</sup> Projected cross-section area of the tested object include mounting pipe  
<sup>3</sup> Diameter of mounting pipe  
<sup>4</sup> Ratio "a" to "b"

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## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

### MEASUREMENT ITEM MANUFACTURER MODEL/TYPE

Wind Direction Sensor  
: Novallix  
: Sensor: WS-02F  
Data logger: 200-WS-25LB

### SERIAL NUMBER

: Sensor: WS0-AS244  
Data logger: AS244

### ID NUMBER

: BKK\_F50887

### CONDITION AS-RECEIVED CUSTOMER

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

### RECEIVED DATE

: 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  
Atmospheric Pressure : 1010 ± 10 hPa

### PLACE OF CALIBRATION

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

### CALIBRATION CONDITION

: Wind tunnel cross-section area<sup>1</sup> 900 cm<sup>2</sup>  
Wind direction frontal area<sup>2</sup> 129 cm<sup>2</sup>  
Diameter of mounting pipe<sup>3</sup> - mm  
Blockage ratio of test object<sup>4</sup> 0.143 [-]

### Preconditioning

: 24 hours at ambient conditions.

### Measurement Condition

: The average values during measurement are (23.6) °C, (57.5) %RH and (1011.1) hPa.

### TABULATION OF RESULTS:

The table on next page give the measured values.

### Calibrated by:

☒ Mr. Sorawit Thachalad  
☐ Miss Jittrapol Lertsomphol



### Approved signatory:

*[Signature]*

Mr. Parinya Booncharoen  
Calibration Department Manager

### Remarks:

<sup>1</sup> Actual cross-section area of the wind tunnel  
<sup>2</sup> Projected cross-section area of the tested object include mounting pipe  
<sup>3</sup> Diameter of mounting pipe  
<sup>4</sup> Ratio:  $\frac{A_2}{A_1}$

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Page 2 of 2 Pages

### MEASUREMENT RESULTS<sup>5</sup>

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

Air speed	D <sub>1</sub> <sub>me</sub>	D <sub>1</sub> <sub>nom</sub>	Error	U (k=2)
m/s	Degree (°)	Degree (°)	Degree (°)	Degree (°)
5.02	45.000	42	-3	0.80
	90.000	87	-3	0.80
	135.000	132	-3	0.80
	180.000	179	-1	0.80
	225.000	226	1	0.80
	270.000	273	3	0.80
	315.000	319	4	0.80
	360.000	359	-1	0.80

### Remark:

<sup>5</sup> Calibration results only count for the tested circumstances and environmental conditions during which calibration took place

<sup>1</sup> Direction of standard

<sup>2</sup> Direction of Unit Under Calibration

\*\*\*End of Certificate of Calibration\*\*\*



## CERTIFICATE OF CALIBRATION

Page 2 of 2 Pages

Certificate No. : CDT-002-67

### MEASUREMENT ITEM

: Data Logger with Temperature sensor

### MANUFACTURER

: Novallix

### MODEL/TYPE

: 200-WS-25LB

### SERIAL NUMBER

: AS244

### ID NUMBER

: BKK\_F50887

### 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 follow:

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

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

### TABULATION OF RESULTS:

The table on next page give the measured values.

### Calibrated by:

☒ Mr. Sorawit Thachalad  
☐ Miss Jittrapol Lertsomphol  
☒ Miss Ruangrump Poommitt



### Approved signatory:

*[Signature]*

Mr. Parinya Booncharoen  
Calibration Department Manager

### Continuation of Certificate of Calibration Number CDT-002-67

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: N0330782.  
Dimension: Diameter 12 mm. Length 80 mm.

Immersion Depth	Standard Reading	UUC Reading	Error	Uncertainty
(mm)	(°C)	(°C)	(°C)	(°C)
70	20.054	19.9	-0.2	0.099
70	25.051	24.8	-0.3	0.099
70	30.042	29.7	-0.3	0.099
70	35.034	34.5	-0.5	0.099
70	40.030	39.4	-0.6	0.099

UUC\*: Unit Under Calibration

\*\*\*End of Certificate of Calibration\*\*\*



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## CERTIFICATE OF CALIBRATION

Certificate No. : CRH-003-67

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Relative humidity with data logger  
**MANUFACTURER** : Novolyne  
**MODEL/TYPE** : 200-WS-25L8  
**SERIAL NUMBER** : AS244  
**ID NUMBER** : BKK\_F50887  
**CONDITION AS-RECEIVED** : Used item  
**CUSTOMER** : ALS laboratory group (Thailand) Co., Ltd.  
104 Phuthanakan 40, Phuthanakan 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 :  $23.0 \pm 3.0$  °C  
Relative Humidity :  $55.0 \pm 15.0$  %RH

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

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

**Calibration procedure:**  
The Relative humidity calibration was done by In-House calibration method as per CL-010 according to comparison method with Standard Calibrated Mirror hygrometer and Standard Humidity generator chamber.

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

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

Calibrated by:  
☐ Mr. Sorawat Thachalad  
☐ Miss Itttrapien Lertsomphol  
☐ Miss Puangpumpal Phoommit



Approved signatory: Mr. Parinya Booncharoen  
Calibration Department Manager

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Continuation of Certificate of Calibration Number: CRH-003-67

Page 2 of 2 Pages

### Measurement Results:

This equipment was connected with indoor air quality probe and Displayed (UIR) on display. Model: HMP60, Serial number: N0330782.

**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	18.8	-1.3	0.40
50.0	51.32	49.0	-2.3	1.0
80.0	82.88	79.2	-3.7	1.6

UUC\*: Unit Under Calibration

\*\*\*End of Certificate of Calibration\*\*\*



Page 2 of 2 Pages

### MEASUREMENT RESULTS<sup>5</sup>

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 36 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)
1.048	25.60	25.50	0.9	-0.1	0.31
2.057	25.46	25.50	1.9	-0.2	0.31
3.031	25.52	25.50	2.8	-0.2	0.31
4.235	25.14	25.50	3.9	-0.3	0.31
5.00	25.80	25.50	4.9	-0.1	0.31
6.00	25.16	25.50	5.9	-0.3	0.31
7.04	25.80	25.50	6.9	-0.2	0.31
8.14	25.10	25.50	8.0	-0.2	0.31
9.07	25.88	25.50	8.9	-0.2	0.31
10.07	25.20	25.50	9.9	-0.1	0.31
11.12	25.90	25.50	11.0	-0.1	0.31
12.11	25.32	25.50	12.0	-0.2	0.31
13.16	25.80	25.50	12.9	-0.3	0.31
14.23	25.40	25.50	14.3	-0.2	0.31
15.22	25.72	25.50	14.9	-0.3	0.31
16.27	25.54	25.50	16.0	-0.3	0.31

### Remark:

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

<sup>2</sup> Velocity of standard

<sup>3</sup> Velocity of Unit Under Calibration

### PHOTO OF CALIBRATION SET-UP



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



\*\*\*End of Certificate of Calibration\*\*\*

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Cup anemometer  
**MANUFACTURER** : Novolyne  
**MODEL/TYPE** : Sensor: WS-027  
Data logger: 200-WS-25L8  
**SERIAL NUMBER** : Sensor: W50-AS377  
Data logger: AS377  
**ID NUMBER** : BKK\_F50917  
**CONDITION AS-RECEIVED** : Used item  
**CUSTOMER** : ALS laboratory group (Thailand) Co., Ltd.  
104 Phuthanakan 40, Phuthanakan Rd, Khwaeng Suan Luang,  
Khet Suan Luang, Bangkok 10250 Thailand.

**RECEIVED DATE** : 17 May 2023  
**MEASUREMENT DATE** : 23 May 2023  
**ISSUE DATE** : 23 May 2023

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

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

**CALIBRATION CONDITIONS** : Wind tunnel cross-section area: 900 cm<sup>2</sup>  
Win direction: Forthal area<sup>1</sup>: 100 cm<sup>2</sup>  
Diameter of mounting pipe<sup>2</sup>: mm  
Blockage ratio of test object<sup>3</sup>: 0.111 [-]

**Preconditioning** : 24 hours at ambient conditions.  
**Measurement Condition** : The average values during measurement are (25.5) °C, (49.6) %RH and (1009.22) hPa.

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

Calibrated by:  
☒ Mr. Sorawat Thachalad  
☐ Miss Itttrapien Lertsomphol



Approved signatory: Mr. Parinya Booncharoen  
Calibration Department Manager

**Remark:**  
<sup>1</sup> Available cross-section area of the wind tunnel  
<sup>2</sup> Projected cross-section area of the tested object include mounting pipe  
<sup>3</sup> Diameter of mounting pipe  
<sup>4</sup> Ratio "to"

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REVIEW BY: Parinya P.  
APPROVED BY: [Signature]  
NEXT CAL DATE: 23/11/24

Certificate Number

CC-001-66

Certificate Number

CC-001-66



Certificate Number

CD-001-66

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

### MEASUREMENT ITEM

### MANUFACTURER

### MODEL/TYPE

### SERIAL NUMBER

### ID NUMBER

### CONDITION AS-RECEIVED

### CUSTOMER

: Wind Direction Sensor

: Novalynx

: Sensor: WS-02T

: Data logger: 200-WS-25LB

: Sensor: WSD-AS377

: Data logger: AS377

: BKK\_FS0517

: Used item

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

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

: Khet Suan Luang, Bangkok 10250 Thailand.

### Calibration procedure:

The wind direction sensor was calibrated against Standard Rotary Encoder model: 42000975/ DMD4-P3-S-U0 in an close test section of Effel-type wind tunnel with 900 cm<sup>2</sup> cross test section area. The W-01-008 based on IEC 61400-12-1, Wind energy generation systems, - Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

### Traceability:

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

### Uncertainty of Measurement:

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

### RECEIVED DATE

### MEASUREMENT DATE

### ISSUE DATE

: 17 May 2023

: 23 May 2023

: 23 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

: 1010.1 hPa

### PLACE OF CALIBRATION

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

### CALIBRATION CONDITION

: Wind tunnel cross-section area<sup>1</sup>

: 900 cm<sup>2</sup>

: Win direction frontal area<sup>2</sup>

: 129 cm<sup>2</sup>

: Diameter of mounting pipe<sup>3</sup>

: 1 mm

: Blockage ratio of test object<sup>4</sup>

: 0.143 [-]

### Preconditioning

: 24 hours at ambient conditions.

### Measurement Condition

: The average values during measurement are (24.2)°C, (41.7) %RH and (1009.1) hPa.

### TABULATION OF RESULTS:

The table on next page give the measured values.

### Calibrated by:

Mr. Sorawit Thakulad

Miss Jitraporn Lertsomphol



Approved signatory:

Mr. Parinya Booncharoen  
Calibration Department Manager

### Remark:

<sup>1</sup> Actual cross-section area of the wind tunnel

<sup>2</sup> Projected cross-section area of the tested object include mounting pipe

<sup>3</sup> Diameter of mounting pipe

<sup>4</sup> Ratio 1 to 1

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

Certificate Number

CD-001-66

Page 2 of 2 Pages

### MEASUREMENT RESULTS<sup>5</sup>

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 <sup>1</sup> <sub>me</sub> Degree (°)	D <sup>1</sup> <sub>me</sub> Degree (°)	Error Degree (°)	U (k=2) Degree (°)
5.00	0.000	0	0	1.0
	45.000	41	-4	1.0
	90.001	87	-3	1.0
	135.000	133	-2	1.0
	180.000	183	3	1.0
	225.000	229	4	1.0
	270.000	275	5	1.0
	315.000	320	5	1.0

### Remark:

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

<sup>2</sup> Direction of standard

<sup>3</sup> Direction of Unit Under Calibration

\*\*\*End of Certificate of Calibration\*\*\*



## CONSOLE CONTROL UNIT CALIBRATION TEST REPORT

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

### Reference Dry Gas Meter Data

Reference Dry Gas Meter ID: BKK\_FS1122

Serial No.: A2003240

Correction Factor (Y): 0.9824

Next Calibration Date: 7 Nov 24

Calibration of Date: 6 Jul 24  
Next Cal. Date: 6 Jan 25

### Console Control Meter Data

Calibration No.: C-060724-BKK\_FS0547

Dry Gas Meter ID: BKK\_FS0547

Serial No.: 1606040

Model No.: XC-572-V

ΔH (mm H <sub>2</sub> O)	Θ Minutes	Reference Dry Gas Meter Calibration				Console Control Dry Gas Meter						Dry Gas Meter Connection Factor R <sub>g</sub>	Office Calibration Factor R <sub>o</sub>	
		Vr (Liters)		Tr		Vm (Liters)		Ti		To				Avg Tr (°C)
		Final	Initial	Total		Final	Initial	Total						
15	12.32	150.11	0.00	150.11	33.0	1068750.0	1068900.0	148.80	32.0	32.0	32.0	33.0	0.9864	46.9784
25	9.51	150.20	0.00	150.20	33.0	1068929.2	1069178.0	149.20	33.0	33.0	33.0	33.0	0.9866	46.4466
50	6.81	150.22	0.00	150.22	33.0	1069004.6	1069155.0	149.60	33.0	33.0	33.0	33.0	0.9817	47.0203
100	4.80	150.10	0.00	150.10	33.0	1069489.3	1069430.0	149.30	33.0	33.0	33.0	33.0	0.9762	47.3261
150	3.94	150.04	0.00	150.04	33.0	1069600.0	1069500.0	149.00	34.0	34.0	34.0	34.0	0.9763	47.7789
														47.2430

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

ΔAvg: Orifice pressure differential that equates to 21.24 in of air @ 25°C and 760 mm of mercury, mmH<sub>2</sub>O; tolerance for individual value ± 5.08 from average.

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

Calibrated by:

Boonyarath I.

(Mr. Boonyarath I.)

Field Scientist(2)

Approved by:

Samart P.

(Mr. Samart Boon-ngan)

Field Specialist(1)

FORM NO. J-06-024 REVISION NO. 2 ISSUE DATE: 30 Jul 22



## Stopwatch Calibration Test Report

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

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

### Reference Stopwatch Data

Stopwatch ID No.: RYG\_FS0540  
Model: F808  
Serial No.: E18061  
Calibration Date: 4 Jul 24  
Certificate No.: E-2407022

### Console Control Meter Data

Dry Gas Meter No.: BKK\_FS0547  
Model: XC-572-V  
Serial No.: 1606040

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

Calibrate by:

Boonyarath I.

Mr. Boonyarath Iamrat

Field Scientist (2)

Approved by:

Samart P.

Mr. Samart Boon-ngan

Specialist (1)



### DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date :		6 Jul 24	Ambient Temperature (°C)		33
Calibration sheet No. : C-060724-BKK_FS0548			Relative Humidity (%) :		64
Digital Temperature ID : BKK_FS0548			Reference Temperature ID		BKK_FS1144
Serial No. : 1606040			Serial No. :		201090006013
Model : XC-572-V			Model :		Digicon-CC-VT-MS
			Next Calibrate :		16 Jan 25
Location	Reference Temperature °C	Digital Temperature °C	Error °C	MPE	Pass / Fail
Stack	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	51	1	±3	Pass
	100	102	2	±3	Pass
	150	152	2	±3	Pass
	200	202	2	±3	Pass
	250	252	2	±3	Pass
	300	302	2	±3	Pass
	500	502	2	±3	Pass
	100	101	1	±3	Pass
Probe	120	121	1	±3	Pass
	140	142	2	±3	Pass
	100	101	1	±3	Pass
Oven	120	121	1	±3	Pass
	140	142	2	±3	Pass
	100	101	1	±3	Pass
Filter	120	121	1	±3	Pass
	140	142	2	±3	Pass
	0	0	0	±3	Pass
Exit	10	10	0	±3	Pass
	20	21	1	±3	Pass
	0	0	0	±3	Pass
Meter	25	25	0	±3	Pass
	50	51	1	±3	Pass
	0	0	0	±3	Pass
AUX	25	25	0	±3	Pass
	50	51	1	±3	Pass

MPE : (Maximum permissible error of measurement) ค่าความผิดพลาดสูงสุดของเครื่องมือวัด

Calibrated by : Boonyarith I. ( Mr.Boonyarith Iamted )  
Field Scientist (2)

Approved by : S.P. ( Mr.Samart Roo-ngan )  
Specialist (1)

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



### PROBE NOZZLE DIAMETER CALIBRATION DATA SHEET

Calibration Date :	6 Jul 24	Nozzle Set ID. :	BKK_FS0547
Calibration Sheet No. : C-060724-BKK_FS0553	Vernier Caliper ID.:		RYG_FS0539

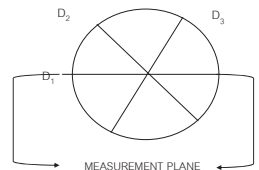
Nozzle ID #	Nozzle Diameter (cm.)			Hi - Lo	(D <sub>1</sub> + D <sub>2</sub> + D <sub>3</sub> ) / 3
	D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>	ΔD	D <sub>avg</sub>
1	0.315	0.315	0.315	0.000	0.315
2	0.475	0.475	0.475	0.000	0.475
3	0.635	0.635	0.635	0.000	0.635
4	0.790	0.790	0.790	0.000	0.790
5	0.950	0.950	0.950	0.000	0.950
6	1.110	1.110	1.110	0.000	1.110
7	1.270	1.270	1.270	0.000	1.270
8	1.600	1.600	1.600	0.000	1.600

Where :

D<sub>1</sub>, D<sub>2</sub>, D<sub>3</sub> = There different nozzle diameters at 60 degrees to each other, each measured the nearest 0.025 mm.

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

D<sub>avg</sub> = (D<sub>1</sub> + D<sub>2</sub> + D<sub>3</sub>) / 3



Calibrated by : Boonyarith I. ( Mr.Boonyarith Iamted )  
Field Scientist (2)

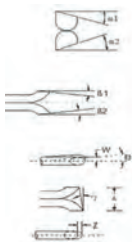
Approved by : S.P. ( Mr.Samart Roo-ngan )  
Field Specialist (1)

FORM NO.: F 06-028 REVISION NO.: 1 ISSUE DATE: 9-1-02



### Type S Pitot Tube Calibration

Date Calibration 3-Jun-24 Due Date 3-Dec-24  
Pitot ID BKK\_FS0501 Inclinator ID BKK\_FS1131  
Pitot SN - Vernier ID SGK\_FS0113



Parameter	Value	Allowable Range	Check
α1	-1.4	-10° < α1 < +10°	OK
α2	1	-10° < α2 < +10°	OK
β1	-0.2	-5° < β1 < +5°	OK
β2	-1.8	-5° < β2 < +5°	OK
γ	-0.3	-	-
θ	-0.5	-	-
Z = A tan γ	-0.005	Z ≤ 0.125"	OK
W = A tan θ	-0.008	W ≤ 0.031"	OK
Dt	0.375	0.188" to 0.375"	OK
A/2Dt	1.227	1.05 ≤ PA/Dt ≤ 1.5	OK
A	0.92	2.1Dt ≤ A ≤ 3Dt	OK

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

Calibrated by : Prasert S. ( Mr.Prasert Surakhan )  
Enviro Field Services Scientist (3)

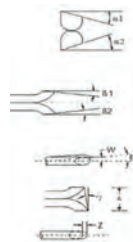
Approved by : S.P. ( Mr.Samart Roo-ngan )  
Enviro Field Services Specialist (1)

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



### Type S Pitot Tube Calibration

Date Calibration 3-Jun-24 Due Date 3-Dec-24  
Pitot ID BKK\_FS0489 Inclinator ID BKK\_FS1131  
Pitot SN - Vernier ID SGK\_FS0113



Parameter	Value	Allowable Range	Check
α1	0.6	-10° < α1 < +10°	OK
α2	0.4	-10° < α2 < +10°	OK
β1	-1	-5° < β1 < +5°	OK
β2	2.6	-5° < β2 < +5°	OK
γ	1.3	-	-
θ	-1.5	-	-
Z = A tan γ	0.020	Z ≤ 0.125"	OK
W = A tan θ	-0.024	W ≤ 0.031"	OK
Dt	0.310	0.188" to 0.375"	OK
A/2Dt	1.452	1.05 ≤ PA/Dt ≤ 1.5	OK
A	0.9	2.1Dt ≤ A ≤ 3Dt	OK

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

Calibrated by : Prasert S. ( Mr.Prasert Surakhan )  
Enviro Field Services Scientist (3)

Approved by : S.P. ( Mr.Samart Roo-ngan )  
Enviro Field Services Specialist (1)

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

Certificate No: G 670023  
Date of issue: 10-Jan-24

Instrument description : Rue Gas Analyzer  
Instrument model : Testo 350 New  
Control unit serial no. : 03580090/1121  
Instrument serial no. : 62985022/1121  
ID no. or control no. : BKK\_FS1156  
Manufacturer : Testo SE & Co. KGaA  
Probe description :  
Probe model :  
Probe serial no. :  
Customer name : ALS LABORATORY GROUP (THAILAND) CO.,LTD.  
Customer address : 104 Phattanakarn 40, Phattanakarn Road, Khwaeng Phattanakarn, Khet Suan Luang, Bangkok, 10250 Thailand

REVIEW BY: *Manakorn P.*  
APPROVED BY: *Atk*  
EFFECTIVE DATE: 9/1/25

Total pages of certificate : 2 Pages  
Receiving no. : L-240106  
Receiving date : 08-Jan-24  
Parameter of calibration : Gas Calibration(Oxygen 2.50,10.04,21.02 %vol, Carbon Monoxide 80.14,302,1003 ppm)  
Nitrogen Dioxide 30.34,80.96,201.9 ppm, Nitric Oxide 30.01,151.5,322.5 ppm,  
Sulphur Dioxide 50.36,100.8,600.8 ppm)

Condition of UUC. : Used  
Ambient condition : All of the Measurement were carried out the stabilized laboratory  
Temperature : 23 ± 5 °C  
Humidity : 55 ± 15 %RH

Calibration place : 17/121 Soi Ngamwongwan 47 Yaek 48, Toongsonghong, Lakki, Bangkok 10210

Calibration procedure no. : This instrument was calibrated by comparison with Standard gas mixture according to calibration Work Instruction no. WI-CL-28-C

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

Date of calibration : 10-Jan-24

*Kwanchoi P.*  
Mr. Kwanchoi Khumduang  
Calibration Technician

*Atk*  
Mrs. Nongluck Wongsettee  
Technical Manager

FM-CL-09-C Rev.8

Page 1 of 2

Issued Date 26/02/16

Entech Industrial Solution Co.,Ltd.

17/121 Soi Ngamwongwan 47 Yaek 48, Toongsonghong, Lakki, Bangkok 10210 THAILAND Tel: 0-2779-8888 Calibration@entech.co.th  
Fax: 0-2105563035591 www.entech.co.th

Certificate No.: G 670023

Standard References (Table 1)

Standard	Certificate No.	Vendor	Due date
Oxygen ( O <sub>2</sub> ) 2.50 % Vol	2412/23	Linde	27-Aug-27
Oxygen ( O <sub>2</sub> ) 10.04 % Vol	CG-0153-21	Nimt	18-Nov-26
Oxygen ( O <sub>2</sub> ) 21.02 % Vol	CG-0041-22	Nimt	10-Feb-27
Carbon monoxide ( CO ) 80.14 ppm	CG-0040-22	Nimt	14-Feb-27
Carbon monoxide ( CO ) 302 ppm	1915/23	Linde	16-Jan-25
Carbon monoxide ( CO ) 1003 ppm	2584/23	Linde	10-Sep-25
Nitrogen Dioxide ( NO <sub>2</sub> ) 30.34 ppm	2703/22	Linde	22-Aug-24
Nitrogen Dioxide ( NO <sub>2</sub> ) 80.96 ppm	3240/21	Linde	26-Jun-24
Nitrogen Dioxide ( NO <sub>2</sub> ) 201.9 ppm	1975/23	Linde	17-Jul-25
Nitric Oxide ( NO ) 30.01 ppm	CG-0014-23	Nimt	19-Feb-25
Nitric Oxide ( NO ) 151.5 ppm	0161/23	Linde	22-Jan-25
Nitric Oxide ( NO ) 322.5 ppm	1974/23	Linde	17-Jul-25
Sulphur Dioxide ( SO <sub>2</sub> ) 50.36 ppm	2004/23	Linde	17-Jul-25
Sulphur Dioxide ( SO <sub>2</sub> ) 100.8 ppm	3507/22	Linde	09-Nov-24
Sulphur Dioxide ( SO <sub>2</sub> ) 600.8 ppm	2003/23	Linde	17-Jul-25

Measured room conditions

Temperature : 23.3 °C Humidity : 59.1 %RH Pressure : 1012.4 mbar

Calibration conditions

Gas Temperature : 23 °C Flow rate : 1,200 ml/min Gas pressure : 1016.5 mbar

Calibration Results (Without adjustment) (Table 2)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O <sub>2</sub> (%Vol)	2.50	2.44	-0.06	0.15
O <sub>2</sub> (%Vol)	10.04	9.93	-0.11	0.20
O <sub>2</sub> (%Vol)	21.02	21.11	0.09	0.30
CO (ppm)	80.14	82	1.86	3.0
CO (ppm)	302	305	3	6.0
CO (ppm)	1003	1008	5	12
NO <sub>2</sub> (ppm)	30.34	28.6	-1.74	8.0
NO <sub>2</sub> (ppm)	80.96	81.2	0.24	8.0
NO <sub>2</sub> (ppm)	201.9	202.7	0.8	12
NO (ppm)	30.01	30	-0.01	8.0
NO (ppm)	151.5	152	0.5	8.0
NO (ppm)	322.5	321	-1.5	12
SO <sub>2</sub> (ppm)	50.36	51	0.64	6.0
SO <sub>2</sub> (ppm)	100.8	101	0.2	6.0
SO <sub>2</sub> (ppm)	600.8	599	-1.8	13

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

End of Report

FM-CL-09-C Rev.8

Page 2 of 2

Issued Date 26/02/16

Entech Industrial Solution Co.,Ltd.

17/121 Soi Ngamwongwan 47 Yaek 48, Toongsonghong, Lakki, Bangkok 10210 THAILAND Tel: 0-2779-8888 Calibration@entech.co.th  
Fax: 0-2105563035591 www.entech.co.th



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISIR)

Mechanical Engineering Standards Laboratory Sol 1, Bangpoo Industrial Estate, Muang, Samutprakan 10280, Thailand.

Request No. 23-67/0215

MTC.No. 23-67/0215-03

Number of Pages(S) 2

CALIBRATION CERTIFICATE

Nomenclature : "P" PRESSURE GAUGE  
Manufactured by "P"  
Dial size 60 mm  
Serial No. VG06 ID. BKK\_FS0896  
Range : -30 in Hg to 0 in Hg  
Scale Interval : 0.05 in Hg

REVIEW BY: *Manakorn P.*  
APPROVED BY: *Atk*  
EFFECTIVE DATE: 31/1/25

Submitted by : ALS Laboratory Group ( Thailand ) Co., Ltd.  
104 Phattanakarn 40, Phattanakarn Rd.,  
Khwaeng Phattanakarn, Khet Suan Luang, Bangkok 10250, Thailand.

Condition of calibrated item : Normal  
Received date : 15 January 2024  
Calibration date : 31 January 2024  
Location of calibration : Mechanical Engineering Standards Laboratory, Room 119  
Standard : Reference Pressure Monitor, Serial 1950, Certificate no. 23-66/0721-05  
Due Date 12 October 2024.  
The Standard used for the measurement is traceable to SI Unit through Thailand Institute of Scientific and Technological Research (TISIR).

CALIBRATED BY: *P. P.* APPROVED BY: *Atk*  
*Soi ( Mr.Uthai Chaiyapat )* ( Ms.Kirana Luanghuan )  
Director  
Mechanical Engineering Standards Laboratory  
Ref. 2013267011500197003  
Issued Date : 16 February 2024

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

FM-BL-MTC.002 Rev.4

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Changwat Pathumthani 12120, Thailand  
Tel. (66) 0 2577 9000  
Fax. (66) 0 2577 9009  
E-mail: numpag@tist.or.th Website: www.tist.or.th

Office Laboratory  
Sol 1C, Bangpoo Industrial Estate, Sukhumvit Road,  
Amphoe Muang, Changwat Samutprakan 10280, Thailand  
Tel. (66) 0 2323 1672-80 ext. 115, 116  
Fax. (66) 0 2323 9165  
E-mail: mtg@tist.or.th

Office  
196 Phahonyothin Road, Chatuchak, Bangkok 10900,  
Thailand  
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217  
Fax. (66) 0 2579 8592  
E-mail: sumalee@tist.or.th



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISIR)

Mechanical Engineering Standards Laboratory Sol 1, Bangpoo Industrial Estate, Muang, Samutprakan 10280, Thailand.

Request No. 23-67/0215

2 / 2

MTC.No. 23-67/0215-03

Calibration range : -28 in Hg to 0 in Hg  
Calibration method : The Pressure Gauge Under Calibration (UUC) was calibrated by comparison method followed DAKS-DKD-R 6-1: Calibration of Pressure Gauge, edition 03/2014  
Calibration condition : Temperature (23.7 ± 2) °C, Relative Humidity (64 ± 10) %  
Atmospheric pressure (1013 ± 10) hPa, Local gravity (9.783003 ± 0.000050) m/s<sup>2</sup>  
Measurement Data :

Gauge position : Vertical Medium : Air  
Reference level : Gauge inlet Unit : in Hg

UUC Reading	Gauge Pressure	Error	(±) Uncertainty
0	0.00	0.00	0.12
-10	-9.94	-0.06	0.13
-20	-19.62	-0.18	0.17
-26	-25.90	-0.10	0.13
-27	-26.87	-0.13	0.15
-28	-27.86	-0.14	0.12

Note : 1.The UUC reading taken after the gauge is lightly tapped.

2. Conversion factor : 1 in Hg = 3.386384 kPa

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

The End of Calibration Certificate

*P. P.*

The results relate only to the items tested/calibrated or value assigned.  
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FM-BL-MTC.002 Rev.4

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Office Laboratory  
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Tel. (66) 0 2323 1672-80 ext. 115, 116  
Fax. (66) 0 2323 9165  
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Office  
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Thailand  
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217  
Fax. (66) 0 2579 8592  
E-mail: sumalee@tist.or.th





Bara Scientific Co., Ltd.  
968 U Chu Liang Building Floor7 Rama4 Road  
Silom Bangkok Bangkok Thailand 10500  
Tel : 02-6324300 Fax : 02-6375496-7  
www.barascientific.com



## Certificate of Calibration

Certificate No. BSCC-UV-367/23  
Equipment UV/VIS Spectrophotometer  
Model UV-1800  
Manufacturer Shimadzu  
Serial No. A11454908533CD  
ID No. BKK\_EN0018  
Date of receipt 15 September 2023  
Date of calibration 15 September 2023  
Date of issue 22 September 2023

Number of Page(s) 1 of 3

REVIEW BY *Sirak P.*  
APPROVED BY *LLAL*  
NEXT CAL DATE *19/9/2024*

Customer name ALS Laboratory Group (Thailand) Co., Ltd.  
Address 104 Soi Phattananak 40, Phattananak Road, Phattananak, 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 Starna Scientific Ltd.  
(UKAS accredited calibration laboratory NO. 0659)

Calibrated by Mr. Wanchana Janioey

Approved by

*[Signature]*

Mr. Kanchit Choothep  
Technical Manager

The above results are valid exclusively for the calibrated item(s) as mention in this report / certificate.  
Advertising the report / Certificate and publicity of the results are prohibited and also shall not be reproduced  
except in full, without written approval of the Bara Scientific Co., Ltd.



Bara Scientific Co., Ltd.  
968 U Chu Liang Building Floor7 Rama4 Road  
Silom Bangkok Bangkok Thailand 10500  
Tel : 02-6324300 Fax : 02-6375496-7  
www.barascientific.com



## Certificate of Calibration

Certificate No. BSCC-UV-367/23

Number of Page(s) 2 of 3

Calibration Results:

### 1. Wavelength Accuracy

Certified Wavelength (nm)	UUC (nm)	Error (nm)	Uncertainty (±nm)
241.70	241.67	-0.03	0.18
334.02	334.03	0.01	0.18
418.53	418.59	0.06	0.18
572.99	573.14	0.15	0.18
879.41	879.21	-0.20	0.18

### 2. Photometric Accuracy (UV)

Wavelength (nm)	Certified Absorbance (A)	UUC (A)	Error (A)	Uncertainty (±A)
235	0.0000	0.0000	0.0000	0.0075
	0.7467	0.7460	-0.0007	0.0075
257	0.0000	0.0000	0.0000	0.0075
	0.8662	0.8646	-0.0016	0.0075
313	0.0000	0.0000	0.0000	0.0075
	0.2904	0.2908	0.0004	0.0075
350	0.0000	0.0001	0.0001	0.0075
	0.6429	0.6415	-0.0014	0.0075

\*CNR = Customer not request

The above results are valid exclusively for the calibrated item(s) as mention in this report / certificate.  
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FM-UV-708-02 Rev.01 (23/01/63)



Bara Scientific Co., Ltd.  
968 U Chu Liang Building Floor7 Rama4 Road  
Silom Bangkok Bangkok Thailand 10500  
Tel : 02-6324300 Fax : 02-6375496-7  
www.barascientific.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
	1.0206	1.0216	0.0010	0.0042
440.0	0.0000	0.0000	0.0000	0.0042
	0.5621	0.5625	0.0004	0.0042
	0.7455	0.7452	-0.0003	0.0042
	0.9985	0.9989	0.0004	0.0042
465.0	0.0000	0.0000	0.0000	0.0042
	0.5227	0.5229	0.0002	0.0042
	0.6880	0.6873	-0.0007	0.0042
	0.9487	0.9486	-0.0001	0.0042
546.1	0.0000	0.0000	0.0000	0.0042
	0.5207	0.5211	0.0004	0.0042
	0.6973	0.6960	-0.0013	0.0042
	0.9959	0.9944	-0.0015	0.0042
590.0	0.0000	0.0000	0.0000	0.0042
	0.5544	0.5538	-0.0006	0.0042
	0.7253	0.7236	-0.0017	0.0042
	1.0942	1.0925	-0.0017	0.0042
635.0	0.0000	0.0000	0.0000	0.0042
	0.5616	0.5612	-0.0004	0.0042
	0.6927	0.6909	-0.0018	0.0042
	1.0881	1.0866	-0.0015	0.0042

\*CNR = Customer not request

### 4. Stray Light\*

Standard cut-off wavelength (nm)	Unit Under Calibration(UUC) 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%T and Stray light absorbance reference is greater than 2.00A.  
\*Stray Light not NSC-ONSC Accredited.

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

\*\*\*End of Certificate\*\*\*

The above results are valid exclusively for the calibrated item(s) as mention in this report / certificate.  
Advertising the report / Certificate and publicity of the results are prohibited and also shall not be reproduced  
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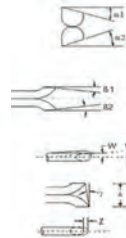
FM-UV-708-02 Rev.01 (23/01/63)



## Type S Pitot Tube Calibration

Date Calibration 5-Jul-24  
Pitot ID BKK\_FS0541  
Pitot SN -

Due Date 5-Jan-25  
Inclinometer ID BKK\_FS1131  
Vernier ID BKK\_FS1405



Parameter	Value	Allowable Range	Check
$\alpha 1$	3.7	$-10^{\circ} < \alpha 1 < +10^{\circ}$	OK
$\alpha 2$	2.3	$-10^{\circ} < \alpha 2 < +10^{\circ}$	OK
$\beta 1$	-0.7	$-5^{\circ} < \beta 1 < +5^{\circ}$	OK
$\beta 2$	5.3	$-5^{\circ} < \beta 2 < +5^{\circ}$	OK
$\gamma$	4.6	-	-
$\theta$	1.2	-	-
$Z = A \tan \gamma$	0.085	$Z \leq 0.125"$	OK
$W = A \tan \theta$	0.022	$W \leq 0.031"$	OK
$Dt$	0.375	$0.188" \text{ to } 0.375"$	OK
$A/2Dt$	1.413	$1.05 \leq PA/Dt \leq 1.5$	OK
$A$	1.06	$2.10t \leq A \leq 3Dt$	OK

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

Calibrated by : *Prasert S.*  
(Mr. Prasert Surakhan)  
Enviro Field Services Scientist (3)

Approved by : *S.P.*  
(Mr. Samart Roo-ngan)  
Enviro Field Services Specialist (1)

FORM NO.: F06-124 REVISION NO.: 0 ISSUE DATE: 25/12/23



SARTORIUS

# Certificate of Calibration

REVIEW BY Y. L. A. I.  
APPROVED BY Smit P.  
NEXT CAL DATE 30/11/24

Model Number : SECURA224-1S  
Description : Analytical Balance  
Serial Number : 0038304165  
ID No. : BKK\_EN0309  
Manufacturer : Sartorius  
Certificate No. : 23BCI068  
Issued Date : Friday, December 01, 2023  
Reference No. : 223958  
Page No. : 1 of 2

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

Calibrated Place : Lab Room

Calibrated By : Mr.Chonchai Inthana  
Calibration Date : Thursday, November 30, 2023  
Calibration Procedure No. : This calibration was conducted by  
Using in-house calibration procedure number (WI-003)  
Based on UKAS LAB 14 : 2019

Metrological data :  
Capacity : 220 g Readability : 0.0001 g  
Ambient Conditions :  
Temperature : 21.1 °C ± 5.0 °C  
Humidity : 58.0 % RH ± 10.0 % RH  
Pressure : ±

Reasons for calibration.  
☐ New Installation ☐ Service / Repair ☒ Re-calibration / Maintenance  
Equipment Condition : ☒ Good Operate ☐ Fair

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

## Traceability:

Model Number	Description	Traceability	Certificate No.	Due Date
YCS011-522-00	Sartorius weight set 1mg - 5000g E2, YCS011-522-00	TCS	M2308197S	23-Aug-2025
MHB-382SD	Humidity/Barometer/Temp. Lutron MHB-382SD	DKSH	C19231845	23-Aug-2024

This certificate relate and apply this equipment only.

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

SOP FM 33 03 February 2022

Mr.Chonchai Inthana(Technical Manager)



SARTORIUS

# Certificate of Calibration

Model Number : SECURA224-1S  
Description : Analytical Balance  
Serial Number : 0038304165  
ID No. : BKK\_EN0309  
Manufacturer : Sartorius  
Certificate No. : 23BCI0468  
Issued Date : Friday, December 01, 2023  
Reference No. : 223958  
Page No. : 2 of 2

## Calibration Results : Without Adjustment

Repeatability	Eccentricity (Off-center loading error)
The repeatability is the ability of a weighing instrument to display nearly identical readings under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express repeatability quantitatively.	The off-center loading error is yielded by the difference between the readout of the load, i.e. 1/3 or 1/4 of maximum capacity, placed in the middle of the weighing pan and between each of four additional measurement points / positions defined according to OIML R110.
Nominal Value : (Low Load) 20 g Tolerance 0.0001 g Nominal Value : (High Load) 200 g Tolerance 0.0001 g Standard Deviation 0.00005 0.00005	Nominal value : 100 g Tolerance 0.0004 g Difference 1 - 2 0.0000 3 0.0000 4 -0.0001 5 -0.0001 6 -

## Linearity

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

Tolerance		0.0002 g		
Nominal Value	Conventional Mass Value	Displayed Value	Deviation	Uncertainty
(g)	(g)	(g)	(g)	(g)
0.01	0.0100	0.0100	0.0000	0.00014
0.05	0.0500	0.0500	0.0000	0.00014
0.1	0.1000	0.1000	0.0000	0.00014
0.5	0.5000	0.5000	0.0000	0.00014
1	1.0000	1.0000	0.0000	0.00014
2	2.0000	2.0000	0.0000	0.00014
5	5.0000	5.0000	0.0000	0.00014
10	10.0000	10.0000	0.0000	0.00014
20	20.0000	20.0000	0.0000	0.00014
200	200.0000	200.0000	0.0000	0.00029

End of Report.

End of Report

SOP FM 33 03 February 2022



## DRY GAS METER CALIBRATION TEST REPORT

Calibration of Date : 3 Jun 24  
Next Calibration Date 3 Dec 24  
Barometric Pressure ( mm.Hg ) : 760  
Relative Humidity (%) : 54.0  
Temperature ( °C ) : 35.0

**Dry Gas Meter Data**  
Calibration sheet No. : C-030624-BKK\_FS0543  
Dry Gas Meter No. : BKK\_FS0543  
Console Serial No. : 1509021  
Model No. : XC-62-CV  
**Reference Dry Gas Meter Data**  
Reference Dry Gas Meter ID. : BKK\_FS0629  
Serial No. : 1607009  
Correction Factor (Yr) : 1.0000  
Next Calibration Date : 9 Jun 24

Reference Dry Gas Meter Calibration				Dry Gas Meter						Dry Gas Meter Correction Factor	
Vr (Liters)			Tr (°C)	Vm (Liters)			Ti (°C)	To (°C)	Avg. Tm (°C)	(Y)	
Final	Initial	Total	(°C)	Final	Initial	Total	(°C)	(°C)	(°C)		
30.00	0.00	30.00	33.0	28.90	0.00	28.90	33.0	33.0	33.0	1.0381	
30.00	0.00	30.00	34.0	28.95	0.00	28.95	34.0	34.0	34.0	1.0364	
60.00	0.00	60.00	34.0	58.10	0.00	58.10	35.0	35.0	35.0	1.0361	
60.00	0.00	60.00	34.0	58.15	0.00	58.15	37.0	37.0	37.0	1.0419	
90.00	0.00	90.00	34.0	87.20	0.00	87.20	37.0	37.0	37.0	1.0422	
90.00	0.00	90.00	34.0	87.53	0.00	87.53	38.0	38.0	38.0	1.0416	
Avg.										1.0394	

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

Calibrate by :

Mr.Prasert Surakhan  
Field Scientist (3)

Approved by :

Mr.Samart Roo-ngan  
Specialist (1)

FORM NO. F-06-027 REVISION NO. 1 ISSUE DATE: 2022



## DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date :	3 Jun 24	Ambient Temperature (°C)	34
Calibration sheet No. :	C-030624-BKK_FS0543	Relative Humidity (%) :	54
Digital Temperature ID :	BKK_FS0543	Reference Temperature ID	BKK_FS1144
Serial No. :	1509021	Serial No. :	201090006013
Model :	XC-62-CV	Model :	Digicon-CC-VT-MS
		Next Calibrate :	14 Aug 24

Location	Reference Temperature °C	Digital Temperature °C	Error °C	MPE	Pass / Fail
Stack	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass
	100	100	0	±3	Pass
	150	150	0	±3	Pass
	200	200	0	±3	Pass
Probe	250	248	-2	±3	Pass
	300	298	-2	±3	Pass
	500	499	-1	±3	Pass
	100	100	0	±3	Pass
	120	121	1	±3	Pass
	140	141	1	±3	Pass
Oven	100	-	-	±3	-
	120	-	-	±3	-
	140	-	-	±3	-
Filter	100	100	0	±3	Pass
	120	119	-1	±3	Pass
	140	141	1	±3	Pass
Exit	0	0	0	±3	Pass
	10	9	-1	±3	Pass
	20	21	1	±3	Pass
Meter	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	49	-1	±3	Pass
AUX	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	51	1	±3	Pass

MPE : (Maximum permissible error of measurement) ค่าความผิดพลาดสูงสุดของกาารวัดที่อนุญาต

Calibrated by :

(Mr.Prasert Surakhan)  
Field Scientist (3)

Approved by :

(Mr.Samart Roo-ngan)  
Specialist (1)

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



### Calibration Certificate

Certificate No. 551422  
Product 200-510M Defender 510 Medium Flow  
Serial No. 208345  
Cal. Date 18-Aug-2023

Sold To:

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

### As Received Calibration Data

Technician	Aaron Schwartz	Lab. Pressure Lab. Temperature	620.1 mmHg 23.5 °C		
Instrument Reading	Lab Standard Reading	Deviation	Allowable Deviation	As Received	
4523.09 ccm	4519.02 ccm	0.09%	1.00%	In Tolerance	
999.43 ccm	999.31 ccm	0.01%	1.00%	In Tolerance	
245.22 ccm	245.88 ccm	-0.27%	1.00%	In Tolerance	

### Mesa Laboratories Standards Used

Description	Standard Serial Number	Calibration Date	Calibration Due Date
ML_800_24	205307	25-May-2023	25-May-2024

REVIEW BY: *Norman P*  
APPROVED BY: *Ab U*  
NEXT CAL DATE: 18/8/24

### As Shipped Calibration Data

Certificate No	551422	Lab. Pressure	618.8 mmHg	
Technician	Xiem Ly	Lab. Temperature	24.2 °C	
Instrument Reading	Lab Standard Reading	Deviation	Allowable Deviation	As Shipped
4516.61 ccm	4515.56 ccm	0.02%	1.00%	In Tolerance
1000.87 ccm	1000.87 ccm	0.02%	1.00%	In Tolerance
249.84 ccm	249.93 ccm	-0.04%	1.00%	In Tolerance

### Mesa Laboratories Standards Used

Description	Standard Serial Number	Calibration Date	Calibration Due Date
ML_800_24	100439	14-Sep-2022	14-Sep-2023

### Calibration Notes

The expanded uncertainty of flow has a coverage factor of  $k = 2$  for a confidence interval of approximately 95%.  
Flow testing is in accordance with our test number MP-00672 with an expanded uncertainty of 0.27% using high-purity nitrogen or filtered laboratory air.  
Traceability to the International System of Units (SI) is verified by accreditation to ISO/IEC 17025 by NVLAP under NVLAP Code 200661-0.

### Technician Notes:

By:

Approved By:

*Xiem Ly*  
Xiem Ly  
Production Technician II

*Norma Aragon*  
Norma Aragon  
QC Inspector

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

### Calibration Certificate

Certificate No. 561587  
Product 200-510L Defender 510 Low Flow  
Serial No. 130026  
Cal. Date 25-Sep-2023

Sold To:

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### As Received Calibration Data

Technician	Aaron Schwartz	Lab. Pressure Lab. Temperature	616.1 mmHg 24 °C		
Instrument Reading	Lab Standard Reading	Deviation	Allowable Deviation	As Received	
0 ccm	456.41 ccm	-100.0%	1.00%	Out of Tolerance	
0 ccm	101.19 ccm	-100.0%	1.00%	Out of Tolerance	
0 ccm	30.36 ccm	-100.0%	1.00%	Out of Tolerance	

### Mesa Laboratories Standards Used

Description	Standard Serial Number	Calibration Date	Calibration Due Date
ML_800_10	103743	25-Jan-2023	25-Jan-2024

REVIEW BY: *Norman P*  
APPROVED BY: *Ab U*  
NEXT CAL DATE: 25/9/24

### As Shipped Calibration Data

Certificate No	561587	Lab. Pressure	622.2 mmHg	
Technician	Aaron Schwartz	Lab. Temperature	23.6 °C	
Instrument Reading	Lab Standard Reading	Deviation	Allowable Deviation	As Shipped
449.75 ccm	450.46 ccm	-0.16%	1.00%	In Tolerance
100.96 ccm	100.82 ccm	0.14%	1.00%	In Tolerance
30.63 ccm	30.38 ccm	0.82%	1.00%	In Tolerance

### Mesa Laboratories Standards Used

Description	Standard Serial Number	Calibration Date	Calibration Due Date
ML_800_10	103743	25-Jan-2023	25-Jan-2024

### Calibration Notes

The expanded uncertainty of flow has a coverage factor of  $k = 2$  for a confidence interval of approximately 95%.  
Flow testing is in accordance with our test number MP-00672 with an expanded uncertainty of 0.27% using high-purity nitrogen or filtered laboratory air.  
Traceability to the International System of Units (SI) is verified by accreditation to ISO/IEC 17025 by NVLAP under NVLAP Code 200661-0.

### Technician Notes:

By:

Approved By:

*Aaron Schwartz*  
Aaron Schwartz  
Assembler I

*David Thomas*  
David Thomas  
Quality Engineer

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



## Calibration Certificate

Certificate No. 561588  
Product 200-510M Defender 510 Medium Flow  
Serial No. 151114  
Cal. Date 30-Sep-2023

Sold To:

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## As Received Calibration Data

Technician	Xiem Ly	Lab. Pressure Lab. Temperature	616.8 mmHg 25.8 °C	Instrument Reading	Lab Standard Reading	Deviation	Allowable Deviation	As Received
0 ccm	4499.86 ccm	-100.0%	1.00%	0 ccm	997.38 ccm	-100.0%	1.00%	Out of Tolerance
0 ccm	250.32 ccm	-100.0%	1.00%	0 ccm				Out of Tolerance

## Mesa Laboratories Standards Used

Description	Standard Serial Number	Calibration Date	Calibration Due Date
ML_800_24	117991	16-Aug-2023	16-Aug-2024



## As Shipped Calibration Data

Certificate No	561588	Lab. Pressure	616.2 mmHg	
Technician	Xiem Ly	Lab. Temperature	26.1 °C	
Instrument Reading	Lab Standard Reading	Deviation	Allowable Deviation	As Shipped
4486.74 ccm	4494.43 ccm	0.05%	1.00%	In Tolerance
997.03 ccm	997.16 ccm	-0.01%	1.00%	In Tolerance
249.84 ccm	250.5 ccm	-0.26%	1.00%	In Tolerance

## Mesa Laboratories Standards Used

Description	Standard Serial Number	Calibration Date	Calibration Due Date
ML_800_24	117991	05-Dec-2022	05-Dec-2023

## Calibration Notes

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

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

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

## Technician Notes:

By:

Xiem Ly  
Production Technician II

Approved By:

Norma Aragon  
QC Inspector

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

## Certificate of Calibration

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

Certificate No : 24-AFM-018 Rev.1

Request No : Req-2024-0043

## Unit Under Calibration Details

Measurement Item : Air Flow Meter  
Manufacturer : Bios  
Model : Defender 510-L  
Serial Number : 206895  
ID : BKK\_FS1346

Sensor Model : -

Sensor Serial Number : -

Location of Calibration : LAB 4 AIR VELOCITY METER

## Calibration Environment and Details

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

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

Reference Standard	Model	Serial Number	Traceable	Due Calibration
Air Flow Meter	Gilibrator 3 Low flow	1850101006	Sensidyne	12 July 2024
Air Flow Meter	Gilibrator 3 Standard flow	19031011003	Sensidyne	12 July 2024
Temperature meter	GT 11	08009057	Qreborn	27 February 2024
Pressure meter	CPG2400	41000KDU/651882	TPA	9 November 2024

## Traceability :

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

## Note :

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

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

Calibration By : Mr. Noppadon Luangart  
Service Calibration Engineer

Approved By : Mr. Pacit Mathavorn  
Calibration Engineer Supervisor

Issue Date : 1 February 2024

Certificate No : 24-AFM-018 Rev.1

Request No : Req-2024-0043

## Result of Calibration : Without Adjustment

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

## Note

STD : Standard UUC : Unit Under Calibration

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

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

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

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

Meas = Measurement Condition ref = Standard Condition

\* Indicates non accredited

End of Certificate



### Certificate of Calibration

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

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

#### Unit Under Calibration Details

Measurement Item : Primary Flow Calibrator  
Manufacturer : Bios  
Model : Defender 510-L  
Serial Number : 130027  
ID : RYG\_FS0208  
Sensor Model : -  
Sensor Serial Number : -  
Location of Calibration : LAB 4 AIR VELOCITY METER

#### Calibration Environment and Details

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

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


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


#### Traceability :

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

#### Note :

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

**Calibration By :**   
Mr. Noppadon Luangart  
Service Calibration Engineer

**Approved By :**   
Mr. Pacit Mathavorn  
Calibration Engineer Supervisor  
**Issue Date :** 13 February 2024

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

#### Result of Calibration : Without Adjustment

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

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

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

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

\* Indicates non accredited

End of Certificate

### Certificate of Calibration

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

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

#### Unit Under Calibration Details

Measurement Item : Primary Flow Calibrator  
Manufacturer : Bios  
Model : Defender 510-M  
Serial Number : 129958  
ID : RYG\_FS0209  
Sensor Model : -  
Sensor Serial Number : -  
Location of Calibration : LAB 4 AIR VELOCITY METER

#### Calibration Environment and Details

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

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


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


#### Traceability :

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

#### Note :

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

**Calibration By :**   
Mr. Noppadon Luangart  
Service Calibration Engineer

**Approved By :**   
Mr. Pacit Mathavorn  
Calibration Engineer Supervisor  
**Issue Date :** 13 February 2024

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

#### Result of Calibration : Without Adjustment

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

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

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

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

\* Indicates non accredited

End of Certificate



### Certificate of Calibration

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

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

#### Unit Under Calibration Details

Measurement Item : Air Flow Meter  
Manufacturer : Bios  
Model : Defender 510-L  
Serial Number : 206895  
ID : BKK\_FS1346

Sensor Model : -  
Sensor Serial Number : -

Location of Calibration : LAB 4 AIR VELOCITY METER

#### Calibration Environment and Details

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

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

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

#### Traceability :

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

#### Note :

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

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

Calibration By : ME  
Mr. Noppadon Luangart  
Service Calibration Engineer

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

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

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

Certificate No : 24-AFM-018 Rev.1

Request No : Req-2024-0043

#### Result of Calibration : Without Adjustment

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

#### Note

STD : Standard UUC : Unit Under Calibration

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

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

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

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

\* Indicates non accredited

End of Certificate

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

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

BKK\_FS0614



### Calibration Certificate

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

Sold To:

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

#### As Received Calibration Data

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

#### Mesa Laboratories Standards Used

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

#### As Shipped Calibration Data

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

#### Mesa Laboratories Standards Used

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

#### Calibration Notes

The expanded uncertainty of flow has a coverage factor of  $k = 2$  for a confidence interval of approximately 95%.  
Flow testing is in accordance with our test number MP-00672 with an expanded uncertainty of 0.27% using high-purity nitrogen or filtered laboratory air.  
Traceability to the International System of Units (SI) is verified by accreditation to ISO/IEC 17025 by NVLAP under NVLAP Code 200661-0.

#### Technician Notes:

By:

Approved By:

Derek Dellape  
Production Assembler II

Troy Thacker  
Quality Engineer

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



### Certificate of Calibration

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

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

#### Unit Under Calibration Details

Measurement Item : Primary Flow Calibrator  
Manufacturer : Bios  
Model : Defender 510-L  
Serial Number : 130027  
ID : RYG\_FS0208  
Sensor Model : -  
Sensor Serial Number : -  
Location of Calibration : LAB 4 AIR VELOCITY METER

#### Calibration Environment and Details

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

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


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


#### Traceability :

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

#### Note :

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

**Calibration By :**   
Mr. Noppadon Luangart  
Service Calibration Engineer

**Approved By :**   
Mr. Pacit Mathavorn  
Calibration Engineer Supervisor  
**Issue Date :** 13 February 2024

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

#### Result of Calibration : Without Adjustment

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

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

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

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

\* Indicates non accredited

End of Certificate

### Certificate of Calibration

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

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

#### Unit Under Calibration Details

Measurement Item : Primary Flow Calibrator  
Manufacturer : Bios  
Model : Defender 510-M  
Serial Number : 129958  
ID : RYG\_FS0209  
Sensor Model : -  
Sensor Serial Number : -  
Location of Calibration : LAB 4 AIR VELOCITY METER

#### Calibration Environment and Details

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

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


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


#### Traceability :

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

#### Note :

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

**Calibration By :**   
Mr. Noppadon Luangart  
Service Calibration Engineer

**Approved By :**   
Mr. Pacit Mathavorn  
Calibration Engineer Supervisor  
**Issue Date :** 13 February 2024

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

#### Result of Calibration : Without Adjustment

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

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

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

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

\* Indicates non accredited

End of Certificate





### Certificate of Calibration

#### Customer

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

Certificate No : 24-AFM-174

Request No : Req-2024-1861

#### Unit Under Calibration Details

Measurement Item : Air Flow Meter  
Manufacturer : MesaLabs  
Model : 510-M  
Serial Number : 208345  
ID : BKK\_FS1347

Accuracy : 1% of Reading

Sensor Model : -

Sensor Serial Number : -

Instrument Status : Used

Location of Calibration : LAB 4 AIR VELOCITY METER

#### Calibration Environment and Details

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

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

REVIEW BY *Nopadon P.*  
APPROVED BY *Mr. Nopadon Luangari*  
NEXT CAL DATE *28/8/29*

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

#### Traceability :

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

#### Note :

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

Calibration By : *Mr. Nopadon Luangari*  
Service Calibration Engineer

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

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

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



Certificate No : 24-AFM-174

Request No : Req-2024-1861

#### Result of Calibration : Without Adjustment

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

#### Note

STD : Standard UUC : Unit Under Calibration

UUC Reference Condition : At atmospheric pressure and room temperature condition

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

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

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

Meas = Measurement Condition ref = Standard Condition

\* Indicates non accredited

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

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

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

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



Certificate No : 24-AFM-174

Request No : Req-2024-1861

#### Decision Rule for Statements of Conformity

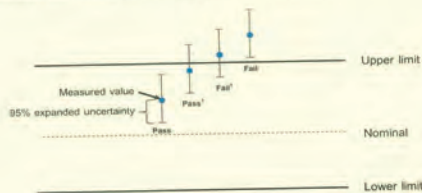
The standard decision rule employed for the statements of conformity to each calibration result will be applied using ILAC-G8:09-2019, Guidelines on the Reporting of Compliance with Specification as following Fig. and statements

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

Pass<sup>1</sup> = The measurement result was within the limit. However, a portion of the expanded uncertainty of measurement at 95% exceeds the limit.

Fail<sup>1</sup> = The measurement result was out of the limit. However, a portion of the expanded uncertainty of measurement at 95% is within the limit.

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



End of Certificate

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

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



### Certificate of Calibration

#### Customer

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

Certificate No : 24-AFM-177

Request No : Req-2024-1862

#### Unit Under Calibration Details

Measurement Item : Air Flow Meter  
Manufacturer : Bios  
Model : Defender 510-L  
Serial Number : 130026  
ID : BKK\_FS0619  
Location of Calibration : LAB 4 AIR VELOCITY METER

Accuracy : 1% of Reading

Sensor Model : -

Sensor Serial Number : -

Instrument Status : Used

#### Calibration Environment and Details

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

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

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

#### Traceability :

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

#### Note :

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

Calibration By : *Mr. Nopadon Luangari*  
Service Calibration Engineer

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

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

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



Certificate No : 24-AFM-177

Request No : Req-2024-1862

Result of Calibration : Without Adjustment

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

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

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

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

\* Indicates not accredited

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

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

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

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

Certificate No : 24-AFM-177

Request No : Req-2024-1862

Decision Rule for Statements of Conformity

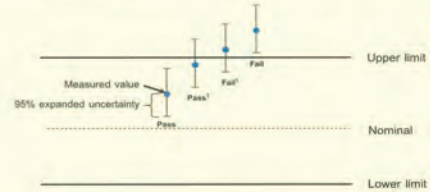
The standard decision rule employed for the statements of conformity to each calibration result will be applied using ILAC-G8:2019: Guidelines on the Reporting of Compliance with Specification as following Fig. and statements

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

Pass<sup>1</sup> = The measurement result was within the limit. However, a portion of the expanded uncertainty of measurement at 95% exceeds the limit.

Fail<sup>1</sup> = The measurement result was out of the limit. However, a portion of the expanded uncertainty of measurement at 95% is within the limit.

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



End of Certificate

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

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



Bara Scientific Co., Ltd.  
968 U Chu Liang Building Floor7 Rama4 Road  
Sikim Bangkok Bangkok Thailand 10500  
Tel : 02-6324300 Fax : 02-6375496-7  
www.barscientific.com



## Certificate of Calibration

Number of Page(s) 1 of 3

Certificate No. BSCC-UV-374/24  
Equipment UV/VIS Spectrophotometer  
Model UV-1800  
Manufacturer Shimadzu  
Serial No. A11454008533 CD  
ID No. BKK\_EN0018  
Date of receipt 13 September 2024  
Date of calibration 13 September 2024  
Date of issue 13 SEP 2024

REVIEW BY *Junda K*  
APPROVED BY *Sinuk P*  
NEXT CAL DATE *10/9/2025*

Customer name ALS Laboratory Group (Thailand) Co., Ltd.  
Address 104 Soi Phattanakarn 40, Phattanakarn Road, Phattanakarn, Suan Luang, Bangkok 10250

Temperature (25.3 - 26.7) °C (On site)  
Humidity (50.4 - 55.9) %RH (On site)

Equipment condition Good Operation

Calibration Location Organic Preparation Lab

Calibration Procedure In-house method WI-UV-702-01 based on ASTM E275-01

Traceability Wavelength Accuracy is traceable to certificate No. 106372 and 106371  
Photometric Accuracy is traceable to certificate No. 106364 and 111398  
Stray Light is traceable to certificate No. 106377  
The above certificate are traceable to SI unit through Stama Scientific Ltd.  
(UKAS accredited calibration laboratory NO. D659)

Calibrated by Mr.Wanchana Jantoley

Approved by

*Sonthei*  
Mr.Sonthei Temboonsakdi  
Service Manager

The above results are valid exclusively for the calibrated item(s) as mention in this report / certificate.  
Advertising the report / Certificate and publicity of the results are prohibited and also shall not be reproduced  
except in full, without written approval of the Bara Scientific Co., Ltd.

BK11/M/2018-02 Rev.01 (2018/05/01)



Bara Scientific Co., Ltd.  
968 U Chu Liang Building Floor7 Rama4 Road  
Sikim Bangkok Bangkok Thailand 10500  
Tel : 02-6324300 Fax : 02-6375496-7  
www.barscientific.com



## Certificate of Calibration

Certificate No. BSCC-UV-374/24

Number of Page(s) 2 of 3

Calibration Results:

1.Wavelength Accuracy

Certified Wavelength (nm)	UUC (nm)	Error (nm)	Uncertainty (±nm)
241.70	241.55	-0.15	0.18
334.02	333.85	-0.17	0.18
418.53	418.57	0.04	0.18
572.99	572.97	-0.02	0.18
879.41	879.17	-0.24	0.18

2.Photometric Accuracy (UV)

Wavelength (nm)	Certified Absorbance (A)	UUC (A)	Error (A)	Uncertainty (±A)
235	0.0000	0.0000	0.0000	0.0075
	0.7171	0.7169	-0.0002	0.0075
257	0.0000	0.0000	0.0000	0.0075
	0.8354	0.8345	-0.0009	0.0075
313	0.0000	0.0000	0.0000	0.0075
	0.2786	0.2781	-0.0005	0.0075
350	0.0000	0.0000	0.0000	0.0075
	0.6199	0.6194	-0.0005	0.0075

\*CNR = Customer not request

The above results are valid exclusively for the calibrated item(s) as mention in this report / certificate.  
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FM-UV-708-02 Rev.01 (2018/05/01)

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 %



### Certificate of Calibration

#### Customer

Name : ALS Laboratory Group Thailand Co., Ltd.  
Address : 104 Soi Phattharakarn 40, Phattharakarn Road, Suan 1, uang, Bangkok 10250

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

#### Unit Under Calibration Details

Measurement item : Sound Level Meter  
Manufacturer : RION  
Model : NL-42  
Serial Number : 01022261  
ID : BKK\_FS0030  
Resolution : 0.1 dB  
Microphone Class : 2  
Microphone Model : UC-32  
Microphone S/N : 180399  
Preamplifier Model : N11-24  
Preamplifier S/N : 88169  
Instrument Status : Used

#### Calibration Environment and Details


Temperature : 23 °C ± 2 °C  
Humidity : 50 %RH ± 20 %RH  
Barometric Pressure : 1013 hPa ± 10 hPa  
Received Date : 20 December 2023  
Calibrated Date : 29 January 2024  
Calibration Procedure : In-house method CP-SLM-01 based on IEC 61672-3 : 2013 Electroacoustics - Sound level meters - Part 3: Periodic tests  
Location of Calibration : Lab Acoustic


#### Reference Standard

Instrument	Brand	Model	SN	Due calibration	Traceability
Standard Microphone	GRAS	40AN	188273	21 August 2024	GRAS
Multifrequency Calibrator	Quest	Quest-cal	EFA000234	26 July 2024	TSI
Audio Generator	Scamek	Svm401	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 :   
Mr. Noppadon Luangari  
Service Calibration Engineer

Approved By :   
Mr. Pacit Mathavorn  
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.

FM-708-SLM-01 Rev.02 Issue date:11/23

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

#### 1. Indication at the calibration check frequency

UUC Setting	Nominal Level	Before Adjust		After Adjust		UNCERTAINTY (± dB)	Acceptance Limit (± dB)
		UUC (dB)	ERR (dB)	UUC (dB)	ERR (dB)		
FAST / A / 30-130							
Calibrator Setting							
1000 Hz 114 dB	113.78	114.1	+0.32	113.8	0.02	0.20	0.30

Note: Absolute sensitivity was established by the use of Sound Calibrator Brand SVANTER, Model SV 35A, SN. 58079

#### 2. Self-generated noise, Microphone installed

UUC Setting	Measured	UNCERTAINTY
FAST / 30-130		
UUC Weighting	(dB)	(± dB)
A	16.2	0.10

#### 3. Self-generated noise, Microphone replaced by the electrical input signal device

UUC Setting	Measured	UNCERTAINTY
FAST / 30-130		
UUC Weighting	(dB)	(± 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 (± dB)	Acceptance Limit (± dB)
	A	C	Z		
FAST / 30-130					
STD Setting	(dB)	(dB)	(dB)		
125 Hz	-0.2	0.4	0.3	0.60	1.5
1000 Hz	0.0	0.0	0.0	0.60	1.0
4000 Hz	1.0	1.0	1.0	0.60	3.0
8000 Hz	-1.3	-1.4	-1.4	0.70	5.0

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FM-708-SLM-01 Rev.02 Issue date:11/23

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 (± dB)	Acceptance Limit (± dB)
	A (dB)	C (dB)	Z (dB)		
FAST / 30-130					
STD Setting					
63 Hz	-0.2	-0.1	0.0	0.20	2.0
125 Hz	-0.1	0.0	0.0		1.5
250 Hz	-0.1	0.0	0.0		1.5
500 Hz	0.0	0.0	0.0		1.5
1000 Hz	0.0	0.0	0.0		1.0
2000 Hz	0.0	0.0	0.0		2.0
4000 Hz	0.0	0.0	0.0		3.0
8000 Hz	0.0	0.0	0.0		5.0
16000 Hz	-1.4	-1.4	0.0		+5, -INF.

#### 6. Frequency and time weightings at 1kHz

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

UUC Setting	STD	Measured		UNCERTAINTY (± dB)	Acceptance Limit (± dB)
30-130 / A	REF	UUC	ERR		
UUC Time Response	(dB)	(dB)	(dB)		
Fast	114.00	114.0	0.0	0.20	0.10
Slow	114.00	114.0	0.0		0.10
Leq	114.00	114.0	0.0		0.10

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FM-708-SLM-01 Rev.02 Issue date:11/23

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

#### 7. Long Term Stability

UUC Setting	Measured	UNCERTAINTY (± dB)	Acceptance Limit (± dB)
FAST / A / 30-130	UUC		
STD Setting	(dB)		
Initial	114.0	0.10	0.30
Final	114.0		
Deviated	0.0		

#### 8. Level linearity on the reference level range

UUC Setting	Anticipated	Deviation		UNCERTAINTY (± dB)	Acceptance Limit (± dB)
FAST / A / 30-130	REF	UUC	ERR		
STD dB	(dB)	(dB)	(dB)		
138.00	138	138.0	0.0	0.30	3.3
134.00	134	134.0	0.0		3.3
129.00	129	129.0	0.0		3.3
124.00	124	124.0	0.0		3.3
119.00	119	119.0	0.0		3.3
114.00	114	114.0	0.0		3.3
109.00	109	109.0	0.0		3.3
104.00	104	104.0	0.0		3.3
99.00	99	99.0	0.0		3.3
94.00	94	94.0	0.0		3.3
89.00	89	89.0	0.0		3.3
84.00	84	84.0	0.0		3.3
79.00	79	79.0	0.0		3.3
74.00	74	74.0	0.0		3.3
69.00	69	69.0	0.0		3.3
64.00	64	64.0	0.0		3.3
59.00	59	59.0	0.1		3.3
54.00	54	54.0	0.0		3.3
49.00	49	49.0	0.0		3.3
44.00	44	44.0	0.0		3.3
39.00	39	39.0	0.0		3.3
34.00	34	34.0	0.0		3.3
29.00	29	29.0	0.0		3.3
24.00	24	24.0	0.0		3.3

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FM-708-SLM-01 Rev.02 Issue date:11/23



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
	200	120.0	120.0	0.0	1.0
SEL	2	100.0	100.0	0.0	+1.0, -2.5
	0.25	91.0	90.8	-0.2	+1.5, -5.0

#### 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.  
FM-708-SLM-018 Rev.02 Issue date: 1/1/23

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

#### 12. Overload indication

UUC Setting	Measured	UNCERTAINTY	Acceptance
FAST / A / 30-130	UUC		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		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
5. Acoustic signal test of frequency weightings at ~4 kHz to 10 kHz	0.70 dB
6. Electrical signal test of frequency weightings, Weighting network response with relative to 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	0.35 dB
13. High Level Stability	0.25 dB
Acceptance limit and Maximum-permitted Uncertainty was IEC 61672-3:2013	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.  
FM-708-SLM-018 Rev.02 Issue date: 1/1/23

## SITHIPORN ASSOCIATES CO., LTD. CALIBRATION LABORATORY

451-451/1 Srinthorn Road, Bangbunmu, Bangpuet, Bangkok, 10700 Thailand  
Tel: +66 2433 8331 Email: calibration@sithiporn.com



Cert. No. : ACL24005  
Pages : 1 of 8

## Calibration Certificate

**Equipment :** SOUND LEVEL METER  
**Manufacturer :** RION  
**Model :** NL-42 / Microphone UC-52 / Preamplifier NH-24  
**Serial No.:** 00858513 / 158763 / 58765  
**ID No.:** BKK\_FS0103

**Condition As Found :** GOOD

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

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

**Received Date :** 19 DECEMBER 2023  
**Calibration Date :** 05-08 JANUARY 2024  
**Date of Issue :** 09 JANUARY 2024

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :** *T. Petchurai*  
( Thanakul Petchurai )

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

## SITHIPORN ASSOCIATES CO., LTD. CALIBRATION LABORATORY

451-451/1 Srinthorn Road, Bangbunmu, Bangpuet, Bangkok, 10700 Thailand  
Tel: +66 2433 8331 Email: calibration@sithiporn.com



Cert. No. : ACL24005  
Job No. : VC67AC0043  
Pages : 2 of 8

**Calibration Procedure :** CP-AC-01

#### Calibration Method :

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

#### Condition of this result of calibration :

##### 1. Reference Standard Instruments :

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

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

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

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

*T. Petchurai*



**Summary of Measurement Result :**

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

*T. Petch*

**Result of calibration :**

**1. Absolute sensitivity**

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

**2. Self-generated noise**

**2.1 Normal test**

Measured Value ( dB )
14.8

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

Frequency Weighting	Measured value ( dB )
A - weight	11.6
C - weight	17.6
Flat	23.4

**3. Acoustical signal tests of frequency weightings**

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

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.7	-0.7	0.6	± 1.5
1000	-0.1	-0.1	-0.1	± 1.0
8000	-2.6	-2.5	-2.5	±5.0

*T. Petch*

**4. Electrical signal tests of frequency weightings**

Weighting network response with relative to 1 kHz

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

**5. Frequency and time weightings at 1 kHz**

**5.1 Frequency weightings at 1 kHz**

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

**5.2 Time weighting at 1 kHz**

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

**6. Long - term stability**

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

*T. Petch*

**7. Level linearity on the reference level range**

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

*T. Petch*



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Cert. No. : ACL24005  
Job No. : VC67AC0043  
Pages : 7 of 8

8. Level linearity including the level range control

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

9. Tone burst response

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

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, Lcpeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±3.0
One	136.4	135.8	-0.6	±3.0

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

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Cert. No. : ACL24005  
Job No. : VC67AC0043  
Pages : 8 of 8

11. Overload indication

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

12. High level stability

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

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

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Cert. No. : ACL24151  
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24  
Serial No. : 00658244 / 158766 / 58768  
ID No. : BKK\_FS0101

Condition As Found : GOOD

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

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

Received Date : 14 MAY 2024  
Calibration Date : 29 MAY 2024  
Date of Issue : 30 MAY 2024

Calibrated by : Nathakorn Pisutpaisan

Approved by : 7. Petchu  
( Thanakul Petchurai )

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Cert. No. : ACL24151  
Job No. : VC67AC0089  
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0009-4	05-FEB-25
Waveform Generator	33511B	MY52302742	EF-0007-24	05-FEB-25
Digital Multimeter	33461A	MY53220104	EEL-BP 21/0267	13-FEB-25
Digital Multimeter	33461A	MY53220076	EEL-BP 20/0267	15-FEB-25
Digital Multimeter	34461A	MY60024273	EEL-BP 22/0267	15-FEB-25
Programmable Attenuator	MAT-1070	62100114	EF-0008-24	05-FEB-25
Condenser Microphone	4180	2977900	AA-1001-24	12-FEB-25
Measuring Amplifier	NA-42KAI	34560495	AA-3001-24	05-FEB-25

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

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

3.1 National Institute of Metrology (Thailand).

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

7. Petchu



Cert. No. : ACL24151  
Job No. : VC67AC0089  
Pages : 3 of 8

Summary of Measurement Result :

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

T. Petch

Cert. No. : ACL24151  
Job No. : VC67AC0089  
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
17.4

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

Frequency Weighting	Measured value (dB)
A - weight	13.8
C - weight	20.5
Flat	25.9

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.2	0.3	0.3	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-0.5	-0.4	-0.4	± 5.0

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Cert. No. : ACL24151  
Job No. : VC67AC0089  
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	0.0	±1.5
250	0.0	0.0	-0.1	±1.5
500	0.0	0.0	-0.1	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.1	0.1	±5.0

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

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Cert. No. : ACL24151  
Job No. : VC67AC0089  
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.1	0.1	± 1.1
84.0	84.1	0.1	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.1	0.1	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.1	0.1	± 1.1
54.0	54.1	0.1	± 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	34.1	0.1	± 1.1
30.0	30.1	0.1	± 1.1
29.0	29.2	0.2	± 1.1
28.0	28.3	0.3	± 1.1
27.0	27.4	0.4	± 1.1
26.0	26.5	0.5	± 1.1
25.0	25.5	0.5	± 1.1

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Job No. : VC67AC0089  
Pages : 7 of 8

**8. Level linearity including the level range control**

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

**9. Tone burst response**

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

**10. Peak C sound level**

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, L <sub>peak</sub> (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±3.0
One	136.4	136.2	-0.2	±3.0

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

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Job No. : VC67AC0089  
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**11. Overload indication**

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

**12. High level stability**

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

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

End of Calibration Certificate

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Cert. No. : ACL24263  
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**Calibration Certificate**

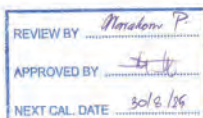
**Equipment :** SOUND LEVEL METER  
**Manufacturer :** RION  
**Model :** NL-42 / Microphone UC-52 / Preamplifier NH-24  
**Serial No.:** 00658243 / 157783 / 48098  
**ID No.:** BKK\_FS0100

**Condition As Found :** GOOD

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

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

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



**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :** *T. Petchur*  
( Thanakul Petchurai )

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



Cert. No. : ACL24263  
Job No. : VC67AC0139  
Pages : 2 of 8

**Calibration Procedure :** CP-AC-01

**Calibration Method :**

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

**Condition of this result of calibration :**

**1. Reference Standard Instruments :**

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0009-24	05-FEB-25
Waveform Generator	33511B	MY52302742	EF-0007-24	05-FEB-25
Digital Multimeter	33461A	MY53220104	EEL-BP 21/0267	13-FEB-25
Digital Multimeter	33461A	MY53220076	EEL-BP 20/0267	15-FEB-25
Digital Multimeter	34461A	MY60024273	EEL-BP 22/0267	15-FEB-25
Programmable Attenuator	MAT-1070	62100114	EF-0008-24	05-FEB-25
Condenser Microphone	4180	2977900	AA-1001-24	12-FEB-25
Measuring Amplifier	NA-42KAI	34560495	AA-3001-24	05-FEB-25

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

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

*T. Petchur*



Cert. No. : ACL24263  
Job No. : VC67AC0139  
Pages : 3 of 8

**Summary of Measurement Result :**

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

*T. Petch.*

Cert. No. : ACL24263  
Job No. : VC67AC0139  
Page : 4 of 8

**Result of calibration :**

**1. Absolute sensitivity**

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

**2. Self-generated noise**

**2.1 Normal test**

Measured Value (dB)
15.4

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

Frequency Weighting	Weighting (dB)
A - weight	12.6
C - weight	18.8
Flat	24.4

**3. Acoustical signal tests of frequency weightings**

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	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	-1.8	-1.7	-1.7	±5.0

*T. Petch.*

Cert. No. : ACL24263  
Job No. : VC67AC0139  
Pages : 5 of 8

**4. Electrical signal tests of frequency weightings**

Weighting network response with relative to 1 kHz.

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

**5. Frequency and time weightings at 1 kHz**

**5.1 Frequency weightings at 1 kHz**

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

**5.2 Time weighting at 1 kHz**

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

**6. Long - term stability**

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

*T. Petch.*

Cert. No. : ACL24263  
Job No. : VC67AC0139  
Pages : 6 of 8

**7. Level linearity on the reference level range**

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	±1.1
136.0	136.0	0.0	±1.1
135.0	135.0	0.0	±1.1
134.0	134.0	0.0	±1.1
133.0	132.9	-0.1	±1.1
132.0	131.9	-0.1	±1.1
131.0	130.9	-0.1	±1.1
129.0	129.0	0.0	±1.1
124.0	124.0	0.0	±1.1
119.0	119.0	0.0	±1.1
114.0	114.0	0.0	±1.1
109.0	109.0	0.0	±1.1
104.0	104.0	0.0	±1.1
99.0	99.0	0.0	±1.1
94.0	94.0	0.0	±1.1
89.0	89.0	0.0	±1.1
84.0	84.0	0.0	±1.1
79.0	79.0	0.0	±1.1
74.0	74.0	0.0	±1.1
69.0	69.0	0.0	±1.1
64.0	64.0	0.0	±1.1
59.0	59.1	0.1	±1.1
54.0	54.0	0.0	±1.1
49.0	49.0	0.0	±1.1
44.0	44.0	0.0	±1.1
39.0	39.1	0.1	±1.1
34.0	34.2	0.2	±1.1
30.0	30.6	0.6	±1.1
29.0	29.6	0.6	±1.1
28.0	28.7	0.7	±1.1
27.0	27.9	0.9	±1.1
26.0	27.3	1.3	±1.1
25.0	26.4	1.4	±1.1

*T. Petch.*



Cert. No. : ACL24263  
Job No. : VC67AC0139  
Pages : 7 of 8

## 8. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
130	94.0	94.0	0.0	±1.1

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
130	30.0	30.3	0.3	±1.1

## 9. Tone burst response

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

Cert. No. : ACL24263  
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## 10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, Lepeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±3.0
One	136.4	135.5	-0.9	±3.0

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

## 11. Overload indication

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

## 12. High level stability

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

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

End of Calibration Certificate

## Certificate of Calibration

## Customer

Name : A.I.S Laboratory Group Thailand Co., Ltd.  
Address : 104 Soi Phatthanakan 40, Phatthanakan Road, Sun Luang, Bangkok 10250  
Request No : Req-2023-2676

## Unit Under Calibration Details

Measurement item : Sound Level Meter  
Manufacturer : RION  
Model : NL-42  
Serial Number : 00858514  
ID : BKK\_FS0104  
Resolution : 0.1 dB  
Microphone Class : 2  
Microphone Model : UC-52  
Microphone S/N : 171453  
Pre-amplifier Model : N1F-24  
Pre-amplifier S/N : 10643  
Instrument Status : Used

## Calibration Environment and Details

Temperature : 23 °C ± 2 °C  
Humidity : 50 %RH ± 20 %RH  
Barometric Pressure : 1013 hPa ± 10 hPa  
Received Date : 20 December 2023  
Calibrated Date : 29 January 2024  
Calibration Procedure : In-house method CP-SLM-01 based on IEC 61672-1:2013 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	180273	21 August 2024	GRAS
Multifrequency Calibrator	Quest	Quest-cal	EFA000234	26 July 2024	TSI
Audio Generator	SvanteK	Svan401	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 :   
Mr. Noppadon Luangart  
Service Calibration EngineerApproved By :   
Mr. Paci Mathavorn  
Calibration Engineer Supervisor  
Issue Date : 29 January 2024

Certificate No : 24-SLM-023

Request No : Req-2023-2676

## 1. Indication at the calibration check frequency

UUC Setting	Nominal Level	Before Adjust		After Adjust		UNCERTAINTY (± dB)	Acceptance Limit (± dB)
		UUC (dB)	ERR (dB)	UUC (dB)	ERR (dB)		
FAST / A / 30-130							
Calibrator Setting							
1000 Hz 114 dB	113.78	113.9	-0.12	113.8	0.02	0.20	0.30

Note : Absolute sensitivity was established by the use of Sound Calibrator Brand SVANTEK, Model SV 35A, SN. 58079

## 2. Self-generated noise, Microphone installed

UUC Setting	Measured (dB)	UNCERTAINTY (± dB)
FAST / 30-130		
UUC Weighting		
A	14.8	0.10

## 3. Self-generated noise, Microphone replaced by the electrical input signal device

UUC Setting	Measured (dB)	UNCERTAINTY (± dB)
FAST / 30-130		
UUC Weighting		
A	11.6	0.10
C	15.7	0.10
Z	20.2	0.10

## 4. Acoustic signal test of frequency weightings (Without Windscreen)

UUC Setting	Deviation from various Frequency Weighting Response curve			UNCERTAINTY (± dB)	Acceptance Limit (± dB)
	A (dB)	C (dB)	Z (dB)		
FAST / 30-130					
STD Setting					
125 Hz	0.4	0.5	0.5	0.60	1.5
1000 Hz	0.0	0.0	0.0	0.60	1.0
4000 Hz	0.5	0.5	0.5	0.60	3.0
8000 Hz	-0.8	-0.9	-0.9	0.70	5.0



Certificate No : 24-SLM-023  
Request No : Req-2023-2676

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 Limit
FAST / 30-130	A (dB)	C (dB)	Z (dB)	( $\pm$ dB)	( $\pm$ dB)
63 Hz	-0.3	-0.1	-0.1	0.20	2.0
125 Hz	-0.1	0.0	0.0		1.5
250 Hz	-0.1	0.0	0.0		1.5
500 Hz	0.0	0.0	0.0		1.5
1000 Hz	0.0	0.0	0.0		1.0
2000 Hz	0.0	0.0	0.0		2.0
4000 Hz	0.0	0.0	0.0		3.0
8000 Hz	0.0	0.1	0.0		5.0
16000 Hz	-1.3	-1.4	0.0		+5, -INF

6. Frequency and time weightings at 1kHz

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

UUC Setting	STD	Measured		UNCERTAINTY	Acceptance Limit
30-130 / A	REF	UUC	ERR	( $\pm$ dB)	( $\pm$ dB)
UUC Time Response	(dB)	(dB)	(dB)		
Fast	114.00	114.0	0.0	0.20	0.10
Slow	114.00	114.0	0.0		0.10
Log	114.00	114.0	0.0		0.10

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.  
FM-709-SLM-01 Rev.02 Issue date: 7/1/23

Certificate No : 24-SLM-023  
Request No : Req-2023-2676

7. Long Term Stability

UUC Setting	Measured	UNCERTAINTY	Acceptance Limit
FAST / A / 30-130	UUC	( $\pm$ dB)	( $\pm$ dB)
STD Setting	(dB)		
Initial	114.0	0.10	0.30
Final	114.0		
Deviated	0.0		

8. Level linearity on the reference level range

UUC Setting	Anticipated	Deviation		UNCERTAINTY	Acceptance Limit
FAST / A / 30-130	REF	UUC	ERR	( $\pm$ dB)	( $\pm$ dB)
STD dB	(dB)	(dB)	(dB)		
138.00	138	138.0	0.0	0.30	1.1
134.00	134	134.0	0.0		1.1
129.00	129	129.0	0.0		1.1
124.00	124	124.0	0.0		1.1
119.00	119	119.0	0.0		1.1
114.00	114	114.0	0.0		1.1
109.00	109	109.0	0.0		1.1
104.00	104	104.1	0.1		1.1
99.00	99	99.0	0.0		1.1
94.00	94	94.0	0.0		1.1
89.00	89	89.1	0.1		1.1
84.00	84	84.1	0.1		1.1
79.00	79	79.0	0.0		1.1
74.00	74	74.1	0.1		1.1
69.00	69	69.1	0.1		1.1
64.00	64	64.1	0.1		1.1
59.00	59	59.1	0.1		1.1
54.00	54	54.0	0.0		1.1
49.00	49	49.0	0.0		1.1
44.00	44	44.0	0.0		1.1
39.00	39	39.0	0.0		1.1
34.00	34	34.0	0.0		1.1
29.00	29	29.0	0.0		0.8
24.00	24	24.0	0.0		1.1

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.  
FM-709-SLM-01 Rev.02 Issue date: 7/1/23

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9. Level linearity including the level range control

UUC Setting	STD	Measured		UNCERTAINTY	Acceptance Limit
FAST / A	REF	UUC	ERR	( $\pm$ dB)	( $\pm$ dB)
UUC Range	(dB)	(dB)	(dB)		
30-130	29.70	29.8	0.1	0.30	1.1
	114	114.0	0.0		1.1

10. Tone burst response

UUC Setting	STD	Anticipated	Measured		UNCERTAINTY	Acceptance Limit
A / 30-130	Timeburst	Ref	UUC	ERR	( $\pm$ dB)	( $\pm$ dB)
UUC Time Response	(ms)	(dB)	(dB)	(dB)		
Fast	200	126.0	126.0	0.0	0.20	1.0
	2	109.0	109.0	0.0		+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	90.9	-0.1		+1.5, -5.0
SEL	200	120.0	120.0	0.0		1.0
	2	100.0	100.0	0.0		+1.0, -2.5
	0.25	91.0	90.9	-0.1		+1.5, -5.0

11. Peak C Sound level

UUC Setting	Anticipated	Measured		UNCERTAINTY	Acceptance Limit
FAST / C / 55-141	REF	UUC	ERR	( $\pm$ dB)	( $\pm$ dB)
STD Setting	(dB)	(dB)	(dB)		
Complete cycle	136.4	136.3	-0.10	0.20	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.  
FM-709-SLM-01 Rev.02 Issue date: 7/1/23

Certificate No : 24-SLM-023  
Request No : Req-2023-2676

12. Overload indication

UUC Setting	Measured	UNCERTAINTY	Acceptance Limit
FAST / A / 30-130	UUC	( $\pm$ dB)	( $\pm$ dB)
STD Setting	(dB)		
Positive one-half cycle	139.7	0.20	1.5
Negative one-half cycle	139.4		
Deviated	0.3		

13. High Level Stability

UUC Setting	Measured	UNCERTAINTY	Acceptance Limit
FAST / A / 30-130	UUC	( $\pm$ dB)	( $\pm$ dB)
STD Setting	(dB)		
Initial	129.0	0.10	0.30
Final	129.0		
Deviated	0.0		

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 1kHz	0.20 dB
7. Long Term Stability	0.10 dB
8. Level linearity on the reference level range	0.30 dB
9. Level linearity including the level range control	0.30 dB
10. Tone burst response	0.30 dB
11. Peak C Sound level	0.35 dB
12. Overload indication	0.25 dB
13. High Level Stability	0.10 dB

\* Acceptance limit and Maximum-permitted Uncertainty was IEC 61672-1:2013

End of Certificate

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.  
FM-709-SLM-01 Rev.02 Issue date: 7/1/23



Cert. No. : ACL24262  
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,  
KHAENG PHATTHANAKAN, KHET SUAN LUANG,  
BANGKOK, 10250 THAILAND.

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

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



Calibrated by : Nathakorn Pisutpaisan

Approved by : *Thanakul P.*  
( 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.

Cert. No. : ACL24262  
Job No. : VC67AC0139  
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Calibration Procedure : CP-AC-01

## Calibration Method :

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

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

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

## Condition of this result of calibration :

## 1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0009-24	05-FEB-25
Waveform Generator	33511B	MY52302742	EF-0007-24	05-FEB-25
Digital Multimeter	33461A	MY53220104	EEL_BP 21/0267	13-FEB-25
Digital Multimeter	33461A	MY53220076	EEL_BP 20/0267	15-FEB-25
Digital Multimeter	34461A	MY60024273	EEL_BP 22/0267	15-FEB-25
Programmable Attenuator	MAT-1070	62100114	EF-0008-24	05-FEB-25
Condenser Microphone	4180	2977900	AA-1001-24	12-FEB-25
Measuring Amplifier	NA-42KAI	34560495	AA-3001-24	05-FEB-25

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

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

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

*Thanakul P.*Cert. No. : ACL24262  
Job No. : VC67AC0139  
Pages : 3 of 8

## Summary of Measurement Result :

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

*Thanakul P.*Cert. No. : ACL24262  
Job No. : VC67AC0139  
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## Result of calibration :

## 1. Absolute sensitivity

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

## 2. Self-generated noise

## 2.1 Normal test

Measured Value ( dB )
17.4

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

Frequency Weighting ( dB )	Weighting ( dB )
A - weight	15.4
C - weight	21.4
Flat	27.2

## 3. Acoustical signal tests of frequency weightings

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

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.1	0.2	0.2	± 1.5
1000	-0.1	-0.1	-0.1	± 1.0
8000	-1.5	-1.5	-1.4	±5.0

*Thanakul P.*



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

## 5. Frequency and time weightings at 1 kHz

## 5.1 Frequency weightings at 1 kHz

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

## 5.2 Time weighting at 1 kHz

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

## 6. Long - term stability

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

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Job No. : VC67AC0139  
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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	89.1	0.1	± 1.1
84.0	84.1	0.1	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.1	0.1	± 1.1
69.0	69.1	0.1	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.1	0.1	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.1	0.1	± 1.1
30.0	30.2	0.2	± 1.1
29.0	29.3	0.3	± 1.1
28.0	28.4	0.4	± 1.1
27.0	27.5	0.5	± 1.1
26.0	26.6	0.6	± 1.1
25.0	25.7	0.7	± 1.1

T. Petch

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Job No. : VC67AC0139  
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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 )
130	94.0	94.0	0.0	±1.1

Range	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
130	30.0	30.1	0.1	±1.1

## 9. Tone burst response

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

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## 10. Peak C sound level

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

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

## 11. Overload indication

Measured value ( dB )		Deviated Value ( dB )	Acceptance Limits ( dB )
Positive one-half cycle	Negative one-half cycle		
89.8	89.5	-0.3	±1.5

## 12. High level stability

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

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

End of Calibration Certificate

T. Petch



Cert. No. : ACL24196  
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## Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24  
Serial No.: 01022262 / 180410 / 22310  
ID No.: BKK\_FS0031

Condition As Found : GOOD

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

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

Received Date : 11 JUNE 2024  
Calibration Date : 27 JUNE 2024  
Date of Issue : 28 JUNE 2024



Calibrated by : Nathakorn Pisutpaisan

Approved by : *T. Petchur*  
( Thanakul Petchurai )

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

Cert. No. : ACL24196  
Job No. : VC67AC0105  
Pages : 2 of 8

Calibration Procedure : CP-AC-01

## Calibration Method :

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

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

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

## Condition of this result of calibration :

## 1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0009-24	05-FEB-25
Waveform Generator	33511B	MY52302742	EF-0007-24	05-FEB-25
Digital Multimeter	33461A	MY53220104	EEL_BP 21/0267	13-FEB-25
Digital Multimeter	33461A	MY53220076	EEL_BP 20/0267	15-FEB-25
Digital Multimeter	34461A	MY60024273	EEL_BP 22/0267	15-FEB-25
Programmable Attenuator	MAT-1070	62100114	EF-0008-24	05-FEB-25
Condenser Microphone	4180	2977900	AA-1001-24	12-FEB-25
Measuring Amplifier	NA-42KAI	34560495	AA-3001-24	05-FEB-25

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

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

3.1 National Institute of Metrology (Thailand).

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

*T. Petchur*Cert. No. : ACL24196  
Job No. : VC67AC0105  
Pages : 3 of 8

## Summary of Measurement Result :

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

*T. Petchur*Cert. No. : ACL24196  
Job No. : VC67AC0105  
Pages : 4 of 8

## Result of calibration :

## 1. Absolute sensitivity

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

## 2. Self-generated noise

## 2.1 Normal test

Measured Value (dB)
19.8

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

Frequency Weighting	Measured value (dB)
A - weight	10.8
C - weight	16.8
Flat	22.7

## 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	-0.1	-0.1	-0.1	± 1.5
1000	-0.2	-0.2	-0.2	± 1.0
8000	-0.4	-0.4	-0.3	± 5.0

*T. Petchur*

#### 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

#### 5. Frequency and time weightings at 1 kHz

##### 5.1 Frequency weightings at 1 kHz

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

##### 5.2 Time weighting at 1 kHz

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

#### 6. Long - term stability

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

T. Petch.

#### 7. Level linearity on the reference level range

Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	53.9	-0.1	± 1.1
49.0	48.9	-0.1	± 1.1
44.0	43.9	-0.1	± 1.1
39.0	38.9	-0.1	± 1.1
34.0	33.9	-0.1	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	27.8	-0.2	± 1.1
27.0	26.9	-0.1	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.8	-0.2	± 1.1

T. Petch.

#### 8. Level linearity including the level range control

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

#### 9. Tone burst response

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

#### 10. Peak C sound level

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

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

T. Petch.

#### 11. Overload indication

Measured value ( dB )		Deviated Value ( dB )	Acceptance Limits ( dB )
Positive one-half cycle	Negative one-half cycle		
89.8	89.6	-0.2	±1.5

#### 12. High level stability

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

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

End of Calibration Certificate

T. Petch.



# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



Cert. No. : ACL23369  
Pages : 1 of 8

## Calibration Certificate

**Equipment :** SOUND LEVEL METER  
**Manufacturer :** RION  
**Model :** NL-42 / Microphone UC-52 / Preamplifier NH-24  
**Serial No.:** 00858517 / 157784 / 48099  
**ID No.:** BKK\_FS0107

**Condition As Found :** GOOD

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

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

**Received Date :** 07 NOVEMBER 2023  
**Calibration Date :** 29-30 NOVEMBER 2023  
**Date of Issue :** 06 DECEMBER 2023

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :**

*T. Petchurai*  
( Thanakul Petchurai )

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

QF-TS12-04-04-020664

# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

## Continuation of Calibration Certificate

Cert. No. : ACL23369  
Job No. : VC67AC0025  
Pages : 2 of 8

**Calibration Procedure :** CP-AC-01

### Calibration Method :

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM).  
The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.

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

### Condition of this result of calibration :

#### 1. Reference Standard Instruments :

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

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

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

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

QF-TS12-04-04-020664

*T. Petchurai*

# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

## Continuation of Calibration Certificate

Cert. No. : ACL23369  
Job No. : VC67AC0025  
Pages : 3 of 8

### Summary of Measurement Result :

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

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

QF-TS12-04-04-020664

*T. Petchurai*

# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

## Continuation of Calibration Certificate

Cert. No. : ACL23369  
Job No. : VC67AC0025  
Pages : 4 of 8

### Result of calibration :

#### 1. Absolute sensitivity

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

#### 2. Self-generated noise

##### 2.1 Normal test

Measured Value (dB)
16.6

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

Frequency Weighting	Measured value (dB)
A-weight	14.6
C-weight	20.9
Flat	26.4

#### 3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.6	0.7	0.7	± 1.5
1000	0.2	0.2	0.2	± 1.0
8000	-0.4	-0.4	-0.3	± 5.0

QF-TS12-04-04-020664

*T. Petchurai*



## Continuation of Calibration Certificate

Cert. No. : ACL23369  
Job No. : VC67AC0025  
Pages : 5 of 8

## 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

## 5. Frequency and time weightings at 1 kHz

## 5.1 Frequency weightings at 1 kHz

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

## 5.2 Time weighting at 1 kHz

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

## 6. Long - term stability

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

QF-TS12-04-04-020664

7. B.T.M.

## Continuation of Calibration Certificate

Cert. No. : ACL23369  
Job No. : VC67AC0025  
Pages : 6 of 8

## 7. Level linearity on the reference level range

Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
137.0	137.0	0.0	±1.1
136.0	136.1	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	109.0	0.0	±1.1
104.0	104.1	0.1	±1.1
99.0	99.0	0.0	±1.1
94.0	94.0	0.0	±1.1
89.0	89.0	0.0	±1.1
84.0	84.0	0.0	±1.1
79.0	79.0	0.0	±1.1
74.0	74.0	0.0	±1.1
69.0	69.0	0.0	±1.1
64.0	64.0	0.0	±1.1
59.0	59.0	0.0	±1.1
54.0	54.0	0.0	±1.1
49.0	49.0	0.0	±1.1
44.0	44.0	0.0	±1.1
39.0	39.0	0.0	±1.1
34.0	34.0	0.0	±1.1
30.0	30.0	0.0	±1.1
29.0	29.0	0.0	±1.1
28.0	28.0	0.0	±1.1
27.0	27.0	0.0	±1.1
26.0	26.0	0.0	±1.1
25.0	25.1	0.1	±1.1

QF-TS12-04-04-020664

7. B.T.M.

## Continuation of Calibration Certificate

Cert. No. : ACL23369  
Job No. : VC67AC0025  
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	107.9	-0.1	1.0 ; -2.5
	200	800	128.0	128.0	0.0	±1.0

## 10. Peak C sound level

Number of cycle in test signal	Anticipated Value ( dB )	Measured Value, L <sub>peak</sub> ( 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	135.1	-0.3	±2.0
Negative half cycle	135.4	135.1	-0.3	±2.0

QF-TS12-04-04-020664

7. B.T.M.

## Continuation of Calibration Certificate

Cert. No. : ACL23369  
Job No. : VC67AC0025  
Pages : 8 of 8

## 11. Overload indication

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

## 12. High level stability

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

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

End of Calibration Certificate

QF-TS12-04-04-020664

7. B.T.M.



Cert. No. : ACL24108  
Pages : 1 of 8

## Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24  
Serial No.: 00710644 / 157228 / 10645  
ID No.: BKK\_FS0028

Condition As Found : GOOD

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

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

Received Date : 03 APRIL 2024  
Calibration Date : 09-11 APRIL 2024  
Date of Issue : 12 APRIL 2024



Calibrated by : Nathakorn Pisutpaisan

Approved by :

*T. Petchurai*  
( Thanakul Petchurai )

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

Cert. No. : ACL24108  
Job No. : VC67AC0075  
Pages : 2 of 8

Calibration Procedure : CP-AC-01

## Calibration Method :

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

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

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

## Condition of this result of calibration :

## 1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0009-4	05-FEB-25
Waveform Generator	33511B	MY52302742	EF-0007-24	05-FEB-25
Digital Multimeter	33461A	MY53220104	EEL_BP 21/0267	13-FEB-25
Digital Multimeter	33461A	MY53220076	EEL_BP 20/0267	15-FEB-25
Programmable Attenuator	MAT-1070	62100114	EF-0008-24	05-FEB-25
Condenser Microphone	4180	2977900	AA-1001-24	12-FEB-25
Measuring Amplifier	NA-42KAJ	34560495	AA-3001-24	05-FEB-25

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

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

3.1 National Institute of Metrology (Thailand).

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

*T. Petchurai*Cert. No. : ACL24108  
Job No. : VC67AC0075  
Pages : 3 of 8

## Summary of Measurement Result :

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

*T. Petchurai*Cert. No. : ACL24108  
Job No. : VC67AC0075  
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## Result of calibration :

## 1. Absolute sensitivity

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

## 2. Self-generated noise

## 2.1 Normal test

Measured Value ( dB )
14.6

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

Frequency Weighting ( dB )	Measured value ( dB )
A-weight	13.1
C-weight	-19.8
Flat	25.2

## 3. Acoustical signal tests of frequency weightings

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

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.8	0.8	0.9	±1.5
1000	0.2	0.2	0.2	±1.0
8000	-2.6	-2.5	-2.5	±5.0

*T. Petchurai*

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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)			Acceptance Limits
	Flat	C-weight	A-weight	
63	-0.1	-0.1	0.0	±2.0
125	0.0	0.0	0.0	±1.5
250	0.0	0.0	-0.1	±1.5
500	0.0	0.0	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.1	0.1	±5.0

#### 5. Frequency and time weightings at 1 kHz

##### 5.1 Frequency weightings at 1 kHz

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

##### 5.2 Time weighting at 1 kHz

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

#### 6. Long - term stability

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

*T. Petch.*

Cert. No. : ACL24108  
Job No. : VC67AC0075  
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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
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.1	0.1	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.1	0.1	± 1.1
69.0	69.1	0.1	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.1	0.1	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	29.0	0.0	± 1.1
28.0	28.0	0.0	± 1.1
27.0	27.0	0.0	± 1.1
26.0	26.0	0.0	± 1.1
25.0	24.9	-0.1	± 1.1

*T. Petch.*

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

#### 10. Peak C sound level

Number of cycle in test signal	Anticipated Value ( dB )	Measured Value, L <sub>peak</sub> ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Continuous	133.0	133.0	0.0	±3.0
One	136.4	135.7	-0.7	±3.0

Number of cycle in test signal	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Continuous	133.0	133.1	0.1	±2.0
Positive half cycle	135.4	135.3	-0.1	±2.0
Negative half cycle	135.4	135.3	-0.1	±2.0

*T. Petch.*

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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	89.7	0.2	±1.5

#### 12. High level stability

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

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

End of Calibration Certificate

*T. Petch.*





## Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42A / Microphone UC-52 / Preamplifier NH-24  
Serial No. : 00623384 / 198630 / 26412  
ID No. : BKK\_FS1217

Condition As Found : GOOD

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

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

Received Date : 01 NOVEMBER 2023  
Calibration Date : 07-08 NOVEMBER 2023  
Date of Issue : 14 NOVEMBER 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by :

*T. Petchur*  
( Thanakul Petchurai )

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

QF-TS12-04-04-020664

Calibration Procedure : CP-AC-01

## Calibration Method :

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

## Condition of this result of calibration :

## 1. Reference Standard Instruments :

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

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

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

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

QF-TS12-04-04-020664

*T. Petchur*

## Summary of Measurement Result :

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

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

QF-TS12-04-04-020664

*T. Petchur*

## Result of calibration :

## 1. Absolute sensitivity

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

## 2. Self-generated noise

## 2.1 Normal test

Measured Value ( dB )
14.8

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

Frequency Weighting	Measured value ( dB )
A - weight	10.8
C - weight	17.5
Flat	23.3

## 3. Acoustical signal tests of frequency weightings

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

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.3	0.3	0.3	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	0.8	0.9	0.9	± 5.0

QF-TS12-04-04-020664

*T. Petchur*



## Continuation of Calibration Certificate

Cert. No. : ACL23346  
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## 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

T. Peth -

## Continuation of Calibration Certificate

Cert. No. : ACL23346  
Job No. : VC67AC0022  
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## 7. Level linearity on the reference level range

Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
137.0	137.0	0.0	±1.1
136.0	136.0	0.0	±1.1
135.0	135.0	0.0	±1.1
134.0	134.0	0.0	±1.1
133.0	133.0	0.0	±1.1
132.0	131.9	-0.1	±1.1
131.0	131.0	0.0	±1.1
129.0	129.0	0.0	±1.1
124.0	124.0	0.0	±1.1
119.0	119.0	0.0	±1.1
114.0	114.0	0.0	±1.1
109.0	109.0	0.0	±1.1
104.0	104.0	0.0	±1.1
99.0	99.0	0.0	±1.1
94.0	94.0	0.0	±1.1
89.0	89.0	0.0	±1.1
84.0	84.0	0.0	±1.1
79.0	79.0	0.0	±1.1
74.0	74.0	0.0	±1.1
69.0	69.0	0.0	±1.1
64.0	64.0	0.0	±1.1
59.0	59.0	0.0	±1.1
54.0	54.0	0.0	±1.1
49.0	49.0	0.0	±1.1
44.0	44.0	0.0	±1.1
39.0	39.0	0.0	±1.1
34.0	34.0	0.0	±1.1
30.0	30.0	0.0	±1.1
29.0	29.0	0.0	±1.1
28.0	27.9	-0.1	±1.1
27.0	27.0	0.0	±1.1
26.0	25.9	-0.1	±1.1
25.0	24.9	-0.1	±1.1

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T. Peth -

## Continuation of Calibration Certificate

Cert. No. : ACL23346  
Job No. : VC67AC0022  
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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, Tb ( ms )	Cycle	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.0	0.0	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
SEL	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.0	0.0	±1.0

## 10. Peak C sound level

Number of cycle in test signal	Anticipated Value ( dB )	Measured Value, L <sub>peak</sub> ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Continuous	133.0	133.0	0.0	±3.0
One	136.4	135.7	-0.7	±3.0

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

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T. Peth -

## Continuation of Calibration Certificate

Cert. No. : ACL23346  
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## 11. Overload indication

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

## 12. High level stability

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

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

End of Calibration Certificate

QF-TS12-04-04-020664

T. Peth -



## Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42A / Microphone UC-52 / Preamplifier NH-24  
Serial No. : 00623386 / 198633 / 26414  
ID No. : BKK\_FS1218

Condition As Found : GOOD

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

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

Received Date : 01 NOVEMBER 2023  
Calibration Date : 07-08 NOVEMBER 2023  
Date of Issue : 14 NOVEMBER 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by : *T. Petchur*  
( Thanakul Petchurai )

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

QF-TS12-04-04-020664

Calibration Procedure : CP-AC-01

## Calibration Method :

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

## Condition of this result of calibration :

## 1. Reference Standard Instruments :

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

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

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

3.1 National Institute of Metrology (Thailand).

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

QF-TS12-04-04-020664

## Summary of Measurement Result :

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

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

QF-TS12-04-04-020664

## Result of calibration :

## 1. Absolute sensitivity

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

## 2. Self-generated noise

## 2.1 Normal test

Measured Value ( dB )
14.8

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

Frequency Weighting	Measured value ( dB )
A - weight	10.8
C - weight	17.0
Flat	22.8

## 3. Acoustical signal tests of frequency weightings

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

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

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## Continuation of Calibration Certificate

Cert. No. : ACL23347  
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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	-0.1	±1.5
250	0.0	0.0	-0.1	±1.5
500	0.0	0.0	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.1	0.1	±5.0

## 5. Frequency and time weightings at 1 kHz

## 5.1 Frequency weightings at 1 kHz

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

## 5.2 Time weighting at 1 kHz

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

## 6. Long - term stability

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

QF-TS12-04-04-020664

T. Petch

## Continuation of Calibration Certificate

Cert. No. : ACL23347  
Job No. : VC67AC0022  
Pages : 6 of 8

## 7. Level linearity on the reference level range

Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
137.0	137.0	0.0	±1.1
136.0	136.0	0.0	±1.1
135.0	135.0	0.0	±1.1
134.0	134.0	0.0	±1.1
133.0	133.0	0.0	±1.1
132.0	132.0	0.0	±1.1
131.0	131.0	0.0	±1.1
129.0	129.0	0.0	±1.1
124.0	124.0	0.0	±1.1
119.0	119.0	0.0	±1.1
114.0	114.0	0.0	±1.1
109.0	109.0	0.0	±1.1
104.0	104.0	0.0	±1.1
99.0	99.0	0.0	±1.1
94.0	94.0	0.0	±1.1
89.0	89.0	0.0	±1.1
84.0	84.0	0.0	±1.1
79.0	79.0	0.0	±1.1
74.0	74.0	0.0	±1.1
69.0	69.0	0.0	±1.1
64.0	64.0	0.0	±1.1
59.0	59.0	0.0	±1.1
54.0	53.9	-0.1	±1.1
49.0	49.0	0.0	±1.1
44.0	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	26.9	-0.1	±1.1
26.0	25.9	-0.1	±1.1
25.0	24.9	-0.1	±1.1

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## Continuation of Calibration Certificate

Cert. No. : ACL23347  
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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, Tb ( ms )	Cycle	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.0	0.0	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
SEL	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.0	0.0	±1.0

## 10. Peak C' sound level

Number of cycle in test signal	Anticipated Value ( dB )	Measured Value, L <sub>cpeak</sub> ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Continuous	133.0	133.0	0.0	±3.0
One	136.4	136.2	-0.2	±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

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T. Petch

## Continuation of Calibration Certificate

Cert. No. : ACL23347  
Job No. : VC67AC0022  
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## 11. Overload indication

Measured value ( dB )		Deviated Value ( dB )	Acceptance Limits ( dB )
Positive one-half cycle	Negative one-half cycle		
89.7	89.6	-0.1	±1.5

## 12. High level stability

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

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

End of Calibration Certificate

QF-TS12-04-04-020664

T. Petch



Cert. No. : ACC24026

Pages : 1 of 3

## Calibration Certificate

Equipment : SOUND CALIBRATOR  
Manufacturer : RION  
Model : NC-74  
Serial No.: 34178117  
ID No.: BKK\_FS0630

Condition As Found : GOOD

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

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

Received Date : 11 JUNE 2024  
Calibration Date : 27 JUNE 2024  
Date of Issue : 28 JUNE 2024



Calibrated by : Nathakorn Pisutpaisan

Approved by :

*T. Petchur*  
( Thanakul Petchurai )

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Cert. No. : ACC24026

Job No. : VC67AC0105

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-0007-24	05-FEB-25
Digital Multimeter	33461A	MY53220104	EEL_BP 21/0267	13-FEB-25
Digital Multimeter	33461A	MY53220076	EEL_BP 20/0267	15-FEB-25
Digital Multimeter	33461A	MY60024273	EEL_BP 22/0267	15-FEB-25
Programmable Attenuator	MAT-1070	62100114	EF-0008-24	05-FEB-25
Condenser Microphone	4180	2977900	AA-1001-24	12-FEB-25
Measuring Amplifier	NA-42KAJ	34560495	AA-3001-24	05-FEB-25
Audio Analyzer	AVR-3360A	V744B6069	EF-0009-24	09-FEB-25

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

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

3.1 National Institute of Metrology (Thailand).

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

*T. Petchur*

Cert. No. : ACC24026

Job No. : VC67AC0105

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	94.14	0.14	0.14	0.40

## 2. Frequency

Specified Frequency (Hz)	Measured value (Hz)	Deviated value (%)	Uncertainty (%)	Acceptance limit (%)
1000	1001.7	0.2	0.1	1.0

## 3. Total distortion

Measured value (%)	Uncertainty (%)	Acceptance limit (%)
1.56	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

*T. Petchur*

Cert. No. : ACL24261

Pages : 1 of 8

## Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24  
Serial No.: 00597161 / 180404 / 88174  
ID No.: BKK\_FS0996

Condition As Found : GOOD

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

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

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



Calibrated by : Nathakorn Pisutpaisan

Approved by :

*T. Petchur*  
( Thanakul Petchurai )

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**CALIBRATION LABORATORY**

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



Cert. No. : ACL24261  
Job No. : VC67AC0139  
Pages : 2 of 8

Calibration Procedure : CP-AC-01

**Calibration Method :**

This equipment was calibrated by follow on IEC-61672-3 (2013) Standard for sound level meter (SLM).  
The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.

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

**Condition of this result of calibration :**

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0009-24	05-FEB-25
Waveform Generator	33511B	MY52302742	EF-0007-24	05-FEB-25
Digital Multimeter	33461A	MY53220104	EEL-BP 21/0267	13-FEB-25
Digital Multimeter	33461A	MY53220076	EEL-BP 20/0267	15-FEB-25
Digital Multimeter	34461A	MY60024273	EEL-BP 22/0267	15-FEB-25
Programmable Attenuator	MAT-1070	62100114	EF-0008-24	05-FEB-25
Condenser Microphone	4180	2977900	AA-1001-24	12-FEB-25
Measuring Amplifier	NA-42KA1	34560495	AA-3001-24	05-FEB-25

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

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

3.1 National Institute of Metrology (Thailand).

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

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Job No. : VC67AC0139  
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**Summary of Measurement Result :**

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

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**Result of calibration :**

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
15.4

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

Frequency Weighting	Weighting (dB)
A - weight	11.6
C - weight	17.7
Flat	23.6

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Flat	C-weight	A-weight	Acceptance Limits
125	0.2	0.2	0.2	± 1.5
1000	0.1	0.1	0.1	± 1.0
8000	0.7	0.7	0.7	± 5.0

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4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Flat	C-weight	A-weight	Acceptance Limits
63	0.0	-0.1	-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	0.0	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.1	0.1	±5.0

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

*T. Petch*



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Cert. No. : ACL24261  
Job No. : VC67AC0139  
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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	78.9	-0.1	±1.1
74.0	74.0	0.0	±1.1
69.0	69.0	0.0	±1.1
64.0	63.9	-0.1	±1.1
59.0	59.0	0.0	±1.1
54.0	53.9	-0.1	±1.1
49.0	48.9	-0.1	±1.1
44.0	44.0	0.0	±1.1
39.0	38.9	-0.1	±1.1
34.0	34.0	0.0	±1.1
30.0	30.0	0.0	±1.1
29.0	29.0	0.0	±1.1
28.0	28.0	0.0	±1.1
27.0	27.1	0.1	±1.1
26.0	26.1	0.1	±1.1
25.0	25.1	0.1	±1.1

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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)
130	94.0	94.0	0.0	±1.1

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

9. Tone burst response

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

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Job No. : VC67AC0139  
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10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, Lcpeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	130.0	130.0	0.0	±3.0
One	133.4	133.3	-0.1	±3.0

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

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

T. Petch

SITHIPORN ASSOCIATES CO., LTD.  
CALIBRATION LABORATORY

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



Cert. No. : ACC23048  
Pages : 1 of 3

Calibration Certificate

Equipment : SOUND CALIBRATOR  
Manufacturer : RION  
Model : NC-75  
Serial No.: 35024431  
ID No.: BKK\_FS1221

Condition As Found : GOOD

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

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

Received Date : 28 NOVEMBER 2023  
Calibration Date : 19 DECEMBER 2023  
Date of Issue : 22 DECEMBER 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petch  
( Thanakul Petchurai )

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QF-TS12-04-04-020664



## Continuation of Calibration Certificate

Cert. No. : ACC23048  
Job No. : VC67AC0035  
Pages : 2 of 3

Calibration Procedure : CP-AC-03

## Calibration Method :

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

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

## Condition of this result of calibration :

## 1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33511B	MY52302742	EF-0010-23	07-FEB-24
Digital Multimeter	33461A	MY53220104	EEL_BP 30/0266	13-FEB-24
Digital Multimeter	33461A	MY53220076	EEL_BP 30/0267	13-FEB-24
Digital Multimeter	33461A	MY60024273	EEL_BP 31/0266	14-FEB-24
Programmable Attenuator	MAT-1070	62100114	EF-0011-23	08-FEB-24
Condenser Microphone	4180	2977900	AA-1001-23	14-FEB-24
Measuring Amplifier	NA-42KAI	34560495	AA-3002-23	14-FEB-24
Audio Analyzer	AVR-3360A	V744B6069	EF-0012-23	10-FEB-24

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

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

3.1 National Institute of Metrology (Thailand).

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

QF-TS12-04-04-020664

T. Petchurai

## Continuation of Calibration Certificate

Cert. No. : ACC23048  
Job No. : VC67AC0035  
Pages : 3 of 3

## Result of calibration :

## 1. Sound pressure level

Specified sound pressure level (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (dB)	Acceptance limit (dB)
94	93.96	-0.04	0.14	0.40

## 2. Frequency

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

## 3. Total distortion

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

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor  $k = 2$ 

or any value following calculation, providing a level of confidence of approximately 95 %

End of Calibration Certificate

QF-TS12-04-04-020664

T. Petchurai

SITHIPORN ASSOCIATES CO.,LTD.  
CALIBRATION LABORATORY451-451/1 Sirinthorn Rd, Bangbunru, Bangplud Bangkok 10700 THAILAND.  
Tel:0-2433-8800 Fax:0-2433-1679 e-mail:center@sithiporn.com http://www.sithiporn.comCert. No. : ACL23345  
Pages : 1 of 8

## Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42A / Microphone UC-52 / Preamplifier NH-24  
Serial No.: 00623383 / 198629 / 26411  
ID No.: BKK\_FSI216

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 : 01 NOVEMBER 2023  
Calibration Date : 07-08 NOVEMBER 2023  
Date of Issue : 14 NOVEMBER 2023

Calibrated by : Nathakorn Pisupaisan

Approved by :

T. Petchurai  
( Thanakul Petchurai )

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

QF-TS12-04-04-020664

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## Continuation of Calibration Certificate

Cert. No. : ACL23345  
Job No. : VC67AC0022  
Pages : 2 of 8

Calibration Procedure : CP-AC-01

## Calibration Method :

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

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

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

## Condition of this result of calibration :

## 1. Reference Standard Instruments :

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

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

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

3.1 National Institute of Metrology (Thailand).

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

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Continuation of Calibration Certificate

Cert. No. : ACL23345  
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Summary of Measurement Result :

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

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

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Continuation of Calibration Certificate

Cert. No. : ACL23345  
Job No. : VC67AC0022  
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Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.8

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

Frequency Weighting	Measured value (dB)
A - weight	10.8
C - weight	17.2
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	0.3	0.3	0.3	±1.5
1000	-0.1	-0.1	-0.1	±1.0
8000	0.3	0.3	0.3	±5.0

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Job No. : VC67AC0022  
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

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Continuation of Calibration Certificate

Cert. No. : ACL23345  
Job No. : VC67AC0022  
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	±1.1
136.0	136.0	0.0	±1.1
135.0	135.0	0.0	±1.1
134.0	134.0	0.0	±1.1
133.0	133.0	0.0	±1.1
132.0	131.9	-0.1	±1.1
131.0	131.0	0.0	±1.1
129.0	129.0	0.0	±1.1
124.0	124.0	0.0	±1.1
119.0	119.0	0.0	±1.1
114.0	114.0	0.0	±1.1
109.0	109.0	0.0	±1.1
104.0	104.0	0.0	±1.1
99.0	99.0	0.0	±1.1
94.0	94.0	0.0	±1.1
89.0	89.0	0.0	±1.1
84.0	84.0	0.0	±1.1
79.0	79.0	0.0	±1.1
74.0	74.0	0.0	±1.1
69.0	69.0	0.0	±1.1
64.0	64.0	0.0	±1.1
59.0	59.0	0.0	±1.1
54.0	54.0	0.0	±1.1
49.0	49.0	0.0	±1.1
44.0	44.0	0.0	±1.1
39.0	39.0	0.0	±1.1
34.0	34.0	0.0	±1.1
30.0	30.0	0.0	±1.1
29.0	28.9	-0.1	±1.1
28.0	27.9	-0.1	±1.1
27.0	26.9	-0.1	±1.1
26.0	25.9	-0.1	±1.1
25.0	24.9	-0.1	±1.1

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8. Level linearity including the level range control

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

9. Tone burst response

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

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, L <sub>peak</sub> (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±3.0
One	136.4	135.9	-0.5	±3.0

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

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11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

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**SITHIPORN ASSOCIATES CO.,LTD.**  
CALIBRATION LABORATORY

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Cert. No. : ACL23346  
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42A / Microphone UC-52 / Preamplifier NH-24  
Serial No. : 00623384 / 198630 / 26412  
ID No. : BKK\_FSI217

Condition As Found : GOOD

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

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

Received Date : 01 NOVEMBER 2023  
Calibration Date : 07-08 NOVEMBER 2023  
Date of Issue : 14 NOVEMBER 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by : T. Petch  
( Thanakul Petchurai )

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CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACL23346  
Job No. : VC67AC0022  
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

Condition of this result of calibration :

1. Reference Standard Instruments :

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

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

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

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

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## Continuation of Calibration Certificate

Cert. No. : ACL23346  
Job No. : VC67AC0022  
Pages : 3 of 8

## Summary of Measurement Result :

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

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

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## Continuation of Calibration Certificate

Cert. No. : ACL23346  
Job No. : VC67AC0022  
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## Result of calibration :

## 1. Absolute sensitivity

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

## 2. Self-generated noise

## 2.1 Normal test

Measured Value (dB)
14.8

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

Frequency Weighting	Measured value (dB)
A - weight	10.8
C - weight	17.5
Flat	23.3

## 3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.3	0.3	0.3	±1.5
1000	0.0	0.0	0.0	±1.0
8000	0.8	0.9	0.9	±5.0

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## Continuation of Calibration Certificate

Cert. No. : ACL23346  
Job No. : VC67AC0022  
Pages : 5 of 8

## 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

## 5. Frequency and time weightings at 1 kHz

## 5.1 Frequency weightings at 1 kHz

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

## 5.2 Time weighting at 1 kHz

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

## 6. Long - term stability

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

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## Continuation of Calibration Certificate

Cert. No. : ACL23346  
Job No. : VC67AC0022  
Pages : 6 of 8

## 7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	±1.1
136.0	136.0	0.0	±1.1
135.0	135.0	0.0	±1.1
134.0	134.0	0.0	±1.1
133.0	133.0	0.0	±1.1
132.0	131.9	-0.1	±1.1
131.0	131.0	0.0	±1.1
129.0	129.0	0.0	±1.1
124.0	124.0	0.0	±1.1
119.0	119.0	0.0	±1.1
114.0	114.0	0.0	±1.1
109.0	109.0	0.0	±1.1
104.0	104.0	0.0	±1.1
99.0	99.0	0.0	±1.1
94.0	94.0	0.0	±1.1
89.0	89.0	0.0	±1.1
84.0	84.0	0.0	±1.1
79.0	79.0	0.0	±1.1
74.0	74.0	0.0	±1.1
69.0	69.0	0.0	±1.1
64.0	64.0	0.0	±1.1
59.0	59.0	0.0	±1.1
54.0	54.0	0.0	±1.1
49.0	49.0	0.0	±1.1
44.0	44.0	0.0	±1.1
39.0	39.0	0.0	±1.1
34.0	34.0	0.0	±1.1
30.0	30.0	0.0	±1.1
29.0	29.0	0.0	±1.1
28.0	27.9	-0.1	±1.1
27.0	27.0	0.0	±1.1
26.0	25.9	-0.1	±1.1
25.0	24.9	-0.1	±1.1

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

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, Lepeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±3.0
One	136.4	135.7	-0.7	±3.0

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

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Continuation of Calibration Certificate

Cert. No. : ACL23346  
Job No. : VC67AC0022  
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11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle	(dB)	(dB)
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 ASSOCIATES CO.,LTD.**  
CALIBRATION LABORATORY

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Cert. No. : ACL23347  
Pages : 1 of 8

**Calibration Certificate**

**Equipment :** SOUND LEVEL METER  
**Manufacturer :** RION  
**Model :** NL-42A / Microphone UC-52 / Preamplifier NH-24  
**Serial No.:** 00623386 / 198633 / 26414  
**ID No.:** BKK\_FS1218

**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 :** 01 NOVEMBER 2023  
**Calibration Date :** 07-08 NOVEMBER 2023  
**Date of Issue :** 14 NOVEMBER 2023

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :** T. Petchur  
( Thanakul Petchurai )

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

QF-TS12-04-04-020664

**SITHIPORN** SITHIPORN ASSOCIATES CO.,LTD.  
CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACL23347  
Job No. : VC67AC0022  
Pages : 2 of 8

**Calibration Procedure :** CP-AC-01

**Calibration Method :**

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

**Condition of this result of calibration :**

1. Reference Standard Instruments :

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

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

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

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

QF-TS12-04-04-020664

T. Petchur



## Continuation of Calibration Certificate

Cert. No. : ACL23347  
Job No. : VC67AC0022  
Pages : 3 of 8

## Summary of Measurement Result :

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

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

QF-TS12-04-04-020664

T. Petch

## Continuation of Calibration Certificate

Cert. No. : ACL23347  
Job No. : VC67AC0022  
Pages : 4 of 8

## Result of calibration :

## 1. Absolute sensitivity

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

## 2. Self-generated noise

## 2.1 Normal test

Measured Value (dB)
14.8

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

Frequency Weighting	Measured value (dB)
A - weight	10.8
C - weight	17.0
Flat	22.8

## 3. Acoustical signal tests of frequency weightings

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

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

QF-TS12-04-04-020664

T. Petch

## Continuation of Calibration Certificate

Cert. No. : ACL23347  
Job No. : VC67AC0022  
Pages : 5 of 8

## 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

## 5. Frequency and time weightings at 1 kHz

## 5.1 Frequency weightings at 1 kHz

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

## 5.2 Time weighting at 1 kHz

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

## 6. Long - term stability

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

QF-TS12-04-04-020664

T. Petch

## Continuation of Calibration Certificate

Cert. No. : ACL23347  
Job No. : VC67AC0022  
Pages : 6 of 8

## 7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	±1.1
136.0	136.0	0.0	±1.1
135.0	135.0	0.0	±1.1
134.0	134.0	0.0	±1.1
133.0	133.0	0.0	±1.1
132.0	132.0	0.0	±1.1
131.0	131.0	0.0	±1.1
129.0	129.0	0.0	±1.1
124.0	124.0	0.0	±1.1
119.0	119.0	0.0	±1.1
114.0	114.0	0.0	±1.1
109.0	109.0	0.0	±1.1
104.0	104.0	0.0	±1.1
99.0	99.0	0.0	±1.1
94.0	94.0	0.0	±1.1
89.0	89.0	0.0	±1.1
84.0	84.0	0.0	±1.1
79.0	79.0	0.0	±1.1
74.0	74.0	0.0	±1.1
69.0	69.0	0.0	±1.1
64.0	64.0	0.0	±1.1
59.0	59.0	0.0	±1.1
54.0	53.9	-0.1	±1.1
49.0	49.0	0.0	±1.1
44.0	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	26.9	-0.1	±1.1
26.0	25.9	-0.1	±1.1
25.0	24.9	-0.1	±1.1

QF-TS12-04-04-020664

T. Petch



## Continuation of Calibration Certificate

Cert. No. : ACL23347  
Job No. : VC67AC0022  
Pages : 7 of 8

## 8. Level linearity including the level range control

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

## 9. Tone burst response

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

## 10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, Lepeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±3.0
One	136.4	136.2	-0.2	±3.0

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

QF-TS12-04-04-020664

T. Petch

## Continuation of Calibration Certificate

Cert. No. : ACL23347  
Job No. : VC67AC0022  
Pages : 8 of 8

## 11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.7	89.6	-0.1	±1.5

## 12. High level stability

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

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

End of Calibration Certificate

QF-TS12-04-04-020664

T. Petch

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ISO/IEC 17025:2017  
NSC-TISI-TIS 17025  
CALIBRATION 0367  
Temperature measurement laboratory  
Calibration services department

## CERTIFICATE OF CALIBRATION

Certificate No. : CDT-113-67

Page 1 of 2 Pages

MEASUREMENT ITEM : Heat Stress Monitor  
MANUFACTURER : Delta OHM  
MODEL/TYPE : HD32.2  
SERIAL NUMBER : 15036018  
ID NUMBER : BKK\_F50677  
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 : 18 Jun 2024  
MEASUREMENT DATE : 21 Jun 2024  
ISSUE DATE : 24 Jun 2024

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

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

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

Calibration procedure:  
The temperature calibration was done by In-House calibration method (as WHCL-002) according to comparison method with standard digital temperature indicator and standard temperature probe. The temperature scale was based on ITS-90.

Traceability:  
The measurement results are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT) Certificate number: TT-0047-24, Certificate number: EB-0101-23

Reference Used During Calibration:  
3. Standard Temperature Probe  
Model: STS-100 AS50, Serial No.: 667682-09,  
Due date: 26 Mar 2025  
2. Digital Temperature Indicator  
Model: DTI-1000-A MK II, Serial No.: 673407-00591 Due date: 14 Sep 2024

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

Continuation of Certificate of Calibration Number CDT-113-67

Page 2 of 2 Pages

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 °C to 40 °C

## Function:

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 16008219.  
Dimension: Diameter 3.3 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.043	20.1	0.1	0.099
80	25.047	25.1	0.1	0.099
80	30.037	30.0	0.0	0.16
80	35.026	35.0	0.0	0.099
80	40.017	40.0	0.0	0.099

Table 2: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 16006602.  
Dimension: Diameter 3.3 mm. Length 205 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.043	20.1	0.1	0.099
110	25.047	25.1	0.1	0.099
110	30.037	30.0	0.0	0.099
110	35.026	35.0	0.0	0.099
110	40.017	40.0	0.0	0.099

Table 3: This equipment was connected with temperature probe Model: TP3207.2 S/N: 15037318.  
Dimension: Diameter 14 mm. Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
75	20.043	20.2	0.2	0.099
75	25.047	25.0	0.0	0.099
75	30.038	29.9	-0.1	0.099
75	35.026	34.8	-0.2	0.099
75	40.017	39.7	-0.3	0.099

UUC\*: Unc Under Calibration

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

\*\*\*End of Certificate of Calibration\*\*\*

Calibrated by:  
☐ Mr. Sorawit Thachalad  
☐ Miss Jittaporn Lertsomphol  
☒ Miss Ruangrumpal Phoommit

Approved signatory:

Mr. Parinya Booncharoen  
Calibration Department Manager



## CERTIFICATE OF CALIBRATION

Certificate No. : CDT-048-67

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Heat Stress Monitor  
**MANUFACTURER** : Delta OHM  
**MODEL/TYPE** : HD32.2  
**SERIAL NUMBER** : 15036019  
**ID NUMBER** : BKIC\_F50678  
**CONDITION AS-RECEIVED** : Used Item  
**CUSTOMER** : ALS laboratory group (thailand) Co., Ltd.  
104 Phatthanakan 40, Phatthanakan Rd.,  
Khaeng Suan Luang, Khet Suan Luang,  
Bangkok 10250 Thailand.

**RECEIVED DATE** : 05 Feb 2024  
**MEASUREMENT DATE** : 14 Feb 2024  
**ISSUE DATE** : 20 Feb 2024

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

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

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

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

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

**Reference Used During Calibration:**  
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.: 673407-  
00591 Due date: 14 Sep 2024

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



Approved signatory:

Mr. Parinya Booncharoen  
Calibration Department Manager

Calibrated by:  
☒ Mr. Sorawit Thachalad  
☒ Miss Jittaporn Lertsomphol  
☒ Miss Ruangrumpal Phoommit

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Continuation of Certificate of Calibration Number CDT-048-67

Page 2 of 2 Pages

**Result of Calibration:** ☒ Without Adjustment ☐ With Adjustment

**Calibration Range:** 20 ~ 40 °C

**Function:**

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 13035045.  
Dimension: Diameter 3.3 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.061	20.1	0.0	0.099
80	25.056	25.1	0.0	0.099
80	30.046	30.1	0.1	0.099
80	35.036	35.1	0.1	0.099
80	40.028	40.1	0.1	0.099

Table 2: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 15022053.  
Dimension: Diameter 3.3 mm. Length 205 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.061	20.1	0.0	0.099
110	25.056	25.1	0.0	0.099
110	30.046	30.1	0.1	0.099
110	35.036	35.1	0.1	0.099
110	40.028	40.1	0.1	0.099

Table 3: This equipment was connected with temperature probe Model: TP3207.2 S/N: 16010556.  
Dimension: Diameter 14 mm. Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
75	20.061	20.1	0.0	0.099
75	25.056	25.1	0.0	0.099
75	30.046	30.0	0.0	0.099
75	35.036	34.9	-0.1	0.099
75	40.028	39.9	-0.1	0.099

UUC\*: Unit Under Calibration

\*\*\*End of Certificate of Calibration\*\*\*



## CERTIFICATE OF CALIBRATION

Certificate No. : CDT-042-66

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Heat Stress Monitor  
**MANUFACTURER** : Delta OHM  
**MODEL/TYPE** : HD32.2  
**SERIAL NUMBER** : 15036021  
**ID NUMBER** : BKIC\_F50679  
**CONDITION AS-RECEIVED** : Used Item  
**CUSTOMER** : ALS laboratory group (thailand) Co., Ltd.  
104 Phatthanakan 40, Phatthanakan Rd.,  
Khaeng Suan Luang, Khet Suan Luang,  
Bangkok 10250 Thailand.

**RECEIVED DATE** : 26 Oct 2023  
**MEASUREMENT DATE** : 27 Oct 2023  
**ISSUE DATE** : 27 Oct 2023

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

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

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

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

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

**Reference Used During Calibration:**  
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.: 673407-  
00591 Due date: 14 Sep 2024

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



Approved signatory:

Mr. Parinya Booncharoen  
Calibration Department Manager

Calibrated by:  
☒ Mr. Sorawit Thachalad  
☒ Miss Jittaporn Lertsomphol  
☒ Miss Ruangrumpal Phoommit

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Continuation of Certificate of Calibration Number CDT-042-66

Page 2 of 2 Pages

**Result of Calibration:** ☒ Without Adjustment ☐ With Adjustment

**Calibration Range:** 20 ~ 40 °C

**Function:**

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 16008209.  
Dimension: Diameter 3.3 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	20.057	20.0	-0.1	0.099
80	25.049	24.9	-0.1	0.099
80	30.042	29.9	-0.1	0.099
80	35.039	34.9	-0.1	0.099
80	40.032	39.9	-0.1	0.099

Table 2: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 16008203.  
Dimension: Diameter 3.3 mm. Length 205 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.057	20.1	0.0	0.099
110	25.050	25.1	0.1	0.099
110	30.042	30.1	0.1	0.099
110	35.038	35.1	0.1	0.099
110	40.032	40.1	0.1	0.099

Table 3: This equipment was connected with temperature probe Model: TP3207.2 S/N: 15037322.  
Dimension: Diameter 14 mm. Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
75	20.057	20.1	0.0	0.099
75	25.050	24.9	-0.1	0.099
75	30.042	29.7	-0.3	0.099
75	35.038	34.6	-0.4	0.099
75	40.032	39.5	-0.5	0.099

UUC\*: Unit Under Calibration

\*\*\*End of Certificate of Calibration\*\*\*





CERTIFICATE OF CALIBRATION

ISSUED BY  
Cirrus Research plc

DATE OF ISSUE  
07 May 2024

CERTIFICATE NUMBER  
213787

REVIEW BY  
*Handwritten*

APPROVED BY  
*Handwritten*

NEXT CAL DATE  
*4/6/25*

Cirrus Research plc  
Acoustic House  
Bridlington Road  
Hunmanby  
North Yorkshire  
YO14 0PH  
United Kingdom

Page 1 of 2

Approved signatory  
N.Smith

Electronically signed:  
*Handwritten*

doseBadge Reader : IEC 60942:2003

Instrument information

Manufacturer: Cirrus Research plc    Notes:

Model: RC:110A

Serial number: 63863

Class: 2

Test summary

The doseBadge reader detailed above has been calibrated to the published data as described in the operating manual and in the half-inch configuration. The procedures and techniques used are as described in IEC60942\_2003 Annex B – Periodic Tests and three determinations of the sound pressure level, frequency and total distortion were made.

The sound pressure level was measured using a WS2F condenser microphone type MK-224 manufactured by Cirrus Research plc.

The results have been corrected to the reference pressure of 101.33 kPa using the manufacturer's data.

The doseBadge Reader has been shown to conform to the Class 2 requirements for periodic testing, described in Annex B of IEC 60942:2003 for the sound pressure level(s) and frequency(ies) stated, for the environmental conditions under which the tests were performed.

However, as public evidence was not available, from a testing organisation responsible for pattern approval, to demonstrate that the model of doseBadge Reader conformed to the requirements for pattern evaluation described in Annex A of IEC 60942:2003, no general statement or conclusion can be made about conformance of the doseBadge Reader to the requirements of IEC 60942:2003.

Notes:

This certificate provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory. The results within this certificate relate only to the items calibrated. The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%.

CERTIFICATE OF CALIBRATION

Certificate Number:  
213787

Page 2 of 2

Environmental conditions

The following conditions were recorded at the time of the test:

Before    Pressure: 100.62 kPa    Temperature: 21.9 °C    Humidity: 34 %

After    Pressure: 100.62 kPa    Temperature: 21.9 °C    Humidity: 34.4 %

Test equipment

Equipment	Manufacturer	Model	Serial number
Distortion Meter	Keithley	2015	0839263
Acoustic Calibrator	Bruel and Kjaer	4231	2610257
Environmental Monitor	Comet	T7510	21962628

Initial Acoustic Results

	Expected	Sample 1	Sample 2	Sample 3	Average	Deviation	Tolerance	Uncertainty
Level (dB)	114.00	114.43	114.42	114.42	114.42	0.42	±0.75	0.11 dB
Distortion (%)	< 4.00	0.19	0.15	0.18	0.17	0.17	+4.00	0.13 %
Frequency (Hz)	1000.0	1000.7	1000.8	1000.8	1000.8	0.8	±20.0	0.1 Hz

The measured quantities or deviations (as applicable), extended by the expanded combined uncertainty of measurement, must not exceed the corresponding tolerance.

Adjusted Acoustic Results

	Expected	Sample 1	Sample 2	Sample 3	Average	Deviation	Tolerance	Uncertainty
Level (dB)	114.00	113.99	113.99	113.99	113.99	-0.01	±0.75	0.11 dB
Distortion (%)	< 4.00	0.18	0.17	0.18	0.17	0.17	+4.00	0.13 %
Frequency (Hz)	1000.0	1000.8	1000.8	1000.9	1000.9	0.9	±20.0	0.1 Hz

Functionality Results

Function	Result
Keypad	Pass
Battery Power	Pass
Display	Pass
Communication	Pass
2 way IR link	Pass
Clock	Pass

End of results

CERTIFICATE OF CALIBRATION

ISSUED BY  
Cirrus Research plc

DATE OF ISSUE  
29 January 2024

CERTIFICATE NUMBER  
207458

REVIEW BY  
*Handwritten*

APPROVED BY  
*Handwritten*

NEXT CAL DATE  
*28/1/25*

Cirrus Research plc  
Acoustic House  
Bridlington Road  
Hunmanby  
North Yorkshire  
YO14 0PH  
United Kingdom

Page 1 of 2

Approved signatory  
N.Smith

Electronically signed:  
*Handwritten*

doseBadge Reader : IEC 60942:2003

Instrument information

Manufacturer: Cirrus Research plc    Notes:

Model: RC:110A

Serial number: 83554

Class: 2

Test summary

Date of calibration: 29 January 2024

The doseBadge reader detailed above has been calibrated to the published data as described in the operating manual and in the half-inch configuration. The procedures and techniques used are as described in IEC60942\_2003 Annex B – Periodic Tests and three determinations of the sound pressure level, frequency and total distortion were made.

The sound pressure level was measured using a WS2F condenser microphone type MK-224 manufactured by Cirrus Research plc.

The results have been corrected to the reference pressure of 101.33 kPa using the manufacturer's data.

The doseBadge Reader has been shown to conform to the Class 2 requirements for periodic testing, described in Annex B of IEC 60942:2003 for the sound pressure level(s) and frequency(ies) stated, for the environmental conditions under which the tests were performed.

However, as public evidence was not available, from a testing organisation responsible for pattern approval, to demonstrate that the model of doseBadge Reader conformed to the requirements for pattern evaluation described in Annex A of IEC 60942:2003, no general statement or conclusion can be made about conformance of the doseBadge Reader to the requirements of IEC 60942:2003.

Notes:

This certificate provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory. The results within this certificate relate only to the items calibrated. The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%.

CERTIFICATE OF CALIBRATION

Certificate Number:  
207458

Page 2 of 2

Environmental conditions

The following conditions were recorded at the time of the test:

Before    Pressure: 101.28 kPa    Temperature: 22.2 °C    Humidity: 39 %

After    Pressure: 101.28 kPa    Temperature: 22.2 °C    Humidity: 38.1 %

Test equipment

Equipment	Manufacturer	Model	Serial number
Distortion Meter	Keithley	2015	0994818
Acoustic Calibrator	Bruel and Kjaer	4231	2610257
Environmental Monitor	Comet	T7510	21962628

Initial Acoustic Results

	Expected	Sample 1	Sample 2	Sample 3	Average	Deviation	Tolerance	Uncertainty
Level (dB)	114.00	114.16	114.16	114.16	114.16	0.16	±0.75	0.11 dB
Distortion (%)	< 4.00	0.21	0.22	0.25	0.23	0.23	+4.00	0.13 %
Frequency (Hz)	1000.0	1001.4	1001.4	1001.4	1001.4	1.4	±20.0	0.1 Hz

The measured quantities or deviations (as applicable), extended by the expanded combined uncertainty of measurement, must not exceed the corresponding tolerance.

Adjusted Acoustic Results

	Expected	Sample 1	Sample 2	Sample 3	Average	Deviation	Tolerance	Uncertainty
Level (dB)	114.00	113.98	113.98	113.98	113.98	-0.02	±0.75	0.11 dB
Distortion (%)	< 4.00	0.19	0.21	0.19	0.20	0.20	+4.00	0.13 %
Frequency (Hz)	1000.0	1001.4	1001.4	1001.3	1001.3	1.3	±20.0	0.1 Hz

Functionality Results

Function	Result
Keypad	Pass
Battery Power	Pass
Display	Pass
Communication	Pass
2 way IR link	Pass
Clock	Pass

End of results





## Certificate of Calibration

Certificate No.: 24PH-FR9  
Page: 1 of 2

Equipment : Lux Meter  
Manufacturer: TENMARS  
Model: TM-201L  
Serial No.: 230701779  
ID No.: BKK\_FS1365  
Condition As-Received: Used Item  
Received Date: 14 November 2024  
Calibration Date: 21 November 2024  
Reference: 2411-0492/VSC  
Ambient Temperature: ( 23 ± 2 ) °C  
Relative Humidity: ( 50 ± 15 ) %  
Submitted by: ALS Laboratory Group (Thailand) Co., Ltd.  
104 Phatthanakan 40, Phatthanakan Rd.,  
Khwaeng Phatthanakan, Khet Suan Luang,  
Bangkok 10250 Thailand  
Procedure used: Calibration were conducted using calibration procedure No. CP-FH01 based on inverse square law technique.

### Condition of this result of calibration

#### 1. Reference standards Instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Photometry & Encoder	LMguide 9.6 m	12RC003	DL-0064-22	20 Jul 2025
2) STANDARD LAMP	OL FEL-U	F-1783	TP-1008-24	09 Jan 2025

2. This result of calibration was made on requested at the point specified by customer.  
3. Test Equipment : Programmable Voltage/Current Source ( Model : OL53A, SN : 16221394 ).  
4. Test Equipment : Illuminance Meter ( Model : S1002, SN : 080129 ).  
5. The certificate is valid only to the item calibrated on date and place of calibration.  
6. This Certification is traceable to the International System of Unit maintained through:-  
- National Institute of Metrology Thailand (NIMT)  
- National Institute of Metrology (Thailand), NSG-ONSC Accredited No. Calibration 0144

REVIEW BY: *Narong P.*  
APPROVED BY: *[Signature]*  
NEXT CAL DATE: 21/11/25

Calibrated by: Nivat Nitas  
Issue Date: 25 November 2024

Approved Signatory: *[Signature]*  
[✓] Phalinee Praibpaipal  
[ ] Chatchawan Khunpluek  
[ ] Nuntawat Khamchai



Cert. No.: 24PH589  
Page: 2 of 2

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

Function : Illuminance Measurement

Standard Value	UUC* Reading	Error	Uncertainty
( lx )	( lx )	( lx )	( ± lx )
0	0.0	0.0	-
15	14.9	-0.1	0.20
20	19.9	-0.1	0.26
50	49.9	-0.1	0.65
100	100.1	0.1	1.3
150	150.0	0.0	2.0
190	190.0	0.0	2.5

Function : Illuminance Measurement

Standard Value	UUC* Reading	Error	Uncertainty
( lx )	( lx )	( lx )	( ± lx )
200	200	0	2.6
500	500	0	6.5
1000	1001	1	13
1500	1489	-11	20
1900	1879	-21	25

Function : Illuminance Measurement

Standard Value	UUC* Reading	Error	Uncertainty
( lx )	( lx )	( lx )	( ± lx )
2000	2000	0	26
3000	3000	0	39
4000	4000	0	52
5000	5000	0	65

The reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor  $k=2$ , providing a level of confidence of approximately 95 %  
UUC\* = Unit Under Calibration.

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## Certificate of Calibration

Cert.No.: 24CH1295  
Page: 1 of 3

Equipment : pH Meter  
Manufacturer: Hach  
Model: HQ411d  
Serial No.: 200100031163  
ID No.: BKK\_EN0342  
Condition As-Received: Used Item  
Received Date: 16 October 2024  
Calibration Date: 17 October 2024  
Reference: 2410-0548DSC-5  
Submitted by: ALS Laboratory Group (Thailand) Co., Ltd.  
104 Phatthanakan 40, Phatthanakan Rd.,  
Khwaeng Phatthanakan, Khet Suan Luang,  
Bangkok 10250 Thailand  
Ambient Temperature : (25 ± 2.5) °C  
Relative Humidity : (50 ± 15) %  
Calibration Procedure :  
- CP-CH5 by direct measurement with certified reference material (CRM)  
- CP-CH8 by comparison with temperature standard  
Calibrated by: Warakorn Lerngatrakul  
Approved by: *[Signature]*  
( ) Unnopphol Harachai  
( ) Ponpan Paipim  
(✓) Sathip Meangmai  
Issue Date: 21 October 2024

REVIEW BY: *Junda K.*  
APPROVED BY: *Siruk P.*  
NEXT CAL DATE: 17/10/25

The Uncertainties are for a confidence probability of approximately 95%

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



Cert.No.: 24CH1295  
Page: 2 of 3

### Condition of this calibration result

#### 1. Reference Standard Instrument

Instrument	Serial No.	ID No.	Cert. No.	Due Date
1) Ref. Standard Thermometer	2188080	130RC044	241022	16 Sep 2025

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

2. Certified Reference Materials : The measurement results are traceable to SI through Hach Lenge GmbH Ltd.  
Deutsche Akkreditierungsstelle, Accredited No. D-RM-15184-01-00  
: The measurement results are traceable to SI through CPA chem Ltd.,  
ANSI-ASQ National Accreditation Board, Accredited No. AR-1835

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	1034203	27 Sep 2026
pH 6.999	Hach Lenge GmbH	C03145	28 Feb 2026
pH 10.010	CPA chem	1034205	27 Sep 2025

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

### Calibration Results

#### Function : pH Measurement

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

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH Measurement (±)	Coverage factor k
pH Electrode S/N: 230473042902	4.008 6.999 10.010	4.028 7.014 10.018	174.6 1.4 -172.8	0.0044 0.0084 0.0066	2.00 2.05 2.00

Remark : - Can not connect the BNC because the plug does not match with the socket.



Cert.No.: 24CH1295  
Page.: 3 of 3

#### Calibration Results

Function : Temperature Measurement

(\*) Without adjustment

This equipment was connected with Temperature Probe;

- Model : PHC281

- Serial No. : 230473042902

Dimension of probe

- Length : 103 mm.

- Diameter : 12 mm.

- Immersion Depth : 90 mm.

Calibration Point (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of measurement (± °C)	Coverage factor k
25.0	25.002	25.0	-0.002	0.13	2.00

Remark : UUC\* = Unit Under Calibration

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

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Sartorius (Thailand) Co., Ltd.  
320 Rama 9 Road, Prangmatong, Huaykong, Bangkok 10250  
Tel : +66 2843 8311-6, e-mail : service.thailand@sartorius.com



ISO 17025  
CALIBRATION 0426

REVIEW BY Junda K  
APPROVED BY Sinluk P

NEXT CAL DATE: 02/08/25

## Certificate of Calibration

Model Number : MSE2245-100-DU  
Description : Analytical Balance  
Serial Number : 0027405555  
ID No. : BKK\_EN0003  
Manufacturer : Sartorius  
Certificate No. : 24BC0270  
Issued Date : Monday, August 05, 2024  
Reference No. : 240942  
Page No. : 1 of 2

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

Calibrated Place : Lab Room

Calibrated By : Mr Chonchai Inthanas  
Calibration Date : Friday, August 02, 2024

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

#### Metrological data

Capacity : 220 g Readability : 0.0001 g

Ambients Conditions : Temperature : 23.0 °C ± 6.0 °C

Humidity : 55.0 % RH ± 10.0 % RH

Pressure : #

#### Reasons for calibration

☐ New Installation ☒ Service / Repair ☒ Recalibration / Maintenance

Equipment Condition : ☒ Good Operate ☐ Fail

Measurement Method : UKAS Publication Ref : Lab 14

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

#### Traceability:

Model Number	Description	Traceability	Certificate No.	Due Date
YCS011-522-00	Sartorius weight set, 5000g 12 YCS011-522-00	YES	M23081975	23-Aug-2025
Testo 174 H	Thermo-Hygrometer, Testo 174H	INTECH	11/1 661303.H081140	12-Nov-2024

This certificate relates 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.

Signature

Michonchai Inthanas (Technical Manager)

SOP FM 33 03 February 2022



Sartorius (Thailand) Co., Ltd.  
320 Rama 9 Road, Prangmatong, Huaykong, Bangkok 10250  
Tel : +66 2843 8311-6 Fax : +66 2843-8387, e-mail : service.thailand@sartorius.com

SARTORIUS

## Certificate of Calibration

Model Number : MSE2245-100-DU  
Description : Analytical Balance  
Serial Number : 0027405555  
ID No. : BKK\_EN0003  
Manufacturer : Sartorius  
Certificate No. : 24BC0270  
Issued Date : Monday, August 05, 2024  
Reference No. : 240942  
Page No. : 2 of 2

#### Calibration Results : Without Adjustment

Repeatability		Eccentricity (Off-center loading error)	
The repeatability is the ability of a weighing instrument to display nearly identical results under identical test conditions when the same load within a measurement range is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express repeatability quantitatively.		The eccentricity loading error is yielded by the difference between the result of one load at 1/3 or 2/3 of maximum capacity placed in the middle of the weighing pan and between each of four additional measurement points (4 positions defined according to OIML R110).	
Nominal Value : (Low Load)	20.0000	200.0000	
20 g	20.0000	199.9999	
Tolerance	20.0001	200.0000	
0.0001 g	20.0000	200.0000	
	20.0000	200.0000	
	20.0000	200.0000	
	20.0000	200.0000	
Nominal Value : (High Load)	200.0000	200.0000	
200 g	200.0000	200.0000	
Tolerance	20.0000	200.0000	
0.0001 g	20.0000	200.0000	
	20.0000	200.0000	
	20.0000	200.0000	
	20.0000	200.0000	
Standard Deviation	0.00004	0.00006	

#### Linearity

The linearity, also called density 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	0.00015
0.1	0.1000	0.1000	0.0000	0.00015
1	1.0000	1.0000	0.0000	0.00015
2	2.0000	2.0000	0.0000	0.00015
5	5.0000	5.0000	0.0000	0.00015
10	10.0000	10.0000	0.0000	0.00015
20	20.0000	20.0000	0.0000	0.00015
50	50.0000	50.0001	0.0001	0.00016
100	100.0000	100.0001	0.0001	0.00019
200	200.0000	200.0000	0.0000	0.00029

End of Report

SOP FM 33 03 February 2022



#### Metrology

SCI ECO Services Company Limited

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

Saraburi Tel : +66 3627 3096 Fax : +66 3627 3100

Bangkok Tel : +668 9205 6851, +669 8247 2360

Website : www.scieco.co.th E-Mail : calibrate@scg.com



Certificate No. T240904

Page 1 of 3

## Certificate of Calibration

Equipment : Chamber ( Oven )  
Manufacturer : Memmert  
Model : UF 450  
Serial No. : B717.0531  
Customer Code : BKK\_EN0273  
ID No. : T8042A4  
Customer : ALS Laboratory Group (Thailand) Co., Ltd.  
104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan, Khet Suan Luang, Bangkok 10250  
Customer Location : Laboratory (Oven Room)  
Date of Receipt : 08 May 2024  
Calibrated By : Preecha Phisassuthikul ( Temperature Calibration Manager )  
Approved By : / Nuafun Sungsom (Metrology Manager)  
Date of Issue : 23 MAY 2024

REVIEW BY Junda K  
APPROVED BY Sinluk P  
NEXT CAL DATE 14/9/25

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

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Metrology.

FM-L14 119/18-08-66



Certificate No. T240994

Page 2 of 3

## Calibration Report

Equipment : Chamber ( Oven )  
Date of Calibration : 14 May 2024  
Environment : Temperature : 26.5-28.1 °C  
Line Voltage : 226.7-229.8 V  
Relative Humidity : 51 - 57 %RH

## Condition of this results of calibration :

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 WI-T20 ( based on ASTM E145-94 ( Reapproved 2001 ) and AS2853-1986 ) . All data show below were final values and the initial data from customer request . The temperature scale used was based on ITS - 90 .
2. Reference Standard Instrument :
- | Instrument  | Model   | Instrument No. | Certificate No. | Due Date         |
|-------------|---------|----------------|-----------------|------------------|
| RTD         | 100 ohm | 21-(CH1-10)    | T231955         | 17 November 2024 |
| DATA LOGGER | 34970A  | T121           | T231955         | 17 November 2024 |
3. This certificate is traceable to :  
National Institute of Metrology ( Thailand ) through Metrological Center ( NSC-TIS-TIS 17025 CALIBRATION 0244 )
4. Condition of calibrated item : good
- Equipment Description :
- Time Constant : 1 Hour 30 Minute At 104 °C
- Fresh Air Damper : ☐ Open ☐ Min ☐ Medium ☐ Max
- ☐ Close
- ☒ Not Available
5. Adjustment :  
( X ) without adjustment ( ) after adjustment

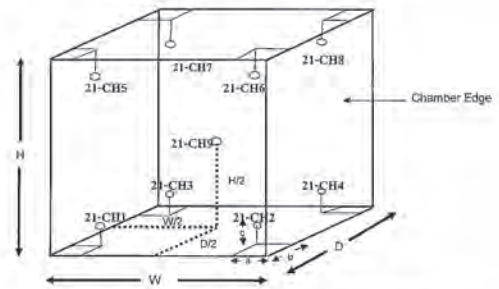
Approved By

FM-L15118/18-08-66

Certificate No. T240994

Page 3 of 3

## Calibration Report



## Remark :

Internal Dimensions of Chamber : W (Width) = 104 cm , H (Height) = 72 cm and D (Depth) = 60 cm .  
Size of Installed Standard sensor number 21-CH1 to number 21-CH8 : a = 5 cm , b = 5 cm and c = 5 cm .  
Size of Installed Standard sensor number 21-CH9 : W/2 = 104 cm / 2 , H/2 = 72 cm / 2 and D/2 = 60 cm / 2

## Measurement Results

Calibration Point	Average Standard Reading at each position (°C)							
	21-CH1	21-CH2	21-CH3	21-CH4	21-CH5	21-CH6	21-CH7	21-CH8
104	103.4	105.0	103.7	103.6	103.3	104.6	103.3	104.0
180	179.5	181.1	179.2	179.5	179.0	181.3	179.8	179.9

Chamber ( Oven )			Temperature Distribution			
Setting (°C)	Reading (°C)		Average (°C)	Stability (± °C)	Uniformity (°C)	Uncertainty (± °C)
	Min , Max	Average				
104.0	103.9 , 104	104.0	103.85	0.14	1.27	0.64
180.0	179.9 , 180.1	180.0	179.94	0.39	2.29	0.76

\* The quoted uncertainty excludes "uniformity"

The calibration result apply only the above calibrated item.

The result of test was found accurate as shown on date and place of test only.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k which for a t-distribution, providing a level of confidence of approximately 95 % .

End of Certificate

Approved By

FM-L15118/18-08-66



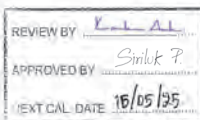
TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3 : EQUIPMENT CALIBRATION AND TESTING SERVICES  
534/4 PATTANAKARN ROAD SOI 16, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL 0-2717-3000 FAX 0-2719-9488

Cert.No.: 23TW243

Page.: 1 of 2

## Certificate of Testing

Equipment : DO Meter  
Manufacturer : YSI  
Model : 5000-230V  
Serial No. : 08J101147  
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 : Walailak Srinthean  
Approved by :   
Approved Signatory  
( ) Saitrip Meangmai  
( ) Warakorn Lemgagatrakul  
( ) Ponpan Paipim  
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	-	1308JU10	23CG1172	22 Mar 2025
2) Balance	1124013362	140RC006	23MM16	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.: 16K100496

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

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

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Cert. No.: 23LM192  
Page.: 1 of 2

## Certificate of Calibration

Equipment : DO Meter with Sensor  
Manufacturer : YSI  
Model : 5000-230V  
Serial No. : 09J101147  
ID No. : BKK\_EN0017  
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd.  
104 Phatthanakan 40, Phatthanakan Rd.,  
Khwang Phatthanakan, Khet Suan Luang,  
Bangkok 10250 Thailand  
Location : TPA Chemistry Calibration Laboratory  
Received Order : 15 November 2023  
Calibrated Date : 16 November 2023  
Ambient Temperature :  $(28 \pm 10) ^\circ\text{C}$   
Relative Humidity :  $(50 \pm 30) \%$   
AC Line Voltage :  $(220 \pm 22) \text{ V}$   
Calibrated by : Kunchit Prompru  
Approved by :   
( ) Pomthippa Tamayakul  
( ) Ponpan Palpin  
(✓) Suwit Imjai  
Issue Date : 17 November 2023

The Uncertainties are for a confidence probability of approximately 95%

This certificate may not be reproduced other than in full except with the prior written approval of the Association of Corporate Services (ACS) - Equipment Calibration and Testing Services.

A 0060730



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

Cert. No.: 23LM192  
Page.: 2 of 2

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

### Condition of this result of calibration

#### 1. Reference standard instrument:-

Instrument	Serial No.	Cert. No.	Traceable	Due Date
1) Digital Thermometer	3240076	231305	TPA	15 Mar 2024

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

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

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

Result of Calibration :- (°C) Without Adjustment

Function : Temperature measurement.

This instrument was connected with temperature sensor, S/N : 16K100496

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty (± °C)	Coverage Factor k
20.0	60	19.997	19.93	-0.067	0.15	2.00

UUC\* : Unit Under Calibration

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

-00-

a 1190298



## QUALITY CALIBRATION CO.,LTD.

235 Petchkasem 63/2 Road, Laksoong, Bangkok, Bangkok 10160  
Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584  
www.qcalibration.com



CERTIFICATE No : 24T2852  
REFERENCE No : 72619-8

PAGE : 1 OF 2

## Certificate of Calibration

EQUIPMENT : COOLED INCUBATOR  
MANUFACTURER : MEMMERT  
MODEL : ICP750  
SERIAL No : F819.0021  
ID No : BKK\_EN0304  
CONDITION AS RECEIVED : USED ITEM  
SUBMITTED BY : ALS LABORATORY GROUP (THAILAND) CO., LTD.  
104 PHATTHANAKAN 40, PHATTHANAKAN  
RD., KHWAENG PHATTHANAKAN, KHET SUAN  
LUANG, BANGKOK 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

REVIEW BY :   
APPROVED BY :   
NEXT CAL DATE : 30/03/25



## QUALITY CALIBRATION CO.,LTD.

235 Petchkasem 63/2 Road, Laksoong, Bangkok, Bangkok 10160  
Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584

CERTIFICATE No : 24T2852

PAGE : 2 OF 2

## Calibration Report

EQUIPMENT : COOLED INCUBATOR  
MANUFACTURER : MEMMERT  
MODEL : ICP750  
ID No : BKK\_EN0304  
RECEIVED DATE : 20-Mar-24  
AMBIENT TEMPERATURE :  $26 ^\circ\text{C} \pm 1 ^\circ\text{C}$   
S/N : F819.0021  
CALIBRATION DATE : 20-Mar-24  
RELATIVE HUMIDITY :  $54 \text{ \%RH} \pm 10 \text{ \%RH}$

### CONDITION OF THIS RESULTS OF CALIBRATION

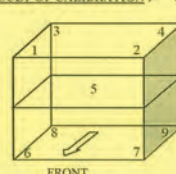
1. THIS INSTRUMENT WAS CALIBRATED ACCORDING TO TLA5 G-20 BY COMPARISON WITH CALIBRATED THERMOCOUPLE TYPE K UNDER NO LOAD CONDITION. THE THERMOCOUPLES WERE PLACED ON NINE POINTS AND LOCATED ONE THERMOCOUPLE IN EACH OF THE EIGHT CORNERS OF THE CHAMBER AND WAS AWAY FROM THE EACH WALL OF 5 cm TO 10 cm. AND PLACED THE NINTH THERMOCOUPLE WITHIN 2.5 cm. OF THE GEOMETRIC CENTER OF THE CHAMBER. THE UNIFORMITY WAS MEASURED BETWEEN REFERENCE PROBE AND OTHER PROBES AT THE SAME TIME.

#### 2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT	MODEL	SERIAL No	CERTIFICATE No	DUE DATE
1) DATA LOGGER WITH TC TYPE K	HYDRA 2635A	7286308	2316641	14-Jul-24

3. THE CERTIFICATE IS VALID FOR THE ITEM CALIBRATED AS SHOWN ON THE DATE AND PLACE OF CALIBRATION ONLY.  
4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.  
5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-  
- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH QUALITY CALIBRATION CO., LTD.

### RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT



FRONT

GENERAL INFORMATION	
Overall Ambient Temperature around the Chamber (°C) variation :	1
Overall Line Voltage (V) variation :	5
Instrument Condition :	Normal

#### CHAMBER PERFORMANCE

Controller Temperature (°C)	Indicating Temperature (°C)	Temperature Stability (±°C)	Temperature Uniformity (°C)	Overall Variation (°C)
20.0	20.0	0.16	0.21	0.41

#### TEMPERATURE MEASUREMENT ACCURACY TEST

Controller	Indicating	Measured Temperature (°C) at Spread Locations									Uncertainty
Temp (°C)	Temp (°C)	#1	#2	#3	#4	Ref. 5	#6	#7	#8	#9	(±°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





## Certificate of Calibration

Cert.No.: 24CG952  
Page.: 1 of 2

Equipment : Burette  
Capacity : 50 mL  
Serial No. : -  
ID. No. : BKK\_EN0171  
Manufacturer : Witeg  
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 Chayingcheiw

Approved by :

( ) Unnopphol Harachai  
(✓) Srisuda Khamtha  
( ) Sa-ngeunkam Wongsu

Issue Date : 27 February 2024

The Uncertainties are for a confidence probability of approximately 95%

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



Equipment : Burette  
Received Date : 23 February 2024  
Condition As-Received : New Item  
Calibration Date : 27 February 2024  
Reference : 2402-0757DSC-1

Cert.No.: 24CG952  
Page.: 2 of 2

### Condition of this result of calibration

#### 1. Reference Standard Instruments :

Instruments	Model	Serial No.	ID. No.	Certificate No.	Traceability	Due date
1) Balance	XP205DR	1126143764	140RC004	23MM538	TPA	15 Sep 2024
2) Thermo-Hygraph	THDX-CE	00016540	140EC001	23H1275	TPA	09 June 2024
3) Thermometer	-	0834181	140EC005	23I948	TPA	10 Aug 2024

This certification is traceable to SI Unit

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

3. True value is converted to true volume at the standard temperature of 20 °C

#### Calibration result :

Nominal capacity ( mL )	Reading ( mL )	Uncertainty ( ± mL )	k Factor
50	50.0032	0.010	2.00

Remark mL = cm<sup>3</sup>

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

-00-



## Metrological Center SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A.Kaengkhloi, Saraburi 18110  
Telephone : +66 2 586 5792-4 Fax : +66 2 586 5109  
Website : www.scieco.co.th E-Mail : calibrate@scg.co.th

Certificate No. T240741

Page 1 of 5

## Certificate of Calibration

Equipment : HOT BLOCK  
Manufacturer : Environmental Express  
Model : B3000- 240  
Serial No. : 2017CODW116  
Customer Code : BKK\_EN0222  
ID No. : T6769A4  
Customer : ALS Laboratory Group (Thailand) Co.,Ltd.  
104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan,  
Khet Suan Luang, Bangkok 10250

Customer Location : Wet Chemistry Lab2

Date of Receipt : 11 April 2024

Calibrated By : Sane Musikawan ( Site Calibration Manager )

Approved By :  / Sujar Naknakred (Site Calibration Manager)

Date of Issue : 23 APR 2024

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

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Metrological Center.



## Metrological Center SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A.Kaengkhloi, Saraburi 18110  
Telephone : +66 2 586 5792-4 Fax : +66 2 586 5109  
Website : www.scieco.co.th E-Mail : calibrate@scg.co.th

Certificate No. T240741

Page 2 of 5

## Calibration Report

Equipment : HOT BLOCK  
Date of Calibration : 22 April 2024  
Environment : Temperature : 22.9-24.4 °C  
Line Voltage : 222.7-227.8 V  
Relative Humidity : 55 - 65 %RH

#### Condition of this results of calibration :

1. This equipment was calibrated by insert 20 standard thermocouples type T into its chamber, the other one standard thermocouples type T use for ambient temperature measurement. The calibration was done in according to WI-T20 ( based on ASTM E145-94 ( Reapproved 2001 ) and AS2853-1986 ).

All data show below were final values and the initial data from customer request. The temperature scale used was based on ITS - 90.

#### 2. Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	TYPE T	TN21-TN30	T240235	17 February 2025
TC	TYPE T	TN31-TN40	T240235	17 February 2025
DATA LOGGER	34970A	T195	T240235	17 February 2025

#### 3. This certificate is traceable to :

National Institute of Metrology ( Thailand ) through Metrological Center ( NSC-TISI-TIS 17025 CALIBRATION 0244 )

#### 4. Condition of calibrated item : good

##### Equipment Description :

Time Constant 1 Hour 10 Minute At 150 °C  
Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max  
☐ Close  
☒ Not Available

#### 5. Adjustment :

( X ) without adjustment

( ) after adjustment

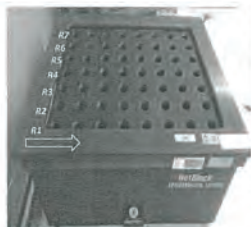
Approved By : 



Certificate No. T240741

Page 3 of 5

## Calibration Report



Row	Hole							
R7	H49	H50	H51	H52	H53	H54	H55	H56
R6	H41	H42	H43	H44	H45	H46	H47	H48
R5	H33	H34	H35	H36	H37	H38	H39	H40
R4	H25	H26	H27	H28	H29	H30	H31	H32
R3	H17	H18	H19	H20	H21	H22	H23	H24
R2	H9	H10	H11	H12	H13	H14	H15	H16
R1	H1	H2	H3	H4	H5	H6	H7	H8

IE: STANDARD THERMOCOUPLE TYPE T

H1 = TN21	H9 = TN29	H17 = TN37	H25 = TN25	H33 = TN33	H41 = TN21	H49 = TN29	H56 = TN29
H2 = TN22	H10 = TN30	H18 = TN38	H26 = TN26	H34 = TN34	H42 = TN22	H50 = TN30	H57 = TN30
H3 = TN23	H11 = TN31	H19 = TN39	H27 = TN27	H35 = TN35	H43 = TN23	H51 = TN31	H58 = TN31
H4 = TN24	H12 = TN32	H20 = TN40	H28 = TN28	H36 = TN36	H44 = TN24	H52 = TN32	H59 = TN32
H5 = TN25	H13 = TN33	H21 = TN21	H29 = TN29	H37 = TN37	H45 = TN25	H53 = TN33	H60 = TN33
H6 = TN26	H14 = TN34	H22 = TN22	H30 = TN30	H38 = TN38	H46 = TN26	H54 = TN34	H61 = TN34
H7 = TN27	H15 = TN35	H23 = TN23	H31 = TN31	H39 = TN39	H47 = TN27	H55 = TN35	H62 = TN35
H8 = TN28	H16 = TN36	H24 = TN24	H32 = TN32	H40 = TN40	H48 = TN28	H56 = TN36	H63 = TN36

Approved By. 

FM-L13 108:30-05-57

Certificate No. T240741

Page 4 of 5

## Calibration Report

### Measurement Results

Calibration Point		Average Standard Reading at each position (°C)									
Point	Setting	Max	TN21	TN22	TN23	TN24	TN25	TN26	TN27	TN28	TN29
150	150.0	Min	150.38	149.73	150.12	150.36	150.56	150.00	150.48	150.25	150.56
		Max	150.13	149.47	149.87	150.16	150.31	149.77	150.25	150.02	149.41
		Average	150.23	149.59	149.96	150.24	150.41	149.87	150.36	150.12	150.45
			TN31	TN32	TN33	TN34	TN35	TN36	TN37	TN38	TN39
		Max	150.17	150.28	150.28	150.37	150.09	149.96	149.75	150.63	150.13
		Min	149.94	150.03	150.01	150.18	149.88	149.69	149.68	149.57	150.41
		Average	150.04	150.14	150.13	150.27	149.98	149.81	149.72	149.63	150.31
			TN21	TN22	TN23	TN24	TN25	TN26	TN27	TN28	TN29
		Max	150.28	150.18	149.87	149.57	150.18	149.90	150.59	149.66	150.39
		Min	150.00	149.94	149.67	149.39	149.88	149.58	150.32	149.34	150.11
		Average	150.14	150.07	149.77	149.49	150.04	149.75	150.48	149.52	150.26
			TN31	TN32	TN33	TN34	TN35	TN36	TN37	TN38	TN39
		Max	150.38	149.71	150.18	149.97	150.03	150.05	150.21	150.07	150.02
		Min	150.12	149.49	149.87	149.66	149.71	149.71	149.89	149.79	149.76
		Average	150.26	149.61	150.04	149.82	149.90	149.89	150.05	149.94	149.91
			TN21	TN22	TN23	TN24	TN25	TN26	TN27	TN28	TN29
		Max	150.37	150.20	150.20	150.44	150.67	149.85	150.31	149.90	150.36
		Min	150.11	149.99	150.04	150.26	150.49	149.69	150.12	149.78	150.20
		Average	150.25	150.12	150.14	150.34	150.57	149.78	150.20	149.83	150.29
			TN31	TN32	TN33	TN34	TN35	TN36			
		Max	150.18	150.02	149.95	150.26	149.92	149.69			
		Min	150.06	149.88	149.79	150.12	149.80	149.58			
		Average	150.13	149.95	149.89	150.18	149.84	149.64			

Approved By. 

FM-L13 108:30-05-57

Certificate No. T240741

Page 5 of 5

## Calibration Report

### Measurement Results

HOT BLOCK			Temperature Distribution	
Setting (°C)	Reading (°C)		Stability (± °C)	Uncertainty (± °C)
	Min	Average		
150.0	150.1	150.0	0.20	0.83

The calibration result apply only the above calibrated item.

The result of test was found accurate as shown on date and place of test only.

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

Approved By. 

FM-L13 108:30-05-57

Certificate No. T232160

Page 1 of 4

## Certificate of Calibration

Equipment : Chamber (Cooling Room)

Manufacturer : KOLDTECH

Model : KM 320

Serial No. : TBN-1012061/05

Customer Code : BKK\_EN0167


ID No. : T2463A3

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

Customer Location : Laboratory

Date of Receipt : 29 November 2023

Calibrated By : Atiphong Rongrat (Technician)

Approved By :  / Boonchai Suriyawong (Site Calibration Manager)

Date of Issue : 09 JAN 2024

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

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Metrology.

FM-L14 119:16-08-60



Certificate No. T232160

Page 2 of 4

## Calibration Report

Equipment : Chamber ( Cooling Room )  
Date of Calibration : 6 December 2023  
Environment : Temperature : 23.4-24.9 °C  
Line Voltage : 221.4-230.2 V  
Relative Humidity : 55 - 65 %RH

## Condition of this results of calibration :

1. This equipment was calibrated by insert 16 standard thermocouples type T into its chamber, the other one standard thermocouples type T use for ambient temperature measurement. The calibration was done in according to WI-T20 ( based on ASTM E145-94 ( Reapproved 2001 ) and AS2853-1986 ).  
All data show below were final values and the initial data from customer request. The temperature scale used was based on ITS - 90.

## 2. Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	TYPE T	TN161-TN170	T230773	10 April 2024
TC	TYPE T	TN171-TN180	T230773	10 April 2024
DATA LOGGER	34970A	T149	T230773	10 April 2024

## 3. This certificate is traceable to :

National Institute of Metrology ( Thailand ) through Metrological Center ( NSC-TIS-TIS 17025 CALIBRATION 0244 )

## 4. Condition of calibrated item : good

## Equipment Description :

Time Constant : 1 Hour 30 Minute At 3 °C  
Fresh Air Damper : ☐ Open ☐ Min ☐ Medium ☐ Max  
☐ Close  
☒ Not Available

## 5. Adjustment :

( X ) without adjustment ( ) after adjustment

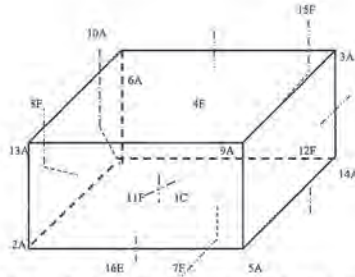
Approved By. 

FM-L15 118/18-08-66

Certificate No. T232160

Page 3 of 4

## Calibration Report



C = Centre, F = Centre of Face, A = Corner, E = Centre of Edge

1C = TN161	12F = TN172
2A = TN162	13A = TN173
3A = TN163	14A = TN174
4E = TN164	15F = TN175
5A = TN165	16E = TN176
6A = TN166	
7F = TN167	
8F = TN168	
9A = TN169	
10A = TN170	
11F = TN171	

Approved By. 

FM-L15 118/18-08-66

Certificate No. T232160

Page 4 of 4

## Calibration Report

## Measurement Results

Calibration Point	Average Standard Reading at each position (°C)											
	TN161	TN162	TN163	TN164	TN165	TN166	TN167	TN168	TN169	TN170	TN171	TN172
3.0	2.83	3.34	2.95	3.46	3.45	3.76	3.25	3.46	3.39	3.50	3.58	3.42
	TN173	TN174	TN175	TN176								
	3.33	3.39	3.15	3.43								

Chamber ( Cooling Room )			Temperature Distribution				
Setting (°C)	Reading (°C)		Average (°C)	Stability (± °C)	Uniformity (°C)	Uncertainty (± °C)	Coverage Factor k
	Min	Max					
3.0	2.8	4.1	3.5	3.36	1.10	2.00	1.50

The calibration result apply only the above calibrated item.

The result of test was found accurate as shown up date and place of test only.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k which for a t-distribution, providing a level of confidence of approximately 95 %.

Approved By. 

FM-L15 118/18-08-66

Certificate No. T231303

Page 1 of 3

## Certificate of Calibration

Equipment : Liquid Bath ( Water )

Manufacturer : MEMMERT

Model : WNB29

Serial No. : L611.0135

Customer Code : BKK\_EN0148

ID No. : T6455A4

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

104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan,

Khet Suan Luang, Bangkok 10250

Customer Location : ORGANIC PREPARATION LAB

Date of Receipt : 27 June 2023

Calibrated By : Sujjar Naknakred ( Site Calibration Manager )

Approved By :  / Boonchai Suriyawong (Site Calibration Manager)

Date of Issue : 11 JUL 2023

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

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Metrological Center.

FM-L14118/31-08-64



## Metrological Center

SCI ECO Services Company Limited

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



Certificate No. T231303

Page 2 of 3

### Calibration Report

Equipment : Liquid Bath ( Water )  
Date of Calibration : 4 July 2023  
Environment : Temperature : 22.2-22.5 °C  
Line Voltage : 221.6-224.8 V  
Relative Humidity : 55 - 65 %RH

#### Condition of this results of calibration :

1. This equipment was calibrated by insert five resistance thermometer detectors into its water bath , the other one thermocouple type T use for ambient temperature measurement . The calibration was done in according to WI-T36 ( based on ASTM E715-80 ( Reapproved 2001 ) ).  
All data show below were final values and the initial data from customer request . The temperature scale used was based on ITS - 90 .

#### 2. Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
RTD	100 OHM	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-TISI-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.

*[Signature]*

FM-L15 117/15-05-63



## Metrological Center

SCI ECO Services Company Limited

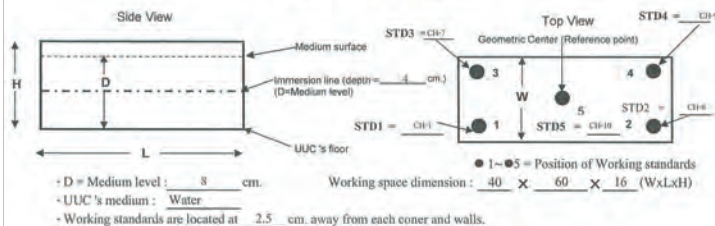
33/2 Moo 3, T.Banpa, A.Kaengkhoh, Saraburi 18110, Thailand.



Certificate No. T231303

Page 3 of 3

### Calibration Report



#### Measurement Results:

Calibration Point	Average Standard Reading at each position ( ° C )				
	CH-1	CH-6	CH-7	CH-9	CH-10
60	60.03	60.06	60.24	60.11	60.18
85	84.79	84.83	85.42	85.05	85.20
95	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 )
	Min , Max	Average				
61.0	60.9, 61.1	61.0	60.12	0.13	0.19	0.29
86.0	85.8, 86.2	86.0	85.06	0.19	0.47	0.44
95.0	94.6, 95	94.9	94.15	0.32	0.65	0.55

\* 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.

*[Signature]*

FM-L15 117/15-05-63



## Metrological Center

SCI ECO Services Company Limited

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

Telephone : +66 2 586 5792-4 Fax : +66 2 586 5109

Website : www.scieco.co.th E-Mail : calibrate@scg.co.th

Certificate No. T240742

Page 1 of 5

### Certificate of Calibration

Equipment : Digestion Unit  
Manufacturer : SCP Science  
Model : DigiPRER HT  
Serial No. : HTC1120480658  
Customer Code : BKK\_EN0366  
ID No. : T2635A5  
Customer : ALS Laboratory Group (Thailand) Co.,Ltd.  
104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan,  
Khet Suan Luang, Bangkok 10250  
Customer Location : Wet Chemistry Lab 1  
Date of Receipt : 11 April 2024  
Calibrated By : Sujjar Naknakred ( Site Calibration Manager )  
Approved By : *[Signature]* / Boonchai Suriyawong ( Site Calibration Manager )  
Date of Issue : 02 MAY 2024

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

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Metrological Center.

FM-L12 109/30-05-57



## Metrological Center

SCI ECO Services Company Limited

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

Telephone : +66 2 586 5792-4 Fax : +66 2 586 5109

Website : www.scieco.co.th E-Mail : calibrate@scg.co.th

Certificate No. T240742

Page 2 of 5

### Calibration Report

Equipment : Digestion Unit  
Date of Calibration : 21 April 2024  
Environment : Temperature : 23.9 - 26.3 °C  
Line Voltage : 221.8 - 225.9 V  
Relative Humidity : 55 - 65 %RH

#### Condition of this results of calibration :

1. This equipment was calibrated by insert four standard thermocouples type S into its chamber , the other one thermocouple type T use for ambient temperature measurement . The calibration was done in according to WI-T10.  
was based on ITS - 90 .

#### 2. Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	Type S	M20A2-(CH11-CH14)	T230886	09 May 2024
DATA LOGGER	34970A	T47	T230886	09 May 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 : 1 Hour 6 Minute At 380 °C  
Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max  
☒ Not Available

#### 5. Adjustment :

( X ) without adjustment ( ) after adjustment

Approved By.

*[Signature]*

FM-L13 108/30-05-57



Certificate No. T240742

Page 3 of 5

## Calibration Report



FRONT

### Measurement Results

Cal. Point	Setting	Reading	STD.	Position of Standards at Block							
(°C)	(°C)	(°C)	Reading	MDA2-CH1	MDA2-CH2	MDA2-CH3	MDA2-CH4	MDA2-CH5	MDA2-CH6	MDA2-CH7	MDA2-CH8
				Block 1	Block 2	Block 3	Block 4	Block 5	Block 6	Block 7	Block 8
380.0	380.0	379.2 - 380.5	Max °C	378.7	378.9	377.9	378.7	380.5	379.8	378.7	377.4
			Min °C	378.2	378.5	377.5	378.2	380.1	379.3	378.3	376.9
			Average °C	378.4	378.7	377.7	378.4	380.3	379.6	378.5	377.2
			Stability ± °C	0.2	0.2	0.2	0.2	0.2	0.3	0.2	0.2

Cal. Point	Setting	Reading	STD.	Position of Standards at Block							
(°C)	(°C)	(°C)	Reading	MDA2-CH1	MDA2-CH2	MDA2-CH3	MDA2-CH4	MDA2-CH5	MDA2-CH6	MDA2-CH7	MDA2-CH8
				Block 9	Block 10	Block 11	Block 12	Block 13	Block 14	Block 15	Block 16
380.0	380.0	379.2 - 380.5	Max °C	378.4	378.6	379.2	379.6	381.9	380.6	379.1	378.1
			Min °C	377.8	378.2	378.7	379.2	381.4	379.9	378.3	377.2
			Average °C	378.1	378.4	379.0	379.4	381.6	380.3	378.7	377.7
			Stability ± °C	0.3	0.2	0.2	0.2	0.3	0.4	0.4	0.5

Approved By: 

FM-L13 108/30-05-57

Certificate No. T240742

Page 4 of 5

## Calibration Report



FRONT

### Measurement Results

Cal. Point	Setting	Reading	STD.	Position of Standards at Block							
(°C)	(°C)	(°C)	Reading	MDA2-CH1	MDA2-CH2	MDA2-CH3	MDA2-CH4	MDA2-CH5	MDA2-CH6	MDA2-CH7	MDA2-CH8
				Block 17	Block 18	Block 19	Block 20	Block 21	Block 22	Block 23	Block 24
380.0	380.0	379.2 - 380.5	Max °C	378.9	379.2	379.5	380.1	382.1	381.0	378.9	377.8
			Min °C	378.2	378.6	379.1	379.6	381.7	380.2	378.3	377.2
			Average °C	378.5	378.9	379.3	379.8	381.9	380.6	378.6	377.5
			Stability ± °C	0.3	0.3	0.2	0.2	0.2	0.4	0.3	0.3

Cal. Point	Setting	Reading	STD.	Position of Standards at Block							
(°C)	(°C)	(°C)	Reading	MDA2-CH1	MDA2-CH2	MDA2-CH3	MDA2-CH4	MDA2-CH5	MDA2-CH6	MDA2-CH7	MDA2-CH8
				Block 25	Block 26	Block 27	Block 28	Block 29	Block 30	Block 31	Block 32
380.0	380.0	379.2 - 380.5	Max °C	378.5	378.1	378.0	378.6	380.7	379.7	377.7	380.9
			Min °C	378.2	377.8	377.7	378.1	380.3	379.0	377.2	380.4
			Average °C	378.4	378.0	377.9	378.4	380.5	379.4	377.5	380.6
			Stability ± °C	0.2	0.2	0.2	0.2	0.2	0.3	0.2	0.3

Approved By: 

FM-L13 108/30-05-57

Certificate No. T240742

Page 5 of 5

## Calibration Report



FRONT

### Measurement Results

Cal. Point	Setting	Reading	STD.	Position of Standards at Block							
(°C)	(°C)	(°C)	Reading	MDA2-CH1	MDA2-CH2	MDA2-CH3	MDA2-CH4	MDA2-CH5	MDA2-CH6	MDA2-CH7	MDA2-CH8
				Block 33	Block 34	Block 35	Block 36	Block 37	Block 38	Block 39	Block 40
380.0	380.0	379.2 - 380.5	Max °C	378.3	377.9	378.7	379.5	381.6	380.5	378.4	378.0
			Min °C	378.0	377.6	378.4	379.1	381.2	380.0	378.1	377.6
			Average °C	378.2	377.8	378.6	379.3	381.4	380.3	378.2	377.8
			Stability ± °C	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

The expanded uncertainty of temperature measurement was  $\pm 1.87^\circ\text{C}$

The calibration result apply only the above calibrated item.

The result of test was found accurate as shown on date and place of test only.

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

Approved By: 

FM-L13 108/30-05-57





บริษัท ดับเบิล เอส ไดแอกโนสติกส์ จำกัด  
DOUBLE S DIAGNOSTICS CO., LTD.  
4 ซอยสุขุมวิท 12 (ซอยสุขุมวิท) กรุงเทพมหานคร 10000 โทรศัพท์: (02) 547-2000 โทรสาร: (02) 747-7000  
4 Soi Sukhumvit 12, Bangkok, Bangkok 10009 Tel: (02) 747-7000 Fax: (02) 747-7000

Maintenance Plan YEAR : 2024

เดือน	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
ทำ												

### Periodical maintenance check list for Konelab

	6M	12M	Note
1.Diluent-wash tubing change	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
2.ISE tubing change	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	None
3.Syringe check/change	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
4.Dispensing check/ change	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
5.Waste tubing change when necessary	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
6.Lamp check/change	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
7.Mixer paddle/paddle change(not Konelab20)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
8.ISE needles check/change	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	None
9.Pump tubing check/ change	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
10.Broken/worn out part check/change	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
11.Peristaltic pump check/cleaning/ lubrication	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
12.Heating check	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
13.Cooling check	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
14.Dispenser mechanic check/adjustment	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
15.Cuvette transfer mechanic check/adjustment	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
16.Dispenser movement check/adjustment	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
17.Sample/reagent register check/adjustment	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
18.Dispensing tubing tightness check	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
19.Photometer and optics cleaning/check/adjustment	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
20.Workstation PC cleaning if necessary	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
21.Mechanic cleaning/lubrication	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
22.Instrument cleaning if necessary	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
23.Complete analyzer testing with waterblank/QC or sample	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
24.Test parameters/Adjustment/config. Save to USB key	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
25.UPS Test	<input type="checkbox"/>	<input checked="" type="checkbox"/>	

Place: ALS LAB Instrument: Konelab  
Date/Time: 16/8/22 Serial no: 82281  
Service done by:  Install date: 16/08/2024  
Signature of customer:  Date/Time: 16/08/2024

Accuracy results

Aquaken 7.2.AQ2

Page: 1

Laboratory  
Analyzer User

8/16/2024 14:53

Performed

8/16/2024

Lot

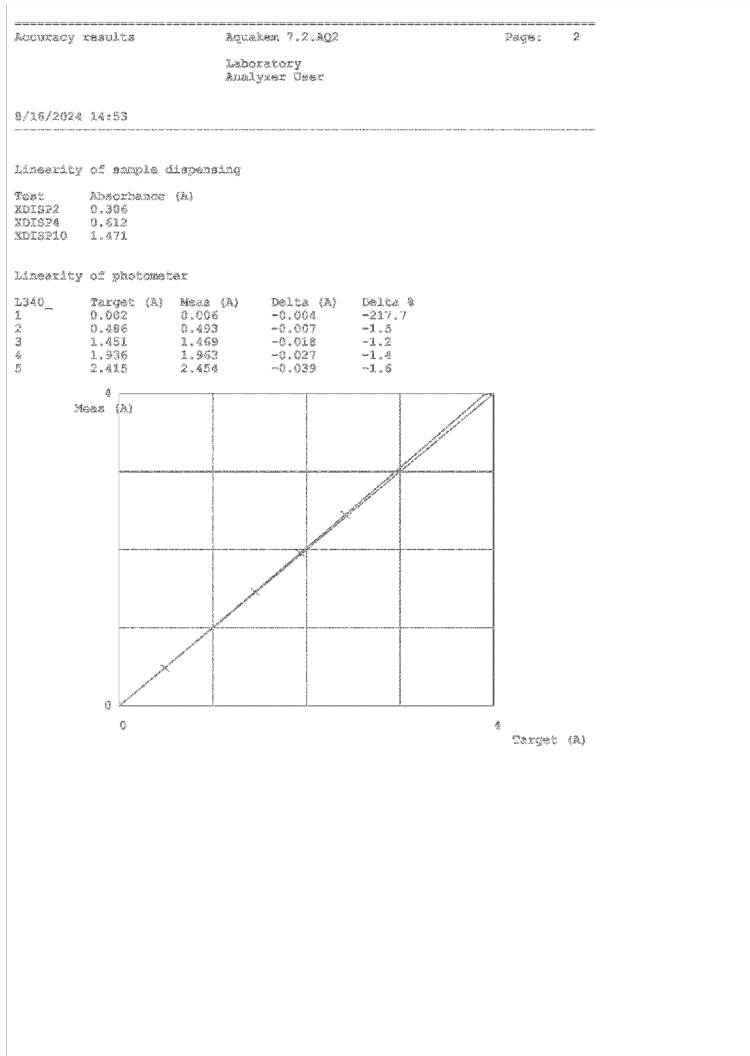
W334

ACCEPTANCE CRITERIA

	Result	Limit	Warning
Temperature (°C)	37.8	37.0 +/- 1.0	
Dispensing ratio	16.4	14.8 -- 17.2	
CV%	0.29	<1.7	
Photometric noise			
Max SD L340_2 (nA)	0.17	<2.0	
Max SD L340_4 (nA)	0.87	<3.0	
Linearity of photometer			
Slope	1.0141	0.94 - 1.06	
Curvature	0.0053	+/- 0.02	
Max bias from linear fit (nA)	4.3	<15.0	
Max delta %	-1.6	+/- 6.0	
Linearity of sample dispensing			
Proport. volume XDISP2 (µl)	2.06	1.96 - 2.16	
Proport. volume XDISP4 (µl)	4.14	3.85 - 4.40	
XDISP2 CV%	1.21	<2.0	
XDISP4 CV%	0.90	<2.0	
XDISP10 CV%	0.68	<2.0	
Needle 0 µl volume			
Average (nA)	0.005	<0.050	
Standard deviation (nA)	0.002	<0.005	
Volume (µl)	0.03	<0.32	

OTHER INFORMATION

Dispensing ratio	Photom. noise: SD (nA)
Posit: Result (nA)	Posit: L340_2 L340_4
1 0.1549	1 0.15 0.80
2 0.1549	2 0.17 0.79
3 0.1537	3 0.04 0.65
4 0.1547	4 0.16 0.31
5 0.1547	5 0.11 0.58
6 0.1545	6 0.14 0.87



BKK\_EL0026

Agilent Technologies

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888 RAMA 4 ROAD, SILOM, BANGRAK  
Bangkok 10500 Thailand

Tel: +662 637 6383  
Fax: +662 632 4334  
Email: ccc-smt@agilent.com  
Website: www.agilent.com/chem

Customer Contact:

ALS Laboratory Group (Thailand) Co Ltd  
Head Office  
104 Phatthanakan 40 Phatthanakan Rd  
Khaeng Phatthanakan Khet Suan  
TAX ID : 0105540004859  
Chanattagarn.lmchom@alsglobal.com  
27603066

Invoice To:

ALS Laboratory Group (Thailand) Co Ltd  
Head Office  
104 Phatthanakan 40 Phatthanakan Rd  
Khaeng Phatthanakan Khet Suan

Delivery Site:

ALS Laboratory Group (Thailand) Co Ltd  
Head Office  
104 Phatthanakan 40 Phatthanakan Rd  
Khaeng Phatthanakan Khet Suan

Location:

Room  
Bldg  
Lab  
Dept

Service Report

Customer Purchase Order Number:	Customer Number:
	70371913
Service Request:	Service Request Date:
Service Order:	Service Confirmation:
6006041263	6905338201

REVIEW BY

APPROVED BY

NEXT CAL DATE

Supahan M.

Savitree N.

15/06/2025

Direct Inquiries to:

Contact Name: Customer Contact Center  
Contact E-mail: ccc-smt@agilent.com  
Contact Telephone: +662 637 6383  
Contact Fax: +662 632 4334

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U Chu Liang Bldg. 22/F Unit A.D  
888 Rama 4 Road, Silom, Bangkok  
Bangkok 10500 Thailand  
Tax ID : 0105540004859

Chobank N.A. Bangkok Branch  
309 Interchange 21 Building, Sukhumvit Road, Khlongtoey New  
Sub-District, Wattana District, Bangkok 10110 Thailand  
Acc. No: 012-4452-807  
THB Krung Thai Bank PCL  
Siam Square Bk. 416/1-2 Rama 1 Rd, Pathumwan, BKK 10330  
Thailand

Service Confirmation Number: 6905338201

Service Confirmation Date: 12/12/2023

Service Instrument:

Model Number	Model Description	Serial Number	System Handle	Parent Asset
SYS-IM-7700-E	ICPMS 7700 System Enhanced		ICP MS 7700 (HPLC)	
G1316A	1260 Thermostatted Column Compartment	DEACN12300	ICP MS 7700 (HPLC)	SYS-IM-7700-E
G1329B	1260 Standard Autosampler	DEAAC1109B	ICP MS 7700 (HPLC)	SYS-IM-7700-E
G1311B	1260 Quaternary Pump	DEAB704360	ICP MS 7700 (HPLC)	SYS-IM-7700-E
G3281A	Agilent 7790x ICP-MS	JP12041612	ICP MS 7700 (HPLC)	SYS-IM-7700-E

Service Items:

Item	Service/Part #	Description	Qty	Entitlement	Service Start	Service End
1000	EQG	Enterprise Operational Qualification	1.00	Agreement Entitlement 100 % covered	12.12.2023	12.12.2023
1010	5185-5850	ICP-MS Checkout Solutions	1.00	Agreement Entitlement 100 % covered		

Additional Information:



products | applications | software | services

Page 1 of 3

Page 2 of 3



Service Information:

<b>Problem Description:</b> WU-QQ-IM/HPLC-7700-5001143113		
<b>Service Provided:</b> Perform OQ Hardware control test CSO logon, Autosample, JISIS, Auto tune, BG and Stability, After done the instrument BKK_EL0054 calibrated pass all.		
<b>Service Overview Code:</b> Reason Code: Scheduled Service Diagnosis Code: Scheduled Service Resolution Code: Scheduled Service		
<b>Reported Hours:</b> 5.0	<b>Travel Hours:</b> 1.0	
<b>Customer Field Service Representative Name:</b> Pantep Kurasathais	<b>Customer Field Service Representative Signature:</b> 	<b>Date:</b> 12 Dec 2023
<b>Customer Name:</b> Supakwan Mak	<b>Customer Signature:</b> 	<b>Date:</b> 12 Dec 2023
<b>Additional Comments:</b>		

Page 3 of 3



Metrological Center

SCI ECO Services Company Limited

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


Telephone : +66 2 586 5792-4 Fax : +66 2 586 5109

Website : www.scieco.co.th E-Mail : calibrate@scg.co.th

Certificate No. T231676

Page 1 of 6

Certificate of Calibration

**Equipment** : HEATING BLOCK  
**Manufacturer** : Environmental Express  
**Model** : SC 196  
**Serial No.** : 6974CECW3285  
**Customer Code** : BKK\_EL0054  
**ID No.** : T5306A3  
**Customer** : ALS Laboratory Group (Thailand) Co.,Ltd.  
104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan,  
Khet Suan Luang, Bangkok 10250  
**Customer Location** : Acid Digestion Lab  
**Date of Receipt** : 13 September 2023  
**Calibrated By** : Saneek Musikawan ( Site Calibration Manager )  
**Approved By** :  / Sujjar Nakkakred ( Site Calibration Manager )  
**Date of Issue** : 26 SEP 2023

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

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Metrological Center.

FM-L12 108/30-05-57



Metrological Center

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Website : www.scieco.co.th E-Mail : calibrate@scg.co.th

Certificate No. T231676

Page 2 of 6

Calibration Report

**Equipment** : HEATING BLOCK  
**Date of Calibration** : 22 September 2023  
**Environment** : Temperature : 21.8-23.1 °C  
Line Voltage : 221.6-226.3 V  
Relative Humidity : 55 - 65 %RH

Condition of this results of calibration :

1. This equipment was calibrated by insert 20 standard thermocouples type T into its chamber , the other one standard thermocouples type T use for ambient temperature measurement . The calibration was done in according to W1-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	TN21-TN30	T230014	17 January 2024
TC	TYPE T	TN31-TN40	T230014	17 January 2024
DATA LOGGER	34970A	T151	T230014	17 January 2024

3. This certificate is traceable to :

National Institute of Metrology ( Thailand ) through Metrological Center ( NSC-TIS1-TIS 17025 CALIBRATION 0244.)

4. Condition of calibrated item : good

Equipment Description :

Time Constant : 2 Hour 20 Minute At 95 °C  
Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max  
☐ Close  
☒ Not Available

5. Adjustment :

( ) without adjustment ( X ) after adjustment

Approved By



FM-L13 108/30-05-57



Metrological Center

SCI ECO Services Company Limited

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

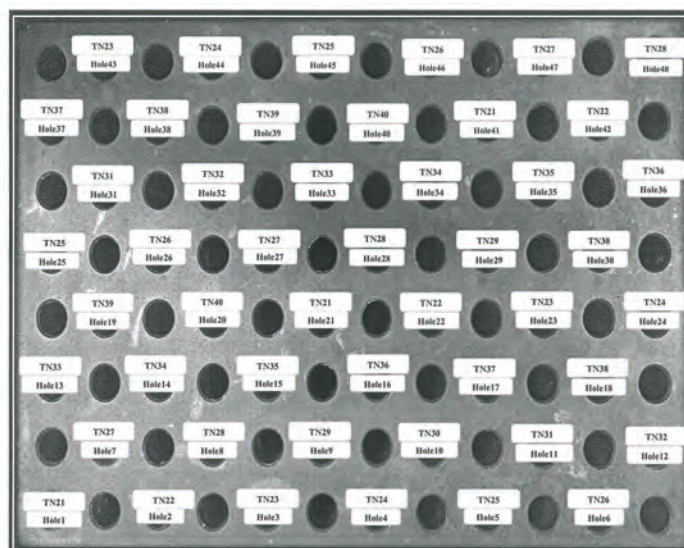
Telephone : +66 2 586 5792-4 Fax : +66 2 586 5109

Website : www.scieco.co.th E-Mail : calibrate@scg.co.th

Certificate No. T231676

Page 3 of 6

Calibration Report



FRONT CONTROL

Approved By



FM-L13 108/30-05-57



Certificate No T231676

Page 4 of 6

### Calibration Report

#### Measurement Results

Calibration Point		Average Standard Reading at each position (°C)					
R1 Hole1-Hole6		TN21	TN22	TN23	TN24	TN25	TN26
CAL POINT	Max	95.01	94.41	95.20	95.41	94.51	95.17
	Min	94.57	93.95	94.75	94.92	94.00	94.72
	Average	94.79	94.18	94.98	95.17	94.26	94.95
R2 Hole7-Hole12		TN27	TN28	TN29	TN30	TN31	TN32
	Max	95.36	95.43	95.19	95.16	95.35	94.97
	Min	94.94	94.95	94.72	94.71	94.90	94.57
	Average	95.15	95.19	94.96	94.94	95.13	94.77
R3 Hole13-Hole18		TN33	TN34	TN35	TN36	TN37	TN38
	Max	95.37	95.50	95.22	95.21	95.33	95.31
	Min	94.99	95.09	94.78	94.82	94.88	94.96
	Average	95.18	95.30	95.00	95.02	95.11	95.13
R4 Hole19-Hole24		TN39	TN40	TN21	TN22	TN23	TN24
	Max	95.39	94.42	94.52	94.24	94.63	94.67
	Min	95.21	94.06	94.13	93.88	94.28	94.27
	Average	95.40	94.24	94.33	94.06	94.45	94.47
R5 Hole25-Hole30		TN25	TN26	TN27	TN28	TN29	TN30
	Max	95.19	95.38	92.93	95.30	95.14	95.03
	Min	94.83	95.03	92.56	94.95	94.79	94.70
	Average	95.01	95.20	92.75	95.12	94.96	94.87
R6 Hole31-Hole36		TN31	TN32	TN33	TN34	TN35	TN36
	Max	94.63	94.90	94.77	94.31	94.24	93.87
	Min	94.24	94.55	94.44	93.98	93.92	93.56
	Average	94.43	94.72	94.60	94.14	94.08	93.71
R7 Hole37-Hole42		TN37	TN38	TN39	TN40	TN21	TN22
	Max	94.30	94.44	94.04	93.81	94.89	95.35
	Min	93.95	94.05	93.67	93.48	94.39	94.90
	Average	94.13	94.24	93.86	93.65	94.64	95.12
R8 Hole43-Hole48		TN23	TN24	TN25	TN26	TN27	TN28
	Max	95.99	95.63	95.28	95.29	95.45	94.87
	Min	95.57	95.15	94.82	94.84	94.99	94.48
	Average	95.78	95.39	95.05	95.07	95.22	94.68

Approved By. 

FM-L13 108/30-05-57



Certificate No T231676

Page 5 of 6

### Calibration Report

#### Measurement Results

Calibration Point		Average Standard Reading at each position (°C)					
R1 Hole1-Hole6		TN21	TN22	TN23	TN24	TN25	TN26
CAL POINT	Max	105.23	104.32	105.43	105.25	104.44	105.27
	Min	104.94	103.95	105.15	105.04	104.11	104.96
	Average	105.09	104.13	105.29	105.15	104.28	105.12
R2 Hole7-Hole12		TN27	TN28	TN29	TN30	TN31	TN32
	Max	105.30	105.12	105.18	105.22	105.12	105.16
	Min	105.11	104.92	104.96	105.00	104.92	104.97
	Average	105.20	105.02	105.07	105.11	105.02	105.06
R3 Hole13-Hole18		TN33	TN34	TN35	TN36	TN37	TN38
	Max	105.37	105.63	105.02	104.80	104.69	105.19
	Min	105.17	105.37	104.75	104.59	104.50	105.00
	Average	105.27	105.50	104.88	104.69	104.60	105.09
R4 Hole19-Hole24		TN39	TN40	TN21	TN22	TN23	TN24
	Max	105.31	104.43	106.41	104.71	105.63	105.82
	Min	105.08	104.22	106.15	104.81	105.37	105.56
	Average	105.19	104.33	106.28	104.56	105.50	105.69
R5 Hole25-Hole30		TN25	TN26	TN27	TN28	TN29	TN30
	Max	104.95	106.26	103.34	105.78	105.59	105.87
	Min	104.67	105.96	103.08	105.56	105.36	105.68
	Average	104.81	106.11	103.21	105.67	105.48	105.77
R6 Hole31-Hole36		TN31	TN32	TN33	TN34	TN35	TN36
	Max	104.75	104.86	104.80	105.20	104.50	104.39
	Min	104.54	104.63	104.59	105.00	104.32	104.18
	Average	104.65	104.75	104.69	105.10	104.41	104.28
R7 Hole37-Hole42		TN37	TN38	TN39	TN40	TN21	TN22
	Max	104.20	104.90	104.85	104.65	104.88	104.85
	Min	104.09	104.72	104.66	104.49	104.63	104.52
	Average	104.19	104.81	104.75	104.57	104.76	104.68
R8 Hole43-Hole48		TN23	TN24	TN25	TN26	TN27	TN28
	Max	105.71	105.85	105.39	105.61	105.42	105.19
	Min	105.45	105.61	105.14	105.27	105.18	104.94
	Average	105.58	105.73	105.27	105.44	105.30	105.07

Approved By. 

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### Calibration Report

#### Measurement Results:

HEATING BLOCK			Temperature Distribution	
Setting (°C)	Reading (°C)		Stability (± °C)	Uncertainty (± °C)
	Min , Max	Average		
100.0	100.3 , 100.5	100.4	0.26	0.81
107.0	107.0 , 107.1	107.1	0.19	0.78

\* 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=2 which for a t-distribution, providing a level of confidence of approximately 95 %.

Approved By. \_\_\_\_\_

FM-L13 108/30-05-57



## ภาคผนวก จ

สำเนาหนังสืออนุญาตขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน



ที่ อก ๐๓๑๐(๑)/ ๑๖๑๖๘

กรมโรงงานอุตสาหกรรม  
ถนนพระรามที่ ๖ แขวงทุ่งพญาไท  
เขตราชเทวี กรุงเทพฯ ๑๐๔๐๐

๒๐ พฤศจิกายน ๒๕๖๖

เรื่อง ต่ออายุหนังสือรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน

เรียน กรรมการผู้จัดการ บริษัท เอแอลเอส แลบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด

อ้างถึง คำขอขึ้นทะเบียน/ต่ออายุ/เปลี่ยนแปลงบุคลากร และชนิดสารมลพิษของห้องปฏิบัติการวิเคราะห์เอกชน  
ลงวันที่ ๔ สิงหาคม ๒๕๖๖

- สิ่งที่ส่งมาด้วย ๑. รายชื่อผู้ควบคุมดูแลห้องปฏิบัติการวิเคราะห์ จำนวน ๑ แผ่น  
๒. รายชื่อเจ้าหน้าที่ประจำห้องปฏิบัติการวิเคราะห์ จำนวน ๕ แผ่น  
๓. ขอบข่ายสารมลพิษที่ได้รับขึ้นทะเบียนจากกรมโรงงานอุตสาหกรรม จำนวน ๓๑ แผ่น

ตามหนังสือที่อ้างถึง บริษัท เอแอลเอส แลบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด ขอต่ออายุหนังสือ  
รับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน เลขทะเบียน ว-๒๐๔ สถานที่ตั้งเลขที่ ๑๐๔ ซอยพัฒนาการ ๔๐  
ถนนพัฒนาการ แขวงพัฒนาการ เขตสวนหลวง กรุงเทพมหานคร ต่อกรมโรงงานอุตสาหกรรม นั้น

กรมโรงงานอุตสาหกรรมพิจารณาแล้ว ให้บริษัท เอแอลเอส แลบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด  
ต่ออายุหนังสือรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน โดยมีองค์ประกอบดังนี้

- ก. ผู้ควบคุมดูแลห้องปฏิบัติการวิเคราะห์ จำนวน ๖ ราย ตามสิ่งที่ส่งมาด้วย ๑  
ข. เจ้าหน้าที่ประจำห้องปฏิบัติการวิเคราะห์ ๑๘๑ ราย ตามสิ่งที่ส่งมาด้วย ๒  
ค. ขอบข่ายสารมลพิษที่ได้รับขึ้นทะเบียนให้วิเคราะห์ในน้ำเสีย น้ำใต้ดิน อากาศเสีย สิ่งปฏิกูล  
หรือวัสดุที่ไม่ใช้แล้ว และดิน ตามสิ่งที่ส่งมาด้วย ๓

หนังสือฉบับนี้จะหมดอายุในวันที่ ๒ กันยายน ๒๕๖๙ หากประสงค์จะต่ออายุหนังสือ  
รับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน ให้ยื่นคำขอต่ออายุพร้อมเอกสารประกอบคำขอต่อ  
กรมโรงงานอุตสาหกรรม ภายใน ๓๐ วัน ก่อนวันสิ้นสุดอายุของหนังสือรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน  
ทั้งนี้ สามารถยื่นคำขอผ่านระบบอิเล็กทรอนิกส์ได้ที่หน้าเว็บไซต์กรมโรงงานอุตสาหกรรม

จึงเรียนมาเพื่อทราบ

ขอแสดงความนับถือ



(นายสิระ จันทน์เลิศ)

นักวิทยาศาสตร์เชี่ยวชาญ วิชาการการแทน

ผู้อำนวยการกองวิจัยและเตือนภัยมลพิษโรงงาน

ปฏิบัติราชการแทนอธิบดีกรมโรงงานอุตสาหกรรม

กองวิจัยและเตือนภัยมลพิษโรงงาน

กลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษและทะเบียนห้องปฏิบัติการ

โทร. ๐ ๒๔๓๐ ๖๓๑๒ ต่อ ๒๑๐๓-๕

โทรสาร ๐ ๒๔๓๐ ๖๓๑๒ ต่อ ๒๑๙๙

ไปรษณีย์อิเล็กทรอนิกส์ saraban@div.mail.go.th



“อุตสาหกรรมก้าวไกล ประเทศไทยก้าวหน้า ร่วมกันพัฒนา อุตสาหกรรมสีเขียว”



สิ่งที่ส่งมาด้วย ๑

เอกสารแนบท้ายหนังสือรับต่ออายุขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน

บริษัท เอแอลเอส แลบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด

เลขทะเบียน ว-๒๐๔

ที่ อก ๐๓๑๐(๑)/ ๑๖๑๖๘

ลงวันที่ ๒๐ พฤศจิกายน ๒๕๖๖

ก. ผู้ควบคุมดูแลห้องปฏิบัติการวิเคราะห์ จำนวน ๖ ราย

๑) นางสาวพภาพร จันทร์เปล่ง

ทะเบียนเลขที่ ว-๒๐๔-ค-๐๐๐๑

๒) นางสาวชนัญ โคมารกุล ณ นคร

ทะเบียนเลขที่ ว-๒๐๔-ค-๐๐๐๒

๓) นายศรายุทธ จิตรานนท์

ทะเบียนเลขที่ ว-๒๐๔-ค-๐๐๐๓

๔) นางสาวกนกกร เอนก

ทะเบียนเลขที่ ว-๒๐๔-ค-๐๐๐๔

๕) นายสุริยา สอนแก้ว

ทะเบียนเลขที่ ว-๒๐๔-ค-๐๐๐๕

๖) นายวิษณุ ชุนทรัด

ทะเบียนเลขที่ ว-๒๐๔-ค-๐๐๐๖





เอกสารแนบท้ายหนังสือรับต่ออายุขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน

บริษัท เอแอลเอส แลบบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด เลขทะเบียน ว-๒๐๔

ที่ อก ๐๓๑๐(๑)/ ๑๖๑๖๘ ลงวันที่ ๒๐ พฤศจิกายน ๒๕๖๖

ข. เจ้าหน้าที่ประจำห้องปฏิบัติการวิเคราะห์ จำนวน ๑๘๑ ราย

๑) นายกาจบัณฑิต กิตติคุณวัฒน์	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๐๑
๒) นายภัทรพล สว่างใจธรรม	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๐๒
๓) นายนราธิป เทือกชัยคำ	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๐๓
๔) นายศิริโชค พงษ์ประสม	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๐๔
๕) นายณัฐวุฒิ ดัวงแพง	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๐๕
๖) นางสาวจินดา ไชยธรรม	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๐๖
๗) นางสาวสาวิตรี น้อยแสงี่ยม	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๐๗
๘) นางสาวชนัญญาญจน์ อัมมขม	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๐๘
๙) นางสาวนรินทร์ สายเสียง	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๐๙
๑๐) นางสาวนันทวดี สมบูรณ์	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๑๐
๑๑) นางสาวศรัณยา เฉลิมธารังค์	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๑๑
๑๒) นางสาวธัญญธร มงคลจิรวุฒิ	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๑๒
๑๓) นางสาวศิริลักษณ์ บุญนาค	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๑๓
๑๔) นายณพพงศ์ จันทร์พันธุ์	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๑๔
๑๕) นายณเรศสรณ์ โกมลาลัย	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๑๕
๑๖) นายธินา จริยา	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๑๖
๑๗) นางสาวเกศรินทร์ แก้วมัน	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๑๗
๑๘) นางสาวสุวิมล ชัยเรืองวุฒิ	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๑๘
๑๙) นางสาวสุชาดา ธรรมถาวร	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๑๙
๒๐) นางสาวเปมิกา ชัยเดชธนกุล	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๒๐
๒๑) นางสาวศศิธร หนูสวัสดิ์	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๒๑
๒๒) นางสาวเสาวลักษณ์ ภูนาอำพร	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๒๒
๒๓) นายอภิสิทธิ์ สิงหา	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๒๓
๒๔) นายศักดิ์สิทธิ์ โพธิ์สุทนต์	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๒๔
๒๕) ว่าที่ร้อยตรีหญิง พรรณีภา ขำเจริญ	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๒๕
๒๖) นางจิตตา คำแก้ว	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๒๖
๒๗) นางสาวอรรพรรณ รักยง	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๒๗
๒๘) นางสาวนพรัตน์ แยมกรานต์	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๒๘
๒๙) นายจุลเดช วารินทร์	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๒๙
๓๐) นางสาวดาญรัตน์ ร้องคำ	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๓๐
๓๑) นายพรมมี ศรีรัตนตร	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๓๑
๓๒) นายอุทิศ อุณสิม	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๓๒
๓๓) ว่าที่ร้อยตรี เฉลิมเกียรติ อมรศรีเสริม	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๓๓
๓๔) นางสาววริยา สร้างนา	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๓๔
๓๕) นายอนุพงศ์ รัตนศรีประเสริฐ	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๓๕

วิมล

๓๖) นางสาวจุฑารัตน์...

๓๖) นางสาวจุฑารัตน์ โอนสันเทียะ	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๓๖
๓๗) นางสาวจรรวณ พิมพอกฤติยา	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๓๗
๓๘) นางสาวปรางค์ทิพย์ กิจไพศาลศักดิ์	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๓๘
๓๙) นางสาวเดือนใจ ทางกลาง	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๓๙
๔๐) นางสาวจิราพร ศิริเวช	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๔๐
๔๑) นายวรารักษ์ ผูกักษ์	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๔๑
๔๒) นายทง วิริยะสทกิจ	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๔๒
๔๓) นายธนิต เจนจบ	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๔๓
๔๔) นายณิศกร ข้าเพชร	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๔๔
๔๕) นายภูวิช พรหมสะอาด	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๔๕
๔๖) นายธนเดช โกคาพิพัฒน์	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๔๖
๔๗) นายชวฤทธิ์ วงษ์จันทร์	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๔๗
๔๘) นายอาทิตย์ ศรีแสน	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๔๘
๔๙) นายเจษฎินทร์ คงศักดิ์ไทย	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๔๙
๕๐) นายจรัส บุญยัง	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๕๐
๕๑) นายธนาณัติ เอนก	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๕๑
๕๒) นายอภิวัฒน์ ทุมหนู	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๕๒
๕๓) นางสาวสุภาขวัญ มาก	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๕๓
๕๔) นางสาวพัทธพร ขวาลสมบูรณ์	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๕๔
๕๕) นางสาวธิดา บุญเพ็ง	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๕๕
๕๖) นางสาวกานมาศ นามวัฒน์	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๕๖
๕๗) นางสาวอุไรรัตน์ ทั้งสร้างแป้น	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๕๗
๕๘) นายธีรวัฒน์ ปวงสุข	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๕๘
๕๙) นายอิทธิพล ยะโส	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๕๙
๖๐) นายประพนธ์ วรรณสุขชัย	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๖๐
๖๑) นายชยธร พวงทิพย์	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๖๑
๖๒) นางสาวกนกวรรณ จันทบาล	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๖๒
๖๓) นายสิทธิโชค ธงเงิน	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๖๓
๖๔) นางศิวารณ ใจบุญ	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๖๔
๖๕) นางสาวพรรณธิดา ทุมคง	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๖๕
๖๖) นายนวภัทร ศรีวิริยะ	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๖๖
๖๗) นายสุวิชา ทองอ่อน	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๖๗
๖๘) นายวิญญู บุญตะนัย	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๖๘
๖๙) นายสมบูรณ์ บุตรจันทร์	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๖๙
๗๐) นายวิรัตน์ ไชยชนะรา	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๗๐
๗๑) นายนฤเบศน์ เพิ่มพูน	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๗๑
๗๒) นายจิรณัฐ ขวาละออ	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๗๒
๗๓) นายอัคริ นามบุรี	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๗๓
๗๔) นายอัคริเรศ จอสา	ทะเบียนเลขที่ ว-๒๐๔-จ-๐๐๗๔

วิมล

๗๕) นายประเสริฐ...



๗๕) นายประเสริฐ สุระขันธ  
๗๖) นายบุญกุล จันทน์นิยม  
๗๗) นายพีรพงษ์ ทองคุณปรีดา  
๗๘) นายณฤพล ทองนุช  
๗๙) นายอนุวัฒน์ ม่วงแพร่  
๘๐) นายเจตศราวุฒิ ปัตตะมะ  
๘๑) นายกฤษณะ สายวรรณ  
๘๒) นายพิชัย บุญยงค์  
๘๓) นายภานุพงศ์ โหมวงศ์  
๘๔) นายสามารถ คุ้มปลี  
๘๕) นายสัญญาชัย โกศรีนาม  
๘๖) นายณัฐวุฒิ ศรีประเสริฐ  
๘๗) นายชวลิต นาคพนม  
๘๘) นายพชรชัย ชัยทิพย์  
๘๙) นายสิทธิโชค ทาสีดา  
๙๐) นายธนากร อินสุตา  
๙๑) นางสาววรรณิษา ขาดีวันชัย  
๙๒) นางสาวพิมพ์ตะวัน มินากุล  
๙๓) นางสาวเพชรรัตน์ สิงห์สมบูรณ์  
๙๔) นางสาวชญาณีน พรหมจันทร์  
๙๕) นายกิตติ ทวีราช  
๙๖) นายจักริน หมั่นวิชา  
๙๗) นายฉัตรชัย สุขเปี้ย  
๙๘) นายณรรณห์ ต๊ะทองคำ  
๙๙) นายศุภพล สนนอก  
๑๐๐) นายทักษ์ดนัย อุบลศรี  
๑๐๑) นายธนศวรร นามะกุลณา  
๑๐๒) นายฉัตรพงศ์ บัวแดง  
๑๐๓) นายณนทชัย อุบลัมภ์  
๑๐๔) นายณัฐพล คุณสุทธิ  
๑๐๕) นายณัฏฐวัฒน์ สาริน  
๑๐๖) นายปิยะนัฐ พลมะศรี  
๑๐๗) นายพงศ์สิริ โสมเขียว  
๑๐๘) นายพีรพัฒน์ กำคำ  
๑๐๙) นายภาณุพงศ์ มานิตย์  
๑๑๐) นายมงคล ผลาทิพย์  
๑๑๑) นายสิรินันท์ ทองอ้น  
๑๑๒) นายอนเษ ทันสมัย  
๑๑๓) นายอดิศักดิ์ ผมไผ

ทะเบียนเลขที่ ๖-๒๐๔-จ-๐๐๗๕  
ทะเบียนเลขที่ ๖-๒๐๔-จ-๐๐๗๖  
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ทะเบียนเลขที่ ๖-๒๐๔-จ-๐๑๑๒  
ทะเบียนเลขที่ ๖-๒๐๔-จ-๐๑๑๓

รวม

๑๑๔) นายอนันตชัย...

๑๑๔) นายอนันตชัย วิสุม  
๑๑๕) นายวรวิฑูรย์ ตีนัก  
๑๑๖) นายแสงตะวัน นະตะสັດ  
๑๑๗) นายยุทธพงศ์ รัตนะ  
๑๑๘) นายชัยวุฒิ ไชยชนะนิจ  
๑๑๙) นายวิศรุต ศรีธรรมมา  
๑๒๐) นายณนทกร เผือกผ่อง  
๑๒๑) นายกำชัย สุทธะ  
๑๒๒) นางสาวณัฐภรณ์ บุญตะนัย  
๑๒๓) นางสาวพัชรินทร์ แสนสร้อย  
๑๒๔) นายไพโรจน์ เปี่ยมพิมาย  
๑๒๕) นางสาวศุภมาศ ทองมาก  
๑๒๖) นางสาวลลิตา จิตรสว่าง  
๑๒๗) นางสาวไข่มพร เล็กภูเขียว  
๑๒๘) นางสาวกฤติมาพร คำมีแก่น  
๑๒๙) นางสาวสกุลรัตน์ ภาคภูมิ  
๑๓๐) นางสาวไพรินทร์ ศรีรูปี  
๑๓๑) นางสาวทิพนตร ผุยปัญญา  
๑๓๒) นางสาวสาธิตา ปานทอง  
๑๓๓) นางสาวอริสา ทองนวล  
๑๓๔) นางสาวอรรยา คำคล่อง  
๑๓๕) นางสาวชุตาภรณ์ สุนทรสนาน  
๑๓๖) นางสาวอัญชลี คำจันทร์  
๑๓๗) นายบุญฤทธิ์ เอี่ยมเทศ  
๑๓๘) นางสาวศุภรดา บัณมยุรา  
๑๓๙) นางสาวพาดิถี คุณน่าน  
๑๔๐) นางสาวจิราเจต ฟ่องดา  
๑๔๑) นางสาวอารยา มีชัย  
๑๔๒) นางสาววิษุตา นาคผจญ  
๑๔๓) นางสาวนันทิยา จันทะลุน  
๑๔๔) นายกิตติพงษ์ แซ่ลี  
๑๔๕) นายอนุวัติ ภูถวิล  
๑๔๖) นายธีรพล แสงทอง  
๑๔๗) นายศักดิ์พิพัฒน์ บุญมัน  
๑๔๘) นายธิตะวัตร เอมอุไร  
๑๔๙) นายชัยณรงค์ ศรีบุรินทร์  
๑๕๐) นางสาวอัจฉราวรรณ สวนสนอง  
๑๕๑) นางสาวณัฐราพร สิงหา  
๑๕๒) นายกัมเรศ แหมมโต

ทะเบียนเลขที่ ๖-๒๐๔-จ-๐๑๑๔  
ทะเบียนเลขที่ ๖-๒๐๔-จ-๐๑๑๕  
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ทะเบียนเลขที่ ๖-๒๐๔-จ-๐๑๕๑  
ทะเบียนเลขที่ ๖-๒๐๔-จ-๐๑๕๒

รวม

๑๕๓) นางสาวอุบล...



๑๕๓) นางสาวอุบล เด็กศิริ  
๑๕๔) นางสาวโนรัตน์ ทองบุตร  
๑๕๕) นายภาคภูมิ แทนไทย  
๑๕๖) นางสาวสุภาณัฐ เมล์พ่วง  
๑๕๗) นางสาวพรทิวา สาดาชนม์  
๑๕๘) นายเอกวิทย์ วันทะนา  
๑๕๙) นายไตรมณฑล ทิพย์วรรณ  
๑๖๐) นายจิรเมธ ประเสริฐสิริพงศ์  
๑๖๑) นายจิรายุส เกษมสุข  
๑๖๒) นายจิรศักดิ์ ศรีวิชัย  
๑๖๓) นายณัฐกฤษณ์ สะพานแก้ว  
๑๖๔) นายบูรณศักดิ์ ปะที  
๑๖๕) นายปณณวิชญ์ เสมอทรัพย์  
๑๖๖) นายพิษณุพงษ์ ไชยา  
๑๖๗) นายภัทรพงษ์ มณฑาทอง  
๑๖๘) นายวสันต์ ตรีนกุล  
๑๖๙) นายภาณุเดช เพชรอุด  
๑๗๐) นายอนุกุล วิละแสง  
๑๗๑) นายภัทรพงษ์ มีสุข  
๑๗๒) นางสาวนุชวี ลีละทีป  
๑๗๓) นางสาวสุภาวดี โกศรีนาม  
๑๗๔) นางสาวอรณิศา เทียนคำ  
๑๗๕) นางสาวพรเพ็ญ ขอบสอน  
๑๗๖) นางสาววันวิสา ขอนพิกุล  
๑๗๗) นางสาวอรรวรรณ เถาว์ทอง  
๑๗๘) นางสาวอัยย์ลีน เมอร์วินณ์  
๑๗๙) นางสาววิสรา คุ่ยครอง  
๑๘๐) นายวุฒิกิจ ศิริวรรณ  
๑๘๑) นางสาวจรรววรรณ กระจางพันธุ์

ทะเบียนเลขที่ ว-๒๐๔-จ-๐๑๕๓  
ทะเบียนเลขที่ ว-๒๐๔-จ-๐๑๕๔  
ทะเบียนเลขที่ ว-๒๐๔-จ-๐๑๕๕  
ทะเบียนเลขที่ ว-๒๐๔-จ-๐๑๕๖  
ทะเบียนเลขที่ ว-๒๐๔-จ-๐๑๕๗  
ทะเบียนเลขที่ ว-๒๐๔-จ-๐๑๕๘  
ทะเบียนเลขที่ ว-๒๐๔-จ-๐๑๕๙  
ทะเบียนเลขที่ ว-๒๐๔-จ-๐๑๖๐  
ทะเบียนเลขที่ ว-๒๐๔-จ-๐๑๖๑  
ทะเบียนเลขที่ ว-๒๐๔-จ-๐๑๖๒  
ทะเบียนเลขที่ ว-๒๐๔-จ-๐๑๖๓  
ทะเบียนเลขที่ ว-๒๐๔-จ-๐๑๖๔  
ทะเบียนเลขที่ ว-๒๐๔-จ-๐๑๖๕  
ทะเบียนเลขที่ ว-๒๐๔-จ-๐๑๖๖  
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ทะเบียนเลขที่ ว-๒๐๔-จ-๐๑๗๕  
ทะเบียนเลขที่ ว-๒๐๔-จ-๐๑๗๖  
ทะเบียนเลขที่ ว-๒๐๔-จ-๐๑๗๗  
ทะเบียนเลขที่ ว-๒๐๔-จ-๐๑๗๘  
ทะเบียนเลขที่ ว-๒๐๔-จ-๐๑๗๙  
ทะเบียนเลขที่ ว-๒๐๔-จ-๐๑๘๐  
ทะเบียนเลขที่ ว-๒๐๔-จ-๐๑๘๑

วิมล

เอกสารแนบท้ายหนังสือรับต่ออายุขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน  
บริษัท เอแอลเอส แลบบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด เลขทะเบียน ว-๒๐๔  
ที่ อก ๐๓๐(๑)/ ๑๖๑๖๘ ลงวันที่ ๒๐ พฤศจิกายน ๒๕๖๖

ค. ขอบข่ายสารมลพิษที่ได้รับขึ้นทะเบียนจากกรมโรงงานอุตสาหกรรม จำนวน ๓๗๔ รายการ  
น้ำเสีย จำนวน 60 รายการ

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
1	Aldicarb	High-Performance Liquid Chromatographic Method <sup>[4]</sup>
2	Aldicarb Sulfone	High-Performance Liquid Chromatographic Method <sup>[4]</sup>
3	Aldicarb Sulfoxide	High-Performance Liquid Chromatographic Method <sup>[4]</sup>
4	Aldrin	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
5	Arsenic	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[4]</sup>
6	Barium	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[4]</sup>
7	α-BHC	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
8	β-BHC	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
9	δ-BHC	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
10	γ-BHC	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
11	Biochemical Oxygen Demand	1) 5-Day BOD Test, Azide Modification Method <sup>[4]</sup> 2) 5-Day BOD Test, Membrane Electrode Method <sup>[4]</sup>
12	Carbaryl	High-Performance Liquid Chromatographic Method <sup>[4]</sup>
13	Carbofuran	High-Performance Liquid Chromatographic Method <sup>[4]</sup>
14	Cadmium	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[4]</sup>
15	Chemical Oxygen Demand	1) Closed Reflux, Colorimetric Method <sup>[4]</sup> 2) Closed Reflux, Titrimetric Method <sup>[4]</sup>
16	Chlordane	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
17	Chromium	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[4]</sup>
18	Color	ADMI Weighted-Ordinate Spectrophotometric Method <sup>[4]</sup>



ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
19	Copper	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[4]</sup>
20	Cyanide	Distillation, Colorimetric Method <sup>[4]</sup>
21	2,4'-DDD	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
22	4,4'-DDD	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
23	2,4'-DDE	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
24	4,4'-DDE	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
25	2,4'-DDT	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
26	4,4'-DDT	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
27	Dieldrin	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
28	Endosulfan Sulfate	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
29	Endosulfan I	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
30	Endosulfan II	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
31	Endrin	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
32	Endrin Aldehyde	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
33	Formaldehyde	Distillation, Colorimetric Method <sup>[3]</sup>
34	Free Chlorine	1) DPD Ferrous Titrimetric Method <sup>[4]</sup> 2) DPD Colorimetric Method <sup>[4]</sup>
35	Heptachlor	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
36	Heptachlor Epoxide	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
37	Hexavalent Chromium	Colorimetric Method <sup>[4]</sup>
38	3-Hydroxycarbofuran	High-Performance Liquid Chromatographic Method <sup>[4]</sup>
39	Lead	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[4]</sup>

40 Manganese...

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
40	Manganese	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[4]</sup>
41	Mercury	1) Digestion, Cold-Vapor Atomic Absorption Spectrometric Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass spectrometric Method <sup>[4]</sup>
42	Methiocarb	High-Performance Liquid Chromatographic Method <sup>[4]</sup>
43	Methoxychlor	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
44	Methomyl	High-Performance Liquid Chromatographic Method <sup>[4]</sup>
45	Nickel	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[4]</sup>
46	Oil & Grease	1) Liquid-Liquid, Partition-Gravimetric Method <sup>[4]</sup> 2) Soxhlet Extraction Method <sup>[4]</sup>
47	Oxamyl	High-Performance Liquid Chromatographic Method <sup>[4]</sup>
48	Propoxur	High-Performance Liquid Chromatographic Method <sup>[4]</sup>
49	pH	Electrometric Method <sup>[4]</sup>
50	Phenols	1) Distillation, Chloroform Extraction Method <sup>[4]</sup> 2) Distillation, Direct Photometric Method <sup>[4]</sup>
51	Selenium	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[4]</sup>
52	Sulfide	Iodometric Method <sup>[4]</sup>
53	Temperature	Laboratory and Field Methods <sup>[4]</sup>
54	Total Dissolved Solids	Dried at 180 °C <sup>[4]</sup>
55	Total Kjeldahl Nitrogen	Semi-Micro Kjeldahl Method <sup>[4]</sup>
56	Total Phosphorous	Digestion, Colorimetric Method <sup>[4]</sup>
57	Total Suspended Solids	Dried from 103-105 °C <sup>[4]</sup>
58	Toxaphene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
59	Trivalent Chromium	1) Digestion, Inductively Coupled Plasma Method; Colorimetric Method; Calculation <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method; Colorimetric Method; Calculation <sup>[4]</sup>
60	Zinc	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[4]</sup>

น้ำใต้ดิน...



น้ำใต้ดิน จำนวน 126 รายการ

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
1	Acenaphthene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
2	Acetone	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
3	Aldrin	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
4	Anthracene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
5	Antimony	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[4]</sup>
6	Arsenic	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[4]</sup>
7	Atrazine	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
8	Barium	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[4]</sup>
9	Benz(a)anthracene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
10	Benzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
11	Benzo(b)fluoranthene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
12	Benzo(k)fluoranthene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
13	Benzoic Acid	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
14	Benzo(a)pyrene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
15	Benzo[g,h,i]perylene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
16	Beryllium	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[4]</sup>
17	Bis(2-chloroethyl)ether	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>

18 Bis(2-ethylhexyl)phthalate...

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
18	Bis(2-ethylhexyl)phthalate	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
19	Bromodichloromethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
20	Bromoform	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
21	Butanol	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
22	Butyl benzyl phthalate	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
23	Cadmium	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[4]</sup>
24	Carbazole	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
25	Carbon disulfide	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
26	Carbon tetrachloride	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
27	Chlordane	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
28	p-Chloroaniline	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
29	Chlorobenzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
30	Chlorodibromomethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
31	Chloroform	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
32	2-Chlorophenol	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
33	Chromium	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[4]</sup>
34	Chromium (III)	1) Digestion, Inductively Coupled Plasma Method; Colorimetric Method; Calculation <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method; Colorimetric Method; Calculation <sup>[4]</sup>
35	Chromium (VI)	Colorimetric Method <sup>[4]</sup>

36 Chrysene...



ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
36	Chrysene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
37	Cyanide	Distillation, Colorimetric Method <sup>[4]</sup>
38	2,4-D	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
39	DDD	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
40	DDE	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
41	DDT	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
42	Dibenz(a,h)anthracene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
43	Di-n-Butyl Phthalate	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
44	1,2-Dichlorobenzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
45	1,3-Dichlorobenzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
46	1,4-Dichlorobenzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
47	3,3-Dichlorobenzidine	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
48	1,1-Dichloroethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
49	1,2-Dichloroethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
50	1,1-Dichloroethylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
51	cis-1,2-Dichloroethylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
52	trans-1,2-Dichloroethylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
53	2,4-Dichlorophenol	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
54	1,2-Dichloropropane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
55	1,3-Dichloropropane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
56	1,3-Dichloropropene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
57	Dieldrin	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
58	Diethyl Phthalate	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
59	2,4-Dimethylphenol	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
60	2,4-Dinitrophenol	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
61	2,4-Dinitrotoluene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
62	2,6-Dinitrotoluene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
63	Di-n-octyl phthalate	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
64	Endosulfan	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
65	Endrin	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
66	Ethylbenzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
67	Fluoranthene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
68	Fluorene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
69	Heptachlor	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
70	Heptachlor epoxide	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
71	Hexachlorobenzene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
72	Hexachloro-1,3-butadiene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
73	n-Hexane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
74	α-HCH	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
75	β-HCH	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>



ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
76	γ-HCH	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
77	Hexachlorocyclopentadiene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
78	Hexachloroethane	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
79	Indeno(1,2,3-cd)pyrene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
80	Isophorone	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
81	Lead	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[4]</sup>
82	Manganese	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[4]</sup>
83	Mercury	1) Digestion, Cold Vapor Atomic Absorption Spectrometric Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[4]</sup>
84	Methanol	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
85	Methoxychlor	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
86	Methyl bromide	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
87	Methylene chloride	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
88	2-Methylphenol	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
89	2-Methylnaphthalene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
90	Methyl tert-butyl Ether	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
91	Naphthalene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
92	Nickel	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[4]</sup>
93	Nitrobenzene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>

94 N-Nitrosodiphenylamine...

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
94	N-Nitrosodiphenylamine	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
95	N-Nitrosodi-n-Propylamine	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
96	Polychlorinated Biphenyls - PCB 1016 - PCB 1221 - PCB 1232 - PCB 1242 - PCB 1248 - PCB 1254 - PCB 1260	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
97	Pentachlorophenol	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
98	pH	Electrometric Method <sup>[4]</sup>
99	Phenanthrene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
100	Phenol	1) Distillation, Chloroform Extraction Method <sup>[4]</sup> 2) Distillation, Direct Photometric Method <sup>[4]</sup> 3) Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
101	Pyrene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
102	Selenium	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[4]</sup>
103	Silver	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[4]</sup>
104	Styrene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
105	1,1,2,2-Tetrachloroethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
106	Tetrachloroethylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
107	Toluene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
108	Toxaphene	Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[4]</sup>
109	TPH (C <sub>5</sub> -C <sub>8</sub> )	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[13,25]</sup>

110 TPH (C<sub>8</sub>-C<sub>16</sub>)...



ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
110	TPH (C <sub>8</sub> -C <sub>16</sub> )	Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic Method <sup>[9,22]</sup>
111	TPH (C <sub>16</sub> -C <sub>35</sub> )	Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic Method <sup>[9,22]</sup>
112	1,2,4-Trichlorobenzene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>[4]</sup>
113	1,1,1-Trichloroethane	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>[4]</sup>
114	1,1,2-Trichloroethane	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>[4]</sup>
115	Trichloroethylene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>[4]</sup>
116	2,4,5-Trichlorophenol	Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[4]</sup>
117	2,4,6-Trichlorophenol	Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[4]</sup>
118	1,3,5-Trimethylbenzene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>[4]</sup>
119	Vanadium	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[4]</sup>
120	Vinyl acetate	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>[4]</sup>
121	Vinyl chloride	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>[4]</sup>
122	m-Xylene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>[4]</sup>
123	o-Xylene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>[4]</sup>
124	p-Xylene	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>[4]</sup>
125	Xylene (Total)	Purge and Trap, Gas Chromatographic/Mass Spectrometric Method <sup>[4]</sup>
126	Zinc	1) Digestion, Inductively Coupled Plasma Method <sup>[4]</sup> 2) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[4]</sup>

อากาศเสีย...

อากาศเสีย (ปล่อยระบาย) จำนวน 28 รายการ

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
1	Antimony	1) Isokinetic Sampling, Digestion, Inductively Coupled Plasma Method <sup>[5]</sup> 2) Isokinetic Sampling, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[5]</sup>
2	Arsenic	1) Isokinetic Sampling, Digestion, Inductively Coupled Plasma Method <sup>[5]</sup> 2) Isokinetic Sampling, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[5]</sup>
3	Beryllium	1) Isokinetic Sampling, Digestion, Inductively Coupled Plasma Method <sup>[5]</sup> 2) Isokinetic Sampling, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[5]</sup>
4	Cadmium	1) Isokinetic Sampling, Digestion, Inductively Coupled Plasma Method <sup>[5]</sup> 2) Isokinetic Sampling, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[5]</sup>
5	Carbon Monoxide	1) Instrumental Analyzer Method <sup>[5]</sup> 2) Sampling Bag Non-Dispersive Infrared Method <sup>[5]</sup>
6	Chlorine	1) Absorption Sampling, Ion Chromatographic Method <sup>[5]</sup> 2) Isokinetic Sampling, Ion Chromatographic Method <sup>[5]</sup>
7	Chromium	1) Isokinetic Sampling, Digestion, Inductively Coupled Plasma Method <sup>[5]</sup> 2) Isokinetic Sampling, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[5]</sup>
8	Cobalt	1) Isokinetic Sampling, Digestion, Inductively Coupled Plasma Method <sup>[5]</sup> 2) Isokinetic Sampling, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[5]</sup>
9	Copper	1) Isokinetic Sampling, Digestion, Inductively Coupled Plasma Method <sup>[5]</sup> 2) Isokinetic Sampling, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[5]</sup>
10	Cresol	Absorption Sampling, Gas Chromatographic Method <sup>[5]</sup>
11	Dioxins	Isokinetic Sampling <sup>[5]</sup>
12	Hydrogen Chloride	1) Absorption Sampling, Ion Chromatographic Method <sup>[5]</sup> 2) Isokinetic Sampling, Ion Chromatographic Method <sup>[5]</sup>
13	Hydrogen Fluoride	1) Absorption Sampling, Ion Chromatographic Method <sup>[5]</sup> 2) Isokinetic Sampling, Ion Chromatographic Method <sup>[5]</sup>
14	Hydrogen Sulfide	Absorption Sampling, Iodometric Method <sup>[5]</sup>



ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
15	Lead	1) Isokinetic Sampling, Digestion, Inductively Coupled Plasma Method <sup>[5]</sup>
16	Manganese	2) Isokinetic Sampling, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[5]</sup>
17	Mercury	1) Isokinetic Sampling, Digestion, Inductively Coupled Plasma Method <sup>[5]</sup>
18	Nickel	2) Isokinetic Sampling, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[5]</sup>
19	Opacity	Ringelmann's Method <sup>[2]</sup>
20	Oxides of Nitrogen	1) Absorption Sampling, Phenoldisulfonic Acid Method <sup>[5]</sup>
21	Selenium	2) Absorption Sampling, Alkaline Permanganate/ Colorimetric Method <sup>[5]</sup>
22	Sulfur Dioxide	3) Instrumental Analyzer Method <sup>[5]</sup>
23	Sulfuric Acid	1) Isokinetic Sampling, Digestion, Inductively Coupled Plasma Method <sup>[5]</sup>
24	Tellurium	2) Isokinetic Sampling, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[5]</sup>
25	Tin	1) Isokinetic Sampling, Digestion, Inductively Coupled Plasma Method <sup>[5]</sup>
26	Total Suspended Particulate	2) Isokinetic Sampling, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[5]</sup>
		1) Isokinetic Sampling, Gravimetric Method <sup>[5]</sup>
		2) Paired Train, Isokinetic Sampling, Gravimetric Method <sup>[5]</sup>

วิภา

27 Vanadium...

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
27	Vanadium	1) Isokinetic Sampling, Digestion, Inductively Coupled Plasma Method <sup>[5]</sup>
28	Xylene	2) Isokinetic Sampling, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[5]</sup>
		Adsorption Sampling, Gas Chromatographic Method <sup>[5]</sup>

สิ่งปลูกหรือวัสดุที่ไม่ใช่แล้ว จำนวน 35 รายการ

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
1	Aldrin	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[1,9,26]</sup>
2	Antimony	2) Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[10,26]</sup>
3	Arsenic	3) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[11,26]</sup>
4	Barium	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>[1,6,16]</sup>
		2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[1,6,17]</sup>
		3) Digestion, Inductively Coupled Plasma Method <sup>[7,16]</sup>
		4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[7,17]</sup>
		1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>[1,6,16]</sup>
		2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[1,6,17]</sup>
		3) Digestion, Inductively Coupled Plasma Method <sup>[7,16]</sup>
		4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[7,17]</sup>
		1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>[1,6,16]</sup>
		2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[1,6,17]</sup>
		3) Digestion, Inductively Coupled Plasma Method <sup>[7,16]</sup>
		4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[7,17]</sup>

5 Beryllium...



ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
5	Beryllium	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>[1,6,16]</sup> 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[1,6,17]</sup> 3) Digestion, Inductively Coupled Plasma Method <sup>[7,16]</sup> 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[7,17]</sup>
6	Cadmium	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>[1,6,16]</sup> 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[1,6,17]</sup> 3) Digestion, Inductively Coupled Plasma Method <sup>[7,16]</sup> 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[7,17]</sup>
7	Chlordane	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[1,9,26]</sup> 2) Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[10,26]</sup> 3) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[11,26]</sup>
8	Chromium	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>[1,6,16]</sup> 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[1,6,17]</sup> 3) Digestion, Inductively Coupled Plasma Method <sup>[7,16]</sup> 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[7,17]</sup>
9	Chromium (III)	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method; Waste Extraction, Colorimetric Method; Calculation Method <sup>[1,6,16,19]</sup> 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method; Waste Extraction, Colorimetric Method; Calculation Method <sup>[1,6,17,19]</sup> 3) Digestion, Inductively Coupled Plasma Method; Alkaline Digestion, Colorimetric Method; Calculation Method <sup>[7,8,16,19]</sup> 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method; Alkaline Digestion, Colorimetric Method; Calculation Method <sup>[7,8,17,19]</sup>

10 Chromium (VI)...

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
10	Chromium (VI)	1) Waste Extraction, Colorimetric Method <sup>[1,6,19]</sup> 2) Alkaline Digestion, Colorimetric Method <sup>[8,19]</sup>
11	Cobalt	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>[1,6,16]</sup> 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[1,6,17]</sup> 3) Digestion, Inductively Coupled Plasma Method <sup>[7,16]</sup> 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[7,17]</sup>
12	Copper	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>[1,6,16]</sup> 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[1,6,17]</sup> 3) Digestion, Inductively Coupled Plasma Method <sup>[7,16]</sup> 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[7,17]</sup>
13	2,4-D	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[1,9,26]</sup> 2) Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[10,26]</sup> 3) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[11,26]</sup>
14	DDD	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[1,9,26]</sup> 2) Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[10,26]</sup> 3) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[11,26]</sup>
15	DDE	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[1,9,26]</sup> 2) Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[10,26]</sup> 3) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[11,26]</sup>
16	DDT	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[1,9,26]</sup>

2) Soxhlet...



ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
17	Dieldrin	2) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup> 3) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup> 1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[1,9,26]</sup> 2) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup> 3) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>
18	Endrin	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[1,9,26]</sup> 2) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup> 3) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>
19	Heptachlor	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[1,9,26]</sup> 2) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup> 3) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>
20	Lead	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>[1,6,16]</sup> 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[1,6,17]</sup> 3) Digestion, Inductively Coupled Plasma Method <sup>[7,16]</sup> 4) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[7,17]</sup>
21	Lindane	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[1,9,26]</sup> 2) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup> 3) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
22	Mercury	1) Waste Extraction, Digestion, Cold-Vapor Atomic Absorption Spectrometric Method <sup>[1,6,20]</sup> 2) Waste Extraction, Digestion, Cold-Vapor Atomic Fluorescence Spectrometric Method <sup>[1,6,30]</sup> 3) Digestion, Cold-Vapor Atomic Absorption Spectrometric Method <sup>[20]</sup> 4) Digestion, Cold-Vapor Atomic Fluorescence Spectrometric Method <sup>[30]</sup> 5) Thermal Decomposition Amalgamation and Atomic Absorption Spectrometric Method <sup>[21]</sup>
23	Methoxychlor	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[1,9,26]</sup> 2) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup> 3) Automated Soxhlet Extraction, Gas Chromatographic /Mass Spectrometric Method <sup>[11,26]</sup>
24	Mirex	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[1,9,26]</sup> 2) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup> 3) Automated Soxhlet Extraction, Gas Chromatographic /Mass Spectrometric Method <sup>[11,26]</sup>
25	Molybdenum	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>[1,6,16]</sup> 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[1,6,17]</sup> 3) Digestion, Inductively Coupled Plasma Method <sup>[7,16]</sup> 4) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[7,17]</sup>
26	Nickel	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>[1,6,16]</sup> 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[1,6,17]</sup> 3) Digestion, Inductively Coupled Plasma Method <sup>[7,16]</sup> 4) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[7,17]</sup>
27	Polychlorinated biphenyls (PCBs) - Aroclor 1016 - Aroclor 1221 - Aroclor 1232 - Aroclor 1242 - Aroclor 1248 - Aroclor 1254 - Aroclor 1260	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[1,9,26]</sup> 2) Soxhlet Extraction, Gas Chromatographic Method <sup>[10,26]</sup> 3) Automated Soxhlet Extraction, Gas Chromatographic Method <sup>[11,26]</sup>

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
28	- 2-Chlorobiphenyl - 2,3-Dichlorobiphenyl - 2,2',5-Trichlorobiphenyl - 2,4',5-Trichlorobiphenyl - 2,2',3,5'-Tetrachlorobiphenyl - 2,2',5,5'-Tetrachlorobiphenyl - 2,3',4,4'-Tetrachlorobiphenyl - 2,2',3,4,5'-Pentachlorobiphenyl - 2,2',4,5,5'-Pentachlorobiphenyl - 2,3,3',4,6-Pentachlorobiphenyl - 2,2',3,4,4',5'-Hexachlorobiphenyl - 2,2',3,5,5',6-Hexachlorobiphenyl - 2,2',4,4',5,5'-Hexachlorobiphenyl - 2,2',3,3',4,4',5-Heptachlorobiphenyl - 2,2',3,4,4',5,5'-Heptachlorobiphenyl - 2,2',3,4,4',5,6-Heptachlorobiphenyl - 2,2',3,4',5,5',6-Heptachlorobiphenyl - 2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl Pentachlorophenol	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[1,9,26]</sup> 2) Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[10,26]</sup> 3) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[11,26]</sup> Electrometric Method <sup>[23,24]</sup>
29	pH	
30	Selenium	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>[1,6,16]</sup> 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[1,6,17]</sup> 3) Digestion, Inductively Coupled Plasma Method <sup>[7,16]</sup> 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[7,17]</sup>

31 Silver...

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
31	Silver	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>[1,6,16]</sup> 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[1,6,17]</sup> 3) Digestion, Inductively Coupled Plasma Method <sup>[7,16]</sup> 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[7,17]</sup>
32	Thallium	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>[1,6,16]</sup> 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[1,6,17]</sup> 3) Digestion, Inductively Coupled Plasma Method <sup>[7,16]</sup> 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[7,17]</sup>
33	Toxaphene	1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[1,9,26]</sup> 2) Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[10,26]</sup> 3) Automated Soxhlet Extraction, Gas Chromatographic/Mass Spectrometric Method <sup>[11,26]</sup>
34	Vanadium	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>[1,6,16]</sup> 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[1,6,17]</sup> 3) Digestion, Inductively Coupled Plasma Method <sup>[7,16]</sup> 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[7,17]</sup>
35	Zinc	1) Waste Extraction, Digestion, Inductively Coupled Plasma Method <sup>[1,6,16]</sup> 2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[1,6,17]</sup> 3) Digestion, Inductively Coupled Plasma Method <sup>[7,16]</sup> 4) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method <sup>[7,17]</sup>

ดิน...



ดิน จำนวน 125 รายการ

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
1	Acenaphthene	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>
2	Acetone	1)Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[15,25]</sup> 2) Equilibrium Headspace, Gas Chromatographic/ Mass Spectrometric Method <sup>[13]</sup>
3	Aldrin	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>
4	Anthracene	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>
5	Antimony	1) Digestion, Inductively Coupled Plasma Method <sup>[7,16]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[7,17]</sup>
6	Arsenic	1) Digestion, Inductively Coupled Plasma Method <sup>[7,16]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[7,17]</sup>
7	Atrazine	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>
8	Barium	1) Digestion, Inductively Coupled Plasma Method <sup>[7,16]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[7,17]</sup>
9	Benz(a)anthracene	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>
10	Benzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[15,25]</sup>

11 Benzo(b)fluoranthene

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
11	Benzo(b)fluoranthene	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>
12	Benzo(k)fluoranthene	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>
13	Benzoic acid	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>
14	Benzo(a)pyrene	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>
15	Benzo(g,h,i)perylene	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>
16	Beryllium	1) Digestion, Inductively Coupled Plasma Method <sup>[7,16]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[7,17]</sup>
17	Bis(2-chloroethyl)ether	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>
18	Bis(2-ethylhexyl)phthalate	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>
19	Bromodichloromethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[15,25]</sup>
20	Bromoform	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[15,25]</sup>
21	Butanol	Equilibrium Headspace, Gas Chromatographic/ Mass Spectrometric Method <sup>[13,25]</sup>
22	Butyl Benzyl Phthalate	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>

23 Cadmium...



ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
23	Cadmium	1) Digestion, Inductively Coupled Plasma Method <sup>[7,16]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[7,17]</sup>
24	Carbazole	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>
25	Carbon Disulfide	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[15,25]</sup>
26	Carbon tetrachloride	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[15,25]</sup>
27	Chlordane	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>
28	p-Chloroaniline	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>
29	Chlorobenzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[15,25]</sup>
30	Chlorodibromomethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[15,25]</sup>
31	Chloroform	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[15,25]</sup>
32	2-Chlorophenol	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>
33	Chromium	1) Digestion, Inductively Coupled Plasma Method <sup>[7,16]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[7,17]</sup>
34	Chromium (III)	1) Digestion, Inductively Coupled Plasma Method; Alkaline Digestion, Colorimetric Method; Calculation Method <sup>[7,8,16,19]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method; Alkaline Digestion, Colorimetric Method; Calculation Method <sup>[7,8,17,19]</sup>
35	Chromium (VI)	Alkaline Digestion, Colorimetric Method <sup>[8,19]</sup>

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
36	Chrysene	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>
37	Cyanide	Extraction, Distillation, Colorimetric Method <sup>[27,28,29]</sup>
38	2,4-D	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>
39	DDD	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>
40	DDE	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>
41	DDT	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>
42	Dibenz(a,h)anthracene	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>
43	Di-n-Butyl Phthalate	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>
44	1,2-Dichlorobenzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[15,25]</sup>
45	1,3-Dichlorobenzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[15,25]</sup>
46	1,4-Dichlorobenzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[15,25]</sup>
47	3,3-Dichlorobenzidine	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>
48	1,1-Dichloroethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[15,25]</sup>



ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
49	1,2-Dichloroethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>(15,25)</sup>
50	1,1-Dichloroethylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>(15,25)</sup>
51	cis-1,2-Dichloroethylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>(15,25)</sup>
52	trans-1,2-Dichloroethylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>(15,25)</sup>
53	2,4-Dichlorophenol	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>(10,26)</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>(11,26)</sup>
54	1,2-Dichloropropane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>(15,25)</sup>
55	1,3-Dichloropropane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>(15,25)</sup>
56	1,3-Dichloropropene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>(15,25)</sup>
57	Dieldrin	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>(10,26)</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>(11,26)</sup>
58	Diethyl Phthalate	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>(10,26)</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>(11,26)</sup>
59	2,4-Dimethylphenol	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>(10,26)</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>(11,26)</sup>
60	2,4-Dinitrophenol	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>(10,26)</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>(11,26)</sup>
61	2,4-Dinitrotoluene	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>(10,26)</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>(11,26)</sup>
62	2,6-Dinitrotoluene	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>(10,26)</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>(11,26)</sup>

63 Di-n-Octyl Phthalate...

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
63	Di-n-Octyl Phthalate	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>(10,26)</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>(11,26)</sup>
64	Endosulfan	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>(10,26)</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>(11,26)</sup>
65	Endrin	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>(10,26)</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>(11,26)</sup>
66	Ethylbenzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>(15,25)</sup>
67	Fluoranthene	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>(10,26)</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>(11,26)</sup>
68	Fluorene	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>(10,26)</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>(11,26)</sup>
69	Heptachlor	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>(10,26)</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>(11,26)</sup>
70	Heptachlor epoxide	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>(10,26)</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>(11,26)</sup>
71	Hexachlorobenzene	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>(10,26)</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>(11,26)</sup>
72	Hexachloro-1,3-butadiene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>(15,25)</sup>
73	n-Hexane	1) Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>(15,25)</sup> 2) Equilibrium Headspace, Gas Chromatographic/ Mass Spectrometric Method <sup>(13)</sup>

73 n-Hexane...



ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
74	$\alpha$ -HCH	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup>
75	$\beta$ -HCH	2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>
76	$\gamma$ -HCH	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup>
77	Hexachlorocyclopentadiene	2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>
78	Hexachloroethane	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup>
79	Indeno(1,2,3-cd)pyrene	2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>
80	Isophorone	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup>
81	Lead	2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>
82	Manganese	1) Digestion, Inductively Coupled Plasma Method <sup>[7,16]</sup>
83	Mercury	2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[7,17]</sup>
		1) Digestion, Cold-Vapor Atomic Absorption Spectrometric Method <sup>[20]</sup>
		2) Thermal Decomposition, Amalgamation, and Atomic Absorption Spectrophotometry <sup>[21]</sup>
		3) Digestion, Cold-Vapor Atomic Fluorescence Spectrometric Method <sup>[30]</sup>

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
84	Methanol	1) Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[15,25]</sup>
85	Methoxychlor	2) Equilibrium Headspace, Gas Chromatographic/ Mass Spectrometric Method <sup>[13,25]</sup>
86	Methyl Bromide	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup>
87	Methylene Chloride	2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>
88	2-methylphenol	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[15,25]</sup>
89	2-Methylnaphthalene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[15,25]</sup>
90	Methyl tert-Butyl Ether	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup>
91	Naphthalene	2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>
92	Nickel	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[15,25]</sup>
93	Nitrobenzene	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup>
94	N-Nitrosodiphenylamine	2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>
95	N-Nitrosodi-n-propylamine	1) Digestion, Inductively Coupled Plasma Method <sup>[7,16]</sup>
		2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[7,17]</sup>
		1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup>
		2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>
		1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup>
		2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>



ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
96	Polychlorinated biphenyls (PCBs) - Aroclor 1016 - Aroclor 1221 - Aroclor 1232 - Aroclor 1242 - Aroclor 1248 - Aroclor 1254 - Aroclor 1260 - 2-Chlorobiphenyl - 2,2',3,5'-Tetrachlorobiphenyl - 2,2',5,5'-Tetrachlorobiphenyl - 2,3',4,4'-Tetrachlorobiphenyl - 2,2',3,4,5'-Pentachlorobiphenyl - 2,2',4,5,5'-Pentachlorobiphenyl - 2,3,3',4',6-Pentachlorobiphenyl - 2,2',3,4,4',5'-Hexachlorobiphenyl - 2,2',3,4,5,5'-Hexachlorobiphenyl - 2,2',3,5,5',6-Hexachlorobiphenyl - 2,2',4,4',5,5'-Hexachlorobiphenyl - 2,2',3,3',4,4',5'-Heptachlorobiphenyl - 2,2',3,4,4',5,5'-Heptachlorobiphenyl - 2,2',3,4,4',5,6'-Heptachlorobiphenyl - 2,2',3,4',5,5',6'-Heptachlorobiphenyl - 2,2',3,3',4,4',5,5',6'-Nonachlorobiphenyl	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>
97	Pentachlorophenol	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>
98	Phenanthrene	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>

ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
99	Phenol	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>
100	Pyrene	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>
101	Selenium	1) Digestion, Inductively Coupled Plasma Method <sup>[7,16]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[7,17]</sup>
102	Silver	1) Digestion, Inductively Coupled Plasma Method <sup>[7,16]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[7,17]</sup>
103	Styrene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[15,25]</sup>
104	1,1,2,2-Tetrachloroethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[15,25]</sup>
105	Tetrachloroethylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[15,25]</sup>
106	Toluene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[15,25]</sup>
107	Toxaphene	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>
108	TPH (C <sub>5</sub> -C <sub>8</sub> )	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[15,25]</sup>
109	TPH (C <sub>8</sub> -C <sub>16</sub> )	1) Automate Extraction, Gas Chromatographic Method <sup>[11,22]</sup> 2) Solvent Extraction, Gas Chromatographic Method <sup>[12,22]</sup> 3) Ultrasonic Extraction, Gas Chromatographic Method <sup>[22,31]</sup>
110	TPH (C <sub>16</sub> -C <sub>35</sub> )	1) Automate Extraction, Gas Chromatographic Method <sup>[11,22]</sup> 2) Solvent Extraction, Gas Chromatographic Method <sup>[12,22]</sup> 3) Ultrasonic Extraction, Gas Chromatographic Method <sup>[22,31]</sup>
111	1,2,4-Trichlorobenzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[15,25]</sup>
112	1,1,1-Trichloroethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[15,25]</sup>
113	1,1,2-Trichloroethane	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[15,25]</sup>
114	Trichloroethylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[15,25]</sup>



ลำดับที่	สารมลพิษ	วิธีวิเคราะห์
115	2,4,5-Trichlorophenol	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>
116	2,4,6-Trichlorophenol	1) Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[10,26]</sup> 2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method <sup>[11,26]</sup>
117	1,3,5-Trimethylbenzene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[15,25]</sup>
118	Vanadium	1) Digestion, Inductively Coupled Plasma Method <sup>[7,16]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[7,17]</sup>
119	Vinyl Acetate	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[15,25]</sup>
120	Vinyl Chloride	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[15,25]</sup>
121	m-Xylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[15,25]</sup>
122	o-Xylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[15,25]</sup>
123	p-Xylene	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[15,25]</sup>
124	Xylene (Total)	Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method <sup>[15,25]</sup>
125	Zinc	1) Digestion, Inductively Coupled Plasma Method <sup>[7,16]</sup> 2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method <sup>[7,17]</sup>

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